Shalini Muralidaran et al /J. Pharm. Sci. & Res. Vol. 8(8), 2016, 832-834

ISSN:0975-1459
Journal of Pharmaceutical Sciences and Research
www.jpsr.pharmainfo.in

Evaluation of Efficacy of 2% Glutaraldehyde for Disinfection of Hand Pieces Used in Dentistry

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Abstract
Aim: To evaluate the efficacy of 2% glutaraldehyde in disinfection of high speed hand piece used in dental clinics.
Background: Within the practice of dentistry,attention must be given to infection control procedures to reduce the chances of cross-contamination which may lead to several infectious diseases. Case reports confirmed the possibility of HIV and hepatitis B infection and control strategies have been recommended in health care settings. Asporin is an aqueous solution of 2% glutaraldehyde. The choice of a specific disinfectant depends on toxicity to the patient or staff, potential damage to the instrument, cost, stability, the degree of microbial killing required and ability to kill micro-organisms rapidly. The time interval available to decontaminate hand instrument between patients is very limited. Consequently, cleaning followed by dis- infection is generally practised, whereas cleaning followed by sterilization might be preferred. The disinfection of hand instruments is the most important of all the requirements as it is necessary to kill micro-organisms rapidly as this allows speedy patient turnaround.

INTRODUCTION

The oral cavity harbours a large number of microorganisms including bacteria, fungi, parasites and viruses. This poses a risk of transmission of infections through aerosols and splatters that are normally generated during dental treatment. The aerosol generated spreads in the surroundings that reaches more than 3 feet of distance from the patient. The hand pieces used in dental treatment can act as a source of infections to the patients as well as the dentist. The transmission of infection is always bidirectional. The microorganisms can be transferred from the patient's mouth to the dentist or from the dentist's hand to the patient. There can also be transmission from patient to patient. The biofilm formed in dental unit waterlines (DUWLs) could be spread by aerosols created by dental hand-pieces, presenting a risk for both the patient and members of the dental team (1). The dental chair consists of water reservoir bottles to supply water to the DUWLs. These bottles are manuallyfilled with water and is easily contaminated with the bacteria present in the skin such as Staphylococcus epidermidis and S. aureus. The dental unit waterlines must be cleaned periodically.

Clean, dry dental hand pieces harbour few bacteria, but contamination of the hand piece lumen with salivary bacteria occurs during its use. Wiping the outside of the hand piece with disinfectant does not eliminate the potential cross-infection risk. Water samples from dental units is heavily infested with bacteria, some are of oral origin, which colonise the water piping of the units. This contamination is reduced using sterilisation and disinfection methods depending on the type of use.(2)

There is a distinction between the terms sterilisation and disinfection. Sterilisation refers to destruction of all microbial forms including viruses. Disinfection refers to the destruction of pathogenic microorganisms only and is often term applied to procedures which are incapable of destroying spores.

Today's concern for the spread of type B hepatitis in dental offices and the carrier state of this disease has led to a number of methods of disinfection from clinical dentistry.2% glutaraldehyde solution was accepted in 1973 by the council of dental therapeutics(3) of the American dental association. Glutaraldehyde is a toxic chemical that is used as a cold sterilant to disinfect and clean heat-sensitive medical, surgical and dental equipment. It provides high level disinfection in 10 minutes. The time required for proper sterilization is 10 – 12 hours and for disinfection is 10 minutes.The disadvantage of this disinfectant may include lesser efficacy in the presence of organic matter and greasy residue after sterilization. The adverse effects of this drug include breathlessness, rhinitis, eye irritation and dermatitis.Glutaraldehyde is also used as a tissue fixative in histology and pathology labs and as a hardening agent in the development of x-rays.

Oral fluids become aerosolised during dental treatment and oral microbes have been used as the markers of their spread that may carry blood-borne pathogens.(4) Aerosol is defined as small droplet usually 5µm or less in diameter, which can remain suspended in air for some time.(5) Bacterial aerosols are an important consideration for infection control and occupational health in the dental clinic, since infective agents can be transmitted via aerosols to patients or dental staff (6,7)

Since the dental hand piece consists of lumen and fissures, they retain the infective material from the patients and this makes it inconvenient to clean and disinfect. The spores existing inside the lumen may survive autoclaving unless it is treated in its interior surface with chemical disinfectants (8).Since these micro organisms are anchored to these equipments, it may not readily detach on flushing but may shed pathogens on high speed operations. The lumen poses to be a potential site of internal contamination which may lead to its high risk of cross contamination unless it is sterlized in between patients.To avoid bacterial contamination in the dental unit Waterlines, protective valves can be installed to prevent the backflip of water from the handpiece into the Waterlines. Studies suggest that there is a high risk of transmission of HIV from the dental personnel to the patient than from patient to patient (9).

Studies reveal thatbacterial biofilms were found on the inner wall of the plastic tubing supplying water to

constituents of dental units using scanning electron microscopy (10). These biofilms could be found in any tubing that supplies water to the dental units. The source of this biofilm comes from environmental aquatic bacteria which can cause disease in vulnerable patients.

The most commonly found micro-organisms in the hand piece include Legionella, Lactobacillus spp , Acinetobacterspp, Micrococcus spp , Staphylococcus spp , Pseudomonas aeruginosa , Klebsiella pneumonia , Streptococcus spp , Burkholderiacepacia (11).

