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EFFECTS OF CHLORHEXIDINE 2% IN ALCOHOL 70% AND POVIDONE-IODINE 10% ON SKIN COLONIZATION AFTER SURGICAL PREP

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ABSTRACT

Introduction: The operating room is a potential place for hospital infection, but we can reduce its costs and side effects by using aseptic surgery techniques. Since the skin is the main source of pathogens, the surgical incision will inevitably create a pathway for them. This study was conducted to compare the effect of two antiseptic solutions of Povidone Iodine 10% and Chlorhexidine 2% in isopropyl 70% on reduction of skin colonization of the surgical site.
Methodology: This is a semi-experimental study, which was performed on 260 patients in the elective operating room of Alzahra Hospital in Isfahan. Patients were randomly arranged in two groups of 130 subjects. From each patient, samples were taken by swab from a region of 2 * 2 cm width from the beginning of each surgical cut in three periods before, 2 minutes and 6 hours after prep. Samples were cultured on Blood Agar and EMB media and sent to the laboratory and the results were analyzed.
Results: The average number of microorganisms on the skin of surgical site 2 minutes and 6 hours after prep was not significantly different in two groups (P-Value = 0.409 * P-Value = 0.453), but the frequency distribution of the type of microorganisms in the surgical site 2 minutes and 6 hours after prep had a significant difference in the two groups (P value = 0.001 * P-value = 0.003).
Discussion and Final Conclusion: The results of research on the application of two solutions are different. This study showed that the effect of Chlorhexidine 2% solution in isopropyl 70% on the reduction of the frequency distribution of microorganisms is strikingly high as compared to Povidone Iodine 10%, indicating the fast and stable effects of this solution. Therefore, it is suggested that Chlorhexidine 2% solution in Alcohol 70% to be used for prep before thoracic and abdominal surgeries.

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Introduction

Hospital infections are a global health problem that affects developing and developed countries [1]. The incidence of hospital infections varies from 1.5 to 25.1% [2, 3]. These infections increase the risk of illness and death as well as the hospital costs due to the increase in the number of days of hospitalization and long-term diagnostic and therapeutic care services and the individual's long-term absence in work place and the family [4].

Surgical site infection is a form of hospital infection. According to the definition of the center for the prevention and control of the disease, any infections in the opened tissue and organ and the cavity manipulated during surgery is called "surgical site infection", and this type of infection is an infection that occurs within one month after the surgery and the surgical wound infectious discharges are abnormal in color, odor, and volume, and the results of its cultivation are positive [5]. SSI (Surgical Site Infection) is a term that has been replaced by surgical wound infections since 1992 [6]. The global prevalence of SSI is 2.5%, and colorectal surgeries are of the highest record of 20% [7]. In Iran, there is no comprehensive statistics on the extent of SSI, and its extent has been reported case by case in various studies [8].

Several factors can affect the level of SSI, including factors related to the patient, such as age, nutritional status, diabetes, smoking and obesity. Moreover, surgical agents such as prophylactic antibiotics, observation of the techniques of aseptic surgery and skin prep before surgery should be taken into consideration [9].

The microorganisms on patient's skin are the most common sources of surgical site infections. The patient's body resists against infections in an integrative way and intrinsically with some physical barriers, but the surgical cut affects the integrity of the patient's skin and inevitably clears a pathway for infection sources [10].

Since skin is the main source of pathogens, it is conceivable that the use of developed skin disinfection solutions (disinfectants) can reduce the surgical site infection [11]. Disinfection or antibacterial solutions for skin in the operating room are determined by the infection control committee. An ideal antiseptic solution is a solution that has wide-spread antimicrobial effects that can quickly reduce the number of germs and should also be effective on viruses and fungi. This solution should retain its effects in the presence of Alcohol and organic matters like blood soap and detergents, and maintain its effects over time, and have lasting effects, and cause no inflammation during the use of lasers, electrocautery, and high-energy tools [12]. Chlorhexidine gluconate solutions, iodine and iodorophor, Alcohol, triclosan, Para chloro methoxy leone, Chlorhexidine gluconate-Alcohol solutions, and iodophyride with Alcohol are used for prep. Chlorhexidine gluconate, Iodophor and Alcohol-based products are the most common solutions that are used for prep [13].

