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Pharmacology
for Dental Students

Padmaja Udaykumar



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CHAPTER

46

Dental Pharmacology

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DENTIFRICES

Dentifrices are therapeutic aids meant for cleaning the teeth with the help of a toothbrush. They are available in the form of powders, liquids and paste, e.g., toothpastes and tooth powders. Though the prime purpose of a dentifrice is to assist the brush in cleaning the teeth, addition of certain substances like fluoride and antiseptics can afford additional benefits. The ingredients are:

Abrasive Agents

Dental abrasives are fine powdered substances which assist the scouring action of the toothbrush. They are inorganic salts of low solubility, e.g., prepared chalk, calcium phosphate, calcium and magnesium carbonates; magnesium oxide, ferric oxide, charcoal, silicates, powder pumice, kaolin and stannic oxide. The abrasive powder should be fine to avoid scratching of the teeth surfaces. Abrasives are also available as pastes. Generally, powders are more powerful abrasives than pastes.

Uses:

- Polishing the teeth and fillings
- Cleaning the teeth
- In toothpastes and tooth powders.

Detergents

Detergents are cleansing agents which act by:

- Lowering surface tension, i.e., they possess emulsifying properties.
- Dissolving fatty substances and mucus plaques.
- Foaming—on scrubbing the teeth, detergents foam and act as lubricants.
- Loosening the debris adhering to the teeth.
- Some of them also liberate oxygen and have antiseptic properties.

Thus detergents act as deodorants, e.g., sodium lauryl sulfate, ammonium lauryl sulfate, lauryl sarcosinate, dioctyl sodium sulfosuccinate and soaps. **Sodium lauryl sulfate**—a pale yellow powder is effective in both acid and alkaline medium and in hard water and is widely used in tooth pastes. It is also used as a skin cleanser and in medicated shampoo.

Antiseptics

The small amount of antiseptics used in dentifrices may not be sufficient to provide adequate antiseptic action. Antiseptics used in dentistry are thymol, menthol, eugenol, benzoic acid, boric acid, myrrh, calcium and magnesium peroxide. Thymol is a powerful antiseptic and a deodorant used in mouthwashes and gargles. Eugenol has the

odor of clove and is also a local anesthetic commonly used for dental filling.

Sweetening Agents

Sweetening agents are substances used to impart a sweet taste to a pharmaceutical preparation. They are used to make the use of dentifrice more pleasant and acceptable. Saccharine sodium is commonly used in tooth powders and is intensely sweet. It is an artificial sugar 500 times sweeter than sugar and can be used as a dilute (1%) solution. Saccharine has no caloric value and is excreted unchanged within 24 hours. It is stable and nontoxic. Saccharine is less likely to encourage the development of caries when compared to other carbohydrates. It enhances the palatability. Though sucrose can also be used, it causes fermentation and is therefore not preferred.

Coloring Agents

Coloring agents are used to make the preparation more attractive for commercial purposes. Bright colors like cherry red, blue and green are used. Liquor rubri imparts red color while methylene blue gives blue color and chlorophyll is employed for green color. Most colors used commercially are synthetically produced, though some of them may also be obtained from natural sources like plants, animals or minerals. Only permitted color can be used in dentifrices.

Flavoring Agents

Flavoring agents are substances used to impart a pleasant smell and taste to the preparation so that it is more palatable. Though natural flavoring agents are available, synthetic flavors are preferred because of their easy availability. Generally fruity and spicy flavors are preferred. Peppermint, lemon, mint, menthol and pineapple are some natural flavors; synthetic flavors include alcohols, aldehydes, esters and fatty acids.

Other Agents

Other agents used in dentifrices include:

- Binding agents like mucilage of tragacanth, gum acacia and bentonite. They help to bind the liquid and solid phases together in a paste.
- Humectants like glycerine and sorbitol prevent drying up of the paste.
- Antacids like sodium bicarbonate—neutralize acidity in the oral cavity.
- Some dentifrices contain certain agents meant to treat specific dental ailments. For example potassium nitrate (desensitizing agent), carbamide peroxide (bleaching agent) and sodium fluoride (prevention of caries).

A good dentifrice should be pleasant in taste, odor and consistency; should not damage the gums or the teeth.

OBTUNDENTS

Obtundents are agents that diminish dentine sensitivity. They are used to make the excavation painless. Obtundents act by one of the following mechanisms.

- Paralyzing the sensory nerves, e.g., phenol, menthol, thymol, clove oil, camphor, benzyl alcohol cause irritation of sensory nerves followed by desensitization.
- Precipitating proteins—astringents like silver nitrate, zinc oxide and zinc chloride.
- Destruction of nervous tissue, e.g., absolute alcohol **(Table 46.1)**.

The disadvantages with the use of obtundents are:

- Pulp may shrink.
- Irritants may stimulate the formation of secondary dentine.

After the advent of local anesthetics, the use of obtundents has declined.

ANTISEPTICS

Antiseptics used in dentistry are phenol, cresol, chloroxylenol, hexachlorophene,

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Table 46.1: Some obtundents, their mechanisms of action, advantages and disadvantages.

