

A Comparative Study on the Effectiveness of Different Hand Disinfectant Solutions Used in Surgical Scrub

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Abstract

Background and Objectives: Hand hygiene is a crucial measure for preventing healthcare-related infections. Surgical scrub is an important factor in the safety and success of a surgical operation. The aim of this study was to comparatively evaluate effectiveness of some conventional surgical antiseptic solutions, and to identify the most effective one.

Methods: Effectiveness of alcohol-based solutions including Mono Rapid, Sterillium, and Desderman was compared with each other and with povidone-iodine (10% Betadine Scrub). Two rounds of sampling were conducted, one before wearing surgical gloves, and the other after removing the gloves upon completion of surgical operation. Colonies were counted after 48 hours of aerobic incubation at 37°C. All counts were conducted twice. Positive cultures were identified and their frequencies were compared. Data were summarized using descriptive statistical methods. Comparison of counts between groups was performed using Chi-square test. Mean values were compared using ANOVA.

Findings: From the 157 obtained samples, 50 (30.9%) were positive cultures. A significant difference in the frequency of positive cultures was identified between four surgical scrub solutions ($df = 3$, $\chi^2 = 17.4$, $P = 0.001$). The lowest frequency of positive culture (7.5%) was observed for the solution containing povidone-iodine (10% Betadine Scrub).

Conclusions: Based on our findings, povidone-iodine has a higher antiseptic effectiveness as compared with alcohol-based solutions.

Keywords: Povidone-iodine, Surgical Scrub, Alcohol-based Solutions, Hygiene

Background and Objectives

Healthcare-related infection is one of the most important causes of morbidity and mortality in hospitalized patients [1, 2]. The hands of healthcare workers are the main carriers of multidrug-resistant bacteria and nosocomial infections in hospitals, which if not disinfected properly, may lead to serious consequences [3]. Healthcare-related infections are the direct cause of 80,000 deaths in the United States and 5,000 deaths in England every year [3, 4].

Effective disinfection of surgeons' hands depends on multiple factors [5]. Washing time and the type of solutions are the most important factors influencing proper disinfection [5]. There are different types of solutions for hand disinfection, including alcohol-based solutions containing rapid action hand rub and povidone-iodine. Comparative studies on the effectiveness of different disinfectants solutions have not yielded consistent results. To gain further insight into effectiveness of disinfecting solutions, in this study we compared the effectiveness of alcohol-based surgical antiseptic solutions with that of povidone-iodine.

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Methods

The effectiveness of different alcohol-based surgical

scrub solutions containing rapid action hand rub in surgical disinfection (Mono Rapid, Sterillium and Desderman) were compared together and with povidone-iodine (10% Betadine Scrub). Forty-eight surgeons were enrolled in this study. None of the participants had a history of skin disease or skin wounds. All surgeons washed their hands using a scrub. Washing time for each solution was specified according to the user instructions. Surgeons dried their hands using sterile compress or paper towel. Sampling was carried out in two rounds. The first round was carried out before participants wore surgical gloves. The second round of sampling was carried out at the end of surgery, immediately after participants removed their gloves. One hundred and fifty seven samples were obtained from flora on the hands of the participants. Participating surgeons used povidone-iodine (10% Betadine Scrub) as follows: washing the hands twice for five minutes, using 5.0 ml of the solution in each instance. The subjects used surgeon hand brushes and followed the standard technique for anatomical scrub.

All surgeons used two layers of orthopedics gloves. Samples were taken by swabbing one square inch of the skin for one minute with a cotton-tipped applicator. Hand flora was recovered in a sterile plastic bag containing 400 ml of a neutralizing solution. The solution was then transferred to a sterile bottle. Samples (1ml undiluted and 1 ml of 10-1 and 10-2 serial dilutions) were placed in 15 ml of tryptic soy agar. Colonies were counted after 48 hours of aerobic incubation at 37°C. All counts were conducted twice.

Statistical Analysis

The data were summarized using descriptive statistical methods. Comparison of counts between groups was made using Chi-square test. Mean values were compared using ANOVA test. $P < 0.05$ was considered statistically significant. All statistical analyses were carried out using IBM SPSS Version 16 Software.

Results

Table 1 compares the number of sample cultures related to each scrub solution. As seen, there is a significant difference in the frequency of positive cultures between four surgical scrub solutions ($df = 3$, $\chi^2 = 17.4$, $P = 0.001$). The lowest proportion of positive culture is observed for the solution containing povidone-iodine (10% Betadine Scrub). Frequency of positive culture is not significantly different among the other three solutions. Colony Forming Units (CFU ml) in the solution containing povidone-iodine did not show any significant difference as compared with other surgical solutions.

Discussion

In this study, povidone-iodine solution (10% Betadine Scrub) was found to be more effective in removing bacterial contamination of surgeons' hands during operation in comparison with other antiseptic solutions (rapid action hand rubbing solutions).

Several studies of similar type have shown that hand rubbing with alcohol based solutions is more effective than antiseptic soap [6]. Girou *et al.* showed that during routine patient care, hand rubbing with an alcohol-based solution is significantly more effective in reducing hand contamination than hand washing using antiseptic soap [1]. Meta-analysis carried out by Jarra *et al.* indicated that use of chlorhexidine as an antiseptic skin preparation solution was associated with significantly reduced Surgical Site Infection (SSI) in clean-contaminated surgery [7]. In addition, povidone-iodine and chlorhexidine have been reported as effective antiseptic solutions in several studies [8, 9]. While the immediate effect of povidone-iodine and chlorhexidine were found to be equivalent, their immediate effects are higher than that of non-medicated soap. In addition, cumulative and permanent effect of chlorhexidine was found to be higher than those of povidone-iodine and non-medicated soap [9]. Our results identified higher a effectiveness for povidone-iodine as compared with alcohol-based solutions. Moreover, its antiseptic power is higher than that of alcohol-based solutions regarding that the number of positive cultures before wearing surgical gloves and after removing gloves at the end of the operation was lower when Betadine was used. However, there was no difference in the frequency of positive cultures in other alcohol-based solutions, suggesting that alcohol-based solutions have more or less similar disinfection effectiveness.

Conclusions

According to our results, the effectiveness of povidone-iodine is higher than that of alcohol-based solutions when used for surgical scrub. The effect of Betadine antiseptic is longer lasting than that of alcohol-based solutions.

Abbreviations

(SSI): Surgical Site Infection

Competing Interests

The authors declare no competing interests.

Table 1 Comparison of the results of hand flora culturing

	Povidone-iodine N=40	Mono Rapid N=37	Sterillium N=42	Desderman N=38	P-value
Positive Culture	3 (7.5%)	12 (32.4%)	16 (38%)	19 (50%)	0.001
Negative Culture	37 (92.5%)	25 (67.6%)	26 (61.9%)	19 (50%)	
CFU (ml)	1.5±1.3	12.2±8.1	14.4±7.3	30.9±21.1	0.03

Authors' Contributions

JS and ME jointly designed the study. AT collected the data and contributed to data analysis and interpretation of the results. AE was involved in data analysis, interpretation of the results, and preparation of the draft manuscript. All authors read and approved the final manuscript.

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