Iodophor is an iodine derivative that was discovered in 1812 and was first used in 1839 for the wound care. The type of Iodophor solution used is Povidone Iodine, which contains surfactant, and is liquid and dispersive, and its main mechanism is based on electrophilic reaction with aerobic enzymes and amino acids in the bacterial wall. It has a broad spectrum antimicrobial activity, and is somewhat effective on a number of viruses and spores. Iodophors are used with caution in prepping the skin of people who are allergic to iodine. Potential allergic reactions and burns in the skin have reduced the use of this solution [12].

The Chlorhexidine gluconate solution was discovered in England in 1950. The solution is available in colored and colorless forms [12]. The Chlorhexidine gluconate is a broad-spectrum cationic base biguanide compound with a rapid onset of action that connects itself to the negative pole of the cell wall of the germs and through the cell membrane rupture and breaking the osmotic balance causes irreversible damage and finally kills the microorganisms. Chlorhexidine has rapid effects and has a wide spectrum effect on Gram-negative-positive bacteria and viruses, but its antifungal effects, sporo-mycobacterium, are lower [14]. Chlorhexidine gluconate solution is not absorbed by the skin, but there are hypotheses about absorption through the mucous membrane. This solution dramatically reduces microbial flora, such as bacteria and fungi, and maintains this condition for at least 4-6 hours. Among all the known skin antiseptic compounds, Chlorhexidine has the most lasting effects, and this compound has a persistent effect through the connection to the stratum corneum of the skin, which does not disappear even by washing. If the solution is combined with iodinated compounds, its effect will be reduced and the effect will increase with increasing temperature due to the connection with the stratum corneum. The other benefits of Chlorhexidine, as compared to Iodophors, are that this compound retains its effects in the presence of blood and organic tissues [12, 15].

As it was said, controlling the infection of the site of surgery is important and one of the ways to control it is to prep the surgical site using antiseptic solution. In recent years, new solutions based on Chlorhexidine and Alcohol has entered the market of disinfectants. One of these solutions is body prep solution that contains 2% Chlorhexidine gluconate and 70% isopropyl Alcohol. Currently, these solutions and similar solutions have little research support in Iran. Since various conditions, such as weather conditions, temperature and humidity, the level of health and ... can affect the components of the skin ecosystem from one country to another and subsequently change the microbial population (16, 17). And considering the advantages and disadvantages of Povidone Iodine and Chlorhexidine in Alcohol solutions and the existence of contradictory results about the difference in the effectiveness of these two solutions in disinfecting the skin of the site of surgery in different studies, we decided to investigate the effect of two solutions of Chlorhexidine 2% in Alcohol 70% and Povidone Iodine 10% on the number and type of microorganisms on skin after prep. It is hoped that the results of this study could be the basis for a broader research in this regard and guidance for using more effective and lasting solutions for surgical prep.

Methodology

A semi-experimental two-group, three-stage study was conducted with pre-test and post-test design with two comparative interventions between December 26, 2016 to May 10, 2017 in the elective surgery room of Al-Zahra hospital (a complex consisted of 20 operating rooms) affiliated with Isfahan University of Medical Sciences in Iran. This research was done before and after the experiment, which was carried out on 2 groups in 3 stages, and culture was performed on each of the units studied once before prep, again 2 minutes after prepping and once 6 hours after the prep. The prepped group by a 2% Chlorhexidine solution in 70% isopropanol was named group A and the group prepped with a Povidone Iodine solution was classified as group B.

The basic criteria for entering the study consisted of all patients undergoing abdominal and thoracic surgery, without skin inflammatory diseases, without history of skin allergy to isopropanol and povidone iodine, no skin damage in the surgical site, no prohibition of the use of solutions used for surgical prepping, no use of immunosuppressive drugs and all patients who received the third-generation cephalosporin antibiotics with metronidazole. The exit criteria included patients who were reluctant to continue to participate in study, failure to follow sterilization points for postoperative dressing, failure to observe sterility points during the prep and changing the patients' dressing less than 6 hours.