Obtundent	Mechanism of action	Advantages	Disadvantages
Phenol	• Protoplasmic poison—paralyzes nerves • Initial irritation followed by numbness	• Rapid action • Does not stain healthy dentine • Penetrability can be increased by combining with KOH and glycerine	• Infected dentine is darkened • Poor penetrability
Thymol Menthol Clove oil Camphor	• Paralyze sensory nerves—initial irritation followed by numbness	• Combination of these oils has rapid action	• Clove oil may stain the dentine yellow
Silver nitrate	• Astringent—precipitates superficial proteins	• Rapid action	• Stains the dentine black • Penetrability is poor
Zinc chloride	• Similar to silver nitrate	• Rapid action • Does not stain the teeth	• Initial pain is sharp
Paraformaldehyde	• Acts by release of formaldehyde which precipitates proteins	• Painless • Nonstaining	• Slow action • Formaldehyde may penetrate pulp to cause inflammation

chlorhexidine, sodium hypochlorite, iodine and iodophors and oxidizing agents like hydrogen peroxide, and sodium perborate; alcohol and benzalkonium chloride.

MUMMIFYING AGENTS

Agents used to harden and dry the tissues of the pulp are called mummifying agents. This hardening makes the tissues resistant to infection. Astringents and antiseptics were used in combination as a paste for this purpose. Some mummifying agents are:

- Liquid formaldehyde—it is used with zinc oxide and glycerine to harden the tissues.
- Paraform—acts by slow release of formaldehyde and is used in combination with zinc oxide and glycerine.
- Iodoform—acts by liberation of iodine. It is made into a paste with eugenol, phenol, tannic acid and glycerol for use in dental practice.
- Tannic acid—is an astringent, precipitates proteins and hardens the tissues. The tissues may also shrink.

With the advent of modern techniques and availability of more suitable material for root canal therapy now, mummifying agents are not of much use.

BLEACHING AGENTS

Bleaching agents are used to remove pigmentation of the teeth and make them appear white. Laser has now been employed for this purpose.

- Oxidizing agents like **sodium peroxide**, **hydrogen peroxide** and perhydrol act by releasing nascent oxygen which reacts with the pigment and loosens it from the pulp.
- Reducing agents like **sodium thiosulfate** and other agents like chlorides, and ultraviolet rays have been used as bleaching agents.
- **Hypochlorites** remove silver and iron stains; sodium thiosulfate removes iodine stains while chlorinated lime or bleaching powder releases chlorine which bleaches and is used to remove stains by aniline dyes.

STYPTICS

Styptics are local hemostatics. They are used to arrest local bleeding following tooth extraction and other dental procedures (*see* page 266).

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MOUTHWASHES

Mouthwashes are solutions containing active ingredients meant for cleansing and deodorizing the oral cavity. 15–30 mL of the diluted solution is used for gargling and rinsing the mouth. Mouthwashes contain astringents, antiseptics and/or obtundents, flavoring and sweetening agents. Prolonged use of concentrated solutions result in staining.

Types of Mouthwashes

- Antiseptic and astringent mouthwash—for soreness under dentures. They harden the mucous membrane.
- Obtundent mouthwash—for sensitive oral lesions.
- Detergent mouthwash—for cleansing and deodorizing action.

Uses:

- Soreness under dentures
- Sensitive oral lesions
- Postoperative and other bedridden patients for deodorizing the oral cavity and to maintain oral hygiene; mouthwashes are refreshing.
- In halitosis
- Stomatitis
- Surgical impaction—after removal of impacted tooth.

Chlorhexidine (CHLORHEX REXIDINE) and Povidone iodine (BETADINE) are some commonly used mouthwashes.

ASTRINGENTS

Astringents are agents that precipitate superficial proteins when applied to the skin or mucous membrane. They form a protective coating and harden the surface. Astringents check minor hemorrhages—arrest capillary oozing as they promote clotting and precipitate proteins on the bleeding surface. Astringents are therefore used as obtundents, styptics and mummifying agents.

Types of Astringents

- Vegetable astringents—tannic acid, gallic acid
- Metallic astringents—salts of zinc, copper, iron, aluminum and silver; also alum
- Miscellaneous—alcohol, dilute acids.

Uses: Astringents are used as mouthwashes, paints, lotions and dentifrices in aphthous ulcers, stomatitis, gingivitis and as local hemostatics.

DISCLOSING AGENTS

Dental plaques are relatively invisible. Certain agents (dyes) and iodine-containing solutions may be used to make the supragingival plaques visible and such agents are called disclosing agents.

Dyes used as disclosing agents are as follows:

- **Erythrosin:** Erythrosin tablets are dissolved into a solution or chewed to dissolve in the mouth. It stains the plaque area red but also may stain soft tissues. It is the most widely used disclosing agent.
- **Fluorescein dye:** On application, fluorescein dye stains the plaque yellow. It does not stain the soft tissues. But special light is required to see the stained plaque. It is more expensive.
- **Two-tone dyes:** A solution containing a combination of two dyes is used. Mature plaques are stained blue, while new plaques are stained red.
  Advantages:
  - Dyes used as disclosing agents help to differentiate mature and immature plaques.
  - They do not stain the gingival tissues.
- **Iodine-containing solutions:** Iodine-containing solutions have been used as disclosing agents but have the disadvantage of causing a high incidence of allergic reactions. They also have an unacceptable taste. Hence iodine solutions are not preferred.

