Dental Pharmacology

1- Antiseptics & Disinfectants

These are the agents which inhibit or kill microbes on contact.

• **Antiseptics** are used on living surfaces.

• **Disinfectants** are used for inanimate objects.

In dentistry, they are used for sterilization of certain instruments and prevention and treatment of dental plaque and peridental diseases. They are also used in root canal therapy (RCT), treatment of acute necrotizing gingivitis and other infective oral conditions. Antiseptics and disinfectants are also used as ingredient in various dentifrices.

Factors which Modify the Activity of Germicides:

1. Temperature & pH.
2. Period of contact with the micro or ganisms.
3. Nature of microbes involved.

Spectrum of activity of majority of antiseptic disinfectants is wide re flecting **non selectivity** of action. However, some are **selective** e.g. hexachlorophene, chlorhexidine, quarternary ammonium antiseptics, gentian violet, acriflavine are more active for gram +ve than gram –ve. Silver nitrate is highly active against gonococci and benzoyl peroxide against P. acnes.

4. Size of inoculum. 5. Presence of blood, pus & other organic matter.

Mechanism of Action (Cidal or Inhibiting Actiono)

i. Oxidation of bacterial protoplasm.

ii. Denaturation of bacterial proteins including enzymes.

i. Detergent like action increasing permeability of bacterial membrane.

Classification Antiseptics & Disinfectants:

1- PHENOL DERIVATIVES

Used as disinfectants

• **Phenol** (carbolic acid): Acts by denaturing bacterial proteins.

• **Methylphenol** (cresol; LYSOL): 3-10 times more active.

• **Resorcinol**: 1/3 as potent as phenol (used both as an antiseptic/ disinfectant). Used as antiseptic.

• **Hexyl-resorcinol**: More potent. Used as mouth wash, lozenges & as anti-fungal.

• **Chloroxylenol**:

– 4.8% sol. (DETTOL): Used for surgical antisepsis.

– 1.0% sol. (DETTOLIN) used as mouth washes, 0.8% cream & soap; 1.4% lubricating obstetric cream (for vaginal examination).

• **Hexachlorophene:**

– Act by inhibiting bacterial enzyme and in high concentration cause bacterial lysis.

– Incorporated in soap & other cleansing antiseptics. Also acts as deodorant.

– Highly active against gram +ve microorganisms.

Phenol is used to disinfect urine, faeces, pus, sputum of patients and sometime included in antipruritic preparation because of its mild anaesthetic action.

2- OXIDIZING AGENTS

A- Potassium permanganate ($KMnO_4$):

Water soluble purple crystals.

• Liberates oxygen which oxidizes bacterial protoplasm.

• Potassium permanganate (KMnO4) is used as Condy's lotion (1 : 4,000 to 1 : 10,000 solution).

• **As antiseptic:**

– Used for gargels, irrigating cavities, urethra & wounds.

– Higher concentration cause burns & blistering.

• **As disinfectants:**

– To disinfect water (well, ponds) & for stomach wash in alkaloidal poisoning (except atropine & cocaine which are not efficiently oxidized).

– Not suitable for surgical instruments (promotes rusting).

B- Hydrogen peroxide (H_2O_2):

– Used as antiseptic.

– Removes slough, ear wax etc.

– Used in cosmetic preparation.

– As gargels.

– Potency loses on keeping and not much used.

C- Benzoyl peroxide (PERSOL 2.5, 5.0% gel, 10% cream):

– Used in acne.

– Gradually liberates oxygen (in the presence of water) which kills bacteria, specially anaerobic.

– Mild irritant to skin.

– Can cause dryness of skin, edema etc.

3- HALOGENS

A- Used as disinfectants:

• **Chlorine**:

– Highly reactive element & potent germicide.

– 0.1-0.25 ppm kills most pathogens in 30 secs.

– Used to disinfect urban water supplies.

– More active in acidic & neutral medium.

B- Used as antiseptic:

- **Iodine:**
  - Act by iodinating and oxidizing microbial protoplasm.
  - 1:20,000 solution kills most vegetative forms within 1 min.
  - Tr. iodine (2%) in alcohol: Used on cuts, for degerming skin before surgery.
  - Mandel's paint (1.25%): Used in sore throat.
  - Non-staining iodine ointment (4%– IODEX) used as counter irritant & antiseptic.
  - More than 5% can cause burning & blistering of skin.
- **Iodophores:**
  - Are soluble complexes of iodine with large molecular organic compounds that serve as carrier release free iodine slowly.
- **Povidone (polyvinyl pyrrolidone):**
  - BETADINE (5% sol.; 5% ointment; 200 mg vag. pessaries).
  - 1% mouth wash.– 10% solution.– 10% cream.
  - 5% spray (aerosol) (RANVIDONE AEROSOL): Used in boils, burns, ulcers, non-specific vaginitis & all surgical dressings. Also for disinfec tions of endoscopes and instruments.
- **Chlorophores:**
  - Compounds that slowly release hypochlorous acid (HOCl).
  - Used in preference of gaseous chlorine due to ease of handling.
- **Chlorinated lime (bleaching powder):**
  - Used as disinfectant for drinking water, swimming pools & sanitizer for privies etc.
- **Sodium hypochlorite solution (4-6% sod. hypochlorite):**
  - Used as disinfectant in dairies for milk.
  - Used for root canal therapy in dentistry as antiseptic.
- **Chlorinated lime (1.25%) with boric acid (1.25%) (EUSOL):**
  - Used to clean infected wounds.
- **Chloramine-T and halazone:**
  - Used as sanitizer.

