The Study Effects of the Hand washing on Hands Bacterial Flora in Operating Room

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Abstract

Introduction: Hand washing and disinfection procedures before surgery is associated with reduced of the bacterial flora. But the decline is unclear. The aim of this study was to determine the effect of disinfectant solutions used in the operating room on the bacterial flora of the population.

Methods: In a cross-sectional study in two stages, and each time the effect of disinfectant solutions on the physicians and staff hands washing were randomly performed. Experimental design was with four phases, in the first and second stage, before hands washing and fingers tip touch and transfer washing solutions onto the culture media were as sampling method. Step 3 and 4 was repeated as before. Inoculated media were incubated for 24 hours. The results have grouped and analyzed using descriptive statistics were carried out.

Results: The findings of this study consisted of aerobic bacteria. The anaerobic bacteria do not include. The results indicate that isolated bacterial populations were highly diverse and more than 25 species of aerobic bacteria were detected. The results indicate that the hand flora in wet condition was more than 10 times. The most common organisms isolated were Staphylococcal SPP. An amazing finding was that the isolate Escherichia coli and Acinetobacter SPP. 4 out of the 25 bacterial isolate had hemolytic and coagulase production. Based on our results, none of the disinfectants solutions used did not able completely remove the natural hands bacterial flora.

Conclusion: Hand washing for removal of hands bacterial flora is not sufficient for 3 minutes. Drying hands could be decline bacterial flora associated with the 90% to 95% in all cases, but did not 100%. Therefore, it seems that other procedure may be necessary for complete control of the hands bacterial flora population.

Keywords: Bacterial Flora, Disinfectants, Hand Washing, Operating Room

Introduction

It is obvious that washes and disinfect of hands before surgery was associated with reduced risk of surgical infections and is the single most important intervention for prevention of nosocomial infections in patients and health care workers (1,2). However, In an experimental study the Polish Society of Hospital Infection control has made a short study of hand washing practices and they showed that as in other countries, Polish healthcare workers fail to understand the importance of hands washing (3). thus, It is recommended that compliance with hand hygiene in hospitals and operating rooms often needs improvement all around the world (4). In this regards, many protocols for surgical hand washing (scrubbing) were evaluated and for their efficiency of removal of micro-organisms and their drying effect on the skin were studied (5). The findings of the studies support the proposition that a scrub protocol using alcohol-based antiseptics is as effective as and no more damaging to skin than more time-consuming, conventional methods using detergent-based antiseptics. The results of another investigation indicated that, alcohol hand rinse was equivalently effective in reducing microbial hand counts as the traditional pre-surgical scrub, both immediately after hand disinfection and at the end of the surgical procedure (6). In order to provide a uniform international guidelines, in 2002, the Centers for Disease Control and Prevention (CDC) published guidelines for surgical hand washing and hand antisepsis were published. According to these guidelines, hand washing must perform from scrubbing with brushes to rubbing with antiseptic. The new method consists of

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scrubbing around the nails with brushes and rubbing the hands and arms with antiseptic from the elbow to the ante brachium for its standardization (7). Further research showed the need to improve and develop the protocol. As an investigation was carried out to determine whether nail picks and nail brushes are effective in providing additional decontamination during a surgical hand scrub. The results of the investigation showed that following three surgical hand-scrub protocols: chlorhexidine only; chlorhexidine and a nail pick; or chlorhexidine and a nail brush do not decrease bacterial numbers and are unnecessary (8). However, surgical site infection after heart surgery increases morbidity and mortality. Thus, pre-surgical hand disinfection showed the influence of the infection risk obligatory. An investigation revealed that before surgery, the hand-rubbing method with alcohol solution preceded by hand washing with mild neutral soap is as effective as hand scrubbing to reduce bacterial counts on hands. Because of, it decreased the bacterial counts immediately after hand disinfection (9). A study investigated the factors influencing the effectiveness of 7.5% polyvidone iodine as a surgical antiseptic. The results of this study revealed that in order to attain effective disinfection with polyvidone iodine, the duration of hand washing should be at least 3 minute and the risk of bacterial recolonization increases when the duration of surgery be exceeds 95 minute (10). Recently, a waterless surgical scrub formulation containing 1% chlorhexidinegluconate was developed and its findings suggest that waterless hand scrub is as effective as traditional hand scrub in cleansing the hands of microorganisms and more efficient in terms of scrub time (11;12). Despite extensive research in this regard, there is uncertainty about the application of adequate infection control measures in the Operating Room (13) and the surgeon uses different methods of surgical hand antisepsis with the aim of reducing surgical site infections (13;14). However, in our country, there are no local studies comparing the efficacy of iodine hand scrub against newer alcohol-based hand rubs with active ingredients, in addition the decline of operating room personnel hand bacterial flora is unknown. So, the aim of this study was to determine the effect of disinfectant solutions used in the operating room on the bacterial flora of the operating room personnel hands.

