Management of Medical Comorbidities in Maxillofacial Surgery

3

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3.1 Introduction

The management of the medically compromised patient is a topic that has received a great deal of attention in recent times. Unfortunately, most of the literature available discusses this topic from a western context. While the human species and the physiology remains unchanged, challenges in South Asia, especially India, stem from a vastly different social structure, a massive urban-rural socioeconomic divide, and social variables that have a major impact on the practice of medicine. In addition, a mixture of patient ignorance, poor training in soft skills of doctors, and an irresponsible fourth estate has vitiated a hitherto-friendly doctor-patient relationship.

While this chapter is not designed to provide a comprehensive guide to the medical management of a maxillofacial patient (which deserves a textbook in its own right), it attempts to provide an insight into the management of medically compromised patients requiring maxillofacial surgery.

3.2 Changing Demographics in India

India encompasses almost a fifth of the world's population with a population estimate of about 1.34 billion [1]. The life expectancy at birth in India has improved from 59.7 years in 1990 to 70.3 years in 2016 for females, and from 58.3 years to 66.9 years for males [1]. In short, the average life span of an Indian has increased by 11 years in the last decade leading to an increase in the geriatric population of the country. The crude death rate has also steadily declined in the last decade from 7.5 to 6.4 per 1000 population [2]. The population continues to grow, as the birth rate has superseded the death rate. This change, while an indicator of improved healthcare delivery, adds to the health burden of the country, and creates a different spectrum of diseases—particularly lifestyle diseases.

There has also been a shift in the societal patterns. We see an increase in urban nuclear families resulting in unattended elderly parents whose medical conditions stay undiagnosed and uncontrolled.

3.3 Lifestyle Changes in India

There has been a sea of change in the lifestyle of today's population compared to a couple of decades ago. Sedentary lifestyle, processed food, industrialization, occupational hazards, etc. have led India to a "dual disease burden" scenario. So, even as the incidence of lifestyle diseases is steadily on the rise, a vast majority of rural and poor patients still suffer from infectious and acute diseases.

As recently as 2016, cardiovascular diseases like Ischaemic Heart Disease (IHD) and stroke contributed 28.1% toward mortality in India. This was a 34.3% increase over 16 years, suggesting the impact of lifestyle disease on society. The major contributors for this change are rapidly aging population, pollution, high blood pressure, dyslipidemia, high fasting plasma glucose, and an increased BMI (body-mass index) [3]. Respiratory diseases like chronic obstructive pulmonary disease (COPD) and bronchial asthma—are the second-largest contributors to the total mortality burden of India—at 10.9%. Diabetes analysis shows that it contributes 3.1% toward the total mortality burden.

Air pollution is a major risk factor for both cardiovascular and respiratory illness and increases the risks for acute respiratory infections and exacerbates asthma [4]. Such unique challenges raise questions of following treatment protocols based on western studies. A preoperative chest X-Ray may

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find an indication in an apparently fit and healthy 28-year-old living in New Delhi (with record levels of pollution) when it would be considered unnecessary for a similar patient from rural Yorkshire.

With the rise of urbanization and urban migration, the problems of air pollution, inadequate sanitation, and an unhealthy diet are accentuated. Population residing in urban areas in India, according to 1901 census, was 11.4%. This count increased to 28.53% by 2001, and the numbers increased to 34% in 2017 [5].

"Cyberchondria" has become a challenge with patients tending to diagnose and treat their problems themselves, and unsurprisingly getting it wrong. India is also among one of the most depressed countries in the world. A World Health Organization (WHO) study states that at least 6.5% of the Indian population suffers from some form of serious mental disorder. The average suicide rate in India is 10.9 for every hundred thousand people with the majority of victims being less than 44 years of age [6]. Diminished mental health is associated with a host of consequences like lack of participation in social activities, odd eating habits, and withdrawal from income generation and employment opportunities—all of which can cascade onto other serious illnesses and even death.

3.4 The Changing Face of Oral and Maxillofacial Surgery

As always, training is struggling to keep up with the changing trends in medicine. Trainees are often unaware of new protocols and the changed scenario of medical comorbidities of the population. Surgery has become heavily technology oriented, sometimes at the cost of clinical expertise. Furthermore, there is improved awareness among medical professionals for crossreferral to review dentition, seen mostly by maxillofacial surgeons rather than general dentists. Referrals are required now before radiotherapy, chemotherapy, cardiac surgery, transplants, etc.

Furthermore, maxillofacial surgery as a specialty has blazed a trail hitherto unimagined with successful foray into head and neck surgery, craniofacial reconstruction, and microvascular surgery. This now has put the onus on the surgeon to educate himself enough to be able to manage a sick patient on the ward to the extent of preventing complications and making appropriate referrals. Gone are the days when a physician could be asked to do the job for us and we could enjoy the comfort of being surgical technicians!

3.4.1 Medical History and India

While veritable treatises about the science and art of history taking, this part of clinical medicine is a unique investigative effort in the Indian context. The challenges to the maxillofacial surgeon are multifold. The first difficulty is encountered with the patient who may deny illness (often hypertension or diabetes) because he/she is adequately treated and all parameters are within normal limits. The next hurdle is when the patient decides to withhold information wantonly due to social taboos or plain ignorance of its importance to the treating doctor. Dentists and maxillofacial surgeons who question their patients seated on dental chairs in an outpatient setting often experience the latter. This stems from the patients' assumption that the information is inconsequential to their treatment. The last situation is the uneducated patient who is truly unaware of his medical condition.

With these intricacies, the oral surgeon needs to employ several out-of-the-box techniques to extract the history. This includes the much-derided leading questions, questioning relatives, sometimes in private, and playing Sherlock by asking them to bring in their medication and working backwards. But this effort is still of paramount importance in this technology-driven age and the modern oral and maxillofacial surgeon will do well to assimilate all the conventional history-taking skills and learn a few new ones as well.

3.5 Cardiovascular System

3.5.1 Hypertension

Hypertension is an extremely common condition and often undiagnosed. Since it is mostly asymptomatic, the oral surgeon has the unique opportunity to be the first healthcare professional to identify the condition. Hence, it is imperative that every procedure should begin with recording the patients' vital signs. The following table offers a guideline for the diagnosis and risk stratification of hypertension (Table 3.1).

The authors stress that aneroid manometers are more accurate than digital ones. Like any delicate instrument, these too need frequent calibration [8].

The long-term effects of hypertension have far-reaching implications on maxillofacial surgery, especially under general anesthesia (Fig. 3.1).

Table 3.1 Guidelines for diagnosis of hypertension [7]

Category	Systolic (mmHg)	Diastolic (mmHg)
Optimal	<120	<80
Normal	120–129	And/or 80–84
High normal	130–139	And/or 85–89
Grade 1 hypertension	140–159	And/or 90–99
Grade 2 hypertension	160–179	And/or 100–109
Grade 3 hypertension	>180	And/or >110
Isolated systolic hypertension	>140	And <90

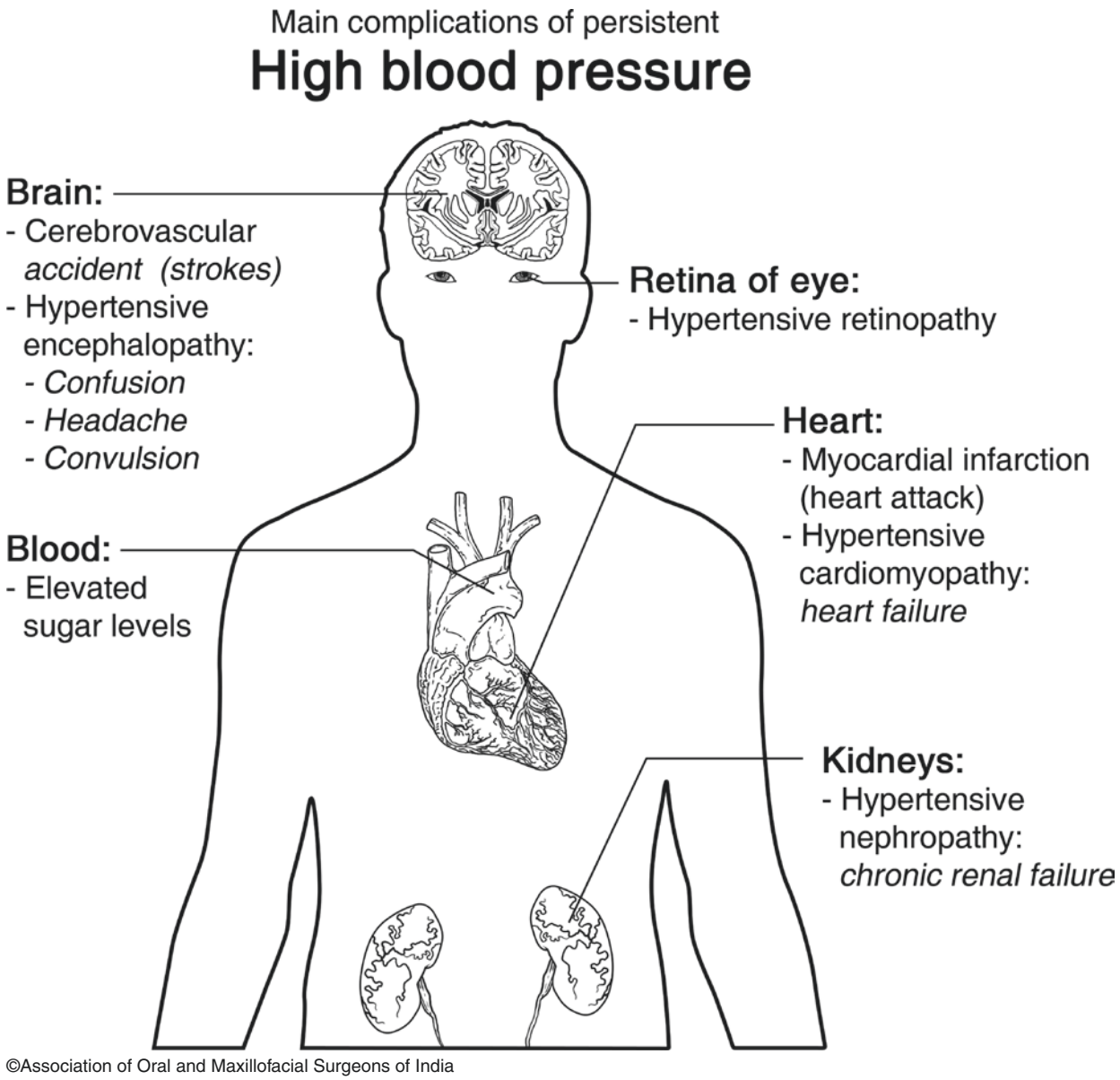


Fig. 3.1 Long-term effects of hypertension

3.5.1.1 Minor Oral Surgery

A thorough history will elicit symptoms of poor blood pressure control and symptoms of end-organ damage in a known hypertensive.

Conversely, end-organ damage points to poor blood pressure control. If such symptoms exist, elective procedures are to be deferred until good control is achieved. The absolute cut off of blood pressure is supposed to be 180/110 mmHg [9]. However, it is the author's experience that this is too high a cut off in the Indian context with social and logistic challenges. This is especially true for an out-of-hospital standalone dental clinic where the average oral surgeon performs his outpatient procedures. This is because there is a lack of clarity on the effect of stress-induced hypertension (white coat hypertension) and the effect it can have in an already-hypertensive patient. Hence, it is advisable to limit elective extractions to stage 2 hypertension [10] (SBP < 160 mmHg and DBP < 100 mmHg). When minor oral surgery is performed within these parameters, excessive bleeding is an unlikely complication.

3.5.1.2 Major Maxillofacial Surgery

Major surgery introduces two important variables into the mix. First is the procedure itself with surgical trauma and the attendant physiologic response (Table 3.2). The second is the requirement of a general anesthetic. While the anesthesiologist takes the final call on the safety of administering general anesthesia, the surgeon is the one who needs

to provide the input regarding the intensity of the surgery. For example, fixing a fractured zygomatic bone can wait while operating on a patient with stridor from Ludwig's angina cannot.

