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Chemical Methods of Sterlization in Dentistry

[1] Akshay Manoj, [2] Dr. Joyson Moses, MDS, [3] Dr. R. Sharanya, MDS

[1]junior Resident, Thai Moogambigai Dental College and Hospital

[2] Professor and Head of The Department, Department of Preventive and Pediatric Dentistry, Thai Moogambigai Dental College and Hospital

[3] Reader, Department of Preventive and Pediatric Dentistry, Thai Moogambigai Dental College and Hospital

ABSTRACT

Disinfection and sterilization are important for preventing transmission of infectious pathogens to patients and as well as the practitioners. Disinfection is a process that kills many or all pathogenic organisms, except bacterial spores. It's usually done with liquid chemicals. Sterilization is a process that kills all kinds of microbial lives. Chemical vapor sterilization occurs when a liquid chemical, usually formaldehyde, is heated to produce a vapor that kills all microorganisms on the dental instruments. This type sterilization is used on heat-sensitive dental instruments. Solutions such as glutaraldehyde or Sodium hypochlorite may be used for this purpose. However, this procedure requires a lot of time to acquire complete sterilization, and therefore it is not recommended. These chemicals can, however, be used for high-level disinfection purposes.

Keywords: Sterilization; Disinfection; Dental Instruments; Patients; Chemicals; Pediatric Dentistry

INTRODUCTION

Micro-organisms are widespread as they cause contamination and infection, it becomes a must to remove or eliminate them from materials or from areas. The purpose of sterilization in dentistry is to prevent contamination by the organisms, in surgery to maintain asepsis, in food and drug manufacture to make sure safety from the contaminating organisms in many other situations[1]. Dental instruments used will be contaminated with the blood, body fluids during the clinical procedures, which will be cleaned and sterilized by different methods of sterilization. This reduces the chances of infection between doctors-patients, patient-dentist, dentist-patient and between patient to patient[2]. Hence, sterilization plays a significant role in the field of dentistry. Dental clinics and hospitals are places where patients should feel safe while they receive essential healthcare. Although heat-resistant plastic instruments are quickly moving to be the fore runners of the oral healthcare industry, there are still some situations where alternative reprocessing methods are required. Cleaning patient care equipment and ensuring it is safe for patients is an important part of dentist's responsibilities[3]. In some instances, cold chemical sterilization is necessary to ensure heat-sensitive tools are properly prepared and safe for reuse on patients. Dentists, other dental auxiliaries and patients can further transmit the diseases to their respective families and friends. Infection can be transmitted by Inoculation of microbes from blood and saliva transmitted through needles and sharps, Touching or exposing non-intact skin to infective oral lesions, infected tissue surfaces or infected fluids, splash and spatter of infected fluids, Inhalation of Aerosols or droplets containing pathogens**,** Touching contaminated inanimate surfaces in the dental clinics and hospitals[4]. The types of sterilization are classified into physical methods and chemical methods. The physical methods of sterilization include – incineration, moist heat, dry heat, filtration and ionizing radiation. The chemical methods include – alcohols, aldehydes, halogens and phenols[5].

Chemical method of sterilization

Chemical sterilization involves the use of chemical agents to kill unwanted microorganisms such as fungi, bacteria and viruses, and other disease-causing agents. Chemical sterilization is an important process in many industries such as food, agriculture, and health care. For example, chemical sterilization is typically used to clean medical equipment in hospitals to decrease the likelihood of harm to patients by microbes. Patients who have undergone surgery can develop life-threatening infections and other complications from these microbes[6]. The use of chemical sterilization is appropriate in instances where the material to be sterilized is intolerable or inconducive to heat, high pressure, irradiation, or filtration, which are other sterilization techniques. The advantages of chemical sterilization are they can be relatively inexpensive, often fast-acting and are efficient at killing target microorganisms also most times does not require expensive and complex equipment. Chemical sterilization techniques can involve liquid or gaseous sterilant. The Food and Drug Administration (FDA) is the agency in charge of regulating chemicals used in sterilization processes. Although the use of a liquid or gas is dependent on application parameters such as the type of material, the FDA considers gaseous techniques to provide more assurance or sterility. As such, they recommend the use of liquid sterilization methods when materials are heat sensitive or inappropriate for gas sterilization techniques. An example of chemical sterilization is that of dental equipment. This typically consists of four steps:

- **Protection**: refers to using personal protective equipment (PPE) such as gloves, gowns, protective eyewear, and masks throughout the sterilization process. PPE helps to prevent harm from the splashing or vapor of chemicals.
- **Preparation**: involves scrubbing all disassembled surfaces with soap and water.
- **Processing**: involves exposing materials to the chemical sterilant. This step will kill the cells of microorganisms. Materials are submerged into liquid chemical sterilant for the prescribed amount of time and then rinsed to remove chemicals. For gas sterilization, gases are applied in a closed chamber.
- **Packaging**: done before exposure to chemicals for gas sterilization allowing materials to remain sterile after application. Materials are packaged after application for liquid sterilization and require adherence to proper sterile techniques to maintain sterility[6].