4- BIGUANIDES

- **Chlorhexidine:**
  - Having high antiplaque activity.
  - Used as antiseptic.
  - Nonirritating antiseptic that disrupts bacterial cell membrane.
  - More active against gram +ve bacteria.
  - Used for surgical scrub, mouth wash, neonatal bath & general skin antiseptic.

5- QUARTERNARY AMMONIUM ANTISEPTICS (CATIONIC)

– Act by altering permeability of cell membranes.

– Soaps (being anionic) neutralise their action while alcohol potentiates.

– Non-irritating & mild keratolytic.

• Cetrimide:

– 20% sol. (CETAVLON).

– Chlorhexidine gluconate (1.5%) + cetrimide (3%) [SAVLON LIQUID].

– SAVLON CREAM: Chlorhexidine (0.1%) + cetrimide (0.5%).

– SAVLON HOSPITAL CONCEN TRATE: Chlorhexidine (7.5%) + cetrimide (15%).

– Also used in soaps, shaving creams.– Used for cleansing action.

– Used as antiseptic & disinfectant for surgical, instruments, utensils, baths etc.

• Cetylpyridinium chloride (similar to cetrimide): Used in mouth wash & in lozenges.

• Benzalkonium chloride: 1 : 5000-1 : 10,000 sol. used for douches, irrigation etc.

– Used as preservative for eye/ear/ nasal drops.

• Dequalinium chloride:

– As an antiseptic used in gum paints & lozenges.

6- ACIDS

• Boric acid:

– Bacteriostatic & weak antiseptic.

– 4% sol.: Used for irrigating eyes, mouth washes, douche etc.

– **Boroglycerine paint (30%):** Used for stomatitis & glossitis.

– 10% ointment (BOROCIDE): Used for cuts & abrasion.

• Acetic acid:

– Weak antiseptic.

– Bactericidal (>5%).

– Occasionally used for burn dressing.

7- METALNJILIC SALTS

a. Mercury compounds: Act by inactivating SH enzymes and acts as bacteriostatic.

• Ammoniated mercury:

– **5-10% ointment:** Used for dermatophytosis & anal pruritus.

– **Phenyl meruric nitrate**: EPHYTOL PAINT used for tinea. MEDITHANE

– anorectal use.

– **Merbromin 1-2% solution (MERCU ROCHROME):** Used in first aid kit.

b. Silver compounds:

– Astringent action.

– React with SH, COOH, PO4 & NH2 groups of proteins.

• **Silver nitrate**:

– Rapidly kills microbes, action per sisting for long periods because of slow release of Ag^+ ions from silver proteinate formed by interaction with tissue proteins.

– Silver nitrate touch is used for hypertrophied tonsillitis and aphthous ulcers.

– Highly active against gonococci (10% sol.).

• **Silver sulphadiazine (SILVEREX 1%):**

– Highly active against Pseudomonas.

– Used in burns.

C- **Zinc salts:** Astringent & mild antiseptic.

• **Zinc sulphate:**

– 0.1-1.0% solution used for eye wash and eye/ear drop (ZINCOSULFA eye drops).

– Lotion containing zinc sulfate & saturated potash (THIOSOL 2.5% 24%): Used in acne.

– Zinc oxide and calamine: Used as dermal protectives & adsorbants.

8- DYES

• **Rosaniline dye:**

– **Gentian violet (0.5-1% alcoholic solution):** Effective against staphy lococci, gram +ve bacteria & fungi.

– **Brilliant green:** Rosaniline dye, similar to gentian violet.

– **Acriflavine & proflavine**: Orange yellow acridine dye. ACRINOL 0.1% cream. Effective against gram +ve bacteria & gonococci. Activity enhanced in alkaline medium. Used in chronic ulcers & wounds.

– Combination of gentian violet (0.25%) + brilliant green (0.25%) + acriflavine (0.1%) (TRIPLE DYE): Used for burns & for dressing umbilical stump in neonates.

9- FURAN DERIVATIVES

• **Nitrofurazone** (FURACIN 0.2% cream, ointment, powder):

– Bactericidal to both gram +ve & ve, aerobic & anaerobic bacteria.

– Highly effective in burns & for skin grafting.

– Act by inhibiting enzymes neces sary for carbohydrate metabolism in bacteria.

10- ALCOHOLS (ETHANOL)

– Act by precipitating bacterial proteins.

– Effective antiseptic & cleansing agent at 40-90% concentration (above 70% antiseptic & up to 90%).

– Used for hypodermic inj. & on minor cuts.

– In open wounds it produces burning sensation.

– Poor disinfectant for instruments (does not kill spores & promotes rusting).