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Methods of application: To stain the plaque, solutions of disclosing agents may be used as follows:

- Painting the teeth with a cotton swab
- Rinsing the mouth
- As tablets/wafers to be chewed dissolving it in the saliva. The mouth should then be rinsed with water.

SIALOGOGUES

Sialogogues are agents which enhance salivary secretions. **Pilocarpine** is generally used as a sialogogue though other drugs like bethanechol and anticholinesterases like neostigmine also reduce salivary secretions. **Cevimeline** a newly introduced drug enhances salivary secretion by directly stimulating the muscarinic receptors. It is used to treat dry mouth in patients with Sjögren's syndrome.

- Sialogogues are used to treat acute symptoms of sialoadenitis that may be seen in sialolithiasis. Surgical excision is required in most cases.
- Xerostomia—often follows radiotherapy of the head and neck. It may be troublesome because it causes difficulty in speaking and swallowing. It may be treated with pilocarpine.
- Sjögren's syndrome—cevimeline is used.

Antisialogogues

An antisialogogue is a substance that reduces salivary secretion. Propantheline bromide an atropine substitute is commonly used for this purpose though atropine and many other anticholinergic drugs also decrease salivary secretion.

Uses:

- **Sialocele:** An antisialogogue is used to suppress glandular function during healing or to encourage spontaneous resolution of the sialocele. Propanthelene bromide (Probanthine) is given in the dose of 15 mg orally 4 times a day half an hour before food.
- **Postsurgical:** An antisialogogue is used for a short period following surgeries of the salivary glands and salivary ducts. Temporary reduction in the flow of saliva is thought to be helpful in faster wound healing.
- In post-traumatic parotid fistulas and sialoceles.
- Trauma to the salivary gland and salivary ducts.

ANTICARIES DRUGS

Caries is a degenerative condition characterized by decay of hard and soft parts of the teeth.

Fermentation of carbohydrates in the oral cavity results in the production of acids like lactic acid. These acids convert the insoluble calcium salts of the teeth into soluble salts (decalcification) which are easily removed. The oral flora produce proteolytic enzymes which digest the organic enamel matrix. Thus both organic and inorganic matter of the teeth are destroyed. As the process continues, the pulp is penetrated and the infection may gain access into the systemic circulation.

Fluorides: Fluorine, a halogen, is the most electronegative of all elements and is therefore highly reactive. The efficacy of fluoride in the prophylaxis of dental caries has been well-established.

Mechanism of action: Fluorides alter the physicochemical properties of the teeth as follows:

- Fluorides inhibit bacterial enzymes which produce acids and therefore prevent decalcification of the teeth.
- Fluorides convert the hydroxyapatite of enamel and dentine to fluorapatite which is more resistant to destruction by acids. Thus fluorides make the outer layers of enamel harder and more resistant to demineralization.

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- Fluorides also stimulate remineralization of the enamel.

Fluoridation of water supplies: Fluoridation of drinking water is the most effective measure in preventing dental caries—if consumed prior to eruption of the permanent teeth. Several large-scale studies have established the beneficial effects of optimum fluoridation of communal water supplies in preventing caries. The optimum level of fluoride is 0.5–1 ppm and is found to be safe and effective. More than 1–2 ppm result in toxicity—cause dental fluorosis.

When communal water fluoridation is impracticable, table salt can be fluorinated.

Topical Fluoride

Topical use of high doses of fluorides effectively prevents caries. It may be used as:

Fluoride dentifrices: Several commercial preparations containing fluoride salts are available. Sodium fluoride, sodium monofluorophosphate or stannous fluoride are the salts used in such dentifrices. Mouth should be thoroughly rinsed and dentifrice should not be swallowed; children should be specially warned—to avoid fluorosis. Used twice a day regularly, they effectively prevent caries.

Fluoride mouthrinses: 0.2% sodium fluoride solution containing 900 ppm of fluoride, retained in the mouth for one minute—to be used twice a week is effective in preventing caries.

Topical application: By a dentist of 2% sodium fluoride or 8 percent stannous fluoride once a week for 4 weeks also prevents caries but is expensive. Special precautions should be taken to avoid swallowing. Topical application is the most effective if done just as the teeth erupt.

Fluoride Toxicity

Chronic toxicity results in mottling of the enamel, brownish-black discoloration of the teeth, joints pain and stiffness, osteosclerosis of the spine and pelvis. Crippling fluorosis is characterized by thickening of the cortex of long bones and bony exostoses especially in the vertebrae.

Acute toxicity could result from accidental or suicidal overdose often due to ingestion of fluoride-containing rat poisons. 2.5–5 g is the lethal dose in adults. Manifestations include nausea, vomiting, diarrhea, hypotension, hypocalcemia, hypomagnesemia, cardiac arrhythmias and acidosis.

Treatment:

- Vomiting should be induced and gastric lavage should be given with fluids containing calcium.
- Cardiac arrhythmias should be treated.
- Correction of acid base imbalance.
- Alkaline diuresis to enhance fluoride excretion.

Prevention of caries: Caries can be largely prevented by the following measures:

- Resistance of the host can be increased by fluoride therapy.
- Oral flora to be controlled by antiplaque agents.
- Soluble carbohydrates present in ice-creams, sweets, chocolates, etc.—the substrate for bacterial growth—should be avoided.
- 'In-between' eating habits should be reduced.
- Public should be educated regarding the proper use of toothbrush, dentifrices and prevention of caries.