Additionally, perioperative hypotension can also be of significant concern, both systemically and surgically (microvascular flaps need excellent perfusion and hypotension with peripheral vasoconstriction can lead to a flap loss). The surgeon and the anesthetist need to walk a tightrope, especially in a hypertensive patient.

Table 3.2 Causes of hemodynamic changes [7]

Hemodynamic changes	Causes
Hypotension	Systemic vasodilatation (GA)
	Sympathetic blockade (spinal/epidural anesthesia)
	Hypovolemia
	Blood loss
	Mechanical ventilation
	Drugs (angiotensin receptor blockers)
	Arrhythmias
	Acute coronary events
	Pulmonary thromboembolism (high-risk surgery for pulmonary thromboembolism and/or patient predisposing factors)
Hypertension	Laryngoscopy and intubation
	Surgical stimulus
	Inadequate plane of anesthesia/analgesia
	Hypothermia
	Hypervolemia
	Reversal and recovery
	Hypoxia (post-op)
	Inadequate analgesia (post-op)
	Full bladder (post-op)

3.5.1.3 Vasoconstrictors and Hypertension

Vasoconstrictors are routinely used in conjunction with a local anesthetic to reduce bleeding, increase the duration of action, and reduce the requirement of the total volume of the anesthetic. The most commonly used vasoconstrictor is adrenaline. Felypressin (Octapressin) is also available as a vasoconstrictor with Prilocaine—but only in a cartridge. The concentration of adrenaline as a vasoconstrictor ranges from 1:80,000 to 1:200,000.

Physiologic effects of adrenaline in varying concentration [11]:

- 1:80,000 significantly increase in systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate;
- 1:100,000 concentrations can increase SBP and heart rate; and
- 1:200,000 is limited to an increase in heart rate, but less significant

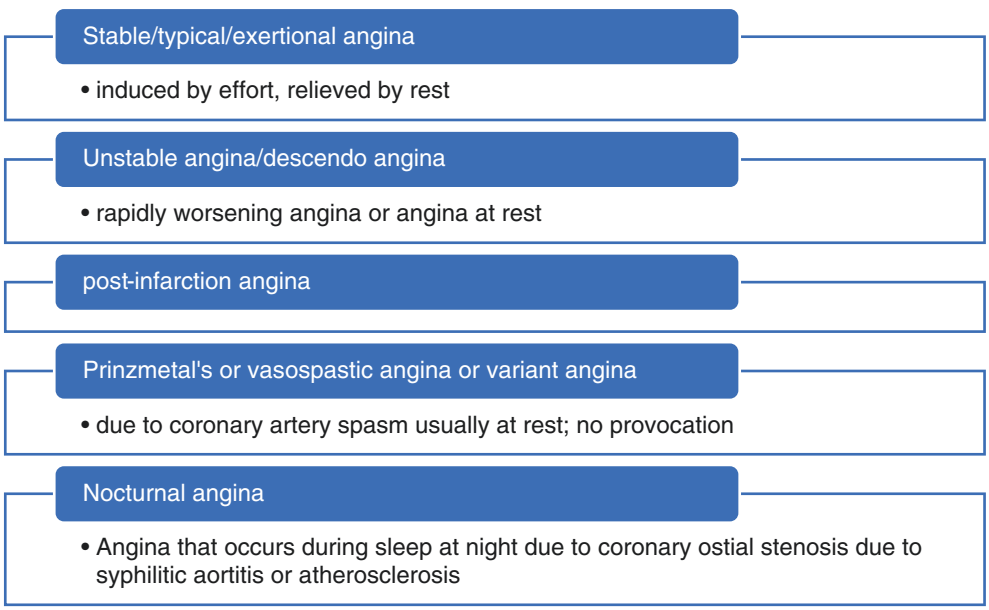
Pain itself has a significant effect on SBP, DBP on heart rate and adrenaline, even in the concentration of 1:200,000 significantly increases the duration and depth of local anesthetic. Adrenalin has a beneficial effect in this concentration without negative cardiovascular implications [11].

3.5.2 Ischemic Heart Disease (IHD)

Atherosclerosis is a progressive disease involving medium-to-large caliber arteries. It may result in ischemic lesions of the brain, heart or extremities leading to thrombosis, infarction of affected vessels, and end-organ damage.

Ischemic heart disease could present as angina or myocardial infarction (Figs. 3.2 and 3.3). Both conditions are caused

Fig. 3.2 Types of Angina



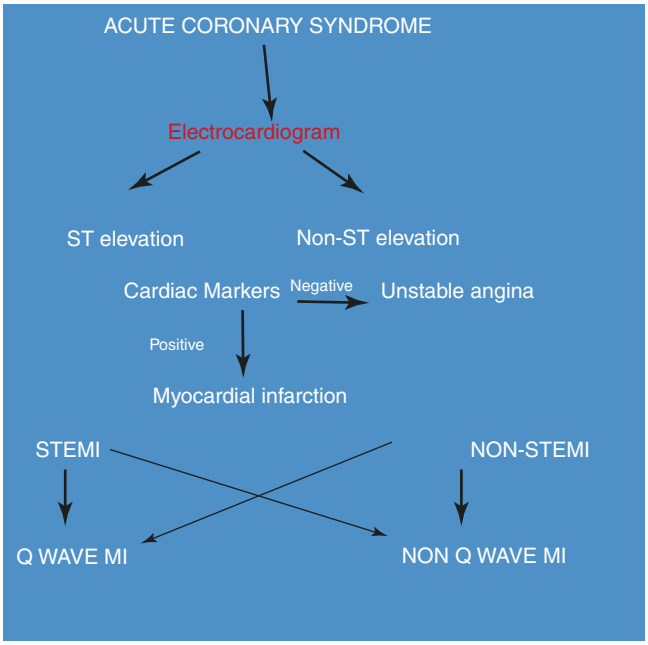


Fig. 3.3 Types of Acute Coronary Syndrome

by decreased coronary blood flow, increased myocardial oxygen demand, and form two ends of a spectrum with several subclassifications.

Oral surgical procedures cause significant surgical, physiological, and psychological stress. It is imperative that the patient is assessed thoroughly prior to any intervention. Patients with IHD are susceptible for another cardiac event within 6 months [12]. With changing management strategies in cardiac patients and medicolegal aspects in mind, it is prudent to liaise with the cardiologist for all but the most straightforward of situations.

3.5.2.1 Minor Oral Surgery

Previous myocardial infarction or unstable angina does not form a contraindication for dental extractions. However, timing and planning are of paramount importance. In the quoted study, about 10% of patients have reported postoperative chest pain [12]. While the sample size of the quoted article is small, it underscores the importance of risk-benefit analysis before undertaking these procedures. The treatment planning may need further input from a cardiologist.

If such patients are on antiplatelet medication, it is of extreme importance to note that single antiplatelet agents do not constitute a contraindication for most minor oral surgery [13]. *Refer to the section on antiplatelet and anticoagulant drugs and surgery.*

3.5.2.2 Major Surgery

Since most surgery considered in this context is emergent or urgent in nature (trauma, oncosurgery, space infections), the benefit of the life-saving procedure by far outweighs the risk of a further cardiac episode. Such procedures are ideally done in a center equipped to deal with any adverse cardiac event. In a country like India, the onus of keeping the appropriate specialty appraised of the situation before starting the procedure is on the operating surgeon.

3.5.3 Postintervention Cardiac Patients

3.5.3.1 Percutaneous Coronary Angioplasty (PTCA) and Coronary Artery Bypass Graft (CABG) and Valve Replacement Procedures

With access to healthcare improving, it is becoming more common for the surgeon to encounter patients with IHD who have had interventions. These range from conventional CABG to Percutaneous angioplasties with stents in place and minimal access CABGs. In our context, the clinician needs to know what these are not only to analyze the impact these procedures have on the maxillofacial procedure but also to tease the information out of the reluctant historian.

PTCA/PCA

Percutaneous transluminal coronary angioplasty has become the intervention of choice for coronary artery disease. This procedure involves the insertion of a stent in the narrowed portion of the artery (Fig. 3.4). This stent intimately hugs the endothelium of the vessel and is reliably and completely endothilized in 6 months to a year. The patient is susceptible to stent thrombosis in this period and hence the antiplatelets. There are many varieties of stents and the design and features are always in a state of flux. Therefore, any changes to antiplatelet therapy are to be made in consultation with the treating cardiologist [14].

Types of coronary stents:

- Bare metal stents
- Drug-eluting stents
- Bioresorbable scaffold system
- Drug-eluting balloons

Following successful revascularization procedures, the patient is expected to be in a far better hemodynamic state than before. If the patient remains symptomatic, then he/she requires to be seen by the cardiothoracic surgery team. The only challenge in these patients is the antiplatelet/anticoagulant medication. In the case of patients with prosthetic cardiac valves, it is vital to provide endocarditis prophylaxis (read following content).

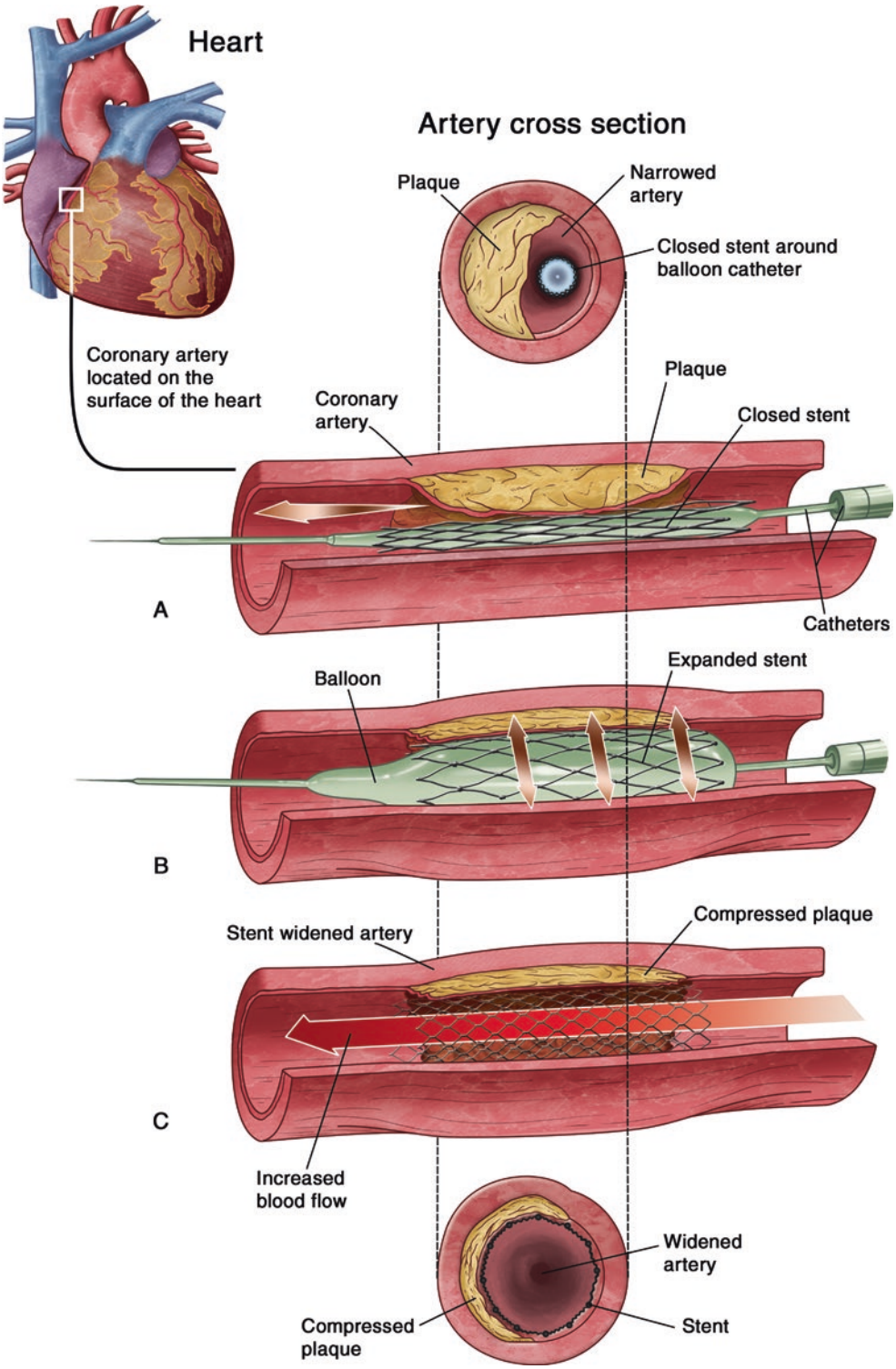


Fig. 3.4 Mechanism of PTCA

3.5.4 Conventional Antiplatelets, Anticoagulants, and Novel Oral Anticoagulants (NOAC)

3.5.4.1 Minor Dentoalveolar Surgery: Antiplatelets

There are several concerns regarding the risk of excessive bleeding following minor oral surgery in anticoagulated patients and those on antiplatelet medication. Most of these are unfounded for dentoalveolar procedures. In most dentoalveolar procedures, we have the advantage of a bony cavity where physical pressure can be effectively applied to obtain hemostasis. This can be further augmented with other local hemostatic measures (sutures, surgical R, AbgelR, etc.). This obviates the need to stop antiplatelet drugs (read following content). However, in patients on dual antiplatelet therapy, the authors suggest caution when operating in critical areas like the floor of the mouth as hematomas can cause airway embarrassment.