• **Isopropanol**: Used as substitute of ethanol.

11- ALDEHYDES (FORMALDEHYDE)

– It denatures proteins, general protoplasmic poison (but acts slowly).

– Broad spectrum germicide.

– Use as antiseptic is restricted because of its irritating nature & pungent odor.

– 4% solution is used for hardening & preserving dead tissues.

– 37% sol. is called FORMALIN.

– Occasionally used to disinfect instruments & excreta.

• **Glutaraldehyde:**

– Less volatile, less pungent, less irritating. 2% solution is used to disinfect surgical instruments & endoscopes.

12- SOAPS

– Anionic detergent.

– Weak antiseptic, mainly used for cleansing action.

– Affect only gram +ve bacteria.

– Medicated by other antiseptic & herbal origin compounds (DETTOL, SAVLON, NEEM, MEDIMEX etc).

2- Astringent and Obtundents

A- Astringents

Astringents act by precipitating proteins in superficial layers of cells and are used to diminish the excretion or exudation of superficial cells. They are also used as local haemostatics and mummifying agents (discussed elsewhere). The different types of astringents used in dentistry are:

1- **TANNIC ACID**: It is vegetable astringent obtained from nutgalls. It acts by precipitating protein and gelatin as tannates owing to its acid radical. While hardening the superficial cells it forms pellicle on them. Tannic acid glycerine (30% tannic acid) and mouth washes/gumpaints containing 1-5% of tannic acid are used to strengthen gums and check bleeding. Its preparations are used as astringent mouth wash, astringent dentrifices, local haemostatics, mummify ing agent and obtundent.

2- **ZINC CHLORIDE**: It is a caustic astringent, used as 5-10% solution in ulcerative gingivitis, pyorrhoeal pockets and apthous ulcers.

3- **ZINC SULPHATE**: It is used as astringent in 0.5-1% concentration in the form of mouthwash and lotion in mastoiditis, stomatitis and chronic alveolar abscess.

4- COPPER SULPHATE: It is used as astringent mouth in 0.5 2% concentration in indolent ulcer of gums.

5- ALUM It has an astringent, antiseptic and haemostatic properties and used in 1-2% concentration to harden the gum or for inflamed and ulcerated gums.

B- Obtundents

Obtundents are the agents which are used to either diminish or eliminate the dentine sensitivity to make the excavation painless. But due to the availability of local anaesthetics e.g. xylocaine for painless excavation, the use of obtundents is very limited.

Obtundents may be classified into three main categories according to their mechanism of action.

I Act by destroying the nervous tissue:

– Absolute alcohol

II Act by paralysing the sensory nerve endings:

– Phenol creosote

– Benzyl alcohol

– Camphor

– Thymol

– Menthol

– Eugenol (clove oil)

III Act by precipitating proteins:

– Silver nitrate

– Zinc chloride

ETHYL ALCOHOL

Ethyl alcohol (70%) is painless and nontoxic to the pulp and penetrates rapidly. It does not cause staining of the dentive. It is to be applied locally, allow the alcohol to evaporate and carry out the excavation.

PHENOL

On local application, it causes irritation followed by numbness. It is used alone and in combination with chloroform and olive oil in a 2:4:10 ratio. It acts rapidly but does not penetrate deeply and due to its protoplasmic poisonous nature it produces its obtundent action.

CREOSOTE

Its characteristics and action is same as that of phenol, in addition its penetrability is relatively more.

BENZYL ALCOHOL

Due to its local anaesthetic property it is used as obtundent agent. It can be used either alone or in combination of chloroform and ethyl alcohol in a 5:3:2 ratio.

CAMPHOR, THYMOL, MENTHOL

All three are volatile oils and are used in a mixture in a ratio of 1:2:1 for rapid action. The mixture acts initially stimulating and then paralysing the sensory nerve endings.

EUGENOL (CLOVE OIL)

Clove oil is used due to the presence of eugenol as its main constituent. It acts by paralysing the sensory never endings. It is non-irritating but stains the dentine yellow.

SILVER NITRATE

It is an astringent and caues pain on application followed by desensitization. It acts by precipitating dentine proteins and liberating acid and stains the dentine black.

ZINC CHLORIDE

Its action is similar to that of silver nitrate but it causes sharp pain and does not stain the dentine.

3- Mummifying and Bleaching Agents

Mummifying Agents

In dentistry, when astringents and antiseptics are used to harden and dry tissues of the pulp and root canal so that the tissues are resistant to infection, they are termed as mummifying agents. It is used in certain dental procedures when it is not possible to completely remove the pulp and contents of root canal. For this, generally a combination of various mummifying agents are used in the form of paste or semi-liquid preparation like tannic acid glycerine.

The following are mummifying agents used in dentistry:

TANNIC ACID:

It is an astringent which is yellowish white to light brown amorphous powder obtained from nutgalls (excrescences produced on the young twigs to Quercus infectoria which gradually darkens on exposure to air and light. It is used along with glycerine and it hardens the tissues and precipitates proteins and thereby avoids bacterial action.