Ideal properties of an antiseptic and disinfectant

They should have a wide spectrum of activity and be effective against all microorganisms and act in presence of organic matters. They should have high penetration power and quick action and also be stable and effective in acidic as well as in alkaline conditions. They should not corrode metals and be compatible with other disinfectants. Disinfectants should not cause any local irritation and not be toxic if it goes into circulation. Finally, be safe and easy to use, be easily available and cheap.

The agents

Alcohols

Frequently used are Ethyl alcohol, Isopropyl alcohol. These must be used at concentration 60-90%. Isopropyl alcohol used in disinfection of clinical thermometer. Methyl alcohol is effective against fungal spores, treating cabinets and incubators. Methyl alcohol is also toxic and inflammable. They are used as skin antiseptics. Oral pathologists use ethyl alcohol for the preparation of cytologic smears. They are used in Disinfection of dental instruments.

Aldehydes

Formaldehyde

Having Bactericidal, sporicidal and formaldehyde has lethal effect on viruses. It is Used to preserve anatomical specimens, destroying anthrax spores on hair and wool. It is used for the fumigation of operation theatres.

Glutaraldehyde

It is effective against tubercle bacilli, fungi, viruses also less toxic and irritant to eyes, skin. It is used to disinfect anaesthetic rubber, face masks, plastic endotracheal tubes, metal instruments and polythene tubing[5].

Fumigation Procedure

- Thoroughly clean windows, doors, floor, and all washable equipments with soap and water.
- Close windows and ventilators tightly.
- Switch off all lights, A/C and other electrical & electronical items
- Calculate the room size and calculate the required amount of formaldehyde
- Formaldehyde is irritant to eye & nose; and it has been recognized as a potential carcinogen. So, the fumigating employee must use the personal protective equipment[4]

Ortho- Phthalaldehyde

It is a high-level disinfectant, more stable at storage also a slow sporicidal. Used for disinfection against glutaraldehyde resistant bacteria.

Phenols

These are obtained from distillation of coal tar between 170- 270 C. Lethal effects are: Capacity to cause cell membrane damage, releasing cell contents and causing lysis. Phenols exhibit bactericidal action. The derivatives of phenol include – cresol, chlorhexidine, chloroxylenol and hexachlorophene. They are used as antiseptics.

Halogens

Chlorination can impact the bacteria directly. The blend of iodine compounds and chlorine compounds can act as an antiseptic. Chlorine compounds are hydrochloride, chlorine bleach and iodine compounds are tincture, iodine, and iodophors.

Chlorine

It is used in water supplies, swimming pools, food and dairy industries. The derivatives of chlorine are Bleaching powder, sodium hypochlorite and chloramine, along with hypochlorides are bactericidal. They also act on viruses.

Iodine

It is used as skin disinfectant. It is available in alcoholic and aqueous solutions. Having Active bactericidal activity &moderate action on spores.

Betadine (Povidone Iodine)

It is most commonly used in dentistry as antiseptics. It is used by the oral surgeons for disinfecting the skin prior to any surgical procedures.

Gases:

The types of gases used for sterilization include Ethylene oxide, Formaldehyde gas and Beta propiolactone (BPL).

Ethylene oxide:

Action is due to its alkylating the amino, carboxyl, hydroxyl and sulphydryl groups in protein molecules. Items that can be disinfected include heart-lung machines, respirators, sutures, dental equipment, books, clothing.

Formaldehyde gas:

This is widely employed for fumigation of Operation Theatre and other rooms. Formaldehyde is produced by adding 150g of KMnO4 to 280ml of formalin for every 1000cu.ft of room volume, after closing the windows and other outlets. After fumigation, the doors should be sealed and left unopened for 48 hours.

Beta propiolactone:

Product of ketone and formaldehyde with a boiling point of 163 C. Having rapid bactericidal activity but carcinogenic. It is capable of killing all microorganisms and is very active against viruses.

Conclusion

Sterilization is a process of killing all micro-organisms in a material or object. Disinfection is the process of reducing the number of pathogenic micro-organisms. Sterilization and disinfection are achieved by using heat, filtration or chemicals. The chemical that provides useful sterilizing and disinfecting agents include alcohols, chlorine and iodine, phenols, aldehydes and ethylene oxide. An understanding of sterilization is essential for all dental personnel. It aids the dentists to understand the need for careful compliance with recommended infection control protocols. The ultimate objective is to protect the patients, professionals and paraprofessionals.

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