Conventional antiplatelets bind irreversibly to platelets and the normal clotting process is restored only with the production of new, unaffected platelets (Fig. 3.5, Table 3.3). It takes 5–10 days for platelets to be produced in the quantity required to produce a clinically normal platelet action. In the interim, if a procedure causes excessive bleeding, the only reliable way to ensure hemostasis is platelet transfusion. However, the newer ones are reversible and can be stopped for 24 h prior to the procedure as a "switch on-switch off"

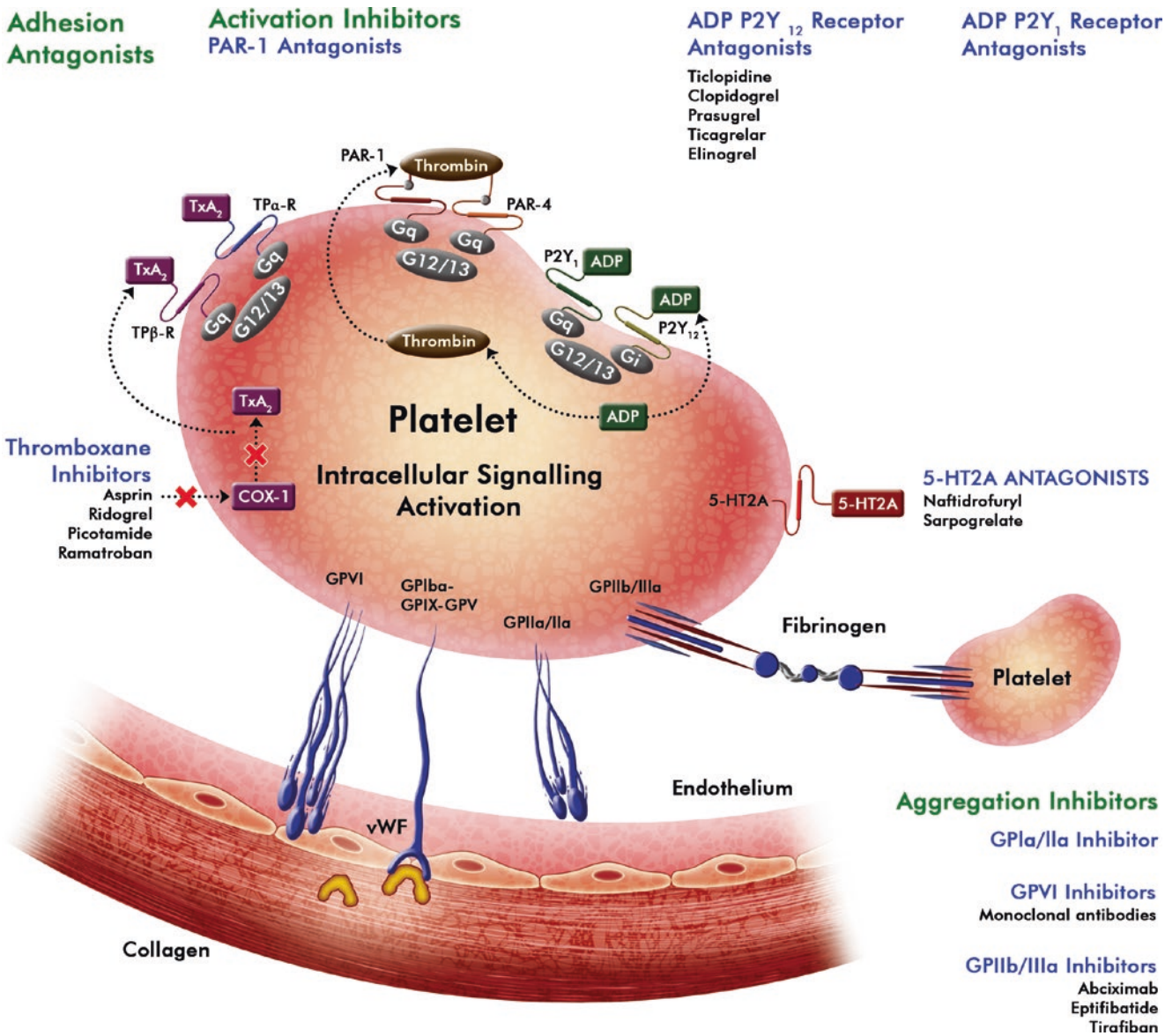


Fig. 3.5 Mechanism of action of commonly used antiplatelet drugs

Table 3.3 Commonly used antiplatelet agents and their characteristics [15]

Drug	Mechanism of action	Loading dose	Maintenance dose	Half-life	Time to recover platelet function after drug withdrawal	Platelet inhibition	Administration route
Aspirin	COX-1 inhibition	325 mg	75–325 mg daily	15–20 min	30% at 48 h	Irreversible inhibition	Oral
Clopidogrel	P2Y12 receptor inhibition	30–600 mg	75 mg daily	7–9 h	40% at 3 days	Irreversible inhibition	Oral
Prasugrel	P2Y12 receptor inhibition	60 mg	10 mg daily	7 h	2–3 days	Irreversible inhibition	Oral
Ticagrelor	P2Y12 and Partly P2Y1 receptor inhibition	180 mg	90 mg twice a day	7–9 h	57% at 24 h	Reversible inhibition	Oral
Cangrelor	Adenosine triphosphate analogue with a high affinity for the P2Y12 receptor	30 μg/kg	2–4 μg/kg/min	3–6 min	Rapid (mins–hours)	Reversible inhibition	i.v
Abciximab	Glycoprotein IIb/IIIa receptor inhibitor	0.25 μg/kg	0.125 μg/kg/min	10–15 min	12 h	Reversible inhibition	i.v
Eptifibatide	Glycoprotein IIb/IIIa receptor inhibitor	180 μg/kg	2 μg/kg/min	2.5 h	2–4 h	Reversible inhibition	i.v
Tirofiban	Glycoprotein IIb/IIIa receptor inhibitor	0.4 μg/kg	0.1 μg/kg/min	2 h	2–4 h	Reversible inhibition	i.v

drug. But these are very expensive and most of the below-poverty-line patients are likely to be on older antiplatelets for some time to come.

3.5.4.2 Maxillofacial Surgery

Patients who need procedures with low risk of bleeding (e.g., fixation of fracture of the parasymphysis) may continue oral antiplatelet/anticoagulation therapy. This applies especially to high-risk patients (e.g., mechanical heart valves). However, when the risk of bleeding is obvious, it outweighs the benefit of continuing antiplatelet/anticoagulant therapy. In such cases, heparin is used as bridge therapy.

3.5.4.3 Bridging with Heparin

In cases where the patient is at high risk for a thromboembolic episode, a "bridge"—a balance between surgical bleed and risk of thrombosis may be achieved either with intravenous unfractionated heparin or with subcutaneous low-molecular-weight heparin [16].

3.5.4.4 Anticoagulants and Oral/Maxillofacial Surgery

While several indications exist for the use of anticoagulants, the authors have noted that there is significant resistance in the medical community to prescribe anticoagulants in these cases and they are often replaced by antiplatelets in India. This is especially true for the rural patient who may not have regular access to monitor his anticoagulation status. However, in urban centers, NOAC are in regular use.

Common indications for anticoagulation—prevention of thrombotic events in:

Mechanical Heart Valves.
Atrial Fibrillation.
Deep Vein Thrombosis and Pulmonary Embolism.
Myocardial infarction.
Acute Ischemic Stroke

The target International Normalized Ratio (INR) range for most conditions is between 2.5 and 3.5.

3.5.4.5 Minor Oral Surgery

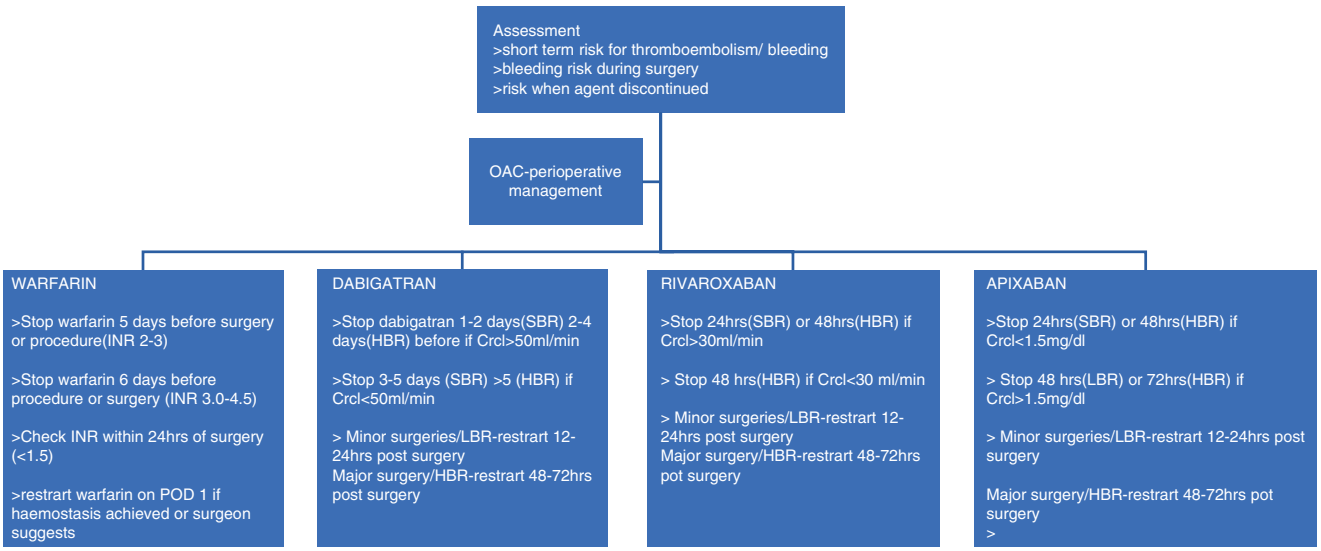
It is beyond doubt that warfarin/acetrom therapy need not be discontinued and INR need not be normalized prior to dento-alveolar surgery. The risk of a thrombotic episode does not justify the risk of a minor bleed that can be controlled by local measures [17]. Simple dentoalveolar surgery (e.g., three simple extractions) can be safely performed with an INR of 3.5 or less with appropriate local hemostatic measures [18]. However, it is imperative that the patient is closely followed. It is sensible to schedule these procedures in the morning.

3.5.4.6 Major Maxillofacial Surgery

Depending on the indication for anticoagulant therapy and the drug used, the decision regarding the control of anticoagulation is made. Ideally the prescribing physician is involved in decision making (Fig. 3.6) (read following content).

