Effectiveness of Disinfection of Anesthetics Tubes in Oral Surgery—An in Vitro Study

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Abstract: Context: Anesthetic tubes are always on the surgical table, for this reason, it's necessary to perform its disinfection, generally by chemicals. Aim: Was to analyze the effectiveness of tubes decontamination made by disinfectant substances used in a clinical setting and to identify the microorganisms found on their surface. Materials and Methods: 14 anesthetic tubes were collected from dental clinic, on 5 groups. 01 plastic and 01 glass tubes that were not submitted to any disinfection process composed the control group and they had been sown in Agar Blood. Experimental groups underwent immersion and fixation with the proposed chemicals for 1 minute, laminar flow hood was used to seed it in Agar Blood and then it was transferred to incubator for 24 hours at 37°C. Tests were used to identify the main Gram positive pathogenic genera. Gram-negative pathogenic colonies isolated were seeded in biochemical means of identification. Results: It was possible to identify the presence of *Staphylococcus coagulase negative*, *Staphylococcus aureus*, *Streptococcus viridans*, *Staphylococcus saprophyticus*, *Escherichia coli* and *Acinetobacter* spp, as well as the effectiveness of chemical solutions proposed in this study. Conclusions: All chemical solutions proposed in this study were effective for the surface disinfection process of anesthetic tubes.

Key words: Anesthetics, antimicrobial effect, disinfection, oral surgery, microbiology.

1. Introduction

One of the biggest problems faced by the specialists of oral surgery clinics and dental clinics is about secondary infection, among other things, due to inadequate practice in the steps to be followed to maintain an aseptic chain during procedures performed [1]. The tubes containing anesthetic solution is a consumables that have been always presented on the surgery table, being necessary to be decontaminated on its surface. This procedure is routinely performed by chemicals such as: Chlorhexidine 2%, Povidone 10% and Ethyl alcohol 70% [2, 3].

It is essential that dental professionals follow criteria to ensure patient safety in the prevention of

possible contamination. Most of the current validated protocols are easy to understand, also they have a low cost and require a minimum time for execution. However, lots of them are not properly followed because the lack of awareness of some professionals [4-6].

In addition, it has been followed by standards for infection control, in view of reducing significantly the risk of contamination in the dental clinics, contributing in transmission controlling and reducing patient exposure to pathogenic microorganisms [4, 6-8].

It is essential to keep the vigilance regarding fundamental pipelines ensuring blocking the transmission of pathogenic microorganisms, preventing cross-contamination. The inappropriate behavior of some careless professionals, to the

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referred biosecurity protocols can enlarge the risk of secondary infection [9].

Biosecurity should be seen as a summation of knowledge, habits and behaviors, which must be incorporated by society, so that professionals may develop it with more security incorporating into the communication and perception of risk in social sectors [10].

Throughout the health care field, the transmission of infectious microorganisms led to the increasing concern about the effective use of disinfectants and antiseptics. This approach is particularly observed in dentistry office, in many instruments and environmental surfaces become contaminated with saliva and blood during routine procedures [11].

There are multiple microorganisms with high contamination potential in the dental office, among which are highlighted: *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus mutans*, *Streptococcus mitis*, *Staphylococcus haemolyticus*, *Brevundimonas* spp., *Streptococcus salivarius*, *Corynebacterium diphtheriae*, *Bacteroides fragilis*, *Staphylococcus warneri* and *Peptoestreptococcus*. Besides these, the existence of *Escherichia coli* and *Enterococcus faecium* in dental offices is an indicator of fecal contamination [12-15].

Because of the importance of the issue, the main purpose of this study was to analyze the effectiveness of surface decontamination of anesthetic tubes submitted to disinfectant substances routinely used to decontaminate objects in dental clinics, as well as to phenotypically identify the most frequently microorganisms found in surfaces, by microbiological testing *in vitro*.

2. Methods and Material

This study, made in laboratory, in an observational and descriptive way, was conducted in dental clinics of the ASCES College, located in the city of Caruaru-PE, Brazil. It collected 14 tubes containing anesthetic solution, 07 plastic tubes and 07 glass tubes,

subsequently packaged in sterile assay tubes, kept tightly closed and transported immediately to the microbiology laboratory. The assay tubes transported from a dental office, were divided into 4 groups: plastic tubes for friction disinfection, glass tubes for friction disinfection, plastic tubes for immersion disinfection and glass tubes for immersion disinfection, and the tests were conducted in triplicate. The control group was consisted by 01 plastic tube and 01 glass tube which have not been subjected to disinfection methods (Fig. 1).