Materials and Methods

Materials: Brain heart infusion broth and agar, eosin-methylene blue (EMB), MacConkey agar from Merck was used for sampling and cultivation. Antiseptics: Povidone Iodine 7.5% (7.5g/100ml) from TolidDaru Company, Tehran Iran. Alcoholic hand sanitizer to rub into the skin solution contains moisturizing substances; Aseptoman Permitted Number: 2456200, Lot: 412784 from desomed Germany. (Based on manufacture labeled 100gram of solution contains 1gram active Propan -2-ol and 1,3- Butandiol, lanolin- poly(oxyethylene)-xx, odors and Purified water). Other required materials for this study were available in our laboratory.

Methods: In a two stages cross-sectional study, based on standard bacteriological methods, the effects of disinfectants solutions uses in operating room were randomly assess on hands bacterial flora of the personnel’s. The study design was including four phases, in the first phases, before washing hands sampling fingers to touch the tip of the medium. Secondly, with 200ml of sterile BHI-broth medium and the receiver's hands were washed and then 500 µl of the washing solution was transferred to the medium and was spread. In the third phase, the subjects were asked to act as usual washing hands with disinfectant solution and then using conducted fingertips the sampling was carried out (as the first phase). The step 4 was repeated as in step 2. Inoculated media were incubated at 37 °C for 24 hours. Then, colony counting was done and the numbers of colonies were determined. More than 25 different types of bacteria in pure culture were obtained and with a set of biochemical identification was performed.

**Figure 1.** the results of 24 hours incubated plates inoculated by fingerprints before washing hands were shown. Counting the number of growth colonies on each plate indicates the difference between the number and variety of bacterial flora. In comparison of the plates; the density of the colony on plates 1 and 4 with the plates 2 and 3 illustrate the difference in the range of 10-fold.

**Figure 2.** Results of 24-h incubation plates inoculated with 500 ml of liquid hand-washing with sterile BHI-broth shows.
Each of the isolated strain by using standard bacteriological tests including: Gram Stain, coagulase, catalase, Oxidase, Arginine dihydrolase, Lysine decarboxylase, Ornithine decarboxylase, TSI, OF, Citrate utilization, Urea hydrolysis, H$_2$S production, sensitivity to bacitracin and novobiocin, sugars fermentation tests and colony morphology were identified. The results of bacteria were grouped and using descriptive statistics were analyzed.

**Results**

During the two-stage of study, 12 operating room personnel (9 surgeon, 2 residents and 1 staff) were enrolled. Consequence of fingers sampling before hands washing (Phase I) indicate the growth of transient bacterial flora in the cumulating form (Fig. 1). In this figure, for example, the fingerprint bacteriology of 4 surgeons before hands washing is presented. As can be seen, the rate of release the kind and number of bacteria in the normal flora is very different. As a results of bacteriological culture, 500µl of the liquid hand washing were to BHI-broth medium is shown in Figure 2. As it was shown, the density of colonies grown on plates 1 and 4 is greater than the density of colonies on plates 2 and 3.

The results of two stages bacteriological hands sampling, the third and fourth steps of study was started. The subjects were asked to wash their hands as regular to action. They were then washed their hands with a disinfectant solution was performed in the operating room. The results of bacteriological sampling and planted the Fingerprinting with wet hands is presented in Figure 3.