3.5.5 Infective Endocarditis Prophylaxis

Much has changed over the years with regard to infective endocarditis (IE) and antibiotic prophylaxis. Since the guidelines change by the year, the authors strongly recommend that the surgeon takes recourse to his smartphone to keep abreast of the changing scenery (Tables 3.4 and 3.5).



*OAC; Oral anticoagulant,POD; Post-operative day, INR; International normalized ratio, LBR; Low bleeding risk, SBR; Standard bleeding risk, HBR; High bleeding risk, CrCl; Creatinine clearance

Fig. 3.6 Perioperative management of oral anticoagulants [19]

3.5.6 Implantable Cardioverter Defibrillators (ICD)

An ICD is a battery-powered device implanted in a patient that generates a small electrical impulse. Indications are patients at risk of sudden cardiac death—ventricular fibrillation/ventricular tachycardia, malignant ventricular tachyarrhythmias. ICDs are also used to treat Brugada syndrome [21].

3.5.6.1 Implications

Bleeding: patients may either be on antiplatelets or anticoagulated. (read earlier content).

Devices: Electrocautery, especially monopolar diathermy, may interfere with the device and this may have to be turned to a "safe mode" by the electrophysiology technician. The concerned cardiologist should be able to assist with the technical details.

Infective endocarditis prophylaxis: Risk being low, current guidelines DO NOT recommend prophylaxis for these patients.

3.6 Impact of Central Nervous System Disorders in Maxillofacial Surgery

Of the many conditions which affect this system, the effects of epilepsy and stroke are most commonly encountered in maxillofacial surgical practice.

Table 3.4 AHA, ESC, and NICE guidelines for infective endocarditis prophylaxis

2007 AHA guidelines	2015 ESC guidelines	2016 NICE guidelines
Highest risk of adverse outcomes: • Previous IE • Prosthetic valve • Unrepaired cyanotic congenital heart disease (CHD) • 6-month period postprosthetic repair of CHD • Repaired CHD with residual defects • Cardiac transplant with valvulopathy	Highest risk of IE: • Previous IE • Prosthetic valve/ Prosthetic material for valve repair • Any cyanotic CHD • 6-month period postprosthetic repair of CHD Intermediate risk of IE: • History of rheumatic fever • Any form of native valve disease • Unrepaired noncyanotic CHD	Risk of developing IE: • Previous IE • Valve replacement • Acquired valvular heart disease • Structural Congenital heart disease • Hypertrophic cardiomyopathy
Antibiotic prophylaxis: • All dental procedures involving gingival tissue manipulation or periapical region of teeth or oral mucosa perforation • Procedures on respiratory tract or infected skin/ musculoskeletal tissue.	Antibiotic prophylaxis: Considered for dental procedures involving gingival tissue manipulation or periapical region of teeth or oral mucosa perforation	Antibiotic prophylaxis: Not routinely recommended

Table 3.5 Revised AHA guidelines for infective endocarditis prophylaxis [20]

Patient group	Antibiotic	Dose (30–60 min before procedure)	
		Adults	Children
Able to take oral medicine	Amoxicillin	2 g	50 mg/kg
Unable to take oral medication	Ampicillin	2 g i.m/i.v	50 mg/kg i.m/i.v
	or		
	Cefazolin/ ceftriaxone	1 g i.m/i.v	50 mg/kg i.m/i.v
Allergic to penicillin or ampicillin and able to take oral medication	Cephalexin[a,b]	2 g	50 mg/kg
	or		
	Clindamycin	600 mg	20 mg/kg
	or		
	Azithromycin/ clarithromycin	500 mg	15 mg/kg
Allergic to penicillins or ampicillin and unable to take oral medication	Cefazolin/ ceftriaxone[b]	1 g i.m/i.v	50 mg/kg i.m/i.v
	or		
	Clindamycin	600 mg	20 mg/kg

Note: *i.m* intramuscular; *i.v* intravenous

[a]Or other first- or second-generation cephalosporins at equivalent adult and pediatric dose

[b]Cephalosporins should not be given to a patient with a history of anaphylaxis, angioedema, or urticaria with penicillin or ampicillin

3.6.1 Epilepsy

A seizure is a result of excessive electrical discharges in a group of brain cells, whereas epilepsy is described as a disease characterized by recurrent seizures. A single seizure does not constitute epilepsy, which is defined as having at least two or more unprovoked seizures. The incidence worldwide is approximately 0.5–0.9%, affecting over 50 million individuals [22].

Etiology of epilepsy can be divided as primary or idiopathic, where the cause is unknown and this constitutes the vast majority of cases. In secondary or acquired epilepsy, the cause can be determined and these include metabolic, genetic, structural, and functional abnormalities.

An increase in the incidence in the elderly can be attributed to conditions such as stroke, tumors, trauma, and Alzheimer's disease. Systemic conditions include diabetes, hypertension, infections, electrolyte imbalances and dehydration, or lack of oxygen. Withdrawal from high-dose, long-term use of drugs such as cocaine, heroin, barbiturates, amphetamines, and alcohol can also precipitate seizures [23]. Seizures generally last for a few seconds to minutes. Although many types exist, they are broadly divided into two groups (Fig. 3.7).

Primary generalized seizures—which begin with involvement both sides of the cerebral hemispheres.

Partial seizures—start in a localized area [25].

3.6.1.1 Basic considerations

While recording history, the duration, type, frequency of the seizure as well as the most recent episode must be recorded as well as the type of medication taken, if any. If the patient is aware of how the seizure starts, if there is any warning or "aura," this too must be noted [23].

Several factors are capable of provoking seizures. These include improper use of medication, lack of sleep, drug abuse, drug interactions, hypoglycemia, electrolyte imbalance among others. Antiepileptic drugs should generally be continued without alteration.

3.6.1.2 Outpatient maxillofacial considerations

If seizures are predictable, then appointments should be scheduled accordingly. Frequency of seizures determines the urgency of treatment. Procedures, unless emergent, should be postponed if frequency of seizures is high. The clinician must reduce anxiety to the patient. Short morning appointments are ideal. Sudden bright lights, noise, or movements must be avoided as these may trigger a seizure [23].

3.6.1.3 Major Surgical Considerations

Trauma is a common consequence of seizures and may result in lacerations of the face or oral cavity and fractures of the maxillofacial skeleton. Other injuries include hematomas, dislocation of temporomandibular joint (TMJ) fracture/loss of teeth. An electroencephalogram (EEG) along with imaging such as CT/MRI is recommended if there is no previous seizure history. Open reduction should be preferred over closed for treatment of facial fractures, as further episodes of seizures might lead to aspiration if intermaxillary fixation (IMF) is attempted [25].

Local anesthetic is considered safe in well-controlled epileptics, as is sedation. General anesthesia is preferred in uncontrolled epileptics, especially if coupled with a mental deficit, as a seizure might be triggered due to stress from difficulties in communication. One drawback of general anesthetic is temporary anoxia to the brain, which itself might trigger a seizure [26].

3.6.1.4 Precautions, complications, & management

As mentioned earlier, appropriate recording of history gives an insight into planning the procedure, particularly for elective surgeries. Objects with the potential to cause harm must be kept away from the vicinity of the patient. Antiepileptics such as phenytoin have been known to cause gingival enlargement, which can be managed either by surgery or by a change in medication. Aspirin, antifungal azoles, metronidazole can interfere with phenytoin. Propoxyphene and erythromycin can interfere with carbemezepine. Contraindicated drugs are chlorpromazine, flumazenil, ketamine, lignocaine in large doses and quinolones, tramadol, and tricyclic antidepressants [25].

3.6.1.5 Management of an acute episode on the dental chair

If possible, all foreign body/material should be removed from the oral cavity. The chair should be reclined to a supine position with the patient turned onto their side to minimize the

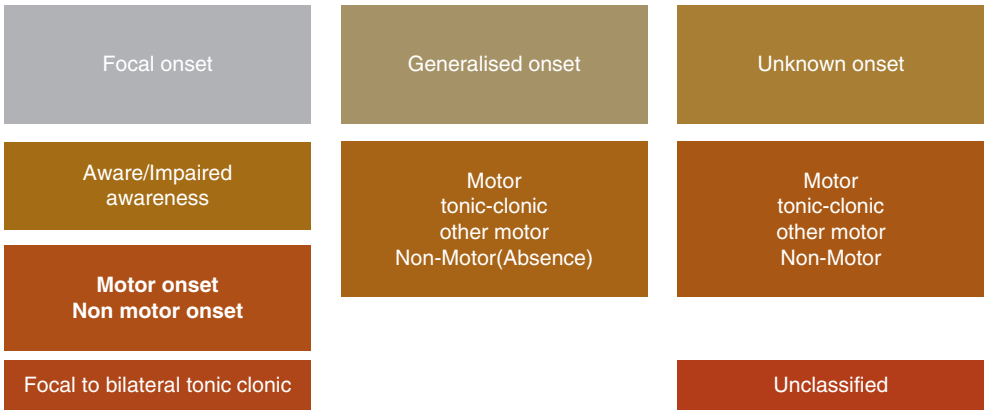


Fig. 3.7 ILAE 2017 classifications of seizure types basic version [24]

risk of aspiration. Passive restraint is used only to prevent them from falling out of the chair. A recurrent seizure or a seizure of more than 3 min requires drug administration. The patient should be monitored to prevent airway obstruction. After the patient recovers, appropriate medical consults should be arranged. Elective treatment should be postponed [23]. However, prolonged seizures, which continue in spite of medication, may lead to status epilepticus, which may be fatal if untreated. Airway patency and peripheral venous access are first line of management. If seizures persist even after administration of drugs such as lorazepam or diazepam, the patient must be shifted to the hospital for further management.

3.6.2 Stroke

Stroke (cerebrovascular accident) is a serious, occasionally fatal neurologic event characterized by the rapid appearance of a focal deficit of brain function. It is estimated that 85% of patients presenting with stroke would have sustained a cerebral infarction because of inadequate blood flow to a part of the brain, with the remainder suffering from an intracerebral hemorrhage. Often, survivors of cerebrovascular accidents are left debilitated in motor function and/or speech [27].

A stroke may be a result of hemorrhage or ischemia as given later (Fig. 3.8).

The initial presentation of stroke includes loss of combination of sensory and motor functions with occasional loss of consciousness. The presenting features include hemiparesis or paraparesis, dysphagia, ataxia, aphasia, dysarthria, loss of vision. Early detection is by assessing facial and arm weakness and any slurring of speech. Mechanism of stroke may be ischemic, primary intracerebral hemorrhage, and subarachnoid hemorrhage. The oral impact of stroke includes facial weakness, dysphagia, and speech impairment [29].

3.6.2.1 Basic Considerations

At the outset, it is paramount to assess the extent of disability of the patient—both physical and mental, as this is vital in determining whether performing the procedure is safe in the outpatient setting. There may be a dependence on others for basic needs. History of past strokes needs to be elicited: including dates, severity and current neurological deficit. Treatment is performed in consultation with the neurologist and precautions according to the specific characteristics of the stroke.

3.6.2.2 Maxillofacial considerations

Outpatient appointments must be ideally scheduled in the morning and must be of short duration. Patients must be treated in an upright position as much as possible, as they are more prone to aspiration due to impaired protective reflexes. Another important consideration is difficulty in oral hygiene maintenance due to facial weakness and xerostomia, which may be observed as a side effect of medications prescribed [24]. Although procedures must be deferred for as long as possible, in unavoidable circumstances such as trauma or progressing head and neck cancers, general anesthesia is reasonably safe. Shorter duration surgery, intraoperative monitoring and maintaining cerebral perfusion, anticoagulation status, and precaution all aid in reducing the incidence of a further episode.

Antiplatelets and anticoagulation: Ref previous section.

3.6.2.3 Precautions

Monitoring of Blood pressure pre- and postprocedure is vital, procedures should be deferred if systolic is >180 mmHg or diastolic is >110 mmHg. Poststroke patients are usually on antiplatelet or anticoagulant medications; hence, coagulation status must be ascertained prior to any procedure. Vasoconstrictors are to be used cautiously as they can increase the risk of adverse outcomes like cerebral hemorrhage due to acute hypertension [29].