DRUGS USED IN DENTAL PLAQUE

Plaque is the soft, nonmineralized bacterial deposit formed on inadequately cleaned teeth. Proteins in saliva adhere to the surface of the enamel. Microorganisms from oral cavity colonize on these to form a plaque. As in caries, poor oral hygiene and carbohydrate-rich food encourage plaque formation. When a plaque

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gets mineralized, it is called a dental calculus or tartar.

Treatment: All plaques should be removed as quickly as possible. The virulent microorganisms of the plaque flora like *Streptococcus mutans* and *Streptococcus sobrinus* are associated with the pathogenesis of caries and many periodontal diseases. These organisms should be controlled either by a suitable antibacterial agent or by altering tooth surface to prevent the bacterial attachment to the plaque. Scaling is done to remove the plaque.

Antibacterial Agents

Though penicillins, erythromycin and tetracyclines are effective in controlling plaque, antibiotics which are not absorbed from the oral mucosa should be preferred. Vancomycin, kanamycin, bacitracin and polymyxin-B are used as topical mouthrinses or gels. Controlled delivery systems containing tetracyclines for intra pocket insertion, effectively suppresses periodontal pathogens. However, long-term use of antibiotics should be avoided because of the risk of toxicity.

Other agents that can be used in plaque control are:

- **Chlorhexidine** is the most effective antiplaque and antigingivitis agent.

Gluconate 0.12–0.2% solution is used twice daily for rinsing—15 mL solution is retained for 30 seconds in the month and then spat out. For the next 30 minutes, eating, drinking and rinsing the mouth should be avoided. Chlorhexidine binds to oral tissues and is slowly released for about 12 hours.

Chlorhexidine is bacteriostatic in low concentrations but bactericidal at higher concentrations. Chlorhexidine binds to the bacterial cell wall and interferes with the uptake of sugars by the bacteria. Higher doses cause precipitation of intracellular proteins leading to cell death. Long-term use of chlorhexidine can cause yellowish brown staining of the teeth, mucosal soreness, desquamation and occasionally altered taste sensation. However, systemic side effects are unlikely since chlorhexidine is used topically. Alexidine can also be used.

Uses:

- Chlorhexidine (bisbiguanides) is used as mouthrinses, gels and in dentifrices for the control of plaque and gingivitis.
- Chlorhexidine mouth wash is also used to disinfect the oral cavity before dental procedures.
- Ulcerative gingivitis
- Following oral surgery and denture insertion
- Prophylactically in immunocompromised patients like those with leukemia, AIDS and agranulocytosis.

- **Fluorides:** Stannous fluoride mouth rinses or gels are effective in plaque control and make the gums healthier. Fluorides inhibit enzymatic reactions involved in glycolysis.

- **Oxygenating agents** like hydrogen peroxide and sodium perborate act by liberating nascent oxygen to suppress the bacterial growth particularly anaerobes.

- **Halogens:** Halogen releasing compounds like chlorophors and iodophors are used in many antiseptic mouthwashes. Chlorine dioxide and povidone iodine have been widely used—but these are not popular because of their unpleasant taste.

- **Other compounds:**

- Other antiseptics like phenol and its derivatives hexylresorcinol and thymol, cetylpyridinium chloride, benzalkonium chloride and cetrimide are used in many antiplaque mouthrinses. However, their undesirable properties like disagreeable taste, rapid discoloration and poor solubility make them less preferred.

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- A combination of oils including thymol (0.06%), eucalyptus oil (0.09%), menthol (0.04) and methyl salicylate (0.06%) in an alcohol-based vehicle is found to be useful in inhibiting plaque. These oils act by inhibiting bacterial enzymes and alcohol acts on the bacterial cell wall. The combination is useful in reducing plaque and gingivitis.
- Detergents like **sodium lauryl sulfate** have also been used in several mouthrinses.
- **Sanguinarine** is an alkaloid converted to the active metabolite at low pH. It is used as an antiplaque and antigingivitis mouth rinse or paste but has a disagreeable taste.
- **Zinc compounds** like zinc chloride and zinc citrate have astringent and mild antiseptic properties and may be used as adjuvants.
- **Triclosan, a nonionic bisphenol** is a germicidal used in toothpaste and in other dental preparations. It has a wide antibacterial spectrum including many gram-positive and gram-negative bacteria. It causes leakage in the bacterial cell membrane leading to bacterial cell lysis. It is retained in the dental plaque for 8 hours. Triclosan also inhibits gingivitis. When triclosan is incorporated in a polyvinyl copolymer its antibacterial activity improves. Therefore triclosan is used along with the copolymer in toothpaste and is found to be useful in controlling plaque and calculus formation.

DENTAL DESENSITIZING AGENTS

Dentin hypersensitivity is a common problem affecting millions of people all over the world. Pain could be evoked by mechanical, chemical or thermal stimuli, i.e., the patient experiences pain while eating hot and cold, sweet or sour food or even while brushing the teeth. The hypersensitivity is due either to loss of enamel or exposure of the root surface. Loss of enamel may follow mechanical wear or chemical erosion due to acidic food. The root surface gets exposed due to gingival recession as seen in old age, incorrect toothbrushing habits or chronic periodontal diseases.

