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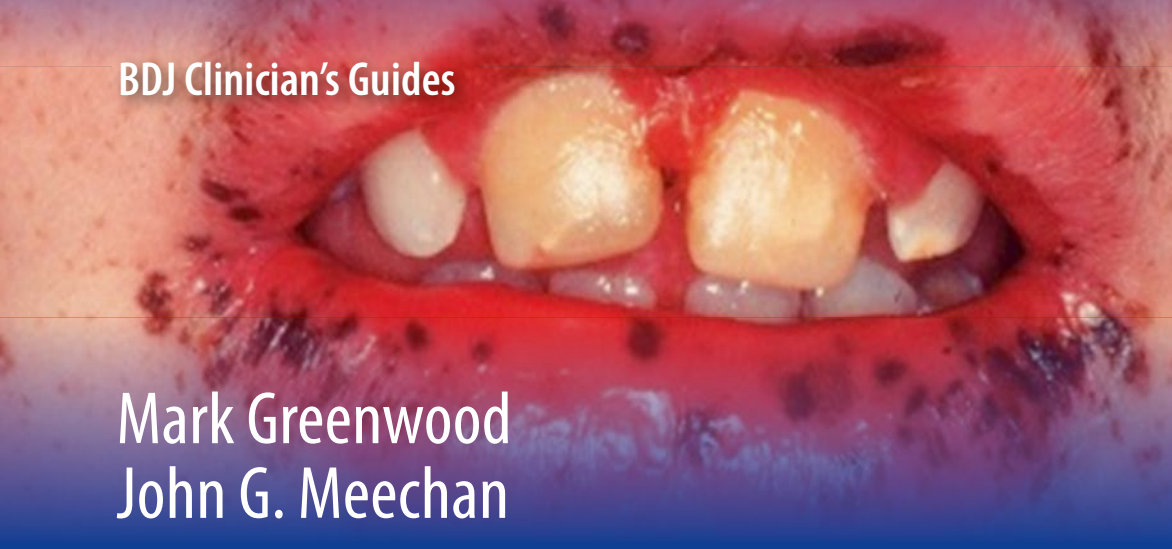

Mark Greenwood
John G. Meechan

General Medicine and Surgery for Dental Practitioners

Third Edition

BDA
British Dental Association

Springer

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Contents

General Medicine and Surgery for Dental Practitioners: History Taking and Examination of the Clothed Patient

1

In Brief

- All dental practitioners must be proficient at taking a medical history and examining a clothed patient and recognising relevant clinical signs.
- The general examination of a patient should take into account findings from the history.
- This chapter does not attempt to address the detailed oral and dental examination carried out by dental practitioners but focuses on the holistic patient assessment—essential for safe patient management.

1.1 Introduction

Dental practitioners are familiar with the component parts of a medical history. It is important that all patients have a comprehensive medical history taken and that it is updated at regular intervals. In this paper, the general principles of medical history taking are revised, and relevant clinical signs in the clothed patient that may be a clue to underlying disease are discussed.

1.2 Main Components of a Medical History

1.2.1 Presenting Complaint

The presenting complaint may be expressed in the patient's own words if this is felt to express the problem in the best way. The information presented is then summarised by the clinician.

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Table 1.1 Points to be obtained from the history with reference to patients in pain

• Site of pain—it is useful to ask the patient to point with one finger to where the pain is worst
• Character, e.g. sharp, ache, throbbing
• Ask about severity—on a scale of 1–10, 10 being the most severe, how bad is it?
• Does the pain radiate anywhere else?
• Timing—was the onset sudden or gradual? How long has the pain been present? Is it continuous or intermittent? Worse at any particular time of day?
• What makes the pain better or worse (including the use and type of medication)?
• Is the patient aware of any relevant preceding event, including previous similar episodes?
• Any associated symptoms, for example, bad taste?

1.2.2 History of Presenting Complaint

A chronological approach should be employed to obtain a history of the presenting complaint. As a minimum, the history of presenting complaint should include the following:

- When the problem/condition first started
- The overall duration and progression of the problem, including whether it is episodic or constant
- The nature of any symptoms (see below)
- Any systemic signs or symptoms such as fever
- Previous treatments, their success or failure
- Previous practitioners seen regarding the same or related condition(s)

In dental practice, the presenting complaint is sometimes one of pain. It is useful to have a generic scheme of questions to assess the nature and severity of a patient's pain. Such a scheme is shown in Table 1.1.

1.2.3 Past Medical History

There are various ways of taking this part of the history. It is often useful to start with generic questioning regarding major systems such as the cardiovascular or respiratory systems. Questioning should then focus on specific disorders such as asthma or other respiratory disorders, diabetes mellitus, epilepsy, hypertension, hepatitis or jaundice. Problems with the arrest of haemorrhage are worth specific enquiry. Any positive responses should be followed up by an assessment of the severity of the disorder, treatments used and their efficacy.

It is essential to ask about any known allergies and if a positive response is obtained, to enquire about the nature of such an allergy.

1.2.4 Medications and Drugs

All medications or drugs that the patient may be taking should be included [1]. This should include "recreational" drugs and homoeopathic or other over-the-counter

substances. In addition it is pertinent to ask about inhaled or topical medicines as many patients do not consider these as "drugs". Concurrent drug therapy can impact upon orofacial signs and symptoms, the safe provision of dental treatment and the use of other medications.

1.2.5 Recreational Drugs

The use of drugs of abuse is common, and dentists should have a working knowledge of the implications for patients who say that they are using these. Cannabis has a sympathomimetic action and in theory could exacerbate the systemic effects of adrenaline in dental local anaesthetics [2]. Heroin and methadone are opioid drugs, the latter being used in rehabilitation programmes [3]. Oral methadone has a high sugar content that can cause rampant caries. Heroin can cause thrombocytopaenia with potential knock-on effects in terms of haemostasis. Some of those addicted to heroin have a low threshold for pain. The drug also interacts with preparations that dentists may prescribe [4]. The absorption of paracetamol and orally administered diazepam is delayed and reduced due to delayed gastric emptying. Carbamazepine reduces serum methadone levels, and methadone increases the effects of tricyclic antidepressants.

Patients who abuse cocaine are subject to increased risk of the effects of ischaemia leading to loss of tissue. Testing the "quality" the drug by rubbing on the oral mucosa to test depth of anaesthesia may lead to loss of gingivae and alveolar bone. An increased incidence of dental caries may be seen if cocaine is bulked out with carbohydrates. As with heroin, thrombocytopaenia may be seen. Like cannabis, cocaine has a sympathomimetic action.

Amphetamines and ecstasy may produce thrombocytopaenia. Concomitant use with monoamine oxidase inhibitors and tricyclic antidepressants can precipitate a hypertensive crisis.

LSD (lysergic acid diethylamide) is a hallucinogenic drug. Such drugs increase the incidence of bruxism, and patients taking it may present with TMJ dysfunction. Dentists should be aware that stressful situations may cause flashbacks and panic attacks in these patients.

In more recent years, the problem of solvent abuse has reached the headlines. A reduction in the dose of adrenaline-containing local anaesthetics is recommended in those who chronically abuse solvents as such agents can sensitise the myocardium to the actions of the catecholamine. Solvent abuse also increases the risk of convulsions and status epilepticus may occur.

Some patients may abuse anabolic steroids and performance enhancers which may precipitate increased carbohydrate consumption with its inevitable effects on the dentition. The systemic effects of adrenaline in dental local anaesthetics can be exacerbated by the sympathomimetic effects of certain anabolic steroid drugs. As with many other illicit drugs, anabolic steroids may interfere with blood clotting.

Complementary therapies are often used by patients. It is important to remember potential interactions with prescription drugs, some of which may be prescribed by dental practitioners. Some of the more common interactions are shown in Table 1.2.

Table 1.2 Complementary medicines and their interactions with conventional medicines with potential consequences

Herb	Conventional drug	Potential problem
Feverfew, garlic, ginseng, ginger	Warfarin	Altered prothrombin time/INR
Echinacea used for >8 weeks	Anabolic steroids, methotrexate, amiodarone, ketoconazole	Hepatotoxicity
Feverfew	Non-steroidal anti-inflammatory drugs	Inhibition of herbal effect
Ginseng	Oestrogens, corticosteroids	Additive effects
St John's wort	Monoamine oxidase inhibitor	Mechanism of herbal effect uncertain
	Serotonin reuptake inhibitor	Insufficient evidence of safety with concomitant use—therefore not advised
	Antidepressants	
Evening primrose oil	Anticonvulsants	Lowered seizure threshold
Kava	Benzodiazepines	Additive sedative effects, coma
Echinacea, zinc (immunostimulants)	Immunosuppressants (such as corticosteroids and ciclosporin)	Antagonistic effects
St John's wort	Iron	May limit iron absorption
Karela, ginseng	Insulin, sulphonylureas, biguanides	Altered glucose concentrations

1.2.6 Past Dental History

The past dental history will assume different forms depending on the patient's previous exposure to dental treatment. It is clearly relevant to find out whether a patient is a regular attender and of their previous experience of dental treatment and its nature. The previous use of local anaesthetic agents and any associated problems can be checked. If not covered by the previous history, adverse events such as post-extraction haemorrhage may be highlighted at this point.

1.2.7 Social History/Family History

The social history is often neglected, but it is an important part of the comprehensive assessment of a patient. It may directly influence treatment or the way it is delivered. As a minimum, enquiry should be made of the patient's smoking status and alcohol consumption, and if positive, these should be quantified. The system of units for measuring alcohol consumption is summarised in Table 1.3. The patient's occupation (or previous occupation if retired) is also important.

Finally, information concerning the patient's home circumstances is significant. It is particularly important to find out whether a patient lives with another "competent" adult, as in cases of intravenous sedation or day-case general anaesthesia, the patient should be looked after for 24 h following the procedure by such an adult.

Disorders with a genetic origin should be recorded.

Table 1.3 The "units" system of alcohol quantification

• A pint of ordinary strength lager—2 units
• A pint of strong lager—3 units
• A pint of ordinary bitter—2 units
• A pint of best bitter—3 units
• A pint of ordinary strength cider—2 units
• A pint of strong cider—3 units
• A 175 ml glass of red or white wine—around 2 units
• A pub measure of spirits—1 unit
• An "alcopop"—around 1.5 units

1.2.8 Psychiatric History

The psychiatric history is not included as routine but may be relevant in some cases as discussed in a previous paper in the series [5].

In hospital practice, a body systems' review making up this book is undertaken after the preliminary history. Whilst it is recognised that this would rarely be used in mainstream dental practice, it is discussed here to highlight its effectiveness on assessing various systems from a medical standpoint.

1.2.9 General Enquiry

It is worth starting with a series of general questions that may highlight relevant conditions that otherwise may be missed from the more specific systems' review [6]. Such findings include:

- Appetite, weight loss
- Lethargy or fatigue
- Fevers
- The presence of any lumps, bumps or swellings
- The presence of skin rashes

1.2.10 Cardiovascular System

- Chest pain (bear in mind other potential causes)—Table 1.4. Does the chest pain occur at rest or after exertion—how much exertion?
- Dyspnoea (remember potential respiratory causes either co-existing or in isolation)
  - Does breathlessness occur at rest/on exertion?
- Paroxysmal nocturnal dyspnoea (waking from sleep feeling breathless) or orthopnoea (breathlessness on lying flat)
- Palpitations
- Prosthetic/replacement heart valves
- History of rheumatic fever and/or infective endocarditis
- Claudication pains and what is required to precipitate them

Table 1.4 A differential diagnosis of chest pain

• Angina
• Myocardial infarction
• Oesophageal reflux
• Musculoskeletal
• Pleuritic (e.g. pulmonary embolism)
• Hyperventilation
• Referred pain from the abdomen

1.2.11 Respiratory System

- Breathlessness/wheeziness
- The presence or otherwise of a cough, its duration and whether productive or not
- Haemoptysis (coughing up of blood)
- Sputum production
- History of known respiratory disorders and exacerbations—note the degree of success of treatment (judged by control/relief of symptoms)

1.2.12 Gastrointestinal System

- Dysphagia (difficulty swallowing)
- Odynophagia (pain on swallowing)
- Indigestion, nausea or vomiting
- Haematemesis (vomiting blood)
- Change in bowel habit
- Spleen or liver problems

1.2.13 Neurological System

- Any history of fits, faints or blackouts
- Headache or facial pain
- Disturbance in motor function or sensation
- Muscle wasting, weakness or fasciculation
- Disorders of co-ordination

1.2.14 Musculoskeletal System

- Pain/swelling/stiffness of joints
- Gait (bear in mind potential neurological problems)
- Joint prostheses
- Locomotor and manual impairment secondary to musculoskeletal disorders

1.2.15 Genitourinary System

Usually the genitourinary system need not be enquired about in any detail. Patients with repeated urinary tract infections may be taking antibiotics, which could be of relevance.

1.3 Examination of the Clothed Patient

It is important to remember to take a holistic approach to the patient and make relevant general observations. If a patient looks ill, they probably are! Is the patient of average weight, or are they cachectic or obese?

A subjective assessment of the patient's level of alertness is important as well as differentiation made between an acute confusional state and a chronic condition, for example, the chronic confusion in a patient with dementia. Potential causes of acute confusion are summarised in Table 1.5.

Notes should also be made of the patient's complexion, for example, are they pale, flushed or cyanotic? Are they breathless, either at rest or after minimal exertion? Clearly positive findings are important but may not be diagnostic. It is more important to gauge the overall "condition" of the patient in order to assess their level of suitability for treatment in a particular clinical environment.

The hands and face are good mirrors of general health problems in dental patients. There are several signs that can be observed in the hands. The overall appearance of the hands should be noted, together with abnormalities of the skin, nails and muscles. Palmar erythema can be seen in pregnancy, some patients with liver problems and rheumatoid arthritis. Swollen proximal interphalangeal (PIP) joints (nearest the knuckles) suggest rheumatoid arthritis, particularly in conjunction with ulnar deviation of the hands (Fig. 1.1). Swelling of the distal interphalangeal joints (DIP) suggests osteoarthritis. The nails can show a variety of abnormalities, which vary according to the underlying aetiology. In the patient with psoriasis, for example, the fingernails may be pitted. Clubbing of the fingers (Fig. 1.2) may indicate disease processes in various systems. In this condition, there is a loss of the angle between the nail and nail bed leading to a fingernail with an exaggerated longitudinal curvature. Potential causes of finger clubbing are shown in Table 1.6.

Table 1.5 Potential causes of acute confusion in patients

• Hypoxia
• Epilepsy
• Hypoglycaemia
• Infection
• Stroke
• Myocardial infarction
• Raised intracranial pressure
• Drugs (prescribed or recreational)
• Drug or alcohol withdrawal

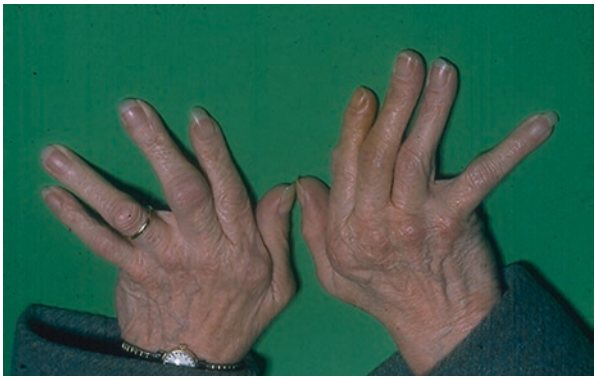

Fig. 1.1 A patient with rheumatoid arthritis showing the typical ulnar deviation of the hands

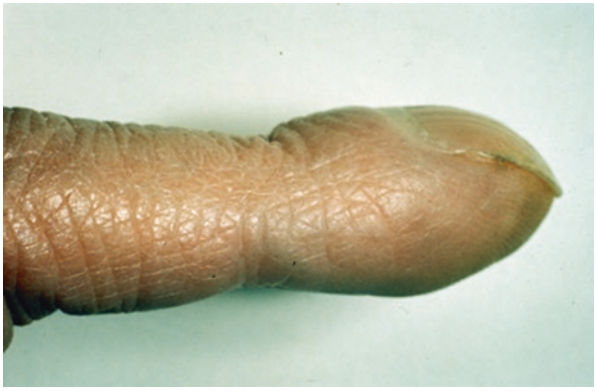

Fig. 1.2 A patient with finger clubbing

Table 1.6 Causes of finger clubbing

Cardiothoracic causes
• Infective endocarditis
• Intrathoracic pus, e.g. bronchiectasis, lung abscess
• Bronchial carcinoma
• Fibrosing alveolitis
• Cyanotic congenital cardiac disease
Gastrointestinal causes
• Inflammatory bowel disease especially Crohn's disease
• Cirrhosis of the liver
Other
• Idiopathic
• Familial
• In relation to thyrotoxicosis

The hand may also show signs of contraction of the palmar fascia, the so-called Dupuytren's contracture as shown in Fig. 1.3. The little and ring fingers in this condition remain flexed even when the hand is passive. The aetiology is not known, but the condition is sometimes associated with alcoholism.

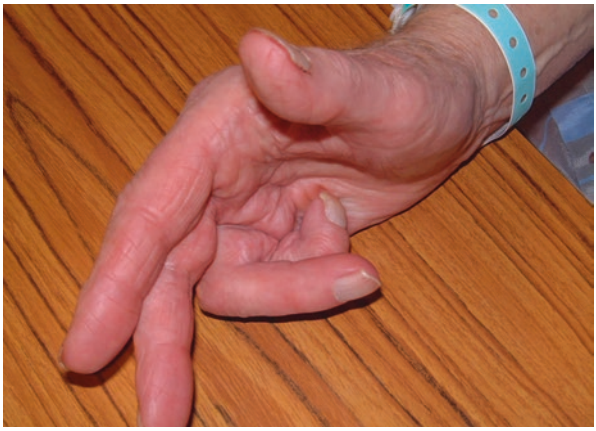

Fig. 1.3 Dupuytren's contracture

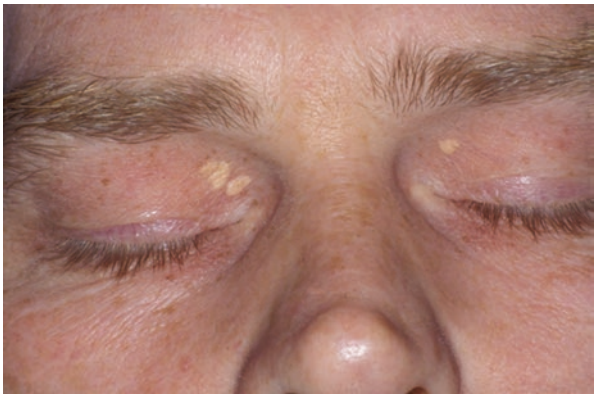

Fig. 1.4 Xanthelasma

The patient's complexion may give clues in relation to underlying systemic problems. Although jaundice may be observed in the skin, the best place to examine for the yellow discolouration is in the sclera of the eyes. The clinical and metabolic syndrome seen in chronic kidney disease (uraemia) may also impart a yellowish discolouration to the skin. Xanthelasma may be observed on the eyelids (Fig. 1.4). These lesions represent fatty deposits, which signify hyperlipidaemia. The so-called malar flush of mitral stenosis or the butterfly rash in systemic lupus erythematosus may be observed. Cyanosis may be observed. If the cyanosis is of the central type, the tongue will acquire a bluish colour. Peripheral cyanosis may be seen in the nail beds and is caused either by vascular insufficiency or peripheral vasoconstriction in cold conditions.

Although not routinely measured in dental practice, practitioners should be aware of the vital signs and their normal values. Oxygen saturation is not considered to be a formal part of the vital signs assessment but is increasingly being considered as a fifth vital sign. The vital signs and normal values are given in Table 1.7.

Table 1.7 Vital signs and normal ranges

Pulse rate
• Normal range 60–100 beats/min (under 60 signifies bradycardia, over 100 signifies tachycardia)
Blood pressure
• Normal range 120–140 mmHg (systolic) 60–90 mmHg (diastolic)
Temperature (*oral*)
• 35.5–37.5 °C
Respiratory rate
• 12–18 breaths/min

Table 1.8 Causes of tachycardia and bradycardia

Tachycardia
• In response to exercise, emotion
• Excess caffeine
• Fever
• In relation to drugs, for example, adrenaline, atropine
• Smoking
• Hyperthyroidism (atrial fibrillation—irregularly irregular pulse)
Bradycardia
• Physiological in athletes
• Immediately after fainting
• Hypothyroidism (atrial fibrillation—irregularly irregular pulse)
• Sick sinus syndrome

Of all the vital signs, one of the most common that could be measured by dental practitioners is the radial pulse. It is useful to have a working knowledge of the more common causes of tachycardia and bradycardia, and these are listed in Table 1.8.

It is important that practitioners have a generic "check list" that enables a comprehensive description of lesions to be carried out. Table 1.9 lists the criteria that should be established when examining any lump.

A similar scheme may be adopted to describe an ulcer. This scheme is summarised in Table 1.10.

1.4 Conclusions

Much of the medical assessment of a patient is derived from the history. It is important, however, that dental practitioners have a sound knowledge of some of the more common signs that may be observed in the clothed patient, which can signal underlying general health conditions. Some underlying conditions will be of direct relevance to the safe management of dental patients.

Table 1.9 Features on examination of a lump

• Site
• Size
• Shape
• Surface—smooth/irregular
• Single or multiple
• Depth
• Colour of overlying skin or mucosa
• Tenderness or warmth to palpation
• Edge (distinct or ill-defined)
• Consistency (hard, soft, rubbery or fluctuant)
• Is it pulsatile?
• Any associated lymphadenopathy
• Is the lump transilluminable?

Table 1.10 Generic features of an ulcer

• Site
• Size
• Base (sloughed, granulation tissue)
• Edge—sloping, punched out (square edge), undermined, rolled or everted
• Depth—is deeper anatomy exposed?
• Any associated discharge?
• Any associated lymphadenopathy?
• Is this an isolated ulcer or one of several?

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The Cardiovascular System

2

In Brief

- Cardiovascular disease is common.
- Pain and anxiety increase cardiac load and increase the risk of precipitating angina/arrhythmias.
- A thorough history will usually elicit the fact that the patient has cardiovascular disease (summarised in Table 2.2).
- Examination of the patient may reveal cardiovascular disease—cyanosis (central/peripheral), shortage of breath, abnormalities in the pulse, finger clubbing, splinter haemorrhages or ankle oedema.
- Drugs used in the treatment of cardiovascular disease impact on patient management.

This book examines aspects of general medicine and surgery which are of relevance to dental practice. The approach is standardised by considering systems under common headings, e.g. history, examination, commonly prescribed drugs and aspects relating to general and local anaesthesia and management in the dental surgery. The first chapter considers the cardiovascular system.

2.1 Introduction

Cardiovascular disease is common and it is inevitable that any practitioner dealing with patients will encounter it. In 1984 it was estimated that 2% of all adult dental patients were receiving antihypertensive therapy [1, 2]. This figure has risen, and in

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Table 2.1 Risk factors for cardiovascular disease

• Smoking
• Excess alcohol
• Diabetes mellitus
• Hypercholesterolaemia
• Family history of cardiovascular disease
• Sedentary lifestyle
• Obesity

1997 it was reported that up to 13% of patients in a dental hospital setting and 5% of those attending dental practice were receiving antihypertensive drugs [3]. There may be a well-established previous history of cardiovascular disease. The incidence increases with age such that, by the age of 70, all patients will have some degree of cardiovascular disease (this may be very minor and subclinical or the origin not recognised by the patient, e.g. calf claudication, a sign of peripheral vascular disease).

Risk factors for cardiovascular disease are shown in Table 2.1.

In the history it is clearly important to assess the degree of compensation that the patient has managed to achieve, i.e. how badly the patient is affected by their condition in terms of signs, symptoms and activity. The efficacy of medication is also important. Some patients may be taking aspirin on a regular basis. Specific enquiry is important due to aspirin's effects on blood clotting.

2.2 Relevant Points in the History

Other points to ask in the history (Table 2.2) include the following.

2.2.1 Chest Pain

The purpose of questioning here is not to try to be diagnostic but to gain an idea as to whether a cardiovascular cause for the pain may be likely, since some patients may be unaware of their condition but nevertheless be at risk. Features which make the pain unlikely to be cardiac in origin are pains lasting less than 30 s however severe, stabbing pains, well-localised left submammary (under the breast) pain and pains which continually vary in location. A chest pain made better by stopping exercise is more likely to be cardiac in origin than one that is not related (see myocardial infarction and angina). Pleuritic pain is sharp and made worse on inspiration, e.g. in pulmonary embolism. Shingles (*Varicella zoster*) may cause pain following a particular nerve territory. The characteristic rash is preceded by an area of hyperaesthesia.

Oesophagitis may cause a retrosternal pain which is worse on bending or lying down. However, oesophageal pain, like cardiac pain, may be relieved by sublingual nitrates, e.g. glyceryl trinitrate (GTN).

Table 2.2 Relevant points in the history with reference to cardiovascular system

• Chest pain
• Angina
• Myocardial infarction
• Hypertension
• Medication, e.g. aspirin, warfarin
• Syncope
• Shortage of breath/exercise tolerance
• Cardiac rate/rhythm
• Cardiomyopathy
• Coronary artery bypass graft
• Valve replacements
• Congenital disorders
• Cardiac transplants
• Rheumatic fever
• Infective endocarditis
• Venous/lymphatic disorders

Hyperventilation may produce chest pain. Gallbladder and pancreatic disease may also mimic cardiac pain. Musculoskeletal pain is often accompanied by tenderness to palpation in the affected region.

2.2.2 Angina Pectoris

This central, crushing chest pain may radiate to the neck, mandible and one or both arms. It may be felt in only one of these sites. Unstable angina is that occurring at rest, minimal exertion or with rapidly increasing severity. There is a significant risk of myocardial infarction and elective surgery should not be carried out on the patient with unstable angina. When performing emergency treatment on such patients, the use of epinephrine (adrenaline)-containing local anaesthetics is best avoided [4]. The severity of angina may be gauged by the exertion required to provoke an attack and the efficacy of medication to induce relief.

Effective analgesia, short appointments, availability of oxygen and GTN are all important in treatment regimens. The use of sedation should be considered in these patients as an added stress reduction measure. GTN should relieve chest pain in angina within 5 min. A spray formulation is now commonly used; this is the preferred formulation as the emergency medicament in practice as it has a longer shelf-life than the tablet formulation (once the bottle is opened).

2.2.3 Myocardial Infarction (MI)

The signs and symptoms of MI are well-known and may be like angina but more severe and of longer duration. Importantly, it is not relieved by GTN. Some

myocardial infarctions are ‘silent’, i.e. occur with no recognised symptoms or signs at the time. The residual deficit is a marker of severity of the original event. Admission to hospital, the coronary care unit and duration of admission are also indicative.

The timings for dental treatment, for both local and general anaesthesia post MI, are given later, but in all cases obviously, local analgesia must be maximally effective and GA carried out in a hospital environment. As mentioned above sedation should be considered for many of these patients.

2.2.4 Hypertension

There is variation but, in general terms, treatment is carried out if the blood pressure is persistently more than 200 systolic or over 110 diastolic. Treatment may be indicated at lower levels if vascular complications are evident.

Most hypertension is ‘essential’ (90%), i.e. no cause found. The aim of treatment is to maintain a blood pressure less than 160/90. Stress may further increase an already raised blood pressure, leading to risk of stroke or cardiac arrest.

Postural hypotension, e.g. on suddenly rising from the supine position or rapid alteration of the dental chair, may be a side effect of some antihypertensive drugs. There may be underlying cardiac or renal disease in some patients with hypertension. Many antihypertensive drugs impact on dental management (see later).

2.2.5 Syncope or Fainting

This, as is well-known, may be precipitated by fear and may be vasovagal or cardiac in origin. Respiratory syncope (in cases of extreme coughing bouts) also exists.

In the ‘carotid sinus syndrome’, mild pressure on the neck causes syncope with bradycardia or cardiac arrest.

2.2.6 Shortage of Breath (SOB)/Exercise Tolerance

SOB is often a sign of cardiac failure but must be differentiated from respiratory disease with which, of course, it may co-exist.

The degree of severity can be assessed by enquiring about whether the patient ever wakes up in the night with breathlessness (paroxysmal nocturnal dyspnoea) or has orthopnoea, i.e. becoming breathless on lying flat at night. The degree of exertion needed to precipitate breathlessness is also important.

In uncontrolled cardiac failure, dental treatment under any form of anaesthesia should be deferred until medication and symptoms are stabilised. Even when relatively well-controlled, putting the patient in the supine position may exacerbate dyspnoea and is therefore best avoided. Cor pulmonale is the term used to describe heart failure secondary to pulmonary disease. In ‘left-sided heart failure’, the oedema is pulmonary, whereas in ‘right-sided heart failure’, it is peripheral (sacral in the bedbound and ankles in the ambulant).

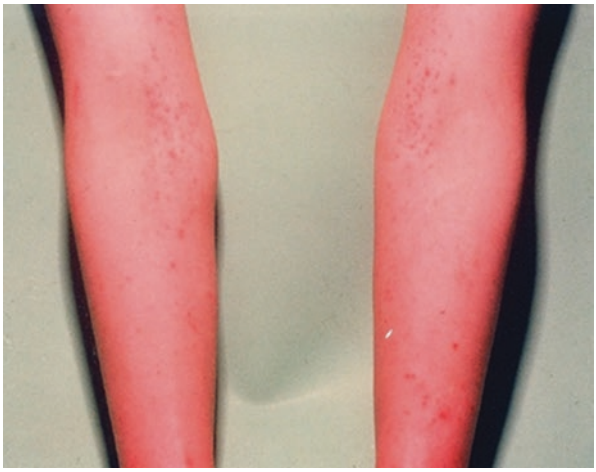

Fig. 2.1 A typical rash on the forearms of a patient who was given oral penicillin for prophylaxis against infective endocarditis

2.2.7 Rheumatic Fever

There may not be any subsequent cardiac damage, but this can only be determined definitively by a cardiologist. These patients may be more at risk of life-threatening reactions to prophylactic antibiotics compared with the development of infective endocarditis (see later) [5]. A typical rash in a patient allergic to penicillin who has taken the antibiotic is shown in Fig. 2.1.

2.3 The Cardiovascular System

Infective endocarditis may be acute or chronic. It is important that dentists have an awareness of the condition. The *viridans* streptococci are the most commonly isolated bacteria [5].

Syndromic patients, for example, those with Down syndrome, should be suspected of cardiac involvement. Individual congenital abnormalities often appear in association. Other causes of infective endocarditis include drug abuse, such as heroin addiction.

It is worth bearing in mind a previous history of rheumatic fever which may have led to cardiac valve damage. In 2008, the National Institute for Health and Care Excellence (NICE) discontinued the regular use of antibiotic prophylaxis for dental procedures that may produce a bacteraemia [6]. In 2016, NICE modified the guidance to state that: 'Antibiotic prophylaxis against infective endocarditis is not recommended routinely for people undergoing dental procedures' (https://pathways.nice.org.uk/pathways/prophylaxis-against-infective-endocarditis). This addition emphasises the standard advice from NICE on healthcare professionals' responsibilities. Doctors and dentists should offer the most appropriate treatment options, in consultation with the patient and/or their carer or guardian. In doing so, they should take into account the recommendations of NICE guidance and the values and preferences of patients and apply their clinical judgement.

Table 2.3 Stratification of the risk of infective endocarditis

High risk
• Patients with a previous history of infective endocarditis
• Patients with any form of prosthetic heart valve (including a trans-catheter valve)
• Those in whom prosthetic material was used for cardiac valve repair
• Patients with any type of cyanotic congenital heart disease
• Patients with any type of congenital heart disease repaired with prosthetic material, whether placed surgically or by percutaneous techniques, for the first 6 months after the procedure of lifelong if a residual shunt or valvular regurgitation remains
Moderate risk
• Patients with a previous history of rheumatic fever
• Patients with any other form of native valve disease (including the most commonly identified conditions, bicuspid aortic valve, mitral valve prolapse and calcific aortic stenosis)
• Patients with unrepaired congenital anomalies of the heart valves

To assist decision-making, NICE produced information regarding what should be considered to be high- and moderate-risk groups for the development of infective endocarditis, Table 2.3.

Following the 2016 revision by NICE, in 2018 the Scottish Dental Clinical Effectiveness Programme (SDCEP) published implementation advice- http://www.sdcep.org.uk. They included a patient management flowchart and a template letter for dentists to use if contacting a patient's cardiac specialist.

The SDCEP guidance also stressed the importance of maintaining good oral health and knowing what signs and symptoms to look out for in infective endocarditis.

SDCEP notes that there are some dental patients that may need special consideration for antibiotic prophylaxis but shifts much of the balance of decision making to the patient's cardiologist and the patient themselves.

2.3.1 Cardiac Rate/Rhythm

The patient may give a history of palpitations or an established history of arrhythmia. They may have a pacemaker.

Pacemakers may be temporary or permanent. Care needs to be taken with electrical equipment which can unbalance the circuits within a pacemaker. Magnetic resonance imaging (MRI) scanners, electrosurgery and diathermy can all be problematical, as can ultrasonic scalers. Electric pulp testers do not present a risk.

2.4 Common Arrhythmias (See Table 2.4)

2.4.1 Sinus Tachycardia (The Pulse Is More than 100 Beats/Min)

This may be physiological (exercise, emotion, anxiety, pain) or be related to fever, post myocardial infarction, shock, heart failure and with some drugs (epinephrine, atropine). Hyperthyroidism, smoking and excessive coffee ingestion may also be causes.

Table 2.4 Common arrhythmias which may be encountered in dental practice

• Sinus tachycardia—pulse over 100 beats/min
• Sinus bradycardia—pulse less than 60 beats/min
• Atrial fibrillation—totally irregular wrist pulse
• Ventricular extrasystole—'missed beats' at the wrist

2.4.2 Sinus Bradycardia (The Pulse Is Less than 60 Beats/Min)

This may occur physiologically in athletes or in vasovagal attack. Drugs such as beta blockers or digoxin may cause it. Post myocardial infarction and the 'sick sinus syndrome' may all be causative, as may hypothyroidism.

2.4.3 Atrial Fibrillation

This is common in the elderly and may be asymptomatic. An irregularly irregular pulse is palpable at the wrist. If a wrist pulse is palpated, e.g. after a faint or during sedation, it will frequently be encountered as a preexisting anomaly.

2.4.4 Ventricular Extrasystole

This is the commonest arrhythmia after a myocardial infarction. Three successive extrasystoles are described as ventricular tachycardia. An extrasystole is an 'extra' ventricular contraction. A ventricular extrasystole may be felt as a 'missed beat' at the wrist. They are usually of no significance.

Arrhythmias are relevant since they may be exacerbated by dental treatment due to the associated stress or by general anaesthesia [7]. Common arrhythmias are summarised in Table 2.4. Arrhythmias may be increased by manipulation of eyes, carotid sinus or neck by pathways mediated by the vagus nerve.

2.5 Cardiomyopathy

This is a general term meaning disease of the heart muscle. Consultation with the patient's cardiologist is important, particularly where there are associated cardiac symptoms.

2.6 Coronary Artery Bypass Graft

Exercise tolerance and history of chest pain should be enquired about post-bypass.

2.7 Valve Replacement

Artificial valves may be tissue or mechanical. The latter patients are placed on life-long warfarin.

2.8 Congenital Cardiac Defects

Congenital cardiac defects may be divided into cyanotic or acyanotic types. In the former, chronic hypoxaemia leads to finger clubbing (Fig. 2.2) and polycythaemia. The polycythaemia may lead to a tendency to haemolysis or thrombosis. The disorders fitting into the broad categories are shown in Table 2.5.

Cerebral abscess and bleeding tendency are risks in these patients.

2.9 Cardiac Transplants

Preoperatively, it is important to eradicate potential or actual sources of infection and to optimise oral hygiene. Such patients will usually be treated in the hospital setting.

Post-transplant treatment may be complicated by:

- Immunosuppression
- Steroid therapy
- Gingival overgrowth as a result of post-transplant drug therapy [8] (Fig. 2.3)
- Supersensitivity of the transplanted heart to circulating catecholamines [9] which may include epinephrine in dental local anaesthetics [10]
- Hepatitis, HIV infection (rarely)

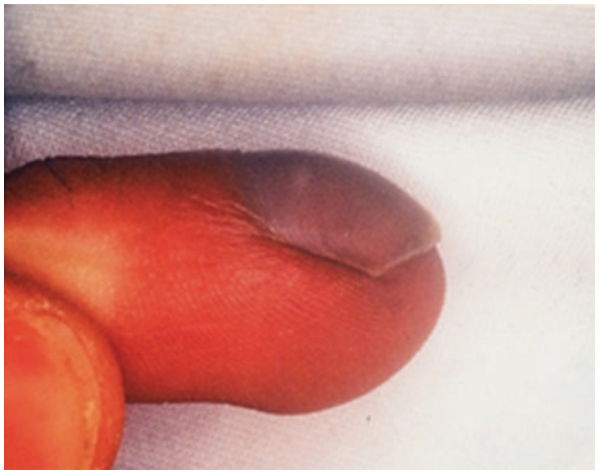

Fig. 2.2 Finger clubbing. This patient also demonstrates peripheral cyanosis

Table 2.5 Congenital cardiac defects may be broadly divided in to cyanotic and acyanotic categories

Cyanotic	Acyanotic
Transposition of great vessels Fallot's tetralogy (Ventricular septal defect Pulmonary stenosis Right ventricular hypertrophy Overriding aorta)	Ventricular septal defect Atrial septal defect Patent ductus arteriosus Aortic coarctation

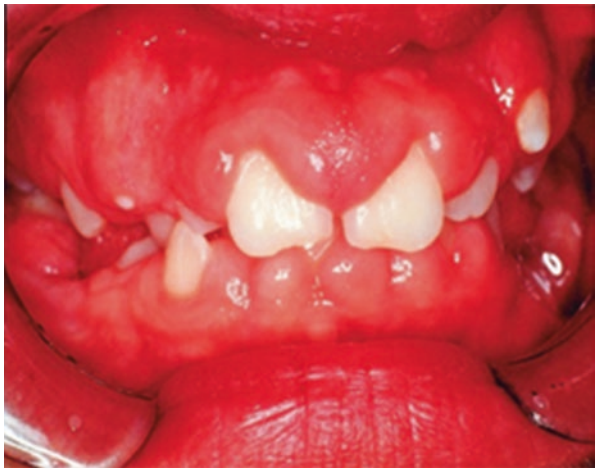

Fig. 2.3 Gingival hyperplasia in a post-cardiac transplant patient who is taking the calcium channel blocker nifedipine

Table 2.6 The swollen limb—many causes in addition to purely cardiovascular

Systemic causes
Congestive cardiac failure
Right heart failure
Hypoalbuminaemia, e.g. nephrotic syndrome
Fluid overload causes
Regional causes
Venous obstruction, e.g. advanced pregnancy lymphatic obstruction
Local
Sluggish venous return, e.g. poor muscle pump in a paraplegic patient
Acute obstruction to venous return, e.g. DVT, previous DVT
Cellulitis, lymphatic aplasia/obstruction

2.10 Venous/Lymphatic Disorders

A swollen limb may be a sign of heart failure. Causes of a swollen limb may be divided into systemic, regional and local as shown in Table 2.6. For dental purposes, the patient should be treated with legs elevated to minimise dependent oedema, but the practitioner should beware of orthopnoea.

2.11 Examination

The most obvious initial observations are those of the patient's general demeanour, colour and whether short of breath at rest (SOBAR) or on minimal exertion, e.g. walking into the surgery (obviously primary respiratory causes may also exist). SOBAR indicates severe cardiorespiratory disease. A pulse oximeter reading is a useful rough guide to the efficiency of ventilation.

Cyanosis may be central, e.g. lip, tongue or peripheral, e.g. nail beds (Fig. 2.2). Cyanosis represents a concentration of desaturated haemoglobin of at least 5 g/dl. The pulse in terms of rate, volume, rhythm and character can give important clues to the state of the cardiovascular system and, indeed, other systems.

Clubbing of the fingers (loss of the angle between nail and nail bed when a finger is viewed from the side) may occur in infective endocarditis, cyanotic congenital heart disease and thyrotoxicosis (in which atrial fibrillation may also be noted).

Splinter haemorrhages are vasculitic consequences of infective endocarditis visible in the nail beds. Osler's nodes may also occur (painful lesions on the finger pulps) and macules on the palms (Janeway lesions) in infective endocarditis.

Swollen ankles may be a sign of cardiac failure and oedema occurs in the sacrum in bedbound patients.

2.12 Drugs Used in Cardiovascular Disease

2.12.1 Beta Blockers

These drugs decrease the sympathetic effects on the cardiovascular system, e.g. atenolol, propranolol and sotalol. Beta blockade inhibits any reduction in diastolic blood pressure produced by epinephrine in dental local anaesthetics [11] which might result in an uncompensated rise in systolic blood pressure. Thus dose limitation of epinephrine is wise when patients are taking beta blockers; two cartridges of an epinephrine-containing solution in an adult are a sensible limit.

Oral side effects can include dry mouth and lichenoid reactions.

2.12.2 Diuretics

These may be used in hypertension (thiazides only) and heart failure. Patients receiving non-potassium-sparing diuretics have been shown to experience an increased hypokalaemic response to epinephrine in dental local anaesthetics compared to healthy patients [12], and this could predispose to arrhythmias. A limit of one to two epinephrine-containing LA cartridges is recommended.

2.12.3 Digoxin

This is used to slow the ventricular rate in fast atrial fibrillation. The old-fashioned use is in the treatment of heart failure—angiotensin-converting enzyme (ACE) inhibitors are now more commonly used (see below).

2.12.4 ACE Inhibitors

Renin, produced by the kidney, converts angiotensinogen to angiotensin I, which is converted in the lungs by angiotensin-converting enzyme (ACE) to angiotensin II. Angiotensin II stimulates the adrenal cortex to produce aldosterone which induces peripheral vasoconstriction. Aldosterone activates the pump in the distal renal tubule leading to reabsorption of sodium and water from urine, in exchange for potassium and hydrogen ions.

ACE Inhibitors may induce cough, angioedema and lichenoid reactions; there may be taste loss with enalapril and captopril. Erythema multiforme may also be induced. Burning mouth has also been reported. NSAIDs should be avoided as the risk of renal damage is increased.

Other vasodilators decrease the blood pressure in hypertension. This decreases the work of the heart in cardiac failure. They may dilate predominantly veins, e.g. nitrates, or arteries, e.g. hydralazine, or a mixture, e.g. prazosin.

2.12.5 Calcium Channel Blockers

These cause coronary and peripheral vessel vasodilation and are negatively inotropic, i.e. they reduce the strength of cardiac contraction. They are antiarrhythmic. Calcium antagonists are used in coronary heart disease and hypertension. Examples include nifedipine and diltiazem.

Oral side effects include gingival hyperplasia [8]. Headache and flushing may occur, as can peripheral oedema.

2.12.6 Potassium Channel Activators

Nicorandil has vasodilating properties on both the arterial and venous sides of the circulation. This drug can produce large ulcers in the mouth [13] that are similar to major aphthae and may be confused with malignancy.

2.12.7 Warfarin

This may be used in the management of atrial fibrillation (as thromboembolic prophylaxis) and deep vein thrombosis (DVT) and prevention of embolisation secondary to MI and after prosthetic heart valve replacement.

The therapeutic efficacy is monitored using the international normalised ratio (INR). There are local variations in what is considered to be a ‘safe’ INR to carry out surgical dental treatment. This aspect is discussed fully in the chapter relating to bleeding disorders (Chap. 10).

The INR should be checked on the day of the procedure. Whenever warfarin dosage is adjusted, the normal regimen is to stop the drug 2 days before the procedure,

with an INR check preoperatively and resumption of the warfarin on the evening of the day of procedure. Adjustment must be in consultation with the patient's physician and is usually not required.

2.12.8 Heparin

This is an anticoagulant usually used in the hospital setting. It is monitored by the activated partial thromboplastin time (APTT).

Since the advent of the low molecular weight heparins, some cases of DVT are now treated on a community basis, and a dental surgeon in practice could encounter a patient on this form of treatment. Tinzaparin and enoxaparin are two of the more commonly used agents; they have little effect on dental treatment.

2.12.9 Direct Oral Anticoagulants (DOACs)

The direct oral anticoagulants (DOACs) are seen more commonly in patients who need anticoagulation. They have a more linear dose-response relationship than warfarin and therefore a more predictable effect for a given dose. They undergo renal excretion, and therefore the dose may produce a different level of anticoagulation in patients with renal impairment.

Examples of DOACs include dabigatran and rivaroxaban. The former is a direct thrombin inhibitor and the latter is a factor X_a inhibitor. These are discussed further in Chap. 10: Haematology and Patients with Bleeding Problems and Dental Practice.

2.13 General and Local Anaesthesia, Sedation and Management Considerations in the Dental Patient with Cardiovascular Disease

The association of oral health and coronary heart disease is controversial. Some studies suggest an association between periodontitis and risk of heart disease [14]. So excellent dental care may play a role in the prevention of cardiovascular conditions.

As alluded to earlier, the key to assessment is the degree of compensation or control of the underlying disorder that has been achieved. The relevance with regard to anaesthesia of some disorders is discussed earlier. The American Society of Anaesthesiologists (ASA) has developed a system known as the ASA classification, which is a universally recognised stratification of patient fitness (encompassing all systems of the body). The classification is shown in Table 2.7.

In hypertensive patients, if feasible, treatment is best carried out under local analgesia, with or without sedation. As mentioned previously both beta-blocking and non-potassium-sparing diuretic drugs can exacerbate unwanted effects of epinephrine in dental local anaesthetics, and dose reduction of epinephrine is wise. Similarly, patients who have had cardiac transplants may super-react to the

Table 2.7 American Society of Anaesthesiologists (ASA) classification

ASA I healthy
ASA II mild systemic disease—no functional limitation
ASA III severe systemic disease—definite functional limitation
ASA IV severe disease—constant threat to life
ASA V moribund
ASA VI brain dead patient whose organs are to be removed for donor purposes

Table 2.8 Prognosis after MI with general anaesthesia

Time since infarction	Incidence of further infarction after surgery (%)
0–6 months	55
1–2 years	22
2–3 years	6
>3 years	1
No infarction	0.66

cardiac effects of epinephrine in dental local anaesthetics. The use of sedation may be valuable in patients with cardiac disease. Firstly, sedation may reduce the effects of stress. Secondly, the use of sedation may eliminate the need for general anaesthesia. Antihypertensive drugs are not usually stopped before a general anaesthetic.

In patients post myocardial infarction, elective surgery under GA or LA should be postponed for at least 3 months and, ideally, a year. Within 3 months of an MI, even emergency treatment is best carried out with medical consultation. The prognosis after an MI of patients undergoing a GA is shown in Table 2.8.

Aspects relating to the management of patients with cardiovascular disease other than operative pain control measures include the treatment of conditions secondary to drug therapy and post-operative pain control. Drug problems which may arise include dry mouth which will necessitate a preventive regimen and when severe may require the use of artificial saliva. Drug-induced gingival overgrowth can occur as mentioned earlier as a result of post-transplantation drugs and calcium channel blockers (Fig. 2.3). Repeated gingival surgery is not uncommon in such patients. Normally, post-operative pain in dentistry is controlled by non-steroidal analgesics. However, the use of non-steroidal anti-inflammatory drugs such as aspirin should be avoided in patients taking warfarin as the anticoagulant effect is increased. Similarly, non-steroidal drugs inhibit the hypotensive effects of antihypertensive medication, and their nephrotoxicity is increased in the presence of diuretics.

Smoking is a common cause of perioperative morbidity in the context of GA. In addition to its deleterious respiratory effects, the carbon monoxide produced by cigarettes has a negatively inotropic effect. Nicotine increases the heart rate and systemic arterial blood pressure.

Carbon monoxide decreases oxygen supply and nicotine increases oxygen demand. This is particularly significant in patients with ischaemic heart disease. These patients can get real benefit by stopping smoking 12–24 h before surgery. The negative respiratory effects of smoking take at least 6 weeks to start to abate.

2.14 Summary

There are many factors which need to be borne in mind from the cardiovascular point of view when assessing the status of a patient requiring dental treatment. The degree of control of the disease, sequelae arising from it and time from the causative event can all be of importance in treatment planning. Much of the information required to make safe decisions will be obtained through a thorough history.

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The Respiratory System and Dental Practice

3

In Brief

- Respiratory disorders may present with cough, sputum, wheeze or haemoptysis. Differentiation from cardiac disease (which may be concurrent) can be difficult since certain features are common to both. These include dyspnoea, finger clubbing and cyanosis. A thorough history helps in differentiation.
- Respiratory failure can be precipitated in a patient with respiratory impairment if they have a GA. The impairment may be temporary, e.g. due to infection. An upper respiratory tract infection may progress to the chest, and therefore a GA should be postponed in the nonurgent case.
- Enquiry should be made regarding the efficacy of medication, e.g. inhalers used in the management of asthma, and should be available for use if required. The possibility that the patient may be taking (or have taken) steroids should be borne in mind.
- Patients who are short of breath feel more comfortable in a sitting position rather than supine.

The respiratory system is always affected to some extent by smoking, and enquiry should always be made with regard to smoking habits. *Cough* is a non-specific reaction to irritation anywhere from the pharynx to the lungs. It may produce sputum or be non-productive. Haemoptysis (coughing up of blood) may occur, and it is important to differentiate this from haematemesis (vomiting of blood). Large volumes of blood may be coughed up in lung cancer, bronchiectasis and tuberculosis. Lesser amounts may be observed in pneumonia and pulmonary embolism. A summary of specific points to obtain in the history is given in Table 3.1, and these are discussed further below.

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https://doi.org/10.1007/978-3-319-97737-9_3

Table 3.1 Points in history of patients with respiratory disease

• Smoking
• Cough
• Sputum (colour)
• Acute problem or chronic disorder?
• Infection—URTI/LRTI
• Sinusitis
• Pneumonia—primary, secondary, atypical
• Asthma
• COPD
• TB
• Bronchiectasis
• Cystic fibrosis
• Haemoptysis
• Lung cancer

Occupational lung disorders, sarcoidosis, ARDS—may be guided by facts obtained in the earlier history

3.1 Relevant Points in the History

Infections of the respiratory tract may be acute or chronic and may be of the upper (i.e. vocal cords or above) or lower tract. Infections of either are a contraindication to GA, which should be deferred until resolution has occurred. An upper respiratory tract infection (URTI) will readily progress to the lower tract if a GA is given. URTIs may occur as part of the common cold, as pharyngitis or tonsillitis and as a laryngotracheitis. The latter in children may cause stridor ('croup').

The *paranasal air sinuses* may become infected secondary to a viral URTI (a viral cause being most common). In acute sinusitis, the most commonly implicated bacteria are *Streptococcus pneumoniae* and *Haemophilus influenzae*. In maxillary sinusitis (which may also occur secondary to periapical infection of intimately related teeth), pain in the cheek and/or upper teeth is worsened by lowering the head, and there is a mucopurulent nasal discharge. The maxilla over the antrum is tender to palpation. An occipitomental radiograph may show increased radiopacity of the antrum, but this can often be difficult to assess objectively and may be due to a thickened mucosal lining rather than acute infection (Fig. 3.1). Analgesics and antibiotics, e.g. amoxicillin, erythromycin or doxycycline, for 2 weeks may be required. In chronic sinusitis, formal drainage of the antrum may be required.

Lower respiratory tract infections are often viral, but bacterial infection will frequently supervene. There are signs of systemic upset, e.g. fever, pleuritic pain (sharp pain on inspiration), cough, green/yellow sputum and possibly haemoptysis. The patient (especially the elderly) may appear confused, and indeed this may be the only sign that something is wrong. There will often be dyspnoea (the subjective feeling of a shortage of breath).

Primary pneumonia occurs in previously healthy individuals and is often due to pneumococci or 'atypical' organisms. Secondary pneumonias occur in patients with impaired defences, e.g. in malignancy or chronic obstructive pulmonary disease (COPD) such as chronic bronchitis and emphysema. Atypical pneumonias include *Legionella pneumophila* and *Pneumocystis carinii* (*jiroveci*) (a protozoan-like cyst) in AIDS. The former organism causes Legionnaires' disease, and the organism

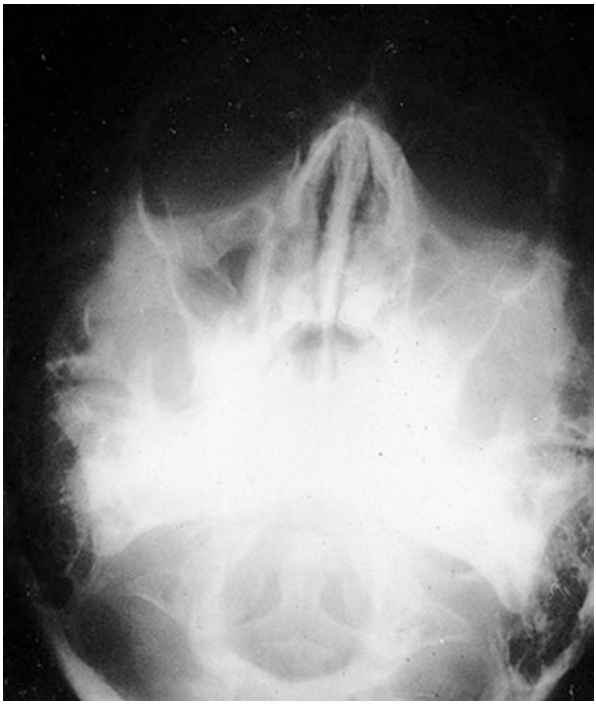

Fig. 3.1 Increased radiopacity of the left maxillary antrum in maxillary sinusitis

multiplies in stagnant water found in air conditioning systems. It has been isolated from dental units which have been unused over a prolonged period, e.g. weekends or holidays [1]. Units such as this should be 'run through' thoroughly before resuming clinical use. An inadequately treated pneumonia may lead to a lung abscess. Aspiration of a foreign body from the mouth can also be a cause. In dentistry this may occur when a rubber dam is not used when it is indicated leading to inhalation of debris or if an inadequate throat pack or uncuffed endotracheal tube is used for dental procedures under GA. The commonest infecting organisms are *Staphylococcus aureus* or *Klebsiella pneumoniae*.

Bronchial asthma is a generalised airway obstruction which in the early stages is paroxysmal and reversible. The obstruction, leading to wheezing, is due to bronchial muscle contraction, mucosal swelling and increased mucus production. Exposure to allergens and/or stress can induce an attack. It is now accepted that inflammation is an important aetiological factor in asthma and this has resulted in the use of anti-inflammatory medication in the management of the condition [2, 3]. In terms of management, infrequent attacks can be managed by salbutamol (Ventolin) inhalers as needed or prophylactically if an attack might be predicted, e.g. before exercise or prior to a stressful event such as dental treatment. If the attacks are more frequent, the salbutamol should be used regularly. If this is insufficient, inhaled steroids (or cromoglycate in the young) should be used. In severe cases systemic steroids may be prescribed. Enquiry should be directed toward the efficacy of medication, use of steroids and whether there have been episodes of hospitalisation.

COPD comprises chronic bronchitis and emphysema. Chronic bronchitis is said to exist when there is sputum production on most days for 3 months of the year in 2 successive years. Emphysema is dilatation of airspaces distal to the terminal bronchioles by destruction of their walls. The two coexist in varying proportions in COPD and smoking is a common predisposing factor [4]. Emphysema may rarely be inherited and is then due to alpha-1-antitrypsin deficiency. Some COPD patients are breathless but not cyanosed ('pink puffers'); some are cyanotic and if heart failure supervenes become oedematous or bloated ('blue bloaters'). In these patients the respiratory centres are relatively insensitive to carbon dioxide, and they rely on 'hypoxic drive' to maintain respiratory effort. It is dangerous to give high levels of supplemental oxygen for longer than brief periods to these patients as breathing may stop or the patient may begin to hypoventilate.

Treatment of acute exacerbations of COPD involves broad-spectrum antibiotics, bronchodilators (inhaled or nebulised) and possibly physiotherapy. Steroids may also be used. Dental treatment should be avoided during an exacerbation and in any event if possible should be carried out under LA.

Tuberculosis caused mainly by *Mycobacterium tuberculosis* is a disease that has increased in prevalence in recent years, largely due to the immunocompromised HIV population, in the malnourished, e.g. the materially deprived and in immigrants from underdeveloped countries. It is unlikely to be a great risk to dental staff unless the patient has an active pulmonary type in which case dental treatment is better deferred until control has been achieved. Pulmonary TB is usually spread by inhaling infected sputum and is highly infectious when active. If delayed treatment is not possible, aerosols should be reduced to a minimum, and it may be useful to carry out treatment under rubber dam. Masks and spectacles are mandatory for all personnel. Most primary infections are subclinical. Haematogenous spread can lead to skeletal or genitourinary lesions. Widespread lesions give rise to the term 'miliary TB'. A diagnosis of TB is suggested by chronic cough, haemoptysis, fever, night sweats and weight loss. Confirmatory tests include chest X-ray, sputum examination for acid and alcohol fast bacilli and the skin test or Mantoux test which shows a delayed hypersensitivity to a protein derived from *Mycobacterium tuberculosis*. Specific chemotherapy is by far the most important measure in the treatment of TB. In the UK, rifampicin, isoniazid, ethambutol, streptomycin and pyrazinamide are considered in the first-line treatment of TB. The majority of patients are treated as outpatients, whereas a policy of 'isolation' was followed in the past. Immobilisation of the patient is necessary in some forms of skeletal TB.

Bronchiectasis is a condition where the bronchi are irreversibly dilated and act as stagnation areas for persistently infected mucus. It should be suspected in any persistent or recurrent chest infection. It may be congenital, e.g. in cystic fibrosis or postinfection, e.g. TB and measles. Haemoptysis may occur. Intensive physiotherapy, antibiotics and bronchodilators are the mainstays of treatment.