Opiods are best avoided as they may result in severe hypotension and benzodiazepines may cause respiratory depression. The practitioner must be mindful that sudden loss of consciousness could result from stroke, and emergency management is the protection of airway and shift to hospital [24].

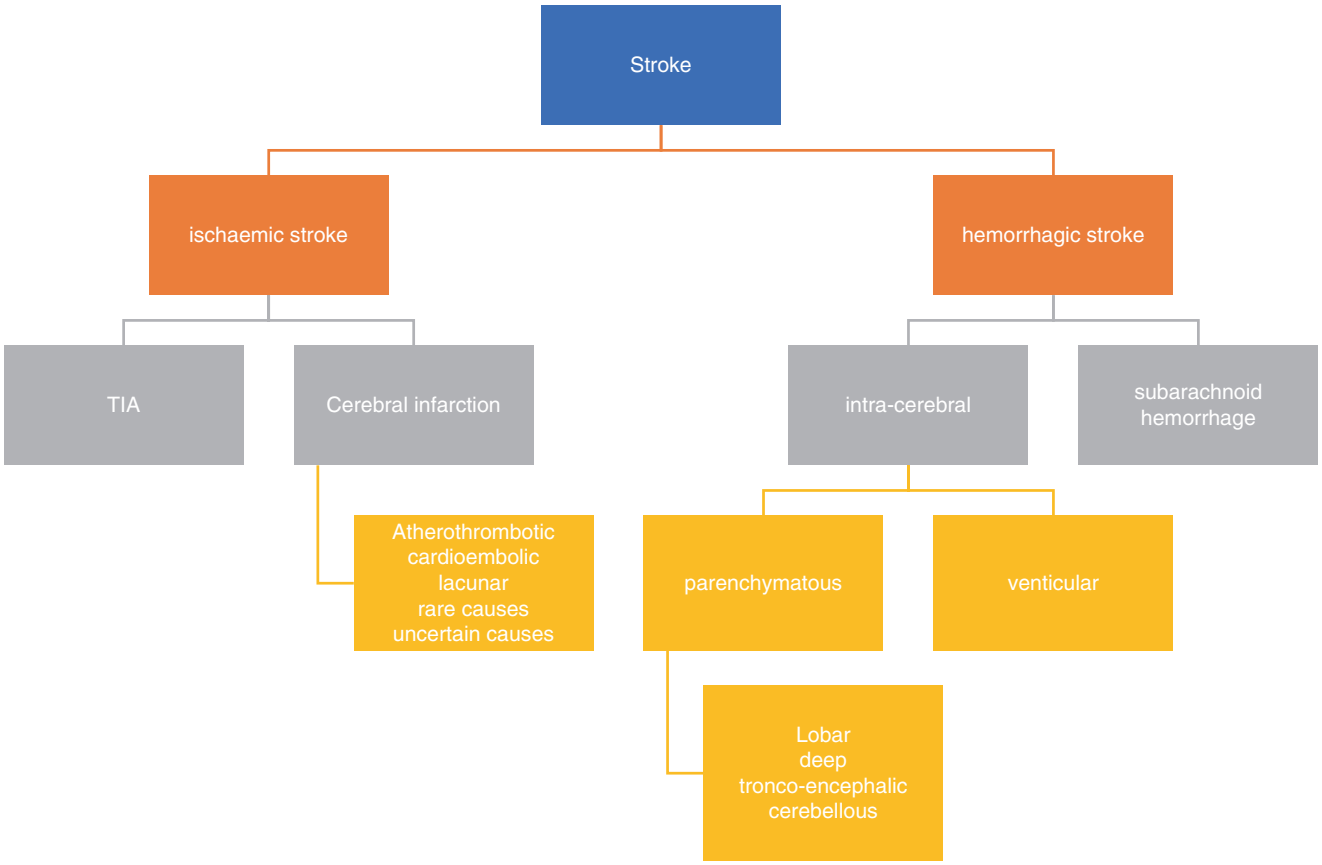


Fig. 3.8 Common causes of stroke [28]

3.7 Impact of Psychiatric Disorders in Maxillofacial Surgery

Psychiatric and psychological disorders are of rising concern in modern society, affecting all aspects of a patient's life, including oral health. Poor oral hygiene is usually due to a combination of lethargy, side effect of medications, and possibly fear of treatment [30]. Common disorders encountered in practice are related to mood, anxiety, substance dependence, eating, or somatoform in nature [31].

Occasionally, oral symptoms may be the initial or single manifestations of the underlying issue. Patients who present with atypical facial pain with vague symptoms, oral dysesthesia, abnormal sensation or movement, salivation often with no identifiable physical cause could be suffering from undiagnosed underlying emotional disturbances. Early detection in such cases benefits both the patient and the practitioner [32, 33].

3.7.1 Maxillofacial Considerations

Pain related to the TMJ and associated structures seems to be another condition, which fits into the previous category, commonly seen and treated by the maxillofacial surgeon. In the absence of an identifiable organic cause, there must be a low threshold for considering an underlying emotional disturbance.

Patients with diagnosed psychiatric conditions and on medication present with obvious oral symptoms. Most common among these are dental caries and periodontal disease. The primary cause of these is due to decreased salivary flow or xerostomia, which is a side effect of medications, including tricyclic antidepressants, lithium carbonate, phenothiazines, and benzodiazepines. Sialorrhea or excessive salivation is a well-known side effect of clozapine and reduction in dose may be of use [32]. Candidiasis is another condition, which may manifest due to xerostomia, especially in denture wearers. Fear of dental treatment is well known. However, recognition of the nature and extent of this fear is important to prevent noncompliance. Anxiety disorders and phobia often stem from two types of experiences, a painful or traumatic procedure, usually at a young age, or a negative interaction with healthcare professional [32]. A specific maxillofacial consideration in this respect is suturing of facial wounds under local anesthetic, in young children. The authors recommend sedation if not a general anesthetic, par-

ticularly in extremely young children, where such procedures are required.

Alcohol, tobacco, and drug abusers are particularly tricky to treat, be it minor or major maxillofacial surgery. The amount of local anesthetic required to produce adequate analgesia tends to be higher in such patients. These groups of patients are at a higher risk of developing oral cancer. Effects of withdrawal can be significant and this must be kept in mind preoperatively, intraoperatively, and postoperatively—especially where procedures of long duration and extended stay are planned. Use of drugs like chlordiazepoxide might be required to offset delirium tremens, particularly in the postoperative period. Head and neck cancer particularly affects the psyche, making a psychologist a very important member of the multidisciplinary team.

Patients suffering from clefts of the orofacial region require multiple surgeries at various stages of their life and the effects of surgery and rehabilitation can be debilitating on both the child and the parents. Timing of surgeries is vital as they disrupt the life of the entire family of the child and for this parental counselling is extremely important [33].

While management of trauma might be comparatively straightforward, one must not underestimate the effect on the psyche in the recovery phase, especially if this is coupled with post-traumatic stress disorder (PTSD). Although these injuries are among the most common treated, these can lead to depression, drug abuse, antisocial behavior, especially in those with a post-traumatic residual defect [34].

Orthognathic surgery, while primarily carried out for cosmetic reasons, occasionally may be performed for functional reasons, as in obstructive sleep apnea. Counselling prior to surgery is useful and the entire process can take up to 3 years. Serious psychological and psychosocial problems have been reported [33].

While awareness of maxillofacial surgery and its benefits is gradually growing in our country, with most centers providing information about technical aspects of surgery, the psychological aspect is often ignored. Communication needs to improve and an assessment of patients' emotional state before and after surgery could help in improving patient satisfaction [33].

3.8 Dental and Maxillofacial Implications in Liver Disease

3.8.1 Introduction

At approximate of 1.4 kg, this reddish, rubbery structure forms an important organ system. Along with the Gall Bladder and Pancreas, the liver works to digest, process, and absorb food. Liver aids in detoxification in the body and is the primary organ of drug metabolism. It also helps in the production and transport of bile [35].

3.8.1.1 The Function of the Liver [36]

Detoxification—Removal of ammonia, exogenous hormones

(a) Alcohol metabolism
(b) Synthesis of essential Serum Proteins (Albumin)
(c) Synthesis—coagulation Factors (V, VII, IX, X), prothrombin, fibrinogen.
(d) Production of Bile and its transporters
(e) Regulation of nutrients
(f) Conjugation of lipophilic compounds

Liver dysfunction hence alters all of these functions, thereby disrupting the homeostasis in the body, which has to be taken into consideration when providing dental and maxillofacial therapy.

Vitamin K levels are significantly lowered in advanced liver disease hampering the production of coagulation factors. This, along with portal hypertension, results in thrombocytopenia, thus resulting in excessive bleeding, which is of consideration during dental and maxillofacial management [37].

3.8.2 Classification of Liver Dysfunctions [35]

Acute or Chronic

(a) Infective (Hepatitis) & Noninfective (Substance abuse)
(b) Extent of damage—steatosis (fatty liver), fibrosis, cirrhosis, hepatocellular carcinoma

3.8.2.1 Viral Hepatitis

Hepatitis A—caused due to Hepatitis A virus, spreads via the orofecal route. It is endemic in nature and is self-limiting.

Hepatitis B—caused by (HBV) that replicates within the hepatocyte; it is a dangerous form of viral disease with high risk to healthcare workers. The surface antigen is routinely detected in the saliva of infected individuals, and hence transmission through the saliva is of concern to the Oral Surgeon [38]. Prevalence of HBV infection is three to five times more in dentists than the general population. Younger individuals with chronic HBV infections have a greater prevalence of developing hepatocellular carcinoma.

Hepatitis C—Caused by a bloodborne virus, it is the most common cause for chronic hepatitis, which over long term could lead to cirrhosis or hepatocellular carcinoma.

3.8.2.2 Autoimmune Hepatitis

It is a chronic liver inflammatory disease as a result of IgG Hypergammaglobinemia as a result of environmental or viral factors inciting an autoimmune response leading to cirrhosis [39].

3.8.2.3 Fulminant Hepatitis

A sudden acute and severe dysfunction of the liver with resulting hepatocellular necrosis and encephalopathy with a very poor prognosis. These patients require liver transplant.

3.8.2.4 Cirrhosis

It is the irreversible damage to the hepatic architecture due to long-term fibrous scarring. A rise in the production of total liver collagen and matrix protein that is troublesome to the function and form of the liver [40].

3.8.2.5 Hepatocellular Carcinoma

It is the fifth most common cancer and a life-threatening malignancy with poor survival rates. HBV and HCV are the most common causes of it.

3.8.2.6 Alcoholic Liver Disease

It is the 10th most common cause of death with 3% of fatalities in the industrialized world [35]. Alcoholism results in varied disruption of the hepatic system ranging from simple fatty liver to complicated life-threatening cirrhosis.

3.8.3 Oral Manifestations of Liver Disease

Foetor hepaticus (Breath of the dead odor of rotten eggs with garlic) is a characteristic late feature of liver dysfunction [36]. Evidence of liver diseases has been noted in the oral cavity as icteric mucosal alteration with gingival bleeding and also associated hemorrhagic changes like hematoma, petechiae [37]. HCV-associated hepatitis is noted as a common cause for Sjogren's syndrome and lichen planus in the oral cavity [41]. Alcoholic hepatitis in association with nutritional deficiencies could cause glossitis along with delayed healing post surgery [37]. Occasionally, parotid enlargement is also noted. These oral manifestations are associated with concomitant general symptoms of liver disease such as hepatomegaly, malaise, confusion, fatigue, weight loss, nausea, and altering the well being of the person [37].

3.8.4 Implications of Liver Disease

1. Hepatic metabolism of drugs is Unpredictable
2. Defective hemostatic cascade and poor coagulation
3. Increased risk of infection

3.8.4.1 Liver Disease and Maxillofacial Surgery

Risk of viral contagion and crossinfection is one of the implications of viral hepatic disease. Hep C viruses are found to be stable at room temperatures for approximately 5 days. The virus is also detected at different surfaces in the clinic after the patient is treated. It is vital to maintain adequate sterilization and observe strict universal protection when treating such patients. Needlestick injury precautions must be adhered to.