An ideal desensitizing agent should be nonirritant, nontoxic, painless, rapid-acting, easy to use and have a long-lasting effect. At present no such single agent is available. Hence multimodal approach could be employed depending on the severity.

Dental Desensitizing Agents are:

1. **Agents occluding dentinal tubules:** Potassium nitrate, potassium oxalate, calcium hydroxide, fluorides, sodium citrate, formaldehyde
2. **Agents precipitating proteins:** Astringents: silver nitrate, zinc chloride
3. **Precipitating tubule proteins causing occlusion:** Strontium chloride, formaldehyde
4. **Tubule sealants:** 4-Methacryloxyethyl trimellitate
5. **Physical methods:** Restorations—glass ionomer cements, composites; laser sealing of the tubule.

Agents Occluding Dentinal Tubules

Potassium nitrate 5% used daily is effective in 4 weeks as a desensitizing agent. It acts by occluding the dentinal tubules through crystallization. Used as a toothpaste twice a day, potassium nitrate is a popular desensitizing agent. The paste has to be applied over the teeth, kept for 5–10 minutes and then brushed for better results.

SENQUEL, SENQUEL AD, THERMO SEAL, Potassium nitrate 5%.

Calcium hydroxide supplies calcium ions which hasten remineralization of the

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exposed dentin. But it has to be applied by a dentist and may require repeated application as the effect is short-lived.

Fluorides: High doses of fluorides used as dentifrices act by hardening the dentin surface and is claimed to be effective in 3–4 weeks. Fluoride iontophoresis (using 2% NaF) may be employed to occlude the dentinal tubule. The procedure is immediately effective but is expensive and may require repetition.

Agents Precipitating Proteins

Astringents—silver nitrate and zinc chloride act by precipitating proteins and were used earlier. But they cause permanent staining of the teeth, are toxic to the gingiva and pulp and are therefore not preferred.

Strontium chloride and formaldehyde act by precipitating proteins within the tubules occluding them. They have been used in the form of dentifrices in the past.

Tubule Sealants

The newer agents including 4 methacryloxyethyl trimellitate have been tried as desensitizers. They are acrylic agents and may be used to seal the exposed dentinal tubules, i.e., they act as **bonding agents**. The bonding is quick and dries fast, so that the sensitive area is sealed off and avoids painful stimuli from reaching the dentine.

Physical Methods

Restorations to cover the dentinal tubules using glass ionomer and composites are found to be effective in patients with eroded gingiva. A combination of glass ionomer and composite resins is more beneficial when compared to either agents used alone. In patients with gingival loss, soft tissue grafts cover the exposed dentin to relieve the sensitivity.

MEDICAL EMERGENCIES IN DENTAL PRACTICE

A dentist can come across several life-threatening emergencies in dental practice although not frequently. Several factors have contributed to an increase in the rate of these emergencies like:

- A rise in geriatric population and a consequent increase in the number of elderly patients seeking dental therapy.
- The tendency for longer dental appointments.
- An increase in the use of drugs in dentistry.

Dentists therefore, must be equipped with adequate knowledge for appropriate management of such situations, because they can be life-threatening. Treatment and prevention of some of the common emergencies that may be encountered in dental practice are discussed below.

Anaphylaxis

It is an immediate type of hypersensitivity reaction and can occur following the use of drugs, and allergens. Anaphylaxis is more common following parenteral administration of drugs. Though it can be induced by any or all drugs, some drugs like lignocaine, penicillins, cephalosporin and sulfonamides are more likely to induce anaphylaxis. Antigen antibody complexes bind to the mast cells leading to the degranulation of these mast cells. This results in the release of massive amounts of histamine and other inflammatory mediators which are responsible for the symptoms of anaphylaxis. Symptoms usually occur within minutes of exposure to the offending agent. Signs and symptoms include:

- Cutaneous—itching at the site of injection and/or generalized itching, swelling of subcutaneous tissues, eyelids, lips and tongue.
- Respiratory—wheezing due to bronchospasm, cough and laryngeal edema.

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- Cardiovascular—hypotension resulting in dizziness and in more severe cases loss of consciousness.

When severe, it can be rapidly fatal. Hence, every medical and dental practitioner must know to manage anaphylaxis.

Treatment—should be immediate

- Intramuscular injection of adrenaline 0.5 mL of 1:1000 solution is life-saving. The dose may be repeated every 10 minutes if required. If hypotension is not significant, adrenaline may be injected subcutaneously. If anaphylaxis is very severe, 0.5 mL adrenaline may even be given intravenously slowly. Dose may be repeated if needed after 5–10 minutes.
- The patient should be put in reclining position.
- Arrangements should be made to transfer the patient to the nearest emergency ward.
- High flow oxygen should be given.
- Vital signs should be carefully monitored.
- Cardiopulmonary resuscitation may be done if required.
- Intravenous hydrocortisone hemisuccinate 100–200 mg will be needed in severe cases particularly in asthmatics.
- An antihistamine like chlorpheniramine 20 mg IM or diphenhydramine 50 mg IM may be given as an adjuvant. Antihistamines should be continued orally for 2–3 days.
- Intravenous fluids should be started. Vasopressors like dopamine may be given if needed.