Cystic fibrosis is one of the commonest inherited diseases (1 in 2000 live births) and is autosomal recessive. The cells are relatively impermeable to chloride (hence diagnosis by measuring the chloride concentration of sweat), and thus salt-rich secretions are produced. The mucus is viscid and blocks glands. In the young adult

or child, recurrent chest infections are seen; bronchiectasis and pancreatic insufficiency also occur.

Lung cancer is usually linked to cigarette smoking and may present in various ways including cough and haemoptysis. The disease may produce cerebral and hepatic metastases. The latter produce hepatomegaly, jaundice or ascites (fluid in the abdomen producing distension). Bone metastases (including the facial bones) may lead to pathological fracture. If the superior vena cava becomes compressed by tumour, facial oedema and cyanosis may occur (the superior vena cava syndrome). These patients may have muscle weakness (the Eaton-Lambert syndrome) in which unlike myasthenia gravis the use of muscles leads to better function rather than deterioration. Ectopic hormone production may occur in lung cancer (commonly adrenocorticotrophic hormone—ACTH).

Occupational lung disease is still seen in patients and may lead to significant respiratory impairment. Most inhaled particles cause no damage as they become trapped in the nose or are removed by the mucociliary clearance system. Particles may be destroyed by alveolar macrophages. The pneumoconioses are conditions which result from inhalation of various dusts and include asbestosis, silicosis and coal workers' pneumoconiosis. They will all restrict respiratory efficiency to some degree and potentially have a bearing on dental treatment provision.

Sarcoidosis is a multisystem disorder of unknown aetiology and is characterised by non-caseating granulomata. It most commonly affects the lungs of young adults but may occur at any age. Thoracic sarcoidosis classically presents incidentally as bilateral hilar lymphadenopathy on chest X-ray and is often asymptomatic. It may, however, be associated with cough, fever, arthralgia, malaise or erythema nodosum. Erythema nodosum comprises painful, erythematous nodular lesions on the anterior shins but is not specific for sarcoid, for example, they may also be seen in TB. Extra-thoracic manifestations of sarcoidosis are listed in Table 3.2. Gingival swelling found to be due to sarcoid is shown in Fig. 3.2. The mainstay of diagnosis is a rise in serum angiotensin-converting enzyme level. Treatment may be carried out using steroids which may have implications for dental treatment as well as potential respiratory impairment.

The *adult respiratory distress syndrome* (ARDS) is a progressive respiratory insufficiency which usually follows a major systemic insult, e.g. trauma and infection, and is largely due to interstitial pulmonary oedema arising from leaking capillaries. It is only relevant to mainstream dental practice in that about one third of surviving patients may be left with pulmonary fibrosis. Other causes of pulmonary

Table 3.2 Extra-pulmonary manifestations of sarcoidosis

General	Fever, malaise, lymphadenopathy, hepatosplenomegaly
Oral	Salivary gland swelling, gingival swelling
Skin	Erythema nodosum
Eye	Enlarged lacrimal glands
Bones	Arthralgia
Heart	Cardiomyopathy
CNS	Cranial and peripheral nerve palsies (especially facial nerve)
Kidney	Renal stones

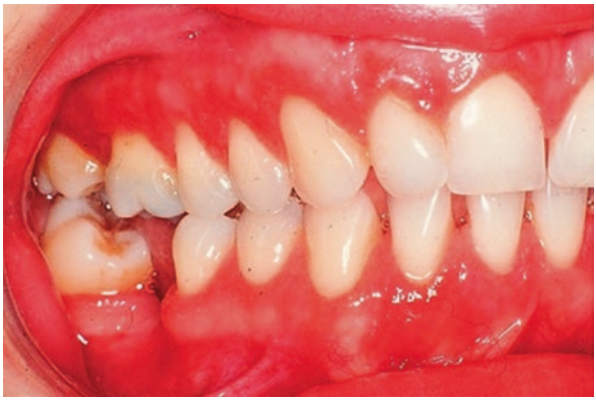

Fig. 3.2 This young female patient presented with gingivitis but had good oral hygiene. The gingival swelling was later found to be due to sarcoid

fibrosis include connective tissue disorders, e.g. rheumatoid arthritis, Sjögren syndrome or may be unknown-cryptogenic. Management is difficult and largely relies on immunosuppression, e.g. with prednisolone.

3.2 Examination

The patient's colour may give an early clue as to their condition, e.g. the pink puffer or blue bloated patient with COPD. The patient may be centrally cyanosed with a bluish hue to the tongue/lips. This is seen when there is a deoxygenated haemoglobin level of concentration >5 g/dL. Respiratory disease may cause the patient to be short of breath or tachypnoeic (breathing quickly) at rest or on minimal exertion, e.g. walking into the surgery. The patient may be using their accessory muscles of respiration. In patients who retain carbon dioxide, the radial pulse at the wrist may feel very full, and 'bounding' and carbon dioxide retainers may also have a flapping tremor of the hands when they are held outstretched. Intra-oral examination may reveal that patients using corticosteroid inhalers are predisposed to developing oral/pharyngeal candidosis (Fig. 3.3) and patients using beta$_2$ agonists and antimuscarinic agents often will have a dry mouth. More uncommon oral findings on examination may be a hyperpigmentation of the soft palate in lung cancer or even bony metastases from lung cancer in the jaws. Chronic ulcers of the dorsum of tongue may rarely be an oral manifestation of TB.

Cervical lymphadenopathy from TB may also be evident, but the more common lymphadenopathy secondary to a URTI should be considered first (Table 3.3).

The pulse oximeter gives a guide to the efficiency of oxygenation of blood (Fig. 3.4). It measures the pulse rate and oxygen saturation. The sensor, placed usually on a fingertip, contains two light emitting diodes (LEDs), one red measuring the amount of oxygenated haemoglobin and the other infrared, measuring the total haemoglobin. The oxygen saturation is the amount of oxygen carried in the blood relative to the maximum possible amount. There is a linear relationship between oxygen in the blood and the arterial oxygen saturation. Pulse oximetry does not necessarily indicate normal ventilation, since the saturation can appear normal if supplemental oxygen is being used.

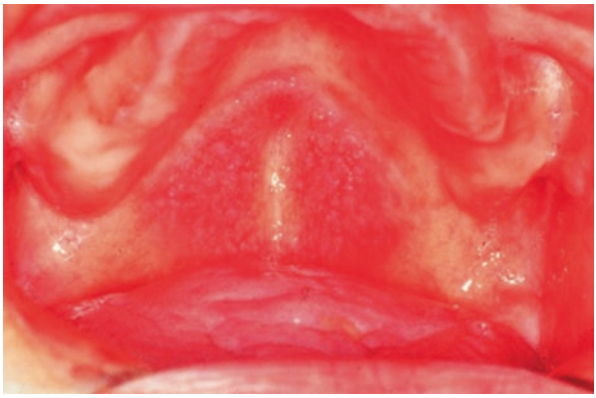

Fig. 3.3 This patient was using inhaled corticosteroids for the treatment of COPD and has developed candidosis as a result. The full upper denture baseplate has protected the palate more anteriorly

Table 3.3 Relevant factors on examination of a dental patient with respiratory disease which may be present

• Colour
• Central cyanosis
• Dyspnoea, tachypnoea (use of accessory muscles)
• Finger clubbing
• Cervical lymphadenopathy (URTI, TB)
• Bounding pulse
• Oral hyperpigmentation
• Flapping tremor

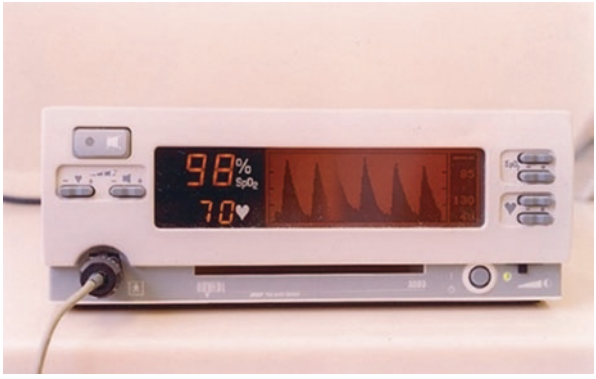

Fig. 3.4 A standard pulse oximeter

3.3 Relevance of Drugs in Respiratory Disorders

3.3.1 Corticosteroids

The use of corticosteroids, normally by inhalation, can lead to some problems related to dental management. Firstly, the use of steroid inhalers can lead to localised lowered resistance to opportunistic infections. As a result of this, oropharyngeal candidal infection may occur [5]. In order to avoid this complication, patients should be advised to rinse and gargle with water after use of their inhaler. Secondly, regular use of inhaled steroids can lead to adrenal suppression; thus the patient may be at risk of an adrenal crisis if they are subjected to stress.

3.3.2 Beta Adrenergic Agonist Bronchodilators

$Beta_2$ adrenergic agonists such as salbutamol and terbutaline can produce dry mouth, taste alteration and discolouration of the teeth. Dry mouth may increase caries incidence, and thus a preventive regimen is important. If the dry mouth is severe, artificial saliva may be indicated. The hypokalaemia which may result from a large dose of $beta_2$ adrenergic agonists may be exacerbated by a reduction in potassium produced by high doses of steroids and by epinephrine in dental local anaesthetics.

3.3.3 Antimuscarinic Bronchodilators

Drugs such as ipratropium can produce dry mouth and taste disturbance and may also cause stomatitis. The absorption of the antifungal agent ketoconazole is decreased during combined therapy with ipratropium.

There is an increased chance of arrhythmia with halogenated general anaesthetic agents during combined therapy with theophylline. In addition theophylline decreases the sedative and anxiolytic effects of some benzodiazepines including diazepam. Plasma theophylline levels are reduced by carbamazepine and phenytoin [5] and increased by erythromycin [6, 7]. Theophylline levels may also be affected by corticosteroids. Hydrocortisone and methylprednisolone have been shown to both increase and decrease theophylline levels. Terfenadine decreases the plasma concentration of erythromycin [8], and this may be clinically important.

Antimuscarinic effects (such as dry mouth) are increased with concurrent use of tricyclic and monoamine oxidase inhibitor antidepressant drugs.

3.3.4 Cromoglycate

Dry mouth, burning mouth and taste disturbance may occur during cromoglycate therapy.

3.3.5 Antihistamines

The more modern antihistamines such as terfenadine may produce dry mouth, but this is less common compared to older antihistamines.

Stevens-Johnson syndrome may occur. Tricyclic and monoamine oxidase inhibitor antidepressants increase antimuscarinic effects such as dry mouth when used concurrently. Among the many drugs which may produce dangerous arrhythmias when combined with terfenadine are erythromycin [8], the antifungal drugs, miconazole, fluconazole, itraconazole and ketoconazole [9], and the antiviral agents, efavirenz, indinavir, nelfinavir, ritonavir and saquinavir. Grapefruit juice must be avoided during therapy with terfenadine to avoid arrhythmias. The antihistamines have an enhanced sedative effect when combined with anxiolytic and hypnotic drugs.

3.3.6 Cough Suppressants and Decongestants

Occasionally cough suppressants such as codeine may be used by patients, and the additive effect of this should be considered when prescribing opioid analgesics (such as paracetamol/codeine compound drugs). There is a theoretical possibility that the adrenergic effects of epinephrine in dental local anaesthetics will be enhanced by ephedrine so dose reduction should be considered. Ephedrine may increase the chance of arrhythmia with halogenated general anaesthetic agents.

3.4 Relevance of Respiratory Disorders in the Provision of Local Anaesthesia Sedation, General Anaesthesia and Management in Dental Practice

Excellent dental care is important in patients with respiratory disorders. There is some evidence of an association of poor dental health with pneumonia and COPD. In addition there is good evidence that improvements in oral hygiene can reduce the impact of respiratory disease in high-risk individuals [10].

The relevant drug interactions and adverse effects of medication used to treat respiratory disorders have been discussed above. Other effects of respiratory disease on management are considered here. In the presence of respiratory impairment, general anaesthesia can be potentially dangerous since respiratory failure may be precipitated. If infection is temporary, then resolution should be awaited. If GA is unavoidable and the condition is chronic, e.g. in cases of COPD or bronchiectasis, then the condition of the patient should be optimised, e.g. using preoperative physiotherapy, sometimes antibiotics, bronchodilators such as salbutamol and antimuscarinics such as ipratropium (sometimes nebulised). Even when treated using LA, these patients may become dyspnoeic, especially when supine. As part of any preoperative workup, benefit can be gained by stopping smoking.

The use of rubber dam may be unacceptable in patients with COPD due to further compromise of the airway. If rubber dam is necessary, supplemental oxygen via a nasal cannula may be required, but low concentrations should be used. Figure 3.5 shows a patient receiving supplemental oxygen via a nasal cannula.

In cases of active TB, a GA is contraindicated, both due to impaired respiratory function or contamination of anaesthetic machine circuits. Asthmatic patients should have treatment carried out using LA if possible. Effort should be made to allay anxiety as far as possible, and treatment should not be carried out if the patient has not brought their normal medication and such medication is otherwise unavailable. Relative analgesia using nitrous oxide and oxygen is preferred to intravenous sedation since the former can be rapidly controlled. GA can be complicated by hypoxia and increased carbon dioxide which can lead to pulmonary oedema even if cardiac function is normal.

As mentioned above patients may not be comfortable in the supine position if they have respiratory problems. If the patient suffers from asthma, then aspirin-like compounds should not be prescribed as many asthmatic patients are allergic to these analgesics [11]. A severe asthmatic attack can be life-threatening, and as stress may contribute to the onset of such a condition, the dentist should have the equipment to deal with such an emergency at hand. A salbutamol inhaler or nebulised salbutamol is useful.

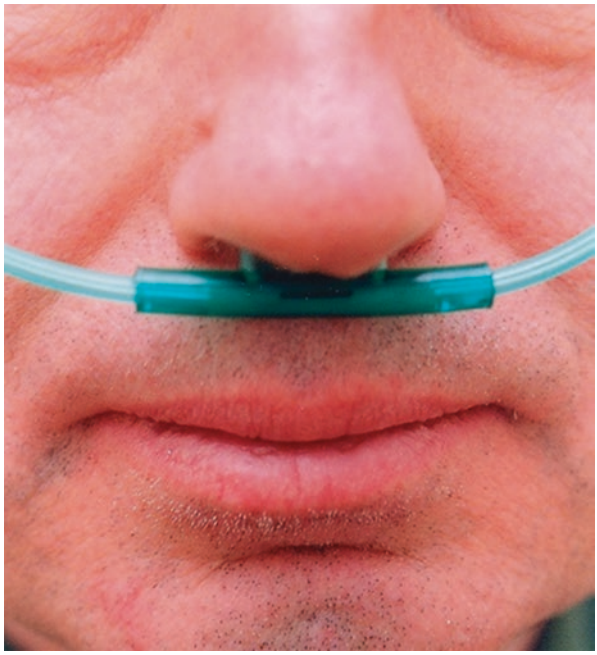

Fig. 3.5 Supplemental oxygen administered via nasal cannula

Intravenous hydrocortisone and intravenous aminophylline are reserved for patients who do not respond quickly to nebulised bronchodilator therapy. Care is needed with patients already taking theophylline preparations, and this step is best left until medical assistance is available.

The use of *supplemental steroids* prior to dental surgery in patients at risk of an 'adrenal crisis' is still a contentious issue although many cases that in the past would have had steroid supplementation are now treated by monitoring the blood pressure during the procedure; see below. The rationale for steroid supplementation is as described below.

Corticosteroids are critical in the body's response to trauma (including operative trauma). A normal response is to increase corticosteroid production in response to stress. If this response is absent, hypotension, collapse and death will occur. The hypothalamic-pituitary-adrenal axis will fail to function if either pituitary or adrenal cortex ceases to function, e.g. administration of corticosteroids, leads to negative feedback to the hypothalamus causing decreased ACTH production and adrenocortical atrophy. This atrophy means that an endogenous steroid boost cannot be produced in response to stress. Studies have suggested that dental surgery may not require supplementation [12]. More invasive procedures, however, such as third molar surgery or the treatment of very apprehensive patients, may still require cover. It is wise, even if supplementary steroids have not been used, to monitor the blood pressure of patients taking steroids. If the diastolic pressure falls by more than 25%, then a steroid injection (100 mg hydrocortisone) is indicated. Patients who may require supplementation are those who are currently taking corticosteroids or have

done so in the last month. A supplement may also be required if steroid therapy has been used for more than 1 month in the previous year. If the patient is receiving the equivalent of 20 mg prednisolone daily, then extra supplementation is not required.

3.5 Summary

Respiratory problems affect many aspects of dental treatment. Eliciting a proper history from the patient with respiratory disease will help prevent serious problems and alert the dentist to orofacial conditions which may result from the use of appropriate medication. Patients with significant respiratory problems, particularly if they need extensive treatment, are best treated in the hospital setting.

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The Gastrointestinal System and Dental Practice

4

In Brief

- Cervical lymph node enlargement is most commonly caused by infection. Neoplasms (local or systemic) may also be responsible.
- Peptic ulceration (related to infection with *Helicobacter pylori*) is a contraindication to non-steroidal anti-inflammatory drugs. Care is also needed with steroid therapy which can lead to peptic ulcer bleeding.
- Anaemia may occur secondary to blood loss from a gastrointestinal cause.
- Vomiting after GA may occur in some gastric disorders leading to an inhalation pneumonitis. Gastric reflux may produce dental erosion.
- Dysphagia (difficulty swallowing) is a symptom which should always be taken seriously.

Diseases of the gastrointestinal (GI) system can be relevant to the dental surgeon for several reasons. The mouth may display signs of the disease itself, for example, the cobblestone mucosa, facial or labial swelling of Crohn's disease or the osteomata of Gardner's syndrome. These are well-covered elsewhere and not discussed further here. The sequelae of GI disease, for example, gastric reflux producing dental erosion, iron deficiency anaemia and treatment such as corticosteroid therapy, may all have a bearing on management and choice of anaesthesia.

4.1 Relevant Points in History

Lethargy, dyspnoea and angina may all occur secondary to *anaemia* from a gastrointestinal cause, but cardiorespiratory causes should also be borne in mind. The cause of an anaemia should always be investigated. The possibility of blood loss from the GI

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Table 4.1 Factors promoting gastro-oesophageal reflux

• Hiatus hernia
• Pregnancy
• Obesity
• Cigarettes
• Alcohol
• Fatty food

tract should be considered. Weight loss may be due to reduced nutritional intake secondary to anorexia, nausea or vomiting. There may be loss of protein from diseased bowel, e.g. in ulcerative colitis. Cancer of the GI tract is the most significant potential cause of weight loss. The quantity and time course of the weight loss are both important. Enquiry with regard to appetite and any changes should also be made.

Heartburn and *indigestion*are vague terms often used by patients and may be used to describe upper abdominal pain, gastro-oesophageal regurgitation, anorexia, nausea and vomiting. *Oesophageal reflux* or 'heartburn' causes epigastric pain, i.e. abdominal pain, around the lower end of the sternum, which radiates to the back and is worse on stooping and drinking hot drinks. It can have implications for general anaesthesia (see below) and can be a cause of dental erosion [1] especially on the palatal/lingual surfaces of the teeth [2] due to the acidity of the gastric fluid. Factors promoting gastro-oesophageal reflux are shown in Table 4.1.

Dysphagia, or difficulty in swallowing, is a symptom which should always be taken seriously. *Plummer-Vinson* syndrome is the name given to dysphagia associated with webs of tissue in the pharynx and upper oesophagus. Other components of the syndrome include glossitis, iron deficiency anaemia and koilonychia (spoon-shaped fingernails suggesting iron deficiency but may also occur in ischaemic heart disease). A patient with koilonychia is shown in Fig. 4.1. Some other causes of dysphagia are listed in Table 4.2.

Vomiting may be due to extra-intestinal causes such as meningitis and migraine or as a result of drug therapy, e.g. morphine. In children, vomiting can be a sign of infection of various body systems. Nausea or vomiting in the morning may be seen in pregnancy, alcoholism and anxiety. Haematemesis, or vomiting of blood, may arise from bleeding oesophageal varices. The relevance to dentistry is mainly related to the fact that these varices may occur secondary to chronic liver disease with its attendant possible implications for blood clotting and drug metabolism due to hepatic impairment.

A current or past history of *peptic ulcer* may be of relevance, particularly when non-steroidal anti-inflammatory drugs (NSAIDs) are being considered. These ulcers are common, affecting around 10% of the world population [3]. Men are affected twice as much as women. The incidence is declining in developed countries; this may be due to dietary changes [4]. Peptic ulcers may affect the lower oesophagus, stomach and duodenum. The pendulum has swung away from surgery for these conditions since the advent of effective drug therapy. *Helicobacter pylori* (a micro-aerophilic Gram-negative bacterium) can be identified in the gastric antral mucosa in 90% of cases of duodenal ulcers and in the body or antral mucosa of about 60% of cases of gastric ulcer and is a common aetiological factor in peptic ulcer disease. Triple therapy regimens are used for treatment, e.g. a proton pump inhibitor such as omeprazole, a broad spectrum antibiotic, e.g. amoxicillin, and metronidazole, when *H. pylori* is involved (see later).

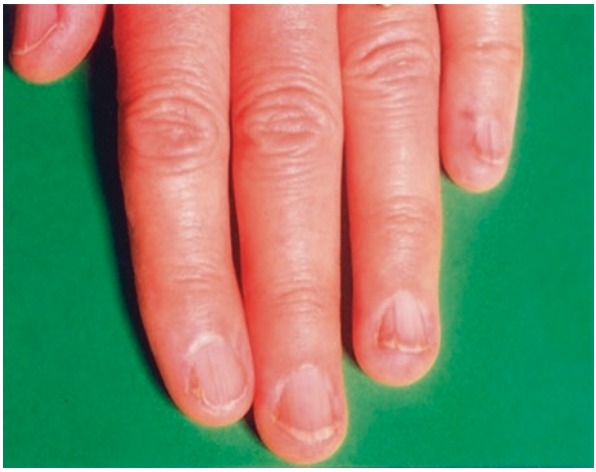

Fig. 4.1 Koilonychia (spoon-shaped fingernails) in iron deficiency anaemia

Table 4.2 Possible causes of dysphagia

Oral causes
Stomatitis
Aphthous ulcers
Herpetic infection
Oral malignancy
Xerostomia
Tonsillitis
Pharyngitis
Infections involving fascial spaces of neck
Obstruction in oesophageal wall
Oesophagitis
Carcinoma of oesophagus
Pharyngeal pouch
Oesophageal web—Plummer-Vinson syndrome (iron deficiency, post-cricoid web)
External compression of oesophagus
Enlarged neighbouring lymph nodes left atrial dilatation in mitral stenosis
Disorders of neuromuscular function
Myasthenia gravis muscular dystrophy stroke Achalasia (failure of oesophageal peristalsis and failure of relaxation of lower oesophageal sphincter)
Other
Foreign body scleroderma
Benign stricture secondary to gastro-oesophageal reflux
Globus hystericus (psychogenic)

The term *inflammatory bowel disease* includes ulcerative colitis, Crohn's disease (www.crohnsandcolitis.org.uk/about-inflammtory-bowel-disease) (Figs. 4.2 and 4.3) and an indeterminate type. Factors which impact on dental practice include the possibility of anaemia secondary to chronic bleeding and corticosteroid therapy in these patients. Extra-intestinal manifestations of inflammatory bowel disease may occur and are listed in Table 4.3.

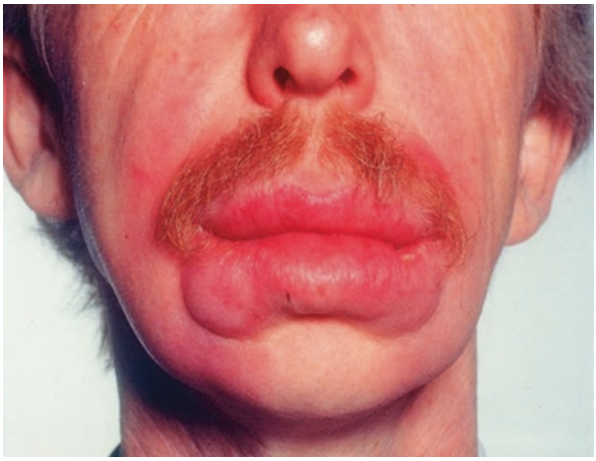

Fig. 4.2 A patient with Crohn's disease and consequent marked labial swelling

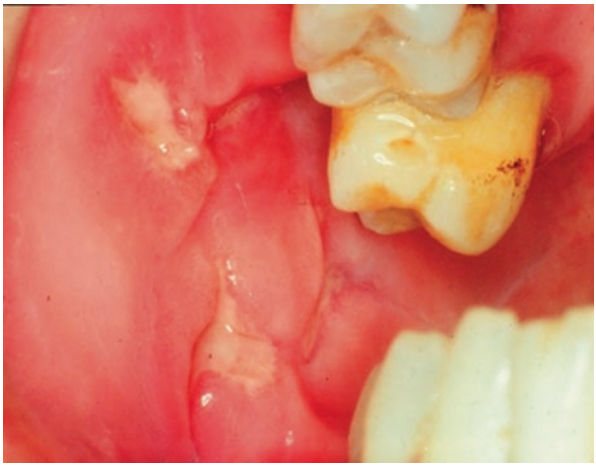

Fig. 4.3 Recurrent oral ulceration in Crohn's disease

Table 4.3 Extra-intestinal manifestations of inflammatory bowel disease

Aphthous stomatitis
Hepatic causes
Fatty change
Amyloidosis
Gallstones
Skin
Erythema nodosum
Pyoderma gangrenosum
Arthritis
Finger clubbing
Eye lesions, e.g. conjunctivitis
Vasculitis
Cardiovascular disease
Bronchopulmonary disease

A history of GI surgery may give clues to nutritional deficiencies which may be present, e.g. iron, vitamin B or folate deficiency post-gastric surgery.

Recurrent oral ulceration and glossitis may ensue.

Pancreatic disease is of relevance in a thorough history since consequent malabsorption of vitamin K may lead to a bleeding tendency. There is also a possibility of diabetes mellitus or a diabetic tendency. Excessive alcohol intake can be a cause of acute pancreatitis and a thorough social history may uncover this information. Other causes of acute pancreatitis include gallstones and some viral infections, e.g. HIV and mumps. Chronic pancreatitis is of a similar aetiology to acute pancreatitis. Endocrine and exocrine function both deteriorate. In both types of pancreatitis, abdominal pain is severe. *Pancreatic cancer* frequently involves the head of the pancreas and local invasion leads to biliary obstruction, diabetes mellitus and pancreatitis. Thrombophlebitis migrans (peripheral vein thrombosis) is a common complication. Pancreatic cancer has the worst prognosis of any cancer in general terms, and treatment is usually surgical and palliative.

The patient may give a history of *jaundice* or may actually be jaundiced. Jaundice may be 'pre-hepatic', e.g. haemolysis, hepatic, e.g. hepatitis (see Chap. 5), or obstructive due to either gallstones or cancer of the head of the pancreas. Patients with obstructive jaundice give a history of generalised itching and passing dark urine and pale stools. The relevance of obstructive jaundice is discussed later.

Congenital disorders of relevance can occur. Familial polyposis has an incidence of 1 in 24,000 and is transmitted as autosomal dominant. People with the condition have rectal and colonic polyps, and a variant is Gardner's syndrome which also includes bony osteomata and soft tissue tumours, e.g. epidermal cysts. The colonic polyps are premalignant and careful follow-up of these patients is needed. Subtotal colectomy with fulguration of rectal polyps may be carried in order to prevent malignancy. Peutz Jeghers syndrome is an autosomal dominant condition comprising intestinal polyps and pigmented freckles periorally extending onto the oral mucosa (Fig. 4.4). The gastric and duodenal polyps have a predisposition to become malignant. Some *skin disorders* may occur as part of a wider picture of GI disease. *Erythema nodosum* and *pyoderma gangrenosum* can occur in inflammatory bowel disease. The skin lesions are painful, erythematous nodular lesions on the anterior shin in erythema nodosum. Bluish edged ulcers occur on the back, thigh and buttocks in pyoderma gangrenosum. The skin disease associated with coeliac disease is dermatitis herpetiformis and comprises an itchy papulovesicular rash mainly on the trunk and upper limbs. IgA deposits at the epithelium basement membrane zone help to establish the diagnosis. There may also be papillary tip micro-abscess formation. There may be intra-oral lesions which may be erosive or vesicular and resemble pemphigoid. Treatment is usually with dapsone. Aphthous ulcers may occur.

Coeliac disease is a permanent intolerance to gluten leading to intestinal villous atrophy and GI malabsorption. The villous atrophy reverses when taking a gluten-free diet. The disease may be complicated by anaemia and GI lymphoma.

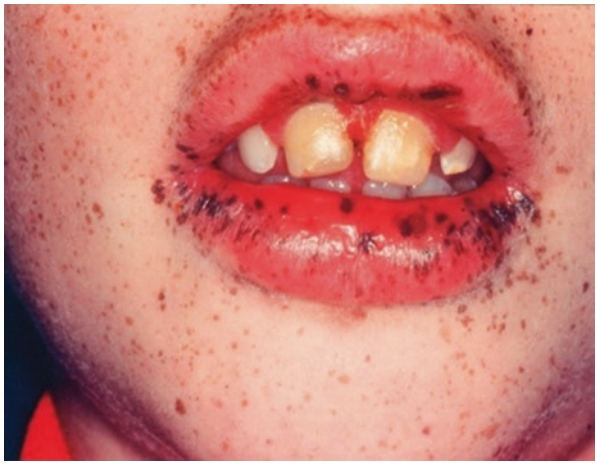

Fig. 4.4 Peutz Jeghers syndrome

Table 4.4 Relevant points in the history

General enquiry, e.g. lethargy, anaemia, weight loss, appetite
Dyspepsia, reflux
Dysphagia
Vomiting, haematemesis
Peptic ulcer (current/past)
Inflammatory bowel disease
Pancreatic disease
Congenital disorders

Pseudomembranous colitis can be caused by many antibiotics particularly clindamycin and lincomycin and results from proliferation of toxigenic *Clostridium difficile*. It is characterised by painful diarrhoea with mucus passage and is treated with oral vancomycin or metronidazole.

A summary of relevant points in the history is given in Table 4.4.

4.2 Examination

Oral lesions as a manifestation of GI disease are well-discussed elsewhere and are not considered further here. It is worth remembering that *cervical lymph node enlargement* is an important sign not to be ignored. Possible causes include infection and neoplasia (primary or secondary).

Pallor can be a very subjective way of trying to assess for anaemia. The mucosa at the reflection in the inferior fornix of the eye is the best site for examination. The patient may readily become dyspnoeic secondary to anaemia, but this should be considered with an open mind because, as mentioned earlier, cardiorespiratory conditions are more likely to present in this manner.

A patient may be jaundiced for ‘extra-hepatic’ reasons such as gallstones, cancer of the bile ducts or cancer of the head of pancreas. The sclera is a good site for examining for the yellow tint of jaundice (Fig. 4.5).

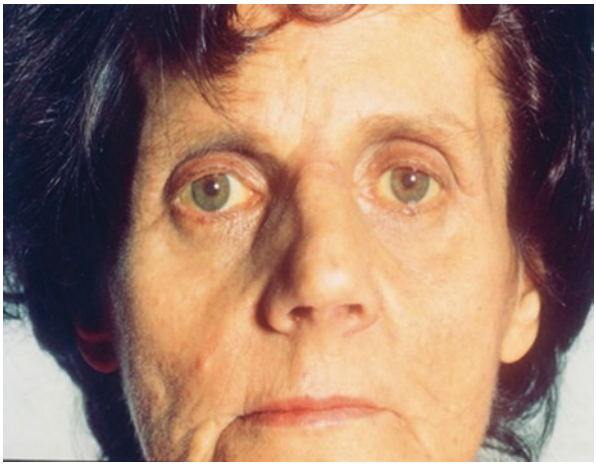

Fig. 4.5 A jaundiced patient with yellow sclera

Examining the hands may reveal spoon-shaped fingernails or koilonychia (Fig. 4.1). The fingers may be clubbed. Gastrointestinal causes of clubbing include inflammatory bowel disease (especially Crohn's), cirrhosis, malabsorption and GI lymphoma.

An enlarged lymph node in the left supraclavicular fossa (Virchow's node, Troisier's sign) can be a sign of stomach cancer. Anaemia or obstructive jaundice may complicate treatment.

4.3 Drugs Used in GI Disease

These are used in ulcer and non-ulcer dyspepsia and in reflux oesophagitis. They are usually aluminium- and magnesium-containing compounds or alginates. These preparations interfere with the absorption of many drugs including fluoride, ketoconazole, metronidazole and tetracycline [5]. Aluminium hydroxide increases the excretion of aspirin and can reduce the plasma concentration of the analgesic to nontherapeutic levels [6]. It has been shown that maintaining antacids in the mouth for a period before swallowing can counteract reductions in oral pH produced by acidic materials, and it has been suggested that this might help counteract the erosion produced by gastrointestinal reflux [7].

4.3.1 Antacids

These are used in non-ulcer dyspepsia, irritable bowel syndrome and diverticular disease, e.g. hyoscine and mebeverine (anti-muscarinic) tend to decrease motility. Anti-muscarinics produce dry mouth, and hyoscine reduces the absorption of the antifungal drug ketoconazole. Drugs such as metoclopramide and domperidone increase motility. The anti-muscarinic drug propantheline bromide delays the absorption of paracetamol [8].

4.3.2 Ulcer-Healing Drug Proton Pump Inhibitors, e.g. Omeprazole and Lansoprazole

These block the proton pump of the parietal cell. Side effects can include erythema multiforme, stomatitis and dry mouth. Omeprazole increases the anticoagulant effect of warfarin but this is usually unimportant clinically [9]. Omeprazole inhibits the metabolism of diazepam and increases the sedative effect of the latter drug [10].

4.3.3 Drugs Used in Inflammatory Bowel Disease

For the acute condition, topical steroids may be given as enemas. In more extensive situations, oral corticosteroids may be prescribed, leading to intravenous steroids in the most severe cases. Sulphasalazine (a combination of sulphaphyridine and 5-amino salicylic acid) may be given. Similar alternatives include mesalazine and olsalazine. Azathiophrine is used in resistant cases.

4.3.4 Pancreatic Supplements

These may be used in cystic fibrosis and chronic pancreatitis. Pancreatin ('Creon') is inactivated by gastric acid and is therefore best taken with food. It can irritate the oral mucosa if held in the mouth. Pancreatin assists in the digestion of starch, fat and protein.

4.4 Effects of Gastrointestinal Disease on Local Anaesthesia, Sedation, General Anaesthesia and Management in Dental Practice

The principal features of the GI system which may have a bearing on general anaesthesia include obesity, anaemia, reflux/vomiting and the effects of drug therapy.

In the case of obesity, this is not always simply related to diet since physiological and genetic factors are also involved. It is significant in that careful consideration needs to be given to the choice of anaesthesia and may preclude general anaesthesia on a day-case basis. To ensure effective assessment and communication between healthcare professionals, the body mass index (BMI) is used. This is the weight in kilogrammes divided by the height in metres (squared), i.e.:

$$\text{BMI} = \frac{\text{weight}}{\left(\text{height}\right)^2}.$$

Grade 1 is a BMI of 25–30, Grade 2 is 30–40, and Grade 3 is more than 40.

After appropriate investigation as to the cause and nature of any anaemia, patients who have developed an iron deficiency anaemia and are awaiting surgery should be treated with oral iron supplements. Blood transfusion would only rarely be indicated

in this context. Transfusion less than 48 h before surgery should be avoided as the oxygen-carrying capacity of stored blood is poor.

Certain groups of patients are at risk of aspiration of stomach contents on induction of anaesthesia. These include patients with a history suggestive of hiatus hernia, all non-fasted patients and pregnant patients (stomach emptying is slowed and the cardiac sphincter relaxed). Aspiration is likely to lead to a pneumonitis (Mendelson's syndrome).

Patients who suffer from reflux of gastrointestinal contents are at risk of erosion of dental hard tissue. This is particularly the case on the palatal and lingual surfaces. In addition such patients may not be entirely comfortable in the fully supine position, and this should be borne in mind during treatment in the dental chair.

Patients with pancreatic disease, e.g. pancreatitis and pancreatic cancer, may have a bleeding tendency due to vitamin K malabsorption (pancreatitis) or biliary obstruction (cancer, especially if there are hepatic metastases). Diabetes mellitus may complicate either pancreatitis or pancreatic cancer as mentioned earlier.

When the patient gives a history suggesting obstructive jaundice, the main risk in safe dental management relates to the risk of excessive bleeding again resulting from vitamin K malabsorption. When possible, surgery should be deferred. If delay is not possible, treatment in hospital with vitamin K supplementation is advised.

Patients with obstructive jaundice are particularly prone to develop renal failure after general anaesthesia (the hepatorenal syndrome). It is thought that this may be due to the toxic effect of bilirubin on the kidney. If at all possible, GA should be avoided in these patients. In emergencies (which would be very rare in dentistry), management of these patients depends on maintaining good hydration immediately prior to the GA and using the osmotic diuretic mannitol.

Drug interactions of relevance to dental practice were mentioned above. In addition to drug interactions the prescription of drugs for the treatment of oro-dental conditions may be influenced by the underlying disease [11]. For example, the use of non-steroidal anti-inflammatory drugs such as aspirin is contraindicated in individuals with peptic ulceration. Similarly, the prescription of systemic steroids should be avoided in patients with peptic ulcers as this may lead to perforation leading to pain and blood loss.

The side effects of long-term steroid therapy were discussed in Chap. 3. The longer the patient is on steroid therapy and the higher the dose, the greater the risk of complications. Although steroids are used in GI disease, the duration is usually limited, with maintenance being achieved via other medications.

4.5 Summary

As with many other conditions, disorders of the GI tract impact on dentistry. Some conditions lead to dental disease, drugs used in the management of GI disease can produce orofacial signs and symptoms, and the prescription of drugs to treat dental conditions is influenced by some underlying disorders.

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Neurological Disorders and Dental Practice

5

In Brief

- Neurological disorders may present in various ways including sensory disturbance, paralysis, altered level of consciousness, fits, speech disturbance, changes in muscle tone or bulk and tremor.
- Facial paralysis may be caused by stroke (upper motor neurone) or Bell's palsy (lower motor neurone). Surgery in the region of the facial nerve, particularly parotid surgery, may also cause dysfunction of the nerve.
- Facial sensory loss (trigeminal nerve) may be caused by extracranial nerve injury. Other causes include multiple sclerosis, stroke and tumours.
- Patients with epilepsy may severely damage the orofacial tissues in grand mal attacks. A good history will alert the practitioner to those who are poorly controlled.
- Some of the drugs used for the treatment of neurological disorders impact on dental disease and its management.
- In patients with severe or complex neurological disorders, consideration should be given to referring such patients for management in a hospital setting.

There are a number of neurological conditions that may be encountered in dental practice. It is important that a dental practitioner has a broad knowledge of the main neurological conditions since they may affect the provision of dental treatment. In addition the first presentation of a neurological disturbance may be a symptom for which the patient seeks a dental opinion. Some malignant disease may present to the dentist as a neurological complaint such as a numb chin [1].

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5.1 Relevant Points in the History

The patient may give a history of 'blackouts'. It is important to be precise about what a patient means by this term as this can indicate anything from a loss of consciousness (LOC) to dizziness. When a history of blackouts is given, information obtained from a witness might be useful. The more that is known about the nature of such an event, the better it can be anticipated and effectively managed (or prevented) [1].

The main points in the history are summarised in Table 5.1.

Syncope may be vasovagal in origin (the *simple faint*) or may occur in response to certain situations such as coughing. A vasovagal attack may be precipitated by the fear of dental treatment, heat or a lack of food. It occurs due to a reflex bradycardia and peripheral vasodilation. Onset is not instantaneous, and the patient will look pale, often feel sick and notice a 'closing in' of visual fields. It cannot occur when a patient is lying down, and placing the patient flat with legs raised is the treatment. Jerking of limbs may occur. In carotid sinus syncope, hypersensitivity of the carotid sinus may cause syncope to occur on turning the head. Unlike vasovagal syncope this may happen in the supine position.

Patients may suffer from *epilepsy* [2]. If this presents as a blackout, the most likely type is grand mal. A description of the fit is useful as this may enable early recognition. Precipitating factors should be asked about, as should questioning about altered breathing, cyanosis or tongue biting during a fit. The latter is virtually a diagnostic feature of this type of epilepsy. Medication taken and its efficacy should be assessed in terms of the degree of control achieved. Tonic-clonic or grand mal epilepsy is classically preceded by a warning or aura which may comprise an auditory, an olfactory or a visual hallucination. A loss of consciousness follows leading to convulsions and subsequent recovery. The patient may be incontinent during a fit. The 'tonic phase' gives way to a 'clonic phase' in which there is repetitive jerky movements, increased salivation and marked bruxism. After a fit of this type, a patient may sleep for up to 12 h. If the fit continues for more than 5 min or continues without a proper end point, 'status epilepticus' is said to be present. This is an emergency situation which requires urgent intervention with a benzodiazepine, e.g. buccal midazolam or intravenous diazepam. Absence seizures or 'petit mal' tend to occur in children who may suddenly arrest speech, attention and movement. So-called 'partial' seizures may be simple or complex. Simple seizures consist of clonic movements of a group of muscles or a limb. Complex seizures may involve hallucinations of hearing, sight or taste. Febrile convulsions are common in infancy and do not predict progression to later epilepsy. Keeping the child

Table 5.1 Main points in the history in the dental patient with possible neurological disorders

• Blackouts, syncope
• Epilepsy
• Stroke, transient ischaemic attack
• Multiple sclerosis
• Facial pain
• Parkinson's disease
• Motor neurone disease
• Cranial nerve problems (especially Bell's palsy)

cool with fans, paracetamol and sponging with tepid water are the mainstays of treatment.*Stokes-Adams attacks* are described as losses of consciousness occurring as a result of cardiac arrhythmias. These may happen with the patient in any position and may occur with no warning except for an awareness of palpitations. Recovery is usually within seconds. Other potential causes of 'blackouts' are shown in Table 5.2.

The patient may give a history of a stroke (*cerebrovascular accident—CVA*) or a so-called mini-stroke (*transient ischaemic attack—TIA*). A CVA may be haemorrhagic (subarachnoid, cerebral), thrombotic or embolic in origin. A subarachnoid haemorrhage results from the rupture of a berry aneurysm of the circle of Willis (which lies at the base of the brain). Subarachnoid haemorrhages tend to affect a younger age group than the other types of CVA, and typically patients give a history of a sudden onset of excruciatingly severe headache. The prognosis is poor but has been improved by surgical and radiological obliteration of the aneurysm. Hypertension and atherosclerosis are contributory factors to other types of CVA. Cerebral thrombosis deprives the brain of a part of its blood supply and is the most common type of stroke. Emboli leading to stroke can arise on the wall of an atrium that is fibrillating or from the wall of a heart damaged after a myocardial infarction. Typical results of a CVA are a sudden loss of consciousness and hemiplegia (on the opposite side to the cerebral lesion), and there may be a loss of speech or slurred speech when the CVA affects the left side of the brain. TIAs comprise a sudden onset of focal CNS signs or symptoms due to a temporary occlusion of part of the cerebral circulation. They are frequently associated with partial or complete stenosis of the carotid artery system. The symptoms resolve in less than 24 h (usually much more quickly). They are harbingers of a CVA, and the known patient will usually be taking prophylactic aspirin. Patients with *multiple sclerosis* have a diverse condition comprising neurological signs and symptoms that are disseminated in both site and time. A viral aetiology has been postulated, but the cause is not known. Onset is variable, but optic neuritis can lead to visual disturbance or blindness, which may be a presenting feature. Weakness or paralysis of a limb can occur. Nystagmus (jerky, oscillating movement of the eyes—which can also be physiological) may occur, as may ataxia (uncoordinated movements) and dysphagia. Loss of sphincter control leading to urinary incontinence may occur. The diagnosis should be considered in a young patient presenting with trigeminal neuralgia or a facial palsy. Enquiry in such cases should be directed towards other areas to check for neurological signs or symptoms elsewhere.

Table 5.2 Possible causes of loss of consciousness or 'blackout'

Vasovagal syncope	Simple faint
'Situational' syncope	Cough micturition
	Carotid sinus hypersensitivity epilepsy
	Hypoglycaemia transient ischaemic attack
Orthostatic hypotension	On standing from lying signifies inadequate vasomotor reflexes, e.g. elderly patients on tablets to lower blood pressure
'Drop attacks'	Sudden weakness of legs usually resolved spontaneously
Stokes-Adams attacks	Transient arrhythmia anxiety
Meniere's disease	Vertigo, tinnitus, hearing loss, choking

5.2 Facial Pain

Facial pain is common and may affect up to 50% of the elderly population [3]. A paroxysm of excruciating stabbing pain lasting only seconds, in the trigeminal nerve distribution, suggests *trigeminal neuralgia* [4], particularly in patients over 50 years of age. In the vast majority of cases, it is unilateral and most commonly affects the mandibular and maxillary divisions. Often a 'trigger area' may be identified from the history that is stimulated by washing or shaving, for example. Talking may be enough to stimulate the pain. Usually the trigger is easily identified. Carbamazepine and phenytoin are the mainstays of treatment.

Other neurological causes of facial pain include *post-herpetic neuralgia* and *atypical facial pain*. In post-herpetic neuralgia the patient complains of a burning pain (often in the ophthalmic division of the trigeminal nerve), which may become chronic. There is no really successful treatment; transcutaneous nerve sectioning and LA infiltration in the painful area have been tried as has carbamazepine. Tricyclic antidepressants have also been used.

When all other causes (including non-neurological causes of facial pain) have been excluded, some patients may still complain of facial pain—usually unilateral. The pain is described as severe, constant and not relieved by analgesics. This type of pain is more common in young females, and many are prescribed with antidepressants (although not always for curative effect). Atypical facial pain is the term applied to this type of facial pain.

5.3 Other Disorders

Parkinson's disease results from degeneration of the pigmented cells of the substantia nigra leading to dopamine deficiency. The incidence is equal in males and females. The disease may also result from previous head injury or cerebrovascular disease. Clinically the patient may have tremor in the arms and hands (the latter being described as 'pill-rolling'). A so-called 'cogwheel' type of rigidity may be seen on movement. Slow movements (bradykinesia) and restlessness (akathisia) may also be noted. The patient may have an expressionless face and a stooped posture. Impaired autonomic function may lead to a postural drop in blood pressure and hypersalivation resulting in drooling of saliva.

Motor neurone disease comprises a group of disorders that affect motor neurones at various levels. There is no sensory loss and this helps differentiation from multiple sclerosis. The aetiology is unknown, but a viral agent is thought possible. Oral hygiene may be difficult in these patients and dysphagia and drooling may occur.

Tumours may arise in various components of the CNS and may be primary or metastatic, the latter being more common in the brain, or benign to those of Crohn's disease.

A summary of other cranial nerve lesions is given in Table 5.4. Nerves may be affected by a systemic cause, e.g. diabetes mellitus and MS, or there may be a local cause. Multiple cranial nerve palsies may occur in bulbar palsy that comprises palsy

of the tongue, muscles of chewing/swallowing and facial muscles due to loss of function of motor nuclei in the brainstem. The onset may be acute, e.g. in infection such as polio, or may be chronic, e.g. in tumours of the posterior cranial fossa. Tics or involuntary facial movements may occasionally be seen in patients. These may be habitual, particularly in children, or may be drug induced, or they may have a more organic cause. Drug-induced dyskinesias are common in the elderly on long-term phenothiazine (antipsychotic) medication which is usually reversible on stopping the drug. Intracranial compression may be caused by brain tumours that are still a significant problem as they may cause pressure effects and may not be amenable to surgery due to their site. Headaches are characteristically worse in the morning. Tumours from which cerebral metastases arise include lung, breast, GIT and kidney.

Impairment of vision may occur and this may vary from mild disability to complete blindness. Diplopia or double vision may occur after a 'blowout' fracture of the orbital floor [5] or injury to cranial nerves III, IV and VI. Transient visual disturbance may occur secondary to local anaesthetic that has tracked to the inferior orbital fissure.

Myasthenia gravis (*MG*) is an antibody-mediated autoimmune disease with a deficiency of functioning muscle acetylcholine receptors that leads to muscle weakness. The disorder more commonly affects young women. The muscle weakness is progressive and develops rapidly. Some cases are associated with the Eaton-Lambert syndrome that may occur in some patients with lung or other cancers. In the Eaton-Lambert syndrome, however, the muscles get stronger rather than weaker with activity.

A facial palsy may have a known cause or be idiopathic (Tables 5.3 and 5.4). If the cause is not known, the name *Bell's palsy* (Fig. 5.1) is applied. Other causes must be excluded before this term is used. In Bell's palsy the onset is rapid and

Table 5.3 Some possible causes of facial weakness (mostly unilateral)

Idiopathic	Bell's palsy
	Melkersson-Rosenthal syndrome
Infection	Ear infections
	TB
	Ramsay-Hunt syndrome
	Glandular fever
	AIDS
Trauma	Facial lacerations/bruising in the region of the facial nerve
	Penetrating parotid injuries
	Post-parotid surgery
Neoplastic	Primary or secondary cancers
	Neuroma of facial nerve
	Acoustic neuroma
Metabolic	Diabetes mellitus
	Pregnancy
	Sarcoidosis
	Guillain-Barré syndrome

Table 5.4 Cranial nerve dysfunction and signs arising from it

Cranial nerve	Possible problem	Sign
I Olfactory	Trauma, tumour	Decreased ability to smell
II Optic	Trauma, tumour	Blindness, visual field
	MS, stroke	Defect
III Oculomotor	Diabetes, increased intracranial pressure	Dilated pupil
		Ptosis
IV Trochlear	Trauma	Diplopia
V Trigeminal	Sensory—idiopathic, trauma, IDN/lingual damage	None, sensory deficit on testing
	Motor—bulbar palsy, acoustic neuroma	Signs in IX, X, XI and XII may be decreased facial sensation. Affects VIII also
VI Abducens	MS, some strokes	Inability of the eye to look laterally
		Eye deviated towards nose
VII Facial	LMN—lower motor neurone	Total facial weakness
	Bell's palsy, skull fracture	
	Parotid tumour	
	UMN—upper motor neurone	Forehead sparing
	Stroke, tumour	Weakness
VIII Vestibulocochlear	Excess noise	Deafness
	Paget's, acoustic neuroma	
IX Glossopharyngeal	Trauma, tumour	Impaired gag reflex
X Vagus	Trauma, brainstem lesions	Impaired gag reflex soft palate moves to 'good' side on saying 'aah'
XI Accessory	Polio, stroke	Weakness turning head away from affected side (sternocleidomastoid)
		Weakness shrugging shoulders (trapezius)
XII Hypoglossal	Trauma, brainstem lesions	Tongue deviated to affected side on protrusion

unilateral, and there may be an ache beneath the ear. The weakness worsens over 1 to 2 days. If presentation is early, most clinicians give prednisolone for 5 days, the aim being to reduce neuronal oedema. An eye patch is of value to protect the cornea. The paralysis is of a lower motor neurone type in which all the facial muscles are affected on that side. In an upper motor neurone lesion, e.g. stroke, the forehead is spared since this region is bilaterally represented in the cortex. Looking for 'forehead sparing' is thus a way of differentiating between upper and lower motor neurone causes of facial weakness.

Bilateral facial paralysis is rare. It may be seen in sarcoidosis or Guillain-Barré syndrome (idiopathic polyneuritis) or posterior cranial fossa tumours. The rare Melkersson-Rosenthal syndrome is a condition comprising tongue fissuring, unilateral facial palsy and facial swelling. The lesions are histologically similar that may result in blepharospasm (contraction of both eyelids). Hemifacial muscle spasm may occur and suggests a lesion, e.g. of the cerebello-pontine angle compressing the facial nerve. Whenever a facial tic is found, consideration should be given to referral for investigation since an underlying cause may often be treated.

Fig. 5.1 A patient with Bell's palsy. The ipsilateral forehead affected also indicating a lower motor neurone lesion. Bell's sign (see text) is also demonstrated

5.4 Neurological Disorders

In *Ramsay-Hunt syndrome*, a profound facial paralysis is accompanied by vesicles in the pharynx on the same side and in the external auditory meatus. It is thought that the geniculate ganglion of the facial nerve is infected with herpes zoster.

Infections affecting the nervous system may be bacterial or viral in origin. The possibility of bacterial meningitis should be borne in mind with maxillofacial injuries involving the middle third of the face. Prompt treatment with antimicrobials (prophylactically in trauma cases) should be undertaken. The viral type of meningitis is usually mild and self-limiting. The patient with meningitis has a severe headache, feels sick or actively vomits and is often drowsy. Painful stiff neck and aversion to light are well known. In meningitis caused by the bacterium *Neisseria meningitidis*, a purpuric rash may be seen on the skin and can progress to adrenocortical failure as a result of bleeding into the adrenal cortex.

Herpetic encephalitis is rare but should be treated promptly with aciclovir. In HIV-associated neurological disease, a wide variety of infections and tumours are seen, for example, lymphomas. Neurological effects of such lesions vary from fits to limb weakness.

Brain abscess is a condition that may be secondary to oral sepsis [6] or infection elsewhere, e.g. the middle ear or paranasal sinuses. A patient with congenital heart disease is also at increased risk. Such abscesses can be a complication of infective endocarditis which should be specifically asked about. Signs and symptoms resulting from a brain abscess depend on its location, and CT and MRI scanning are useful in localisation and diagnosis. Urgent surgical drainage is required.

Cerebral palsy is primarily a disorder of motor function secondary to cerebral damage, most frequently associated with birth injury or hypoxia. It is the most common cause of a congenital physical handicap, the patterns of which are variable. There are three main subtypes—spastic, ataxic and athetoid varieties. In the spastic type, the muscles are contracted and there may be associated epilepsy. In the ataxic type, a cerebellar lesion is responsible for a disturbance of balance. Writhing movements characterise the athetoid type of cerebral palsy.

In *spina bifida*, the vertebral arches fail to fuse, possibly due to a deficiency of folic acid during foetal development. The condition may lead to significant physical handicap such as an inability to walk, epilepsy or learning difficulties. There may be an association with hydrocephalus which often requires decompression using a shunt. This is discussed further in Chap. 11.

Patients with *syringomyelia* have a condition in which cavitation of the central spinal cord occurs leading to a loss in pain and temperature sensibility. Syringobulbia is the term used if the brain stem is affected—facial sensory loss may occur, as may tongue weakness.

An *acoustic neuroma* is a benign tumour occurring at the cerebello-pontine angle on the vestibular part of the vestibulocochlear nerve. Cranial nerves V, VII, IX and X may also be involved leading to tinnitus, deafness and vertigo. Facial twitching weakness or paraesthesias may occur. Other causes of facial sensory loss (innervated by the trigeminal nerve except over the angle of the mandible which is innervated by cervical nerves) are given in Table 5.5.

Table 5.5 Potential causes of facial sensory loss

Intracranial	
• Neoplasm	Cerebral tumour
• Inflammatory	MS
	Granulomatous conditions, e.g. sarcoid TB
	Connective tissue disorders
• Others: Paget's disease (nerve compression), trigeminal neuropathy cerebrovascular disease	
Extracranial	
• Neoplasm	Cancer, metastatic cancers
• Inflammatory	Osteomyelitis
	Pressure from adjacent lesions
• Trauma	Maxillary/mandibular fractures
	Iatrogenic, e.g. removal of mandibular third molars

Other neurological disorders that may be encountered include *Huntington's chorea*, which is an autosomal dominant disorder where there is progressive dementia with marked involuntary movements. The signs do not begin to appear until middle age. *Friedreich's ataxia* is an autosomal recessive or sometimes sex-linked cord degeneration of unknown cause. Severe ataxia and deformity occur, and there may be associated cardiac disease with arrhythmias.

5.5 General Examination

The patient's gait may give an immediate clue to an underlying neurological condition, for example, the shuffling gait of Parkinsonism. A spastic gait is demonstrated by stiff limbs that are often swung around in a circular motion as the forward movement proceeds.

The patient with a neurological condition may appear confused. This may be for several reasons and a summary of potential causes is given in Table 5.6. Raised intracranial pressure can occur following trauma to the head, for example, in a patient attending with an injury associated with dental trauma. Such patients will complain of headache and may be restless or vomiting.

The classical signs of increased blood pressure and decreased pulse rate occur, and there is dilation of the pupil on the same side as the lesion. Patients with a head injury can be assessed according to the *Glasgow Coma Scale* (*GCS*) which involves three scored categories of assessment—eye opening, muscle responses and responses to vocal stimuli.

Horner's syndrome comprises the four signs of a constricted pupil, ptosis (drooping of the upper eyelid), loss of sweating on the ipsilateral face and enophthalmos. It is caused by interference with the cervical sympathetic chain, e.g. after a radical neck dissection, trauma to the neck or tumour.

Patients with cerebral palsy have an increased incidence of dental malocclusion and abnormal movement of the oral and facial musculature that may cause difficulty in dental treatment provision.

Sturge-Weber syndrome (Fig. 5.2) is described as an association between a facial port wine stain (haemangioma) and focal fits on the contralateral side. Exophthalmos and spasticity may also be evident. The fits are caused by a capillary haemangioma in the brain.