Detailed history taking is important to identify any indications of liver disease, including that of hepatitis, jaundice, alcohol intake, recreational drugs, or rank abuse. Abnormal bleeding patterns are elicited in history [42]. Past surgical history provides a valuable indicator for any doubts regarding the adequate functioning of the liver system. Additional information of identifying the etiology for cirrhosis and any continued risk factors like alcohol consumption should be noted [35]. Review of blood investigations such as serum bilirubin, albumin, alanine aminotransferase (ALT), Aspartate aminotransferase (AST), complete blood counts, and coagulation profile must be performed prior to any surgical planning [43].

Elective surgery is contraindicated in acute phases of viral hepatitis and acute liver failure. Patients who present with hepatitis due to alcohol/drug abuse are poor candidates for elective surgery due to liver dysfunction and psychological impact of withdrawal during their hospital stay.

Plasma level of coagulation factors is depressed in liver disease and can potentially alter the hemostasis. Complete blood counts, PT, PTT, INR, and liver functions tests are mandatory in all patients with any signs/symptoms of liver dysfunctions. The goal of surgical therapy is to minimize trauma to the tissues. It is also advisable to involve the hematologist if required. Any dental or minor oral surgical procedure must terminate with the use of local hemostatic agents or antifibrinolytic agents to aid in hemostasis. Maxillofacial surgical work and major invasive oral surgery are ideally performed in the hospital. Fresh Frozen Plasma and Vitamin K infusions to optimize the coagulating process might be required to offset intraoperative bleeding.

Patients with liver disease are more susceptible to infection with a greater risk post invasive dental or maxillofacial procedure. Antibiotic prophylaxis is recommended.

Drug metabolism is altered in these patients (Table 3.6). Unlike serum creatinine, which is an indicator of renal function, the liver function test is more of an indicator for liver damage. Hence, it is difficult to obtain exact dose modification formulae when medicating patients with liver disease. Drug usage, dosage, and interactions must be consulted with the specialist prior to their usage.

The metabolism of these drugs is well tolerated in mild liver dysfunctions but is impaired in severe dysfunction and hence requires modifications and contraindications. The beta lactams mainly utilized in maxillofacial surgery are quite safe. NSAIDS are to be used with caution to avoid gastric bleedings [35]. Hepatotoxic drugs should be avoided eg. erythromycin, ketoconazole, halothane, phenytoin etc. Prilocaine or articaine is preferred over lidocaine. Sedatives,

Table 3.6 Drugs metabolized in the liver [37]

Local anesthetics	Lidocaide, Bupivacaine, Prilocaine,
Sedatives	Barbiturates, Diazepam
Analgesics	Paracetamol, Aspirin, Ibuprofen, Codiene
Antibiotics	Erythromycin, Clindamycin, Tetracyclin
Antifungal	Ketaconozol, Fluconozol

hypnotics or opiods should be used with caution. A balance has to be struck constantly to maintain the anesthesia and concern is of the depressive action of alcohol and central nervous system depressors. Postoperative care in view of alcohol withdrawal must be noted. Ensure alcohol-based mouth rinses are avoided.

3.9 Maxillofacial Implications in GI Disorders

3.9.1 Perioperative Maxillofacial Implications

3.9.1.1 GERD

Extraesophageal symptoms of GERD must be identified to prevent any airway issues primarily. Due to delayed gastric emptying, preoperative fasting hours must be prolonged. In high-risk patients, Proton pump inhibitors and H2 receptor antagonists are potent drugs to increase gastric pH and reduce secretions. Nasogastric suctioning through nasogastric tube aids in protecting the airway from gastric secretions during surgery. It is important to manage nausea and vomiting postoperatively effectively.

3.9.1.2 Peptic Ulcers

Stress reduction protocol is vital. GI symptoms from NSAIDS are delayed and identified when the ulcers are in an advanced stage with a greater risk of bleeding. Corticosteroids must be avoided in these patients along with NSAIDS. GI bleeding due to ulceration could cause anemia and has to be managed prior to any surgery. Surgery is contraindicated in active peptic ulcers. Ranitidine, when used over a long phase for management, could cause thrombocytopenia [44].

3.9.1.3 Ulcerative Colitis

One must rule out anemia in these patients and assess the effect of long-term steroid therapy. Antibiotics such as clindamycin, ampicillin, and cephalosporins are implicated in aggravation of colitis and are hence avoided. If the patient has undergone Vitamin K malabsorption, its effects are considered.

Postoperative nausea and vomiting, though not a complication, is still detrimental in patient management perioperatively. Volatile inhalation anesthetic agents and opiod analgesics are emetogenic and need to be used with caution. Postoperative anxiety, dehydration, and pain could result in nausea and vomiting. Scarred ulcers in the duodenum delay gastric emptying resulting in vomitus. Antiemetics in these patients must be prescribed at the end of the surgery and dexamethasone 1 h prior to the surgery is helpful if not contraindicated. In high-risk patients, antiemetics must be administered prior to anesthesia itself [45]. Postoperative ileus could occur due to prolonged opiate use during anesthesia, decreased potassium levels, trauma or due to iliac bone harvesting as a complication or resultant severe pain.

3.10 Pregnancy

Pregnancy is often associated with changes in cardiovascular, endocrine, hematological, respiratory, gastrointestinal, and genitourinary system. These alterations may occasionally be subtle and can lead to disastrous complications if not identified [46].

3.10.1 Physiologic Changes

There will be increase in the heart rate leading to an increase in cardiac output. Cardiac output increases mostly in the first trimester and remains fairly unchanged with minimal increase in the final trimester.

During the second and final trimesters, a decrease in blood pressure and cardiac output may occur while the patient is in a supine position. This is caused by the gravid uterus compressing the inferior vena cava leading to a decreased venous return to the heart leading to hypotension, bradycardia, and syncope. This phenomenon is called *supine hypotension syndrome* [47].

The concentration of all coagulation factors, other than factors XI and XIII, is increased. As Thrombin-mediated fibrin generation increases during pregnancy, this combines with an increase in the aforementioned clotting factors and hematocrit, leading to the hypercoagulable state of pregnancy. This leads to a higher risk of deep vein thrombosis (DVT) and pulmonary embolism (PE).

In the abdomen, the enlarging uterus displaces the stomach onto the spleen and liver leading to high intragastric pressure. This and the delayed gastric emptying leads to regurgitation and gastric reflux. Hyperventilation that begins in the first trimester might increase throughout pregnancy. This has obvious implications on drug dosage, route and timing of administration.

In the first trimester, glomerular filtration rate increases 30–50%, which results in an increase in clearance of creatinine, uric acid, and urea. This leads to a decrease in levels of the same. While prescribing drugs, doses may need to be increased to account for this rapid clearance [48].

3.10.2 Treatment Protocol

3.10.2.1 Minor Surgery

While minor oral surgery is not a contraindication in the pregnant patient, it is advised that the oral surgeon should consult with the patient's obstetrician to address specific concerns should dental emergencies arise during the first trimester.

Unless emergency treatment is required, it is advisable to defer treatment during the first trimester because of the potential vulnerability of the fetus. The second trimester is the safest time to perform the routine dental treatment. No elective treatment is advisable late in the third trimester.

3.10.2.2 Dental Radiology

Two important factors to be considered are the dose of radiation to be given and the time of gestation. Animal and human data clearly support the conclusion that no increase in congenital anomalies due to exposures totaling less than 0.05–0.1 Gy during pregnancy. The amount of radiation used in dental radiographs is well below the threshold dose [47]. With modern features such as high-speed film, filtration, collimation, and use of lead aprons, dental radiography is deemed quite safe.

3.10.2.3 Major Surgery

Elective surgery should be postponed until after delivery. If possible, nonurgent surgery should be performed in the second trimester when preterm contractions and spontaneous abortion are least likely. Fetal safety requires that potentially dangerous drugs are avoided and adequate uteroplacental perfusion is ensured. No anesthetic drugs have been proven to be clearly hazardous to the human fetus. However, teratogenic effects of nitrous oxide have been demonstrated in animal models following prolonged administration in high concentration [49].

Anxiety in itself leads to decrease in uteroplacental perfusion secondary to increase in circulating catecholamines. Appropriate timing of surgery and anxiolysis is of paramount importance.

3.10.3 Drug Usage in Pregnancy

Most drugs cross the placental barrier by simple diffusion. Hence, the major concern of drug administration during pregnancy is the potential of teratogenic adverse effects. The period of maximum risk for teratogenicity is during organogenesis. This occurs from the end of the predifferentiation period until the end of the 10th week after the last menstrual period (Table 3.7).

Table 3.7 Commonly used safe and unsafe drugs during pregnancy [46]

Drug	Safe	Unsafe
Local anesthetics	Articaine Lignocaine Prilocaine	Bupivacaine
Analgesics	Paracetamol Ibuprofen (first and second trimesters)	Aspirin Diclofenac Ibuprofen (third trimester) Naproxen
Antibacterials	Amoxicillin Azithromycin Cephalosporins Erythromycin	Aminoglycosides Metronidazole Sulfonamides Tetracyclines
Antifungals	Fluconazole Nystatin	Ketoconazole
Anxiolytics	None	Alprazolam Diazepam

3.11 Endocrine Disorders

3.11.1 Diabetes

Diabetes is an endocrine disease manifesting as hyperglycemia, leading to microvascular and cardiovascular complications. Type 1 diabetes mellitus is an autoimmune pancreatic beta cell destruction leading to inadequate production of insulin. In type 2 diabetes mellitus, there is a condition of insulin resistance in addition to defects in insulin secretion by the pancreatic beta cells, and increased endogenous glucose production, primarily by the liver [50].

The current recommendation for diagnosis of diabetes stands at >126 mg/dl of fasting plasma glucose levels or a 2-h plasma glucose level of 200 mg/dl [51]. The Endocrine Society guidelines indicate that patients with hyperglycemia and glycated haemoglobin (HbA1c) of 6.5% or higher can be identified as having diabetes [52].

Optimal glycemic control is advised in each patient to avoid hyperglycemia or hypoglycemia. The surgical patient with diabetes is at higher risk of perioperative morbidity and mortality and subsequently longer length of hospital stays. This is mainly due to increased chances of surgical site infections and systemic infections, other complications like acute kidney injury, acute coronary syndromes, acute cerebrovascular accidents, hospital-acquired diabetic ketoacidosis, etc [53].

The stress of surgery and anesthesia derails the glycemic control of the patient due to the metabolic response to surgery. Nondiabetic patients evoke a catabolic response with a release of cortisol, glucagon, catecholamines, etc., promoting hepatic glycogenolysis and gluconeogenesis causing hyperglycemia. There is a catecholamine-induced inhibition of insulin production as well as insulin resistance. The type of anesthesia and the length of the procedure are also said to influence the amount of catabolism [54].

The preoperative preparation for a diabetic patient begins with a thorough history, including the type and dosing of medications, any history of cardiac events, or diabetic ketoacidosis. ECG is mandated as these patients have a higher occurrence of hypercholesterolemia, hypertension, macrovascular disease, autonomic neuropathy, and hence silent ischemia. If the ECG does suggest so, further investigation is indicated [55].

Renal function tests should include serum urea and creatinine. Hypertension should be ruled out or treated if present. Diabetic neuropathy should be evaluated as it may cause aspiration, silent myocardial ischemia, or even sudden death. It may manifest as postural hypotension, heartburn, or resting tachycardia [56].

HbA1c is usually advised in diabetic patients undergoing treatment as it reflects mean control over the previous 3 months. This allows one to estimate the quality of glycemic control before the consultation and adaptation of treatment to fixed objectives. It is also important to know the duration of the diabetes, dependence on insulin, and whether the glycemic control is achieved by oral hypoglycemics and lifestyle modification.

3.11.1.1 Management of Patients Undergoing Procedures

The recommendations for target glycemic control vary. The Endocrine Society and the American Diabetes Association/AACE Practice Guidelines recommend that patients on insulin maintain a target preprandial glucose of less than 140 mg/dl and a random Blood Glucose (BG) of less than 180 mg/dl for patients treated [52]. The Joint British Diabetes Societies guideline, however, recommends that insulin therapy be commenced when random blood glucose levels exceed 180 mg/dl [53].

