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RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

Evaluation of four practical procedures of disinfection of surgical instruments

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Abstract

In present study efficacy of four simple procedures for preparing the surgical instruments (SI) was evaluated. Four procedures were used separately for preparing agent of surgical instruments (SI). A: liquid soap and rinsing with tap water for 5 minutes; B: 70% ethanol (immersion time of SI in ethanol was 5 minutes); C: 2% Nanosil (with 5 minutes immersion time); and D: 2% Nanosil (with 10 minutes immersion time). Samples from twelve surfaces of the SIs in each treatment groups were collected using a sterile wet swab. Then solution was made using 1/10 ml sample dilution and 1 ml of each dilution was cultured on blood agar and EMB plates and the colonies were counted after 24 hours. The mean values (±SE) of bacterial population from the surface of SI_s were obtained as CFU and were recorded for groups A, B, C and D as $1.13\times10^5\pm4.77\times10^4$, 491.5±105.74, 460±101.15 and 144.5±66.16 respectively. Reduction of bacterial load between group A and other was significant ($P\leq 0.05$). The results showed that treatment D was more effective than the others in reducing the bacterial load of the instruments. There were no significant differences between groups B and C ($P>0.05$). So introducing an effective and convenient procedure for SI preparation is important and can be used especially in large animal practice. Nanosil is a disinfectant that contains hydrogen peroxide and silver. Its 2% concentration is effective for preparation of surgical instruments. Immersion of SI_s in this concentration of nanosil is recommended for preparation of surgical instruments in field at least for 10 minutes.

Keywords: Surgical instruments; asepsis method; nanosil

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Introduction

Contaminated instruments are a major source of microorganisms that could transmit infection into the surgical site. So the main goal of surgical instruments sterilization is prevention of infection in every surgery (Sharbaugh, 1997). Autoclaving and ethylene oxide fuming are the popular methods used in surgical instrument pack sterilization (Reichert, 1997; Ulhalaykaka and Chala-aim, 2002). An alternative to high-pressure steam or dry-heat sterilization is chemical sterilization (often called cold sterilization). In fact, antiseptic and disinfectants are chemical agents used to reduce the microbial load of a surface, either living or inanimate objects or instruments, with bactericidal and bacteriostatic effect (McDonnell, 2007). Disinfectants are divided into high, intermediate and low-level according to their efficacy. Phenolics, alcohol and chlorine are considered as intermediate level and glutaraldehyde, hydrogen peroxide and formaldehyde as high-level disinfectants (Cremieux and Fleurette, 2001). Efficacy of some chemical disinfectants had been evaluated for sterility of dental instruments (Best et al., 1990; Russell, 2002; Azimi Hoseini et al., 2006; Ayaki et al., 2007).

Alcohol has been employed as an available and relatively effective disinfectant for many situations (McDonnell and Russell, 1999; Kovacs et al., 1999; Tvedt and Bukholm, 2005; Jeong et al., 2010). In large animal practice of veterinary medicine, especially in field's surgeries, alcohols as a simple and fast effective disinfectant are used frequently for preparation of surgical instruments and surgical sites.

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Nanosil is a unique formulation of highly concentrated hydrogen peroxide (H_2O_2) and processed silver ions. H_2O_2 is a strong oxidizer which is powerful and fast reacting on wide range of pathogens and micro-organism, whose disinfection mechanism is based on release of free oxygen radicals which eliminates proteins that are source of growth of various pathogens and micro-organisms through oxidizing, as hydrogen peroxide rapidly decomposes to water (H_2O) and oxygen, the stabilizing agent of processed silver ions are added to H_20_2 through special manufacturing process to delay the rapid decomposition of H_2O_2 and enhance the disinfection ability to a considerably longer time period.

In veterinary medicine, use of a simple, effective and applicable method for decontaminating of surgical instruments is very important in field surgeries when there are no enough facilities for sterilizing the surgical instruments. Therefore, final consequence will help in prevention, reduce the cases of surgical site infection, decreases cost of treatment and the death of animals due to surgical infection. In present study efficacy of 2% nanosil and 70% ethanol in different times for disinfection of surgical instruments were evaluated.