Table 5.6 Possible causes of confusion that may be encountered in a dental patient

Hypoxia	Ensure clear airway, care with sedatives
Epilepsy	
Infection	Significant orofacial infection, pneumonia, meningitis
Metabolic	Hypoglycaemia
Drug/alcohol withdrawal	
Vascular	Stroke, MI
Raised intracranial pressure	
Nutritional	Deficiency of various B vitamins

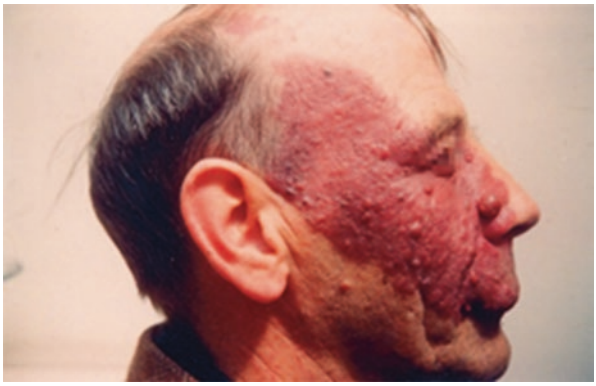

Fig. 5.2 A patient with Sturge-Weber syndrome

5.5.1 Consideration of the Cranial Nerves

A systematic approach is needed for examining the *cranial nerves*. One approach is to consider the cranial nerves in the following groups: nerve(s) subserving the sense of smell, eyes, face, mouth, neck and ears. A summary of disorders affecting the cranial nerves and resulting signs is given in Table 5.4.

Any changes in the sense of smell may reflect a problem with the olfactory nerve. Colds and sinusitis may be the cause, but trauma involving the cribriform plate can also cause the nerve to have impaired function. Some operations on the nose may cause injury to the olfactory nerves.

Visual acuity may be roughly assessed by asking the patient to read a printed page. Defects of the optic nerve may also affect the field of vision. A lesion of cranial nerve III leads to complete or partial ptosis (drooping of the upper eyelid). The external ocular muscles are controlled by the action of cranial nerves III, IV and VI. Disruption of the third nerve (which supplies all of the extrinsic eye muscles apart from superior oblique and lateral rectus) causes a paralysis of internal, upward and downward movement of the eye leading to double vision. The eye points downwards and outwards except when looking to the affected side. A fixed dilated pupil may also be seen. Disruption of IV, the trochlear nerve supplying superior oblique, prevents the eye moving downwards and medially. The double vision is worse on looking down. Disruption of VI (abducens supplying lateral rectus) causes an inability to abduct the eye (look to the ipsilateral side). There is deviation of the eye towards the nose and double vision.

The muscles of facial expression are innervated by the cranial nerve VII (*facial nerve*). As mentioned previously, upper motor neurone lesions affecting the facial nerve, e.g. after a stroke, may be differentiated from lower motor neurone causes, e.g. Bell's palsy, since the latter causes the whole side of the face to be weakened, whereas the forehead is spared in an upper motor neurone lesion due to bilateral representation at the level of the cerebral cortex. The ipsilateral eye moves upwards on attempted closure of the eyes in Bell's palsy—this is known as Bell's sign (Fig. 5.1).

In terms of *facial sensation*, the sensory division of the trigeminal (V cranial) nerve subserves this over most of the face. The ophthalmic, maxillary and mandibular divisions may be compared by testing skin sensation on either side with a wisp of cotton wool. The corneal (blink) reflex is often the first clinical deficit to be seen in trigeminal nerve lesions.

The *mouth* can demonstrate signs of cranial nerve problems in the case of cranial nerves V (motor division), IX, X and XII. If the masseter muscles are palpated whilst asking the patient to clench the teeth and the motor division of V is inactive, the masseter on that side will not contract properly. With a unilateral lesion, the mandible deviates to the weak side on opening the mouth (V being motor to the pterygoid muscles).

Asking the patient to say 'aah' will allow an appraisal of IX and X nerves. The ninth (glossopharyngeal) nerve is mainly sensory for the pharynx and palate and the tenth (vagus) mainly motor. With a unilateral lesion of the vagus, the soft palate is pulled away from the weaker side. Lesions of both nerves lead to an impaired gag reflex. The 12th (hypoglossal) nerve may be tested by asking the patient to protrude the tongue. The tongue deviates to the weaker side.

To test the accessory (11th) cranial nerve, the patient should be asked to put their chin towards the left or right shoulder against resistance by the examiner. The sternomastoid muscle (supplied by XI) does not function when XI is affected.

The *eighth* (*vestibulocochlear*) nerve has two components—the vestibular (appreciation of position and movements of the head) and the cochlear (responsible for hearing). Lesions of the nerve may cause hearing loss, vertigo or ringing in the ears (tinnitus). Special tests are needed to test the balance and positional functions of the nerve.

5.6 General and Local Anaesthesia, Sedation and Management Considerations in the Dental Patient with Neurological Disease

Patients prone to syncope should be treated with regard to avoidance of known precipitating factors as far as possible. Treatment in the supine position has obvious advantages.

Epileptic patients referred for GA should not be given methohexitone or enflurane since these are epileptogenic. It is important to ensure that an epileptic patient has taken their normal medication on the day of the procedure. Intravenous sedation is useful in managing epileptic patients. The benzodiazepines have anticonvulsant properties and anxiolysis should decrease the chances of a fit. When treating epileptic patients with sedation, supplemental oxygen should be provided via a nasal cannula [7]. The use of the benzodiazepine reversal agent flumazenil should be avoided in patients with epilepsy as this drug can precipitate convulsions.

Patients who have had a CVA should have treatment if possible only when their condition has been optimised. There may be a loss of reflexes such as swallowing [7] or the gag reflex, which has implications for the safe provision of treatment under LA, with or without sedation. The ability to protect the airway is also relevant

for the provision of GA since all these modes of treatment jeopardise the airway to some extent. Stroke patients may be taking anticoagulants or may be hypertensive.

In both multiple sclerosis and motor neurone disease, the degree of compliance achievable for treatment is likely to be impaired. It is best to use LA alone if possible. Limited mobility and/or associated psychological disorders may cause difficulties with treatment. Patients are better treated sitting so that respiration is assisted as much as possible since it may be impaired. Patients with MS may be taking corticosteroids, particularly early in the disease. Care of the airway may be made more difficult due to muscular incoordination.

Patients with Parkinson's disease suffer from excess salivation, which can cause difficulties with visibility not only in providing the treatment itself but also for the safe provision of an anaesthetic. Anti-muscarinic drugs will reduce the salivation and degree of tremor. The autonomic insufficiency often found in these patients makes them liable to postural hypotension and poor candidates for GA.

In myasthenia gravis, local anaesthetic is the option of choice. Doses should be kept to a minimum. Muscle fatigue appears to increase during the day and therefore treatment is best carried out early. Intravenous sedation should not be given in a dental practice setting [8] since respiratory impairment may be worsened. A small oral dose of a benzodiazepine is acceptable if the patient is very anxious about their treatment. For similar reasons general anaesthetics are also not advised if possible. In addition, some of the agents used with GA, e.g. the muscle relaxant suxamethonium or opioids, e.g. fentanyl, may have their effects potentiated in these patients.

Patients with problems with vision may be permanently disabled or the disorder may be transient. It is important that a 'tell-do' approach is used for these patients to minimise anxiety. It is worth bearing in mind in these patients that other senses, e.g. hearing, may be heightened. Diplopia can be a transient complication of LA as mentioned earlier. Other cranial nerve lesions of potential relevance include lesions affecting cranial nerves IX and X since the gag reflex may be impaired leading to potential airway compromise, particularly if sedation or GA is being used.

Patients with cerebral palsy may not be able to tolerate treatment under LA and GA may be the only way of achieving it. In the athetoid type, potential epilepsy should be borne in mind. Anxiety will often worsen the effects of the cerebral palsy, and therefore premedication, e.g. with diazepam, is often wise. Patients with spina bifida have increased incidence of latex allergy. Such patients may be prone to postural hypotension and are therefore best treated sitting up. Epilepsy and renal anomalies may also be associated. In Friedreich's ataxia, possible arrhythmias should be remembered.

5.7 Effects of Drugs Used in Neurological Disorders on Oro-dental Structures

Drugs used to treat neurological conditions can produce unwanted effects in and around the mouth. Anticonvulsants have a number of unwanted effects of interest to dentists. Gingival overgrowth is a recognised side effect of phenytoin [9] but may also

occur with sodium valproate and ethosuximide. In addition, phenytoin causes taste disturbance and may produce Stevens-Johnson syndrome. This drug may also affect the teeth. It has been implicated in producing hypercementosis and shortening of the roots [10]. Sodium valproate may produce parotid gland enlargement. Lamotrigine may cause dry mouth and Stevens-Johnson syndrome. Ethosuximide may produce Stevens-Johnson syndrome and gingival bleeding. Carbamazepine may produce xerostomia, glossitis and oral ulceration. Stevens-Johnson syndrome is the name given to a severe form of erythema multiforme. The latter predominantly affects young males and is characterised by mucosal lesions with or without skin lesions. The typical skin lesion is described as looking like a target as it consists of concentric erythematous rings. The rashes may appear differently however, hence the name 'multiforme'. The aetiology of erythema multiforme is not known but is thought to be a disorder of immune complexes. The antigens can be as diverse as microorganisms or drugs.

The anti-muscarinic anti-Parkinsonian drugs such as orphenadrine and benzhexol can produce dry mouth, which may increase caries incidence. In addition, the dopaminergics drugs such as levodopa and co-careldopa may produce taste disturbances.

5.8 Summary

As with disorders of other systems, neurological diseases impact on dental treatment provision, both in terms of the treatment itself and the provision of safe methods of anaesthesia/analgesia to facilitate it.

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Liver Disease and Dental Practice

6

In Brief

- Liver disorders are important to the dentist due to a potential bleeding tendency; intolerance to drugs, e.g. general anaesthetics and benzodiazepines; and the possibility of the underlying infective causes for the liver dysfunction.
- Signs of liver disease include jaundice, spider naevi, leuconychia, finger clubbing, palmar erythema, Dupuytren's contracture, sialosis and gynaecomastia.
- The general anaesthetic agent halothane (now used infrequently) should not be given twice to the same patient within 3 months. A 'halothane hepatitis' is likely to result.
- Dental sedation should only be performed in specialist units for patients with significant liver disease as small doses can lead to coma.

The liver has a number of important functions. It metabolizes drugs and endogenous substances and contributes to their excretion by the body. Plasma proteins are synthesized in the liver which also acts as a storage organ for glycogen and vitamin B12. The liver is also important in the production of clotting factors for normal haemostatic function.

6.1 Points in the History

The history may reveal evidence of liver disease. This is important in terms of potential *drug toxicity*, *bleeding tendency* and the possibility of *viral hepatitis*. Chronic liver disease (defined as liver disease present for more than 6 months) can

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enter an acute phase if unrecognized, e.g. after the administration of sedation. Acute liver failure itself may be precipitated by any type of viral hepatitis, the anaesthetic agent halothane, paracetamol overdose or Reye's syndrome (see later).

Viral hepatitis is clearly of importance to the dentist [1]. Indeed, dental students must show satisfactory immunization against hepatitis B in order to undergo clinical training in the United Kingdom [2]. *Hepatitis A* is transmitted via the faeco-oral route and has a 3-week incubation period. There is no known carrier state. *Hepatitis B* may be transmitted by blood-to-blood contact, e.g. via contaminated sharps, and droplet infection. It has an incubation period of 6 weeks to 6 months. A small proportion of patients will progress to a hepatitis B carrier state associated with chronic active hepatitis and eventually cirrhosis. The presence of hepatitis B surface antigen (HBsAg) is the first manifestation of infection. The presence of antibody to HBs is associated with protection from infection. Hepatitis B core antigen (HBcAg) is detected by the development of an antibody to it. It may persist for 1–2 years signifying donor infectivity if HBsAg negative but HBcAg positive. Hepatitis B e antigen is only found in HBsAg-positive sera and appears during the incubation period. It is an index of infectivity. DNA polymerase is first detected when the level of HBsAg is increasing and indicates the presence of virions in the serum and is associated with replication. A summary of serological markers for hepatitis B is given in Table 6.1.

Hepatitis C can be contracted from a contaminated blood transfusion. *Hepatitis D* (or delta) is a viral RNA associated with hepatitis B and demonstrated in association with HBcAg. Other viral causes of hepatitis include cytomegalovirus, herpes simplex, Epstein-Barr virus and Coxsackie B virus.

Efficient cross-infection control [3] should minimize the risk of contracting the infective types of hepatitis. There is an adjunct in the form of a *hepatitis B vaccine* (Engerix B). Other hepatitis viruses have been characterized: hepatitis E, G, X and possibly F. Poor responders tend to be members of the older population, smokers and male. An anti-HBs level of less than 100 is not enough to confer protection, and in such cases a booster is required and a further level checked a month later. Even with a good response, it is not until 6 weeks after the first injection that protection is achieved, and therefore a specific anti-hepatitis B immunoglobulin is required for individuals exposed to the virus during this time.

A history of *jaundice* may be obtained. This does not necessarily imply liver disease, e.g. bile duct obstruction due to gallstones, or malignant disease may also cause jaundice. Jaundice at birth is common and is usually of no significance. Normally, bilirubin (a breakdown product of haemoglobin) is conjugated in the liver where it becomes water soluble and is excreted in the bile which colours the faeces. If the bilirubin is not conjugated, e.g. due to parenchymal liver disease, it colours the skin and

Table 6.1 Serological markers for hepatitis b

Hepatitis B surface antigen—first manifestation of infection
Antibody to hepatitis B surface antigen—associated with protection from infection
Hepatitis B core antigen—detected by the development of antibody and signifies donor infectivity if surface antigen negative but core antigen positive
Hepatitis B e antigen—only found if HBs antigen positive (an index of infectivity)

mucous membrane ('jaundice'). In obstructive jaundice, bile does not reach the gut leading to pale faeces, but there is increased urinary bilirubin; the urine therefore is dark. Dark urine and pale faeces are a hallmark of obstructive jaundice.

It is important to suspect and enquire about any *bleeding tendency* (and testing of clotting is required). Poor absorption of fat-soluble vitamin K occurs with its attendant effects on clotting, and there is also decreased synthesis of clotting factors.

Obstruction to blood flow in the liver (portal circulation) leads to an increase in portal blood pressure with the formation of enlarged blood vessels (varices) at the base of the oesophagus (one place where systemic and portal circulations meet) with consequent risk of gastrointestinal haemorrhage. Chronic bleeding may lead to anaemia.

In *cirrhosis* of the liver, the architecture is irreversibly destroyed by fibrosis and regenerating nodules of hepatocytes. The cause is often unknown but a quarter of cases are alcohol related. Hepatitis B or C and the chemotherapy drug methotrexate can all be implicated. Primary biliary cirrhosis (PBC) is a disease primarily of females thought to be autoimmune in origin. It can be associated with Sjogren syndrome or oral lichen planus [4].

The most common liver tumours are *metastases*. These signal advanced disease, and the outlook depends on the extent and nature of the primary tumour. Recent advances in surgery have meant that in certain situations resection of metastases is possible and chemotherapy may be appropriate. Jaundice, if present at all, is a late sign. Hepatocellular cancer may occur after hepatitis B or C infection and cirrhosis of the primary biliary type.

The patient may give a history of liver problems after certain *medications*. Likely to be of interest to the dentist are aspirin, carbamazepine, erythromycin estolate, tetracycline and halothane [5]. Halothane is discussed later. Aspirin is not indicated in children due to the risk of Reye's syndrome which comprises liver damage and encephalopathy occurring after aspirin ingestion.

Patients, who have undergone a liver transplant, may encounter the most common indication which is end-stage liver disease. Management considerations are discussed later.

Familial conditions may occur, e.g. Gilbert's syndrome in which the bilirubin level increases but is not conjugated and therefore does not enter the urine. It generally presents as mild jaundice. Many patients have no symptoms, but some have episodes of malaise, anorexia and upper abdominal pain with jaundice. These episodes may be related to infection, fatigue or fasting.

A summary of the main areas of enquiry in a patient with liver disease is given in Table 6.2.

Table 6.2 Points in the history in a patient with liver disease

Hepatitis
History of jaundice
Bleeding tendency
Cirrhosis
Liver tumours
Reaction to medications
Liver surgery, e.g. transplants
Familial disorders

6.2 Examination

There may be significant clues to the presence of liver disease that are discernible from a patient sitting in a dental chair (Table 6.3).

The hands may show a Dupuytren's contracture (a condition in which the ring and little fingers are held flexed when the hand is held passive due to thickened palmar fascial tissue), or there may be palmar erythema. The fingers may be clubbed, and the fingernails may have a whitish colouration (leuconychia). If the hands are held outstretched in front of the patient, a marked flapping tremor may be noted—'liver flap' in severe liver decompensation.

Oedema (secondary to hypoproteinaemia) may lead to ascites (fluid in the abdomen leading to distension) or ankle oedema. The commonest cause of the latter however is likely to be cardiovascular. Itching may produce scratch marks on the skin. The itching occurs due to the deposition of bile salts in the skin. The patient may be jaundiced. Gynaecomastia (enlarged breast tissue in the male) may occur due to increased circulating oestrogen levels. This is also said to be responsible for the palmar erythema mentioned earlier. Spider naevi (numerous thin, tortuous blood vessels emanating from a central arteriole) may occur on the face, neck, upper chest and back (said to be within the distribution of the superior vena cava). Parotid enlargement (sialosis) [6] may be seen in cases of cirrhosis, but this is due to the associated alcohol intake rather than the cirrhosis itself.

6.3 Factors Affecting Dental Treatment Under GA/LA/Sedation

Agents such as sedatives and general anaesthetics can be potentially dangerous in liver disease mainly due to impairment of detoxification. In the case of halothane, a hepatitis may follow its use especially in the obese, in smokers and in middle-aged females and if a halothane anaesthetic has been given in the last 3 months. The precise mechanism is not known. The hepatitis tends to develop after about a week and comprises jaundice, malaise and anorexia. The newer agents, e.g. enflurane and sevoflurane, are less hepatotoxic, and as a result the use of halothane has waned.

Table 6.3 Signs that may be seen in a patient with a chronic liver disorder

Dupuytren's contracture
Palmar erythema
Finger clubbing
Leuconychia
Parotid enlargement
Jaundice
Spider naevi
Gynaecomastia
Ascites/ankle oedema
Scratch marks (itching)

A patient with a history or signs suggestive of a liver disorder or a high alcohol intake which might potentially cause liver damage should have blood taken for liver function tests (LFTs) and clotting studies. These should be carried out prior to GA or surgery. Severe bleeding can occur after dental extractions in patients with chronic liver disease [7] so the clotting status must be tested. There are many different types of LFT, but the commonest involves measurement of aspartate transaminase (AST) and alanine transaminase (ALT). ALT may also be raised in cardiac or skeletal muscle damage and is therefore not specific for liver disease. Gamma-glutamyl transferase (yGT), when it is raised, usually reflects alcoholic liver disease. Alkaline phosphatase levels may be raised in obstructive jaundice, but this is not a specific marker. The level of alpha fetoprotein may be raised in hepatocellular cancer. In cirrhosis, treatment should only be carried out in conjunction with the patient's physician. Relative analgesia is preferred to sedation with a benzodiazepine. A specialist anaesthetist is required even if GA is acceptable.

In many liver diseases, brain metabolism is altered, and it therefore becomes more sensitive to certain drugs. Encephalopathy can be triggered by sedatives or opiates. In obstructive jaundice, the main risk is bleeding due to vitamin K malabsorption. If surgery is required in such patients, intravenous vitamin K may be required for several days beforehand to correct any bleeding tendency. Any patient with jaundice has an increased risk of bleeding excessively following any surgical procedure including dental extractions. A perioperative infusion of fresh frozen plasma will often be required. If the patient is severely jaundiced, a GA may precipitate renal failure, the *hepatorenal syndrome*. The risk is decreased if the patient is well hydrated with intravenous fluids and given the osmotic diuretic mannitol to ensure a good urine flow pre-, per- and post-operatively.

Local anaesthesia is not entirely safe in patients with hepatic impairment. Most of the amide local anaesthetics used in dental practice undergo biotransformation in the liver. Articaine is metabolized partly in plasma [8], and prilocaine receives some metabolism in the lungs [9]. However, the liver is the main site of metabolic activity. All of an injected dose of local anaesthetic will eventually reach the circulation, and if metabolism is affected, the concentration in the plasma will slowly increase. Only about 2% of the drug will be excreted unchanged. This may lead to signs of CNS toxicity with relatively low doses, as little as two cartridges in an adult patient may be too much if liver disease is severe.

If possible a full dental assessment should be carried out prior to a liver transplant particularly since post-operatively the patient will be immunosuppressed. Invasive dental treatment should only be carried out after consultation with the patient's physician. After transplantation no elective dental treatment should be carried out for the first 3 months. GA, if needed, must be carried out in units with the required expertise.

Dental sedation should only be performed in specialist units for patients with significant liver disease as small doses can lead to coma.

6.4 Prescribing for Patients with Liver Disease

The use of any drug in a patient with severe liver disease should be discussed with the patient's physician. Hepatic impairment will lead to failure of metabolism of many drugs that can result in toxicity. In some cases where dose reduction is required, other drugs should be avoided completely.

The British National Formulary [10] lists those drugs that should be avoided or used with caution in patients with liver disease. Dentists should note that the antifungal drug miconazole is contraindicated if there is hepatic impairment and fluconazole requires dose reduction. Erythromycin, metronidazole and tetracyclines should be avoided. Non-steroidal anti-inflammatory drugs increase the risk of gastrointestinal bleeding and interfere with fluid balance and are best avoided. Paracetamol doses should be reduced as at high doses this drug is hepatotoxic.

6.5 Summary

Knowledge of liver disorders is important for the safe delivery of dental care. A thorough history will usually alert the clinician to potential problems. Haemostasis may be affected and this should be particularly borne in mind.

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The Endocrine System and Dental Practice

7

In Brief

- Diabetic patients should be treated first on a treatment session so that the start time is predictable. Hypoglycaemia must be avoided and presents more quickly than hyperglycaemia. A physician should be consulted if a general anaesthetic is being considered.
- Thyroid disease may present as a goitre. Thyroid function should be stabilised before a general anaesthetic is used.
- Oral contraceptives may predispose to thromboembolism, and their action may be impaired by some antibiotics and anticonvulsants.
- In pregnancy essential treatment should be carried out in the second trimester when possible.
- Acromegaly may be associated with headaches, visual loss, diabetes and hypertension.

7.1 Points in the History

The patient may suffer from diabetes mellitus (DM). This is a persistent state of hyperglycaemia due to either a lack of insulin or a diminished physiological effect of the hormone after production by the pancreas. DM may be diagnosed by two fasting venous blood glucose levels of ≥7.8 mmol/L. The disease may be Type I (insulin-dependent diabetes mellitus (IDDM)) or Type II (non-insulin-dependent diabetes mellitus (NIDDM)). Type I occurs most frequently in young people, whilst Type II is usually maturity-onset diabetes. Type II diabetes is treated by careful diet or oral hypoglycaemics. Factors predisposing to DM include pancreatic disease and drugs, e.g. thiazide diuretics and steroids. Other endocrine disorders such as

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Cushing's disease, phaeochromocytoma and acromegaly (all of which are discussed later) may also be relevant as the likelihood of DM is increased in these disorders. The diabetic tendency tends to resolve if the underlying disorder is corrected [1].

Good control of DM helps to prevent or manage some of the associated complications of the disease which particularly relate to the cardiovascular system and retina. DM may be asymptomatic, but the patient may have noticed drinking excessive fluids, passing lots of urine, lethargy, weight loss and possibly recurrent skin infections.

It is important to ascertain some idea of the degree of diabetic control patients will often know their typical blood sugar level and have experienced episodes of hypoglycaemia or 'hypo's', which is discussed in more detail later.

Abnormalities of the circulating levels of thyroxine are usually due to disorders of the *thyroid gland* and may be due to overproduction (hyperthyroidism) or underproduction (hypothyroidism). Two main hormones are produced by the thyroid gland—T3 (triiodothyronine) and T4 (thyroxine)—the former is five times as active as the latter and both are bound to protein in the blood. The hypothalamus produces thyroid-releasing hormone (TRH) stimulating the release of thyroid-stimulating hormone (TSH) from the anterior pituitary, which in turn causes the release of T3 and T4 from the thyroid. Details of hyper- and hypothyroidism are given in Table 7.1 and the pathway of T3 and T4 production in Fig. 7.1. Hypothyroidism may decrease the immune response leading to an increased incidence of opportunistic infections such as oral candidosis.

Many patients will be taking the *oral contraceptive pill* (OCP) which comprises varying proportions of synthetic oestrogens and progestogens. It is the oestrogen component that tends to cause complications. The major risk is the increased risk of

Table 7.1 Hyperthyroidism and hypothyroidism

Hyperthyroidism		Hypothyroidism
Causes	Grave's disease—antibodies against TSH receptors	Spontaneous—primary atrophic
	Common cause in women between 30 and 50 years	Drug induced, e.g. antithyroid drugs
	Other causes: toxic multinodular goitre, some thyroid cancers	Iodine deficiency
Symptoms	Weight loss	Weight gain
	Dislike of heat	Dislike of cold
	Tremor, irritability	Lethargy
	Emotionally labile	Depression
Signs	Tachycardia	Bradycardia
	Atrial fibrillation	Goitre
	Tremor	Dry skin and hair
	Enlarged thyroid	
	Exophthalmos	
	Diplopia	
Treatment	Carbimazole	Thyroxine replacement
	Partial thyroidectomy	
	Radioactive iodine	

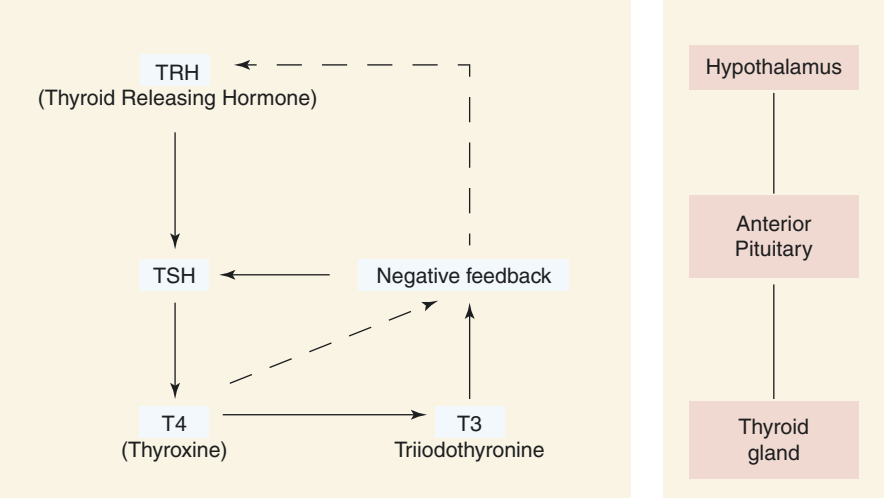

Fig. 7.1 Production of T3 and T4 in the thyroid gland

thromboembolic disease, especially deep vein thrombosis (DVT). Hypertension and a diabetic tendency are other potential risk. The "pill" is usually maintained for minor procedures, but if a prolonged GA is being given, prophylaxis against DVT, e.g. subcutaneous heparin, should be given due to the increased risk from venous stasis. Some surgeons would recommend discontinuing the OCP for 2 months prior to a surgical procedure to eliminate the potential for the complications mentioned above.

Many patients are receiving hormone replacement therapy (HRT) which may be given orally or as an implant and aims to replace oestrogen which is deficient due to reduced secretion, e.g. after the menopause or ovary removal. Osteoporosis is inhibited in the patient on HRT, and it also appears to reduce the rate of alveolar bone resorption.

A patient may be unaware of pregnancy, especially in the first 2 months, a time when the foetus is particularly vulnerable. In diabetic patients good control of blood sugar levels may become more difficult during pregnancy. Diabetes may occur for the first time in pregnancy (gestational diabetes), and this usually resolves after birth. In the later stages, the patient should not be laid fully supine since the gravid uterus compresses the inferior vena cava and impedes venous return. Likewise, in the unlikely event of having to carry out CPR on a pregnant patient, it is important that the patient is put in a left lateral position; otherwise venous return would be similarly impeded.

Cardiac output is increased in pregnancy which leads to a tachycardia. Hypertension in pregnancy will often be asymptomatic but should always be taken seriously. If the hypertension is associated with protein in the urine and oedema, the condition is known as preeclampsia. This may culminate in eclampsia (hypertension, protein in urine and convulsions) and can have fatal consequences.

Cushing's disease occurs as a result of excess glucocorticoid produced secondary to adrenal hyperplasia. The adrenal hyperplasia, in turn, may be secondary to excess adrenocorticotrophic hormone (ACTH) production, e.g. by a pituitary adenoma. Ectopic ACTH may be produced by a small cell lung cancer, producing similar effects. The hypothalamic-pituitary-adrenal axis is shown in Fig. 7.2.

Cushing's syndrome is similar clinically but caused by primary adrenal disease, e.g. cancer or adenoma. The terms Cushing's syndrome and Cushing's disease are often used synonymously—but incorrectly. The clinical features are discussed later.

Patients with *Conn's syndrome* have a tumour or hyperplasia of the adrenal cortex. The resulting high levels of aldosterone secretion lead to potassium loss and sodium retention. The decreased potassium leads to muscle weakness and polyuria, whereas sodium retention leads to hypertension.

Addison's disease is a disease of the adrenal glands leading to decreased secretion of cortisol and aldosterone. The cause may be tuberculous destruction of the adrenals but is not known in up to 80% of cases. There may be an association with Grave's disease (see later) or IDDM. If known, the cause is treated, but replacement steroids are needed, and a steroid boost is therefore required for surgical dental treatment.

Disorders of the parathyroid glands may occur. The function of parathyroid hormone (PTH), secreted by the glands, is to regulate the level of calcium in the plasma by acting on the kidney, gut and bone. Secretion of PTH is stimulated if the plasma calcium level falls. The hormone causes increased reabsorption of calcium by the kidney and gut and induces resorption of bone to restore the calcium level. Hypoparathyroidism occurs most commonly after thyroid surgery since the thyroid and parathyroid glands are anatomically very close (the four parathyroid glands normally lying posterior to the thyroid gland).

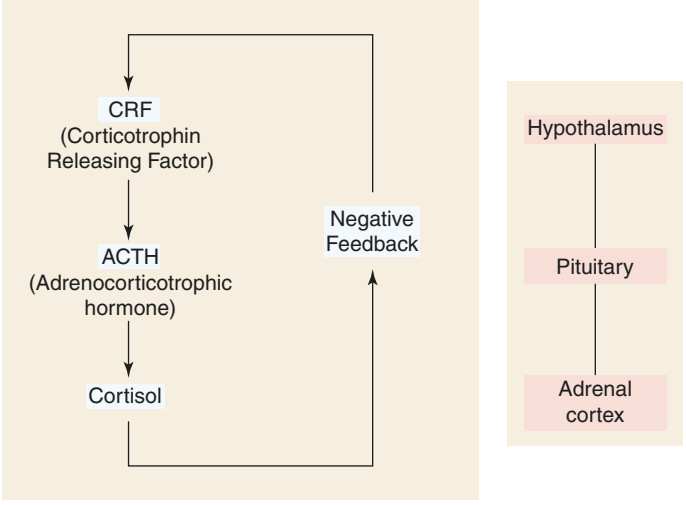

Fig. 7.2 The hypothalamic-pituitary-adrenal axis

Hyperparathyroidism may be classified as primary, secondary or tertiary. The most common cause of primary hyperparathyroidism is a parathyroid gland adenoma. Secondary hyperparathyroidism occurs when there is a chronically low plasma calcium level, e.g. in chronic renal failure or malabsorption. Tertiary hyperparathyroidism is said to occur when the parathyroid glands have started to produce PTH autonomously, usually after a prolonged period of secondary hyperparathyroidism. Hyperparathyroidism may lead to a loss of lamina dura around the teeth, and central giant cell granulomas may occur [2]. These are known as brown tumours and are histologically indistinct from other giant cell lesions. If such granulomas are found, it is therefore prudent to arrange for a test of calcium and PTH levels.

A phaeochromocytoma is a rare cause of hypertension. It is a usually benign tumour of the adrenal medulla (usually unilateral) producing excess catecholamines, e.g. adrenaline. Symptoms are episodic and consist of headaches, palpitations and sweating together with pallor and hypertension. Elective treatment should be delayed until the tumour has been dealt with (local anaesthetic injections with epinephrine [adrenaline] should be avoided). Treatment of phaeochromocytoma is surgical, and both alpha and beta blockers are used to prevent hypertensive crises during such surgery.

The patient may report having been diagnosed with diabetes insipidus—a condition in which impaired reabsorption occurs in the kidney either as a result of too little antidiuretic hormone (ADH) being produced by the posterior pituitary or an impaired response to ADH by secretion (SIADH) may occur secondary to some malignancies and certain benign chest disorders, e.g. pneumonia. It may occur secondary to trauma and is characterised by a low blood sodium level with a high urinary sodium concentration.

Acromegaly (Fig. 7.3) is caused by increased secretion of growth hormone from a pituitary tumour. It has an insidious onset and the clinical features are discussed in Sect. 7.1.1. Relevant complications include hypertension, DM and cardiomyopathy (disease of the cardiac muscle).

The main pancreatic problem of relevance in an endocrine context is DM and is discussed above. Hormone-secreting *pancreatic tumours* are rare and include the Zollinger-Ellison syndrome in which a gastrin-secreting tumour leads to duodenal ulceration and diarrhoea. Insulinomas may also occur leading to hypoglycaemia. Glucagonoma leads to hyperglycaemia, oral bullae and erosions.

Nelson's syndrome affects people who have had bilateral adrenalectomy, e.g. to treat Cushing's syndrome, which leads to increased pituitary activity and adenoma formation. ACTH is released in great quantities and cutaneous or oral pigmentation may result.

A summary of the main points in the endocrine history is given in Table 7.2.

7.2 Examination of Patients with Endocrine Disorders

The diabetic patient may have little or nothing of note to see on clinical examination that gives a clue to their condition. There may be sialosis (swelling of the salivary glands). If diabetic control is poor, oral candidosis may develop. These patients are

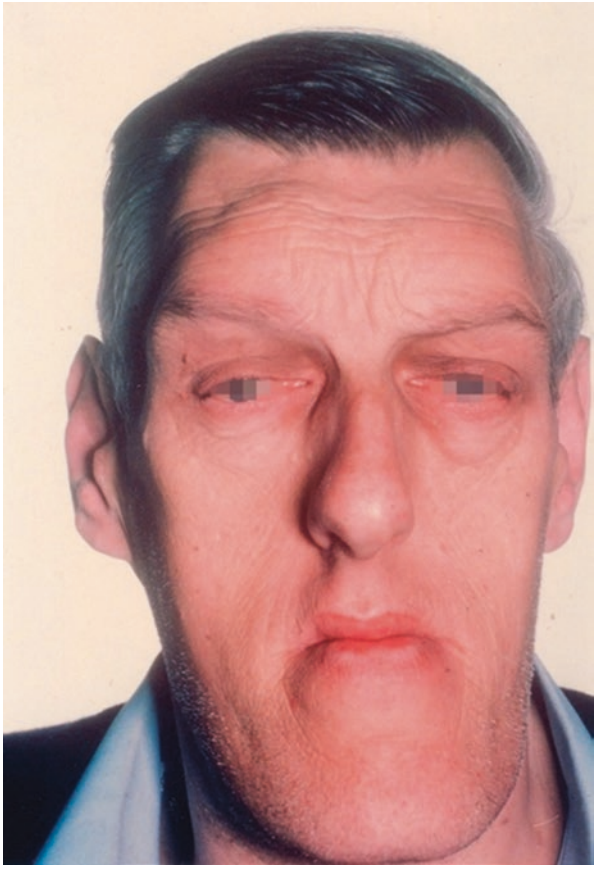

Fig. 7.3 A patient with acromegaly exhibiting the classic facial appearance

Table 7.2 Points in the history in a dental patient with an endocrine disorder

Diabetes mellitus • Insulin dependent • Diet or tablet controlled • Degree of control achieved
Thyroid disease • Hyper • Hypo
Oral contraceptives
Pregnancy
Cushing's disease
Addison's disease
Hyper-/hypoparathyroidism
Conn's syndrome
History of phaeochromocytoma
Diabetes insipidus
Acromegaly

generally more prone to infections and may have more severe gingivitis than might be expected from the level of oral hygiene. Certainly, diabetic patients are more prone to periodontal breakdown compared to healthy patients [3]. The skin is more prone to infections. Peripheral neuropathy may lead to severe foot infections since foreign bodies can be trodden on and not noticed.

A *goitre* may be noted. This is a lump in the neck comprising an enlarged thyroid gland, usually due to hyperplasia caused by stimulation by TSH, secondary to a decreased level of circulating thyroid hormone. The thyroid gland begins its development at the foramen caecum at the junction of the posterior one third with the anterior two thirds of the tongue and descends to its normal position in the neck during development. On rare occasions remnants of thyroid tissue remain along the developmental path and may be seen as a lump in the midline lying at any point between foramen caecum and epiglottis, the so-called thyroglossal cyst. A goitre may lead to difficulty in swallowing or even compromise the airway. Thyroid tissue may occasionally be present within the tongue—the so-called lingual thyroid. All goitres should be fully investigated, particularly to exclude cancers.

The poorly controlled hyperthyroid patient is tachycardic and may well be in atrial fibrillation with an irregularly irregular pulse. A fine tremor is sometimes noted and the patient may have exophthalmos with resultant diplopia. The thyroid gland itself may be enlarged. The hypothyroid patient may have a bradycardia, dry skin and hair and a goitre.

A patient with hypoparathyroidism, the commonest cause of which is as a complication of thyroid surgery, may exhibit facial paraesthesia and facial twitching when the preauricular skin over the facial nerve is tapped—known as *Chvostek's sign*—due to decreased plasma calcium levels.

In a *Cushingoid patient*, the tissues are wasted, leading to peripheral myopathy and thin skin which bruises easily. Purple striae on the skin (usually abdominal) may also occur. Water retention leads to the characteristic moon face with hypertension and oedema (Fig. 7.4). There is obesity of the trunk, head and neck (buffalo hump). A summary of the clinical features of Cushing's syndrome is given in Table 7.3. In hypofunction (*Addison's disease*), hyperpigmentation may be seen, e.g. of palmar creases and buccal mucosa. This pigmentation is related to high circulating levels of melanocyte-stimulating hormone (MSH).

Hirsutism is sometimes seen in Cushing's syndrome and hyperthyroidism as well as acromegaly. It may also be seen in ovarian or adrenal tumours.

Facial flushing may be seen in phaeochromocytoma due to the release of sympathomimetic substances or may be a sign of the carcinoid syndrome due to the overproduction of 5-hydroxytryptamine. Diarrhoea may be associated with the carcinoid syndrome, and flushing may be precipitated by alcohol or coffee ingestion.

The *acromegalic patient* (Fig. 7.3) is easily recognised due to the gigantism, prominent mandible, thickened soft tissues, 'spade-like hands' and prominent supraorbital ridges. There may be visual field defects due to pressure from the pituitary tumour compressing the optic chiasma. A diabetic tendency should be borne in mind.

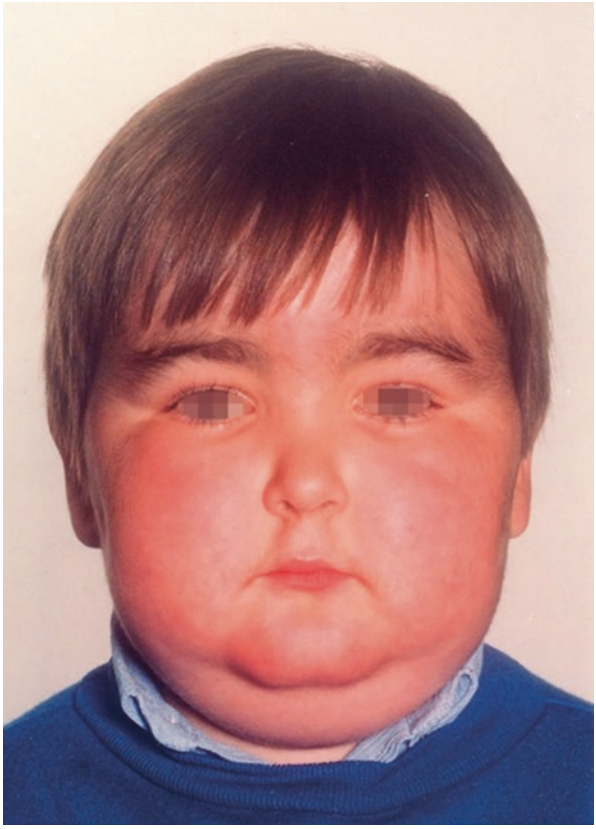

Fig. 7.4 The facial appearance of a patient taking long-term steroids

Table 7.3 The clinical findings in a patient with Cushing's syndrome

Moon face
Buffalo hump (excess interscapular fat)
Excess fat on trunk (relative sparing of limbs)
Purple skin striae
Hirsutism
Tendency to acne
Hypertension
Diabetic tendency
Osteoporosis
Peripheral muscle weakness

7.3 Factors Relating to Dental Treatment and GA/LA/IV Sedation in Endocrine Disorders

The most common condition to consider is the management of the diabetic patient. The prevention of infections is important in the patient with diabetes as these can interfere with normal control. There is some evidence that effective periodontal care can improve metabolic control in those suffering from Type II diabetes [4]. When

Table 7.4 Hypoglycaemia and treatment

Symptoms of hypoglycaemia
Autonomic
• Sweating
• Tremor
• Hunger
Secondary to depressed levels of glucose on nerves
• Drowsy, confused
• Fits
• Perioral tingling
• Loss of consciousness
Treatment in dental surgery
Conscious—oral sugar, 2 teaspoons
Unconscious—20 mL of 50% dextrose IV or 1 mg glucagon subcutaneously
Oral glucose when conscious

Table 7.5 Hyperglycaemia

• Slower onset than hypoglycaemia
• Unlikely presentation in a dental surgery
• Mainstay of treatment is rehydration

providing treatment under LA alone, it is important to check the patient has eaten that day and taken their usual medication. The signs and symptoms of hypoglycaemia and hyperglycaemia are given in Tables 7.4 and 7.5, respectively. When the diabetic regimen needs to be altered, e.g. for GA, this is best done in conjunction with the patient's physician. The management should be matched to the severity of the diabetes, as well as to the planned surgical procedure.

For diabetes controlled by diet or oral hypoglycaemics undergoing relatively minor dental surgery under LA, the morning dose of oral hypoglycaemic should be omitted with monitoring of blood sugar levels and recommencement of oral hypoglycaemic therapy post-operatively. For an IDDM patient undergoing major surgery, an IV infusion of insulin and dextrose and potassium may be used, with the infusion rate titrated against hourly blood sugar measurements. Potassium is required since insulin causes potassium to enter cells, and thus the blood level must be replenished.

The use of supplemental steroids prior to dental surgery in patients at risk of an 'adrenal crisis' is a contentious issue [5, 6] and is discussed in Chap. 3. After unilateral adrenalectomy for a Cushing's adenoma, steroid support may be required for a period of weeks or months, and the patient's physician should be consulted. After adrenal surgery for phaeochromocytoma, steroid supplementation may rarely be required if the adrenal cortex has been damaged at operation. A GA should not be given to the uncontrolled patient with phaeochromocytoma. Local anaesthetics containing epinephrine should be avoided. Treatment may also be complicated by dysrhythmias and hypertension. Elective treatment should be carried out when the phaeochromocytoma has been treated. If emergency treatment is necessary, the blood pressure should first be controlled by the patient's physician.

A GA may precipitate a thyroid crisis in the untreated patient with hyperthyroidism resulting in the risk of dysrhythmias. Such a crisis is characterised by dyspnoea,

marked anxiety and tremor. Hyperthyroidism must therefore be controlled before GA is contemplated. With appropriate management, this complication should not arise in modern-day practice. A treated hypothyroid patient may lapse into hyperthyroidism, and this must obviously be considered if a GA is planned. Indeed the use of general anaesthesia and sedation in patients who are hypothyroid must be performed with great care and should only be carried out in specialist units. The use of local anaesthetics containing epinephrine is not contraindicated in patients receiving thyroid replacement therapy. The only time epinephrine should be avoided is during thyroid storm [7], i.e. extreme hyperthyroidism due to thyroid surgery, infection or trauma.

GA or IV sedation should be avoided in the first trimester and last month of pregnancy. There is an increased tendency to vomiting, particularly in the last trimester due to the impaired competence of the lower oesophageal sphincter secondary mainly to pressure from the gravid uterus.

The prescription of some drugs by dentists is affected by concurrent endocrine therapy. Erythromycin may interact with diabetic medications, for example, combined therapy with chlorpropamide may produce liver damage, and concurrent use with glibenclamide may precipitate hypoglycaemia. There may be a reduced efficacy of oral contraceptives during therapy with antibiotics. Although the evidence for this is scarce, it is wise to recommend other methods of contraception during antibiotic therapy [8]. Similarly, carbamazepine, which may be prescribed for the treatment of trigeminal neuralgia, may decrease the efficacy of the OCP, and patients must be warned of this hazard.

7.4 Effects of Drugs Used in Endocrine Disorders on Orodental Structures

The impact of corticosteroids on dental treatment was mentioned above. Other drugs used in the management of endocrine disorders may affect the mouth and surrounding structures.

Insulin given by injection may cause pain and swelling of the salivary glands. The oral hypoglycaemic metformin may produce a metallic taste [9]. Sulphonylurea hypoglycaemics such as gliclazide and glibenclamide have been implicated in causing oral lichenoid eruptions, erythema multiforme and orofacial neuropathy such as burning tongue.

Hormone replacement therapy with oestrogens may increase gingivitis and cause gingival pigmentation. The OCP may increase gingival and periodontal disease. The amount of gingival exudate is increased in women taking the OCP [10], and there is a correlation between the level of progesterone in plasma and gingival inflammation [11]. Calcitonin may cause taste disturbance.

7.5 Summary

A good basic knowledge of endocrine disorders is essential for safe dental practice. The multisystem effects of various endocrine disorders should be remembered.

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Renal Disorders and Dental Practice

8

In Brief

- Renal patients may have impaired drug excretion. Drugs used in dental sedation and general anaesthesia should be used with caution and in consultation with a physician.
- Renal disease influences the use of other drugs in dentistry, particularly NSAIDS and some antimicrobials.
- Platelet dysfunction may occur in renal patients giving rise to a bleeding tendency. Patients on haemodialysis may be heparinised. Dental treatment should be carried out on the day after dialysis. Renal condition is optimal at this time and the anticoagulant effect has stopped.
- The arm with vascular access for dialysis (the surgically created arteriovenous fistula) should not be used for venepuncture by the dentist.
- Patients who have had a kidney transplant may need corticosteroid cover, have a bleeding tendency if anticoagulated, may have gingival hyperplasia if taking ciclosporin and are prone to infection due to immunosuppression.

Patients with kidney disorders are increasingly encountered in dental practice due to improvements in medical care leading to prolonged life expectancy. In order to provide appropriate and safe dental care for these patients, it is important to have a working knowledge of renal disorders and related problems.

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8.1 Points in the History

The principal renal condition that the dental practitioner is likely to encounter is *chronic kidney disease* (*formerly chronic renal failure*). Occasionally, patients with *nephrotic syndrome* are seen (see later). It is not uncommon to encounter patients who have undergone a *renal transplant*.

It is worth bearing in mind that there is significant potential for renal problems in diabetic patients. *Diabetic nephropathy* is the most common cause of end-stage renal failure (ESRF) in developing countries and accounts for 14% of those patients affected in the UK. It is unlikely that the dentist would be the first to diagnose diabetes mellitus, but suspicion should be raised in patients who show a changing profile of dental disease such as newly presenting or rapidly progressive periodontal disease. Further questioning may elicit that the patient feels the need to drink plenty of fluids and appears susceptible to infections including dental abscesses and fungal conditions [1, 2].

Chronic kidney disease (*CKD*) occurs after progressive kidney damage and constitutes a low glomerular filtration rate persisting over a period of 3 months or more. The symptoms and signs vary depending on the degree of malfunction. In early CKD the patient may notice a need to urinate frequently at night (nocturia) or may notice an uncharacteristically poor appetite. Adult CKD leads to hypertension and uraemia (a clinical and biochemical syndrome constituting end-stage renal disease). CKD can affect diverse body systems and these are summarised in Table 8.1. This can have wide-ranging implications on patient management [3].

Table 8.1 Clinical features of chronic renal failure (chronic kidney disease)—a systemic approach

Cardiovascular
• Hypertension
• Congestive cardiac failure
• Atheroma
Gastrointestinal
• Anorexia, nausea, vomiting
• Peptic ulcer
Neurological
• Lassitude
• Headaches
• Tremor
• Sensory disturbances
Dermatological
• Itching
• Hyperpigmentation
Haematological/immunological
• Bleeding tendency
• Anaemia
• Susceptibility to infection
Metabolic ‘uraemia’
• Thirst
• Nocturia/polyuria
• Electrolyte disturbances
• Secondary hyperparathyroidism

Bone disease or 'renal osteodystrophy' is an almost universal feature of CKD and may take one or a combination of forms. As a result of an increase in plasma phosphate levels, there is a consequent suppression of plasma calcium resulting in an elevated parathormone (PTH) level. Calcium metabolism is further compromised by disruption in vitamin D metabolism. There is a failure in conversion of 25-hydroxycholecalciferol to the active form 1, 25-dihydroxycholecalciferol. This results in secondary hyperparathyroidism. Hyperparathyroidism is discussed in more detail in Chap. 7.

Many patients have been taking *steroids*, either to combat renal disease or to avoid transplant rejection. Steroids are well known to produce osteoporosis after prolonged use, and this may become evident following a renal transplant.

Chronic renal disease almost invariably causes an anaemia. This occurs mainly due to failure of production of erythropoietin (EPO) by the kidney. Renal loss of red blood cells, marrow fibrosis and increased red cell fragility with subsequent early destruction also contribute. The anaemia may result in tiredness and decreased concentration. Shortage of breath and palpitations due to decreased oxygen carriage and increased cardiac output may also occur. Marrow fibrosis leads to a reduced platelet count and poor platelet function. Patients may give a history of taking recombinant EPO, having multiple transfusions and taking iron supplements.

It is worth asking which type of dialysis a patient undergoes and when the last session was since patients are best treated when they have recently dialysed. Haemodialysis may be carried out in the body (*peritoneal*) or outside (*extracorporeal*). Both types rely on the patient's blood being exposed to a solution hypotonic in metabolites across a semipermeable membrane. Extracorporeal dialysis relies upon a high flow of blood from the patient to the dialysis machine and then back to the patient. The dialysis team produces a peripheral *arteriovenous fistula* for regular large vessel diameter access (Fig. 8.1). It is of vital importance that the fistula is well-maintained and not used for any other purposes. Accidental damage to the area can result in torrential haemorrhage. Peritoneal dialysis uses the patient's own peritoneal membrane as the semipermeable barrier. The dialysing fluid is instilled into the peritoneal cavity, left in situ and drained as effluent. Infection of the peritoneal catheter is a major potential complication leading to peritonitis. Dialysis itself still carries a risk of infection (HIV, hepatitis, bacterial) and this should be borne in mind.

Haemostasis is impaired to varying degrees in patients with CKD, and enquiry regarding any bleeding tendency should be made. The main factors involved are impaired platelet adhesiveness, decreased von Willebrand's factor and decreased thromboxane. Prostacyclin levels are raised leading to vasodilatation. The bleeding time is often prolonged. In addition, patients who are being dialysed will be heparinised during dialysis. However, as the effects of heparin are not prolonged, treatment performed on a day when the patient is not being dialysed presents no problem with drug-induced anticoagulation.

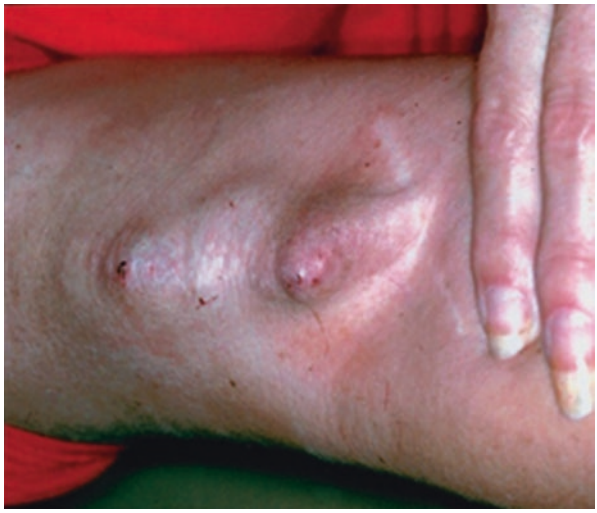

Fig. 8.1 A surgically created arteriovenous fistula in the antecubital fossa. A thrill is present on palpating the skin over the fistula

Infections tend to be poorly controlled in a patient with CKD, and patients *post-kidney transplant* are immunosuppressed to prevent rejection. Signs of infection tend to be masked particularly in patients taking steroids, and therefore care needs to be taken to treat odontogenic infections promptly and effectively. Transplant patients have an overall mortality of less than 5%, and steroids will be used as part of the immunosuppression as well as other agents, usually *ciclosporin*. The increased risk of infection in these patients should be remembered. Patients may give a history of oral candidosis or oral viral infections, e.g. herpes simplex, cytomegalovirus and Epstein-Barr virus (EBV). There is an increased chance of malignancy due to immunosuppression, and these may range from *lymphomas* to *cutaneous cancers*, e.g. basal cell (Fig. 8.2) and squamous cell cancers.

The *nephrotic syndrome* is found in some patients. This comprises proteinuria, hypoalbuminaemia, oedema and hyperlipidaemia. Causes include diabetes mellitus and systemic lupus erythematosus. An increase in the level of circulating factor VIII leads to hypercoagulability and the possibility of thromboses. As a result such patients may give a history of taking prophylactic heparin. A patient with nephrotic syndrome may also be taking corticosteroids and using a low salt and high-protein diet. There is an increased likelihood of atheroma in these patients.

Kidney stones are of little relevance to dental practice, except for the fact that they may be associated with hyperparathyroidism. A summary of salient points to be obtained in the history is given in Table 8.2.

8.2 Examination of the Dental Patient with Renal Disease

Oedema may occur as a result of sodium retention and may be evident both at the ankles and around the face. *Periorbital oedema* is often seen, and the patient may exhibit the characteristic ‘moon face’ of steroid therapy. The fluid retention may

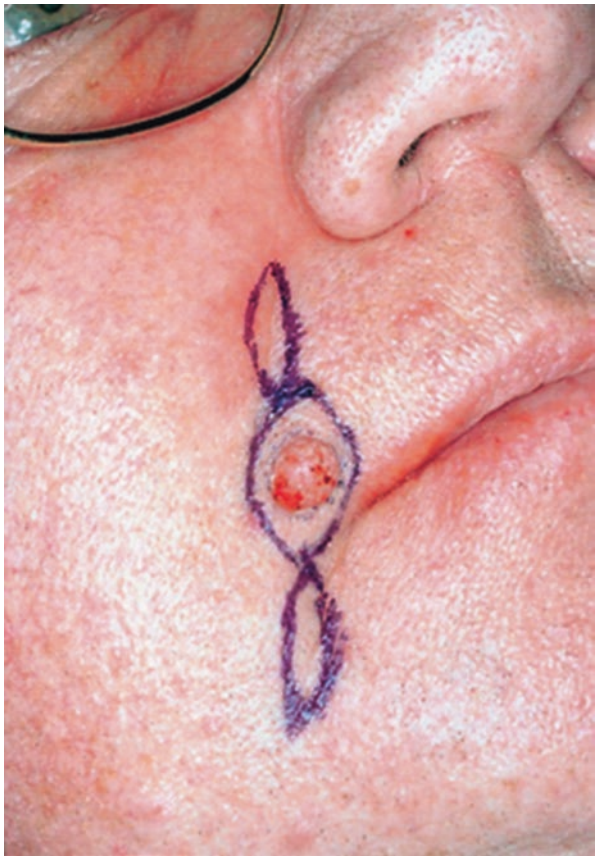

Fig. 8.2 A patient with a facial basal cell cancer due to immunosuppression after a kidney transplant. The patient is 'marked up' prior to surgical excision

Table 8.2 Points of relevance in the history of a patient with a renal disorder

History of diabetes mellitus
Chronic kidney disease (CKD)
Related bony disorders
Anaemia
Dialysis –Type –How often –Presence of A-V fistula
Transplant –When? –Associated medication including steroids
Susceptibility to infections/recent history of repeated infection (dental or generalised)

lead to pulmonary oedema and pleural and cardiac effusions which may present as shortage of breath and an inability to lie flat during dental treatment. *Bone pain* may result from a disruption of vitamin D metabolism.

The incidence of *oral ulceration* is increased in these patients, and the oral mucosa may be pale secondary to anaemia, but this sign is often rather subjective. As mentioned previously dental infections may become widespread very rapidly, and oral candidosis may be present. Herpes simplex, zoster, cytomegalovirus, EBV and toxoplasmosis are increased in incidence, and prophylactic aciclovir may be used.

Gingival hyperplasia occurs with ciclosporin therapy [4]. It is also associated with an increased and rapid build-up of calculus. The hyperplasia often improves with improved oral hygiene involving scaling and polishing.

The dentist should be aware that there is an increased incidence in disorders that can be related to immunosuppression including lymphoma, skin cancers (Fig. 8.2), hairy leukoplakia, leukoplakia and Kaposi's sarcoma [5]. Any renal transplant patient with a suspicious lesion should be referred urgently for specialist investigation. Lip cancers appear to be more likely during the function of the transplanted kidney, the incidence regressing during failure of transplant and the return to dialysis [6].

Patients undergoing dialysis may experience swelling of the major salivary glands (especially the parotid glands). Salivary flow may be decreased in CKD leading to increased oral problems [7]. Palatal and buccal keratosis is sometimes seen.

The conditions tend to resolve with established dialysis or transplant. The tongue may be dry and coated. Periodontal disease may be evident and there may be bleeding from the gingival margins. In children, CKD leads to decreased growth and sometimes delayed tooth eruption and enamel hypoplasia. A summary of clinical features which may be encountered in CKD is shown in Table 8.1.

The patient may have an *arteriovenous fistula* at the wrist or in the antecubital fossa (Fig. 8.1). High blood flow through the fistula leads to a palpable vibration or thrill when the examiner's fingers are placed lightly on the skin over the area of the fistula. As mentioned earlier, this arm should not be used for routine venepuncture or IV sedation.