3.11.1.2 Preoperative Glycemic Control in patients on Oral Hypoglycemic Agents

3.11.1.2.1 Minor surgery

Patient should adhere to his daily oral diabetic medication and follow his usual diet [50].

3.11.1.2.2 Major surgery

- Most oral hypoglycemics can be continued till the day before surgery. Sulfonylureas and insulin secretagogues should be stopped on the day of surgery to reduce the chances of hypoglycemia [52].
- If normal oral intake is expected to resume on the day of surgery, metformin may be given on the day of surgery [53].
- Metformin is discontinued if there is either prolonged state of fasting or use of i.v contrast dyes or reduced renal function
- (Dipeptyl Peptidase-4) DPP-4 inhibitors are not contraindicated throughout the perioperative period [54].

3.11.1.3 Preoperative Glycemic Control in Type 2 Diabetics on Insulin

Patients on basal insulin: If they are on twice daily dosing then morning dose to be reduced to 80% of normal dose; whereas if those on single dose then evening dose to be reduced to 80% [57].

If the morning glucose levels are above 120 mg/dl, Neutral protamine Hagedorn (NPH) insulin and premixed formulations are reduced by 20% the evening before surgery and by 50% the morning of surgery. If not, morning insulin dose is withheld [58].

Naturally, these are guidelines and the diabetologist will tailor the doses to the individual requirement of the patient.

3.11.1.4 Preoperative Glycemic Control in Type 1 Diabetics on Insulin

3.11.1.4.1 Minor surgery:

- Well-controlled patients should halve their daily dose of insulin the morning of surgery and also eat their normal breakfast.
- Morning appointments are preferred. If preoperative glucose is between 100 and 200 mg/dl, surgery can be performed.
- If blood glucose is >200 mg/dl, an intravenous infusion of 10% dextrose in half-normal saline is initiated. 10-mEq potassium chloride should be added to each 500 ml of dextrose/saline infusion.
- Rapid-acting insulin is administered subcutaneously.
- Blood glucose should be monitored hourly if the surgery lasts beyond 1 h [50].

3.11.1.4.2 Major surgery:

These patients are at risk of developing stress-induced hyperglycemia and ketoacidosis and hence need insulin coverage during perioperative period. These patients should receive 80% of basal insulin dose the evening before surgery and on the morning of surgery in order to prevent hypoglycemia [54].

3.11.1.4.3 Intraoperative glycemic control:

The endocrine society recommends an intraoperative BG level within 180 mg/dl [52].

Levels above that are treated either with subcutaneous rapid-acting insulin analogs or with an IV infusion of regular insulin. In patients undergoing short surgeries (under 4-h operative time), ambulatory surgeries, expected hemodynamic stability and those expected to resume oral diet soon can be managed with subcutaneous rapid-acting insulin correction scales [3]. When it is used, the BG should be checked every 2 h [52].

An IV insulin infusion is preferred where there is anticipated hemodynamic disturbance, significant fluid shifts, expected changes in temperature, inotropic support, or lengthy operative times (greater than 4 h). In this situation, hourly insulin monitoring is needed.

3.11.1.4.4 Postoperative glycemic control:

For noncritical and non-ICU patients, the subcutaneous sliding scale insulin is used with BG being checked every 2 h. If BG drops below 70 mg/dl, insulin is stopped and oral dextrose or iv dextrose is given. For patients in the ICU, continuous iv insulin infusion is given instead of the subcutaneous sliding scale for BG > 180 mg/dl. Oral antidiabetic agents are best avoided in hospitalized patients due to the limited data available on their safety and efficacy. DPP-4 has shown promising results for in-patient hyperglycemia control [54].

3.11.2 Hypo/Hyperthyroidism

The thyroid gland releases the hormone thyroxine (T4) and its active form T3. The thyroid hormones are released upon stimulation by the thyroid-stimulating hormone (TSH) released from the pituitary gland. This is, in turn, stimulated by thyrotropin release hormone (TRH). Secretion of T3 and T4 is regulated by the negative feedback loop modulating release of TSH [59].

Thyroid hormones play a critical role in maintaining metabolic homeostasis in the adult. Thyroid-related disorders are due to either overproduction of thyroid hormones (thyrotoxicosis) or hormone deficiency (hypothyroidism). These situations may arise due to infectious, autoimmune, proliferative, or tumorous pathologies [60].

Most patients with well-compensated thyroid disease do not need special consideration prior to surgery. Patients with a newly diagnosed thyroid disorder around the time of surgery will need to undergo risk assessment and optimization before surgery.

Routine thyroid screening is not done for asymptomatic patients unless there is a reason to suspect thyroid dysfunction. Thyroid disease present with a myriad of symptoms clinically. These include-unexplained weight changes, and fine tremor or changes in bowel habits, skin, hair, exophthalmos, goiter, abnormal reflexes. Palpitations, tachycardia, or bradycardia are common cardiovascular manifestations. In such situations as well as in patients with a known thyroid disorder, a TSH test should be included in the preoperative analysis [61].

3.11.2.1 Hypothyroidism

Hypothyroidism may be primary (due to thyroid disease) or secondary due to hypothalamo-pituitary disorders. Commonly, it is due to thyroid loss from surgery, irradiation, autoimmune diseases, or drug induced [59]. The diagnosis is confirmed by blood tests revealing low T3 and T4 levels and high TSH in primary and decreased TSH in secondary hypothyroidism. These patients pose challenges during perioperative period due to their effects on various organ systems.

3.11.2.1.1 Physiologic Challenges

Cardiac disturbances like increased peripheral vascular resistance, decreased cardiac output; Respiratory implications like increased incidence of pneumonia, impaired respiratory drive, respiratory muscle weakness. Decreased renal perfusion, decreased gastric motility, and slower drug metabolism need to be considered.

One of the most serious complications of surgery in hypothyroid patients is myxedema coma. It is associated with a mortality rate as high as 80%. It is characterized by altered mental status, which may manifest as coma or seizure, and hypothermia, bradycardia, hyponatremia, heart failure, and hypopnea. It is precipitated by surgery, infection, cold exposure, and administration of sedatives [61].

3.11.2.1.2 Management

A condition of euthyroidism is usually targeted preoperatively and elective surgery is usually postponed. Once TSH values normalize, surgery can be performed. Use of sedatives, benzodiazepenes and Opiods should be avoided [59].

For urgent and emergent procedures, surgery may be performed in mild-to-moderate hypothyroidism with levothyroxine cover preoperatively. Surgery should be postponed in patients with severe hypothyroidism in case of nonemergent surgery. In an emergency, thyroid hormone levels should be normalized as rapidly as possible, using IV levothyroxine in a loading dose of 200–500 μg followed by 50–100 μg IV daily [62].

3.11.2.2 Hyperthyroidism

It is commonly due to autoimmune disease (e.g., Graves' disease), multinodular goiter, or adenoma presenting as thyroid nodule. The diagnosis is confirmed by elevated serum T3 and T4. It usually causes exopthalmos, heat intolerance, anxiety, sweating, diarrhea, and weight loss [59]. It has a positive ionotropic and chronotropic effect on the heart coupled with decreased vascular resistance [61]. Hence, these patients manifest tachycardia, arrhythmias, or cardiac failure frequently.

Thyroid storm is a severe manifestation of uncontrolled hyperthyroidism and is characterized by tachycardia, confusion, fever, gastrointestinal complaints, and potentially leading to cardiovascular collapse. It is precipitated by pain, anxiety, trauma, or GA. Hence, elective surgery should always be postponed in patients with overt untreated hyperthyroidism. Hyperthyroidism is usually treated by β-blockers like atenolol or metoprolol as they decrease the sympathetic overactivity. When there is no time to render a patient euthyroid as in emergency cases, cardiac monitoring and adequate β-blockers with

antithyroid medication should be given [61]. While epinephrine with lidocaine is not contraindicated, caution should be exercised. Benzodiapines should be avoided. Carbamizole causes agranulocytosis and this can manifest as oral ulcers.

3.11.3 Adrenal Gland Disorders

3.11.3.1 Primary Adrenocortical Hypofunction

Addison's disease occurs due to autoantibody-mediated destruction of the adrenal cortex leading to failed cortisol and aldosterone secretion. It may also occur due to tuberculosis, histoplasmosis, sarcoidosis, etc [59]. Due to lack of adequate corticosteroid production, these patients are prone to hypotensive collapse, hypoglycemia, profound weakness, and dehydration (Adrenal crisis).

Adrenal crisis is rare in outpatient oral surgery. However, patients with Addison's disease who need surgery should be covered with supplemental steroids. Drugs like barbiturates, azole antifungals, etomidates, phenytoin, and rifampins should be avoided as they accelerate cortisol metabolism.

3.11.3.2 Secondary Adrenocortical Insufficiency

Corticosteroids are prescribed as long-term treatment for various ailments such as inflammatory bowel disease, blood dyscrasias like idiopathic thrombocytopenia, rheumatologic disease, reactive airway disease, and immunosuppression for transplant recipients, etc. due to their immunosuppressive, anti-inflammatory, metabolic, and hemodynamic properties. This external source of long-term steroid can lead to secondary adrenal insufficiency that may manifest in the perioperative period [63].

In a healthy individual, corticotrophin-releasing hormone (CRH) has a diurnal pattern of release from the hypothalamus. This in turn acts on the anterior pituitary to release the Adrenocorticotrophic hormone (ACTH). ACTH acts on the adrenal cortex to release cortisol (hydrocortisone), corticosterone, and mineralocorticoids. Circulating corticosteroids have a subsequent negative feedback effect on CRH and ACTH release. This constitutes the hypothalamic-pituitary adrenocortical (HPA) axis [59].

Normally, an unstressed adrenal gland secretes approximately 8–10 mg of cortisol per day (Table 3.8). Stress, such as illness or surgery, is the stimulus for raised production of cortisol. During surgical stress, the rate varies between individuals and also upon the type of surgery. It is usually up to 50 mg/day for minor procedures and up to 75–150 mg/day for more complex procedures, rarely exceeding 200 mg/day. However, patients on exogenous corticosteroids aren't able to secrete adequate amounts of corticosteroids in response to stress due to HPA axis suppression and a resulting low level of ACTH and CRH leading to atrophy of the zona fasciculate of adrenal cortex [63].This may predispose them to develop adrenal crisis, with rapidly developing hypotension, hypoglycemia, collapse, and even death [59].

Even though there is no consensus on the exact dosage of corticosteroids that leads to hypofunction of the adrenal cortex, doses greater than physiologic doses of cortisol lead to suppression [59]. HPAA suppression does not extend beyond 1 year after exogenous steroid therapy is stopped [64]. Hence, those at risk are:

- Patients currently taking >5 mg of systemic prednisolone
- Corticosteroids been taken in the past 30 days
- Corticosteroids taken for more than a month during the past 1 year.

These patients require steroid cover/supplementation when undertaken for surgeries. Most dentoalveolar and maxillofacial surgeries result in stress and hence require steroid supplements, but most other dental procedures do not require any additional steroid supplements [59].

Following table shows the normal corticosteroid response to the particular level of stress and the appropriate steroid cover needed in cases of adrenal suppression (Table 3.9):

During the procedure, blood pressure and blood sugar levels should be monitored. NSAIDs should be avoided to avoid increasing risk of peptic ulceration. Prophylactic antibiotics should be given in such patients to avoid postoperative infections.

3.11.4 Renal Disorders

The kidneys are responsible for eliminating metabolic waste; fluid and electrolyte homeostasis; and to maintain acid and base balance. The kidneys also affect the cardiovascular and hematologic systems.