PARAFORM (PARAFORMALDEHYDE):

It is a prodrug used in combination of zinc oxide or zinc sulphate glycerine and creosote and act by slow liberation of fomaldehyde. It is also used alone as obtundents. Its main disadvantage is that formaldehyde may penetrate the pulp and can cause inflammation. Liquid formaldehyde is also used in the form of paste with zinc oxide, glycerine along with local anaesthetic and it hardens the tissue without causing the shrinkage.

IODOFORM

It acts by slow liberation of iodine and has both antiseptic and local anodyne properties. It is used in the form of paste which contains tannic acid, phenol, eugenol (clove oil), cinnamon oil and glycerine.

TOOTHACHE DROPS

These are the preparations used for tem porary relief of toothache by application of a small pledget of cotton soaked with the product into the tooth cavity. Certain local anaesthetic compounds. e.g. benzocaine, eugenol or clove oil, camphor, menthol, creosote and alcohol has been considered safe and effective for toothache but re stricted its use only for first aid type or tem porary relief.

Bleaching Agents

Bleaching agents are used to remove pigmentation of teeth. They are classified as:

1- Oxidizing agents e.g. perhydrol, pyrozone, sodium peroxide.

2- Reducing agents e.g sodium thio sulphate.

3- Chlorinated lime.

4- Ultraviolet rays.

OXIDIZING AGENTS

Hyrdrogen peroxide in various percentages e.g. perhydrol (30% H2 O2 in water) and sodium peroxide (50% aqueous solution) are used as oxidizing agents to remove pigmentation of teeth.

REDUCING AGENTS

Saturated solution of sodium thio sulphate is used to remove superficial stains with silver, iodine or permanganate.

CHLORINATED LIME

It is a chlorine compound, which acts by evolution of chlorine to remove the pigmentation of teeth. It is also used clinically by packing into the cavity as a dry powder.

ULTRAVIOLET RAYS

To bleach the dentine from a carbon or mercury, arc lamp UV rays have been used. Other agents are also available, which are used to remove pigmentation of teeth e.g. weak ammonia solution is used to remove iodine stains, hypochlorite or iodine solution are used to remove silver stains, hypochlorites are used to remove iron stains of teeth and for dye stains, chlorinated lime and acetic acid are used.

4- Styptics (Local Haemostatics) and Disclosing Agents

Styptics (Local Haemostatics)

After tooth extraction and many dental procedures, bleeding occurs due to disruption of arterioles and minute blood vessels which cannot be surgically repaired or sutured. Styptics or local haemostatics are the agents used to arrest bleeding, or to control oozing of blood form minute blood vessel, by the formation of an artificial clot, or by providing a matrix which facilitates bleeding. After extraction of tooth, bleeding from the tooth socket is generally controlled by a cotton guaze pressure pack which may be aided by use of local haemostatics. They can be categorized as:

I- **Gelatin sponge**: It is used for packing wounds after moistening with normal saline or thrombin solution which is completely absorbed in 2 to 4 weeks and generally cause no foreign body reaction. Gelatin sponge is also available with 5% colloid silver(GELATAMP). It facilitates optimum wound treatment when applied to a surgical cavity and can be cut to the required size to fit smaller wound cavities or tooth socket after tooth extraction. The evenly porous foam structure absorbs its own weight in blood several time over, promotes thrombocyte aggregation due to large surface and fills the wound cavity. It remains in the wound and is completely absorbed within four weeks. The addition of colloid silver has an antimicrobial effect whilst being nontoxic and these type of preparations can be easily gamma sterilized.

II- **Fibrin foam**: Fibrin foam or sheets are prepared from human plasma and these dried sheets are used to cover or pack the bleeding surfaces where it gets absorbed in the body. It is applied directly to the bleeding area and it is also combined with thrombin.

III- **Human or bovine thrombin**: Dry powder or freshly prepared solution of human or bovine thrombin can be applied on the oozing surfaces and it is employed in haemophilia, skin grafting and in neurosurgery. Thrombin solution with fibrinogen is also used locally to induce clotting.

IV- **Oxidized cellulose**: It is a surgical gauze, specially treated to promote clotting by reaction between haemoglobin and cellulosic acid. Since it is not well absorbed it is used only for surface haemostatics.

V- **Russel's Viper venom**: It has a strong thromboplastin activity and used in haemophilia cases by applying locally.

VI- **Vasoconstrictors**: Adnenaline (1% solution) is used in the form of cotton gauze pack in the bleeding socket. It stops bleeding by causing local vaso constriction and useful in epistaxis.

VII- **Astringents**: Tannic acid (20% in glycerine) is used for bleeding gums and bleeding piles.

Certain systemic haemostatics e.g. **tranexamic acid**, **ethamsylate** etc. are also used in the prevention and treatment of capillary bleeding in epistaxis, haematuria and after tooth extraction.

Disclosing Agents

A dye used in dentistry as a diagnostic acid, applied to the teeth to reveal the presence of dental plague.