8.3 Dental Management of Patients with Renal Disorders (Table 8.3)

It is important to appreciate the problems faced by a patient with chronic renal disease and anticipating their reduced resistance to infection as well as their concurrent disease. Routine dental care requires little modification, but it is obvious from the above that oral hygiene is important. Standard procedures should be employed to

Table 8.3 Management considerations in dental patients with renal disorders

• Awareness of reduced resistance to infection
• Antibiotic prophylaxis for bacteraemia producing procedures should be considered and is required for at least 2 years post-transplant
• Best treated under local anaesthesia
• These patients may be taking (or have taken) corticosteroids
• The day after dialysis is the optimum time for treatment
• Electrolyte disturbances can predispose to cardiac arrhythmias
• Impaired drug excretion leads to the need for care with drug prescriptions

prevent cross infection. Infiltration analgesia is not contraindicated, but any bleeding tendency should be excluded prior to administering a nerve block.

Most patients are best treated under local anaesthetic due to the anaemia and potential electrolyte disturbances which would complicate GA. Corticosteroids are often prescribed for these patients, and thus a steroid boost may be required for surgical procedures (see Chap. 3).

These patients are often hypertensive and this should be considered prior to any form of treatment. It is important to ensure good haemostasis after oral surgical procedures because of this and the bleeding tendency. Patients are best treated the day after dialysis as platelet function will be optimal and the effect of the heparin will have worn off. Consultation with the renal physician is advised. Desmopressin (DDAVP) has been used to assist with haemostasis in cases of prolonged bleeding.

Renal disease progresses at a varying rate ranging from subclinical loss of renal reserve to renal insufficiency culminating in ESRF. The loss of reserve may not manifest itself unless the kidneys are placed under stress. This can happen after the administration of certain drugs, a heavy dietary protein load or pregnancy. Swallowed blood acts as a protein load and may occur, for example, from a post-extraction haemorrhage. Dietary manipulation is useful in decreasing sodium and potassium load, and a low-protein diet reduces the need to excrete nitrogenous metabolites.

The patient's cardiovascular status should be considered since these patients are predisposed to arrhythmias due to electrolyte disturbances and the incidence of atheroma is increased in patients with nephrotic syndrome, as stated earlier. Congestive cardiac failure may ensue, and such patients are best treated sitting up to minimise pulmonary oedema and avoidance of placing the legs in a dependent position, again to minimise oedema. Impaired drug excretion leads to the need for care with drug prescriptions and is discussed in the next section.

8.4 Prescribing for Patients with Renal Disease

Renal disease influences the use of drugs in dentistry. Many drugs prescribed by dentists are excreted by the kidney [8]. Failure to excrete a drug or its metabolites may lead to toxicity. As a general rule, any drug that is nephrotoxic (such as gentamicin which is to be used in prophylaxis against endocarditis) should be avoided. Other drugs may require dose reduction. Erythromycin is contraindicated in patients who have had a kidney transplant and are taking ciclosporin. Ciclosporin metabolism is reduced leading to an increase in toxicity [9]. Drugs contained in the *Dental Practitioners' Formulary* whose dose should be reduced in the presence of significant kidney disease include the antimicrobials acyclovir, amoxicillin, ampicillin, cephalexin and erythromycin. Tetracyclines other than doxycycline should be avoided. Non-steroidal analgesics should not be prescribed in those with more than mild renal impairment, paracetamol being the drug of choice for post-operative pain control.

Drugs used in dental sedation should be used with extreme care as a greater effect than normal may be produced. The British National Formulary [10] summarises the advice concerning the prescription of drugs in patients with renal dysfunction.

8.5 Conclusion

Renal disease impacts on dental management. The timing of treatment may be affected in patients with serious renal impairment. Co-operation with the physician is necessary in such patients.

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The Musculoskeletal System and Dental Practice

9

In Brief

- Musculoskeletal disorders can affect co-operation during dental treatment.
- Musculoskeletal disorders may affect orofacial function.
- Musculoskeletal disorders can affect the structure and eruption of the dentition.
- Sedation with benzodiazepines is contraindicated in some muscular diseases.
- Drugs used to control musculoskeletal disease may affect oral structure.

Disorders of the musculoskeletal system may impact on dental management in diverse ways. Diseases of the bones may have a direct influence on treatment and joint disorders can also cause difficulties.

Cervical spine involvement may lead to poor neck extension causing difficulties in providing dental treatment under local anaesthesia or allowing the provision of a safe general anaesthetic. Muscular disorders may mitigate against safe general anaesthesia. As with all medical disorders, a thorough history can help to prevent many of the possible problems which may occur secondary to musculoskeletal diseases.

9.1 Points in History

These can be divided into diseases of bone, joint disorders and relevant soft tissue disorders. If the patient gives a history of radiotherapy to the head and neck region, the possibility of irradiation of the maxilla or mandible should be borne in mind. Dental extractions in such patients should be avoided if possible due to the risk of osteoradionecrosis (death of bone due to endarteritis obliterans).

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https://doi.org/10.1007/978-3-319-97737-9_9

9.2 Disorders of the Bone

Osteoporosis is a condition in which there is a deficiency of bone matrix and calcium salts. Bone which fractures easily is the principal complication. Patients will often complain of low back pain due to vertebral collapse. The bone is structurally normal but there is a deficiency of it. Hormone replacement therapy in the postmenopausal female decreases the severity of the disorder. Osteoporosis is considered a major risk factor for periodontal disease. Many patients with osteoporosis will be taking bisphosphonates. These drugs alter osteoclast function and can lead to osteonecrosis after dental extraction (see Chap. 16).

Fibrous dysplasia may affect a single bone (monostotic) or multiple bones (polyostotic). It consists of an area of bone replaced by fibrous tissue leading to local swelling. In the polyostotic disorder, there may be associated skin pigmentation (café au lait patches). Rarely there may be mucosal pigmentation. The disease is usually self-limiting although in the craniofacial region it may interfere with occlusion and vision [1]. In cases of polyostotic fibrous dysplasia associated with pigmentation and precocious puberty in females, the name Albright's syndrome is applied. Radiographically the bone has a ground glass appearance. Serum calcium and phosphate levels are normal. Surgical treatment consists of 'debulking' lesions.

Paget's disease of the bone is a condition in which there is progressive bone enlargement. There is a male predominance. The prevalence of this disease appears to be decreasing [2]. The disorder consists of alternating bone deposition and resorption. Initially there may be no symptoms but later, bone pain and deformities may become evident. There is an increased likelihood of pathological fracture and there may be cranial nerve compression. The bone is hypervascular which can ultimately lead to high-output cardiac failure. Rarely, an osteosarcoma may develop in Paget's disease. Diagnosis is made by clinical and radiographic features, and the blood alkaline phosphatase level is greatly increased. The skull may show a large irregular area of radiolucency-osteoporosis circumscripta, and the bone is described as having a 'cotton wool' appearance. There may be hypercementosis. These patients are susceptible to chronic suppurative osteomyelitis. In view of the hypercementosis, extractions will often need to be 'surgical' and carried out under antibiotic cover.

Osteopetrosis signifies a condition in which the bone density is increased but the bone is nevertheless structurally weak. The patient may suffer fractures or bone pain but is often asymptomatic. Decreased marrow activity may lead to anaemia. Some patients may be taking corticosteroids. These patients are prone to osteomyelitis or fracture. Dental extractions should be as atraumatic as possible, flaps should be avoided if possible, and extractions should be carried out under antibiotic cover.

Cleidocranial dysplasia occurs as a result of a defect in membrane bone formation inherited as autosomal dominant. It involves mainly the skull and clavicles. The head is large and brachycephalic with a persistent frontal suture. The clavicles are absent or stunted conferring the ability to approximate the shoulders anteriorly (Fig. 9.1). There are a persistent deciduous dentition, often unerupted permanent teeth, dentigerous cysts and supernumeraries [3].

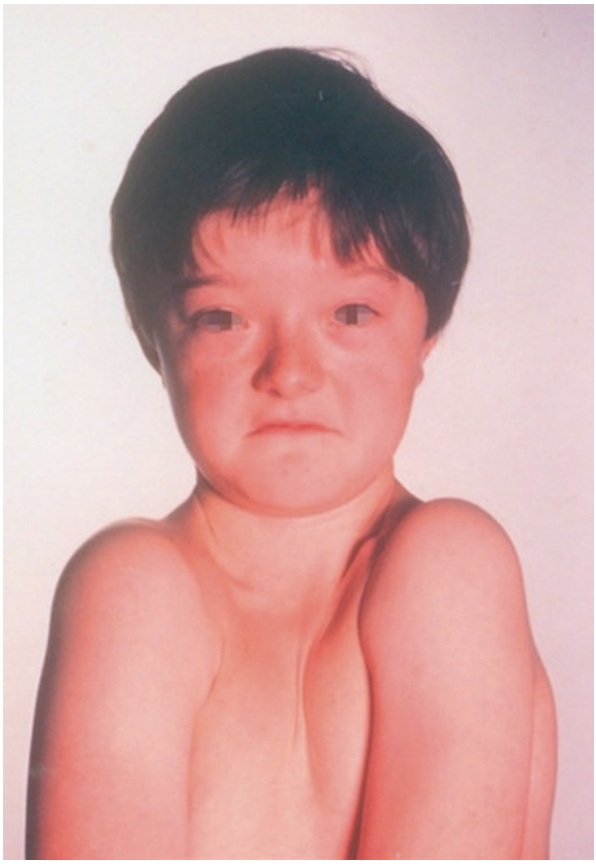

Fig. 9.1 A patient with cleidocranial dysplasia. The clavicles are absent or stunted due to a defect in membrane bone formation

Osteogenesis imperfecta is a rare autosomal dominant condition consisting of a defect in collagen formation. It may be associated with dentinogenesis imperfecta. The patient may give a history of multiple fractures secondary to relatively minor trauma. There may be associated deafness and the patients tend to have weak tendons and bruise easily. Heart valve problems may occur. It is rare to fracture the jaw as a result of dental treatment.

Rickets and *osteomalacia* may occur in conditions of defective skeletal mineralisation, the former occurring in children ('knock knees') and the latter in adults. The conditions are usually related to a deficiency of intake or absorption of vitamin D. Osteomalacia is sometimes seen in patients with chronic kidney disease. Excess osteoid matrix at the costochondral rib junction leads to the appearance of the so-called Rickety Rosary. Dental defects are seen only in severe cases. When there is associated malabsorption, the possibility of reduced vitamin K uptake should be considered, as this may affect blood clotting.

A patient with *achondroplasia* would be obvious as the classic 'circus dwarf'. The condition arises due to a defect in cartilaginous bone formation and is inherited as autosomal dominant. The relevance to dentistry is that the incidence of malocclusion is increased and patients may have a diabetic tendency.

9.3 Joint Disease

Osteoarthritis may occur as a 'wear and tear' phenomenon and occurs due to a degeneration of articular cartilage. It has characteristic radiographic appearances (see later). There are no systemic symptoms. Treatment is mainly by reduction in weight if required when the disease affects weight-bearing joints, physiotherapy, local application of heat and anti-inflammatories which may lead to a bleeding tendency.

Rheumatoid arthritis is a multisystem disorder which is thought to be autoimmune in nature. One theory is that an autoantibody to abnormal immunoglobulin in joint tissues leads to the formation of an antigen-antibody complex which activates complement causing inflammation and synovial damage. The mean age of onset is between 30 and 40 years; the juvenile form is known as Still's disease. There is a female predominance.

Juvenile chronic arthritis may lead to an increased incidence of caries and periodontal disease [4]. In addition, if the TMJ is involved, facial growth may be disturbed [5]; however, the condylar condition can improve with age [6]. One of the early signs of development of rheumatoid arthritis may be stiffness of the fingers, particularly in the early morning ('early morning stiffness') which usually decreases during the day. In more advanced disease, the direction of the fingers appears to drift away from the thumb (ulnar deviation) (Fig. 9.2). The onset is often slow but it can be acute with malaise, fever and joint pain. There is anaemia which is normocytic and normochromic, the so-called anaemia of chronic disease. Treatment in the early stages is usually with nonsteroidal anti-inflammatory drugs. Second-line treatment includes a variety of agents such as gold and the chemotherapy agent methotrexate

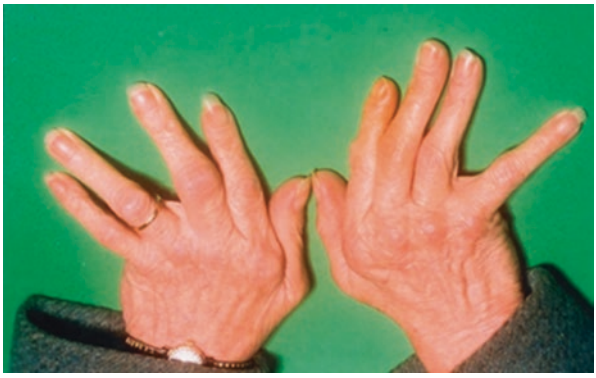

Fig. 9.2 The fingers are deviated to the ulnar side in this patient with rheumatoid arthritis

Table 9.1 The multisystem nature of rheumatoid arthritis

Cardiovascular
• Myocarditis
• Pericarditis
• Valve inflammation
Respiratory
• Pulmonary nodules/fibrosis
Renal
• Amyloidosis
Liver
• Hepatic impairment
Skin
• Palmar erythema
• Subcutaneous rheumatoid nodules
General
• Malaise
• Anaemia of chronic disease
• Thrombocytopaenia

(this may lead to folic acid deficiency with the potential for secondary oral problems). Corticosteroids have been used for treatment as have antimalarial medications. The mainstay of physical treatment involves occupational therapy and includes household device modification, e.g. modified toothbrush handles and modified kitchen appliances. Table 9.1 lists the potential multisystem manifestations of rheumatoid arthritis. The recommendation of electric toothbrushes for these and other patients with musculoskeletal disorders should be considered to aid oral hygiene. *Felty's syndrome* consists of rheumatoid arthritis, splenomegaly leading to leucopenia, anaemia and lymphadenopathy.

The skin disorder psoriasis may have an associated arthritis which usually resembles a less severe version of a rheumatoid arthritis. Blood tests are normal; oral lesions are rare. Occasionally treatment might be with methotrexate.

Gout may be of primary or secondary type. In primary gout, there are raised serum levels of uric acid leading to the deposition of urates especially in joints leading to arthritis. In secondary gout, certain drug treatments may precipitate the condition. An alcoholic binge can instigate gout in those predisposed to it. Gouty tophi may occur where masses of urate crystals become deposited in joints or extra-articular sites, e.g. the subcutaneous nodules of the helix of the ear. The classic joint affected by gout is that of the great toe. Gout may lead to renal failure. The treatment in an acute attack is usually indomethacin, but longer-term maintenance requires allopurinol which decreases uric acid production.

In patients with prosthetic *joint replacements*, there is no indication for antibiotic cover for dental treatment [7, 8], but there is a suggestion of a degree of immunocompromise in rheumatoid arthritis, and thus, antibiotic cover may be wise for these patients. The same may be said of the patient with diabetes mellitus who has a prosthetic joint.

9.4 Other Disorders

Ankylosing spondylitis is a chronic inflammatory disease mainly of young males, affecting the spine. Over 90% of cases are HLA B27 positive; the disease is partly genetically determined. There is ossification of ligaments and tendons and the onset is insidious. The patient often complains of low back pain. A quarter of patients may develop eye lesions. Patients may also have aortic valvular disease or cardiac conduction defects. As intervertebral ossification develops, the radiograph takes on a so-called 'bamboo spine' appearance. Treatment is with anti-inflammatory medications. There are implications for general anaesthesia and these are discussed later.

Reiter's disease consists of the triad of arthritis, urethritis and conjunctivitis. Like patients with ankylosing spondylitis, a majority of patients are HLA B27 positive. They are usually 20–40-year-old males.

Marfan's syndrome is an autosomal dominant condition which comprises skeletal, ocular and cardiovascular malformations. The patients are conspicuously tall and have lax ligaments. They have a predisposition to lung cysts leading to risk of pneumothorax. Ocular lens dislocation can occur. Aortic dissection is a possibility leading to aortic and mitral valve incompetence. The palatal vault is high and there is an increased incidence of TMJ dysfunction. There may be associated cardiac disease.

In *Ehlers-Danlos syndrome*, the patient's principal complaints are of lax joints and bruising easily (there may be deficient platelet function). The skin is elastic (Fig. 9.3) and there is a predisposition to mitral valve prolapse. This disorder of collagen formation (of which there are various subtypes) may be autosomal dominant, but some types are recessive. *Myasthenia gravis* is an autoimmune disease of the neuromuscular junction involving the post-junctional acetylcholine receptors. The condition is characterised by muscle weakness. Ocular, facial and pharyngeal muscles may be involved. The condition is described in more detail in Chap. 5.

Muscular disorders may be of relevance in dental treatment. *Duchenne muscular dystrophy* is a sex-linked disorder comprising widespread muscle weakness which tends not to affect the head and neck but may be relevant in terms of ease of access to treatment or provision of general anaesthesia or sedation (see later). The affected muscles appear to be enlarged pseudohypertrophy. Cardiomyopathy and respiratory impairment may occur. Acquired myopathies include *polymyositis* and *dermatomyositis* (the latter if there is an associated skin disorder). These are rare and immunologically mediated inflammatory myopathies comprising pain and muscle weakness. There are often circulating autoantibodies present. The female incidence is twice that of the male. Speech and swallowing may be difficult. The characteristic rash may occur in up to a third of cases of polymyositis which consists of a butterfly-shaped violet rash across the bridge of the nose and cheeks. They may be associated with Raynaud's disease (a vasospastic disorder resulting in excessive reaction of extremities to cold) or other connective tissue disorders, for example, Sjögren syndrome. Treatment often involves corticosteroids.

Cranial arteritis and *polymyalgia rheumatica* (PMR) are disorders of the blood vessels but cause muscle pain due to ischaemia. Inflammation with luminal

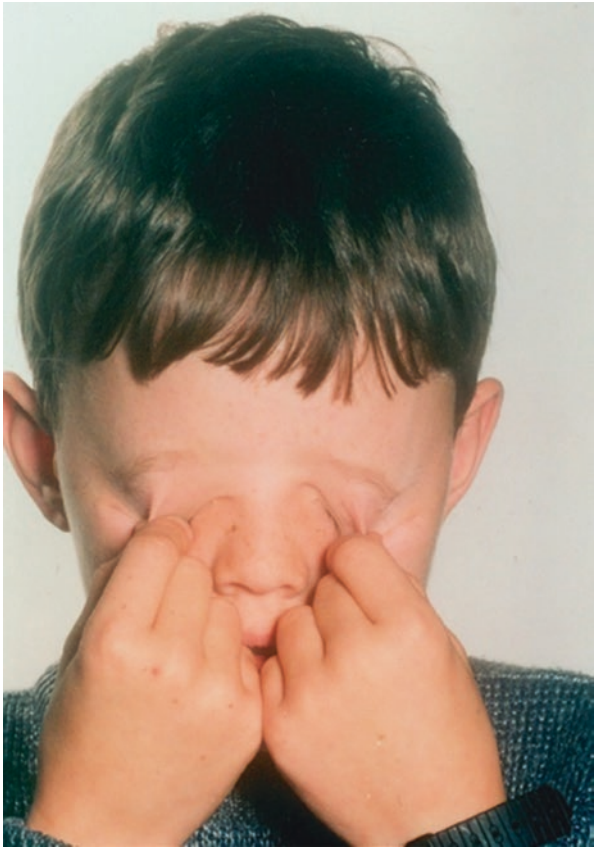

Fig. 9.3 Hyperelasticity of the skin in a patient with Ehlers-Danlos syndrome

obliteration of the medium-sized arteries occurs. Giant cells may be found histologically, thus, the arteritis is a giant cell type. The affected area may be cranial/temporal or more widespread in the case of PMR.

In cranial arteritis, the eye can be involved leading to blindness. In this form of arteritis, there is a unilateral throbbing headache usually affecting middle-aged or older females. A biopsy of the temporal artery confirms the diagnosis. Early administration of prednisolone is mandatory if the disorder is suspected to prevent blindness. Ischaemic pain may be felt in the muscles of mastication and this must be differentiated from TMJ pain. Unlike TMJ pain, it tends to have a later onset, i.e. middle age or older, and there is no diurnal variation. The pain is more severe and there is an increased erythrocyte sedimentation rate (ESR). In trigeminal neuralgia, the pain may be associated with mastication, but the ESR is normal, and it may thus be differentiated from cranial arteritis. In cases of PMR, a similar age and sex distribution is seen compared to cranial arteritis.

A summary of salient points to be obtained in the history is given in Table 9.2.

Table 9.2 Points in the history which may be of relevance in musculoskeletal disease

Bone disorders
• Osteoporosis
• Rickets and osteomalacia
• Fibrous dysplasia
• Paget's disease of bone
• Osteopetrosis
• Cleidocranial dysostosis
• Osteogenesis imperfecta
• Achondroplasia
Joint disorders
• Osteoarthritis
• Rheumatoid arthritis
• Psoriatic arthritis
• Gout
• Mouth opening
• Neck extension
Other disorders
• Ankylosing spondylitis
• Marfan's syndrome
• Ehlers-Danlos syndrome
• Reiter's syndrome
Muscular disorders
• Duchenne muscular dystrophy
• Polymyositis
• Dermatomyositis
• Cranial arteritis
• Polymyalgia rheumatica

9.5 Examination

The dental patient may have signs which can be related to their musculoskeletal disorder. A summary is given in Table 9.3. The patient with osteogenesis imperfecta may have the classic blue sclera, for example (Fig. 9.4). If there is associated dentinogenesis imperfecta, the teeth may have a brown discolouration with marked attrition due to the weakened tooth substance.

Joint disorders may be suspected from the patient's gait or a deformity may be evident. The osteoarthritic patient may have nodules close to the distal interphalangeal joints of the fingers, the so-called Heberden's nodes. The radiographic appearances of osteoarthritis are characteristic with reduced joint space, subchondral bone cysts and sclerosis and lipping of osteophytes at the joint margins. TMJ function does not appear to be correlated with the radiographic appearance.

Patients with rheumatoid arthritis may complain of systemic symptoms in addition to those of the joints. The fingers may be deviated to the ulnar side, i.e. away from the thumb. There may be redness over the small joints of the hands and feet and palmar erythema. Rheumatoid nodules are sometimes seen the principal site being near the elbow on the extensor surface of the arm. Radiographic examination shows a widened joint space and the shadows of associated soft tissue swelling. The adjacent bone may be osteoporotic. Sjögren syndrome may be associated.

Table 9.3 Summary of points on examination of a dental patient with a musculoskeletal disorder

Joint disorders
• Gait
• Swelling, deformity
• Heberden's nodes (see text)
• Rheumatoid hands
• Subcutaneous nodules in rheumatoid arthritis
Osteogenesis imperfecta
• Blue sclera, may have brown heavily worn teeth if associated with dentinogenesis imperfecta
Cleidocranial dysplasia
• Large, brachycephalic head
• Hypoplastic maxilla
• Absent/hypoplastic clavicles
Marfan's syndrome
• Tall stature
• Long fingers
• High-arched palate
• Lax ligaments
Osteoporosis
• Vertebral collapse possibly leading to spinal deformity
Fibrous dysplasia
• Localised areas of 'swelling' of skeleton (may be associated with skin pigmentation)
Paget's disease of bone
• Sabre tibia
• Increased head circumference
• Increased alveolar ridge width
Ankylosing spondylitis
• Flexed/hunched appearance to back
Muscle disorders
• May be altered speech/muscle tone
Dermatomyositis
• Violet/purple butterfly rash over bridge of nose/cheek
Cranial arteritis
• Tender, prominent temporal artery

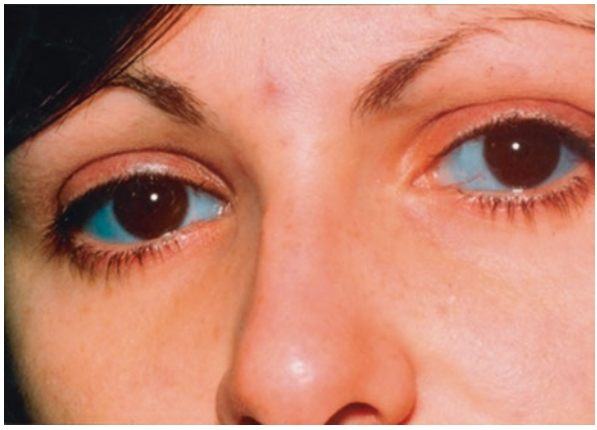

Fig. 9.4 A patient with osteogenesis imperfecta with the classic blue sclera

Table 9.4 Potential oral complications of radiotherapy to the head and neck region

• Osteoradionecrosis, irradiation-induced osteomyelitis
• Xerostomia
• Radiation caries
• Mucositis, ulceration
• Trismus
• Candidosis
• Periodontal disease
• Taste loss

Radiographic changes are common in the TMJ and include erosions and flattening of the condylar head. As with osteoarthritis, major TMJ problems are not necessarily associated. Still's disease may be complicated by bony ankylosis.

The oral complications of radiotherapy to the oral cavity/salivary glands are summarised in Table 9.4. The most common complication is a mucositis. When osteoradionecrosis occurs, the mandibular bone becomes avascular and necrotic. The overlying mucosa and skin may be destroyed and the bone exposed. An ill-fitting denture can induce a postirradiation osteomyelitis due to mucosal ulceration.

Infective arthropathy of the TMJ is an unusual event and usually follows a penetrating injury. *Haemophilus, Staphylococcus aureus* or *Mycobacterium tuberculosis* are the common infecting organisms.

The patient with cleidocranial dysplasia has a large, brachycephalic head with bulging frontal, parietal and occipital regions. There is a persistent metopic (frontal) suture visible radiographically, and the middle third of the face is hypoplastic. The clavicles are either hypoplastic or absent leading to an ability to approximate the shoulders anteriorly.

A Marfan's patient is often suspected not only due to the tall stature but also the long fingers and ligament laxity. Such laxity also exists in the patient with Ehlers-Danlos syndrome but here the skin is also elastic. These patients have a predisposition to bruising and a haematological cause should also be considered.

The sequelae of osteoporosis may be seen as a collapse of the spine leading to a subsequent chest deformity. There also may be decreased alveolar height due to bone loss.

The patient with fibrous dysplasia may have bilateral lesions of the maxilla giving the appearance which has been labelled 'Cherubism'. The eyes are classically described as being 'upturned towards heaven'. True cherubism is a separate condition with bone replaced by cellular and vascular fibrous tissue with giant cells. Hyperpigmentation may be associated with the polyostotic type as mentioned earlier; the lesions are usually on the same side as the bone lesions. Radiographic examination shows a ground glass appearance of the bone. Paget's disease of bone may be recognised by a characteristic appearance of the lower leg (being convex forward), the so-called sabre tibia. The patient may be deaf or have impaired vision secondary to cranial nerve compression. Radiographs may show a mixture of sclerosis and radiolucency giving a so-called 'cotton wool' appearance to the bone (Fig. 9.5). Symmetrical malar bulging may occur giving the appearance of the so-called leontiasis ossea. The alveolar ridges may be widened, and radiographic examination of the teeth may reveal a loss of lamina dura as well as hypercementosis.

Ankylosing spondylitis may be recognised by the flexed or hunched appearance of the back. On radiographic examination, the spine has a 'bamboo' appearance.

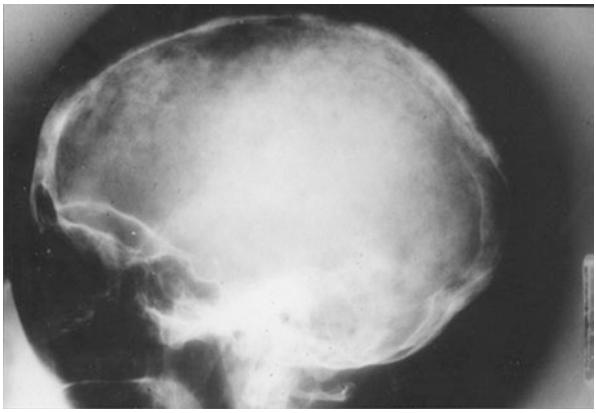

Fig. 9.5 This 'cotton wool' appearance to the skull is seen in Paget's disease of bone

The patient with Reiter's syndrome has an arthritis, urethritis and conjunctivitis. There is an associated keratotic thickening of the skin of the soles of the hands and feet, a condition known as keratoderma blennorrhagica. Oral lesions include white patches with a surrounding red area which are painless and transient and may affect any part of the mouth.

Muscular disorders may be suspected from the patient's gait or their speech. A waddling gait develops in Duchenne muscular dystrophy along with the pseudohypertrophy of muscles mentioned earlier. In the facioscapulohumeral type, there is a lack of facial expression. The myotonic disorders are characterised by slow muscle relaxation after contraction. If the tongue is affected, dysarthria results. Ptosis may be evident and there is atrophy of the muscles of mastication. Intellectual deterioration also occurs.

Patients with polymyositis and dermatomyositis may have difficulties in speaking and swallowing due mainly to muscle contracture. A violet/purple butterfly-shaped facial rash may occur extending over the bridge of the nose and cheeks. There may be associated Sjögren syndrome. The mouth may have a purple erythematous appearance with areas of superficial ulceration.

The patient with cranial arteritis will have little to see on clinical examination but may have a prominent temporal artery on the same side as the pain which is tender to palpation. Diagnosis is confirmed by temporal artery biopsy. Patients with PMR predominantly have painful, weak and stiff shoulders.

9.6 General and Local Anaesthesia, Sedation and Management Considerations in the Dental Patient with Musculoskeletal Disease

The patient with osteogenesis imperfecta may have secondary chest deformities which may be severe enough to compromise respiratory function. This should be borne in mind when assessing a patient for GA and, in extreme cases, intravenous sedation. The patient with osteopetrosis may be anaemic or may be on corticosteroid therapy, and both of these will have a bearing on their management. Patients with osteoporosis may have impaired respiratory function due to vertebral collapse,

unfavourably altering the dimensions of the thorax. In cases of fibrous dysplasia, patients are at increased risk of being hyperthyroid or having a diabetic tendency. In cases of Paget's disease of the bone, there is the possibility of cardiac failure and chest deformities.

The best management of osteoradionecrosis or osteonecrosis is prevention. It is sensible to complete any dental treatment prior to radiotherapy or commencement of bisphosphonate therapy. Osteoradionecrosis may follow at any time after radiotherapy, but a third of cases develop in the first 6 months, and it is particularly important to avoid extractions in the first 6 months to 1 year. In the case of pre-radiotherapy extractions, particular care should be taken to ensure that the bone is covered by the mucosa. Post-radiotherapy extractions should be avoided if possible, but if unavoidable, trauma should be kept to a minimum. Local anaesthetic without vasoconstrictor should be used and raising of periosteum should be minimised. Any sharp bone edges should be gently trimmed. Soft tissue should be closed accurately and prophylactic antibiotics continued for at least 1 month. Radiation caries should be controlled by optimising oral hygiene, and daily topical fluoride application may also be used. Extracting teeth can lead to necrosis of the bone following radiotherapy to the mandible. Extractions are best avoided in the first year after radiotherapy. A preventative protocol is important.

Similar considerations apply in patients taking bisphosphonates who require dental extractions. Table 9.4 summarises the oral complications that may be seen in patients who have undergone radiotherapy to the head and neck region.

9.7 Syndromic Patients

A patient with Marfan's syndrome may have lung cysts which predispose to spontaneous pneumothorax. Curvature of the spine in an anteroposterior direction (kyphosis) and lateral direction (scoliosis) may lead to a significant diminution in respiratory function. The aortic and mitral valve incompetence may lead to cardiac symptoms.

Patients with Ehlers-Danlos syndrome are predisposed to mitral valve prolapse and conduction defects. Patients with ankylosing spondylitis may have decreased mouth opening making intubation difficult as well as causing problems with the treatment itself. Spinal deformity may lead to secondary thoracic deformity and consequent respiratory impairment. These patients may have associated aortic valvular problems.

9.8 Joint Disorders

In both osteoarthritis and rheumatoid arthritis, cervical spine mobility may cause problems in positioning the patient appropriately, both in terms of facilitating treatment provision and anaesthesia. Patients with rheumatoid arthritis will frequently wear a cervical collar. Corticosteroids may be used in both types of arthritis and will

often be given by local joint injection and therefore not produce a need for steroid cover. Systemic treatments may be used in some cases, however. The variety of chronic diseases associated with rheumatoid arthritis may be of relevance (Table 9.1). The TMJ in rheumatoid arthritis often does not produce pain, but there may be decreased movement, i.e. diminished mouth opening. A management outline of rheumatoid arthritis is given in Table 9.5.

Patients with gout are at increased risk of hypertension, ischaemic heart disease, diabetes mellitus and renal disease.

9.9 Other Disorders

In muscular dystrophy patients, cardiomyopathy and respiratory disease should be considered. These patients are also sensitive to the muscle relaxant suxamethonium and are predisposed to developing malignant hyperthermia if a GA is used. Steroid therapy may be of significance when treating patients with cranial arteritis or PMR.

The use of benzodiazepine sedation is contraindicated in patients with myasthenia gravis due to the muscle relaxant properties of this group of drugs.

9.10 Effects of Drugs Used to Treat Musculoskeletal Disorders on Oro-dental Structures

The effects of corticosteroids have been discussed in Chap. 3.

Nonsteroidal anti-inflammatory drugs (NSAIDs) may offer some protection against periodontal disease as they interfere with prostaglandin synthesis. COX 2 inhibitors such as celecoxib may cause stomatitis and taste disturbance.

Penicillamine may also cause taste disturbance. This latter drug has been implicated in producing lichenoid reactions and oral ulceration. In addition as it may produce a thrombocytopaenia, spontaneous gingival bleeding may result.

Ciclosporin is occasionally used in the management of rheumatoid arthritis, and this may cause gingival overgrowth in about 30% of patients [9]. Methotrexate is sometimes used to treat rheumatoid arthritis and may be the cause of oral ulceration. The important point to note about methotrexate is that its toxicity is greatly increased by combined therapy with NSAIDs, corticosteroids and penicillins (including amoxicillin) [10]. Combined therapy with these drugs must be avoided as fatalities may occur.

The cytokine-inhibitor agents, e.g. adalimumab, etanercept and infliximab, are increasingly used as second-line treatments in rheumatoid arthritis (and sometimes in ankylosing spondylitis). As a consequence of the effect of these agents on the immune response, it is important that patients are rendered dentally fit prior to the commencement of therapy. Any problems that do occur after such treatment has been started should be treated promptly and aggressively.

Disease-modifying antirheumatic drugs (DMARDs) are now an established part of the treatment regimen in rheumatoid arthritis for patients who have tried

Table 9.5 Disease-modifying antirheumatic drugs (DMARDs)

Commonly used	Less commonly used
• Methotrexate	Minocycline
• Sulphasalazine	Ciclosporin
• Leflunomide	Azathioprine
• Hydroxychloroquine	Penicillamine
• Steroids (usually by local injection)	

analgesics and some of the first-line treatments. Methotrexate itself is a DMARD. There is now a wide range of new DMARDs that dental practitioners may encounter, and some of the more common ones are listed in Table 9.5. DMARDs aim to reduce symptoms and prevent joint damage. Patients taking them require regular haematological monitoring, in particular by periodic full blood counts and liver function tests. Clearly both tests have a bearing on dental management and liaison with the physician is important.

Allopurinol, which is used in the management of gout, may cause taste disturbance and oral paraesthesias. In addition, it can produce erythema multiforme.

Sulfasalazine, which may be used in the management of rheumatoid arthritis, can cause oral ulceration, stomatitis, glossitis, lichen planus and lupus erythematosus. It may also cause parotitis. Anaemia, leucopaenia and thrombocytopaenia are other unwanted effects of this drug that can impact on surgical dentistry.

Baclofen, which is a skeletal muscle relaxant, may produce xerostomia.

9.11 Summary

Musculoskeletal disorders may alter the management of dental patients in diverse ways. Management may need to be altered because of medication used to combat the disorder, e.g. steroid therapy, the nature of the disorder itself or related conditions, e.g. pulmonary fibrosis as part of the multisystem disorder rheumatoid arthritis.

As with many disorders, a thorough history will lead to safe and effective patient management.

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Haematology and Patients with Bleeding Problems and Dental Practice

10

In Brief

- Disorders of the blood can affect the timing of dental treatment.
- White cell defects influence healing after surgical treatments.
- Red cell defects influence healing and the choice of anaesthesia.
- Clotting problems impact on surgical treatments and the choice of local anaesthesia.
- Anticoagulant medication interacts with drugs used in dentistry.

Disorders of the blood can affect the management of dental patients. Particular oral signs may be produced. In addition, healing may be affected, and the choice of anaesthesia for operative procedures will be influenced. Similarly, patients who have problems with haemostasis are a concern. Surgical procedures are obvious problems. However, restorative dentistry is not trouble-free as patients with bleeding problems may present difficulties regarding the choice of local anaesthesia, as regional block techniques may be contraindicated in some patients.

Disorders of the blood can be categorised as:

- Problems with red blood cells
- Problems with white blood cells
- Bleeding disorders may be congenital or acquired, for example, due to drug therapy. They may be due to:
- Problems with platelets
- Deficiencies in clotting factors
- Vascular problems
- Fibrinolytic problems

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10.1 Points in the History

The routine medical history taken from each patient before treatment should include enquiries about the blood and bleeding. Feelings such as lethargy may be produced by many disorders but may indicate an underlying anaemia. Repeated infections may be the result of deficiencies in white cell numbers or function. Regular nose bleeds or bruising after minor trauma should be taken seriously as should episodes of prolonged bleeding after dental extractions. Nevertheless, it is possible that a dental surgical procedure could be the first discovery of a bleeding problem in a patient otherwise thought to be normal. The authors have been involved in a case of a patient in his 20s who had undergone orthopaedic surgery uneventfully but who suffered a life-threatening bleed following the removal of third molar teeth. Investigations performed after that event provided a diagnosis of von Willebrand's disease.

A full drug history should be elicited. This is important because, in addition to detecting drugs taken to directly interfere with bleeding, such as warfarin, many drugs can produce bleeding disorders as an unwanted side effect. It is not only the prescribed medication that may interfere with haemostasis; drugs of abuse including alcohol and heroin may cause excess bleeding. Finally, any family history of problems with bleeding should be elicited.

When a haematological or bleeding disorder is suspected, special investigations to be performed include a full blood count and clotting studies. The ranges of normal haematological values are given in Tables 10.1 and 10.2.

Table 10.1 Normal ranges for haematological measurements in males and females

Parameter	Normal range (male)	Normal range (female)
Red cell count	$4.5–6.5 \times 10^{12}$/l	$3.9–5.6 \times 10^{12}$/l
White cell count	$4.0–11.0 \times 10^{9}$/l	$4.0–11.0 \times 10^{9}$/l
Platelets	$150.0–400.0 \times 10^{9}$/l	$150.0–400.0 \times 10^{9}$/l
Reticulocytes	$25–100 \times 10^{9}$/l	$25–100 \times 10^{9}$/l
Erythrocyte sedimentation rate	Upper limit = (age in years/2)	Upper limit = (age in years + 10)/2
Haematocrit	0.4–0.54	0.37–0.47
Haemoglobin	13.5–18.0 g/dl	11.5–16.0 g/dl
Mean cell volume	76–96 fl	76 –96 fl
Mean cell haemoglobin	27–32 pg	27–32 pg
Mean cell haemoglobin concentration	30–36 g/dl	30–36 g/dl
Plasma folate	2–20 ng/ml	2–20 ng/ml
Vitamin B_{12}	200–900 ng/ml	200–900 ng/ml
Prothrombin time	10–14 s	10–14 s
Activated partial prothrombin time	35–45 s	35–45 s

Table 10.2 Differential white cell count (normal range)

Cell	(%)
Neutrophils	40–75
Eosinophils	1–6
Basophils	0–1
Lymphocytes	20–45
Monocytes	2–10

10.2 Problems with Red Blood Cells

Two categories of disorder may occur; these are:

- Anaemia
- Polycythaemia

10.2.1 Anaemia

Anaemia is a reduction in the oxygen-carrying capacity of the blood. Anaemia may be caused by a number of disease states or because of drug therapy [1]. This may be the result of reduced numbers of erythrocytes or defects in haemoglobin function. Red cell numbers can be low because of decreased production due to a deficiency state or bone marrow aplasia. Alternatively, the erythrocyte numbers may be reduced because of increased destruction; this is known as haemolytic anaemia.

Anaemia can be caused by lack of iron, vitamin B_{12} or folate. The different deficiencies produce different effects on the erythrocyte. Iron deficiency produces small cells; lack of vitamin B_{12} or folate results in large erythrocytes. Deficiency states are corrected by replacement therapy. Iron deficiency may be due to dietary factors or due to loss of blood, for example, from an intestinal malignancy. Vitamin B_{12} deficiency, known as pernicious anaemia, is not due to dietary problems but is caused by poor absorption of the vitamin. This is a result of defective intrinsic factor function caused by autoantibody attack. Pernicious anaemia is of interest to dentists as it is one of the complications of nitrous oxide abuse. Haemolytic anaemia can be the result of extrinsic factors (such as malaria) or problems with haemoglobin. Included among the conditions that produce defects in haemoglobin are sickle cell disease, the thalassaemias and glucose 6-phosphate dehydrogenase deficiency. Sickle cell disease represents a variant in haemoglobin that is known as haemoglobin S. This haemoglobin causes distortion of the erythrocyte when the oxygen tension is reduced leading to increased haemolysis. Sickle cell disease is a homozygous condition. More common is the heterozygous state sickle cell trait. This trait is normally asymptomatic and only causes problems when the patient is in a situation of reduced oxygen concentration. Sickle cell disease and sickle cell trait are more common in patients of African and Afro-Caribbean descent than in other populations.

The thalassaemias may be found in patients of Asian, Mediterranean and Middle Eastern descent. Like sickle cell disease, these conditions increase haemolysis. They are often associated with a cardiomyopathy. The thalassaemias can produce bone marrow expansion, which can present as maxillary enlargement.

Glucose 6-phosphate dehydrogenase deficiency causes a metabolic disturbance in the erythrocyte leading to an accumulation of oxidants. These oxidants produce methaemoglobin and cause denaturing of haemoglobin with resultant haemolysis.

These can be divided into diseases of bone, joint disorders and relevant soft tissue disorders. If the patient gives a history of radiotherapy to the head and neck region, the possibility of irradiation of the maxilla or mandible should be borne in mind. Dental extractions in such patients should be avoided if possible due to the risk of osteoradionecrosis (death of bone due to irradiation obliterans).

10.2.2 Polycythaemia

Polycythaemia is the overproduction of red blood cells. It may be a sign of cardiac problems that decrease the amount of blood passing through the lungs, for example, a cardiac shunt from the right to the left side of the heart. A serious complication of polycythaemia is thrombosis. The condition may be controlled by frequent blood-letting or by cytotoxic drug therapy.

10.3 Problems with White Cells

White cell problems can present as:

- Reduced numbers (leucopenia)
- Increased numbers (leucocytosis)
- Malignancy

10.3.1 Leucopenia

Leucopenia is a white blood cell count of less than 4.0×10^9/L. It may be the result of a disease process such as HIV infection or the early stages of leukaemia. Alternatively it may be caused by drug therapy [1]. Cyclic neutropenia is a condition in which there are cycles where the white cell count drops. The clinical presentation of leucopenia is known as agranulocytosis. This produces susceptibility to infection. The dentist may be involved as oral ulceration may occur with this condition.

10.3.2 Leucocytosis

Leucocytosis is a white cell count of greater than 11×10^9/L. Many infections raise the white cell count and it is a feature of leukaemia.

10.3.3 Malignancy

Malignant diseases of the white cells include:

- Leukaemias
- Lymphomas
- Myeloma

10.3.3.1 Leukaemias

Leukaemias are divided into acute and chronic forms. Two types of acute leukaemia and two kinds of chronic leukaemia are recognised. These are:

- Acute lymphoblastic leukaemia (ALL)
- Acute myeloblastic leukaemia (AML)
- Chronic lymphocytic leukaemia (CLL)
- Chronic myeloid leukaemia (CML)

Acute lymphoblastic leukaemia (ALL) is the commonest presentation in children. The prognosis in children with ALL is better than that for adults for whom the long-term survival is low.

Acute myeloblastic leukaemia is more common in adults compared to children. The prognosis for both adults and children is poor.

The treatment for the acute leukaemias is with cytotoxic drug therapy or bone marrow transplantation.

The chronic leukaemias involve the proliferation of more mature cells than those found in the acute conditions. The prognosis is better than for the acute leukaemias, and adults are more commonly affected than children. Chronic lymphocytic leukaemia (CLL) is the more common form. Some patients with this condition are asymptomatic. The disease may present with splenomegaly (an enlarged spleen) and lymph node enlargement. Chronic myeloid leukaemia (CML) affects adults of a slightly younger age group than CLL. Splenomegaly occurs but lymph node enlargement is not as common as with CLL. Treatment is with chemotherapy and radiotherapy.

10.3.3.2 Lymphomas

Lymphomas are divided into two types:

- Hodgkin's
- Non-Hodgkin's

Hodgkin's lymphoma mainly affects males with the peak incidence in the fourth decade of life. It presents as lymph node enlargement. This enlargement often occurs in the neck. Non-Hodgkin's lymphomas have a poorer prognosis than the Hodgkin's type. Whereas Hodgkin's can be centred on one node, non-Hodgkin's is usually multifocal. Burkitt's lymphoma is a condition associated with the Epstein-Barr virus and may present in the jaws. Treatment for the lymphomas is with combined chemotherapy and radiotherapy.

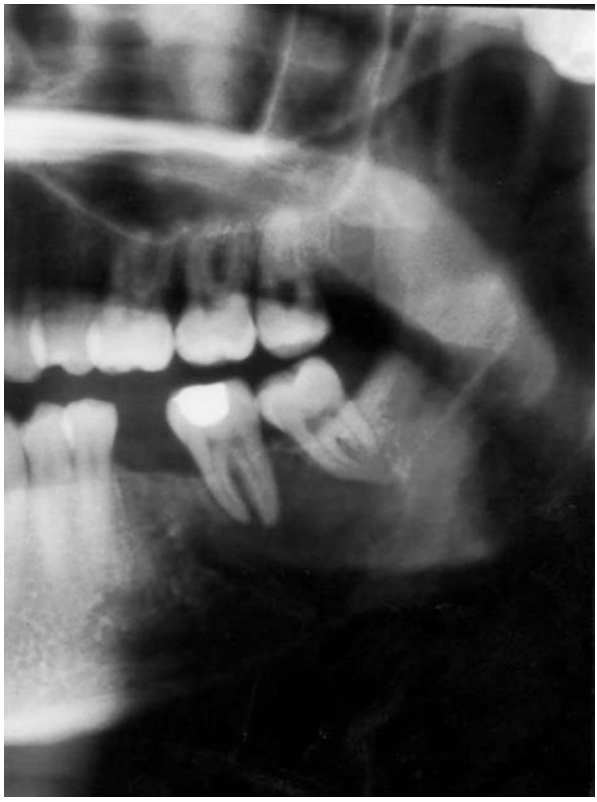

Fig. 10.1 A plasmacytoma presenting as a mandibular radiolucency at the lower molar apices

10.3.3.3 Myeloma

Multiple myeloma is a malignancy of plasma cells. It may present in the jaws as a radiolucency associated with loosening of the teeth and altered sensation. Treatment is with chemotherapy. Occasionally an isolated lesion (a plasmacytoma) may occur in the jaws (Fig. 10.1); these are treated by radiotherapy.

10.4 Problems with Platelets

Platelet problems may be:

- Congenital
- Acquired

The problem may be due to decreased platelet numbers or deficiencies in function. The normal platelet count is over 150×10^9/L. The lowest level acceptable for dental surgery is 50×10^9/L. Patients with counts of less than 100×10^9/L may show prolonged bleeding, but normally local measures such as suturing and the placing of a haemostatic pack can control this (Figs. 10.2 and 10.3). Replacement therapy is required if the platelet level is less than 50×10^9/L. Normally a platelet transfusion will be performed 30 min before surgery. If the problem is one of idiopathic

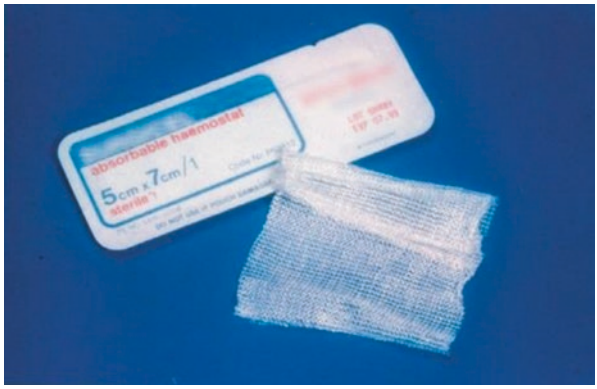

Fig. 10.2 Resorbable haemostatic agents can be placed in sockets to aid healing

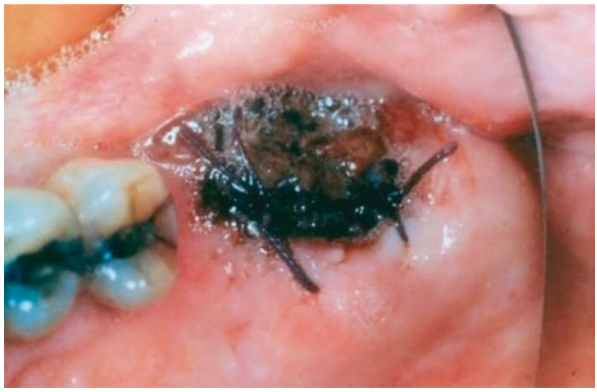

Fig. 10.3 A haemostatic pack held in place with sutures (courtesy Dr. U. J. Moore)

thrombocytopenia, oral systemic steroids can be prescribed for 7–10 days preoperatively. This can increase the platelet numbers to a suitable level.

Platelet function can be affected by disease or by drugs. Glanzmann's syndrome is a defect in platelet aggregation. A platelet infusion must be given prior to surgery as bleeding can be severe. A number of drugs interfere with platelet function. Those specifically used for this purpose include aspirin and dipyridamole. There is normally no treatment other than local measures required to obtain haemostasis in patients taking these drugs. If there is a concern in a patient taking aspirin, then the drug must be stopped for at least 10 days prior to surgery as irreversible changes are produced and replacement with unaffected platelets is needed. Normally, aspirin does not produce problems.

10.5 Deficiencies in Clotting Factors

The classic example of a clotting factor deficiency is haemophilia. Haemophilia A is a sex-linked condition that varies in severity. It is due to a deficiency in Factor VIII. Factor VIII function of 25% or above of normal usually provides satisfactory clotting. Patients with levels of less than 5% will have symptoms of abnormal bleeding such as easy bruising. When the Factor VIII level is less than 1% of normal, then the condition is classified as severe.

The management of patients with haemophilia who are to undergo surgery relies on a threefold regimen. Therapy can:

- Increase Factor VIII production
- Replace missing Factor VIII
- Inhibit fibrinolysis

Factor VIII levels can be increased by 1-desamino-8-D-arginine vasopressin (DDAVP). In patients with mild forms of the disease, this therapy may be sufficient; it may be supplemented with an antifibrinolytic agent (see below) in others.

Replacement therapy is with cryoprecipitate, Factor VIII, fresh frozen plasma or purified forms of Factor VIII. Unfortunately some individuals with haemophilia produce Factor VIII inhibitors. In some cases the level of inhibitors is low and can be combated with high doses of Factor VIII. However, in others the inhibitors are induced in response to Factor VIII, and this represents a problem. Inhibitors may be overcome by administering activated Factor IX or prothrombin complex concentrates.

Antifibrinolytic therapy is useful in the postsurgical phase to protect the formed blood clot. Agents used in this way include tranexamic acid and epsilon-aminocaproic acid (EACA).

Christmas disease is not as common as haemophilia but is similar to the latter condition with the exception that the problem is reduced Factor IX action. Management is the same as with haemophilia A except that any replacement therapy is with Factor IX that is not present in cryoprecipitate. As with haemophilia von Willebrand's disease has variable severity. This condition is not sex-linked and is more common than haemophilia. The disease presents with prolonged bleeding times and reduced factor VIII activity. In mild cases DDAVP and antifibrinolytic therapy are sufficient to cover surgical procedures. However, in severe cases Factor VIII replacement therapy is required.

As well as problems with bleeding, these patients may be infected with HIV or hepatitis viruses because of the transfusion of infected blood or blood products.

In addition to congenital causes, problems with clotting may arise due to liver disease or because of drug therapy. An example is the patient who abuses alcohol. Before performing surgery on patients with potential liver problems, it is essential to perform a clotting screen to determine if any corrective therapy must be provided to achieve good haemostasis.

Drugs that interfere with clotting include warfarin and heparin. The management of patients on these medications is discussed below.

10.6 Vascular Problems

An example of a vascular disorder is hereditary haemorrhagic telangiectasia. Vascular defects due to deficiency states such as scurvy are rare nowadays, except in some members of immigrant communities. Vascular problems encountered are

mainly the result of immunological or connective tissue disease (such as Ehlers-Danlos syndrome). Patients with vascular disorders have a prolonged bleeding time. Local haemostatic measures are all that are usually employed to arrest haemorrhage.

10.7 Fibrinolytic Problems

Problems with fibrinolysis are not commonly encountered in dental practice. This effect can be produced by drugs (e.g. streptokinase used as a 'clot-buster' to treat thromboses or pulmonary embolism) or by disease. Plasmin levels may be increased in hepatic or malignant disease such as prostate carcinoma. The treatment is to use an antifibrinolytic agent such as tranexamic acid which is prescribed in hospital practice but is not available for use in the dental practice.

10.7.1 Direct Oral Anticoagulants (DOACs)

DOACs have emerged as a commonly used alternative to warfarin for patients who require anticoagulation and are approved for both the treatment of venous thrombosis and prophylaxis against stroke in patients with atrial fibrillation.

The two main groups of DOACs are thrombin inhibitors (e.g. dabigatran) and Factor Xa inhibitors (e.g. rivaroxaban). DOACs have a much more specific anticoagulant effect than warfarin, require no routine laboratory monitoring and are administered using a standard dose. Other advantages include a rapid onset of action and rapid clearance. Clearance is dependent on renal function. There is now an antidote for dabigatran. A Factor Xa inhibitor antidote is under development.

10.8 Examination

Anaemia may be obvious as pallor of the skin and mucosa but this can be rather subjective. A glossitis may be due to iron-deficiency anaemia. Opportunistic infections or oral ulceration may indicate defects in red or white cells. Gingival enlargement or bleeding, oral paraesthesia or swellings of the parotid glands may be presenting signs of leukaemia.

Signs of bleeding disorders may be apparent during the general assessment of the patient prior to intra-oral examination.

Jaundice may be present indicating hepatic disease that can result in clotting problems. Bruising or petechiae on the arms and hands may be visible (Fig. 10.4). There may also be signs of bruising intra-orally, especially in areas subjected to trauma from the dentition or a denture. Bleeding gingiva in the absence of inflammatory periodontal disease should raise the level of suspicion.

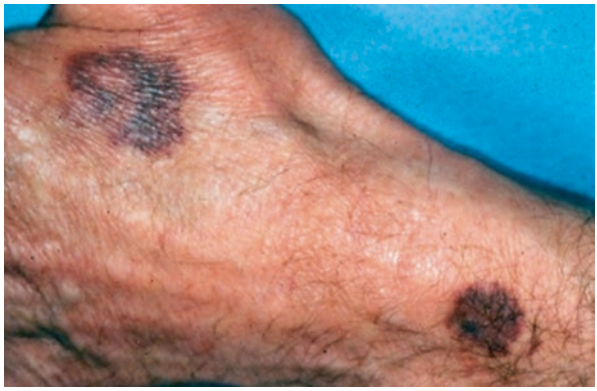

Fig. 10.4 Bruising on the hand should alert the dentist to a bleeding problem

10.9 Influence of Haematological and Bleeding Disorders on Dental Management

The management of patients with haematological and bleeding disorders in dentistry may be complex.

The following aspects must be considered:

1. Surgical procedures
2. Choice of anaesthesia
3. Medication prescribed
4. Cross-infection control

10.9.1 Surgical Procedures

Healing after surgical procedures may be compromised in patients with anaemia or white cell disorders, and antibiotics should be administered if this is a concern. The aim is to achieve optimum levels of antibiotic in the forming blood clot so they must be given prophylactically [2], not after the procedure. Anaemia is not a contraindication to the provision of minor surgical procedures in dental practice. The timing of surgery in patients undergoing treatment for conditions such as leukaemia is important. Surgical treatments should be performed during stages of remission and between chemotherapeutic regimens when the cell count is optimal. Close liaison with the supervising haematologist is vital.

No surgical procedure, no matter how minor, should be performed on a patient with a bleeding disorder without prior consultation with the patient's haematologist or physician. Patients with congenital bleeding disorders should be treated in specialist centres where co-operation between surgeon and haematologist is established. Patients with haemophilia A, Christmas disease or von Willebrand's disease may require replacement therapy prior to surgery and an antifibrinolytic agent

post-operatively. The use of local measures such as suturing and packing with a haemostatic agent should also be considered to prevent post-operative haemorrhage (Figs. 10.2 and 10.3).

The management of patients taking drugs that interfere with bleeding is controversial. If aspirin needs to be withdrawn, then therapy should cease 10 days before surgery as the effect of the drug on platelets is irreversible and replacement of the platelet population will take this length of time to occur. However, aspirin therapy does not normally need to be stopped, and local haemostatic measures normally suffice. Similarly other antiplatelet drugs such as clopidogrel and dipyridamole do not need to be stopped prior to surgery, and local measures control bleeding. These patients can receive minor surgical procedures in general practice.