As it was shown, after that washing and disinfecting of hands touch fingers sampling on surface medium was perform and were incubated for 24 hours. A substantial numbers of normal bacterial flora were transferred to the medium and to grow as colonies appeared. Similarly, the disinfected hands were subject to washing with 200ml of BHI-broth and the fluid was collected in a sterile container. Then 500µl of this solution were transfer to BHI- Agar medium and grown for 24 hours incubation with bacteria was associated with a substantial numbers. As shown in fig 4: part 1 and 5. The results of experimentally repeated with operating room personnel and finally the same pattern followed in all cases. The results of isolation and identification of the bacterial flora of the study population are presented in table 1. Twenty five out of Twenty seven types of isolated bacteria were identified using phenotypic and biochemical tests.

The results of our study revealed very diverse population of bacterial flora. Twenty species of aerobic bacteria were detected. The most common organisms isolated were the genus of Staphylococcus. Four out of twenty five isolated bacteria were hemolytic and coagulase production. Based on the results of this study none of the used disinfectants, were enable completely remove the bacterial flora.

**Discussion**

For more than 120 years hands of surgeons have been treated before a surgical procedure in order to reduce the bacterial density and as a routine measure of infection prevention (15).
However, the results of recent studies indicated that the risk of surgical site infection (SSI) is approximately 1-3% for elective clean surgery (16). Therefore, the surgeon uses different methods of hand antisepsis with the aim of reducing surgical site infections is an essential process in the Operating Room (17). It is necessary to evaluate disinfectants solution used in the operating room have to be examined periodically. Thus, in this study, the effects of antisepsic solution used in the operating room were evaluated on the resident and transient bacterial flora. In order to determine the transient bacterial flora, used contact fingers on the surface of the culture medium and also, transfer defined a volume of collecting hands washing solution to culture media before disinfectant of hand surgeons. In this study, the results of the first sampling and culturing are shown in figure 1. The total of bacteria transferred from dry hand to the medium and growth colony indicated the transient bacterial flora. Different types of bacteria were identified. As can be seen, the colony growth on the first plate of figure 1, the genus Staphylococcus and Micrococcus is dedicated by the predominant. On the surface of Plate 2 Figure 1 shows the minimum number of bacteria. In addition of coccioided morphology, the Gram-positive Corynebacterium genus was diagnosed. In Plate 3 Figure 1, a Gram-negative bacterium was identified. On the surface of plate 4 Figure 1 species of black fungi have been found. As shown in Figure 2. Incubation of 500 μl surgeon hand washing solution showed that in all cases a large number of transient bacterial flora were growth. Although, this may be indicate of the level of surgeon health habitat. Similarly, the results of the recent study revealed that the combination of a scrub and rub with products containing povidone Iodine and Alcohol was shown to reduce significantly and persistently both the resident flora and contaminating transient bacteria on skin (18). However, applying a variety of antisepic and methods of hand washing was associated with a sharp reduction in the number of bacterial flora. Consequently, more reduction of post operating infection is occurred. It should be kept in mind that each resident bacteria flora can never be eliminated. As a result of this study it also shown. None of antisepsic solutions could not able completely delete the bacterial flora (see Figure 4). Morrison et al, showed the brief contact time incorporated in hand washing technique reflects clinical usage patterns and the marked bacterial reduction demonstrated by the 60% isopropanol formulation substances (19). While in this study, three minute hand washing technique reflects the markedly reduction of hands bacterial flora demonstrated by the 90% by Povidone Iodine formulation.

### Table 1. Represent the frequency of isolated bacteria from surgeon hands in the operating room before and after hands washing.

<table>
<thead>
<tr>
<th>Morphology</th>
<th>Bacterial Species</th>
<th>Frequency</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gram Positive Coci</td>
<td>Staphylococcus aureus</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Staphylococcus pidermidis</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Staphylococcus hominis</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Staphylococcus haemolyticus</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Staphylococcus saprophyticus</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Streptococcus α Hemolitic</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Gram Negative Bacilli</td>
<td>Micrococcus SPP</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Acinetobacter SPP</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Kelesiella SPP</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Escherichia coli</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Gram Positive Bacilli</td>
<td>Bacillus SPP</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Fungal</td>
<td>Aspergillus SPP</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

25 100

### Reference