5- Dentifrices and Mouth Washes

Dentifrices

These are the agents or mechanical aids which are available as tooth powder, paste, or gel and used with tooth brush to cleanse and polish natural teeth. They are prepared in the form of bulk powder and containing soap or detergent and mild abrasive agent which should have maximum cleansing efficiency with minimum tooth abrasion.

Properties of an Ideal Dentifrice:

1. An ideal dentifrice should assist the toothbrush to mechanically remove debris, soft deposits and stains from the teeth.
2. It should be non-decalcifying and non overabrasive to the teeth.
3. It should impart a polished surface to the teeth.
4. It swallowed, it should be nonpoisonous to the body as a whole and also to the mucous membrane.
5. Should have pleasant taste and odour and having sufficient cleansing property.
6. Should help to reduce caries, maintain healthy gingiva, improve aesthetics and reduce mouth odours.

For getting all these properties in one single oral preparation, the following ingredients/agents are used together:

A- Abrasive agents: These are fine dental preparations used to help the scouring action to toothbrush mechanically. And, abrasion is defined as the wearing a way of a substance or structure through a mechanical process, such as grinding, rubbing or scrapping. The abrasives is made into a paste and supplied in a tube.

Abrasives used in dentistry can be classified into three categories:

I- Finishing abrasives: They are hard, coarse abrasives which are used initially to develop contour and remove gross irregularities e.g. coarse stones.

II- Polishing abrasives: They have fine particle size and less hard than abrasive used for finishing. They are used for smoothening the surfaces that have been roughened by coarse stones e.g. pumice, polishing cakes etc.

III- Cleansing abrasives: They are soft materials with small particle size and are used to remove soft deposits that adhere to enamel or restorative material.

Commonly used abrasives are:

1- **Pumice**: It is a highly siliceous material of volcanic origin and is used either as an abrasive or polishing agent depending upon particle size. It consists of aluminium, potassium and sodium chiefly. It is available as pumice with glycerine and its use ranges from smoothening dentures to polishing teeth in the mouth.

2- Emery: It consists of a natural oxide of aluminium called corundum. The different impurities e.g. iron oxide present in it also act as an abrasive.

3- **Aluminium oxide**: It can be replaced by emery for abrasive purpose. Pure alumina which is manufactured from bauxite (an impure aluminium oxide) is also used as a polishing agent.

4- **Chalk/precipitated calcium carbon ate**: Chalk is a calcium carbonate pre pared by precipitation method. Vari ous grades of precipitated calcium carbonate is available depending upon its fineness, weight and colour. It is mild abrasive and used to give fi nal polish to silver amalgam fillings.

5- **The other abrasive agents** used are tin oxide, chromic oxide, sand, carbides (silicon carbide and boron carbide), zirconium silicate, zinc oxide, garnet, rouge (fine red powder of iron oxide), kieselgurh, tripoli, magnesium oxide, hydrated silica etc.

B- Humectants: These are the agents which are used to keep paste from drying out e.g. glycerine, sorbitol, propylene glycol etc.

C- Detergents and foaming agents These are cleansing agents and de creases surface tension of dentrifrice. Most common detergent used in dentistry is sodium lauryl sulfate. They cause loosening of debris which adhere to teeth and also dissolving fatty substances and mucous plaques. They also act as an lubricant when scrubbed over the teeth.

D- Binders Carboxy methyl cellulose is the most commonly used binder in the dental preparation.

E- Sweetening agents Artificial sweeteners such as sorbitol saccharin is used as synthetic sweetening agent which is more palatable having no food value and can be used by diabetic patients.

F- Antiseptics/therapeutic agents Certain antiseptic and therapeutic agents (such as sodium fluoride, stannous fluoride, strontium chloride, urea, dibasic ammonium phosphate, are used in dentrifrices for their anticarcinogenic, bacteriostatic and bactericidal actions.

G- Coloring and flavoring agents Certain coloring agents (methylene blue (0.001%), magenta (0.05%) and flavoring agents (peppermint, clove etc.) are also used to make the preparation more attractive, palatable and acceptable.

H- **Preservatives** To preserve the quality and stability, certain preservative e.g. methyl paraben etc. are also used in dental preparations.

Mouth Washes

Mouthwashes are aqueous concentrated solutions containing one or more active ingredients and excipients. They are used by swishing the liquid in the oral cavity. Approximately 15–30 ml. of mouthwash are used for single mouthful of rinse for about a minute. Mouthwashes can be used for therapeutic and cosmetic purpose. Therapeutic mouthwashes are used to reduce plaque, dental caries, gingivitis and stomatitis while cosmetic mouthwashes are used to reduce bad breath and it contains used antimicrobial and/or flavoring agent. Mouthwashes other than used for cosmetic purpose, should only be used under the direction of physician/dentist since it contains certain medicines.

Mouthwashes contain the following ingredients and excipients:

Alcohols:

It is used in the range of 10 20%. Alcohol enhances the flavor, aids in masking the unpleasant taste of certain ingredients and also serve as solubilizing agent and preservative.

Humectants:

Humectants such as glycerine and sorbitol (5-20% of the mouthwashes) increase the viscosity of the preparation and enhance the sweetness of the final product. It also enhances the preservative property of the product along with alcohol.