Materials and Methods

The study was carried out at Razi University, Veterinary Teaching Hospital and Shafa Laboratory of Pathobiology. Subsequent of mechanical cleansing of surgical instruments with a piece of gauze and rinsing them with water, four procedures were used separately for preparing agent of surgical instruments (SI). A: soapy water and rinsing with tap water for 5 minutes; B: 70% ethanol (immersion time of SI in ethanol was 5 minutes); C: 2% Nanosil (with 5 minutes immersion time), D: 2% Nanosil (with 10 minutes immersion time).

Samples from twelve surfaces of the surgical instruments in each treatment groups were collected using a sterile wet swab. Then solution made using 1/10 ml sample dilution and 1 ml of each dilution was cultured on blood agar and EMB plates and the colonies were counted after 24 hours at 37ºC for optimum bacterial growth (Carter and Cole, 1991). Bacterial colonies were counted, and colony forming unit (CFU) of each plate was calculated based on the dilution factor used. Plates having between 30-300 colonies were considered for counting while those with fewer than 30 and above 300 were not considered for statistical reasons. For statistical analysis, Kruskal-Wallis and Mann-whitney tests were used.

Results

The mean values of bacterial population from the surface of SI were obtained as Colony Forming Unit/ml and were recorded for groups A, B, C and D respectively ($1.13\times10^5\pm4.77\times10^4$), (491.5±105.74), (460±101.15) and (144.5±66.16) (Table 1). Reduction of bacterial load between in group A and other was significant ($P\leq 0.05$). The results showed that treatment D was more effective than the others in reducing the bacterial load of the instruments. There were no significant differences between groups B and C ($P>0.05$). Therefore, 10 minutes immersion of SIs into 2% Nanosil has shown to be effective in reducing bacteria loads of surgical instruments than immersion of them into 2% Nanosil and 70% ethanol for 5 minutes.

Discussion

The purpose of any type of pre surgical preparation is to facilitate fast healing and recovery by preventing desired post operative complications due to infection, to shortened the duration and cost of post surgical care. Inadequate sterilization of instruments is one of the risk factors of surgical infections (Florman and Nichols, 2007).

Cleaning is the removal of foreign material (e.g., soil, and organic material) from objects and is normally accomplished by using water with detergents or enzymatic products. Cleaning of surgical instrument is done manually in use areas without mechanical units (e.g., ultrasonic cleaners or washer-disinfectors) or for fragile or difficult-to-clean instruments. With manual cleaning, the two essential components are friction and fluidics. Friction (e.g., rubbing/scrubbing the soiled area with a brush) is an old and dependable method. Fluidics (i.e., fluids under pressure) is used to remove soil and debris from internal channels after brushing and when the design does not allow passage of a brush through a channel (Reichert, 1997). Sibinovic (1975) has given short reports on the sonosynergism of chemical disinfectants and ultrasonic waves. Although, Jatzwauk and others (2001) showed the synergistic effect ultrasound with disinfectants to improve instrument disinfection. In fact, ultrasound alone does not significantly inactivate bacteria; sonication can act synergistically to increase the efficacy of a disinfectant. The present study confirmed failure of alone utilizing efficacy of a detergent (soapy water) to disinfection of instruments. In fact, the main advantage of a detergent is removing of gross contamination of instruments. So, use of a disinfectant as an effective agent for preparation of surgical instruments is necessary.