Patients taking warfarin should have their INR (international normalised ratio, a measure of the prothrombin time) measured prior to any surgical procedure. This can now be performed at the chair-side with a finger-prick sample (Fig. 10.5). The normal therapeutic INR for patients on warfarin is 2.0–3.0 except for those with cardiac valve replacement where the range is 2.5–3.5. A level above 4.0 is nontherapeutic and requires adjustment of the warfarin dose. One question that has to be addressed is whether it is more dangerous to reduce the level of anticoagulation with the risk of a thromboembolic episode than to perform surgery in the warfarinised patient. There is evidence that patients are more likely to die from a thromboembolic problem than they are to develop a bleed that does not settle with local haemostatic measures [3].

Current opinion [4, 5] is that most surgical operations that can be performed in dental practice such as extractions and simple minor oral surgical procedures may be carried out if the INR is less than 4.0 without alteration of the warfarin dosage. If the INR is greater than 4.0, referral to the supervising physician is needed. Possible deep regional block anaesthesia should be avoided, for example, by the use of intraligamentary injections in the mandible. Post-operative bleeding should be controlled by local measures such as suturing haemostatic packs.

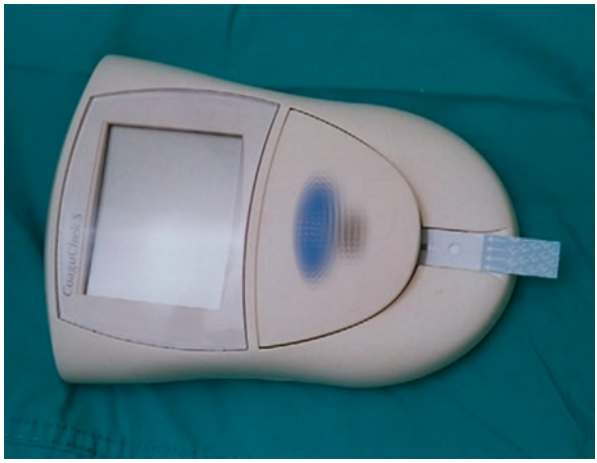

Fig. 10.5 The INR can be measured at the chair side by portable machines that require only a finger-prick blood sample

Generally, a pragmatic approach to the dental surgery in patients receiving DOACs has been advocated. Clearly there is no need for a preoperative INR, but the dental management for patients on DOACs is the same as would be the case for a patient who was taking warfarin with a stable INR, consistently less than 4.0. For dental procedures associated with a particularly high risk of bleeding, omission of the DOAC dose on the morning of the procedure is suggested [6].

Patients receiving heparin will not be encountered regularly in dental practice. Those who may seek treatment are patients on haemodialysis due to renal failure. These patients are heparinised on the days they are dialysed (normally 3 alternate days a week). However, due to the short half-life of heparin (around 5 h), the effect is short-lived, and treatment can be performed safely on the days between dialysis.

10.9.2 Choice of Anaesthesia

Anaemia should be corrected before intravenous sedation or general anaesthesia as the reduction in oxygen-carrying capacity could be dangerous. The use of nitrous oxide sedation is probably best avoided in patients with pernicious anaemia, as one of the side effects of this gas is the production of vitamin B_{12} deficiency [7].

The concern for patients with bleeding disorders is local anaesthesia. The use of deep injections such as inferior alveolar nerve blocks is contraindicated in patients with bleeding problems unless some form of prophylaxis has been provided. This is for fear of producing a bleed that may track around the pharynx leading to airway obstruction. Fortunately there are alternative methods of anaesthetising mandibular teeth, which allow this problem to be circumvented.

Haemophiliac patients who had received intraligamentary anaesthesia for restorative dentistry without administration of Factor VIII recorded no complications related to haemorrhage or haematoma formation [8, 9]. Infiltration injections should not produce significant problems.

10.9.3 Medication Prescribed

A number of drugs that dentists may prescribe can interfere with haemorrhage control and cause bleeding; the classic example is aspirin, which interferes with platelet function as described above. In addition, some drugs commonly used in dentistry including analgesics and antimicrobials interact with anticoagulants. Aspirin, diclofenac, diflunisal, ibuprofen and the prolonged use of paracetamol all increase the effect of warfarin. Penicillins can increase the prothrombin time when given to patients receiving warfarin. However this effect is uncommon. Erythromycin enhances the anticoagulant effects of both warfarin and nicoumalone by reducing the metabolism of the latter drugs. Combined use is not absolutely contraindicated but monitoring of the patient is required. The effect of warfarin is significantly increased by metronidazole due to the antibiotic inhibiting the metabolism of the anticoagulant. This interaction is clinically important [10]. If metronidazole is

essential, then the dose of warfarin may have to be reduced. Tetracycline may enhance the anticoagulant effect of warfarin and the other coumarin anticoagulants.

Miconazole enhances the anticoagulant effect of warfarin even after topical use. Dentists should know about this important interaction as it may lead to catastrophic bleeding. A case has been reported of a warfarinised patient's INR increasing from 2.5 to 17.9 following the use of miconazole oral gel [11]. One other drug worth mentioning is carbamazepine. This may reduce the effect of warfarin due to increased metabolism of the anticoagulant.

10.9.4 Cross-Infection Control

The chances of transmitting infected material between patients or from patient to operator should be minimised for all dental treatments. However, this is especially so when treating patients who are at high risk of carrying viral diseases such as HIV and hepatitis. Sadly some patients who have received treatments for bleeding disorders, principally multiple transfusions of blood products, fall into this category. Rigorous cross-infection control measures must be adopted when dealing with these patients.

10.10 Conclusions

Haematological problems impact on all aspects of dentistry. The taking of a thorough history and close liaison with medical colleagues will help reduce the problems that may occur in the patient with disorders of the blood. Patients with clotting defects represent a challenge to both surgical and restorative dentistry. Although all patients should have their management discussed with their supervising haematologist or physician when surgical procedures are to be performed, many cases can be adequately treated using local measures and skills commonly employed by dentists.

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The Paediatric Patient and Dental Practice

11

Medical problems in children can cause unique difficulties for the safe provision of dental treatment [1]. Such problems can affect the type and timing of dental treatment as well as methods of control of pain and anxiety. In this chapter conditions which influence the choice of anaesthesia as well as those which affect dental development are discussed.

In Brief

- Disease can affect dental development in children.
- Congenital conditions can interfere with provision of dental treatment.
- Underlying disease and its treatment can affect the timing of dental treatment in children.
- Diseases of childhood influence the choice of anaesthesia.
- Close co-operation with paediatricians is important in managing children with serious conditions.
- Liaison is needed not neglect.

11.1 Points in the History

11.1.1 Background Information

Some conditions are relevant since they affect oral and dental development and will often be discovered in a thorough history. These include disorders of the bone such as cleidocranial dysplasia where delayed eruption and multiple supernumerary teeth occur and fibrous dysplasia which can produce malocclusions (see Chap. 9). Disorders localised to the teeth such as amelogenesis imperfecta provide a

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challenge to preventive and restorative dentistry. Other disorders such as dentinogenesis imperfecta may be associated with osteogenesis imperfecta, and surgery may be hazardous. Referral to an oral surgeon is sensible in such cases. Hypodontia [2] occurs in ectodermal dysplasia, and successful management of this condition often requires co-ordinated specialist treatment. The general dental practitioner, however, has an important role in the management of these patients.

The medical history in a child patient should follow a similar theme to that of an adult, but there are differences in emphasis in certain areas. It is important that dental practitioners have a working knowledge of normal child development. Whilst clearly this is most important with regard to the dentition, it is also important with regard to general development [3]. It is useful to obtain information regarding previous levels of compliance with treatment since disorders that interfere with patient co-operation can make routine dental treatment difficult.

Conditions such as severe physical and mental disability, severe convulsive disorders and extensive behavioural problems can create problems. Techniques such as inhalation sedation can be used with success in some of these patients, but there are limits as to what can be achieved since a level of co-operation and understanding is required. Organ transplantation is a procedure which is relatively commonplace today, and the number of children with renal, heart, heart/lung, liver and bone transplants will increase. The dental team can play an important role in pre-transplant assessment as it is vital and that any focus of infection is eliminated prior to transplantation. Disorders of different organ systems have been described in the earlier chapters in this book. Problems that impact on the younger patient are discussed more fully here.

11.1.2 Cardiovascular Conditions

Close consultation with the cardiologist is required if a cardiac condition is encountered, particularly if there is functional limitation.

The patient may have Down syndrome (trisomy 21). This occurs in 1 in 700 live births. In nearly half of Down's patients, congenital cardiac anomalies are found. There is some degree of learning disability in all these patients, and immunological defects predispose them to infection. Down's patients have a higher risk of developing acute leukaemia than the general population.

11.1.3 Respiratory Conditions

Asthma affects about 12% of all children. The severity varies from mild to moderate to severe. In mild cases attacks are only occasional and can be precipitated by infection. Between attacks patients are asymptomatic. In moderate cases episodes are severe and recurrent, but patients are symptom-free between attacks. Exercise induces bronchoconstriction. When a child suffers from severe asthma, attacks vary in severity, but the child is never asymptomatic, and the illness affects growth and lung function. A history should always ascertain the degree of severity of the asthma and the efficacy of prescribed treatment.

Cystic fibrosis is an inherited disorder of exocrine glands. It occurs in 1 in 2000 births and is inherited as autosomal recessive. Mucus has an increased viscosity and pancreatic insufficiency in childhood occurs. Diabetes mellitus may be a complication and some patients have cirrhosis of the liver. Recurrent respiratory infections may occur resulting in bronchiectasis.

11.1.4 Haematological Conditions

Disorders such as anaemia and leukaemia, in addition to interfering with wound healing, may also lead to a bleeding tendency, and consultation with the haematologist or oncologist is essential before considering surgery on such children.

It is important to enquire about sickle-cell disease in patients of African, Asian and West Indian descent since the administration of a general anaesthetic to an undiagnosed sufferer can cause severe complications. Deoxygenation during anaesthesia causes the erythrocyte to deform into a sickle shape which causes the cells to aggregate and inhibits blood flow in small diameter vessels. A finger prick Sickledex test, if positive, should be followed by haemoglobin electrophoresis. In patients of Mediterranean descent, the possibility of thalassaemia should be borne in mind.

It is important to enquire about possible bleeding disorders. Congenital disorders such as haemophilia and acquired clotting disorders preclude surgical dental treatment outside the hospital environment. The most common hereditary haemophilias (sex-linked recessive) are haemophilia A (factor VIII deficiency) and haemophilia B (factor IX deficiency). These patients require replacement of the appropriate clotting factor(s) prior to surgery and usually the provision of anti-fibrinolytic therapy following treatment. Treatment planning and timing of intervention must be coordinated with the haematologist. Children with platelet deficiencies (Fig. 11.1) may require a platelet transfusion, or if the problem is one of idiopathic thrombocytopenic purpura, then a preoperative course of steroids can increase platelet numbers to an acceptable level for surgery (greater than 50×10^9/L).

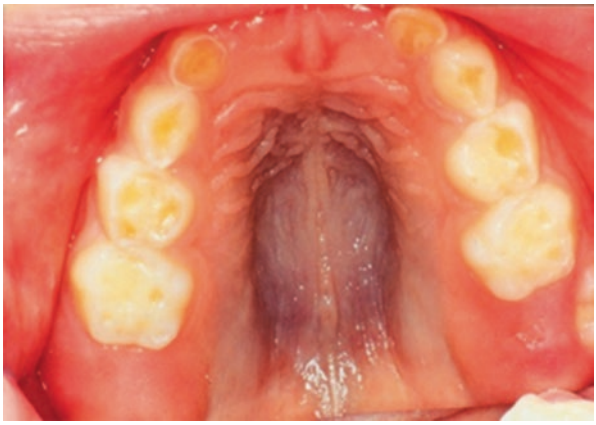

Fig. 11.1 A palatal bruise in a child taking immunosuppressants. This has led to a low platelet count

11.1.5 Neurological Conditions

Enquiry should be made about any history of convulsions since the stress of dentistry may induce fits in epileptic patients. Epilepsy affects 3–5% of the paediatric population and most cases are idiopathic. Attacks may be stimulated by hyperventilation, fever, photic stimulation, withdrawal of anticonvulsants (or poor compliance), lack of sleep, over-sedation, overhydration, emotional upset and some medications, e.g. antihistamines. The use of relative analgesia can be of great benefit for children with a history of convulsions in the dental chair. Cerebral palsy is the leading cause of significant disability in children. Uncontrolled movement and abnormal posture are the main handicaps, but other neurological and mental problems can also occur. Epilepsy and visual and hearing impairment are features which may cause difficulties with dental treatment.

A number of children with hydrocephalus have shunts which drain cerebrospinal fluid (CSF) from the brain to other areas of the body, thereby reducing intracranial pressure and preventing brain damage. An older form of shunt drained fluid from the brain to the ventricles of the heart (atrioventricular). A newer shunt drains fluid to the peritoneum (atrio-peritoneal).

11.1.6 Renal Conditions

Renal disease in children mainly comprises the so-called nephritic syndromes which may progress to chronic kidney disease (CKD). Progression to CKD leads to the need for dialysis and possibly transplantation. CKD patients may cause difficulties with management due to corticosteroid and other immunosuppression therapy. Potential problems include:

- Impaired drug excretion
- Anaemia
- Bleeding tendencies
- Associated anticoagulant therapy
- Hypertension
- Infections, e.g. hepatitis B
- Renal osteodystrophy

11.1.7 Hepatic Conditions

Chronic liver disease with impaired hepatic function is uncommon in childhood (Fig. 11.2). Problems can be categorised into:

- Coagulation disorders
- Drug toxicity
- Disorders of fluid and electrolytes

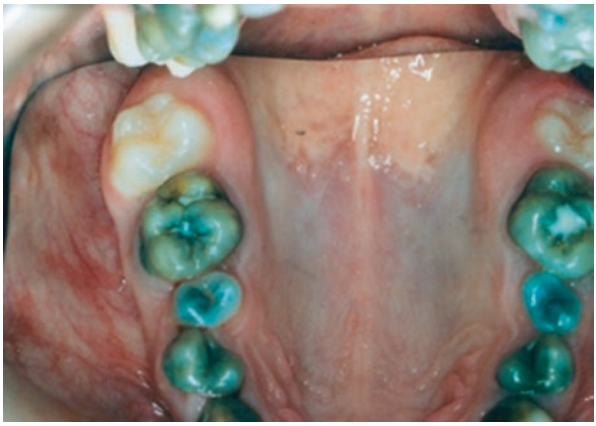

Fig. 11.2 Severely bilirubin-stained teeth that started mineralising pre-liver transplant at age 2.5 years. The second permanent molars are normal

- Balance
- Problems with drug therapy
- Infections

11.1.8 Endocrine Conditions

Insulin-controlled diabetic children who require a general anaesthetic should be treated as in-patients because the starvation required before the procedure would render them hypoglycaemic. Hospitalisation will enable them to be stabilised pre- and post-operatively on an intravenous drip that will control both sugar and insulin. There is no contra-indication to treatment in general dental practice under local anaesthetic or local anaesthetic with inhalation sedation as long as the treatment time does not interfere with a normal snack intake. Extra carbohydrate can always be taken in liquid form prior to a procedure.

11.1.9 Drug Therapy

Although there have been positive moves towards the provision of sugar-free medication [4, 5], there are still cases of dental caries exacerbated by drug therapy (Fig. 11.3). This can be due either to the direct effect of sugar-based medicines or to an indirect action such as xerostomia. Medications which can produce xerostomia in children include antihistamines and major tranquillisers.

A summary of salient points in the history of a child dental patient are shown in Table 11.1. It should not be forgotten that abuse of drugs during pregnancy can produce orofacial defects in children. For example, cleft lip and palate are seen in the foetal alcohol syndrome, and cigarette smoking can cause reduction in crown size of primary teeth. Cocaine misuse by mothers has been associated with tongue-tie in their offspring [6].

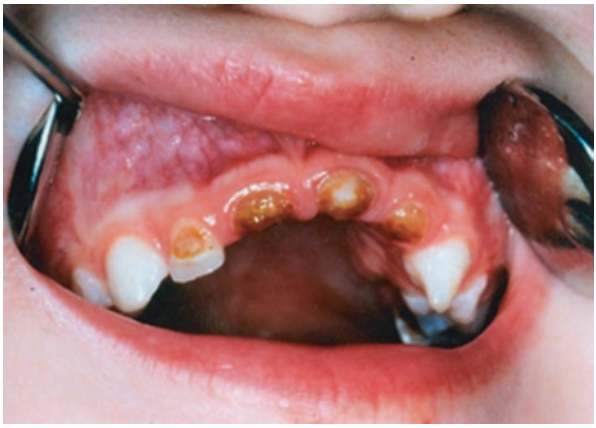

Fig. 11.3 Caries due to prolonged use of sweetened liquid oral medicines

Table 11.1 Points in the history in a paediatric patient

• Previous levels of compliance with treatment
- Asthma
- Diabetes
- Cystic fibrosis
• Sickle-cell disease
- Thalassaemia
• Bleeding disorders
- Epilepsy
• Shunt in hydrocephalus
• Craniofacial disorders
- Renal disorders
• Hepatic conditions
• Drug therapy

11.1.10 Craniofacial Disorders

Certain inherited or acquired craniofacial disorders, e.g. temporomandibular joint ankylosis, should be enquired about since access to the mouth may be limited causing difficulties with treatment. In some cases surgical correction of the deformity is necessary before intra-oral procedures can be performed.

11.2 Examination

The degree to which it will be possible to achieve compliance with dental treatment can be obvious very quickly in a consultation. The child may have a condition that interferes with their ability to co-operate.

In cleidocranial dysplasia there may be delayed eruption and multiple supernumerary teeth, whilst in fibrous dysplasia and cerebral palsy, a malocclusion may be present as mentioned earlier. The disorder may specifically affect the teeth, e.g. amelogenesis imperfecta or a systemic condition may be associated with an abnormal dentition. Dentinogenesis imperfecta may be associated with osteogenesis

imperfecta or hypodontia with ectodermal dysplasia. There may in addition be extensive caries that has been exacerbated by drug therapy.

Patients with Down syndrome tend to have an open-mouthed posture with a protruding tongue which can cause difficulties with dental treatment. Tooth development and eruption are retarded. An anterior open bite is common, as is a class III malocclusion. The incidence of cleft lip and palate is increased in these patients. Periodontal disease is severe and has an early onset, but caries incidence, by comparison, is surprisingly low.

In cystic fibrosis there are recurrent chest infections and often a productive cough. Many patients also have nasal polyps and recurrent sinusitis which may preclude the use of RA due to the poor nasal airway. The salivary glands may be enlarged. The enamel may be hypoplastic and eruption dates may be delayed.

Medication may produce oral signs, for example, the pancreatic replacement drug pancreatin may produce oral ulceration.

The possibility of child abuse is an important phenomenon which should always be borne in mind if findings on examination appear to be inconsistent with the history. An injury where there has been a long delay between the incident and attendance for treatment is a cause for suspicion. Injuries which do not 'fit' with the history and multiple injuries, particularly those which appear to be different ages, are also cause for concern. Child abuse, whilst more common in the lower social classes, is by no means confined to these groups. Local guidelines will be available to guide the dental practitioner in their referral.

11.3 General and Local Anaesthesia, Sedation and Management Considerations in the Paediatric Dental Patient

The possibility of local anaesthetic toxicity is more likely in children than adults due to their smaller size. A dose of 1/10th of a cartridge per kilogram as a maximum is recommended [7]; this means that two cartridges are the maximum in a healthy 20 kg 5-year-olds. The use of local anaesthetics should be reduced in children with liver disorders. The use of any drug, including local anaesthetics in children with severe hepatic dysfunction, should be discussed with the supervising physician. The use of local anaesthetics containing vasoconstrictors, e.g. adrenaline, should be avoided when injecting into an area with a compromised blood supply such as a mandible which has been irradiated for the treatment of childhood malignancy. Intraligamentary and infiltration anaesthesia are the techniques of choice in the mandible for children with bleeding disorders such as haemophilia when restorative dental treatment is required.

In patients with sickle-cell disease, if practicable, LA with or without inhalation sedation is preferable to GA. If a GA is required in a patient with the sickle trait, careful oxygenation must be ensured. Patients with the disease itself may need a preanaesthetic transfusion so that the level of haemoglobin A is at least 50%.

The use of transcutaneous electronic nerve stimulation has been shown to be effective in reducing injection discomfort in children [8]; however this should be avoided in epileptic children and those with cardiac pacemakers.

Children with mild or moderate asthma, if asymptomatic at the time of treatment, do not need prophylaxis pretreatment. If oral medication is being taken, this should be continued to prevent rebound bronchospasm. If the asthma is severe, there is greater risk of bronchospasm being induced by GA or the stress of surgery. If GA is required, the child must be in optimal condition, i.e. no evidence of respiratory infection and an in-patient facility should be available.

In children with cystic fibrosis, sputum clearance is assisted by regular physiotherapy. Amoxicillin and flucloxacillin are used (often long term) as prophylaxis against chest infection. If respiratory function is poor, GA is contra-indicated. Tetracycline, which is a very effective broad-spectrum antibiotic, may need to be given when children develop multiple drug sensitivity.

Diabetes and cirrhosis can also cause difficulties with dental treatment provision. In children with diabetes, infections and surgical procedures which create stress or alter food intake may disturb diabetic control. Diabetic children are best managed under LA if possible. Any infection should be treated vigorously. In children with cirrhosis, routine dental treatment is not usually a problem. A physician should be consulted if GA or surgery is needed due to the possibility of bleeding tendency and anaemia and the possibility of drug toxicity.

Intravenous sedation is considered unsuitable for children as it is unpredictable. Inhalation sedation is the technique of choice. Inhalation sedation has been shown to be an acceptable and cost-effective alternative to general anaesthesia in children having minor oral surgery [9]. The contra-indications to the use of inhalation sedation include respiratory disorders. Acute upper respiratory tract infections necessitate postponement of treatment, whereas chronic obstructive pulmonary disease is an absolute contra-indication. Children who suffer from myasthenia gravis should not be treated with inhalation sedation outside a hospital environment as they are at risk of respiratory arrest, and even in the hospital setting, consultation with the physician is essential before considering anything other than local anaesthesia. Children with severe behavioural problems and those who suffer from claustrophobia are not suited to inhalation sedation as they may not be able to tolerate the nasal mask. Certain surgical procedures in children, such as labial frenectomy, are not possible under inhalation sedation as the mask denies access to the surgical site.

Oral sedation is not in a widespread use for children in the UK to facilitate dental treatment. As with any other drug, allergy to an oral sedative obviously precludes its use. Drugs which are used in the UK include benzodiazepines, chloral hydrate derivatives and promethazine. Hepatic or renal impairment is a contra-indication to use of outpatient oral sedation. Similarly the concurrent administration of any central nervous system depressant prevents the use of oral sedation. In addition, chloral hydrate derivatives and promethazine should be avoided in the presence of cardiovascular disease.

In patients with Down syndrome, the possibility of cardiac anomalies should be borne in mind. Immunological impairment means that respiratory infections are more likely and there may additional congenital abnormalities of the respiratory tract. The hypoplastic midface may cause difficulties with endotracheal intubation. General anaesthesia may also be complicated by the possibility of atlanto-axial subluxation when extending the neck if care is not taken. These patients, when institutionalised, have increased likelihood of hepatitis B carriage.

Children who have disorders likely to adversely affect wound healing should be treated with prophylactic antibiotics. These include children with decreased resistance to infection. Metabolic disturbances such as uncontrolled diabetes and long-term use of corticosteroids also affect wound healing. Well-controlled diabetic patients should be considered 'normal' in relation to healing.

Haematological problems such as anaemia, leukaemia and cyclic neutropenia also affect healing ability. Children on immunosuppressant therapy and those being treated with antimetabolites or local irradiation are also at risk of postsurgical infection. The objective of prophylactic use of antibiotics is to achieve optimal drug concentration in the initial blood clot. The timing of antibiotic administration is aimed at having optimal blood levels of the antimicrobial at the end of the surgical procedure (i.e. when the clot forms). Consultation with the supervising paediatrician is essential prior to the use of antibiotics in children with significant renal or hepatic impairment.

The use of antimetabolites to treat childhood malignancies such as leukaemia is not a contra-indication to dental treatment, but it does affect its timing. Consultation with the appropriate paediatrician is again important here in order that essential treatment can be performed at the optimal time during cyclical anticancer therapy when platelet and white cell counts are acceptable. This treatment is best completed in a hospital setting whilst the patient is undergoing chemotherapy [10].

The production of a healthy mouth should be the 'accepted norm' before transplant surgery, and consultation with the transplant team and physicians is essential to determine the influence of the organ deficit on dental treatment. The transplanted heart reacts differently to the normal heart to epinephrine [11]. This is apparent after the use of epinephrine-containing dental local anaesthetics [12]. It is sensible to use dose reductions or even avoid the use of this vasoconstrictor in the child who has had a cardiac transplant. The management of all transplant patients is complicated by maintenance drug therapy. Steroid therapy may necessitate the administration of a steroid boost prior to stressful procedures, and the possibility of adrenal crisis must be borne in mind. The use of post-transplant immunosuppressant therapy can increase the risk of haemorrhage and postsurgical infection. Post-transplantation therapy with drugs such as ciclosporin and nifedipine leads to gingival overgrowth similar to that seen with epanutin. Regular oral hygiene review is essential, and repeated surgical visits for gingival recontouring may well be required.

11.4 Conclusions

Advances in medical care (especially in the treatment of childhood malignancy and organ transplantation) mean that dentists are increasingly likely to encounter medically compromised children. The keys to successful treatment are:

- Accurate medical history
- Close liaison with medical colleagues and not neglect
- Rigorous preventative programmes
- Dental intervention at times appropriate to medical care
- Regular follow-up

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The Older Patient and Dental Practice

12

The proportion of older people in the UK population has been on the increase for several years. Dental practitioners who treat the general public often see older patients on a regular basis. This chapter considers aspects of clinical management in the older patient with particular reference to the presentation of disease and factors to be considered in prescribing medication.

In Brief

- Frail older people require special consideration in order to successfully receive the healthcare they require.
- Older people often suffer with multiple medical problems and are taking multiple medications.
- Physical disability, impaired vision and hearing and reduced mental function cause practical difficulties.
- Liaison with the patient's carers and general medical practitioner is vital.

12.1 Introduction

A significant proportion of any general dentist's work will be with those over retiring age, but it is over the 80 age group that has the largest population growth rate and which often presents with multiple ongoing medical problems requiring multiple medications and with disabilities requiring special consideration.

It is important that elderly patients have appropriate access to dental care [1].

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12.2 Points in the History

One definition of ageing is 'the gradual development of changes in structure and function that are not due to preventable disease or trauma, and that are associated with decreased functional capacity and an increased probability of death'. Although this definition of the pure ageing process excludes age-related disease, older people suffer from a wide range of medical conditions and accumulate long-term consequences of past illnesses. Some common medical problems of old age are listed in Table 12.1.

It is essential to know an older person's medical background when assessing or treating any new health problem. Many of the conditions listed in Table 12.1 have a direct effect on the delivery of dental treatment. To take the example of common cardiovascular disorders, in patients with ischaemic heart disease, angina may be brought on by the stress of dental treatment and may need to be treated in the surgery with sublingual nitrates. Lying flat may aggravate breathlessness in heart

Table 12.1 Common medical conditions of old age

Cardiovascular
Ischaemic heart disease—angina/myocardial infarction
Heart failure
Atrial fibrillation
Respiratory
Chronic obstructive pulmonary disease (COPD)
Respiratory infections
Gastrointestinal
Gastro-oesophageal reflux
Peptic ulceration
Constipation
Genitourinary
Incontinence
Urine frequency
Obstructive uropathy due to prostate disease
Musculoskeletal
Arthritis
Osteoporosis and fractures
Muscle weakness
Neurological/psychiatric
Poor vision
Deafness
Poor memory/confusion/dementia
Depression/agitation/anxiety
Parkinson's disease
Strokes
Metabolic/endocrine
Diabetes mellitus (type 2, non-insulin-dependent)
Hypothyroidism
Neoplastic
Common cancers in old age include breast, lung, gastrointestinal tract and prostate

Table 12.2 Features of illness in older people

• Non-specific presentation
• Multiple pathology and consequent polypharmacy
• Interaction between conditions and between medications
• Loss of functional independence
• Impaired homeostasis, resistance to disease and recovery

Table 12.3 Giants of geriatric medicine

• Incontinence
• Instability (falls)
• Immobility
• Intellectual impairment (dementia, delirium)

Table 12.4 Elements of a medical history

• Presenting complaint
• History of presenting complaint
• Past history (including ongoing chronic problems)
• Review of other systems
• Family history
• Social history
• Treatment history—drugs and allergies

failure patients. Those with atrial fibrillation are likely to be on anticoagulants and may have ischaemic heart disease, heart failure or underlying valvular conditions.

Table 12.2 lists certain features which distinguish illness in older people from that in the younger population. Older people often present with atypical symptoms or nonspecific presentations of disease. For example, loss of appetite and weight may have many potential causes including physical illness such as cancer; mental illnesses, including depression; and oral conditions. It is therefore important to obtain as clear a picture as possible of the presenting complaint.

The adverse effects of ageing and illness on functional ability result in the so-called giants of geriatric medicine, as listed in Table 12.3. They all have obvious practical consequences for the delivery of dental care, and the practitioner should enquire whether any special consideration needs to be given, for example, assistance with mobility or toilet use.

A commonly used framework of headings for taking a medical history is given in Table 12.4. Obtaining a clear and full history from an older person can be difficult. The complexity of their medical history itself may result in omission or misunderstanding on the patient's part. Communication may be impeded by visual impairment or deafness. The patient may suffer from impaired memory, poor concentration or frank dementia. Therefore, it is important to recognise these problems, seek a corroborative history from a relative or carer and to confirm medical details with the patient's general medical practitioner. Since illness is often associated with loss of function or independence, it is important to enquire about the impact of the condition on the patient's life. This may often be quite disproportionate to the apparent seriousness of the underlying condition. For example, a relatively minor oral infection in a frail older person may result in the person stopping eating and

drinking, becoming dehydrated and consequently requiring emergency hospital admission. Conversely, the older person's stoicism and expectations of ill health can sometimes result in late presentation of advanced disease, the symptoms of which had wrongly been accepted as a natural consequence of old age.

Social circumstances and support are important considerations for older people with reduced physical or mental function. The ability to co-operate with aspects of dental treatment such as maintaining oral hygiene or taking prescribed medication may be impaired. Aids and appliances can significantly enhance an older person's independence with activities of daily living. Written instructions and reminders may be helpful in those with impaired memory. Actual physical help or supervision from a carer is needed when other measures fail. It is therefore essential to ascertain details of the support that is available to the patient, for example, whether they live with an able relative, have carers visiting them in their home, or live in a protected institution with 24 h care. Over 20% of those over 85 years of age will live in a residential or nursing home or sheltered housing.

Drug-related problems are common in older people. Compliance is often poor, and the list of medications provided by the general medical practitioner may differ significantly from what the patient is actually taking. Therefore, obtaining a correct drug history often requires effort beyond simply transcribing a list from the GMP or asking the patient what they take. Checking through a prescription list with the patient and their carer and reading the labels of medications or dosing boxes brought by the patient are valuable ways of obtaining correct information.

12.3 Examination of the Older Dental Patient

Specific points in the examination of patients with the medical conditions listed in Table 12.1 are covered in other chapters. This chapter will therefore concentrate on the more general features in older people and assessment of their function and ability.

An idea of an older person's physical function can be obtained by general observation. Do they appear well-nourished? Is their gait strong and steady, or do they use walking aids? Do they appear breathless on walking? Are there obvious bone or joint deformities from arthritis or osteoporotic fracture? How good is their manual dexterity when removing their coat or signing forms? Can they see and hear adequately?

Observation may be used to deduce the mental function of elderly patients informally. Do they appear orientated to their surroundings, able to concentrate and converse appropriately? Are they clean and appropriately dressed? Are their answers to questions clear and plausible?

There are pitfalls in the use of general observation, however. Apparent mental impairment in conversation may actually be due to deafness or a speech disorder such as dysphasia following a stroke. Conversely, a patient may be able to conceal significant dementia by maintaining social graces and giving plausible answers to questions.

Manual dexterity may be significantly impaired due to muscle weakness without obvious clues such as deforming arthritis or the tremor of Parkinson's disease. Patients with macular degeneration of the retina may have severely impaired central vision, to the level of being registered blind, while retaining sufficient peripheral vision for safe navigation while walking into the surgery. All of these can have practical consequences for the ability to co-operate with dental treatment and oral hygiene instructions or comply with the taking of medication.

12.4 Dental Management of the Older Patient

Some important principles of management of both health and social care were set out in the National Service Framework for older people, a government document which sets standards of care in England and Wales [2]. Three standards relevant to dental care are given in Table 12.5.

An example of overt age discrimination found during work for standard 1 was a national guideline restricting conscious sedation for outpatient dental procedures to those <70 years of age. It is perfectly true that certain comorbidities in older patients put them at increased risk of harm from sedation. It may cause respiratory suppression in patients with chronic lung disease, confusion in those with underlying chronic brain conditions or falls in those with postural instability. However, it is not appropriate to introduce such a generalisation for all patients over 70 receiving sedation. Certainly some elderly patients have the ability to appropriately cope with patient-controlled sedation [3]. Each case should be considered on its own merits and provision made for inpatient treatment where sedation is warranted, but increased risk is anticipated.

Covert age discrimination is also common and can take different forms.

Health professionals may wrongly assume that an older person has a short life expectancy and therefore has limited capacity to benefit from certain interventions. The average life expectancy of an 80-year-old is 8–9 years [4]. Services required by older people may be under-provided and have long waiting lists. The problem may be compounded if younger patients are given priority. Services may be inconvenient or inaccessible to frail or disabled people who require assistance and transport. They may not know who to ask or how to seek the help required.

Table 12.5 National service framework for older people

Standard 1: Rooting out age discrimination
'NHS services will be provided, regardless of age, on the basis of clinical need alone…'
Standard 2: Person-centred care
'NHS and social care services treat older people as individuals and enable them to make choices about their own care'
Standard 8: The promotion of health and active life in older age
'The health and well-being of older people is promoted through a coordinated programme of action…'

A key requirement for standard 2, relevant to dental healthcare, is the need to provide information available to older people in a way that they can understand. For the cognitively impaired, this may involve tolerant and careful explanation in simple language. For the visually impaired, information leaflets should be available in large print. Special effort is also needed to communicate effectively with hearing-impaired older people. When care is taken, the majority of older people can make appropriate choices and give valid consent. Where this is not possible, there is a duty to act in the patient's best interests and involve relatives and carers in decision-making.

Standard 8 should contain dental health promotion, including screening programmes, routine checks and preventive treatment.

Dental problems commonly seen in the older patient are covered in other texts and will not be discussed here.

12.5 Administration of Medicine and Prescribing for Older Dental Patients

As older people are already taking multiple medications, there is increased likelihood of drug interactions. Their impaired homeostasis and multiple comorbidities put them at increased risk of unwanted effects. It is therefore essential to take a full treatment history and document a patient's known medical conditions before prescribing.

Altered pharmacodynamics often increases the sensitivity of older people to drug actions. Renal function deteriorates with age, even in the absence of known renal disease, resulting in reduced drug excretion. Liver function also deteriorates, slowing elimination of drugs metabolised there. Low serum albumin in chronic ill health may increase free concentrations of protein-bound drugs. Absorption of drugs is often relatively normal, so the result of these changes is that older people often need lower doses, particularly of drugs with a narrow therapeutic window.

The most common drug that a dentist will prescribe to an elderly patient is a local anaesthetic. It is important not to overdose the elderly patient, and this may happen more readily in this population compared to younger adults. This is the result of lower body weight (the maximum dose is determined by body weight) and also due to decreased ability to metabolise the drug. Most local anaesthetics are primarily metabolised in the liver, and as hepatic function is decreased, the chances of overdose increase. As a working rule, it is sensible to halve the normal maximum dose in patients over 65 years of age.

As mentioned above, elderly patients may be taking a number of medications. The chance of an adverse reaction to local anaesthetics increases with medical risk factors [4, 5]. A survey of local anaesthetic complications in Germany showed that the incidence of complications attributable to local anaesthesia in dentistry was 3.3% in patients with no risk factors compared to 6.9% in patients taking more than two medications daily [5].

The anti-Parkinsonism drug entacapone is an inhibitor of the enzyme catechol-O-methyltransferase, which is the enzyme that initiates metabolism of exogenously administered adrenaline (such as during dental local anaesthesia). Thus, in patients taking this drug, dose-reduction or avoidance of adrenaline-containing local anaesthetics is advised.

It is not all bad news, however, in relation to local anaesthesia. There is evidence that the onset of local anaesthesia after intra-oral infiltration is more rapid in elderly patients compared to their younger counterparts [6]. In addition, the duration of pulpal anaesthesia may be longer in the older patient [5]. These effects on local anaesthesia may be the result of poorer vascularity and fatty degeneration of bone in the older patient [6].

Of the medications listed in the Dental Practitioners' Formulary section of the British National Formulary [7], most antibiotics can be prescribed at the standard doses. Some antibiotics and antifungals interact with warfarin, which older patients may be taking following cardiovascular disease or stroke and can be problematic. Single doses of drugs such as amoxicillin should not be troublesome, but long term-treatment with this antibiotic and metronidazole can alter clotting status, which is measured by the international normalised ratio (INR). Thus if these antibiotics are used, monitoring of the INR is required. The azole antifungal agents can cause dramatic increases in the INR; even topical use of miconazole can create this problem [8], and combined use is contraindicated. Many older patients take iron or calcium preparations, which can impair absorption of tetracyclines.

Non-steroidal anti-inflammatory drugs (NSAIDs) should be used with caution, particularly in patients with dyspepsia and those with renal disease or heart conditions requiring treatment with angiotensin converting enzyme (ACE) inhibitors and those taking anticoagulants. NSAIDs such as ibuprofen decrease the hypotensive effect of beta blockers.

Older patients are particularly prone to side effects from drugs acting on the central nervous system, which can cause confusion, drowsiness and falls. This is especially true of benzodiazepines and other sedatives, such as promethazine, but can also be a problem with opioid analgesics including pethidine.

Difficulty in dealing with multiple medications in the context of impaired vision, mental function or dexterity results in poor compliance. It is therefore important to consider means of enabling the patient to take their medication correctly. Careful explanation of the reason for the drug should be given, including whether it is 'as required' or to be taken as prescribed. It is useful to write down the main points and to explain them to a relative or carer. Small print on bottle labels may be difficult to read for the visually impaired patient, and childproof containers should be avoided unless the patient indicates that they are confident in their use. It may be difficult for the older patient with impaired manual dexterity to correctly dose liquid medicines if these have to be measured out using a spoon. One way round this problem is to provide a plastic syringe for drug dosing and dispensation.

Other means of enhancing compliance include supervision by a carer and the use of dosing boxes. These contain the medications set out in compartments labelled with the time and day of the week. They can be set up by a relative or, commonly, by the community pharmacist. If the patient already uses one of these and an additional prescription is needed, then liaison with the pharmacist or carer is necessary to ensure correct administration.

Further advice on prescribing in older people is given in the British National Formulary [7].

12.6 Conclusion

Older people in general are frequent users of dental care, and the frail elderly patient with disabilities and multiple medical problems provides a particular challenge. The patient's general medical practitioner and their relatives or carers are an essential source of information and help in the delivery of dental treatment.

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Metabolic Disorders and Dental Practice

13

In Brief

- Metabolic disorders, or drugs which affect metabolism, are commonly seen in dental patients.
- There will often be no physical signs in the patient with metabolic problems.
- A thorough history is particularly important, and a thorough family history will often uncover important findings.
- Knowledge of metabolic disorders will highlight patients who need special precautions to facilitate safe treatment.

It is important for dental practitioners to have a basic knowledge of the more common metabolic disorders as some may impact on the practice of dentistry. Many of these disorders do not have overt clinical signs. Taking a thorough medical history and, where necessary, liaising with the patient's physician are particularly important.

13.1 Introduction

Knowledge of metabolic disorders is essential for the safe management of dental patients. This chapter considers conditions that impact on the practice of dentistry.

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13.2 Points in the History

Several points in the history may reveal an underlying metabolic disorder (Table 13.1).

13.2.1 Hypercholesterolaemia

Hypercholesterolaemia is a condition which has received significant attention in recent years. It has little significance for the provision of local anaesthesia, but the possibility of ischaemic heart disease should be remembered. Low-density lipoproteins (LDL) are associated with a higher risk of coronary heart disease. They are formed from intermediate density lipoproteins in the liver and contain a core of cholesterol. They bind to LDL receptors and are taken up by cells. This is particularly so when there is inhibition of 3-hydroxy-3-methylglutaryl coenzyme A reductase (HMG CoA reductase), which raises cellular cholesterol. On the other hand, high-density lipoproteins (HDL) are associated with a reduced risk of coronary heart disease. They carry cholesterol back to the liver from intercellular tissue.

13.2.2 Porphyrias

Porphyrias are rare disorders but potentially impact on dental treatment. They arise principally as the result of errors in haem metabolism causing accumulation of porphyrins, which are intermediate compounds in haemoglobin synthesis. Two main groups are recognised. These are the liver (hepatic) porphyrias and the red blood cell (erythropoietic) porphyrias. Patients with porphyrias may remain asymptomatic, but acute illness or drugs may precipitate an attack.

Variegate porphyria is the commonest form and is found mainly in people of Afrikaans descent. Acute intermittent porphyria affects all populations but is seen less frequently. A further form, *hereditary coproporphyria*, is also recognised.

Between attacks, a patient with porphyria may appear normal although they may have photosensitive skin resulting in rashes. An acute attack may result in neuropsychiatric symptoms. Porphyria that becomes acute as a result of drugs may cause cardiovascular symptoms such as hypertension and tachycardia. Gastrointestinal symptoms may also occur. Some of the drugs that dentists prescribe can induce an acute attack of porphyria. Details of these are given later.

Table 13.1 Points in the history in patients with metabolic disorders

• Hypercholesterolaemia
• Porphyria (or subtypes)
• Malignant hyperpyrexia
• Neuroleptic malignant syndrome
• G6PD deficiency
• Suxamethonium apnoea
• Haemochromatosis
• Amyloidosis
• Abnormalities of carbohydrate metabolism

13.2.3 Malignant Hyperpyrexia

Malignant hyperpyrexia (MH) is a rare but potentially fatal condition. It is inherited and presents as a rapid temperature rise if the patient is subjected to general anaesthesia or other medications. The family history may elicit a history of MH. Two forms are recognised: firstly, an autosomal dominant type where patients are normal between attacks and, secondly, a recessive form that affects boys with muscle disorders, for example, myotonic dystrophy.

The most common trigger of MH is a combination of halothane [1] (an anaesthetic agent) and muscle relaxants including suxamethonium [2]. The rising temperature is accompanied by tachycardia or arrhythmias and hypotension. Management involves removing the precipitating cause, cooling and hyperventilating the patient to correct any respiratory acidosis and the use of dantrolene.

13.2.4 Neuroleptic Malignant Syndrome

Neuroleptic malignant syndrome (NMS) is rare but again potentially fatal. It is induced by the administration of certain drugs but none commonly used in dentistry. It is recognised clinically by disturbance in the patient's mental state, autonomic function and temperature regulation.

13.2.5 Glucose-6-Phosphate Dehydrogenase Deficiency

Patients may give a history of known glucose-6-phosphate dehydrogenase (G6PD) deficiency. This is the most common enzyme deficiency seen mainly in people of Mediterranean, African, Asian or Middle Eastern descent. Glucose can be metabolised via the glycolytic or the hexose monophosphate shunt pathways (Fig. 13.1). G6PD is involved in the latter. A derivative of the hexose monophosphate shunt is NADPH, which is involved in removing dangerous oxidative metabolites. If the activity of G6PD is low, *methaemoglobinaemia* (oxidised haemoglobin molecule) results, and when red cells are exposed to oxidising agents, sometimes present in drugs, haemolysis results. Diagnosis is confirmed by measuring levels of the enzyme. The haemolysis is usually self-limiting but occasionally splenectomy is required.

13.2.6 Suxamethonium Apnoea

Sensitivity to suxamethonium or scoline ('scoline apnoea') is sometimes seen, and patients are often aware of its existence in the family. It is inherited as an autosomal recessive trait. Suxamethonium is a muscle relaxant that acts as a depolarising neuromuscular blocker. It behaves in a similar way to acetylcholine at the neuromuscular junction. Its action is usually brief since it is quickly destroyed by plasma cholinesterase. Around 1 in 2000 of the population has a defect in plasma

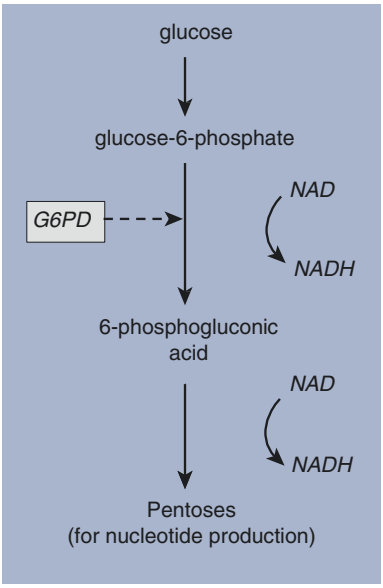

Fig. 13.1 The role of glucose-6-phosphate dehydrogenase (G6PD) in the hexose monophosphate shunt pathway

cholinesterase. This makes such people abnormally sensitive when suxamethonium is administered, resulting in persistent muscle paralysis. This means that the patients are unable to breathe for themselves (apnoea). It is postulated that the disorder may be a form of hypersensitivity reaction.

13.2.7 Haemochromatosis

Patients may give a history of haemochromatosis. This is a disorder of iron metabolism resulting in too much iron being absorbed from the intestine, which causes high serum ferritin levels. Deposition of iron occurs in the liver, joints, skin, adrenal glands and various other organs including the heart. The iron is deposited as haemosiderin. This is more problematic in males than females due to menstrual blood loss. The haemosiderin deposits provoke a fibrotic reaction that can produce disorders wherever the deposits are found, resulting in disorders such as cirrhosis, adrenocortical insufficiency, cardiomyopathy, skin pigmentation and diabetes (so-called 'bronze' diabetes). The condition is treated by bloodletting to reduce the iron load and sometimes medically using the chelating agent desferrioxamine.

13.2.8 Amyloidosis

Amyloidosis (Fig. 13.2) is a disorder characterised by the deposition of eosinophilic hyaline protein in the tissues. It is really a manifestation of disease processes. It can affect the functions of the heart, gastrointestinal tract, spleen, kidney, liver and

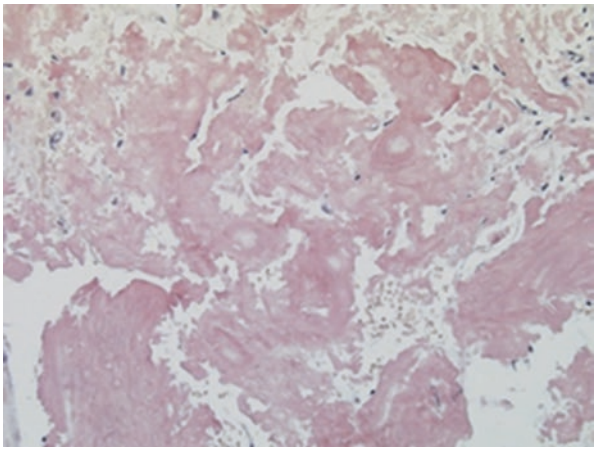

Fig. 13.2 The histological appearance of amyloid stained with Congo red

adrenals when it is deposited there. There may also be a bleeding tendency due to a Factor X defect.

13.2.9 Abnormalities of Carbohydrate Metabolism

Defects in carbohydrate metabolism are uncommon but may be seen in dental patients. The two main conditions are glycogen storage diseases and defects in fructose metabolism. In the glycogen storage disorders, there is accumulation of the polysaccharide as a result of inherited defects in the enzymes that metabolise it. This causes hypoglycaemia. The glycogen accumulates preferentially in liver and muscle resulting in an enlarged liver, muscle pain and weakness (including the respiratory muscles). Heart failure may also supervene. One subdivision of glycogen storage disease produces a bleeding tendency.

13.3 Examination of the Dental Patient with a Metabolic Disorder

There is often little to be seen in patients with metabolic disorders that would facilitate diagnosis of their condition. Some observations which may give a clue to an underlying metabolic condition are discussed below. Xanthomas are yellowish plaques that may be apparent on the skin. These are termed xanthelasmas when on the eyelids (Fig. 13.3). They are seen in familial hyperlipidaemia and are associated with accelerated atherosclerosis and coronary heart disease.

In haemochromatosis, the skin may take on a bronze hue. Patients with porphyria may be subject to photosensitive skin rashes.

Amyloidosis may only be diagnosed formally by biopsy. It can present with an intraoral lesion, for example, deposition in the tongue may lead to enlargement or

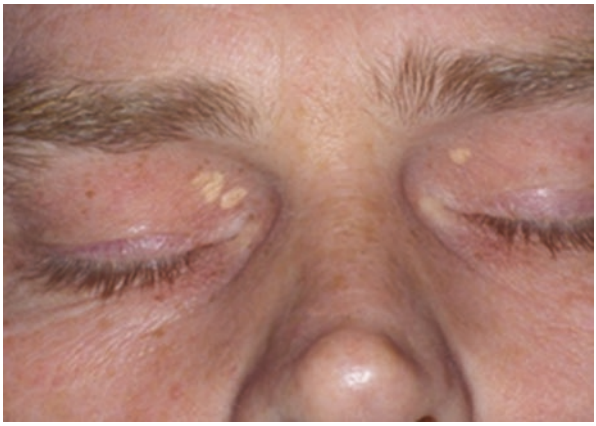

Fig. 13.3 Xanthelasmas in the eyelids

localised swelling. The gingivae may also be affected. Bullae and petechiae may be seen intra-orally.

13.4 Dental Management of Patients with Metabolic Disorders

It should be remembered in the patient with hypercholesterolaemia that there is an increased risk of ischaemic heart disease. This heightens the risks of general anaesthesia. Conscious sedation is a suitable alternative but local anaesthesia is the preferred method.

The safest management of a patient with porphyria is care with drug prescription. This is discussed below. It should be borne in mind, however, that data in this area are still incomplete. Thus the prescription of drugs in this group of patients should be carried out with this in mind.

Some drugs should be avoided in cases with G6PD deficiency for fear of producing haemolysis. The only drugs that may be used in the practice of dentistry that fall into this category are the sulphonamide antibacterial drugs.

In patients with malignant hyperpyrexia (MH), it is important to treat infections promptly and aggressively as they are known to be potential precipitants of an attack. It is safe to give local anaesthetics. The response to adrenaline (epinephrine) may be similar to the early signs of an MH reaction, and this should be remembered. Such signs include tachycardia, rising blood pressure and rapid breathing. Adrenaline also potentiates the release of calcium in muscle cells, which theoretically would enhance MH, because this dose limitation is important. The use of sedation in patients with MH is discussed below.

In patients with suxamethonium sensitivity, a careful history will usually uncover this; however some patients may be unaware of the condition. The use of local anaesthetics in such cases is discussed below.

Drugs that may be used in the practice of dentistry that are considered unsafe in patients with porphyria include tricyclic and monoamine anti-depressants, sulphonamides, anticonvulsant medications such as carbamazepine and phenytoin, diazepam, chloral hydrate and triclofos, clindamycin, doxycycline, erythromycin, ketoconazole, metronidazole, miconazole and oxytetracycline.

13.5 Factors Affecting Dental Treatment Under Local Anaesthesia, Sedation, General Anaesthesia and Management in Dental Practice

The first step is to obtain a full history, which will alert the practitioner to the patient suffering from a metabolic disorder. Many patients will have no overt clinical signs.

The patient with hypercholesterolaemia is best treated under local anaesthesia, but conscious sedation is a suitable mode of treatment. The risk of ischaemic heart disease should be remembered with general anaesthesia.

In the patient with porphyria, consideration needs to be given in the use of local anaesthesia as sodium metabisulphite, which is contained in some local anaesthetic preparations to prevent the oxidation of adrenaline, can precipitate an attack [3]. Lidocaine and prilocaine are considered safe when administered for local anaesthesia.

Local anaesthesia is considered safe in patients who give a history of malignant hyperpyrexia [4]. As stated earlier, however, adrenaline can produce similar signs to the early stages of MH, and this should be remembered. It is therefore wise to limit the dose of adrenaline in these patients. Adrenaline should not be used as a topical agent to manage gingival bleeding in such patients.

Benzodiazepines are not considered to be triggers of MH, and conscious sedation using inhalation sedation is usually safe [4]. MH has, however, been reported after inhalation of nitrous oxide [5] but this is very rare.

In patients with G6PD deficiency, local anaesthesia may induce methaemoglobinaemia in high doses. The most likely candidates are prilocaine and the topical agent benzocaine [6]. Inhalation sedation is usually safe. General anaesthesia should be given in a hospital environment. The use of large doses of aspirin and the sulphonamide antibacterial drugs may precipitate haemolysis in patients with G6PD deficiency and should be avoided.

Patients with suxamethonium sensitivity may metabolise local anaesthetics differently from normal. As mentioned above this condition results from defects in plasma esterases. All of the injectable local anaesthetics used in modern dental practice are amides, unlike the earlier ester procaine. Nevertheless one of the amides, articaine, is initially metabolised in plasma by esterases [7], so the use of this drug in patients with suxamethonium sensitivity may increase the toxicity of the anaesthetic. If a patient's history reveals sensitivity to suxamethonium, they can be safely treated under general anaesthesia with avoidance of this muscle relaxant.

Haemochromatosis affects dental management in many ways, although local anaesthesia is usually safe. The possibility of cirrhosis, cardiomyopathy, diabetes and adrenocortical insufficiency should be borne in mind in these patients. Providing that liver function is adequate, conscious sedation is usually safe.

Local anaesthesia and conscious sedation can safely be given in patients with amyloidosis in most cases. It should be remembered, however, that amyloid can affect diverse organ systems. If the heart, adrenal glands or kidneys are involved or a bleeding tendency has developed, this will affect function and/or haemostasis.

Methaemoglobinaemia is a conversion of iron in haemoglobin from the ferrous to the ferric form. This latter configuration of iron does not allow such good availability of oxygen to the tissues which can result in cyanosis. Methaemoglobinaemia is a side effect of injecting large doses of some local anaesthetics, especially prilocaine [8] and articaine. Thus if using these drugs, dose limitations should be employed or an alternative local anaesthetic should be used in the anaemic patient.

13.6 Effects of Drugs Used in Patients with Metabolic Disorders on Dental Management

Some of the lipid-regulating drugs can increase bleeding after surgery. The anion-exchange resins cholestyramine and colestipol may interfere with the absorption of vitamin K leading to hypoprothrombinaemia. Ezetimibe, which interferes with the absorption of cholesterol, may rarely cause a reduction in platelet numbers. The fibrates, such as bezafibrate, may also cause a thrombocytopaenia as well as reduce white cell numbers and cause anaemia.

Statins such as atorvastatin can also produce a thrombocytopaenia. Thrombocytopaenia with a platelet count of $<50 \times 10^9$/L precludes elective oral surgery; when levels are $<100 \times 10^9$/L, tooth sockets should be packed with a haemostatic agent and sutured. Omega-3-acid ethyl esters can occasionally produce taste disturbance.

A number of drugs may be prescribed in the management of amyloidosis. The use of cytotoxic drugs and corticosteroids such as dexamethasone can lead to opportunistic oral infections, delayed healing and poor haemostasis. Colchicine, which is sometimes used in symptomatic treatment, can produce stomatitis and glossitis.

13.7 Drug Interactions with Drugs Used in Dentistry

One of the unwanted effects of statins is myopathy. The incidence of this is increased when statins are administered concurrently with other drugs, some of which may be prescribed to treat orofacial conditions. The important drugs in this regard are the antibacterial erythromycin and the azole antifungals. Erythromycin, itraconazole, ketoconazole and miconazole should not be prescribed to patients receiving

simvastatin. Similarly, itraconazole should be avoided in patients taking atorvastatin. The toxicity of colchicine is increased during concurrent therapy with erythromycin.

13.8 Conclusions

Metabolic disorders can impact on dental treatment in diverse ways. A thorough history and a high index of suspicion are essential for safe patient management.

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Skin Disorders and Dental Practice

14

In Brief

- Dentists should have a sound knowledge of skin disorders, particularly those which have oral manifestations.
- History and examination (lesion recognition) are important.
- Some of the treatments for skin disorders, particularly steroid treatment, may impact on dental treatment and should be borne in mind.

14.1 Introduction

The skin is subject to a number of disorders that can arise as a result of external insults such as trauma and infection, internal factors due to systemic disease and disorders specific to the skin itself. Skin disorders can be congenital, developmental or acquired.

As areas of the skin such as the hands and face are visible, they can be easily examined in the clothed patient. Some skin conditions may present with oral manifestations that can occur either simultaneously or precede the main dermatological features.

Conditions are summarised in Table 14.1.

Dermatology is a descriptive subject with an extensive range and variety of conditions that often appear clinically very similar and can only be differentiated histologically. Table 14.2 gives some commonly used terms and definitions of skin conditions.