Surfactants:

Non-anionic surfactant e.g. polyoxyethylene derivative of sorbitol, fatty acid esters may be used over anionic surfactant e.g. sodium lauryl sulfate. They aid in the solubilization of flavours and in the removal of debris by its foaming action. Certain other agents e.g. cetylpyridinium chloride (cationic surfactant) is used for its antimicrobial property.

Flavouring agents:

Flavouring agents e.g. peppermint, spearmint, menthol, cinnamon, oil of wintergreen (methyl salicylate) are used in conjunction with alcohol and humectants to overcome disagreeable taste.

Colouring agents:

Certain colouring agents (e.g. methylene blue, magenta etc.) are used in mouthwashes for pleasing colour.

Medicated mouthwashes:

Mouth washes are also being used as a dosage form in certain specific conditions in oral cavity e.g.:

i- Mouthwashes containing a combination of antihistaminics, corticosteroids, antimicrobial agent (nystatin, tetracycline etc.) have been prepared from

commercially available syrups, suspensions, solutions, powders for the treatment of stomatitis.

ii- Mouthwashers containing allopurinol for the treatment of stomatitis. (iii) Pilocarpine for dry mouth.

iv- Amphotericin B for oral candidiasis. (v) Tranexamic acid for prevention of bleeding after oral surgery.

vi- Chlorhexidine gluconate for control of plaque.

vii- Hexetidine for its antibacterial and antifungal property.

6- Caries and Fluorides

Dental Caries

It is a degenerative condition which is characterized by decay of the hard and soft tissues of the teeth. Infection and decaying food are the main causative factors of dental caries. Carbohydrates mainly act as decaying food and acids are formed in the oral cavity due to fermentation of carbohydrates. The acid thus formed then react with the insoluble calcium salts of the teeth and convert them into soluble salts. Proteolytic enzyme (produced by the bacteria present in the mouth) digest the organic enamel matrix and also enhances the action of acids and digest the organic matter of dentine, and organic acids of the oral cavity destroy the inorganic matter. In a later stage, pulp also affected with the advancing decay and infection may progress in the body. For dental caries, the preventive phase is probably the most important which include regular brushing, flossing and periodic dental checkup. Regular brushing has been shown to be very effective at controlling caries as well as gum problems. Caries involves the actual demineralization and destruction of tooth structure.

Treatment

Dental caries can be treated by using the following chemical agents.

A- Ammonium ions: To reduce the in cidence of dental caries, ammonium ions are applied locally in the oral cavity. Cer tain dentifrices which contain ammonia or ammonium compounds e.g. dibasic am monium phosphate and urea carbamide which liberates ammonia in the mouth are used. They decrease the number of acid producing pathogen, decrease the acidity of the oral cavity and dissolve the dental plaques.

B- Urea:

It is used to treat dental caries and is one of the oldest chemical used. In some dentifrices, urease is present. Urea is broken down to ammonia by urease.

Fluorides

Fluoride therapy and fluoridation of drinking water has played a significant role in deccreasing the dental caries. The incidence of dental caries can be significantly

decreased by adding fluorides into the drinking water supply. Fluorides prevent decalcification of the structure of tooth by inhibiting bacterial enzymes which produce lactic acid. Fluorides also increase the tooth resistance to acid decalcification. Fluorides can be used prophylactically as well as therapeutically. Prophylactically, fluoride (in the form of sodium fluoride) can be used in drinking water and one part of fluoride to one million part of drinking water is sufficient for reducing the incidence of dental caries by 50%. Therapeutically, 2% sodium fluoride solution is applied locally to the teeth after cleaning. The local application of fluoride leads to the absorption of fluorine on the enamel surface as calcium fluoride. But, sodium fluoride must be used with caution as it may cause nausea, vomiting and abdominal pain and on chronic ingestion it may lead to chronic fluoride poisoning and also affects enamel and dentine of developing teeth.

Antimicrobial agents

Certain antimicrobial agents e.g. **penicillin**, **bacitracin**, **aeuromycin** etc. are being used to reduce the bacterial count which may be beneficial in reducing the incidence of dental caries. Certain other agents such as **hexachlorophene**, **silver nitrate**, **chlorophyll** are also used to clean debris and decaying material and incidence of dental caries.

7- Anticaries and drugs used in prevention of dental plaque

Introduction

Anticaries agents and drugs used to prevent dental plaque primarily focus on inhibiting bacterial growth, promoting remineralization of tooth enamel, and disrupting the formation of dental plaque. These agents include **fluoride**, antimicrobial agents like **chlorhexidine** and **triclosan**, and **calcium phosphate** compounds.

1- Anticaries Agents:

A- Fluoride:

Fluoride is a key component in preventing tooth decay. It strengthens tooth enamel by making it more resistant to acid attacks from bacteria and promotes remineralization of early lesions. Fluoride can be delivered through various methods, including toothpaste, mouthwashes, and professional topical applications.

B- Silver Diamine Fluoride (SDF)

SDF is a topical solution used to arrest existing caries lesions and manage tooth hypersensitivity.