Uncontrolled Bleeding

Most dental procedures cause some bleeding. It is mostly minor and local application of mild pressure for 10–20 seconds would generally arrest bleeding. If bleeding continues, a cotton swab dipped in 1% adrenaline solution may be used as a pack. Ice pack for a few minutes may also be tried. Gel foam may be used in more severe bleeding.

Uncontrolled bleeding following dental procedures may be seen in one of the following:

- Patients on antiplatelet drugs or those with thrombocytopenia due to any cause
- Patients on anticoagulant therapy
- Hemophiliacs
- Vitamin C deficiency
- Long-term glucocorticoid therapy.

They should be controlled as follows:

- Reduction in the platelet count or impaired platelet function due to antiplatelet drugs can result in severe bleeding. Appropriate measures should be taken to correct the above before taking the patient for surgery or other dental procedures associated with bleeding. If the patient is on drugs that inhibit platelet aggregation, consult the physician 1–2 weeks before an elective surgery and under his guidance such drugs may be withdrawn temporarily. Duration of antiplatelet effects of clinically used drugs like ticlopidine and clopidogrel is around 7–10 days. Therefore these drugs should be withdrawn about 7–8 days before the procedure and prothrombin time should be brought down to 1½ to 2 times the control value. The antiplatelet drugs should be restarted after adequate healing has occurred. Even minor bleeding including petechiae and ecchymoses should be watched for.
- If thrombocytopenia is due to any other cause, platelet transfusion may be required before any surgical procedure is undertaken in consultation with a physician.
- If the patient is on anticoagulants, they may be temporarily withdrawn or the dose reduced in consultation with a physician.
- Drugs with antiplatelet effects like NSAIDs should be used carefully.
- Vitamin C deficiency as such may result in bleeding from the gums and may enhance bleeding from dental procedures and also

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impair wound healing. Local application of adrenaline pack or pressure may be needed following minor dental procedures. Major dental procedures should be done after the correction of vitamin C deficiency.

- Glucocorticoid therapy: Patients on long-term glucocorticoid therapy may bleed more and wound healing may be impaired. Wounds are also more susceptible to infections. Adequate local hemostatic measures should be taken.
- Hemophiliacs—are deficient in coagulation factor VIII and are therefore likely to bleed more even from minor dental procedures. Factor VIII should be supplemented before the dental procedure and adequate local hemostatic measures should be taken.

Unconsciousness

Patients with no response to stimuli need immediate attention.

Unconsciousness in dental practice may be due to one of the following causes:

1. **Vasovagal attack/syncope/fainting:** Vasovagal attack is the transient loss of consciousness due to a painful or an emotional stimulus. Pathophysiology involves an autonomic imbalance. In response to the stimulus, the vagus is stimulated which, in turn, results in bradycardia, reduced cardiac output and hypotension accompanied by peripheral vasodilation. Hypotension reduces the blood supply to the brain leading to cerebral hypoxia which in turn results in unconsciousness. However, the patient recovers in 1–2 minutes because the sympathetic system gets activated and reverses the symptoms.

   Treatment:
   - Loosen tight clothing to facilitate breathing.
   - Elevate feet to increase venous return.
   - Give cold compress to promote peripheral vasoconstriction and increase venous return.
   - Oxygen inhalation may be given.
2. **Hypoglycemia:** It is to be expected in patients with diabetes mellitus. Signs and symptoms include sweating, tachycardia, tremors, blurred vision, weakness, hunger, confusion and drowsiness leading onto unconsciousness. In mild hypoglycemia, oral administration of sugar or sugar-containing fruit juices are sufficient to overcome the symptoms. In unconscious patients, 50 mL of 50% dextrose is given intravenously—usually patient recovers within a few minutes.
3. **Seizures**—*see* below
4. **Arrhythmias**—may be:
   - Bradyarrhythmias—transient loss of consciousness with slow irregular heart rate of <40 beats/minute.
   - Tachyarrhythmias—heart rate >150/minute may be associated with fatigue, breathlessness and syncope.
5. **Cardiac arrest** is stoppage of the heart, also called cardiac standstill. If revived on time the heart may recover.

Clinical features:

- Loss of consciousness
- Absence of pulses
- Gasping or absence of breathing.

Management:

- Maintain airway—turn the patient's head to a side, use mouth gag.
- Raise the foot end.
- Mouth-to-mouth respiration to be given—take 4 quick, deep breaths and then exhale into the patient's mouth. This has to be repeated 12 times per minute.
- As an alternative, bag mask may be used with 100% oxygen.
- External cardiac massage to be given at 60 chest compressions per minute.
- 0.5 mL of 1:1000 solution of adrenaline should be injected intravenously or in

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more severe cases intracardiac adrenaline injection may be needed.
- Medical assistance should be taken at the earliest possible.
- Dentists should be trained in cardio-pulmonary resuscitation (CPR).

Seizures

Patients can develop symptoms ranging from brief lapses of awareness to generalized convulsions usually lasting for less than 5 minutes.