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Table 14.1 Broad categories that can be applied to skin disorders

• Lumps and bumps
• Malignant conditions
• Rashes
• Collagen vascular diseases
• Blistering disorders
• Skin infections
• Disorders of hair
• Disorders of pigmentation

Table 14.2 Examination and description of a skin rash

Macule	An area of discolouration. May be more red or paler than the surrounding skin, or may be a different colour, e.g. blue
Papule	A small raised area. A maculopapular rash is both raised and discoloured
Nodule	A firm papule (more than 0.5 cm diameter)
Vesicle	A small blister (<0.5 cm diameter)
Bulla	A large blister (more than 0.5 cm diameter)
Pustule	A papule that contains pus
Erythema	Redness due to increased perfusion of the skin
Scale	A flake of easily detached keratin
Crust	An accumulation of dried exudate
Atrophy	Thinning of the skin, often with loss of skin markings and increased translucency
Sclerosis	An induration of the dermis, usually due to increased collagen
Excoriation	A scratch mark
Ulcer	A breach in the epidermis, which may range from a small superficial erosion to a massive defect of the skin and underlying tissue

14.2 Points in the History

Patients with skin conditions present in a variety of ways. Such presentations can include the appearance (or change in appearance) of a lesion, a rash or an itch—the latter can vary from being a minor nuisance to a debilitating problem interfering with sleep. In addition, itching usually leads to scratching with resultant damage to the skin, pain, secondary infection and scarring. In some instances the skin disorder may be asymptomatic, and the patient only presents after it is pointed out to them. A thorough history is essential to making a diagnosis; this includes relevant past medical history and systemic enquiry. For skin conditions, the history should include specific questions about onset, any change in appearance over time, exacerbating and relieving factors and possible causative factors such as contact with potential infection or allergens; details about occupation and exposure to ultraviolet light (sunlight or sunbeds—Table 14.3) are also important.

As many skin conditions, such as atopic eczema and psoriasis, have a genetic element, a family history should be included. When considering rashes, their spread and distribution over the body are important features, as many have a characteristic pattern. When oral mucosa is involved, tactful questioning about lesions of the genital and conjunctival mucosa should be made.

Table 14.3 Points in the history of a patient with a skin disorder

• Onset
• Change in appearance over time
• Exacerbating or relieving factors
• Possible causative factors
• Infections
• Allergen contact
• Exposure to ultraviolet light (sunshine or sun beds)
• If a rash, is it itchy?
• Past medical history
• Systemic enquiry
• Family history

14.3 Categorisation of Skin Disorders

14.3.1 Lumps and Bumps

Basal cell papilloma (seborrhoeic wart) is a pigmented lesion which commonly occurs in the elderly (Fig. 14.1). It has a characteristic warty surface, often with a greasy appearance. It is unrelated to the more aggressive basal cell carcinoma, and treatment is usually for cosmetic purposes using either surgical removal or cryotherapy.

Keratoacanthoma is a rapidly growing lesion which develops into a dome-shaped lump with a central keratin-filled crater (Fig. 14.2). The lesion can resemble a squamous cell carcinoma but may resolve spontaneously.

Pyogenic granuloma usually presents as a rapidly developing red lump that bleeds readily when touched (Fig. 14.3). In many cases there is a history of trauma to the area before the appearance of the lump, and it actually represents excess production of granulation tissue. These lesions are usually either surgically removed or treated with cryotherapy.

Epidermoid cyst is a common cystic lesion of the scalp, filled with a cheesy keratinous material. These lesions are commonly called sebaceous cysts, although this term is a misnomer. The usual treatment is surgical removal.

14.3.2 Vascular Anomalies

There are a number of vascular anomalies that can affect the skin, and all can be identified as having a vascular nature by blanching on pressure. *Campbell de Morgan* spots are small capillary haemangiomas that occur on the trunk with increasing age and are of no significance. They should not, however, be confused with *hereditary haemorrhagic telangiectasia* (*HHT*), which as the name implies has a genetic factor and can present with numerous red ‘spots’ around the lips as well as in other areas. HHT can lead to extensive bleeding from the nasal passages and bowel leading to iron deficiency anaemia. As a result, individual lesions may need to be cauterised.

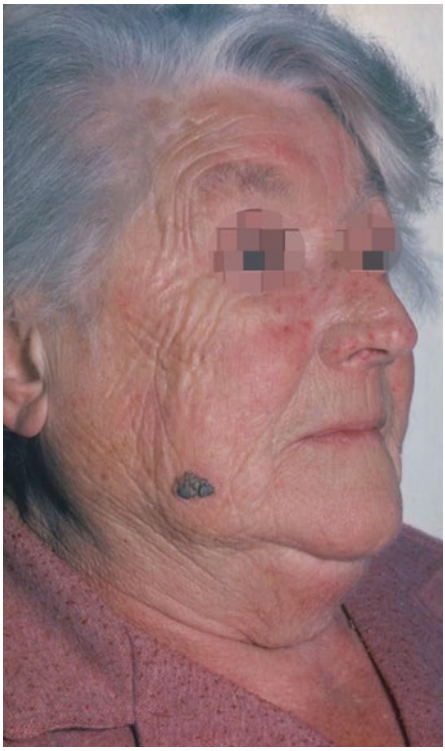

Fig. 14.1 Basal cell papilloma

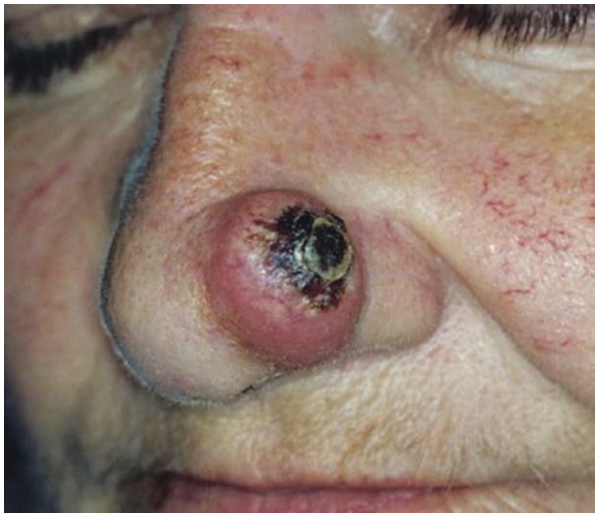

Fig. 14.2 Keratoacanthoma

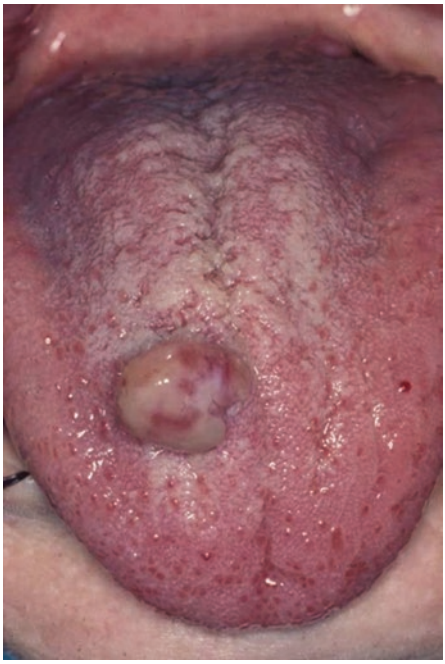

Fig. 14.3 Pyogenic granuloma

'Port wine stain' is a more extensive capillary haemangioma that is present at birth and can cause a considerable cosmetic problem. They can be treated by laser [1], however some resort to cosmetic camouflage. Lesions on the face are occasionally associated with vascular malformations in the brain and resultant epilepsy. It is worth considering that lesions affecting the mandible or maxilla may extend into the adjacent bone and could pose a problem with dental extractions in the area. In such cases a pre-operative radiograph should be taken, and if involvement is shown, referral for angiography should be arranged.

Strawberry naevus is a term used to describe a vascular malformation that presents in infancy as a raised red lump. Such lesions initially appear to enlarge but eventually regress, and consequently treatment should, if possible, be deferred until adolescence.

14.3.3 Malignant Conditions

The most important factor predisposing to malignancy of the skin is ultraviolet radiation, and most cutaneous malignancy occurs on parts of the body exposed to light. As well as producing damage to genes, ultraviolet light may cause immunosuppression, and this may be implicated in its role in carcinogenesis [2]. Other causes of skin cancer include X-rays, chemicals (e.g. arsenic and benzpyrene) and genetic factors. Lesions in this group include basal cell carcinoma and squamous cell carcinoma.

Basal cell carcinoma (*rodent ulcer*) characteristically appears as a pearly papule that enlarges slowly and then ulcerates to form an ulcer with a rolled edge (Fig. 14.4). Although these lesions do not metastasise, they are locally aggressive and destructive and require prompt referral. Treatment is usually surgical excision, although some lesions can be treated with radiotherapy.

Squamous cell carcinoma (*SCC*) often arises on the skin that shows evidence of sun-induced degenerative changes (e.g. solar elastosis or keratosis). The lesion may present as an indurated lump or an ulcer with a firm base (Fig. 14.5). Lesions require surgical excision and careful follow-up. Affected patients need advice on limiting future exposure to ultraviolet light and need to be aware of changes in other areas of pre-existing solar damaged skin. *Bowen's disease* is a patch of non-invasive squamous cell carcinoma. It may mimic psoriasis and has a relatively good prognosis.

Melanotic lesions of the skin are common and represent collections of melanocytes within the epidermis, dermis or subdermal tissues. A variety of descriptive terms are used depending on the clinical appearance and histological distribution of the melanocytes, but all are commonly referred to as 'moles'. *Melanocytic naevus* (intradermal naevus) is due to melanocytes congregating in the dermis. They may develop at any time but commonly enlarge during puberty or pregnancy. They may be variably pigmented, flat or raised and hairy or hairless. They are essentially a cosmetic defect and rarely become malignant.

Malignant melanoma originates from melanocytes and may arise in a pre-existing mole or in otherwise normal skin or oral mucosa (Fig. 14.6). Factors that raise suspicion of malignant change in a pre-existing pigmented lesion include progressive enlargement, colour change, spread of pigment beyond the edge of the lesion, bleeding, itching or inflammation (Table 14.4). Any such changes require urgent

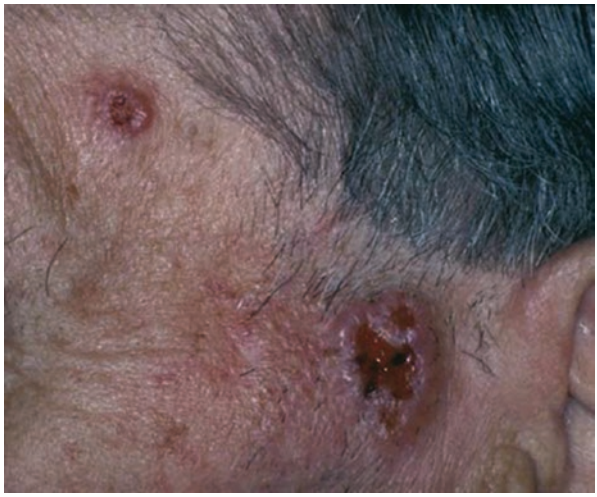

Fig. 14.4 Basal cell carcinoma ('rodent ulcer')

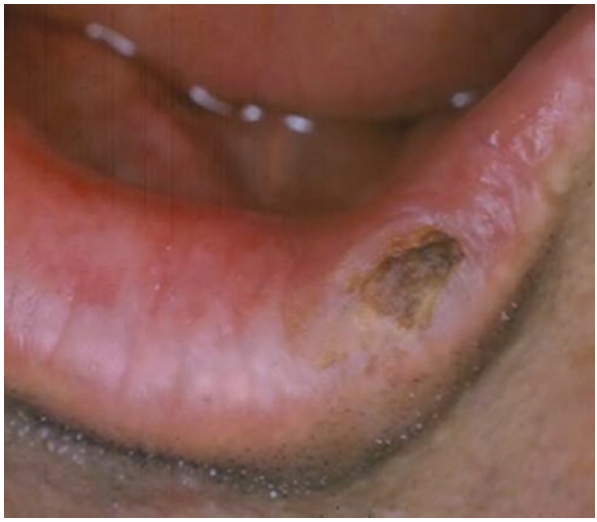

Fig. 14.5 Squamous cell cancer of the lower lip

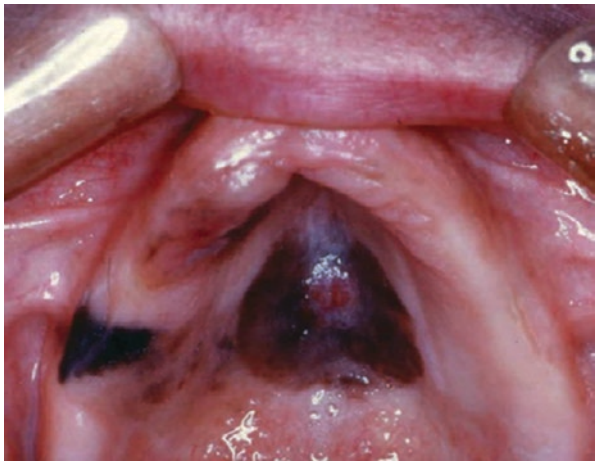

Fig. 14.6 Malignant melanoma of hard palate

referral as malignant melanomas have a propensity to metastasise widely at a relatively early stage. Treatment is usually surgical excision with a wide margin and careful follow-up.

14.3.4 Rashes

Rashes are common. Most have a short duration and accompany viral infections, especially in childhood. A few are the main manifestation of the illness, such as in

Table 14.4 Factors suggestive of possible malignancy in a pigmented lesion

• Progressive enlargement
• Colour change
• Spread of pigment beyond the edges of the lesion
• Bleeding, itching or inflammation

chickenpox, rubella (German measles) or measles. In this section the non-infectious causes of rashes are considered.

Eczema is a distinctive inflammation of the skin in which the prickle cells of the epidermis become separated from each other by oedema fluid. Eczema is characterised by severe itching and erythema, with a variable degree of papule formation, vesiculation, scaling and weeping.

Eczema can be divided into two main types: exogenous, due to an external cause, and endogenous, due to either an internal or unknown cause.

Exogenous eczema includes:

- Primary irritant eczema—arises as a result of irritants such as caustics, mineral oils and detergents. Occupational hand eczema is often due to regular contact with these chemicals.
- Allergic contact dermatitis is due to a type IV (delayed) hypersensitivity reaction and may develop to a variety of substances such as nickel, rubber and dyes (discussed further in this chapter).

Endogenous eczema usually begins in infancy and tends to clear during childhood. Severe cases can be lifelong. In many instances there is a family history, and the condition may be associated with hay fever, urticaria and asthma (‘atopic’ patients). It is an interesting observation that in such patients when their eczema is bad, their asthma improves and vice versa.

Most affected individuals can control their skin condition with topical emollients and intermittent topical steroids and only in a few cases are systemic steroids required. Courses are usually kept for as brief a time as possible. In addition to conventional therapy, a number of atopic patients could be using various complementary therapies, which may be self-prescribed. It is known that some of these, in particular herbal remedies, can interfere with medication such as antibiotics and it is worth checking what the patient is using before issuing a prescription.

Seborrhoeic dermatitis is an ill-defined type of eczema, classically causing dandruff, scaly eyebrows, redness of the nasolabial folds and patches of red rash over the sternum and in the body folds. Some patients have a greasy skin, but the term ‘seborrhoeic’ is probably a misnomer. Although the exact cause of this condition is unknown, the role of *Pityrosporum* yeasts has been recently emphasised. The condition is usually controlled with topical steroids, tar-based products and antifungal medication.

Varicose eczema affects the lower leg and is due to venous stasis. The affected skin often becomes irritable and pigmented. The affected area can readily ulcerate following often mild trauma. Management is usually symptomatic.

Psoriasis is a common inflammatory skin disease with well-demarcated patches of red skin covered with thick white scales (Fig. 14.7). The most commonly affected areas are the extensor surfaces, knees, elbows and base of the spine. There are a number of recognised subtypes, but apart from the scalp, the face is rarely affected. The exact cause of psoriasis remains unknown, although in a number of cases there is a strong family history. The basic abnormality in psoriasis appears to be an increased rate of epidermal regeneration of the affected skin. Some patients develop an associated arthritis (psoriatic arthropathy) and pitting of the finger nails. Psoriasis can range from being a minor nuisance to a life-threatening incapacity. There are numerous therapies advocated for psoriasis, which depend on the severity of the condition but include topical coal tar preparations, steroids, ultraviolet radiation and systemic treatments such as retinoids (vitamin A analogues).

Acne vulgaris is a common disease of adolescence and is characterised by greasy skin (seborrhoea), blackheads (comedones), papules and pustules. In addition, there may be deep-seated cysts which tend to leave pitted scars. Lesions start on the face and may spread to the shoulders, back and chest. The condition starts around puberty, when sebaceous glands become active due to androgenic stimulation. Colonisation with anaerobic diphtheroids follows, which break down the sebum to free fatty acids causing comedone formation. The exact cause of the subsequent inflammation is unknown. Antibiotics such as tetracycline decrease the bacterial count and suppress inflammation.

Acne rosacea is a skin disorder of the middle aged and elderly characterised by redness, papules and pustules of the face, a tendency to facial flushing and telangiectasia. The condition is exacerbated by sunlight and heat and can be distinguished from acne vulgaris by the absence of comedones and scarring. The exact cause of the condition is unknown, and treatment is similar as for acne vulgaris.

Lichen planus is a disorder of unknown aetiology. It is characterised by flat topped, violaceous papules which are extremely itchy (Fig. 14.8). The most

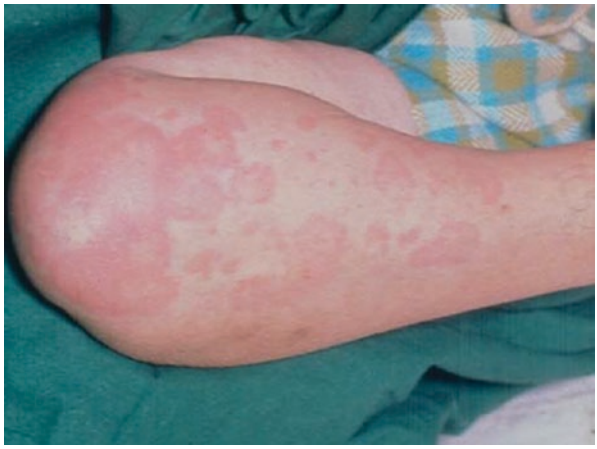

Fig. 14.7 Psoriasis

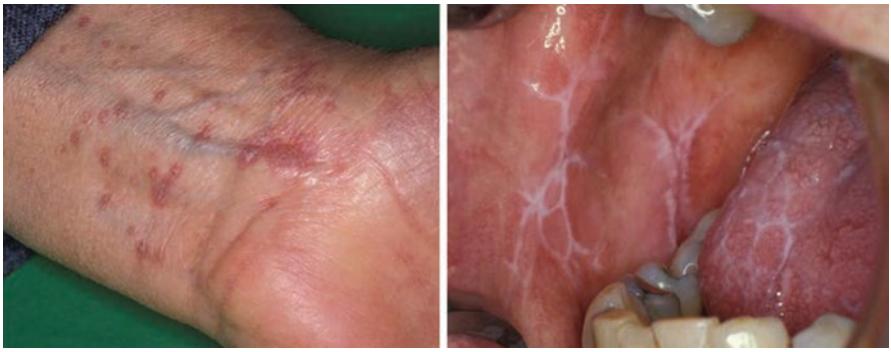

Fig. 14.8 The skin and oral lesions of lichen planus

common sites affected are the flexor surfaces of the wrists, the shins and midriff; the face is rarely involved. The oral mucosa is frequently affected with white streaks, often with a reticulate pattern and is predominantly found on the buccal mucosa and lateral margins of the tongue (Fig. 14.8) although a number of different clinical features may be present [3]. The oral lesions may become erosive and painful, and chronic cases have a slightly increased risk of malignant transformation.

The natural history of lichen planus is for gradual resolution over 18 months to 2 years leaving residual pigmented macules. However, oral involvement can take much longer to resolve and can last for years. Treatment depends on severity and usually involves topical steroids [4] with only the more severe cases requiring systemic treatment. More intractable disease can respond to specific immunomodulating drugs such as ciclosporin or tacrolimus.

Urticaria is a blotchy rash, characterised by wheals, erythema and itching. It usually develops rapidly, fading within 24 h. The condition is a result of histamine release from mast cells increasing capillary permeability and giving a red axon flare. It is often due to a type I hypersensitivity reaction to a specific food (e.g. shellfish), food additives or drugs. In many cases no specific trigger is found, and treatment is symptomatic with either avoidance of the trigger substance or antihistamines.

Angioedema is a similar condition to urticaria, but the increased capillary permeability occurs at a deeper level, with swelling of the subcutaneous tissues. It most commonly affects the eyelids and lips. Rarely, it may cause respiratory obstruction due to laryngeal oedema in which case the condition becomes a medical emergency requiring the immediate use of intra muscular adrenaline; otherwise the condition is managed in the same way as urticaria.

It should be remembered that cases due to a type I hypersensitivity can have an exaggerated response on subsequent contact with the provoking allergen and can develop a potentially fatal anaphylaxis. In view of such a possibility, affected patients are advised to carry an emergency supply of adrenaline for self-administration of an 'EpiPen'®.

A similar presentation to angioedema can arise due to a genetic disorder in which a component of the control of the complement cascade is missing (C1 esterase

inhibitor) with the result that minor trauma, including possible tissue handling during dental treatment, can provoke an inflammatory response with localised oedematous swelling. This condition is usually much less severe than its hypersensitivity counterpart, and episodes settle without the need for intervention.

14.3.5 Collagen Vascular Diseases

Lupus erythematosus (LE) is an autoimmune disorder in which antibodies are directed against the skin. It can present in two forms, discoid LE and systemic LE.

Discoid LE (DLE) is a disease confined to the skin, although antinuclear factor may be present in the blood. The rash is characterised by disc-shaped areas of redness with scaling and atrophy and mainly affects the sun-exposed areas of the skin, including the face. The condition is exacerbated by sunlight and consequently is worse during the summer months. About 5% of affected patients progress to the systemic form.

In *systemic LE* (*SLE*), the rash tends to be nonspecific, though classically patients develop a 'butterfly' distribution over the cheeks and bridge of the nose, reflecting the photosensitive nature of the condition. The systemic changes are variable but may include pyrexia, malaise, arthralgia, pleurisy, pericarditis, renal failure and neuropsychiatric involvement. Both DLE and SLE require specialist treatment. Such treatment often involves protracted courses of systemic steroids and steroid-sparing immunomodulating medication such as methotrexate. DLE and SLE can produce oral lesions which vary from non-specific mucosal ulceration to lesions with a lichenoid appearance. There is also an association between SLE and the development of dry eyes and dry mouth (Sjögren syndrome) with oral consequences such as increased rate of dental caries, periodontal disease and secondary candidal infection.

Systemic sclerosis is a chronic and ultimately fatal condition often presenting with Raynaud's phenomenon (painful vascular spasm of the extremities, usually fingers, triggered by cold) some years before an insidious induration of the skin develops. Facial changes are pathognomic and include immobile 'bound-down' skin, small mouth with radial furrows and loss of bulk in the nasal alae—the result giving a taught, smooth-skinned appearance. More systemic (and potentially fatal) involvement includes pulmonary fibrosis, loss of oesophageal peristalsis, renal failure and, in the latter stages, progressive digital ischaemia with gangrene, ulceration and loss of digits.

Dermatomyositis is an autoimmune inflammatory disorder affecting the skin and muscle. The rash is non-specific, but a violaceous rash of the eyelids and red plaques over the knuckles suggest the diagnosis. A progressive proximal myopathy causes difficulty in climbing steps and eventually limits mobility. The disorder is associated with internal malignancy in 50% of middle-aged patients. A similar condition seen in children does not have the same association with malignancy.

Polyarteritis nodosa is an autoimmune disorder resulting in a necrotising vasculitis occurring in medium-sized arteries. Any organ may be affected, but the skin

involvement includes a blotchy reticulate cyanosis (livedo reticularis), haemorrhagic blisters and irregular punched-out ulcers. There are many milder forms of vasculitis affecting smaller vessels only, with lesions confined to the skin. Some of these disorders are a result of circulating immune complexes.

14.3.6 Blistering Disorders

Blistering disorders may be classified according to where the split in the skin leading to the blisters occurs.

Intra-epidermal blisters tend to have a thin roof and rupture easily, whereas those occurring subepidermally rupture less readily and present with tense, dome-shaped blisters.

There are a number of subtypes of *pemphigus* [5], all of which are autoimmune with the autoantibodies (usually IgG) directed against the 'cement' of the prickle cell layer of the epidermis with resultant breakdown and blister formation in this region. Patients, most frequently middle-aged women, present with widespread flaccid blisters of the skin but often involving the mucous membranes of the mouth, conjunctiva, nose, vagina and rectum. In roughly 50% of patients, the condition may first manifest as an oral problem. Pemphigus, if untreated, is fatal and warrants vigorous and lifelong immunosuppressive treatment.

Pemphigoid is also an autoimmune disorder that usually occurs in the older patient and tends to be a much milder condition than pemphigus. The autoantibodies, usually IgG, are directed towards the basement membrane zone resulting in subepidermal blister formation. It tends to spare the mucous membranes, but a variant, *mucous membrane pemphigoid* [6], predominantly involves the oral and conjunctival mucosa. The latter is of significance because, if not treated, it can lead to conjunctival scarring and blindness. Pemphigoid is usually treated symptomatically with topical steroids and only in severe cases is systemic treatment required.

Erythema multiforme [7] is an immunological reaction to a number of causes such as viral infections (especially herpes simplex) and drugs. The rash can assume several forms but classically appears as 'target lesions' with a central bulla surrounded by concentric rings of erythema (Fig. 14.9). The condition tends to

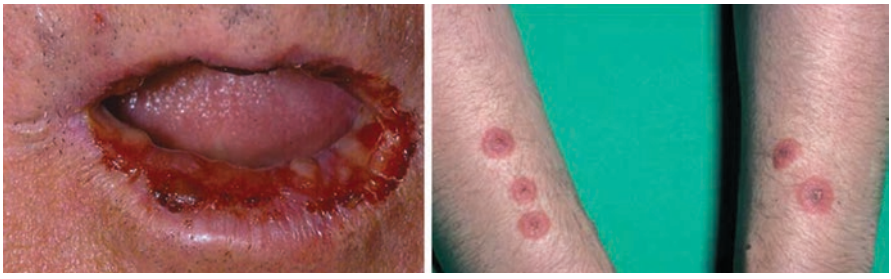

Fig. 14.9 The oral and skin manifestations of erythema multiforme

predominantly affect adolescent males with recurrent episodes often diminishing in severity with increasing age. The most severe form involves the eyes, mouth and genitalia (Stevens-Johnson syndrome). The disease is self-limiting and the use of systemic steroids is controversial.

Dermatitis herpetiformis is a rare blistering disorder in which IgA antibody is directed against the skin causing widespread, often small vesicles that are extremely itchy. The condition is often associated with coeliac disease but oral involvement is unusual. It usually responds well to dapsone, and for those with associated coeliac disease, a gluten-free diet can be beneficial.

14.3.7 Skin Infections

Infections of the skin are common and can be divided into those caused by bacteria, viruses, fungi and parasites.

14.3.7.1 Bacterial Infections

Furuncle is a deep abscess of a hair follicle due to infection with *Staphylococcus aureus*. Precipitating factors include poor hygiene, stress and diabetes mellitus although many cases develop for no specific reason. Such patients often carry the causative strain of *Staphylococcus* in the nose, axillae and groin.

A *carbuncle* is a larger staphylococcal abscess which discharges pus through several sinuses.

Impetigo is a superficial skin infection caused by *Staphylococcus aureus*, sometimes with streptococci in addition. The lesions are golden crusted and can spread quite rapidly. The condition is contagious and as a result can pervade an institution such as a nursery. Sometimes it accompanies infestation with scabies or lice.

Cellulitis describes a deeper spreading of streptococcal infection that involves the subcutaneous tissues and can spread quite widely. *Erysipelas* is a form of cellulitis and is a superficial infection due to *Streptococcus pyogenes*. The lesion is a well-defined area of tender, red and oedematous skin and is often associated with fever and malaise. Recurrent episodes of cellulitis are not uncommon [8].

14.3.7.2 Viral Infections

Verrucae (common warts) are common lesions that usually occur on the hands or soles (plantar warts) and are often self-limiting. Lesions can occur around the mouth, usually by autoinoculation, particularly in thumbsuckers.

Herpes simplex infection is usually acquired from close contact with an infected individual during infancy. The primary infection involves painful vesicles/ulcers around the oral mucosa and gingivae. The condition is accompanied by fever, malaise and lymphadenopathy. It is usually self-limiting. In a number of cases, the primary infection is subclinical, although once infected the virus remains for life and gives the potential for the development of secondary (recurrent) lesions.

Recurrent herpes infections may occur throughout life and are most commonly seen around the lips (‘cold sores’, Fig. 14.10). Attacks are often precipitated by

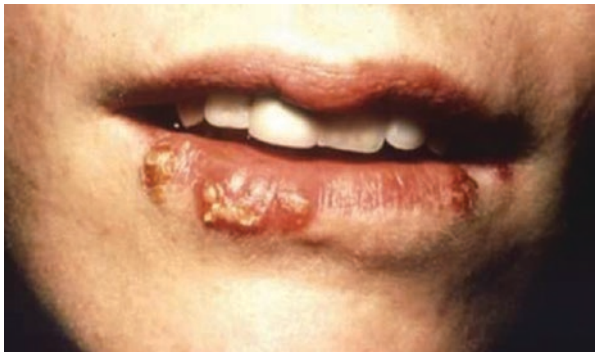

Fig. 14.10 Herpes simplex infection of the lip

febrile illness, local trauma, sunburn or menstruation. The lesion usually starts as a patch of localised painful erythema, in which it develops a crop of clear vesicles that burst, crust and heal over a period of 10 days. Genital herpes follows the same pattern although the primary infection is usually acquired through sexual intercourse.

Herpes zoster infection, like herpes simplex, has a bimodal presentation with the primary condition usually being acquired in childhood as chickenpox (varicella zoster). The virus remains latent in the sensory root ganglia where it can become reactivated later in life causing shingles.

Shingles starts with pain, then erythema and vesicles in the distribution of a sensory nerve root. The preceding pain can be severe and occur up to 2 days before the development of the characteristic rash. Although any sensory nerve root distribution can be affected, it is most common on the trunk. The condition may involve any of the three branches of the trigeminal nerve and usually settles within 2 weeks, although it can leave pain in the affected region for several months afterwards (postherpetic neuralgia). Lesions affecting the ophthalmic division of the trigeminal nerve may develop corneal damage and should be treated with an antiviral agent promptly to prevent long-term complications. Shingles affecting the mandibular division of the trigeminal nerve is shown in Fig. 14.11.

The *Coxsackie group* of viruses can produce two infections of the orofacial region; both are highly contagious but otherwise self-limiting. *Herpangina* produces characteristic painful lesions of the soft palate, accompanied by pyrexia and malaise. *Hand, foot and mouth disease* produces characteristic linear vesicles of the hands and feet, with shallow ulcers of the buccal mucosa. It is usually a mild self-limiting illness which often occurs as an epidemic in institutions.

14.3.7.3 Fungal Infections

Numerous fungal infections can affect the skin, but most have little effect on the orofacial region. The most common yeast to affect the perioral region is the *Candida* species (usually albicans). This yeast is a common commensal in the mouth and, being highly opportunistic, can cause a variety of intra-oral manifestations depending on local conditions such as poor denture hygiene or systemic disease. Spillage

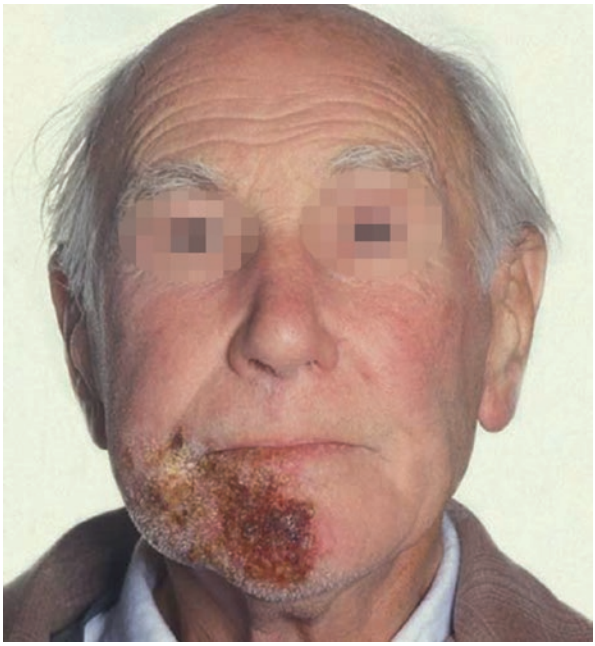

Fig. 14.11 Shingles—confined to the mandibular division of the trigeminal nerve

from the mouth can affect the adjacent skin, either alone or in combination with other opportunistic organisms such as *Staphylococcus aureus*, and give rise to *angular cheilitis*.

Angular cheilitis occurs as a result of saliva maceration at the corners of the mouth due to drooling or the presence of deep skin folds or ill-fitting dentures. Other factors that potentiate the development of secondary infection at this site are iron deficiency, diabetes mellitus or being immunocompromised. In younger, dentate and otherwise fit individuals, the condition is often solely an infection by *Staphylococcus aureus.*

In treating angular cheilitis, it is important to assess all possible contributing factors and to treat any accompanying intra-oral infection with an appropriate antifungal agent or the condition will recur.

14.3.8 Disorders of Hair

Hirsutism refers to growth of coarse hair in the 'male' pattern (especially in the beard area) occurring in a female. It is usually only a cosmetic defect, but it can sometimes be a sign of overproduction of androgen due to a tumour or hyperplasia of the ovary (polycystic ovaries) or adrenal gland. Affected individuals often have greasy skin and irregular periods.

Alopecia ('baldness') commonly happens in men with a family history of baldness and normal androgen levels. It rarely happens in women before the menopause, and if it does occur in a young woman, it usually indicates an overproduction of androgens. Generally hair loss is more common with increasing age in both sexes.

Diffuse alopecia can occur in hypothyroidism, hypopituitarism, iron deficiency and (transiently) in pyrexial illness or childbirth. Some drugs, particularly cytotoxics, can also cause temporary hair loss. *Alopecia areata* is thought to be an autoimmune disorder resulting in patchy hair loss. Most cases recover spontaneously, but some progress to total hair loss, including the eyelashes and body hair (alopecia universalis).

14.3.9 Disorders of Pigmentation

Malignant melanoma is considered earlier in this chapter.

14.3.9.1 Hyperpigmentation

The most common pigment in the skin is melanin produced by dendritic cells in the basal layer—melanocytes. All races have a similar number of melanocytes, but those races with a darker skin have more active melanocytes. In general, melanin is protective against ultraviolet light, and production of melanin occurs in direct response to exposure (sun tan). However, there are a number of conditions associated with an increase in pigmentation.

In adrenocortical deficiency as a result of destruction of the adrenal glands by either autoimmune (*Addison's disease*) or metastatic disease, overproduction of pituitary ACTH stimulates melanocytes to produce melanin. As a result the patient becomes pigmented and, due to low or absent cortisol, has a poor tolerance to stress (such as in the dental surgery) and can develop steroid crisis (severe hypotension and collapse) without adequate steroid prophylaxis.

Certain drugs can result in increased pigmentation (e.g. busulfan), and a patchy hyperpigmentation can develop around the eyes and cheeks in pregnancy (melasma) or from the contraceptive pill.

Localised areas of hyperpigmentation can occur in old age (lentigines) and perioorally in *Peutz-Jeghers' syndrome*, a hereditary condition associated with intestinal polyps.

14.3.9.2 Hypopigmentation

Loss of pigment can be generalised, as in *albinism* (a congenital defect in melanin production), or localised such as in *vitiligo*. Vitiligo is probably an autoimmune disorder that destroys melanocytes. Although largely cosmetic, loss of pigment increases the risk of sun damage to the skin. Those affected should limit exposure and use appropriate sun block.

14.4 Miscellaneous Conditions

14.4.1 Genodermatoses

There is a genetic background in many skin disorders, but several are recognised as primarily genetic.

Ectodermal dysplasia is a rare, sex-linked recessive disorder characterised by the sweat glands that fail to form (hypohidrosis) and scant hair (hypotrichosis) with the absence of eyebrows and eyelashes. The importance of this condition in dentistry is that it is associated with hypodontia and abnormalities of tooth form [9].

The term *epidermolysis bullosa* encompasses a group of rare bullous diseases affecting the skin and mucous membranes with various forms of inheritance. Vesicles and bullae form in response to mild or insignificant trauma and may lead to disabling scarring and deformity.

Neurofibromatosis type 1 (*von Recklinghausen's disease*) is an autosomal dominant condition characterised by multiple tumours of the nerve sheath (neurofibromas), in which sarcomatous change may develop, and patches of pigmented skin (café-au-lait spots).

Multiple basal cell naevi syndrome [10] (*Gorlin-Goltz syndrome*) is an autosomal dominant condition consisting of multiple basal cell carcinomas, odontogenic keratocysts and anomalies of the vertebrae, ribs and skull deformities, including calcification of the falx cerebri.

Tuberous sclerosis is an autosomal dominant trait characterised by epilepsy, learning disability and skin lesions in a butterfly pattern across the bridge of the nose, forehead and chin.

14.5 Dental Management of Patients with Skin Disorders

Dental implications of various skin disorders likely to be seen in dental practice include direct involvement of the oral mucosa by a mucocutaneous disorder. In some circumstances, for example, pemphigus, the oral lesions may precede the full-blown condition and provide early diagnosis.

Some asymptomatic conditions in their early phase, such as basal cell carcinomas, commonly involve the facial skin, and the dentist is in a good position to make the diagnosis and promote early referral. Some dermatological problems such as epidermolysis bullosa or systemic sclerosis may present specific problems in maintaining adequate oral hygiene, and patients with these conditions require regular assistance. In such cases the wearing of dentures can prove extremely difficult, and every effort to maintain the dentition should be taken.

A number of patients with dermatological conditions will be taking or have taken systemic steroids and may require steroid cover before any surgical intervention, such as extractions, to prevent steroid crisis. This is an area of controversy, and

some evidence suggests that the routine use of prophylactic steroids is unnecessary [11]. Many more patients will be using topical steroid medication, which could theoretically lead to adrenal suppression. However this appears not to be a problem, and steroid cover for surgical dental procedures in this group is usually not required.

Many dermatological conditions are visible and cause considerable distress to those affected. Treatment by an understanding and knowledgeable practitioner can be of enormous reassurance to a sometimes emotionally vulnerable person.

From a dental perspective, patients affected with systemic sclerosis may be compromised by difficulty in accessing the oral cavity due to the tautness of the circumoral skin. This can result in difficulty in maintaining adequate oral hygiene, a problem that can be exacerbated if the hands are affected to a degree where holding an oral hygiene aid such as a toothbrush becomes difficult.

Some skin conditions such as systemic lupus erythematosus are associated with a bleeding tendency caused by thrombocytopaenia and clotting defects (see below).

14.6 Considerations for Treatment Under Local Analgesia with or Without Sedation and General Anaesthesia

As mentioned above, Addison's disease is associated with hyperpigmentation, and the lack of production of endogenous corticosteroids may lead to adrenal crisis. The use of prophylactic steroids is not universally advised for treatments on most patients receiving endogenous steroids (see below). The exception is the patient with Addison's disease, where steroid cover is still recommended.

Some of the systemic conditions such as systemic lupus erythematosus are associated with prolonged bleeding as a result of both thrombocytopaenia and a coagulation deficit as mentioned above. A careful history is required to see if the patient has any haemorrhagic problem and pre-surgical screening for platelet numbers, and clotting studies may be required.

In cases of C1 esterase deficiency, supplementation before dental treatment may be provided to prevent the development of angioedema.

Dentists and their assistants may become sensitised to rubber gloves, medicaments, or chemicals such as acrylic monomer resins producing a type IV (delayed) hypersensitivity reaction. Such hypersensitivity usually causes hand eczema, but aerosols can lead to facial eczema. Patch testing the skin (usually on the back) to a range of possible sensitisers for 48 h is the usual way of identifying the cause. Treatment, like that for irritant eczema, is avoidance of the cause or the use of a barrier (e.g. hypoallergenic gloves). It should be remembered with hypersensitivity reactions, however, that subsequent contact will lead to an exacerbated response and should be avoided at all costs. Acute flare-ups can be treated by a topical steroid cream or ointment.

14.7 Impact of Drugs

A number of different drugs are used in the management of skin disorders, and an understanding of the impact of these on dental treatment is merited.

14.7.1 Corticosteroids

As mentioned above, the use of supplementary steroids is no longer considered essential for most patients taking these drugs. Monitoring of the blood pressure is recommended during treatment, and if the diastolic pressure drops by more than 25%, then an intravenous injection of 100–200 mg hydrocortisone is required.

Patients taking long-term steroid therapy may be more susceptible to infections such as *Candida*, and any acute infection should be treated without delay.

The use of non-steroidal anti-inflammatory drugs is not recommended in patients taking corticosteroids on a long-term basis as such a combination can lead to gastrointestinal ulceration.

14.7.2 Antimicrobial Drugs

Long-term tetracycline use, if it coincides with dental development, can lead to staining of the teeth. Tetracycline may also be a cause of lichenoid lesions intraorally. This drug can reduce the efficacy of other antibacterials such as penicillin. Tetracycline is commonly used in the treatment of acne vulgaris.

14.7.3 Immunosuppressant Drugs

A number of immunosuppressant drugs such as ciclosporin, tacrolimus and methotrexate are used in the management of skin disorders. Patients on immunosuppressant therapy are more at risk of oral and perioral malignancies, and any suspicious lesions should be biopsied on an urgent basis. Ciclosporin can produce gingival overgrowth [12].

Drugs that dentists prescribe can interact with immunosuppressants, for example, non-steroidal anti-inflammatory drugs, increase the toxicity of ciclosporin, methotrexate and tacrolimus, and antifungal agents such as miconazole and ketoconazole reduce metabolism of ciclosporin and tacrolimus. Immunosuppressants may reduce platelet numbers leading to post-extraction bleeding; a reduction in white cell count may also increase the likelihood of post-operative infection. Full blood counts will inform the clinician if such sequelae are likely.

14.7.4 Dapsone

Dapsone can produce Stevens-Johnson syndrome leading to oral ulceration and crusting of the lips. This drug can reduce the red and white cell count leading to poor postsurgical healing.

14.7.5 Retinoids

Patients receiving retinoids may complain of dry lips.

14.8 Conclusion

With the similarities between skin and oral mucosa, it is hardly surprising that some dermatological conditions may have an oral component that occasionally may precede other manifestations. Many patients may not appreciate this connection which can only be ascertained by careful history taking and, where appropriate, examination.

In addition, many serious skin conditions such as malignant neoplasia frequently occur on the face, enabling the dental practitioner to facilitate early diagnosis and referral. It is an area where close co-operation between different professionals is beneficial.

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Psychiatry and Dental Practice

15

In Brief

- Mental illness is a common problem and can present in many ways.
- Psychiatric problems may not always be relevant to a patient's dental management, but a little knowledge may avoid problems.
- It is important to presume all patients have capacity to consent unless proven otherwise.
- Mental illness may affect dental professionals and it is important to know how to access help.

There are a significant number of patients in society who have some form of psychiatric disorder. It is important that dental practitioners have an awareness of the more common psychiatric disorders and their potential implications as they are likely to encounter them in clinical practice.

15.1 Introduction

Mental illness is common, affecting up to one in four people in the UK at some time in their lives [1]. It is thus highly likely that a dentist will encounter psychiatric problems in their personal and/or professional lives.

Psychiatric problems may present to the dentist in a number of ways. The oral problem may be incidental or part of the psychiatric symptomatology. Pure dental anxiety may influence management. Thus it is important that dentists have some understanding of the basic concepts of psychiatry and the nature of psychiatric disorders.

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https://doi.org/10.1007/978-3-319-97737-9_15

Table 15.1 Psychiatric disorders relevant to dentistry

Dental anxiety
Dental phobia
Obsessive-compulsive disorder
Hypochondriasis
Psychogenic pain—atypical facial pain, TMJ dysfunction, atypical odontalgia, oral dysaesthesia
Eating disorders—anorexia nervosa, bulimia nervosa
Drug and alcohol misuse
Schizophrenia
Depression
Bipolar disorder ('manic depression')

The dentist may encounter mental health problems in relation to one of the following:

1. The underlying psychiatric condition, for example, anxiety disorder, is exacerbated by the visit to the dentist or creates problems in management.
2. A psychiatric illness may be detected by the dentist, for example, psychogenic pain, eating disorders, substance abuse and occasionally psychosis.
3. Dental complications of psychiatric illness, for example, pain syndromes, bruxism and poor oral hygiene.
4. The illness may be unrelated to the dental attendance, but some understanding may be useful to aid management, for example, dementia, learning disability or in relation to medication.
5. The dental professional may be affected by a mental illness, most commonly alcohol problems and depression.

This chapter provides an overview of how psychiatric symptoms might present to the dentist with a brief description of some common psychiatric syndromes (Table 15.1). Consent with reference to the Mental Capacity Act (2005) is briefly discussed, concluding with how to access support and advice from psychiatric services when required.

15.2 The Underlying Psychiatric Condition Is Exacerbated by a Visit to the Dentist or Creates Problems in the Consultation

15.2.1 Anxiety

Anxiety can be a normal response to perceived danger, activating the sympathetic nervous system in the performance-enhancing response commonly known as 'fight or flight'. If anxiety becomes too intense, frequent or persistent and interferes with daily life, it may be considered pathological and part of an anxiety disorder.

Certain circumstances will induce a 'state' of anxiety in all of us. Some people are naturally more anxious than others, however, with a high level of 'trait' anxiety and may be predisposed to anxiety disorders. Anxiety symptoms may be physical or psychological (Table 15.2) and may be so severe the individual attempts to avoid all

Table 15.2 Symptoms of anxiety

Psychological	Physical
Worry	Gastrointestinal: dry mouth, nausea, swallowing difficulties, disturbance of bowel habit
Sense of dread irritability	Cardiovascular/respiratory: shortness of breath, chest pain, palpitations, tachycardia
Poor concentration restlessness	Neuromuscular: headache, light-headedness, weakness, 'jelly legs', tremor, muscle aches
	Other: sweating

possible triggers, potentially restricting their lifestyle significantly. Of particular interest to the dentist is dental anxiety. Some estimates suggest up to 90% of people experience significant levels of anxiety before visiting the dentist, with 40% of adults delaying or completely avoiding visits because of anxiety. This may be highly specific amounting to *odontophobia* or be a feature of *generalised anxiety disorder*. Anxious patients may not tolerate dental procedures without prior measures to reduce their anxiety and may find it difficult to pay attention to questions or advice, leading to difficulties in communication. One study [2] reported that in addition to apprehension about injections, common fears were seeing, hearing and feeling the vibrations of a dental drill. Specific questionnaires such as the Corah anxiety scale [3, 4] are available to assess anxiety. These are not employed by many British dentists but are more likely to be used by practitioners providing intravenous sedation [5]. Management of anxiety needs not necessarily include medication, though anxiolytics such as benzodiazepines may be beneficial in the short term. Non-medical interventions of benefit include cognitive behavioural therapy. Ideally steps should be taken to avoid the development of dental anxiety in the first instance, particularly for children. Simple measures aimed at making the dental consultation a pleasant experience may be invaluable, with judicious use of lighting and music and perhaps adjusting one's attire.

15.2.2 Paranoia

Meaning literally 'outside the mind', this term describes extreme suspiciousness or mistrust without reason. It may be a symptom of a number of disorders, including *paranoid schizophrenia*, *psychotic depression*, *mania* or *drug and alcohol misuse*. It may also be a feature of *dementia* or simply a personality trait which may or may not be part of a personality disorder. In all these conditions, paranoia may be associated with hallucinations in any modality, as well as changes in behaviour and cognitive function.

A paranoid patient may, like a dental phobic, avoid the dentist altogether. Alternatively paranoia may lead to mistrust of the dentist's advice, complaints against the dentist or seeking repeated consultations with different practitioners.

15.2.3 Depression

A lowering of mood may be a feature of many illnesses or a side effect of many common medications (e.g. beta blockers). When severe enough to affect daily life

Table 15.3 Core features of depression

Core features of depression	Additional features
Depressed mood	
Most days	Diurnal variation of mood
For most of the day	Poor appetite and weight loss
For 2 weeks or more	Sleep disturbance
Lack of energy (anergia)	Poor concentration
Loss of enjoyment (anhedonia)	Psychomotor retardation or agitation
Hopelessness and suicidal ideation	Feelings of guilt and worthlessness
Loss of libido	
Delusions and hallucinations if severe (guilt, worthlessness, poverty or disease)	

and associated with symptoms such as disturbance of sleep, appetite and reduced enjoyment of usual activities, it may be part of a syndrome of clinical depression (Table 15.3). Depressive illness is very common, affecting up to 10% of men and 20% of women at some point in their lives.

The dentist may find such patients slow to answer questions, make decisions or grasp advice given and might easily feel frustrated with their negativity or avoidance of eye contact. They may also have lower tolerance for pain or discomfort associated with dental conditions or treatment.

15.2.4 Disinhibition

This may be seen as part of a manic episode of bipolar disorder or in patients with dementia or learning disability.

Bipolar affective disorder (manic depression) is characterised by discrete episodes of elevated mood (mania or less severe hypomania) interspersed with episodes of either normal mood or periods of depressed mood. In an episode of elated mood, a patient may seem disinhibited either socially or sexually. They may be over-talkative, elated and excitable or agitated and at times dress or behave inappropriately. Concentration may be poor and patients may be unreliable historians. Although this is most likely to occur in the manic phase of bipolar disorder, alcohol, illicit drugs and occasionally prescribed medication such as steroids can cause a similar picture. Such a presentation could render dental intervention impossible during a particular visit but is most likely to make the dentist uncomfortable; a chaperone is thus advisable at all times in the interests of both dentist and patient.

15.2.5 Hyperactivity

Extreme restlessness may be a side effect of certain psychiatric drugs or a feature of stimulant drug use. Hyperactivity is most likely to be seen in children with attention

deficit hyperactivity disorder (ADHD) and its variants. It may be particularly difficult to examine an overactive child, and the environment of the dental surgery may prove hazardous. As with all children's consultations, if an examination is essential, it may be useful to try to simplify the environment as much as possible in advance. Simple calming measures such as softer lighting and music or projecting something to capture the child's attention on the ceiling may prove useful.

15.3 The Dentist May Detect a Psychiatric Illness

Some psychiatric disorders have significant dental signs and symptoms and may thus be noted for the first time in a dental consultation. This includes eating disorders, pain syndromes, use of certain illicit drugs and occasionally psychosis.

15.3.1 Eating Disorders

Induced vomiting may be a feature of either *anorexia nervosa* or *bulimia nervosa*, leading to some specific signs pertinent to the dentist. Erosion of the dental enamel, especially on the palatal surfaces, may be caused by exposure to gastric acid in vomiting. This may be associated with callusing on the dorsum of the fingers (Russell's sign). In addition to affecting the dental hard tissues, eating disorders may be the cause of mucosal lesions such as erythema, periodontitis and salivary hypofunction [6]. As well as symptoms of malnutrition and vitamin deficiency, there may be profound disturbances of electrolytes, particularly potassium, which can lead to fatal arrhythmias.

15.3.2 Pain Syndromes

Up to 50% of psychogenic pain is experienced as occurring in the head. There are four major recognised syndromes: *atypical facial pain*, *temporomandibular joint dysfunction syndrome (TMD)* (facial arthromyalgia), *atypical odontalgia* and *oral dysaesthesia*. It can be difficult to distinguish between true pain of dental origin, for which a dental intervention may be appropriate, and psychogenic

Table 15.4 Features suggestive of psychogenic pain

Inconsistency with known anatomical landmarks/nerve distribution
Bilateral
Continuous with little fluctuation
May prevent falling asleep but does not wake the patient up
History of repeated negative investigations
Analgesia has a very limited effect
Association with emotional factors
Nature of the pain may have a symbolic significance for the patient

pain, particularly as the experience for the patient is as for real pain. Certain clues in the history may suggest a psychological origin, however, and these are summarised in Table 15.4.

15.3.3 Hypochondriasis

Occasionally the dentist may see a patient convinced of the presence of an underlying disease, despite an absence of physical signs or positive investigations. Multiple minor symptoms may be presented as evidence, and these should be taken seriously, with relevant examination and investigations undertaken to exclude physical disease. If hypochondriasis is suspected, however, it is advisable to seek psychiatric help at an early stage, as prolonged investigations and repeated assessments will reinforce the illness beliefs and may in fact exacerbate the condition.

15.3.4 Substance Misuse

It is not only one patient who is at risk of substance misuse—drug and alcohol problems are high among medical and dental professionals [7]. It is therefore worth being alert to the signs of problematic substance use which, untreated, can be devastating on a personal, social and professional level.

Misuse of drugs can cause many oro-dental manifestations and interfere with dental management [8]. A few examples are given here.

Dental consequences of misuse of the stimulant *methamphetamine* may include xerostomia, bruxism (which can lead to TMD), self-neglect and a rapidly deteriorating, advanced state of dental decay known as 'meth mouth' [9].

Cocaine use can cause problems that may present to the dentist in the absence of overt dental pathology. Pain in the teeth and gums is a recognised feature of cocaine abuse and may be due to teeth grinding and jaw clenching. The localised vasoconstriction produced by cocaine can cause gingival necrosis if this area is used by abusers to test the 'quality' of the drug.

Benzodiazepine withdrawal may cause a characteristic syndrome of paraesthesia, hypersensitivity and pain in the teeth or jaw in almost 50% of patients who try to stop or reduce these drugs, making a reduction in long-term use problematic. Similar problems may occur with *opiate* withdrawal.

15.3.5 Psychosis: Hallucinations and Delusions

Sometimes paranoia may take the form of a delusion—a fixed belief that persists despite evidence to the contrary and is at odds with the individual's culture, religion and circumstances. This may occur in psychotic depression or schizophrenia as well as mania or drug use.

An example of relevance to the dentist might be a patient complaining of pain or requesting an extraction in the belief that a transmitter has been implanted in a tooth.

15.4 Dental Complications of Psychiatric Illness

Oral dystonias, drooling and bruxism may be the extrapyramidal side effects of a number of drugs used to treat psychiatric illness, primarily the older (but still used) 'typical' antipsychotics such as haloperidol, chlorpromazine and most slow-release 'depot' medications. These, and the drugs commonly used to counter such side effects, also have anticholinergic properties and may cause a dry mouth. Potential interactions with psychiatric drugs are summarised in Table 15.5.

Poor oral hygiene and general self-care may occur in chronic mental illness, resulting in advanced dental caries or infection with late presentation to the dentist. This may also occur in dementia and people with learning disabilities, occasionally requiring multiple extractions or total dental clearance.

15.5 Psychiatric Illness Present but Unrelated to Dental Problems

In many cases the presence of psychiatric illness may be of no relevance to dental management, particularly for routine work. Nonetheless it can be useful to have some understanding of certain conditions and in particular the drugs used to treat them.

Table 15.5 Potential drug interactions

Drug type	Interactions
Antidepressants	
Tricyclics (amitriptyline, clomipramine, imipramine, trimipramine, lofepramine)	Local anaesthetic: sympathomimetics (e.g. adrenaline) → hypertension and arrhythmias—not a contraindication to adrenaline but dose reduction is advised General anaesthetic (GA) → increased risk of cardiac arrhythmias and hypotension
MAOIs (monoamine-oxidase inhibitors, e.g. phenelzine)	GA → hypertension and arrhythmias Risk of hypertensive crisis—MAOI should be 2 weeks before anaesthetic
Mood stabilisers	
Lithium	Antibiotics, particularly metronidazole, may cause lithium toxicity NSAIDS, e.g. ibuprofen, diclofenac may cause lithium toxicity
Antipsychotics	GA → enhanced hypotensive effect antibiotics Erythromycin → increased risk of convulsions with clozapine
Dementia drugs	Ketamine → toxic combination with memantine
ADHD drugs	GA → hypertension with methylphenidate

15.5.1 Dementia

Dementia is defined as an acquired impairment of global cognitive function, which is generally progressive and largely irreversible. It is a disorder which is of relevance to most healthcare professionals. Alzheimer's disease is the most common cause of dementia, with a prevalence increasing significantly with age. Approximately 1% of 65-year-olds, 5% of 75-year-olds and 20% of 85-year-olds are affected [10]. Vascular dementia due to atherosclerosis is also common though there are also several other types of dementia.

The patient in the early stages of dementia may not seem cognitively impaired but may struggle to take in new information and may therefore not follow the dentist's advice. In cases of more advanced dementia, the disability will be obvious, and it may be a challenge to persuade the patient to co-operate with a dental examination. In both cases dental pain or the presence of infection may significantly exacerbate any cognitive impairment or confusion, and swift treatment can lead to dramatic improvements in function.

15.5.2 Learning Disability

'Learning disability' is the term used to describe the presence of an intellectual deficit present from childhood. It should be remembered that although a carer may seem to speak for patients with cognitive impairments, under the Mental Capacity Act (2005), all individuals over 16 years of age are presumed to have capacity unless proven otherwise. Consent should thus always be sought from the patient regardless of the apparent extent of their impairment.

15.6 The Dental Professional May Be Affected by *a Psychiatric Illness*

Most common conditions have already been mentioned; depression (see above) and alcohol misuse are perhaps the most relevant in this scenario.

15.6.1 Alcohol

Alcohol abuse may be suspected if the individual smells of alcohol or has a tremor, which could be due to withdrawal. Attention should be paid to the time of day, as those with alcohol dependence may drink early in the morning to overcome withdrawal phenomena. The CAGE questionnaire (Table 15.6) is a simple and useful screening tool to detect alcohol dependency. Patients scoring 2 or more are highly likely to have alcohol problems, but a negative CAGE response does not rule out alcohol misuse.

Table 15.6 Cage questionnaire

C:	Have you ever felt you should cut down the amount you drink?
A:	Are you annoyed if people comment upon the amount you are drinking?
G:	Do you ever feel guilty about the amount you are drinking?
E:	Have you ever had a drink early in the morning as an 'eye-opener'?