SDF is used to control early childhood caries, arrest root caries, prevent fissure caries and secondary caries, desensitise hypersensitive teeth, remineralise hypomineralised teeth, prevent dental erosion, detect carious tissue during excavation and manage infected root canals. Fluoride promotes remineralisation and inhibits the

demineralisation of teeth. SDF also inactivates proteolytic peptidases and inhibits dentine collagen degradation. It arrests caries without affecting dental pulp or causing dental fluorosis. Indirect pulp capping with SDF causes no or mild inflammatory pulpal response. However, direct application of SDF to dental pulp causes pulp necrosis. Furthermore, SDF stains carious lesions black. SDF therapy is simple, painless, non-invasive, inexpensive, and requires a simple armamentarium and minimal support. Both clinicians and patients generally accept it well. In 2021, the World Health Organization included SDF as an essential medicine that is effective and safe for patients.

C- Calcium Phosphate Compounds

These compounds, like tricalcium phosphate and hydroxyapatite, are incorporated into oral care products to enhance the remineralization of tooth enamel and increase its resistance to acid.

2- Anti-plaque Agents:

- **Chlorhexidine**: A widely used antiseptic and antimicrobial agent that effectively prevents plaque formation, gingivitis, and other oral infections.
- **Triclosan**: A chlorinated diphenyl ether that is a potent antibacterial agent used in various oral hygiene products.
- **Delmopinol**: An anti-plaque agent that disrupts biofilm formation.
- **Amine Fluoride/Stannous Fluoride**: These compounds have anti-plaque and anti-caries properties

3- Other Approaches:

Propolis: A natural substance with antimicrobial and anti-inflammatory properties, often used in toothpastes and mouthwashes to prevent plaque and treat gingivitis .

Probiotics: Certain probiotic strains produce bacteriocins and other antimicrobial compounds that can inhibit the growth of harmful bacteria in the oral cavity.

8- Essential emergency drugs in dental clinic

1- Epinephrine

Epinephrine is the most important drug in different pharmaceutical forms that is used in dentistry for local anesthetics; however, in the emergency kit and box, it should be in a pharmaceutical form other than the usual dental capsule. This medicine, which is stored as 1 in 1000 in syringes ready for injection, is a sympathetic stimulant drug that plays a vital role in saving the patient's life in anaphylactic shock, which is the most dangerous

emergency in a dental office. This medicine is also used in dangerous asthma attacks. It can be used by injection, intramuscularly, and subcutaneously. In cardiac resuscitation, epinephrine is injected intravenously or directly into the heart.

2- Hydrocortisone

A corticosteroid such as **hydrocortisone** may be prescribed for the prevention of recurrent anaphylaxis. Hydrocortisone would also help in the management of an adrenal crisis. However, their relatively slow onset of action (even one hour when administered IV) is considered as their limitation. The prototype for this group is hydrocortisone, which may be administered in a dose of 100 mg as part of the management of these emergencies. Patients with primary adrenal insufficiency should be advised to bring their emergency hydrocortisone injection kit to all dental appointments. The recommended dose, which should be presented in the patient's letter, depends on the patient's age; Adults: 100 mg, Children six years of age or older: 50–100 mg, Children one to five years of age: 50 mg; Infants up to one year of age: 25mg

3- Dexamethasone

Dexamethasone is used as an antiemetic and for the treatment of severe allergies, pruritus, asthma, bronchospasm, and postoperative edema. With a slow onset of action, its classical dose is 4 to 12 mg IV. Care should be taken for patients with pre-existing infections, peptic ulcers, or hyperglycemia.

4- Atropine

Atropine is an anticholinergic medicine that can be available in the emergency medicine kit as an injection. In cases of bradycardia and cardiac arrest caused by intense vagal stimulation, asystole, pulseless electrical activity with a heart rate less than 60 is very effective, and in higher doses, it can be used as an antidote for organophosphorus poisoning.

5- Benzodiazepines (Diazepam)

Benzodiazepines are administered to manage prolonged or recurrent seizures (status epilepticus). IV diazepam 5- 10mg is fast in impeding all types of seizures. An alternative treatment for seizures is **midazolam** or **lorazepam** IM/IV. Patients should be monitored vigilantly after administration to check for any respiratory depression and sedation. Recently, buccal midazolam is also suggested to treat seizures.

6- Lidocaine 1 and 2%

Lately, lidocaine has come back into focus for the treatment of acute sustained ventricular tachyarrhythmias.

7- Naloxone

Naloxone is a specific opioid antidote that reverses the opioid-induced respiratory depression. This medicine should be used for the emergency management of opioid

(morphine) overdose. As a narcotic antagonist; it is employed to relieve respiratory depression caused by opium-like medicines to treat opioid poisoning. After administration of naloxone, patients should be monitored in the office for 1 hour to rule out re-sedation. A typical dose is 0.1-mg increments.