Table 3.8 Approximate potencies of systemic corticosteroids relative to cortisol [59]

Steroid	Glucocorticoid activity	Mineralocorticoid activity	Equivalent dose (IV/PO)
Cortisol (hydrocortisone)	1	1	20
Cortisone	0.8	0.8	25
Prednisone	4	0.8	5
Prednisolone	4	0.8	5
Methylprednisolone	5	0.5	4
Dexamethasone	30–40	0	0.5–0.75

Table 3.9 Normal corticosteroid response to the particular level of stress and the appropriate steroid cover needed in cases of adrenal suppression [63]

Surgery type	Endogenous cortisol secretion rate	Examples	Recommended steroid dosing
Superficial	8–10 mg/day (baseline)	Dental surgery Biopsy	Usual daily dose
Minor	50 mg/day	Multiple extractions LA, Dental implant surgery Inguinal hernia repair Colonoscopy Uterine curettage Hand surgery	Usual daily dose plus Hydrocortisone: 50 mg IV before incision Hydrocortisone: 25 mg IV every 8 h × 24 h Then usual daily dose
Moderate	75–150 mg/day	Minor maxillofacial trauma, Orthognathic surgery Lower-extremity revascularization Total joint replacement Cholecystectomy Colon resection Abdominal hysterectomy	Usual daily dose plus Hydrocortisone: 50 mg IV before incision Hydrocortisone: 25 mg IV every 8 h × 24 h Then usual daily dose
Major esophagectomy	75–150 mg/day	Total proctocolectomy Major cardiac/vascular Hepaticojejunostomy Delivery Trauma	Usual daily dose plus Hydrocortisone: 100 mg IV before incision Followed by continuous IV infusion of 200 mg of hydrocortisone more than 24 h or Hydrocortisone: 50 mg IV every 8 h × 24 Taper dose by half per day until usual daily dose reached plus Continuous IV fluids with 5% dextrose and 0.2–0.45% NaCl (based on degree of hypoglycemia)

The best parameter to assess the function of the kidneys is the glomerular filtration rate (GFR). It is measured by calculating the creatinine clearance based on serum creatinine (SC). The normal value of GFR for an adult male is 130 ml/1.73 m^2 and is 120 ml/1.73 m^2 for an adult female. Chronic kidney disease occurs when the GFR is reduced by at least 50 ml/min [65].

Patients with chronic kidney disease who are either on dialysis, dialysis naive, or renal transplant recipients or post-transplant patients require modification of treatment plan from a surgical point of view. These patients always have a risk of developing acute renal failure in the postoperative period either due to pre-existing renal dysfunction or solely due to the effects of surgery.

3.11.4.1 Acute Renal Failure (ARF)

ARF is the rapid loss of renal function over the course of days to weeks, resulting in the patient's inability to clear nitrogenous waste, including creatinine and urea, from the body [66]. The term Acute Kidney Injury (AKI) has replaced acute renal failure in current literature. Perioperative AKI is a leading cause of morbidity and mortality due to increased risk of sepsis, anemia, coagulopathy, and mechanical ventilation.

There are three types of ARF based on etiology: prerenal, renal, and postrenal causes. The most common cause of AKI in perioperative period is the prerenal cause and the ischemic acute tubular necrosis (renal AKI) due to hypoxic damage to medullary region secondary to hypovolemia, hypotension, and dehydration [67]. Prerenal AKI and ischemic ATN are a part of a spectrum of manifestations of renal hypoperfusion. Hypotension or hypovolemia may be due to preoperative factors like hemorrhage, diarrhea, fasting, use of diuretics, due to intraoperative factors like ongoing blood loss, activation of sympathetic reflexes, and due to postoperative factors like intravascular volume depletion, myocardial infarction, etc [68]. Hypotension and hypovolemia result in activation of the sympathetic nervous system and the renin–angiotensin–aldosterone axis, which compromises GFR by inducing afferent arteriolar renal vasoconstriction. Other common causes of AKI are the use of NSAIDs, ACE inhibitors, nephrotoxic drugs like aminoglycosides, radiocontrast materials, myoglobin, hemoglobin, and amphotericin B. Pre-existing diseases like diabetes, hypertension, and obstructions of the urinary system also lead to perioperative AKI [68].

The strategy around perioperative AKI is ideally prevention. Preoperatively potential risk factors such as volume depletion, hypotension, sepsis, nephrotoxin exposure, and pre-existing chronic kidney disease should be identified and elective surgery should be postponed till optimization is complete. Anemia should be corrected before surgery. The choice of fluid in intra-

operative resuscitation is usually a balanced crystalloid solution like Ringer's lactate and not a chloride-rich crystalloid. Hydroxyethyl starch is best avoided. Mean arterial pressure should be maintained and hemodynamic stability is of utmost importance. Diuretics should be only given in cases of volume overload and not for increasing GFR. Norepinephrine is preferred over dopamine as it maintains renal perfusion pressure, but the role is still not very clear [67].

3.11.4.2 Chronic Renal Failure (CRF)

CRF is permanent renal insufficiency that develops over months or years caused by the structural and intrinsic damage of the glomerulus or tubulointerstitial system. This usually occurs when GFR is reduced by 50 ml/min. If necessary treatment is not started, most cases of CRF would lead to End Stage Renal Disease (ESRD). ESRD is maintained by regular dialysis or by transplant, in the absence of which, death may occur [68].

Preoperative assessment:

Detailed history and physical examination;
Cardiac work up as dictated by clinical symptoms. ECG and Echocardiogram
Complete blood count
Metabolic panel, serum magnesium, and phosphorus levels
Coagulation profile.

Coronary artery disease and congestive heart failure are commonly found in patients with ESRD and those on dialysis. Hence, cardiac workup and monitoring is required in the perioperative period. Maintaining euvolemia perioperatively in ESRD patients is mandatory. For patients not undergoing dialysis, euvolemia can be achieved with appropriate hydration or diuresis. Dialysis is usually performed a day before surgery to prevent fluid overload and to reduce uremic complications (bleeding). Postoperative dialysis helps to achieve euvolemia if large amounts of fluids were given during surgery. Heparin is withheld if dialysis is performed on the day of surgery.

Anemia complicates CKD due to the decreased production of erythropoietin. Transfusion should be considered in the perioperative period when hemoglobin levels fall below 8–10 g/dl due to surgical blood loss in patients with ESRD. If anemia has been detected, erythropoietin should be initiated several weeks before the elective surgery with iron supplementation to raise hemoglobin to the desired level. Patients who have ESRD may be susceptible to more intraoperative and postoperative bleeding due to platelet dysfunction caused by uremia. Hence, NSAIDs and dipyridamole should not be given within 72 h before surgery to patients who have ESRD due to their effects on platelet function. Hypertension and glycemic control should be tightly monitored in such patients as well.

These patients have inefficient mechanisms of drug clearance that inherently predispose them to adverse drug responses. Hence, NSAIDs, aminoglycosides, benzodiazepines, morphine, and radiocontrast media are avoided. Drugs like propofol, fentanyl, and inhalational anesthetics are usually the preferred drugs of choice.

3.12 Patients with Non-head and Neck Malignancies

3.12.1 Introduction

The most common cancers in India in women are Breast, Oral, Cervical, ovary, and esophagus. Men tend to be afflicted with head and neck cancers, lung, esophagus, stomach, and colorectal cancer [69]. The cancers that most commonly metastatize to the jaws and oral soft tissues are breast, lung, prostrate, thyroid, kidney, stomach, and colon [70]. Another group of malignancies that receive chemoradiotherapy are the lymphoproliferative and hematologic malignancies [70].

Chemotherapy is often employed either with an intent of palliation or for cure. It may be administered as adjuvant therapy or as neoadjuvant therapy. Cytotoxic chemotherapeutic agents have hematologic effects (myelosuppression) as well as nonhematologic effects. The effects of myelosuppression, i.e., leukopenia, thrombocytopenia, and anemia start after 5–7 days with the nadir occurring at 10–14 days. It is usually followed by bone marrow recovery [71]. Hence, the oral surgical treatment should be planned in a manner that it doesn't coincide with the nadir of the myelosuppression where the neutropenia can be as low as 500.

Radiotherapy is a part of treatment for a variety of Head and neck cancers either as primary treatment modality or as adjuvant therapy to the primary tumor or to the associated lymphatic structures. Unlike the effects of chemotherapy, effects of radiotherapy are more long lasting. These include mucositis, xerostomia, trismus, radiation-induced fibrosis, and dysguesia.

3.12.2 Treatment Protocol

3.12.2.1 Chemotherapy

It is best to undertake a dental screening before the start of the chemotherapy so that the hopeless teeth can be extracted, be restored, periodontal therapy, alveoloplasty be performed, and primary closure be done. After extraction, it takes approximately 10 days to 6 weeks for healing to be enough for chemotherapy to start [72]. Ill-fitting and loose dentures should be discontinued and replaced ideally with implants especially in patients scheduled to take systemic bisphosphonates or RANK-L therapy as it might lead to osteonecrosis of the jaws [73]. Fluoride treatment can also be done.

However, patients suffering from leukemia, lymphomas have a state of myelosuppression even before the start of the

Table 3.10 Modification of invasive dental treatment according to hematologic indices [75]

Platelet count	Treatment modification	Neutrophil count	Treatment modification
>75,000 cells/mm^3	No modification	>1000 cell/mm^3	No need for antibiotic prophylaxis.
40,000–75,000 cell/mm^3	Platelet transfusion may be considered in the preoperative and postoperative (24 h).	<1000 cell/mm^3	Postpone the dental treatment. In cases of emergency, discuss antibiotic coverage and endocarditis prophylaxis before treatment with the medical team. Hospitalization may be required
<40,000 cell/mm^3	Postpone the dental treatment. In the case of dental emergency, contact the patient's physician before dental treatment to discuss supportive measures, such as platelet transfusion, control of bleeding, and need for hospitalization. Other coagulation tests may be necessary in some cases.		

chemotherapy. Only acute situations need to be dealt with. Elective treatments can wait till the time the patient is in optimal clinical and hematological parameters, which is usually until after chemotherapy is over. Hence, extractions of grossly carious and severely periodontally compromised teeth, ill-fitting denture, etc. should be addressed. For extractions to be done, or other invasive dental procedures, hematologic indices should be evaluated and antibiotic prophylaxis should be considered [74] (Table 3.10).

Once the chemotherapy starts, a gap of 1 week before the next cycle is essential before any dental intervention. For surgical procedures that cannot wait, like facial trauma or infection, the complete blood counts should be assessed and consultation should be sought with the medical oncologist to determine the nadir in blood counts, the timing of the chemotherapy cycle, and duration [72]. For platelet levels below 40,000/mm^3, platelet transfusions are usually needed [76].

Opportunistic infections may complicate mucositis and may be of viral, fungal, or bacterial origins. Treatment should be guided by culture and sensitivity. Febrile neutropenia needs to be treated usually by intravenous antibiotics like amoxicillin and clavulanic acid with a fluoroquinolone or clindamycin with fluoroquinolone. Hematopoeitic growth factors like granulocyte colony-stimulating factors or granulocyte-macrophage colony-stimulating factors are effective drugs for prophylaxis and treatment of febrile neutropenia. Mucositis occurs in almost all patients and causes great difficulty in feeding, hydrating, and causes pain. It is preferable to manage it with saline mouth rinses rather than with chlorhexidine mouthwashes. Some chemotherapeutic agents are also neurotoxic and cause a deep mandibular pain as well as altered taste sensation and dysguesia. Most of these symptoms subside after cessation of treatment [72].

3.12.2.2 Radiotherapy

The same prophylactic measures of extraction, restoration, alveoloplasty, etc. have to be taken before radiotherapy as for chemotherapy. Additionally, jaw-opening exercises should be initiated and coronoidectomy should be considered as a part of the ablative procedure [72].

3.12.3 Prevention and Treatment of Osteonecrosis After Chemotherapy and Radiation

Osteonecrosis of the jaws occurring in an irradiated bone is called osteoradionecrosis (ORN). Those occurring in a patient on antiresorptive therapy like bisphosphonates or monoclonal antibodies to RANK-L is termed Antiresorptive osteonecrosis of jaws (AONJ) [72]. The incidence of ORN in areas of jaws that have received greater than 60 Gy of radiation is 5–15%. Incidence of AONJ in patients who have received denosumab is 1.3% and is 1.8% in patients treated with nitrogen-containing bisphosphonates [77, 78].

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