- *If tonic clonic seizures* start during a dental procedure:
  - Remove instruments or dentures if any from the oral cavity.
  - Place a gag or a padded tongue depressor in the mouth between the teeth.
  - Turn the head to a side—this keeps the airway clear and prevents the tongue from falling back.
  - If seizures continue, 10 mg diazepam should be given intravenously.
  - Whenever possible dental procedure may be postponed.
  - If the patient continues to have seizures despite treatment, physician should be called and managed as status epilepticus.
- *Absence seizures*—there is sudden impairment of consciousness associated with starring. The patient stops all on-going activities but recovers within a few seconds. The episode lasts for a brief period, generally less than 30 seconds. It only requires reassurance at the time but the patient should be advised to see a physician.
- *Atonic seizures*—also called drop attacks are characterized by sudden loss of postural tone and the head may drop for a few seconds or the person may drop to the ground for no obvious reasons. The patient recovers usually within a few seconds and only requires reassurance particularly if the patient is already on treatment by a physician.

Ischemic Heart Disease

Ischemic heart diseases (IHD) include angina and myocardial infarction.

Angina pectoris is the principal symptom of ischemic heart disease and is characterized by sudden severe substernal pain or discomfort which may radiate to the left shoulder or medial aspect of the left arm. It is precipitated by stress and anxiety. Most dental procedures are painful and may evoke some anxiety. Therefore, during a dental procedure, IHD patients may experience an episode of exertional angina or very rarely develop myocardial infarction.

- IHD patients should be taken up for early appointments in the morning and not made to wait.
- Patients with known IHD should be asked to carry their rescue medication, i.e., nitroglycerine tablets for sublingual use to the dental clinic. In patients with moderate to severe angina, prophylactic nitroglycerin (0.5 mg tab sublingually) may be used 5 minutes before starting the dental procedure.
- If a patient gets an acute episode of angina during a dental procedure:
  - Stop the dental procedure for a few minutes.
  - Administer tab nitroglycerin 0.5 mg sublingually. It relieves pain in 2–5 minutes.
  - Monitor pulse and BP.
  - If pain is not relieved in 8–10 minutes, nitroglycerin dose may be repeated (maximum of 3 tablets in 15–20 minutes). Even then, if the pain does not subside, there are chances that the patient may be going into myocardial infarction. Immediate medical attention should be sought.

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Myocardial Infarction

Signs and symptoms—severe substernal pain, radiating to the left shoulder, with nausea, vomiting, palpitation, and sweating, patient appears pale and apprehensive. Patient should be shifted to emergency care at the earliest possible. While such arrangements are being done, injection pethidine 50 mg or morphine 10 mg should given intramuscularly. Patient should be made to swallow a tablet of aspirin 300 mg. Oxygen inhalation should be given if possible.

Shock

Treatment of shock is discussed in page 133. Intravenous fluids are given in almost all the different types of shock. Therefore, a knowledge of the different IV fluids available is important.

Intravenous Fluids

Intravenous fluids are sterile solutions meant for intravenous administration. The content and quantity of solute varies. Intravenous fluids are used for replacement of fluid, electrolytes and nutrition. There are different types of IV fluids to be given depending on the patient's requirements.

Types of IV Solutions

Intravenous solutions are of three types depending on osmolality—isotonic, hypotonic or hypertonic. Fluids having an osmolality nearly equal to that of extracellular fluid (ECF) or if the electrolyte content (cations + anions) is nearly equal to 310 mEq/L—they are considered isotonic.

Isotonic-electrolyte content = 310 mEq/L

Hypotonic-electrolyte content < 250 mEq/L

Hypertonic-electrolyte content >375 mEq/L

(Plasma osmolality is nearly equal to 300 mmol/L. Osmolality of 10% dextrose is 505 mmol/L.)

Isotonic fluids: As isotonic fluids have an osmolality nearly equal to that of ECF, they do not alter the size of RBCs (neither shrink nor swell). One liter of isotonic solution expands ECF by 1 liter. But it quickly diffuses into the ECF compartment and therefore around 3 liters of isotonic fluid is needed to replenish volume of one liter of lost blood. However, patients with hypertension and cardiac failure need careful monitoring to avoid fluid overload. Isotonic solutions include normal saline and lactated Ringer solution.

Normal saline solution: 0.9% sodium chloride. It is used in hyponatremia. It should be avoided in heart failure, pulmonary edema and renal impairment.

Lactated Ringer solution contains potassium, calcium and sodium chloride. It is used to correct dehydration, hyponatremia and to replace gastrointestinal fluids. Many other similar solutions are available with minor changes in the electrolyte content.

Hypotonic fluids: Hypotonic fluids replace cellular fluid because they are hypotonic as compared to plasma. Half normal saline (0.45% sodium chloride solution) is the commonly used hypotonic solution but other electrolyte solutions are also available. Hypotonic sodium solution is used in hypernatremia and other hyperosmolar conditions. Overdosage can result in intravascular fluid depletion, hypotension, cellular edema and later cell damage.

Hypertonic fluids: 5% dextrose in normal saline or lactated Ringer's solution or in hypotonic solution has osmolality more than ECF. 45–50% dextrose solution may be administered in hypoglycemia or to supplement calories. Since these solutions are strongly hypertonic, they should be injected into central veins for rapid dilution. Hypertonic saline solutions draw water from the cells and the cells shrink. They should be injected slowly and carefully to avoid ECF volume overload.

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Hypoglycemia

Hypoglycemic episodes are fairly common in diabetics on treatment and the severity may vary from mild tachycardia to confusion and coma depending on various factors. In presence of symptoms suggestive of hypoglycemia, sugar or glucose or any suitable fruit juice should immediately be given. Since the patient may be unable to take food for some time after dental procedures, special precautions are needed in such patients.