15.7 Capacity and Consent

It is easy to assume that patients suffering from significant psychiatric illnesses, dementia, learning disability or other impairments may not have the capacity to make their own decisions about treatment or to give consent; indeed dentists may at times find themselves under pressure from relatives and carers to accept their decisions made on behalf of a patient. The Mental Capacity Act (2005) [11] (introduced into practice in 2007) is an important piece of legislation designed to protect the rights of individuals to make their own decisions and provides guidelines to address this. It sets out guidance for decision-making on behalf of people who lack decision-making capacity and applies to all people aged 16 and over in England and Wales.

Decision-making capacity is considered to be task-specific, relevant only to a specific decision at a given time and should not be generalised to other situations and decisions.

There are five basic principles:

- *Autonomy*: presumption of capacity. People are presumed to have capacity until proven otherwise.
- Decision-making capacity must be maximised by all practicable means.
- An individual has the right to make an unwise decision.
- *Best interests*: decisions or acts taken on behalf of a person who is found to lack capacity must be taken in their best interests.
- *Least restrictive*: the least restrictive decision or action should be taken, where an individual is found to lack decision-making capacity.

Capacity should be assessed by the person who is proposing treatment and seeking consent, using a standard two-part question:

1. Is there an impairment of, or a disturbance in the functioning of, the mind or brain?
2. If so, does its presence impair the person's ability to make a particular decision?

A staged test adapted from common law must then be applied, looking at the decision-making process itself:

'A person is unable to make a decision for himself if he/she is unable:

(a) To understand the information relevant to the decision
(b) To retain that information (for at least long enough to make the decision)

(c) To use or weigh that information as part of the process of making the decision, or
(d) To communicate his/her decision (whether by talking, using sign language or any other means).

Relevant information should be provided in a manner appropriate to the needs of the patient, involving an interpreter where necessary, and the patient should be similarly aided in communicating his/her decision. There is also a requirement to attempt to determine whether a lasting power of attorney (LPA) exists, appointing someone to act on their behalf in relation to health and welfare decisions.

If an individual is found to be lacking the capacity to make a particular decision, there are two possible courses of action—either to defer treatment and reassess or to act in 'best interests'. 'Best interests' must be determined on an individual basis, taking into account all possible sources of information and may require the involvement of an independent mental capacity advocate (IMCA). The Act contains guidance for doing this.

Further information is contained within the Mental Capacity Act and its Code of Practice, and guidance is freely available for healthcare professionals through organisations such as the British Medical Association [12].

15.8 What to Do When Problems Arise

There are no hard and fast rules about who should or should not be referred for further assessment. A number of scenarios may arise in dental practice:

- New presentation of psychiatric illness—such patients should be encouraged to speak to their general medical practitioner (GMP) about whatever symptoms have been noticed. It is not necessary to suggest it may be due to psychiatric illness.
- Deterioration of existing illness—these patients should be asked to speak to their GMP or existing psychiatric services.
- Overt suicidal ideation (either as new or altered presentation)—such patients should be advised to speak to their GMP or go to A&E, or the on-call psychiatric services or police should be contacted directly.
- Patient presenting an immediate danger to others—call the police.
- You or a colleague needs help—a GMP or A&E should be able to help or contact the confidential Dentists' Health Support Programme.

15.9 Psychiatric Assessment

As with all assessments, the psychiatric history focuses on the presenting complaint, followed by detailed contextual information including previous psychiatric problems, physical health problems, medication and a detailed developmental,

personal and social history. A physical examination remains relevant and can reveal many clues as to the source of the psychiatric symptoms (e.g. hyper- or hypothyroidism, needle tracks from injection of illicit drugs, neurological abnormalities). The main difference in a psychiatric assessment is the mental state examination, which requires careful observation of the patient and provides valuable clues as to which diagnosis should be reached (Table 15.7), and the risk assessment.

15.10 Risk Assessment

Contrary to what the media would have us believe, patients with psychiatric illness are rarely a risk to others. Around 5% of all homicides are committed by people with a diagnosis of schizophrenia. Drug or alcohol abuse, however, are thought to contribute to over half of all murders. Far more likely is the risk to self, either through self-neglect due to illness, self-harm or suicide. While the best predictor of future behaviour is past behaviour, there are also a number of risk factors recognised to increase the likelihood of suicide, not all of which may be modified. Some of these are summarised in Table 15.8.

Along with doctors and lawyers, dentists are recognised as a group of professionals at a high risk of mental health problems including drug and alcohol misuse and suicide. Recognising and understanding problems in oneself or in colleagues may be just as important as recognising and understanding them in our patients.

Table 15.7 Mental state examination

Appearance and behaviour	How are they dressed? Are they clean? Shaven? Well-groomed, or dishevelled and unkempt or flamboyantly or scantily dressed for the weather? Still in their pyjamas or slippers?
	Do they seem withdrawn or slowed down? Overactive or intrusive? Jumpy or on edge? Are they aggressive? Are there any notable mannerisms or unusual movements?
Speech	Fast or slow, quiet or loud, monotonous, repetitive, slurred or stuttering?
Thoughts	Form—are they in an ordered flow or disordered, fragmented and disconnected?
	Content—is there a particular preoccupation? Are there unusual beliefs which are held firmly and may not be based in reality (delusions)?
Mood	Objective (practitioner's view) and subjective (the patient's view)—elated, depressed, neither?
	Reactivity—is there an emotional response to sad or funny material? Is the response as would be expected?
Abnormal sensory experiences	Hallucinations—do they seem to be responding to sensory stimuli which cannot be detected? Or are there misperceptions of stimuli?
Cognitive functioning	Orientation—do they know where they are in time and place and who they are?
	Memory—can they recall how they got there? Can they recall their last appointment, or what advice they received?
	Concentration—are they following discussion? Where is their attention? Poor concentration may make memory seem impaired
Insight	Do they recognise there is a problem? Do they understand it? Are they willing to receive help or treatment?

Table 15.8 High risk characteristics for suicide

Male > Female
Age > 40 years (increasing in young men)
Evidence of planning
Social classes I and V
Certain occupations: dentists, doctors, vets, lawyers
Unemployed
Living alone
Not married
Loss events: relationships, housing, finance

15.11 Conclusion

Psychiatric problems are common and are likely to be encountered in routine dental practice. Many disorders have common symptoms that may be managed using the same general guiding principles, aiming to alleviate distress and anxiety and respecting the individual's autonomy. Communication with carers may be important, as well as liaising with the patient's GMP or psychiatric services when necessary.

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Cancer, Radiotherapy and Chemotherapy and Dental Practice

16

In Brief

- Dentists will encounter patients with various types of cancer who require dental care.
- Patients may be at various stages of cancer treatment but the dentist may be involved at any stage.
- A working knowledge of the potential effects of cancer and its treatment is essential for safe practice.

Dental practitioners will encounter patients who have been affected by cancer or who are current cancer patients. Dentists play an important role in the overall healthcare of such patients, particularly in those with head and neck malignancy. This chapter gives an overview of the impact of cancer and its treatment on dental management.

16.1 Introduction

Cancer is the term applied to malignant tumours and is essentially a genetic disease caused by somatic mutation. The multistage theory of carcinogenesis suggests that individual cancers arise from several sequential mutations in cellular DNA. There is a close correlation between cancer incidence and increased age, reflecting the time required to accumulate the critical number of genetic abnormalities needed for malignant change. Improvement in cancer treatment outcomes means that in modern clinical practice, a general dental practitioner will have to advise and treat many patients requiring oral healthcare with malignancies at various stages of the disease.

M. Greenwood, J. G. Meechan, *General Medicine and Surgery for Dental Practitioners*, BDJ Clinician's Guides,
https://doi.org/10.1007/978-3-319-97737-9_16

16.2 Points in the History

As a consequence of their malignancy, patients with cancer may suffer from a number of general physical, medical and emotional problems. It is important that dental practitioners have an understanding not only of the effects of malignant disease on their patient but also of the specific problems resulting from cancer treatments (Table 16.1). While the range, symptomatology and diagnosis of malignant neoplasms presenting in the head and neck region will be well known to dentists (Table 16.2), the effects of cancer treatment may not be, and it is often this area that leads to confusion and compromised dental care.

In general, malignant neoplasms are treated using one or some combination of the following treatment modalities:

- Surgery
- Radiotherapy
- Chemotherapy

The patient may give a history of having experienced such treatment, may be undergoing it or waiting for it. The selection, timing and prescription of these anticancer treatments are now the remit of highly specialised multidisciplinary oncology teams and vary considerably depending upon tumour type and site. While the principles of surgical access, tumour resection with wide margins and tissue

Table 16.1 General complications of cancer

Cachexia and wasting
Anaemia and infection
Nutritional deficiencies
Cutaneous manifestations
Endocrine disorders
Rare manifestations

Table 16.2 Orofacial manifestations of cancer

Primary tumours in orofacial tissues
Oral squamous cell carcinoma
Salivary adenocarcinoma
Metastases in jaws or oral soft tissues
From breast, lung and prostate primaries
Effects of tumour metabolites
Facial flushing
Pigmentations
Amyloidosis
Oral erosions
Functional disturbances
Purpura
Bleeding
Infections
Anaemia

reconstruction are familiar to dentists, particularly in relation to orofacial cancers, the mechanism of action, efficacy and side-effects of radiotherapy and chemotherapy are often less well understood.

A patient may give a history of planned or previous radiotherapy. It is possible, but more unlikely, that they are undergoing radiotherapy at the time of attendance for dental treatment. Radiotherapy refers to the therapeutic application of localised ionising radiation (X-rays, beta rays or gamma rays) to destroy malignant cells. Cells exposed to radiation form free radicals in their intracellular water and, as a result of DNA damage, undergo death when stimulated to divide. Radiotherapy is thus particularly effective against rapidly proliferating tumour cells which are killed more efficiently than slowly growing or normal cells. While this is a considerable advantage in cancer treatment, it does not spare normal cells with high replication rates such as epithelium of skin and mucous membranes or highly specialised cells in neurological tissue, salivary gland secretory tissue or osteoblasts in bone which, when damaged, are unable to repair themselves. Other types of radiation may also be employed; for example, radioactive iodine (given orally or by intravenous injection) can be used to treat thyroid cancers. Such treatment can affect the function of the salivary glands [1].

Patients may reveal a history of chemotherapy or be awaiting or undergoing this modality of treatment. The use of chemotherapeutic agents (anticancer drugs) is most often employed systemically in the treatment of widespread malignancies such as leukaemia or lymphoma, although more recent recognition of early systemic spread of solid tumours such as breast cancer and even head and neck malignancy has resulted in greater use of chemotherapy in modern treatment protocols.

Chemotherapy agents (Table 16.3) target actively dividing cells to eliminate tumours while allowing normal cells to recover and repair. Drugs are usually administered in high doses intermittently and often in combination to achieve synergy and overcome resistance. Newer head and neck regimens utilise chemotherapy agents administered as radiosensitisers before radiotherapy to increase treatment efficacy, but this may also enhance treatment side effects.

Table 16.3 Chemotherapy drugs and regimens

Drug classification	Examples	
Alkylating agents	Busulfan, chlorambucil, cyclophosphamide	
Cytotoxic antibiotics	Bleomycin doxorubicin	
Antimetabolites	Fluorouracil methotrexate	
Vinca alkaloids	Vinblastine vincristine	
Platinum compounds	Cisplatin	
Treatment regimen	Administration	Aim
Induction	Before other treatments	Reduce tumour size
Sandwich	Between treatments	Reduce risk of metastases
Adjuvant	After treatment	Improve disease-free survival
Concurrent	With other treatments	Sensitise tumour cells
Palliative	After other treatments	Shrink residual tumours pain relief

16.3 Examination

The patient with cancer may look relatively well or may be cachectic. The term cachexia refers to a profound and marked state of constitutional disorder, general ill health and malnutrition. The signs and symptoms of oral cancer are well covered in relevant texts and therefore will not be covered further here.

The orofacial region contains one of the highest concentrations of specialised tissues and sensory organs in the body, and it is hardly surprising that the effects of cancer treatment are particularly severe here. The cellular damage effects of radiotherapy and chemotherapy produce similar effects on oral tissues, although more widespread and systemic complications occur following chemotherapy. Table 16.4 lists the oral complications of radiotherapy and chemotherapy which may be seen on examination.

Mucositis is a particularly distressing condition arising from damage to the oral mucosal lining. It presents as widespread oral erythema, pain, ulceration and bleeding. It may arise during localised head and neck radiotherapy or as a consequence of systemic chemotherapy. Although acute and usually relatively short-lived problem, it can significantly impair quality of life and prevent oral dietary intake leading to hospitalisation. If it is particularly severe, it may cause interruption to therapeutic regimens and can act as a portal for septicaemia.

Xerostomia is responsible for the most common and long-standing problems following orofacial radiotherapy. Salivary gland function rarely recovers following secretory cell damage, and while newer computerised radiotherapy techniques help to spare full salivary gland irradiation, it remains difficult to avoid gland damage. As mentioned above, salivary gland damage may also occur secondary to the use of radioactive iodine for the destruction of thyroid tumours.

Permanent mouth dryness, glutinous sputum in the posterior oral cavity and pharynx and reduction of or altered taste, together with fragile and sensitive oral mucosa, are significant post-radiotherapy sequelae impairing a patient's quality of life. Xerostomia also increases the risk of rapidly destructive dental caries ('radiation caries') and advanced periodontal disease. Artificial saliva preparations

Table 16.4 Oral complications of cancer therapy

Radiotherapy
Mucositis/ulceration
Radiation caries/dental hypersensitivity/periodontal disease
Xerostomia/loss of taste
Dysphagia
Candidosis
Osteoradionecrosis
Trismus
Craniofacial defects (children)
Chemotherapy
Mucositis/ulceration/lip cracking
Infections
Bleeding
Orofacial pain

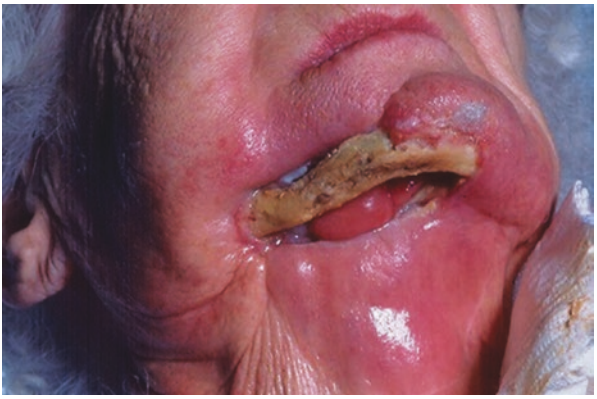

Fig. 16.1 A patient with osteoradionecrosis. The overlying skin has broken down due to its poor blood supply

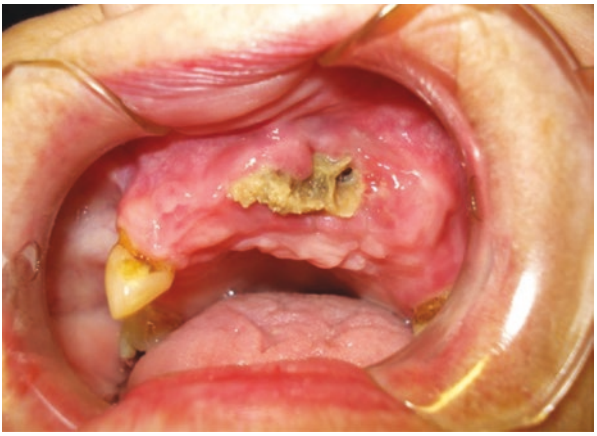

Fig. 16.2 Osteonecrosis in a patient who has been prescribed bisphosphonates and has had dental extractions in this area

including saliva sprays, replacement gels or pastilles may be helpful. Oral administration of pilocarpine may help to increase flow in patients with residual salivary gland function.

Infections are common due to immunosuppression, especially candidal and herpetic types. Appropriate use of antifungal agents such as miconazole or systemic fluconazole may be necessary to treat severe oral candidosis.

The lesions of osteoradionecrosis, as shown in Fig. 16.1 (nonvital bone secondary to radiotherapy), or osteonecrosis, as in Fig. 16.2 (nonvital bone secondary to bisphosphonate treatment) may be evident and should be managed as described in the next section.

16.4 Dental Management of Head and Neck Cancer Patients

The important management principles for patients undergoing radiotherapy for head and neck malignancy are summarised in Table 16.5. The general dental practitioner has an important role in management. It is important that the patient is rendered dentally fit before the commencement of radiotherapy treatment. This also applies to patients who are about to receive chemotherapy. The principles of management are summarised in Table 16.6.

The importance of general dental care and oral hygiene, especially for head and neck cancer patients, cannot be emphasised too strongly. A comprehensive dental assessment and proactive preventive treatment plan are mandatory before definitive head and neck cancer treatment. While this is often led by specialist restorative dentists working in multidisciplinary oncology teams, the role of the general dental practitioner remains central.

Patients undergoing radiotherapy for orofacial cancers need dental input to minimise radiation caries, the need for post-radiotherapy dental extractions, and to reduce the risk of osteoradionecrosis. Extractions are advised for grossly

Table 16.5 Management of patients receiving head and neck radiotherapy

Before radiotherapy
Oral hygiene/preventive and restorative dentistry
Risk/benefits of retaining teeth
Dental extractions
During radiotherapy
Discourage smoking and alcohol
Eliminate infections: antibiotics/antifungals/antivirals
Relieve mucositis
Saliva substitutes
TMJ physiotherapy for trismus
After radiotherapy
Oral hygiene/preventive dentistry
Specialist OMFS for dental extractions/oral surgery
Topical fluorides
Avoidance of mucosal trauma
Saliva substitutes

Table 16.6 Management of patients receiving chemotherapy

Before chemotherapy
Oral/dental assessment
Oral hygiene/preventive dentistry
During chemotherapy
Folic acid to reduce ulceration
Ice to cool oral mucosa
Chlorhexidine mouthwashes
Eliminate infections: antibiotics/antifungals/antivirals
After chemotherapy
Oral hygiene/preventive dentistry
Risk of anaemia/bleeding/infection

carious, nonvital, periodontally involved teeth or retained roots, and their removal should be performed carefully before radiotherapy starts to ensure rapid healing.

Osteoradionecrosis arises due to the death of irradiated and lethally damaged bone cells stimulated to divide following traumatic stimuli such as dental extractions or localised infection (Fig. 16.1). Diminished vascularity of the periosteum also exists as a result of late radiation effects on endothelial lining cells, which is particularly pertinent for the dense and less vascular mandibular bone. The radionecrotic process usually starts as ulceration of the alveolar mucosa with brownish dead bone exposed at the base. Pathological fractures may occur in weakened bone, and secondary infection leads to severe discomfort, trismus, foetor oris and general malaise. Radiographically, the earliest changes are a 'moth-eaten' appearance of the bone, followed by sequestration.

Treatment should be predominantly conservative, with long-term antibiotic and topical antiseptic therapy and careful local removal of sequestra when necessary. Hyperbaric oxygen and ultrasound therapy to increase tissue blood flow and oxygenation have also been recommended [2] and are used as a treatment modality in the UK [3].

Osteonecrosis is a recognised complication of bisphosphonate treatment [4] (Fig. 16.2). This condition is defined as exposed bone in the maxillofacial region for longer than 8 weeks in the absence of radiotherapy but in a patient using bisphosphonates. It is diagnosed clinically but local malignancy must be excluded [5]. Bisphosphonates are a group of drugs, including alendronic acid, disodium etidronate and risedronate sodium, which are adsorbed onto hydroxyapatite crystals, thus slowing their rate of growth and dissolution. They have been used in treatment of bony metastases, the hypercalcaemia of malignancy and the management of osteoporosis in post-menopausal women.

Dental extractions should be avoided wherever possible while patients are on bisphosphonate therapy to reduce the risk of necrosis. Established cases require analgesia, long-term antibiotic and topical antiseptic therapy, together with careful local debridement to remove limited bony sequestra similar to the management of osteoradionecrosis [6]. Risk factors that will increase the possibility of osteonecrosis development include local infection, steroid use, trauma, chemotherapy and periodontal disease.

The mechanism by which bisphosphonates increase the risk of osteonecrosis is not fully understood. Trauma caused by dental extraction in the presence of impaired osteoclast function may cause inadequate clearance of necrotic debris. Local osteonecrosis may also occur due to secondary infection. It is also thought that bisphosphonates might have toxic effects on soft tissues around the extraction site and thereby impair the function of vascular and epithelial cells [5].

Chemotherapy agents are inevitably highly toxic and risk important systemic effects such as infections and bleeding due to bone marrow involvement and resultant neutropenia and thrombocytopaenia. It is important to liaise with an individual patient's oncologist to ensure dental or oral surgical treatments are timed to avoid periods of maximum bone marrow depression.

Management of established mucositis includes systemic analgesia, the use of intraoral ice and topical analgesics such as benzydamine hydrochloride or 2% lidocaine lollipops or mouthwash.

Subsequent to radiotherapy and chemotherapy, meticulous oral hygiene is essential, especially during treatment when the mouth is inflamed and sore. Dilute chlorhexidine mouthwashes, topical fluoride applications, saliva substitutes and active restorative care may all be needed to preserve the remaining dentition. Should teeth have to be extracted, this is best carried out in a specialist oral and maxillofacial surgery unit, and it is essential that atraumatic techniques are used, with primary closure of the oral mucosa together with antibiotic therapy until healing is complete. Similar considerations apply to patients taking bisphosphonates. The timing of extractions in patients undergoing chemotherapy is critical. This should be co-ordinated with the treating oncologist so that the ideal 'window of opportunity' is used.

16.5 Effects of Drugs Used in Patients with Oral Malignancy on Dental Management

As mentioned above, many drugs used in the management of malignant disease will affect white cell and platelet numbers. This means that bleeding and infection are risks of surgical dentistry such as extractions. A full blood count is needed to ensure that any extractions can be performed safely. Elective extractions should be carried out when the blood picture is normal; however emergency extractions may need to be performed. If the platelet count is less than 50×10^9 per litre, then intra-oral surgery is contraindicated unless a platelet transfusion can be provided; if less than 100×10^9 per litre, then sockets should be packed with a haemostatic agent such as Surgicel® and sutured. If the white cell count is less than 2.5×10^9/L, then prophylactic antibiotics are recommended.

It was mentioned above that xerostomia and stomatitis are side-effects of radiotherapy. These can also be unwanted effects of some drugs used to treat malignancy. Thus excellent oral hygiene and caries prevention measures such as the use of fluoride are recommended. If dentures are ill-fitting, these should be removed as they may worsen drug-induced mucositis.

Some of the drugs used to treat malignancies will interfere with medications dentists might prescribe. Examples include paracetamol and metronidazole, both of which increase the toxicity of busulphan by inhibiting metabolism and increasing plasma concentration of the cytotoxic drug. Similarly, erythromycin increases the toxicity of the chemotherapeutic drug vinblastine. The toxicity of methotrexate is increased with concomitant administration of non-steroidal anti-inflammatory drugs, penicillins and tetracyclines. These are just some examples of pertinent drug interactions. The dentist should consult a publication such as the *British National Formulary* or discuss with the patient's oncologist if there is any doubt about prescribing another medication.

Patients who have received treatment for childhood cancers may have dentofacial abnormalities as normal development may have been compromised. Problems such as poor root formation, enamel defects, prominent incremental lines in dentine and facial asymmetry may arise [7, 8].

16.6 Conclusions

Many patients with cancer will present to their dental practitioner requiring routine dental care or specific attention to oral complications resulting from malignancy or radiotherapy and chemotherapy treatments. It is imperative that dental practitioners make an appropriate assessment of the patient's general medical status (including nutrition, debilitation and haematology) before embarking upon dental care. Prevention is vital throughout to avoid worsening dental disease in patients with compromised general health.

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The Drug Box, Equipment and Basic Principles of Management

17

In Brief

- The currently recommended contents of the emergency drug box are highlighted.
- The ABCDE approach to the sick patient is discussed.
- The importance of defibrillation is included.

17.1 Introduction

Medical emergencies in dental practice are uncommon but can occur at any time. A study from Germany has shown that the incidence of medical emergencies in the dental environment may be more common than often thought [1]. All members of the dental team need to be aware of their role in the event of a medical emergency and should be trained appropriately with regular practice sessions.

Anticipation of potential medical emergencies that might arise should be highlighted by taking a thorough medical history. A risk assessment should be made by considering the patient's American Society of Anaesthesiologists (ASA) classification category. The ASA classification is summarised in the Box 17.1. If medication is normally used, a check should always be made to ensure that this has been taken as usual.

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https://doi.org/10.1007/978-3-319-97737-9_17

Box 17.1 The ASA Classification

- ASA I healthy
- ASA II mild systemic disease—no functional limitation
- ASA III severe systemic disease—definite functional limitation
- ASA IV severe disease—constant threat to life
- ASA V moribund
- ASA VI patient being ventilated for organ donation purposes

The management of specific medical emergencies is considered in the next chapter in this series. This chapter considers principles of management.

17.2 The Emergency Drug Box

Patients should only undergo dental treatment in situations where appropriate equipment and drugs are available and have not passed their expiry date.

A minimum list of drugs to be included in the emergency drug box are summarised in Table 17.1. The list is based on that given in the Resuscitation Council (UK) document on Medical Emergencies and Resuscitation in Dentistry [2].

The Resuscitation Council (UK) recommends that such kits should be standardised [2]. Wherever possible, they recommend that drugs in solution should be carried in a pre-filled syringe or kit (Fig. 17.1). All drugs should be stored together, ideally in a purpose-designed container.

The intravenous route for emergency drugs is no longer recommended for dental practitioners. Formulations have now been developed that allow other routes to be used. These are quicker and user-friendly. Oxygen must always be available in a format that allows delivery at flow rates up to 15 l per minute.

Table 17.1 Contents of the emergency drug box and routes of administration

Drug	Route of administration
• Oxygen	Inhalation
• Glyceryl trinitrate (GTN) spray (400 µg per actuation)	Sublingual
• Dispersible aspirin (300 mg)	Oral (chewed)
• Salbutamol aerosol inhaler (100 µg per actuation)	Inhalation
• Adrenaline injection (1:1000, 1 mg/ml)	Intramuscular
• Glucagon injection (1 mg)	Intramuscular/subcutaneous
• Oral glucose solution/gel (GlucoGel®)[a]	Oral
• Midazolam 10 or 5 mg/ml (buccal or intranasal)	Infiltration/inhalation

[a]Alternatives: two teaspoons of sugar/3 sugar lumps; 200 ml milk; non-diet Lucozade® 50 ml; Coca-cola® non-diet 90 ml. If necessary this can be repeated at 10–15 min

Fig. 17.1 A "Glucagon kit" with water for dilution already drawn up and powder for reconstitution. Kits such as these can save valuable time in managing emergencies, in this case hypoglycaemia

17.3 Equipment and Training

The Resuscitation Council (UK) has recommended the equipment shown in Table 17.2 [2] as the minimum that should be available. Named individuals should be nominated to check equipment. This should be carried out at least weekly and audited.

It is a public expectation that automated external defibrillators (AEDs) should be available in the healthcare environment and dentistry is not considered an exception [2]. All emergency medical equipment should be latex-free and single-use wherever possible.

17.4 Staff Training

Staff should be trained in the management of medical emergencies to a level which is appropriate to their level of clinical responsibility. This training should be updated on at least an annual basis. It is important that new members of staff have medical emergency training incorporated into their induction programme. A full record should be kept of training. Staff should know who to contact in the event of help being required, and designated emergency phone numbers should be readily available.

Table 17.2 Suggested minimum equipment for medical emergency management (adapted from Resuscitation Council (UK))

• Portable oxygen cylinder (D size) with a flowmeter and pressure reduction valve
• Oxygen face mask with tubing
• Oropharyngeal airways–sizes 1, 2, 3 and 4 (Fig. 17.4)
• Pocket mask with port for oxygen
• Bag and mask apparatus (1 l bag capacity) with oxygen reservoir
• Well-fitting face masks
• Portable suction
• Single-use sterile syringes and needles
• "Spacer" device for inhaled bronchodilators
• Blood glucose measurement device (Fig. 17.7)
• Automated External Defibrillator (AED)—Fig. 17.8

17.5 The "ABCDE" Approach

Medical emergencies can often be prevented by early recognition. Signs such as abnormal patient colour, pulse rate or breathing can signal an impending emergency.

It is important to have a systematic approach to an acutely ill patient and to remain calm. The principles are summarised in the "ABCDE" approach (Table 17.3).

Ensure that the environment is safe. It is important to call for help at an early stage—this includes anything from other members of the dental team to calling for an ambulance with paramedic support. A continuous reappraisal of the patient's condition should be carried out. The airway must always be the starting point for this. Without a functioning, oxygenated airway, all other management steps are futile. It is important to assess the success or otherwise of manoeuvres or treatments given, remembering that some therapies may take time to work.

If the patient is conscious, ask them how they are. This may give important information about the problem (e.g. the patient who cannot speak or tells you that they have chest pain). If the patient is unresponsive, the patient should be shaken and asked "Are you all right?" If they do not respond at all, have no pulse and show "no signs of life", they have had a cardiac arrest and should be managed as described later. They may respond in a breathless manner and should be asked "Are you choking?" [3].

17.5.1 Airway (A): Assessment and Management

Airway obstruction is a medical emergency and must always be managed quickly. Usually, a simple method of clearing the airway is all that is needed. A head tilt, chin lift (Fig. 17.2) or jaw thrust (Fig. 17.3) will open the airway. Patients who are suddenly unable to speak are in real danger, and establishing a patent airway is critical. It is important to remove any visible foreign bodies, blood or debris, and the use of suction may be beneficial. Clearing the mouth should be done with great care with a "finger sweep" in adults to avoid pushing material further into the upper airway.

Table 17.3 The ABCDE approach to an emergency patient

A	Airway
B	Breathing
C	Circulation
D	Disability (or neurological status)
E	Exposure (in dental practice, to facilitate placement of AED paddles) or appropriately exposing parts to be examined

Fig. 17.2 A demonstration of head tilt, chin lift

Simple adjuncts, such as oropharyngeal airways (Fig. 17.4), may be used. An impaired airway may be recognised by some of the signs and symptoms summarised in Table 17.4.

It is important to administer oxygen at high concentration (15 l/min) via a well-fitting face mask with a port for oxygen (Fig. 17.5) and a rebreathe mask. Even patients with chronic obstructive pulmonary disease who retain carbon dioxide

Fig. 17.3 A demonstration of jaw thrust

Fig. 17.4 Oropharyngeal airways

should be given a high concentration of oxygen. Such patients may depend on hypoxic drive to stimulate respiration, but in the short-term, a high concentration of oxygen will do no harm.

Table 17.4 Signs of airway obstruction

• Inability to complete sentences or speak
• "Paradoxical" movement of chest and abdomen ("see-saw" respiration)
• Use of accessory muscles of respiration
• Blue lips and tongue (central cyanosis)
• No breathing sounds (complete airway obstruction)
• Stridor (inspiratory)—obstruction of larynx or above
• Wheeze (expiratory)—obstruction of lower airways, e.g. asthma or chronic obstructive pulmonary disease
• Gurgling—suggests liquid or semi-solid material in the upper airway
• Snoring—the pharynx is partly occluded by the soft palate or tongue

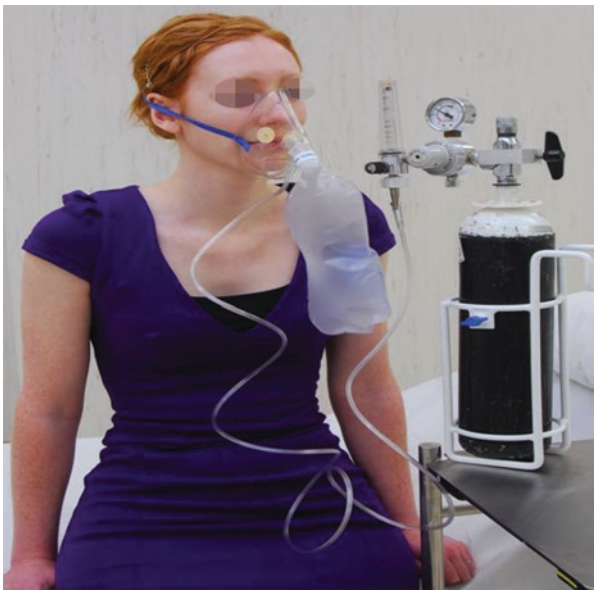

Fig. 17.5 An oxygen cylinder and mask applied to a patient

17.5.2 Breathing (B) and Circulation (C)

Look, listen and feel for signs of respiratory distress. This should be done whilst keeping the airway open, and the clinician should:

- Look for chest movement.
- Listen for breath sounds at the victim's mouth.
- Feel for air on the rescuer's cheek with the rescuer's head turned against the patient's mouth.
- This should be done for no more than 10 s to determine normal breathing.
- If there is any doubt as to whether breathing is normal, action should be as if it is not normal, i.e. to commence cardiopulmonary resuscitation (CPR).

Agonal gasps refer to abnormal breathing present in up to 40% of victims of cardiac arrest. CPR should therefore be carried out if the victim is unconscious

(unresponsive) and not breathing normally. Agonal gasps should not delay the start of CPR as they are not normal breathing.

If the patient is breathing normally, the patient should:

- Be turned into the recovery position (essentially on their side—best learnt as a practical exercise).
- Send for help or call for an ambulance.
- Ensure that breathing continues.

If the patient is not breathing normally

- Ensure an ambulance is called; this may necessitate leaving the victim, but in a dental setting, the practitioner should not be working alone.
- Chest compressions should be started with the patient in the fully supine position on a firm surface.
  - Kneel/stand at the side of the patient.
  - Place the heel of one hand in the centre of the patient's chest and the other hand on top of the first hand—it will usually be possible to do this without removing the victim's clothes. If there is any doubt, outer clothing should be undone/removed.
  - Interlock the fingers of both hands avoiding pressure over the ribs, upper abdomen or the lower end of the sternum.
  - The clinician should be positioned vertically above the patient's chest. With straight arms the sternum should be depressed 4–5 cm.
  - After each compression all the pressure should be released so that the rib cage recoils to its rest position, but the hands should be maintained in contact with the sternum.
  - The rate should be approximately 100 times per minute (a little less than 2 compressions per second)
- After 30 compressions, the airway should be opened using head tilt and chin lift, and two rescue breaths should be given. This may be carried out using a bag and mask or mouth-to-mouth resuscitation (with the nostrils closed between thumb and index finger) or mouth-to-mask.
- Practical skills are best learnt on a resuscitation course, but certain principles are given below:
  - Inflations should make the chest rise. About 1 s should be taken to do this.
  - The chest should be allowed to fall whilst maintaining the airway. Two rescue breaths should be given.
  - Hands should be returned to the sternum without delay to continue the chest compressions in a ratio of 30:2.
- Only stop to recheck the patient if normal breathing starts; otherwise resuscitation should be continued until:
  - Qualified help takes over
  - The rescuer becomes exhausted

If rescue breaths do not make the chest rise:

- Check for visible obstruction(s) in the mouth and remove it/them if possible.
- Make sure that the head tilt and chin lift are adequate.
- Do not waste time attempting more than two breaths each time before continuing chest compressions.

Carrying out these manoeuvres is tiring, and if there is more than one rescuer, CPR should be alternated between them every 2 min. The algorithm for adult basic life support is given in Fig. 17.6.

17.5.3 Circulation (C)

Circulatory assessment should never delay the start of CPR. Simple observations to make a gross assessment of circulatory efficiency are given in Table 17.5. By far the most common cause of a collapse that is essentially circulatory in origin is the simple faint (vasovagal syncope). A rapid recovery can be expected in these cases if the patient is laid flat and the legs raised. Prompt management is required as cerebral hypoxia has devastating consequences if prolonged. Causes other than a faint must be considered if recovery does not happen quickly.

Checking the carotid pulse to diagnose cardiac arrest can be unreliable, even when attempted by some healthcare professionals [4]. Checking the carotid pulse

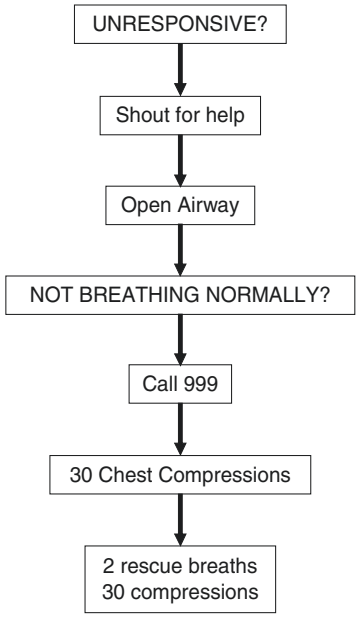

Fig. 17.6 Algorithm for Basic Life Support in an adult patient

Table 17.5 Simple methods of circulatory assessment

Signs
• Are the patient's hands blue or pink, cool or warm?
• What is the capillary refill time?[a]
• Pulse rate (carotid or radial artery), rhythm and strength
Symptoms
• Is there a history of chest pain/does the patient report chest pain?

[a]If pressure is applied to the finger nail to produce blanching, the colour should return in less than 2 s in a normal patient. Remember that local causes such as a cold environment could also delay the response

should only be carried out by those proficient in doing this. The latest guidelines highlight the need to identify agonal gasps (as well as the absence of breathing) as a sign to commence CPR and lay no particular emphasis on checking the carotid pulse.

17.5.4 Disability (D)

The term disability refers to an assessment of the neurological status of the patient. Primarily it refers to the level of consciousness (in trauma patients a more widespread neurological examination is required). Hypoxia and hypercapnia (increased blood levels of carbon dioxide) are possible causes, together with certain sedative or analgesic drugs.

It is important to exclude hypoxia or hypotension as a cause for any alternation in conscious level. Attention to the airway, giving supplemental oxygen and supporting the patient's circulation (by lying them supine and raising their legs) will in many cases solve the problem. All unconscious patients who are breathing and have a pulse should be placed in the recovery position if they are unable to protect their own airway.

A rapid gross assessment can be made of a patient's level of consciousness using the AVPU method: Are they *A*lert? Do they respond to *V*ocal stimuli? Do they respond to *P*ainful stimuli? Or are they *U*nresponsive?

A lapse into unconsciousness may be to the result of hypoglycaemia—if the blood glucose level is less than 3 mmol/l when checked by a glucose measuring device (Table 17.2 and Fig. 17.7), then glucagon should be injected by the subcutaneous or intramuscular route.

17.5.5 Exposure (E)

Exposure refers to loosening or removal of some of the patient's clothes, for example, for the application of defibrillator paddles (in dental practice), or if the patient has been involved in a traumatic incident (usually in hospital), for examination

Fig. 17.7 A glucometer

Table 17.6 Possible causes of cardiac arrest

• Arrhythmia (most common type ventricular fibrillation or VF)
• Myocardial infarction (may lead to an arrhythmia)
• Choking
• Bleeding
• Drug overdose
• Hypoxia

purposes. It is important to bear in mind the patient's dignity as well as the potential for clinically significant heat loss.

Cardiac arrest can occur as a result of several causes. These are summarised in Table 17.6. It has been suggested [5] that cardiopulmonary resuscitation can be performed effectively in the dental chair.

Interruptions to chest compression in resuscitation are common and are associated with a reduced chance of survival [6]. Chest compression-only CPR is a way to increase the number of compressions but is only effective for a period of about 5 min [6]. For this reason the technique is not recommended. The principle on which

compression-only CPR works is that during the first few minutes after a non-asphyxial cardiac arrest (in an adult), the blood oxygen content remains high, and therefore at this stage, ventilation is less important than chest compression.

17.6 Defibrillation

Defibrillation refers to the termination of fibrillation. It is achieved by administering a controlled electrical shock to the heart, which may restore an organised rhythm enabling the heart to contract effectively. Early defibrillation is important. Ventricular fibrillation (VF) is the most common cause of cardiac arrest. It is a rapid and chaotic rhythm, and as a result the heart is unable to contract effectively. The only effective treatment for VF is defibrillation, and the sooner the shock is given, the greater the chance of survival [7].

The provision of defibrillation has been made easier by the development of automatic external defibrillators (AEDs) (Fig. 17.8). AEDs use voice and visual prompts to guide rescuers and are suitable for use by lay people and healthcare professionals [8]. The device analyses the victim's heart rhythm, determines the need or otherwise for a shock and then delivers a shock. The AED algorithm is given in Fig. 17.9. CPR should not be interrupted or delayed to set up the AED.

17.6.1 Placement of AED Pads

Use of the AED is a skill that requires practical training and experience. The victim's chest must be sufficiently exposed. Excessive chest hair can stop the pads adhering properly and if markedly so must be rapidly removed if possible. Razors are available in AED kits. Resuscitation should never be delayed for this reason.

One pad should be placed to the right of the sternum below the clavicle and the other in the left side mid-axillary line, centred on the fifth intercostal space. This electrode works best if orientated vertically. This position should be clear of any breast tissue.

Fig. 17.8 An AED

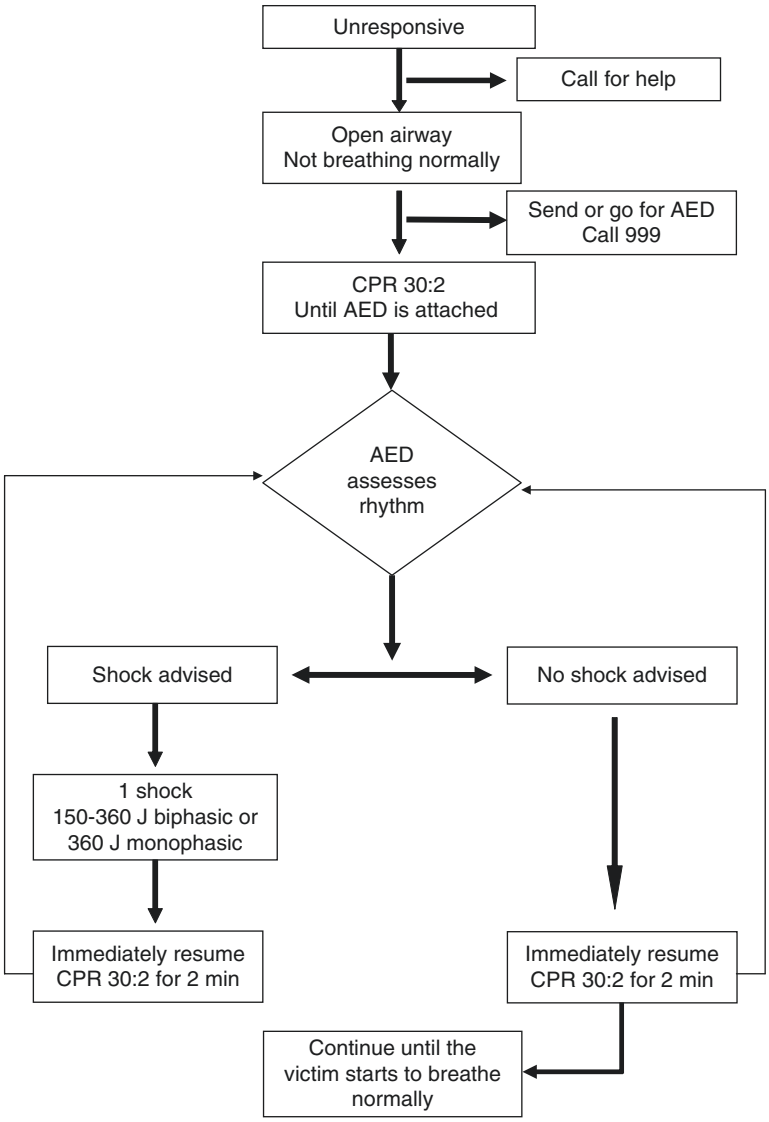

Fig. 17.9 AED algorithm

17.7 Ongoing Management after Initial Treatment of a Medical Emergency

An ambulance with paramedic support should be called at the earliest opportunity as part of the management of any significant medical event. If the dental practitioner feels competent and confident that the emergency has been managed satisfactorily and the patient is stable, they should still not be allowed to leave the dental practice

unaccompanied or be allowed to drive a motor vehicle. The decision will be easier to take in some circumstances than others. For example, the patient who has an angina attack in the surgery responds very quickly to their normal GTN and who has a clear history of similar episodes and makes a complete recovery will usually be well enough to be allowed to go home.

If a patient remains unwell or there is any doubt at all, they should undergo assessment by a medical practitioner. Before any transfer is made, the patient's condition should be stabilised so long as that does not delay ongoing treatment. It is important that a written summary is given to the receiving team so that the treatment that has been undertaken and its timing are made clear. A working party of The Royal College of Surgeons published a report on a system for assessing acutely ill patients intended for use across the NHS in its entirety [9]. The National Early Warning Score (NEWS) considers six simple physiological parameters. These are:

Respiratory rate
Oxygen saturation
Temperature
Systolic blood pressure
Pulse rate
Level of consciousness (using the AVPU system mentioned above)

If the information suggested by this template can be provided by the dentist, then it is helpful in the transfer process.

17.8 Summary

Medical emergencies in dental practice are not common but could occur at any time. Adherence to basic principles is critical for effective management. Such events are less alarming and best managed if they have been anticipated and if mechanisms are in place for dealing with them.

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Management of Specific Medical Emergencies in Dental Practice

18

In Brief

- Discusses treatment for specific emergencies and where appropriate the drugs used
- Recognises signs and symptoms of relevant medical emergencies
- Outlines routes of drug administration appropriate to dental practitioners

18.1 Introduction

The basic principles discussed in the previous paper [1] in this series (Chap. 17) should be applied to all medical emergency situations. The cornerstone of emergency management is the ABCDE approach. Emergencies can usually be anticipated by obtaining a thorough medical history [2]. Once the nature of the emergency has been established, more specific management must be instituted, underpinned by the ABCDE approach.

Examples of medical emergencies that can arise in dental practice are listed in Table 18.1. The diagnosis and management of specific medical emergencies is discussed below.

18.2 Vasovagal Syncope (Simple Faint)

Vasovagal syncope, or the simple faint, is the most common medical emergency to be seen in dental practice. It results in loss of consciousness due to inadequate cerebral perfusion. It is essentially a reflex which is mediated by autonomic nerves, leading to widespread vasodilatation in the splanchnic and skeletal vessels and bradycardia, resulting in diminished cerebral perfusion. Fainting can be precipitated by

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Table 18.1 Summary of medical emergencies that may be encountered in dental practice

• Vasovagal syncope (faint)
• Hyperventilation/"panic attack"
• Acute asthma attack
• Angina/myocardial infarction
• Epileptic seizures
• Diabetic emergencies
• Allergies/hypersensitivity reactions
• Choking and aspiration
• Adrenal insufficiency
• Cardiac arrest (see Paper 1)

pain or emotional stress, changes in posture or hypoxia. Some patients are more prone to fainting than others, and it is wise to treat fainting-prone patients (established from the history or previous experience) in the supine position.

A similar clinical picture may be seen in 'carotid sinus syndrome'. Mild pressure on the neck in such patients (usually the elderly) leads to a vagal reaction producing syncope. This situation may progress to bradycardia or even cardiac arrest.

18.2.1 Signs and Symptoms: Fainting

- Patient feels faint/light headed/dizzy
- Pallor, sweating
- Pulse rate slows
- Low blood pressure
- Nausea and/or vomiting
- Loss of consciousness

18.2.2 Treatment of Fainting

- Lie the patient flat and raise the legs—recovery will normally be rapid
- A patent airway must be maintained
- If recovery is delayed, oxygen (15 L/min) should be administered, and other causes of loss of consciousness be considered

18.3 Asthma

Asthma is a potentially life-threatening condition and should always be taken seriously [3]. An asthma attack may be precipitated by exertion, anxiety, infection or exposure to an allergen. It is important to gain some idea of the severity of attacks from the history. Clues include precipitating factors, effectiveness of medication, hospital admissions due to asthma and the use of systemic steroids.

It is important that asthmatic patients bring their usual inhaler(s) with them—if the inhaler has not been brought, it must be in the emergency kit, or treatment

should be deferred. If the asthma is in a particularly severe phase, elective treatment may be best postponed. Drugs which may be prescribed by dental practitioners, particularly non-steroidal anti-inflammatory drugs (NSAIDs), may worsen asthma and are therefore best avoided.

18.3.1 Use of Inhaler in Patients With Asthma

18.3.1.1 Inhalers

Even if an inhaler is used properly, around 50% will be deposited in the mouth, and only 10% reach the airways below the larynx.

18.3.1.2 Procedure for Using an Inhaler

- Explain to the patient how to remove the mouthpiece cover.
- Shake the inhaler and breathe out.
- Advise patient to place mouthpiece in his mouth with the lips and teeth closed around it.
- At the start of inspiration, the patient should press the canister down and continue to inhale slowly and deeply
- Mouthpiece should be removed from the mouth and lips should be closed.
- The patient should hold breath for up to 10 s and breathe out normally.
- Wait 30–60 s before repeating.

18.3.1.3 Spacer Device

- Only works with an aerosol inhaler
- Removes the need for coordination between actuation of an inhaler and inhalation
- Reduces velocity of aerosol leading to increased passage into the airway
- Reduces side effects from “preventer” medicines

18.3.1.4 Spacer Procedure

- As with inhaler.
- Inhalation should be within 30 s of actuation.

18.3.1.5 Signs and Symptoms of Asthma

- Breathlessness (rapid respiration—more than 25 breaths/min)
- Expiratory wheezing
- Use of accessory muscles of respiration
- Tachycardia

18.3.1.6 Life-Threatening Asthma: Signs and Symptoms

- Cyanosis or slow respiratory rate (less than 8 breaths/min)
- Bradycardia
- Decreased level of consciousness/confusion

18.3.1.7 Asthma: Treatment

- Most asthma attacks will respond to the patient's own inhaler, for example, salbutamol (may need to repeat after 2–3 min),
- If no rapid response, or features of severe asthma, call an ambulance.
- A medical assessment should be arranged for patients who require additional doses of bronchodilator to end an attack.
- A spacer device may need to be used if patient has difficulty using the inhaler.
- If the patient is distressed or shows any of the signs of life-threatening asthma, urgent transport to hospital should be arranged.
- Fifteen litres per minute of oxygen should be given whilst awaiting transfer. Up to 12 actuations from the salbutamol inhaler via a spacer device should be used and repeated every 10 min. In the *British National Formulary* [4], a technique is described for a "home-made" space device. A hole can be cut on the base of a paper or plastic cup. The mouthpiece of the inhaler is pushed through this. The open end of the cup can then be applied to the mouth when the inhaler is activated.

All patients, including those who have chronic obstructive pulmonary disease, should be given high-flow oxygen as even if these patients are dependent on "hypoxic drive" to stimulate their respiration, they will come to no harm in the short term.

18.4 Hyperventilation

Anxiety is the principal precipitating factor of hyperventilation. When hyperventilation persists it can become extremely distressing to the patient.

18.4.1 Signs and Symptoms of Hyperventilation

- Anxiety
- Light headedness/dizziness
- Weakness
- Paraesthesia
- Tetany (see below)
- Breathlessness
- Chest pain and/or palpitations

18.4.2 Treatment: Hyperventilation

A calm and sympathetic approach from the practitioner is important. The ABCDE approach will lead to safe identification of the condition.

- Exclude other causes for the symptoms (ABCDE approach).
- Encourage the patient to rebreathe their own exhaled air to increase the amount of inhaled carbon dioxide—a paper bag placed over the nose and mouth allows this.
- If no paper bag is handy, the patient's cupped hands could be an alternative.

Hyperventilation leads to carbon dioxide being "washed out" of the body producing an alkalosis. If hyperventilation persists, carpal (hand) and pedal (foot) spasm (tetany) may be seen (Fig. 18.1). Rebreathing exhaled air helps to return the situation to normal relatively quickly.

18.5 Chest Pain

Most patients who experience chest pain from a cardiac origin in the dental surgery are likely to have a previous history of cardiac disease. If a patient uses medication to control known angina, they should have brought this with them, or it should be ready to hand in the emergency kit. Similarly, it is important to check that the patient has taken their normal medication on the day of their appointment.

Classically, the pain of angina is described as a "crushing" or "band-like" tightness of the chest which may radiate to the left arm or mandible. There are many variations, however. The pain of myocardial infarction (MI) will often be similar to that of angina but more severe and, unlike angina, will not be relieved by GTN. In cases of angina, the patient should use their GTN spray, which will usually remove the symptoms. Dental treatment may be best left until another day if there is an attack, according to the practitioner's discretion. More severe chest pain always warrants postponement of treatment, and an ambulance should be called.

Fig. 18.1 A demonstration of carpal spasm

Features which make chest pain unlikely to be cardiac in origin are pains which last less than 30 s, however severe, stabbing pains, well-localised left submammary pain and pains which continually vary in location. Chest pain which improves on stopping exertion is more likely to be cardiac in origin than one that is not related. Pleuritic pain is sharp in character, well localised and worse on inspiration.

Oesophagitis can produce a retrosternal pain which worsens on bending or lying down. A complicating factor in differentiation from cardiac chest pain is that GTN, due to its action on the muscle of the oesophagus, may ease the pain.

Musculoskeletal pain will often be accompanied by tenderness to palpation in the affected region or on movement. As mentioned earlier, hyperventilation may produce chest pain. A list of possible causes of chest pain is given in Table 18.2.

It is clearly important to exclude angina and myocardial infarction in the patient complaining of chest pain [5, 6]. If in doubt, treat as cardiac pain until proven otherwise.

18.5.1 Signs and Symptoms: Myocardial Infarction

- Severe, crushing chest pain which may radiate to the shoulders and down the arms (particularly the left arm) and into the mandible.
- The skin becomes pale and clammy.
- Shortness of breath.
- Pulse becomes weak and patient may become hypotensive.
- Often there will be nausea and vomiting.
- Not all patients fit this picture.

18.5.2 Treatment: Myocardial Infarction

- The practitioner should remain calm and reassuring.
- Call 999 immediately.
- Most patients will be best managed in the sitting position, but patients who feel faint should be laid flat.
- Administer high-flow oxygen (15 l/min)
- Give sublingual GTN spray.

Table 18.2 Possible causes of chest pain

• Angina
• MI
• Pleuritic, e.g. pulmonary embolism
• Musculoskeletal
• Oesophageal reflux
• Hyperventilation
• Gall bladder and pancreatic disease

- Give 300 mg aspirin orally to be chewed (if no allergy)—ensure that when handing over to the receiving ambulance crew that they are made aware of this.
- A patient who has had surgical dental treatment should be highlighted to the ambulance crew as any significant risk of haemorrhage may affect the decision to use thrombolytic therapy.
- If the patient becomes unresponsive, the practitioner should check for "signs of life" (breathing and circulation) and start CPR.

18.6 Epileptic Seizures

The history will usually reveal the fact that a patient has epilepsy [2]. A history should obtain information with regard to the nature of any seizures, their frequency and degree of control. The type and efficacy of medication should be determined. Signs and symptoms vary considerably.

18.6.1 Signs and Symptoms: Epilepsy

- The patient may have an "aura" that a seizure is about to occur.
- Tonic phase—loss of consciousness, patient becomes rigid and falls and becomes cyanosed.
- Clonic phase—jerking movements of the limbs and the tongue may be bitten.
- Frothing at the mouth and urinary incontinence.
- The seizure often gradually abates after a few minutes. The patient may remain unconscious. They may remain confused after consciousness has been regained.
- Hypoglycaemia may present as a fit and should be remembered (including in epileptic patients)—blood glucose measurement at an early stage is therefore wise.

In patients with a marked bradycardia (pulse rate less than 40 beats/min), the blood pressure may drop to such an extent that it causes transient cerebral hypoxia leading to a brief fit. This is not a true fit and represents a vasovagal episode.

18.6.2 Treatment of an Epileptic Seizure

The decision to give medication should be made if seizures are prolonged (with active convulsions for 5 min or more (status epilepticus) or seizures occurring in quick succession). If possible, high-flow oxygen should be administered. The possibility of the patient's airway becoming occluded should be constantly remembered, and the airway must therefore be protected.

- As far as possible, ensure safety of the patient and practitioner (do not attempt to restrain).
- Midazolam is given via the buccal or intranasal route (10 mg for adults). The buccal preparation is marketed as "Epistatus®" (10 mg/ml) (Fig. 18.2). A paediatric formulation, Buccolam® (5 ml), is now licensed for use.
- For children (Epistatus®):
  - Child 1–5 years, 5 mg
  - Child 5–10 years, 7.5 mg
  - Child over 10 years, 10 mg
- The parents of some children with poorly controlled epilepsy will carry rectal diazepam. As part of pretreatment preparation, it is wise to arrange with the parent for them to be on hand to administer this should a seizure occur.
- In the absence of rapid response to treatment, call an ambulance.

The criteria for sending a patient with epilepsy to the hospital after a seizure have been developed by the National Institute for Health and Care Excellence and are summarised in Table 18.3.

18.7 Diabetic Emergencies

The history should be used to assess the degree of diabetic control achieved by the patient. A history of recurrent hypoglycaemic episodes and markedly varying blood glucose levels (from the patient's measurements) suggest that a patient attending for

Fig. 18.2 A Midazolam preparation used in the treatment of epileptic seizures

Table 18.3 NICE Guidelines for sending a patient with epilepsy to hospital after a fit

• Status epilepticus
• High risk of recurrence of fits
• First fit
• Difficulty in monitoring the patient's condition

dental treatment is more likely to develop hypoglycaemia. It is wise to treat diabetic patients first on any list and ensure that they have had their normal medication and something to eat prior to attending.

A dentist in general practice is much more likely to encounter hypoglycaemia than hyperglycaemia since the latter has a much slower onset. It should be remembered that diabetic control may be adversely affected by oral sepsis, leading to an increased risk of complications [7].

18.7.1 Signs and Symptoms: Hypoglycaemia

- Trembling
- Hunger
- Headache
- Sweating
- Slurring of speech
- "Pins and needles" in the lips and tongue
- Aggression and/or confusion
- Seizures
- Unconsciousness

18.7.2 Treatment: Hypoglycaemia

- Lay the patient flat (remember A, B, C).
- If the patient is conscious, give oral glucose (three lumps of sugar or two to four teaspoons of sugar) or GlucoGel® (Fig. 18.3).
- If the patient is unconscious, give 1 mg glucagon intramuscularly (or subcutaneously).
- Get medical help.