All anesthetic cartridges were inoculated by rolling technique in Agar Sheep Blood. Except for the control group, other anesthetic tubes were submitted to immersion and friction methods with the chemicals proposals: Chlorhexidine 2%, Povidone 10% and Ethyl alcohol 70%, during a period of 1 minute, all procedures were performed in a laminar flow hood. The inoculated plates were transferred to a bacteriological incubator from 18 to 24 hours, average temperature of 35-37 °C, after they were analyzed about the presence or absence of phenotypic laboratory, to identify the gender and, when possible, the species. For this, Gram staining technique was used, seeding in selective culture media and differential, as well as in complementary biochemical tests, that allow the microorganism metabolism viewing interest pathogenic microbial growth. Positive samples, for the presence of the microorganism *Staphylococcus* spp. were used into the catalase test, the DNase culture and also examined the sensitivity or resistance to novobiocin. In the search for Gram-positive bacteria of the genus *Streptococcus* spp., it was observed the type of hemolysis, from which complementary testing was used to identify species of dental interest. For Gram-negative bacteria isolated, colonies were seeded in the following biochemical identification means: TSI (Triple Sugar Iron), SIM (Sulfito, Indol e Motilidade), Simmons of Citrate and Urea of Christensen. The oxidase test was used for analysis of

Fig. 1 Scheme representing the distribution of anesthetic tubes for microbiological procedures.

Table1 Microorganisms isolated in anesthetic tubes in control group.

Microbial Classification	Genus and/or bacterial species found
Gram Positive Bacteria	<i>Staphylococcus</i> coagulase Negativa, <i>Staphylococcus aureus</i> , <i>Streptococcus viridans</i> , <i>Staphylococcus saprophyticus</i> .
Gram Negative Bacteria	<i>Escherichia coli</i> , <i>Acinetobacter</i> spp.

bacilli Gram-negative non-fermenting glucose levels.

3. Results

Before the submission of anesthetic tubes to disinfection procedures by immersion and friction methods, the surface of anesthetic tubes were isolated, 06 kinds of microorganisms, which are identified according to their morphology, Gram positive species of the genus *Staphylococcus* spp. and *Streptococcus* spp., as well as Gram negative fermenters and non-fermenters Glucose (Table 1).

After immersion and fixation made by the disinfectant solutions proposed in this study during 1 minute and then incubated in the same culture media recommended, it was found that both techniques (immersion and friction) associated with the

Chlorhexidine 2%, Povidone 10% and Ethyl alcohol 70%, proved effectiveness, disinfecting the surface of anesthetic tubes, either plastic or glass surface.

4. Discussion

The diagnostic of microorganisms in periodontal diseases has been greatly highlighted, considering that these pathologies has presented, in most cases, with the presence of microorganisms. The main source of aggression to periodontal structures is the complexity of normal microorganisms living in the oral cavity, particularly the gingival sulcus [13]. Beyond the oral microorganisms, which live there, external microorganisms might interfere, causing infection in lots of dental procedures, whether invasive or not. This can be aggravated by the lack of appropriate care

in handling materials used in various processes as well as the use of anesthetic tubes.

Agreeing with the study of Stephens et al. [12], who mentioned possible microorganisms contamination indicators in dental office as the species *Staphylococcus aureus*, *Staphylococcus coagulase negative*, *Streptococcus mutans*, *Streptococcus mitis*, *Streptococcus salivarius*, *Corynebacterium diphtheriae*, *Bacteroides fragilis*, *Peptostreptococcus* and also the presence of *Escherichia coli*, in the dental environment as an indicator of fecal contamination, this research has revealed the presence of *Staphylococcus aureus*, *Staphylococcus* negative coagulase and *Escherichia coli* in anesthetic tubes, found previously in disinfection process.

The present study has compared the techniques routinely used for disinfection of surface anesthetic tubes ranging in fixation and immersion techniques. To Malamed [16] the friction technique is more suitable to carry out disinfection, and the immersion technique may be diffusion of solution into the anesthetic tubes by semipermeable diaphragm.