Diabetic Ketoacidosis

May be precipitated by infection, stress or trauma. It is more common in patients with insulin-dependent diabetes mellitus. Diabetic ketoacidosis is a medical emergency and can be life-threatening. Insulin deficiency results in severe hyperglycemia (600–800 mg/dL) and excessive production of ketone bodies.

Clinical features include metabolic acidosis, dehydration with loss of sodium and potassium in the urine causing electrolyte imbalance, impaired consciousness and hyperventilation—may proceed to coma. Diabetic ketoacidosis should be suspected when the patient has IDDM, diabetes is uncontrolled, patient is under stress, or has infection and develops the above signs and symptoms.

Treatment:

- **Correction of hyperglycemia**—intravenous regular (plane) insulin 0.1U/kg bolus followed by 0.1 U/kg/hour by continuous IV infusion till the patient recovers. Once the patient has fully recovered, insulin should be administered subcutaneously 30 minutes before stopping the infusion.
- **Correction of dehydration**—fluid and electrolyte replacement are important. Normal saline infusion 1 liter in the first hour and then 1 liter over the next 4 hours and then the quantity can be titrated based on the severity of dehydration.
- **Correction of acidosis**—sodium bicarbonate may be needed in some patients with severe acidosis.
- **Potassium**—rapid correction of hyperglycemia may result in the movement of potassium into the cells resulting in hypokalemia. 10–20 mEq/hour potassium chloride is added to the drip. When serum phosphate is also low, potassium biphosphate may be given to supplement both potassium and phosphorus.

Hyperglycemic, hyperosmolar, nonketotic, coma: Severe hyperglycemia and glycosuria result in severe dehydration and increased plasma osmolarity leading to coma and has a high mortality rate. The treatment is similar to ketoacidosis with correction of fluid and electrolyte imbalance and plane insulin.

Acute Addisonian Crisis

It is an emergency condition that could be precipitated by an infection or sudden withdrawal of steroids after long-term administration. Proper *drug history* is therefore very important. If the patient has been on glucocorticoids like (prednisolone) for more than 2 weeks, at the time of presenting for a dental procedure, the glucocorticoid should be continued. The dentist should make sure that the patient receives his dose of glucocorticoid on the day of dental procedure particularly if it is a major procedure.

Symptoms of Addisonian crisis include nausea, vomiting, weakness, hypotension, dehydration, hyponatremia and hyperkalemia. Treatment intravenous hydrocortisone hemisuccinate 100 mg bolus followed by infusion 100 mg every 4–6 hours is given immediately. The dose may be repeated depending on the patient's condition. Once the patient recovers, switch over to oral preparations. Immediate correction of fluid and electrolyte balance is important. When acute adrenal insufficiency

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Table 46.2: Emergency drugs tray for dentists.

	Drug	*Indications*	*Dose and route*
1.	Inj Adrenaline (1:1000)	Anaphylactic shock	0.2–0.5 mL IM
2.	Inj Hydrocortisone	Anaphylactoid reaction Anaphylactic shock	100 mg IV
3.	Inj Lorazepam	Convulsions	4–6 mg IV/IM
4.	Inj Midazolam	Convulsions	4–6 mg IV
5.	Inj Diazepam	Convulsions	10 mg IV
6.	Inj Chlorpheniramine	Severe allergic reaction	25 mg IM
7.	Dextrose 25%	Hypoglycemia	100 mL IV
8.	Tab aspirin	MI, unstable angina	350 mg oral
9.	Inj calcium gluconate 10%	Tetany	Very slow IV over 10 min
10.	Nitroglycerin tab	Angina	10 mg sublingual
11.	Inj Atropine	Bradycardia	0.6 mg IV
12.	Salbutamol inhaler	Bronchospasm	100 μg 2 puffs
13.	Oxygen	Hypoxia	As required
14.	Adrenaline pack 1:10000	Uncontrolled bleeding	Local application
15.	IV fluids Ringer lactate Normal saline	Hypotension	2–4 mL/kg bolus
16.	Tranexamic acid	Uncontrolled bleeding	1 g stat IV/IM

(tab: tablet; Inj: injection; IV: intravenous; IM: intramuscular; MI: myocardial infarction)

is not confirmed, dexamethasone (4 mg IV) should be used in place of hydrocortisone because dexamethasone does not interfere in the estimation of hydrocortisone levels for diagnosis.

Table 46.2 shows emergency drugs tray for dentists.

Tetany

Tetany is due to hypocalcemia. Other features of hypocalcemia include muscle cramps, paresthesias, laryngospasm and in more severe cases—convulsions. Slow intravenous injection of 5–20 mL of 10% calcium gluconate relieves tetany. Care should be taken to inject calcium slowly because rapid intravenous injection of calcium can cause cardiac arrhythmias which can be fatal.

Status Asthmaticus

An acute attack of bronchial asthma may be precipitated by dental procedures themselves, the stress or anxiety due to them or the drugs and materials used in such procedures. A known asthmatic patient should be told to attend the clinic with bronchodilator inhaler which the patient has been taking—preferably salbutamol. An acute attack should be treated with 1–2 puffs of 100–200 μg salbutamol.

Acute severe asthma or status asthmatics needs immediate treatment (*see* page 248).

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