A much wider range of antimicrobial chemicals (also referred to biocides) are used for various microbicidal and/or preservative applications, including types of alcohols, aldehydes, halogens, antimicrobial metals, and phenolics (McDonnella, 2009). The present results showed heavy microbial load of surgical instruments after soapy water preparation which was

Table 1: Bacterial load on surgical instruments (CFU/ml) groups A, B, C and D

Group	A	B	C	D
mean values of bacterial load (CFU/ml)	$(1.13\times10^{5}\pm4.77\times10^{4})^{a}$	$(491.5\pm105.74)^{b1}$	$(460\pm101.15)^{b1}$	$(144.5\pm66.16)^{b2}$

[ab12] The different letters show significant differences among the all groups (Kruskal-Wallis test) and the larger number shows effectiveness power of procedure (Mann-whitney test, $P\leq 0.05$)

enough to cause surgical site infection (Dougherty and Simmons, 1992). The most feasible explanation for the antimicrobial action of alcohol is denaturation of proteins. Protein denaturation also is consistent with observations that alcohol destroys the dehydrogenases of *Escherichia coli* and that ethyl alcohol increase the lag phase of Enterobacter aerogenes (Dagley et al., 1950) and that the lag phase effect could be reversed by adding certain amino acids. The bacteriostatic action of alcohol was believed caused by inhibition of the production of metabolites essential for rapid cell division. According to study of Salzman and others (1993), 70 and 97% ethanol reduced microbial numbers effectively from the hubs of vascular catheters. Isopropyl alcohol and ethyl alcohol have been excluded as high-level disinfectants because of their inability to inactivate bacterial spores and because of the inability of isopropyl alcohol to inactivate hydrophilic viruses (Klein and DeForest, 1963; Simmons, 1983). Ethyl alcohol, at concentrations of 60%–80%, is a potent virucidal agent inactivating all of the lipophilic viruses (e.g., herpes, vaccinia, and influenza virus) and many hydrophilic viruses (e.g., adenovirus, enterovirus, rhinovirus, and rotaviruses but not hepatitis A virus or poliovirus (Mbithi et al., 1990; Tyler et al., 1990). Ethanol can retain its bactericidal activity in the presence of organic matter. Despite of fast bactericidal effect of ethanol, Langenberg and others (1990) have described that immersion in 70% ethanol for 3 minutes are ineffective for eliminating *H. pylori* from endoscopes. The present study confirmed bactericidal activity of ethanol.

Nanosil is a unique formulation of highly concentrated H_2O_2 and processed silver ions. Published reports ascribe good germicidal activity to H_2O_2 and attest to its bactericidal, virucidal, sporicidal and fungicidal properties (Turner, 1983; Sattar, 1998). H_2O_2 works by producing destructive hydroxyl free radicals that can attack membrane lipids, DNA, and other essential cell components. Catalase, produced by aerobic organisms and facultative anaerobes that possess cytochrome systems, can protect cells from metabolically produced hydrogen peroxide by degrading hydrogen peroxide to water and oxygen (Block, 2001). In fact, H_2O_2 is active against a wide range of microorganisms, including bacteria, yeasts, fungi, viruses, and spores (Rutala et al., 1993; Block, 2001). Commercially available 3% hydrogen peroxide is a stable and effective disinfectant when used on inanimate surfaces. It has been used in concentrations from 3 to 6% for disinfecting soft contact lenses (Turner, 1983; Silvany et al., 1990; Moore, 1990). As with other chemical sterling agents, dilution of the H_2O_2 must be monitored by regularly testing the minimum effective concentration (Rutala and Weber, 1999). The silver ions are added to hydrogen peroxide through special manufacturing process to delay the rapid decomposition of H_2O_2 and enhance the disinfection ability to a considerably longer time period. Nabizadeh and others (2008) recommended the application of Nanosil with the concentration of >3% (30000 mg/L) for contact time of 30 min or more for practical disinfection in swimming pools environment. A comparative evaluation of six disinfectant formulations for residual antimicrobial activity demonstrated that only the silver disinfectant demonstrated significant residual activity against *S. aureus* and *P. aeruginosa* (Brady et al., 2003). Our study demonstrated simple and effective activity of nanosil as a disinfectant for preparation of surgical instruments.

So immersion of surgical instruments in 2% nanosil is recommended for preparation of surgical instruments in field at least for 10 minutes.

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