These results show that all disinfectant solutions proposed (Chlorhexidine 2%, Povidone 10% and Ethyl alcohol 70%) were effective within one minute of disinfection on anesthetic tubes. The analysis of Jarral et al. [17] both solutions promote immediate reduction in the number of bacteria, however, Chlorhexidine has more effective reduction. Tanner et al. [18] compared with Chlorhexidine and Polyvinylpyrrolidone in surgical interventions, with regard handwashing, showing that microbiological results after the use of chlorhexidine, were more effective than with Polyvinylpyrrolidone about reducing the number of Colony Forming Units (UFCs) both immediately, washing during 2 hours, after wash at the end of the surgery. Gonçalves et al. [19] in their systematic review, concluded that there is safe use of alcoholic preparation for surgical antisepsis of hands, however, he emphasized that the effectiveness of alcohol depends on its concentration and contact time.

The fact of this study has highlighted the presence of Gram Positive *Staphylococcus coagulase negative*, *Staphylococcus aureus*, *Streptococcus viridans* and *Staphylococcus saprophyticus* in anesthetic tubes before the disinfection process, and fortified the importance of this disinfection process, prior to dental procedures using anesthetic tubes.

Barreto et al. [5] reported about assessing the degree and extent of contamination generated in the environment of a dental clinic, during procedure with ultrasound device. After exposure petri dishes containing agar BHI (Brain Heart Infusion) supplemented with sheep blood (5%), arranged in five specific locations close to the patient, there was a significant difference in the degree of contamination between different areas analyzed and the genus *Staphylococcus* spp. predominated in the samples, making up more than half of the total species found. In the case of Gram Negative found in this study, *Escherichia coli* and *Acinetobacter* spp., was related the same about the failure of various procedures in dentistry. Pereira et al. [20], has analyzed the antimicrobial capacity of 8 dental cements used for cementation on bacterial cultures of *Streptococcus mutans*, *Streptococcus pyogenes*, *Staphylococcus aureus*, *Enterococcus faecalis* and *Escherichia coli*. It was shown that only the *E. coli* is resistant before all evaluated cementing agents, demonstrating their viability even after the disinfection procedures performed, may, this ineffectiveness, be linked to the fact that the chemical composition of the cell wall of Gram negative bacteria differs from Gram positive bacteria.

Acinetobacter spp., also mentioned in this study, has been a major challenge for dentistry, when it refers to patients with serious systemic conditions hospitalized in Intensive Care Units (ICUs). Barbosa et al. [21] isolated *Acinetobacter baumannii*, *Escherichia coli* and other gram-negative organisms in blood cultures and tracheal secretion of 73 patients in the ICU. It is noteworthy that Gram-negative bacteria

are not the most common in the microflora of the mouth, however, it occurs when changing the oral environment due to biofilm accumulation and development of periodontal disease. The species *Staphylococcus aureus*, *Escherichia coli* and *Acinetobacter baumannii*, in this study, in addition to *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Pseudomonas aeruginosa*, *Streptococcus hemolyticus* and *Enterobacter* spp., mentioned by Barbosa et al. [21], Gomes, Esteves [22] and Xie et al. [23] belong to oral microbiota of patients ICU.

It is possible that during the execution of some dental procedures in the ICU decubitus, there is a need to use local anesthetics [16, 24]. In this study, it was found that the presence of microorganisms of the species *Staphylococcus aureus*, *Escherichia coli* and *Acinetobacter* spp., which have a high level of contamination of these patients ICU [21], highlights the need for disinfecting the surface of anesthetic tubes before using.

It is expected that this study may contribute to future research allowance that addresses protocols for disinfection of surface critical materials directed to oral surgery, as well as, in specialties that trigger a high risk of cross-contamination, seeking to provide greater patient safety and create opportunities of better working conditions to the dental professional.

5. Conclusions

Microbiological aspects have become increasingly important in current dentistry, especially when related to invasive procedures.

In general, there is a need for disinfection to prevent recurrent infections caused by possible pathogens identified on the surface of anesthetic tubes used in dentistry.

All chemical solutions proposed in this study (Chlorhexidine 2%, Povidone 10% and Ethyl alcohol 70%) were effective for the surface disinfection process of anesthetic cartridges, both the friction method and immersion.

Conflicts of Interest

There are no conflicts of interest to declare.

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