Patients who do not respond to glucagon (a rarity) or those who have exhausted their supplies of liver glycogen will require 20 ml of intravenous glucose solution (20–50%) and should be managed under medical supervision or by the attending ambulance team. It can take glucagon 5–10 min to be effective, and the patient's airway must be protected at all times.

Fig. 18.3 GlucoGel® for use in hypoglycaemia

Once the patient regains consciousness and has an intact gag reflex, they should be given glucose orally and a high-carbohydrate food. If full recovery is achieved and the patient is accompanied, they may be allowed to go home but should not be allowed to drive. The patient's general medical practitioner should be informed of the event.

The principle of treatment of hyperglycaemia is through intravenous rehydration. This should be carried out under medical supervision and is beyond the scope of this discussion.

18.8 Allergies/Hypersensitivity Reactions

18.8.1 Anaphylaxis

Anaphylaxis is a type 1 hypersensitivity reaction involving IgE to which free antigen binds leading to the release of vasoactive peptides and histamine. Penicillin and latex are the most likely causes in dentistry. Local anaesthetics are rarely responsible [8].

18.8.1.1 Signs and Symptoms: Anaphylaxis

- Itchy rash/erythema.
- Facial flushing or pallor.
- Upper airway (laryngeal) oedema and bronchospasm leading to stridor, wheezing and possibly hoarseness.
- A respiratory arrest may occur, leading to cardiac arrest.
- Vasodilatation leading to low blood pressure and collapse which may progress to cardiac arrest.

18.8.1.2 Initial Treatment: Anaphylaxis

- The ABCDE approach should be employed whilst the diagnosis is being made.
- Manage airway and breathing by administering 15 l/min of oxygen.
- Restore blood pressure by laying the patient flat and raising the legs.

In life-threatening anaphylaxis (hoarseness, stridor, dyspnoea, cyanosis, drowsiness, confusion or coma), adrenaline should be administered:

- Administer 0.5 ml of 1 in 1000 adrenaline IM and repeat and 5 min intervals if no improvement.
- The optimum site for injection is the anterolateral mid-third of the thigh.

Chlorphenamine (antihistamine) and hydrocortisone (steroid) need not be given by non-medical "first responders". As a result, the only drug required to be administered by dental practitioners is adrenaline. The other drugs will be administered by ambulance personnel, if necessary.

Many patients with a history of anaphylactic reactions will carry an "EpiPen", which contains 300 μg of epinephrine. This may be used if such a patient has an anaphylactic reaction in the dental surgery (Fig. 18.4). Variation in the doses of adrenaline which may be given to different age groups are summarised in Table 18.4.

Fig. 18.4 An "EpiPen" for use in anaphylactic reactions. It contains 300 μg of adrenaline

Table 18.4 Variation in dose of intramuscular adrenaline with age

• Adult (or child over 12 years)—500 μg (0.5 ml)
• Child (6–12 years)—300 μg (0.3 ml)
• Child (less than 6 years)—150 μg (0.15 ml)

All refer to IM doses of adrenaline (1:1000)

18.8.2 Angioedema

Angioedema is triggered when mast cells release histamine and other chemicals into the bloodstream producing rapid swelling. This may be life-threatening if the airway is involved. It may be precipitated by substances such as latex and penicillin. There is a hereditary component. Signs and symptoms are summarised in Table 18.5.

Hereditary angioedema (HANE) is caused by complement activation resulting from a deficiency of the inhibitor of the enzyme C1 esterase. It is usually inherited as autosomal dominant and may not present until adulthood. C1 esterase inhibitor concentrates are available to supplement the deficiency. Such supplements should be administered prior to dental treatment if such treatment has previously triggered the onset of angioedema.

18.9 Choking and Aspiration

Prevention is important by the use of rubber dam, instrument chains, mouth sponges, etc. during dental treatment. Careful suction of the oral cavity and close observation minimises risk.

In a patient suspected of having aspirated a foreign body, they should be encouraged to cough vigorously in attempt to clear the airway and "cough up" the object. A foreign body may lead to either mild or severe airway obstruction. Signs and symptoms that aid in differentiation of the degree of airway obstruction are shown in Table 18.6. In a conscious victim, it is useful to ask the question "Are you choking?". An algorithm for the management of a choking patient has been published by the Resuscitation Council (UK) [9] and is given in Fig. 18.5.

Back blows are delivered by standing to the side of the victim and slightly behind. The chest should be supported with one hand and the victim leant well forwards so that when the obstruction is dislodged, it is expelled from the mouth rather than passing further down the airway. Up to five sharp blows should be given between

Table 18.5 Signs and symptoms of angioedema

• Swelling around the eyes, lips, throat and extremities
• Laryngeal oedema and bronchospasm

Acute allergic oedema may develop alone or be associated with anaphylactic reactions

Table 18.6 Management of a choking victim (adapted from Resuscitation Guidelines Resuscitation Council (UK))—signs and symptoms

General signs of choking
• Attack occurs whilst eating/misplaced dental instrument/restoration
• Victim may clutch his neck
Signs of mild airway obstruction
Response to question "Are you choking?"
• Victim speaks and answers "yes"
Other signs
• Victim is able to speak, cough and breathe
Signs of severe airway obstruction
Response to question "Are you choking?"
• Victim is unable to speak
• Victim may respond by nodding
Other signs
• Victim is unable to breathe
• Breathing sounds wheezy
• Attempts at coughing are silent
• Victim may be unconscious

the shoulder blades with the heel of the other hand. After each back blow, a check should be made to see if the obstruction has been relieved.

If back blows fail, up to five abdominal thrusts should be given.

- Stand behind the victim, and put both arms around the upper part of their abdomen, and lean them forwards.
- The rescuer's fist should be clenched and placed between the umbilicus and lower end of the sternum.
- The clenched fist should be grasped with the other hand and pulled sharply inwards and upwards.
- This should be repeated up to five times.
- The back blows and abdominal thrusts should be continued in a cyclical fashion.
- Chest thrusts, similar but quicker than chest compressions using two fingers, should be employed in infants (under 1 year of age) rather than abdominal thrusts.

18.10 Adrenal Insufficiency

Adrenal crisis may result from adrenocortical hypofunction leading to hypotension, shock and death. It may be precipitated by stress induced by trauma, surgery or infection. It is rare that this would happen as a result of dental treatment and if a patient collapses; other causes are much more likely and should be considered first.

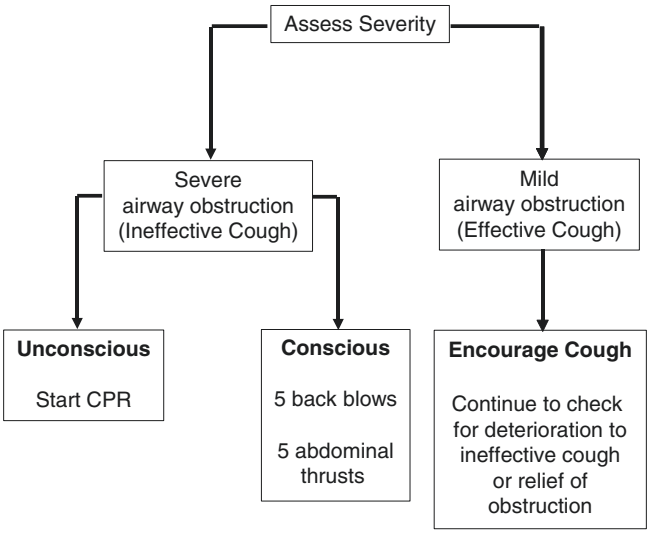

Fig. 18.5 Algorithm for management of the choking patient (Resuscitation Council (UK) 2005)

18.10.1 Signs and Symptoms: Adrenal Crisis

- The patient loses consciousness.
- The patient has a rapid, weak or impalpable pulse.
- The blood pressure falls rapidly.

It is important in the history to ascertain whether the patient has recently used or is currently using corticosteroids. Some patients carry a "steroid warning card". Acute adrenal insufficiency can often be prevented by the administration of a steroid boost prior to treatment. Studies have suggested that dental surgery may not require supplementation [10]. More invasive procedures, however, such oral surgical procedures or the treatment of very apprehensive patients may still require cover. Patients who are systemically unwell (e.g. patients with a significant dental abscess) are also recommended to have a prophylactic increase in steroid dose [11].

The guidance for patients with Addison's disease is to double the patient's steroid dose before significant dental treatment under local anaesthesia and continue this for 24 h.

18.10.2 Treatment: Adrenal Crisis

- Lay the patient flat and raise their legs.
- Ensure a clear airway and administer oxygen (15 l/min).
- Call an ambulance.

18.11 Stroke

Stroke may be either haemorrhagic or embolic in aetiology, but clinically the effects are essentially the same. Risk factors for stroke are summarised in Table 18.7. Signs and symptoms vary according to the site of brain damage. There may be loss of consciousness and weakness of limbs on one side of the body. One side of the face may become weak. Stroke causes an upper motor neurone lesion; therefore the forehead muscles of facial expression will be unaffected. Speech may become slurred.

In 2009, the Stroke Association recommended following the FAST approach to assess whether the patient has had a stroke. The acronym represents the following:

- *F*acial weakness
- *A*rm weakness
- *S*peech problems
- *T*ime to call 999

18.11.1 Initial Management: Stroke

- FAST approach to assess likely diagnosis.
- ABCDE approach. The airway should be maintained and an ambulance called.
- High-flow oxygen (15 l/min) should be given via a non-rebreathe mask.
- The patient should be carefully monitored for any further deterioration (AVPU).
- If the patient is or becomes unconscious and is breathing, they should be placed in the recovery position.

18.12 Local Anaesthetic Emergencies

Allergy to local anaesthetic is rare but should be managed as any other case of anaphylaxis. When taken in the context of the number of local anaesthetics administered, complication rates are low [12]. The signs and symptoms in allergy are those of anaphylaxis.

Table 18.7 Risk factors for stroke

• Hypertension
• Smoking
• Diabetes mellitus
• Cardiac and peripheral vascular disease
• Atrial fibrillation
• Previous transient ischaemic attack (TIA)—focal CNS disturbances caused by vascular events such as microemboli and occlusion leading to ischaemia. By definition, symptoms last for less than 24 h
• Obesity
• Hyperlipidaemia
• Excess alcohol intake

Fainting in association with the injection of local anaesthetic is more common and can usually be avoided by administering the local anaesthetic whilst the patient is supine.

18.13 Conclusions

Medical emergencies in the dental practice are not common. It is important that each member of the dental team knows what their role should be in the event of such a situation arising, however. Adhere to basic management principles such as the ABCDE approach and regular updates, [13] and practice facilitate safe patient management.

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General Medicine and Surgery for Dental Practitioners: Infections and Infection Control

19

In Brief

- All dental practitioners need to have a sound knowledge of the basics of infection and infection control.
- Common methods used to control cross infection are discussed.
- Safe working with sharps is considered.
- Some of the theoretical aspects of specific infections are highlighted.

19.1 Introduction

Healthcare-associated infections (HCAIs) are common in hospitals and clinics. In the UK in 2011, approximately 6.4% of hospital patients acquired infections as a result of procedures, devices or interventions [1]. The most common HCAIs involve the respiratory system, the urinary tract or at the site of surgery. In a dental setting, blood-borne viruses (BBVs) including hepatitis B virus (HBV), hepatitis C virus (HCV) and HIV, along with respiratory pathogens, present the highest risks of cross infection. There is a much lower risk of transmitting prions, but these agents are extremely difficult to inactivate and so pose unique problems in dentistry. New infectious agents frequently emerge, and dental practitioners must be prepared to respond to outbreaks of infection.

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19.2 Points in the History

In the medical history, it is sometimes possible to identify patients at high risk of transmitting or acquiring infection. However, many pathogens can exist in asymptomatic carriage states or are infectious before clinical disease symptoms appear. Therefore, the underlying principle of cross-infection control involves taking standard precautions to minimise the risk of transmission regardless of the health status of the patient or healthcare worker. Effective cross-infection control requires constant vigilance and involves the combined efforts of the entire dental team.

19.3 Measures to Control Cross Infection

Standard infection control precautions have been outlined by the NHS [2] and must be employed alongside local NHS policies and guidelines. These precautions are listed in Table 19.1 and described below. In addition, it is important to establish a culture of safety within a dental practice. This involves all practice staff and ensures that systems are in place for assessing and minimising the risk of cross infection, as well as for reporting incidents and potential exposure to infection. The design of the surgery must be considered carefully to ensure that dirty equipment is well separated from clean equipment and that the whole area is well ventilated and accessible for cleaning. Cross infection control depends on putting in place effective barriers to block the transmission of infectious agents. The major routes of transmission in the dental clinic are listed in Table 19.2.

19.3.1 Hand Hygiene

Good hand hygiene is one of the most important mechanisms to limit the spread of HCAIs. Every dental practice should have a hand hygiene policy. Sinks should be kept uncluttered and clean. Hands must be cleaned using a thorough procedure such as the Ayliffe technique [3], with scrubbing for between 20 and 30 s for a general wash or for to 2–3 min for a surgical scrub. Hands should be dried using clean disposable paper towels. Patients should be encouraged to clean their hands with an alcohol gel upon entering and leaving the treatment area.

Table 19.1 Standard cross infection precautions in a dental surgery

• Hand hygiene
• PPE (see text)
• Safe working with sharps
• Sterilisation and disinfection of dental instruments
• Surgery design and disinfection
• Dental unit waterlines
• Waste management
• Immunisations and screening

Table 19.2 Possible routes of infective agent transmission

• Inoculation, e.g. sharps injuries or surgical procedures
• Inhalation of aerosols or droplets
• Absorption through intact or broken skin
• Absorption through mucous membranes including the eyes
• Ingestion

It is important to be aware of the "five moments for hand hygiene at the point of care". These "moments" are defined as:

- Before patient contact
- Before an aseptic task
- After body fluid exposure risk
- After patient contact
- After contact with patient surroundings

Effective handwashing is essential in the prevention of spread of methicillin resistant *Staphylococcus aureus* (MRSA). The alcohol gels are also effective against this bacterium. Another bacterium that has received significant attention recently is *Clostridium difficile*. This bacterium lives in the bowel of less than 5% of the adult population. Patients develop problems if they are brought into contact with contaminated surfaces or unwashed hands. Unlike MRSA, alcohol gels are not effective against *C. difficile* spores, and handwashing is therefore mandatory.

It is essential that healthcare workers remove all hand jewellery (although wedding bands are not included). Staff should be "bare below the elbows" and not wear a wrist watch. Nails should be kept short to make them easier to clean. Cuts and abrasions should be covered with waterproof adhesive dressings after handwashing.

The regular use of an emollient hand cream is important to prevent drying of the skin after frequent handwashing. Contact dermatitis can cause significant problems in susceptible individuals.

19.3.2 Personal Protective Equipment

The appropriate personal protective equipment (PPE) should be selected on the basis of a risk assessment and will depend on the procedure being carried out. Standard infection control precautions call for the use of gloves, aprons or gowns and mouth/eye protection such as masks or goggles for any procedures that involve direct contact with patients' body fluids. Note that PPE will only reduce the risk of transmission and cannot provide a failsafe barrier. All PPE falls under medical device regulations and must be approved and marked with the European CE mark (Fig. 19.1).

Fig. 19.1 Markings on a packet of endodontic syringes and needles, including the CE mark and an indication that the product is latex-free

Gloves should be worn for all dental procedures, including mopping up spills or handling waste. Hands should be washed before and after wearing gloves. Single-use gloves must be changed between patients and should never be washed as they will lose their protective function. They should not be worn outside the clinical area. Most organisations now routinely use latex-free gloves. Allergies to natural rubber latex gloves occur in 6–18% of healthcare workers and cause symptoms such as dermatitis, asthma and occasionally anaphylaxis. Patients with known allergies to latex gloves should be identified in the medical history, and their notes should be clearly labelled. Latex gloves should be avoided for these patients or for healthcare workers with latex allergies. Alternatives to latex include nitrile, polychloroprene (neoprene), vinyl or copolymer gloves. Look for "latex-free" markings on gloves or other items in the surgery (Fig. 19.1).

Masks are recommended for all dental procedures to protect against droplets and aerosols and should be tight-fitting around the mouth and nose. Masks are single use and should be discarded between patients. During care of patients with respiratory infections, particulate respirator masks should be worn since standard surgical masks do not provide adequate protection against small particles. British standard EN149:2001 (amended in 2009) classifies disposable filtering facepiece (FFP) respirators into three categories (FFP1–3), of which FFP3 provides the highest level of protection. FFP2 respirators should be worn when treating patients with active tuberculosis. During pandemic influenza, any aerosol-generating procedures on infected patients should be performed only with an FFP3 respirator, and the user must have undertaken a respirator fit test prior to using it. Elective procedures should be postponed until the infection has resolved.

Eyes must be protected by face shields or goggles during all dental procedures. If goggles are selected, they should have side protection conforming to BS EN166:1988 and should be cleaned according to manufacturers' instructions. Visors are usually single use and disposable. Reusable face shields must be cleaned with disinfectant.

Tunics and uniforms should be washed daily on a hot cycle of 60 °C. Tunics and uniforms are not considered PPE since they are made of absorbent materials and provide little protection against pathogens. Single-use plastic aprons should be worn to protect against spatter and must be changed between patients. For minor oral surgery, surgical gowns with tight-fitting cuffs should be worn to protect both the clinician and the patient from transmission of microorganisms on the skin.

19.3.3 Safe Working With Sharps

"Sharps" injuries are amongst the most common type of injury in the dental surgery. It is estimated that approximately half of these are preventable. Puncturing the skin is the major route of transmission for BBVs. It is essential, therefore, that appropriate risk assessments, accident reporting procedures and, most importantly, safe working practices are applied for work that involves sharps.

Many sharps injuries occur outside the mouth during re-sheathing, dismantling or disposal of needles or during cleaning of sharp instruments such as burs and probe tips. When working inside the mouth, the use of a mirror or other device rather than fingers to retract the tongue and cheeks reduces risk. Needles should not be re-sheathed, recapped, bent or disassembled after use. Consider the use of a "sharp-safe" needle design that does not require re-sheathing (Fig. 19.2). Passing instruments from hand to hand during dental procedures should be avoided. Instruments are best transferred in a receiver. Used sharps must be placed in a container conforming to UN3291 and BS7320 standards. These containers need to be placed out of reach of children and should not be filled above the indicated level. Sharps must never be removed from disposal containers.

The European Council Directive 2010/32/EU [4] which was published in June 2010 and implemented in May 2013 dictates that "the practice of recapping shall be banned with immediate effect" and that staff require training in the "correct use of medical devices incorporating sharps protection mechanisms".

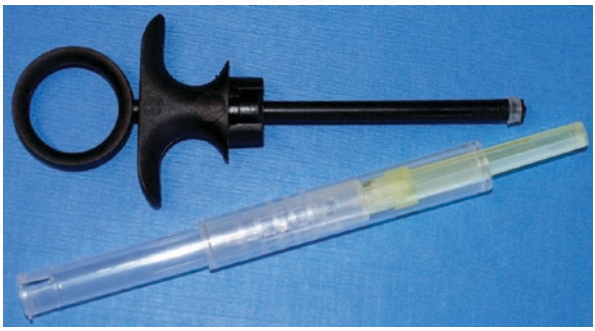

Fig. 19.2 Example of a "sharp-safe" syringe design. The outer plastic is drawn down to cover the needle after use. If the outer sleeve is clicked into place once, the sleeve can be retracted again for further use of the syringe. A double click permanently locks the cover into position

19.3.4 Sterilisation and Disinfection of Dental Instruments

Sterilisation is aimed at the complete removal of viable organisms, including bacterial spores. The simplest method of sterilisation involves the use of steam under pressure, for example, at a temperature of 121 °C for 15–30 min or at 134 °C for 3–4 min in an autoclave. It is necessary to clean all devices thoroughly prior to autoclaving since particles of dirt can protect microorganisms from the autoclave cycle. To ensure that the steriliser is functioning correctly, automatic control tests must be performed daily, and records should be retained in a logbook for at least 2 years. Chemical process indicators, such as autoclave tape, sterilisation packaging or bags containing an indicator are useful to identify items that have been sterilised but cannot be used to validate the autoclave cycle. Steam sterilisation is not appropriate for all equipment, and chemical sterilisation with ethylene oxide gas, formaldehyde gas, hydrogen peroxide gas, liquid peracetic acid or ozone can be used as an alternative. Validated chemical sterilisation methods are not usually available in dental surgeries and are most easily obtained through a specialist contractor. Single-use devices provide a simple alternative to sterilisation of sensitive equipment and are indicated by a clear logo, as shown in Fig. 19.3.

Disinfection processes aim for a reduction in microbial load to levels that are considered acceptable. Cleaning and disinfection may be performed manually or, preferably, using automated systems. Ultrasonic baths provide excellent cleaning for intricate, jointed or serrated stainless steel instruments. Thermal washer disinfectors include a high-temperature step (typically 90 °C for 1 min), which significantly reduces the microbial contamination of devices. The final rinsing should be performed with high-quality water, such as reverse osmosis (RO)-treated water.

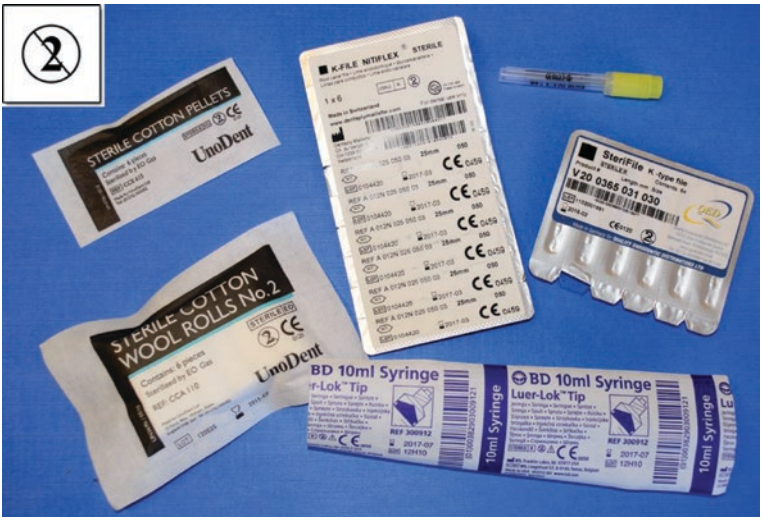

Fig. 19.3 Single-use items labelled with the appropriate logo

19.4 Surgery Design and Disinfection

Dental surgeries should be designed with a view to easy cleaning and provide adequate workspace (17 m^2 is usually considered sufficient), good ventilation, and separation of clean and dirty zones. The layout should provide access for disabled patients or staff and an easy escape route in case of emergency.

In ideal surgery design, the room should be well ventilated by open windows or air conditioning, with a fresh air supply of at least 5–8 L/s per occupant. Air should be ventilated outside the building and filters need to be replaced regularly. The floor should be non-slip and should curve up the wall by 7.5 cm to allow easy cleaning. It is important to clean and disinfect the floor daily. Dental chairs and other furnishings within the surgery should be upholstered with wipeable material and should be free from visible damage. A sink must be available within the room and should be kept clean and clear of clutter. Elbow-operated or motion-sensitive taps are preferred. The water jet must not be directed straight down the plughole as this creates aerosols. Taps that are only used sporadically should be flushed weekly to limit the accumulation of microorganisms in stagnant water.

All areas of a dental practice should be cleaned regularly. The patient treatment area should be cleaned between each patient using disposable alcohol hand wipes or clean microfibre materials. The treatment area includes local work surfaces, dental chairs, inspection lights, hand controls, trolleys, spittoons, aspirators, sinks and taps. Computer keyboards in clinical areas should be of the "easy-clean" type or should be fitted with wipeable covers. For blood spillages, NaOCl (sodium hypochlorite) at a concentration of 1%, yielding at least 1000 ppm free chlorine, must be applied for at least 5 min. Sodium hypochlorite is not recommended for use on metal surfaces due to the risk of corrosion.

"Clean" and "dirty zones" must be kept well-separated, and a logical workflow from dirty to clean should be established. Ideally, decontamination areas should be in a separate room from patient treatment areas. Where this is not possible, controls are needed to prevent cross-contamination between the patient and the dirty equipment. Manual cleaning and decontamination procedures liable to generate aerosols should not be performed whilst the patient is present. The physical layout of the surgery should facilitate the easy movement of devices from dirty to clean areas. For example, an area of bench just inside the dirty zone should be designated as the receiving area. Washing and rinsing sinks and/or equipment should be sited close to the receiving area. A steriliser should be located away from the washing area to avoid contamination of freshly sterilised instruments. Once sterilised, instruments should be stored in a clean area well away from the dirty zone and preferably in a different room.

19.4.1 Dental Unit Waterlines (DUWLs)

If not maintained adequately, DUWLs can harbour microbial pathogens such as pseudomonads or *Legionella*. These organisms grow as biofilms on the internal surfaces of water bottles and tubing, where they are protected against chemical cleaning

agents. To prevent the accumulation of biofilms, systems should be drained down at the end of each day. If present, self-contained water bottles should be removed and emptied. DUWLs should be fed with RO-treated water and should be flushed regularly. Flushing for 2 min at the start and end of each day, and for 20–30 s between patients, is recommended. Disinfection of DUWLs should be performed periodically and additionally if visible contamination is observed. A number of different agents are available for disinfection of DUWLs, and the appropriate agent should be selected on the basis of the manufacturer's instructions. All hand pieces, ultrasonic scalers and waterlines should be fitted with anti-retraction valves, and these should be maintained and checked periodically. In-line filters used in DUWLs should be checked at intervals or, if they are the disposable type, should be changed daily.

19.4.2 Waste Management

Any waste containing human or animal tissue, blood or bodily fluids, drugs, swabs or dressings, or other potentially infectious material, must be clearly labelled as "clinical waste" and segregated from non-clinical waste. Used disposable syringes, needles or other sharp instruments must be deposited in a "sharp's box". Teeth containing amalgam should not be incinerated as the amalgam will release toxic mercury compounds. Extracted teeth with amalgam fillings must be stored in a rigid container and removed by a specialist contractor. Amalgam removed from the mouth must be collected using an amalgam separator and collected in the waste line of the apparatus.

Waste should be stored in a dedicated area, away from public access, prior to collection. Excessive waste build up should be avoided. A consignment note is required for all collections of hazardous waste, and the appropriate sections must be completed by the waste producer and the waste carrier. Consignment notes should be retained by the practice for at least 3 years. All practices that produce over 500 kg of waste per annum must register with the Environment Agency as a hazardous waste producer.

19.5 Immunisations and Screening

Immunisations provide an additional layer of protection against the transmission of certain pathogens from patients to dental care professionals. In a dental practice, it is recommended that one member of staff is designated to maintain confidential records of immunisations and healthcare screening of all workers in the practice. In the UK, all healthcare workers should stay up to date with routine immunisations against diphtheria, tetanus, polio, measles, mumps and rubella. Annual vaccination against seasonal influenza is also strongly recommended. Clinical staff who have direct contact with body fluids of patients should additionally be vaccinated against tuberculosis, varicella zoster virus (if not immune already) and HBV. Recommended immunisations are summarised in Table 19.3.

Table 19.3 Recommended immunisations

• HBV
• Varicella
• TB
• MMR
• Influenza

Healthcare workers are significantly more likely than the general public to be exposed to tuberculosis (TB). All healthcare workers entering the NHS, including students on clinical dentistry courses, are required to complete a TB screen or health check before treating patients [5]. Varicella causes chickenpox or shingles and is highly infectious. If a woman is infected in the first 20 weeks of pregnancy, damage to the foetus can result. It is therefore recommended that female healthcare workers of childbearing age should receive the vaccine if they are not already immune.

Vaccination against HBV is essential for healthcare workers due to the high risk of exposure to infection, and workers must obtain a certificate of immunity prior to performing exposure prone procedures. A recombinant vaccine is administered in three doses, followed by a blood test for antibodies to hepatitis B surface antigen. Approximately 10–15% of adults respond poorly to the vaccine, and an additional dose may be necessary. In all cases, a booster is required 5 years after the initial course of vaccination. Students entering UK dental schools are required to be screened for HCV and HIV infection [5]. Students who are carriers of HBV or HCV and are subsequently treated will become eligible to undertake exposure-prone procedures provided that the disease is appropriately monitored.

19.6 Infectious Agents of Concern to the Dental Practitioner

The major infectious agents of concern in a dental clinic are listed in Table 19.4 and described below.

19.6.1 Blood-Borne Viruses

In the 1970s and 1980s, before widespread immunisation, studies in the USA revealed that healthcare workers had a significantly higher rate of HBV infection than the general population [6]. The emergence of HIV in the 1980s prompted the US Centers for Disease Control to issue guidance about universal precautions for avoiding direct contact with blood or blood-contaminated secretions from all patients independent of infection status [7]. These measures have subsequently been modified and merged with other guidance to create a set of standard precautions to be used with all patients at all times, which have been outlined above. Since the introduction of such measures in both the USA and the UK, rates of BBV infection amongst healthcare workers have decreased to the point where they are no higher than the general population [8]. Nevertheless, there continues to be occasional reports of transmission of BBVs between patients and dental professionals.

Table 19.4 Infectious agents of concern in dentistry

• BBVs
• Respiratory viruses
• TB
• MRSA
• *Pseudomonas*
• *Legionella*
• Prions

Hepatitis B virus is endemic in the UK but at a low prevalence rate of 0.1–0.5%. The incidence of chronic HBV is increasing in the UK as a result of immigration from parts of the world where HBV prevalence is much higher. Infection with HBV involves an acute phase, lasting around 75 days, in which symptoms including fever, nausea, abdominal pain, dark urine, grey-coloured faeces, joint pain and jaundice often appear. The likelihood that acute infection will progress to chronic or carriage state varies from around 90% of neonates, 25% of children or 5% of adults that acquire HBV. Fortunately, there is an effective vaccine against HBV, which gives approximately 95% protection, and all healthcare professionals should receive this vaccine.

Approximately 216,000 individuals in the UK are chronically infected with hepatitis C virus (HCV). Intravenous drug users are at particularly high risk of acquiring infections: in some parts of the UK, HCV infection rates in this group exceed 50%. Following infection, around 80% of individuals remain symptom-free, whilst others exhibit symptoms similar to those of HBV. The incubation period for HCV is 2 weeks to 6 months. Chronic disease occurs in 75–85% of individuals infected with HCV, and of these around 60–70% develop chronic liver disease. A further 5–20% of individuals develop cirrhosis, and a small proportion (1–5%) die from cirrhosis or liver cancer. There is no vaccine for HCV, but the disease is curable with a combination of antiviral agents.

At the end of 2011, around 96,000 people in the UK were infected with HIV. Of these, almost one quarter were unaware of their infection. Following infection, most individuals experience a short "flu-like" illness, followed by a period of several years without symptoms. Antiretroviral therapy (ART) is extremely effective for delaying the onset of late-stage HIV infection, or AIDS. The majority of individuals receiving antiretroviral therapy are virally suppressed and hence not infectious. The incidence of TB in HIV patients has declined from around 30% in 2002 to 8.8% in 2010 but nevertheless remains higher than the general population.

19.6.2 Respiratory Viruses

Several different viruses cause respiratory infections, including the common cold (rhinovirus), coronaviruses, respiratory syncytial virus, adenoviruses and influenza. Influenza A is a particular concern since infection can be severe. In some cases, influenza A leads to secondary complications such as bronchitis and secondary

pneumonia, which can be life-threatening. Seasonal variants of influenza appear each year, and annual vaccination is recommended. Occasionally, larger variations in the structure of the virus lead to rapidly spreading strains that cause global episodes of infection or pandemics.

Following the pandemic "flu of 2009", the UK Department of Health developed a UK Influenza Pandemic Preparedness Strategy to put in place structures for rapid responses to a new pandemic. During a pandemic, dental professionals should contact patients 24 h in advance of appointments to ensure they are free of symptoms. Treatment of patients with infection should be delayed until symptoms abate if at all possible. Where emergency dental care is required for infected patients, care should be provided by practices selected and supported by primary care trusts or the appointed Commissioner of services. Infected patients must be separated from non-infected individuals in segregated waiting areas. Equipment that generates aerosols should be avoided if possible in this situation. Treatment should not be administered by healthcare workers who are at high risk of complications from influenza infection, including pregnant women and the immunocompromised.

19.6.3 *Mycobacterium tuberculosis*

Around one third of the world's population is infected with *Mycobacterium tuberculosis*, the primary causative agent of TB. In the UK, around 9000 cases of TB are reported each year, mostly in major cities. Symptoms may not occur until months or even years after infection. Symptoms of pulmonary TB include severe coughing for 3 weeks or more productive of sputum and sometimes blood, breathlessness which gradually worsens, lack of appetite and weight loss, temperatures in excess of 38 °C, night sweats, extreme tiredness or pain lasting more than 3 weeks. Extrapulmonary TB occurs most commonly in HIV patients and can affect the lymph nodes, the bones and joints, the gastrointestinal tract, the genitourinary tract or the central nervous system. Treatment with a prolonged course of antibiotics is usually successful, although the number of cases of multidrug-resistant *M. tuberculosis* has gradually risen.

19.6.4 Methicillin-Resistant *Staphylococcus aureus* (MRSA)

Staphylococcus aureus is a commensal of the skin or nasopharynx and is detected in the oral cavities of around 30% of people [9]. Acquired resistance to antibiotics was first noted in *S. aureus* in the 1940s, shortly after the introduction of penicillin, and the spectrum of antibiotic resistance has been increasing ever since. Strains of MRSA are resistant to multiple antibiotics, and some *S. aureus* infections are now very difficult to treat. For many years, hospital-acquired MRSA (HA-MRSA) has been the major threat in the UK. However, more recently community-acquired MRSA (CA-MRSA) has emerged as a significant problem in the USA, and it is possible that this will also take hold in the UK. Whereas HA-MRSA tends to affect

elderly or immunocompromised patients in healthcare settings, CA-MRSA often occurs in young, otherwise healthy individuals. *S. aureus* is primarily transmitted through contact and causes a wide range of different infections ranging from superficial lesions to deep-seated infections such as septic arthritis, endocarditis or pneumonia. Toxins produced by *S. aureus* can cause food poisoning or toxic shock syndrome. In the mouth, *S. aureus* may be responsible for angular cheilitis, parotitis, osteomyelitis or mucositis. Standard cross infection control measures should restrict the spread of MRSA, and hand hygiene is particularly important.

19.6.5 Pseudomonads

Pseudomonas and related genera are very common in water systems including dental unit waterlines. These gram-negative bacteria are opportunistic pathogens, responsible for lung infections or for infections of wounds or burns. Pseudomonads are of significant concern in augmented care units, such as burns or intensive care units. There is little evidence, however, that these organisms have been transmitted during dental treatment.

19.6.6 Legionella

Legionnaire's disease was first identified following a convention of the American Legion in Philadelphia in 1976, where 182 attendees fell ill with symptoms of pneumonia and 28 of those died. *Legionella pneumophila* lives in water systems and can survive within amoebae, where it is protected from chlorination. Inadequate maintenance of water systems can lead to outbreaks of disease. Dental unit waterlines may harbour *Legionella* and must be cleaned regularly. All dental practices in the UK are now required to have a risk assessment for *Legionella* [10]. It is recommended that practice managers engage with organisations that are registered members of the Legionella Control Association to ensure that working practices are safe and comply with legal requirements.

19.6.7 Prions

Prions are infectious proteins that can nucleate the misfolding of natural proteins in brain tissue. This process leads to progressive neurodegeneration and ultimately to death. An epidemic of prion disease in cattle, bovine spongiform encephalopathy (BSE, or mad cow disease), occurred in the UK between 1985 and 1996 and resulted in the slaughter of 4.4 million cows. Subsequently, a new variant of Creutzfeldt-Jakob disease (vCJD) was identified in humans and has caused 176 deaths up to the end of 2012. Prion diseases are extremely rare, but the infectious agent is highly resistant to standard disinfection and sterilisation protocols, even including steam sterilisation. Harsh chemical treatments such as 1–2M sodium hydroxide for 1 h at

room temperature or immersion in greater than 20,000 ppm sodium hypochlorite l for 1 h at room temperature may inactivate prions, as will extended steam sterilisation, for example, 121 °C for 1 h, or 134 °C for 18 min. However, these procedures may not be compatible with manufacturers' recommendations for devices and are likely to be most appropriate for known or suspected cases of prion disease. Alternatively, single-use devices are a good option if there is a significant risk of prion transmission.

19.7 Summary

Good management systems are essential for maintaining effective cross infection control in a dental practice. Responsibilities for overseeing cleaning, sterilisation and maintenance of equipment should be allocated to individual members of staff. However, all staff in the surgery need to be aware of the importance of cross infection control and the underlying principles behind maintaining a safe working environment. Understanding the modes of transmission of infectious agents is important in order to put in place appropriate barriers against transmission. Regular reviews of procedures are required to ensure that systems are functioning properly and that they conform to the latest local and national guidelines and legislation.

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Immunology and the Dental Practitioner 20

In Brief

- Provides an overview of clinical immunology and how it interfaces with dentistry
- Highlights signs of possible immunodeficiency
- Discusses oral conditions that may be seen in patients with inherited or induced immunodeficiency states

20.1 Introduction

The immune system consists of multiple physical, chemical and cellular components to protect the individual from disease. In certain patients, parts of the immune system are absent (immunodeficiency) or react inappropriately against things such as food and drugs (allergy) or the subject's own tissues (autoimmunity). There are a variety of oral conditions that are related to the activity of the immune system.

The components of the immune system have been classified as innate or adaptive. The innate immune system provides a constant level of protection and is the line of first defence against microorganisms. Specific protection is provided by the adaptive immune system, which has a long-standing immunological memory. It adapts (hence the name) over the lifetime of an individual to infections. The innate and adaptive systems work closely together and provide long-lasting immunity to microorganisms that have been encountered.

20.2 Classification of Immune Deficiency

Patients may highlight symptoms or previous disorders which raise suspicion of possible dysfunction of the immune system. Immunodeficiency occurs when one or more components of the immune system are absent or defective. Primary

M. Greenwood, J. G. Meechan, *General Medicine and Surgery for Dental Practitioners*, BDJ Clinician's Guides,
https://doi.org/10.1007/978-3-319-97737-9_20

immunodeficiency is often the result of a single-gene disorder and may be inherited or the result of a new mutation. Immunodeficiency which results from an insult, such as an infection (such as HIV), disease (such as lymphoproliferative disease) or medication (e.g. immunosuppressants), is termed secondary immunodeficiency. A classification of immunodeficiency is given in Table 20.1. Potential warning signs of immunodeficiency are given in Table 20.2.

20.3 Points in the History

Patients with immunodeficiency usually give a history of excess numbers and severity of infections. Despite this, many patients with immunodeficiency are diagnosed after significant delay which can result in substantial morbidity and increased mortality. Table 20.2 shows ten warning signs that should raise suspicion of immunodeficiency.

It is clear from the above that practitioners should check for a history of recurrent infections, a family history of problems with the immune system and relevant drugs.

Patients with immunodeficiency are clearly more prone to recurrent or serious infections which may be particularly difficult to treat. Most infections will be bacterial or fungal, although serious viral infections may also occur in these patients. Infections may occur with rare or unusual organisms, or at unusual sites. Patients with immunodeficiency may also present with relatively common infections, for example, oral candidiasis, but it is the persistent nature of infection which may be unusual.

Patients with immunodeficiency are also prone to malignancy and autoimmune disease as they have lost regulatory and surveillance cells that normally keep the immune system in check. Dental practitioners should be particularly vigilant for signs of cutaneous cancers such as basal cell carcinomas and squamous cell carcinomas on sun-exposed surfaces, particularly the lips [1] (Fig. 20.1). There may be clinical signs that suggest more widespread immune dysregulation such as autoimmune disease resulting in patches of skin depigmentation, a condition known as vitiligo, or hyperpigmentation can occur as the result of Addison's disease.

Examples of specific primary immunodeficiencies which may be seen in dental practice include:

Table 20.1 A classification of immunodeficiency

Inherited (primary) immunodeficiency
• B cells (lack of antibody)
• T cells
• Combined B and T cells
• Neutrophils
• Complement
Acquired (secondary) immunodeficiency
• For example, infections such as HIV, lymphoproliferative disease, malnutrition, drugs—immunosuppressives

Table 20.2 Signs or points obtained from the history that should alert a practitioner to the possibility of immunodeficiency

• Eight or more new ear infections in 1 year
• Two or more serious sinus infections in 1 year
• Two or more pneumonias in 1 year
• Recurrent, deep-skin or organ abscesses
• Two or more deep-seated infections, for example, osteomyelitis, cellulitis
• Antibiotics for 2 months without effect
• Surgical intervention for chronic infection, for example, recurrent incision of boils
• Persistent oral candidosis or cutaneous candidosis after age 1 year
• Failure to thrive
• Family history of immunodeficiency

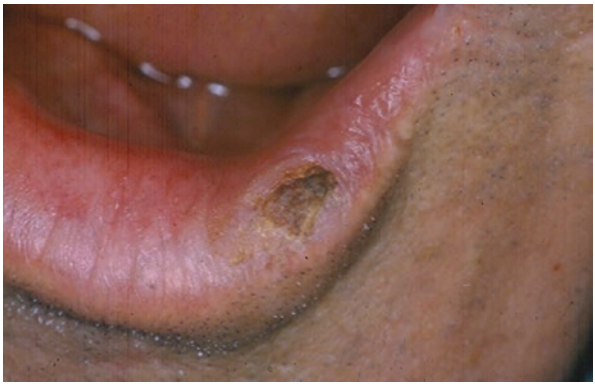

Fig. 20.1 A squamous cell cancer of the lower lip

- *C1 esterase inhibitor deficiency (hereditary angioedema)* is a condition that may be inherited resulting in uncontrolled activation of the complement pathway. Significant soft tissue swelling can occur after exposure to minor trauma or stress such as dental treatment (Fig. 20.2). Laryngeal oedema is particularly important as it can lead to airway obstruction. One of the means of distinguishing the condition from anaphylaxis is that urticaria does not occur. Treatment of acute attacks is with replacement of the missing enzyme, and clearly patients with this condition should be managed in conjunction with an immunologist. Prevention is always best, and prior to dental treatment, patients may require supplementation with a C1 esterase inhibitor concentrate.
- *Chronic mucocutaneous candidosis (CMC)* is a rare condition affecting both sexes. It presents with chronic candida infection of the skin and mucous membranes. An associated autoimmune endocrine deficiency may be found. Regular antifungal treatment at high doses may be required over prolonged periods.

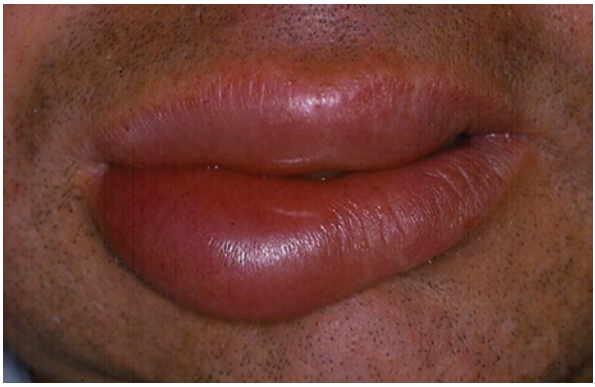

Fig. 20.2 Lip swelling in a patient with angioedema

- *Common variable immunodeficiency (CVID)* is a form of antibody deficiency disorder of unknown cause. It may be the result of multiple gene defects. Treatment is with lifelong antibody replacement therapy.
- *Chronic granulomatous disease (CGD)* usually presents in childhood with recurrent deep-seated abscesses, which may be in unusual sites. The underlying immunological defect is a failure of the neutrophil oxidative burst and subsequent killing of organisms.
- *Wiskott-Aldrich syndrome (WAS)* classically affects males and is associated with eczema, recurrent infections and low platelet counts.
- *DiGeorge syndrome* is a genetic disorder with variable features including congenital cardiac defects, cleft palate and abnormal facial features. It is a disorder of T-cell function and leads to predisposition to infection.
- *Severe combined immunodeficiency (SCID)* is a genetic disorder leading to impaired function of B and T lymphocytes. Patients may present with chronic diarrhoea, recurrent ear infections, candidosis and respiratory infections due to *Pneumocystis jiroveci*. Haemopoietic stem cell transplants (bone marrow transplants) are the mainstay of management in these patients.

Antibiotic prophylaxis should be considered for procedures that have a high risk of leading to post-operative infection, and liaison with an immunologist is important.

20.4 Allergy

Patients may give a history of allergy, for example, to Elastoplast® (Fig. 20.3). Hypersensitivity reactions are immune-mediated antigen-specific reactions that are either inappropriate or excessive and result in harm to the host. They have been classified by Gell and Coombs [2] (Table 20.3).

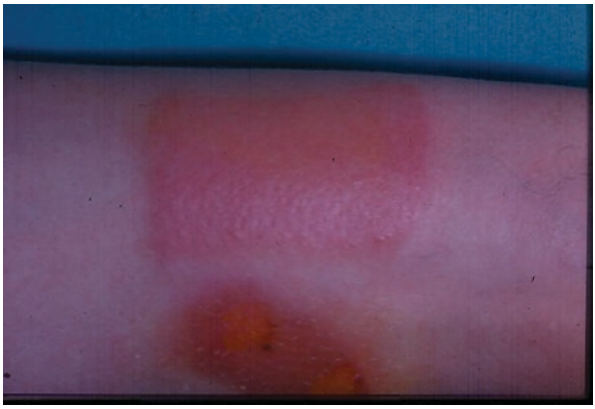

Fig. 20.3 An allergic reaction to Elastoplast®

Table 20.3 An abbreviated version of Gell and Coombs' classification of hypersensitivity reactions

Type I	IgE mediated—example allergic rhinitis, asthma, anaphylaxis
Type II	IgG mediated—example transfusion reaction, autoimmune disease
Type III	IgG mediated—example systemic lupus erythmatosus
Type IV	T cell mediated—contact dermatitis, chronic asthma, chronic allergic rhinitis

The incidence of allergic disease in Western societies is increasing, and it is hypothesised that reasons for this may be as a result of a decrease in infections that are encountered and a consequence of immunisation regimens. The proposed "hygiene hypothesis" suggests that the reduced exposure of the immune system to pathogens has led to a switch in the immune system leading to responses that allow the development of allergic conditions. Changes in the environment, for example, changes to housing, have led to increased exposure to house dust mites, and dietary changes may also have a part to play.

There are many materials that are used in dental practice that may be considered as irritants or potential allergens. A selection of these is listed in Table 20.4.

Signs and symptoms can be variable in patients who have an adverse reaction to materials or media used in dentistry. They can range from stomatitis, mouth ulceration, lichenoid reactions (Fig. 20.4), burning or tingling to lip swelling, oral swelling or facial rashes. More systemic symptoms may arise such as urticaria, wheezing or anaphylaxis.

Type I hypersensitivity reactions to chlorhexidine have been seen in patients and healthcare workers [3] but are not common when the ubiquitous nature of this substance is taken into account. Nevertheless fatal anaphylaxis to chlorhexidine has been attributed to dental use [3].

Table 20.4 Potential irritants/allergens in dental practice

• Latex
• Mouthwashes
• Adhesives
• Acrylic
• Amalgam
• Cements
• Impression materials
• Antiseptics
• Local anaesthetics
• Ultra violet radiation

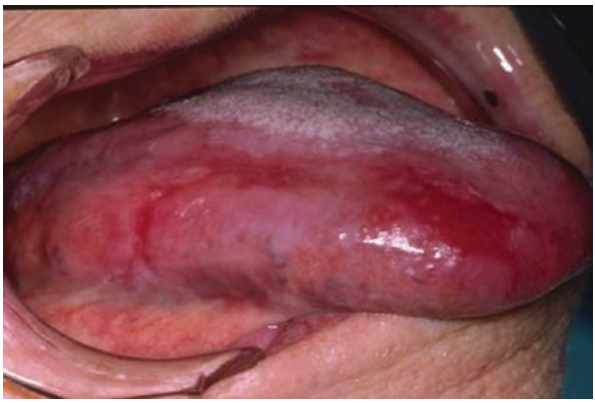

Fig. 20.4 An intraoral lichenoid reaction

20.5 Anaphylaxis

Anaphylaxis is a Type I hypersensitivity reaction mediated by IgE to which free antigen binds leading to the release of vasoactive peptides and histamine. The signs and symptoms of anaphylaxis are given in Table 20.5. The treatment of anaphylaxis is discussed in the chapter on medical emergencies in this series (Chap. 18).

20.6 Potential Features on Clinical Examination

Oral lichenoid lesions may cause patients to complain of oral soreness, and ulceration can occur. Amalgam has been implicated in the production of oral lichenoid reactions in the tissues that contact restorations with this material [4]. Figure 20.4 shows a lichenoid reaction. Some patients with this condition have been found to have Type IV sensitivity to mercury and other metals, and patch testing may be useful in identifying this problem. Removal of an amalgam restoration adjacent to a lesion may lead to improvement even when patch testing is negative as these materials can also act as irritants.

Table 20.5 Signs and symptoms of an anaphylactic reaction

• Itchy rash with or without erythema
• Pallor or facial flushing
• Upper airway oedema and bronchospasm leading to stridor, wheezing and hoarseness
• Vasodilatation leading to hypotension and circulatory collapse
• If untreated or rapidly progressive, respiratory arrest and/or cardiac arrest may occur

Oral erythema can also occur secondary to Type IV hypersensitivity. Implicated substances include acrylic. Cheilitis is an inflammatory eruption of the lip and may be due to contact allergy or irritation from constant licking of lips, atopic dermatitis, infection, usually with *Staphyloccocus aureus*, or iron deficiency.

Candidosis may be seen in immunosuppressed patients. Candidal organisms are highly opportunistic and are present in a dormant yeast phase in a significant proportion of the population. Local and/or systemic factors may lead to the yeast developing into its pseudohyphal (pathogenic) form. Management of these conditions usually involves eliminating local factors such as poor denture hygiene and antifungal medication. In immunocompromised individuals antifungal treatment may need to be used for a prolonged period. Systemic fluconazole is usually the drug of choice.

Immunosuppressed patients are susceptible to viral infections, in particular, those of the herpes group such as herpes simplex and varicella zoster virus [5]. A significant proportion of the population carry these viruses in a latent form having acquired them during childhood. Reactivation occurs if the host is unable to mount a significant immune response to the virus. In immunocompetent individuals, these infections are usually self-limiting, but in the immunocompromised, both infections can be more serious and lead to life-threatening conditions such as herpes encephalitis. Such patients need aggressive management with early antiviral medication.

Other viral infections include the papilloma virus group which leads to lesions anywhere on the skin or oral mucosa. Other virus-related lesions may include hairy leukoplakia, which is related to Epstein-Barr virus and can be a feature of HIV.

There is a large number of conditions which results from autoimmunity. These conditions can be organ-specific such as hyper or hypothyroidism or non-organ specific, for example, rheumatoid arthritis, systemic lupus erythematosus (SLE) and vasculitis.

Certain autoimmune conditions may present with oral signs. Signs of Addison's disease, or autoimmune adrenal insufficiency, include increased pigmentation of skin folds, buccal mucosa and scars. In general terms it can present with symptoms of fatigue and depression.

In Type I diabetes mellitus, where there is immunologically mediated destruction of the islets of Langerhans in the pancreas, oral complications include candida infection, dry mouth, sialosis and glossitis. Severe oral infection can upset glycaemic control, and patients are prone to increased superficial infections and poor wound healing.

Patients with coeliac disease may present with aphthous ulceration secondary to anaemia. Some may describe a blistering skin rash known as dermatitis herpetiformis.

Other well-known but relatively rare autoimmune diseases that may be seen by dental practitioners include the vesiculobullous disorders pemphigoid and pemphigus. Bullous pemphigoid is seen most commonly in the elderly with subepidermal blisters with the mucous membranes usually spared. Treatment may be with immunosuppression. Pemphigus vulgaris is often associated with non-healing erosion of mucous membranes, and treatment is with high-dose steroids.

Scleroderma is a multisystem disorder characterised by fibrosis of connective tissue. Oral manifestations can include periarticular involvement of the temporomandibular joint, and skin involvement around the mouth leads to microstomia. The tongue may become thickened and stiffened with oral telangiectasia and widening of the periodontal membrane space but without associated tooth mobility. The hands may be affected which can lead to difficulties with compliance with oral hygiene measures.

Cutaneous manifestations of disorders such as systemic lupus erythematosus (SLE) may include oral ulceration. A photosensitive facial skin rash (classically described as a "butterfly" rash), alopecia and Raynaud's phenomenon may also be seen.

Clearly one of the best known immunological diseases recognised by dental practitioners is that of Sjögren's syndrome comprising dry eyes, dry mouth and associated inflammatory arthritis. Clearly the dry mouth may lead to other signs and symptoms from the mouth including impaired taste sensation, gingivitis, difficulty in swallowing, predisposition to candida infection, angular stomatitis and ascending parotitis. The salivary glands may be enlarged.

Behcet's disease, a systemic vasculitis, has significant oral manifestations. Patients with the disease suffer from a clinical triad comprising aphthous-type oral ulceration, genital ulcers and iritis. The ulceration can be severe, but oral symptoms may occur before the other features. As a result, dental practitioners may be the first clinicians to see patients with this disease. There may be associated skin lesions including a folliculitis.

Erythema multiforme is a disorder characterised by recurrent mucosal lesions with or without skin lesions. The typical skin lesion is described as a "target lesion" due to its characteristic appearance. Many different types of rash can be seen, hence the use of the word multiforme. Severe cases are described as Stevens-Johnson syndrome. Ocular and genital lesions may also be seen.

It is uncertain what causes erythema multiforme, but it is thought to be an immune complex disorder with a diverse range of possible antigens ranging from herpes simplex virus (thought to be responsible for most oral manifestations) to mycoplasma and drugs.

On examination, the characteristic clinical appearance is of oedematous, crusted and blood-stained lips. Vesicles or bullae may be seen. Treatment is usually via topical corticosteroids, chlorhexidine and possibly in severe cases systemic steroids. If

a viral aetiology is implicated or suspected, acyclovir may be prescribed. If the oral signs and symptoms are significantly limiting nutrition or in particular hydration, the patient may need to be admitted to the hospital.

20.7 Drugs That May Be Taken by Patients With Immunological Disease

The largest group of drugs that may be encountered are the immunosuppressants. Clearly patients with other disorders may also take immunosuppressants as well as those with pure immune disease. Some of the more common ones encountered are summarised in Table 20.6. Most immunosuppressants target the induction phase of the immune system by reducing lymphocyte proliferation.

Immunosuppressants can produce unwanted intra-oral effects. Ciclosporin produces gingival hyperplasia and has been reported to cause this side-effect in up to 30% of patients taking this drug [6]. Cyclophosphamide, methotrexate and mycophenylate cause bone marrow suppression, which can lead to oral ulceration [7] as well as a reduced resistance to periodontal disease. As well as increasing the risk of infection, bone marrow suppression can increase post-operative bleeding as a result of thrombocytopaenia. A platelet count below 50×10^9/l is a contraindication to surgery until corrected or a platelet transfusion is administered. Platelet counts of less than 100×10^9/l require the use of local haemostatic measures such as packing with haemostatic gauze and suturing after dental extractions.

Corticosteroids have a dual effect on the periodontium. Their anti-inflammatory effects can offer protection against periodontal breakdown. On the other hand, chronic use of steroids may produce osteoporosis, which increases the risk of periodontal disease [8]. Dental practitioners should also remember that methotrexate has an hepatotoxic effect which varies between individuals but may be significant enough to adversely affect liver function, in particular its role in clotting factor metabolism.

Table 20.6 Immunosuppressants which may be encountered by dental practitioners

Drug	Target within the immune system
• Ciclosporin and tacrolimus	Inhibits IL-2 production and action. Specific effect on T-helper cells
• Corticosteroids	Inhibits cytokine gene expression
• Azathioprine	Inhibits purine synthesis
• Cyclophosphamide	Binds and cross-links DNA preventing interfering with DNA replication and transcription (alkylating agent)
• Methotrexate	Competitive inhibitor of dihydrofolate reductase. Interferes with thymidine and therefore DNA synthesis
• Mycophenylate mofetil	Blocks synthesis of guanine
• Monoclonal antibodies	Antibodies of a single specificity. Available to multiple cytokine and receptor targets

Patients on long-term immunosuppressant therapy, such as those who have had organ transplants, are at risk of developing malignancies on the lip [1] as well as other cutaneous cancers. As mentioned above dentists treating these patients should have a high level of suspicion and be vigilant in monitoring the lips, oral mucosa and skin. Any suspicious lesions should be referred for urgent biopsy.

Concurrent therapy with immunosuppressant medication impacts on the drugs the dentist may prescribe. The main groups to note are the nonsteroidal anti-inflammatories (NSAIDs) and antibacterials. NSAIDs should be avoided in those taking corticosteroids as this combination can lead to peptic ulceration. Similarly NSAIDs interact with methotrexate leading to an increase in methotrexate toxicity. The toxicity of the latter drug may also be increased by the penicillins. If an alternative antibacterial drug is not feasible, then current advice is that patients receiving a penicillin and methotrexate should be carefully monitored during treatment. Monitoring involves measuring platelet levels and blood counts twice weekly for 2 weeks, with methotrexate levels being taken if the patient becomes symptomatic [9]. NSAIDs also increase the nephrotoxic effects of ciclosporin.

In addition to immunosuppressants, patients may be receiving other medications to treat conditions secondary to their underlying disease, for example, antimicrobial drugs.

20.8 Summary

The study of immunology is a specialist area. There are some fundamental concepts and conditions with which it is essential for a dental practitioner to be familiar for safe clinical practice.

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