8- Bronchodilators (salbutamol Spray, aminophylline)

Salbutamol is a short-acting selective beta-2 adrenergic receptor agonist. This is the preference for bronchospasm with acute asthmatic episodes. It is suggested 1-2 puffs of spray for adults every 4-6 hours. **Aminophylline**, whose injectable form is 250mg ampoule in 10 ml, is a suitable medicine to be present as another bronchodilator in the emergency kit. In acute bronchospasm (following an allergic reaction) and asthma attacks, it can be life-saving.

9- Nitroglycerin sublingual tablets and spray

Nitroglycerin is the drug of choice to treat acute angina or myocardial infarction. It has a fast onset of action. It is presented as oral and transmucosal preparations (spray), transcutaneous patches, and IV solutions. Sublingual tablets or sprays are appropriate forms for dental settings.

10- Aspirin (ASA)

Aspirin reduces overall mortality from acute myocardial infarction by preventing further clot formation. It used to reduce the risk of heart attack. It is usually on the medication list of patients with a history of myocardial infarction or heart attack and unstable angina. Aspirin is a platelet aggregation inhibitor and can prevent further damage by diluting the blood clot. It should be noted that aspirin should not be used after dental surgery. On the other hand, dentists should pay attention to patients who have a history of daily aspirin use. If they decide to perform dental services with bleeding surgeries and tooth extraction, they must stop taking aspirin 3-5 days before performing the service, after consulting with the related specialist.

11- Metoclopramide

Metoclopramide is used to avert nausea and vomiting after procedural sedation. The recommended dose is 10 mg. It can cause movement disorders. It should not be administered in patients with Parkinson's disease. It can also prompt neuroleptic malignant syndrome, which shows up as high fever, confusion, rigid muscles, and autonomic imbalance. To manage this situation, impeding the agent, rapid cooling, dantrolene, and benzodiazepines is suggested.

12- Injectable antihistamines (diphenhydramine, chlorpheniramine)

Diphenhydramine is the best choice for a dental emergency kit, which can also be used in milder allergic reactions (compared to anaphylactic shock). After epinephrine, it is

considered an important medicine in anaphylaxis shock. In a dose of 50 mg, it is used IV or IM. The paediatric dose of diphenhydramine dose is 1-1.25 mg/kg every 6 hours.

The most common use of **chlorpheniramine** is in the disease known as rhinitis, which is chronic inflammation of the nose or inflammation of the mucous membranes of the nose. It is also used in common colds, allergies, urticaria, and angioedema. Recommended doses for adults are 10 to 20 or 25mg of chlorpheniramine.

13- Glucose and oral carbohydrates

There are many problems when your patient has lost consciousness and cannot drink sugar water. In this case, dextrose or glucagon serum (1mg) is injected into the patient. Oral carbohydrates such as fruit juice or non-diet soft drinks are used to control early hypoglycemia in conscious patients. Oral carbohydrates can quickly restore blood sugar levels. A missed meal might likely be the cause of hypoglycemia in insulin-dependent diabetic patients. A vial of 50% hypertonic glucose (dextrose 50%) is used to increase glucose levels in hypoglycemia (caused by cold, lack of energy caused by dehydration, anorexia, and ketosis, prolonged hunger). If patients are unable to swallow, IV access should be employed.

In adults, 1 ml/kg of body weight of 50% dextrose solution is recommended. If there is no response to the treatment, it should be repeated after 12 hours. In children, the recommended dosage is 5ml/kg of body weight of 20% dextrose solution.

14- Oxygen

Oxygen is used for the treatment of hypoxemia, which is frequent in several medical emergencies. A supplemental oxygen delivery system (oxygen capsule) and its complete accessories are needed and indicated for all dental emergencies. Oxygen can be used in almost all dental emergencies and it does not pose any danger to the patient. It is very beneficial for dentists to help patients in case of shortness of breath during work. A portable full-sized cylinder should be available for the patient's oxygenation until the arrival of emergency services. Oxygen is delivered with a clear full-face mask with a flow rate of 10 l/min for the impulsively breathing adult patient and 3-5 l/min for breathing children. Bag-valve-mask device is necessary for providing oxygen for the unconscious and apnoeic patient at a flow rate of 10-15 l/min, and in case of positive pressure device usage, the flow rate should not go beyond 35 l/min for adults. The oral surgery office must also be equipped with a bag valve mask with a full face mask to permit positive pressure ventilation.

15- Other Necessary Medications

Verapamil, which is used in the treatment of tachycardia, anti-angina, and anti-hypertension, **morphine**, which is used to control the pain of myocardial infarction and acute pulmonary edema, **dopamine** (in severe hypotension), **amiodarone** (the most

effective anti-arrhythmic medicine, **dobutamine** (increasing cardiac output), **heparin** (after MI, thrombosis and embolism), **magnesium sulfate** (pregnancy hypertension and acceleration of bowel movements), **propranolol** (antiarrhythmic and antianginal), **furosemide and hydralazine** (diuretic and hypertensive), **phenytoin** (anticonvulsant and antiarrhythmic), **nitroprusside** (blood pressure control in anesthesia) are other emergency medicines, which, of course, require the presence of a nurse or an experienced doctor in the field of emergency for usage.

Reference:

Singh, Surender. ***Pharmacology for dentistry***. New Age International, 2007.