Mechanism of action of glutaraldehyde

Target microorganism	**Action of glutaraldehyde**
Bacterial spores	At low concentration they inhibit the germination, at high concentration they have a sporicidal action
Mycobacterium	Involves mycobacterial cell wall
Non sporulating bacteria	Associated with the outer layers of gram positive and gram negative bacteria by inhibiting transport processes into the cell
Fungi	Attacks the cell wall by interacting with chitin
Viruses	Involves protein DNA cross linking and changes in capsid
Protozoa	Unknown mechanism of action

Table.1

Methods to reduce cross contamination include dilution ventilation, filtration, pressurisation, rubber dam isolation, high volume suction apparatus, sterilisation and disinfection, face mask with at least 93% filtration efficiency, flushing out the water from the hand piece of the scalar for 2 minutes before the procedure, protective eye wear and regular disinfection of dental unit waterlines.

MATERIALS AND METHODS

This study was to determine the efficacy of 2% glutaraldehyde in disinfecting the high speed hand pieces. According to the ADA specification high speed and low speed dental hand piecesused intra- orally must be sterilized. The water sample was collected from the high speed hand piece by flushing it in a sterile uricol container for 6seconds, approximately 3ml, to avoid dilution. The first sample was collected after using the high speed hand piece in a patient. Then the hand pieces were disinfected with 2% glutaraldehyde .This was done by taking 2% Glutaraldehyde in a sterile container and fitting it in a dental unit waterline. Then the second sample was collected by flushing out contents from the hand piece after a 2 minute purge.

The collected water samples were labelled as 'before disinfection' and 'after disinfection' respectively. Then 10 micro litre of these samples were inoculated into brain heart infusion agar (Hi-media Code- CM1135) using sterile micro tips and spread uniformly using looping technique. This was then incubated for 24 hours at 37 degree Celsius. After incubation the bacterial colonies were counted. The number of bacterial colonies formed in the 'before disinfection' samples were compared with the colonies formed in 'after disinfection' samples.

RESULTS

No. of Samples	***CFU /ml Before disinfection***	***CFU/ml After disinfection***
1.	**4000**	**200**
2.	**3200**	**300**
3.	**300**	**100**
4.	**200**	**0**
5.	**500**	**100**
6.	**1100**	**300**
7.	**5800**	**1100**
8.	**400**	**100**
9.	**5500**	**0**
10.	**500**	**0**
11.	**3200**	**0**
12.	**6500**	**500**
13.	**5400**	**100**
14.	**5400**	**0**
15.	**400**	**100**
16.	**7600**	**100**
17.	**1400**	**200**
18.	**9600**	**200**
19.	**1400**	**700**
20.	**5600**	**300**
21.	**2700**	**300**
22.	**1200**	**100**
23.	**1300**	**100**
24.	**6200**	**500**
25	**11300**	**900**

Table.2

DISCUSSION

The hand pieces used in dentistry is constantly exposed to the oral cavity of the patients**.** It is contaminated by saliva and blood of the patient. The hand pieces harbours bacteria from the patients mouth as well as by the DUWL. This may cause infections in the patients and may also transmit the infections from one patient to another patient. According to the ADA protocol the hand pieces are to be sterlized for the clinical use. Sterlisation can be done by physical methods or chemical methods, 2% glutaraldehyde can be used as a high level disinfectant for sterlisation of hand pieces during the day. Proper flushing and treating with 2% glutaraldehyde will definitely reduce the risk of transmission.

The study revealed that 2% glutaraldehyde had 93.06% efficacy in destroying the microorganisms present in the high speed hand pieces. Since not all hand pieces can be sterilized, routine disinfection of hand pieces in between patients must be carried out. This includes flushing the hand piece after use for 30 seconds and then thoroughly scrubbing the hand piece under running water with a mild detergent. This must then be wiped with a material

impregnated with a chemical germicide recorded under the EPA as a hospital disinfectant. The disinfectant must remain in contact with the hand piece by the time designated by the manufacturer (12). The dental unit water lines should be installed along with check valves to decrease the scope of transfer of contaminants (13). Few studies suggest that bacterial contamination can occur overnight which can be reduced by flushing out the water from the hand piece for 5 minutes at the beginning of the clinic day (14). It can also be prevented by flushing the hand piece for 2 minutes after completing the days clinic work. The disinfection of dental unit water lines provides the best approach forimproving the quality of water (15). The commonly found bacteria in dental unit water lines include Legionella spp., Pseudomonas aeruginosa and atypical mycobacterium spp and yeast, amoeba, Protozoa and fungi may also be present but in lower content. Agents like hydrogen peroxide, sodium hypochlorite, chlorine dioxide, per acetic acid and citric acid are the most commonly used agents for treating theseWaterlines.

CONCLUSION

2% Glutaraldehyde is an effective bacterial disinfectant which acts against gram positive, gram negative and viruses including HBV, HIV, fungi and spores.It's mechanism of action is by denaturating cell wall proteins by acting with cellular constituents. There is an increased risk of cross contamination if the high speed hand piece is not disinfected between patients and poses a risk for immuno-compromised patients. To prevent disease transmissionin the dental clinic,control measures must be adopted to provide the patients with a safe experience during their visits. This includes non- chemical approaches such as flushing the hand piece, use of distilled water and use of antimicrobial filters in DUWL's. Many chemical agents biocides and cleaning agents should be used periodically or intermittently to treat the formation of biofilm.

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