Qualified samples were randomly selected using a random sampling table, in a way that each individual sample was randomly assigned an odd or even number, and sampling was continued until the required number of samples was completed. Of 260 eligible specimens, 130 specimens were included in the group prepped by Chlorhexidine 2% solution in 70% isopropanol (group A) and 130 specimens were put into the group prepped by Povidone Iodine (Povidone-iodine) (group B).

In order to collect data, a 2-part data record sheet was used in the first part of which, the demographic characteristics of the patient, disease diagnosis, the surgical procedure, the type of surgical incision and the type of solution used for prep (Chlorhexidine 2% in isopropanol 70% or Povidone Iodine) were recorded by referring to the case and observation, and in the second part, information about the number and type of microorganisms was recorded based on the response of the cultures sent to the laboratory. For the stability and accuracy of the results, all cultures were performed by the researcher himself and was sent to lab within the same time intervals and all cultures were kept under the same environmental conditions. The cultures were read by the same laboratorial technician with a standard laboratory method for all units under study.

With regard to the double-blind nature of the research, the colored type of body prep solution (Chlorhexidine gluconate 2% - Alcohol 70%) with the same color of iodine Povidone Iodine 10% solution was used, and the samples were encoded and sent to the lab.

After obtaining the necessary training regarding the sample taking and receiving the relevant certificate from the laboratory and obtaining the final license for conducting research, sampling was started. All surgical procedures were performed by three thoracic and abdominal surgeons along with their residents during the week. After the patient's transferal onto the surgical table and general anesthesia, the patient was placed in a specific position appropriate for a particular surgical procedure and then the surgical incision was carried out by the surgeon using a sterile marker on the skin. Using a special template (stencil) on a surgical incision, the researcher made a square of 2 * 2 cm (4 cm^2) size with a 2-cm distance from the beginning of the cutting line with a sterile marker. Then the surgical site of the skin was dipped by sterile swab and a sample was taken in TSB environment, that is, the swab was gently run over the area 5 times horizontally and 2 times vertically, and the sample immediately cultured on Blood Agar and EMB environments following the sterile points.

To prep with each of the 2 introduced solutions, the surgeon or resident used 3 sterile gauzes, a Ring Forceps, gallipot and disinfectant solutions, and begin to prep with one of the two solutions (Chlorhexidine 2% in Alcohol 70% and Povidone iodine 10%). They imbued a gauze with green Povidone Iodine 10%, which was used to prep the skin for 2 minutes, or with a solution of 2% chlorohexidine gluconate and 70% isopropanol, which should be applied 2 minutes on the skin, and moved it around the surgical site using Ring Forceps in circular form with at least 15 cm space from the center of the surgical site and did not return it to the center and threw the gauze into the pan. Right after this he took 3 sterile gauzes with ring forceps and repeated the same process in order to sterilize and disinfect the surgical site in a standard way. Skin cultures were performed by running a sterile skin swab dipped with sterile TSB solution 2 cm from the cut line in the marked area using special template, so that the swab is loaded 5 times horizontally and 2 times vertically after the standard time passes and was immediately cultured on the blood agar and EMB observing the sterile points of swab.

After closing the abdominal layers, the skin was stitched with nylon thread, the site of surgery was washed with 100 cc of normal saline solution and then the surgical site was dressed. For sampling 6 hours after surgery, the researcher referred to the intended area where the patient was hospitalized, and after wearing sterile gloves, skin cultures were done by running a sterile skin swab dipped with sterile TSB solution with 2 cm space from the cutting line in the area as determined by stencil in a way that the swab was run over the surgical site 5 times horizontally and 2 times vertically (18) after the standard time passed and immediately cultured with the observation of sterile points of swab on the blood agar and EMB environments.

The cultured plates were sealed before being sent to the laboratory at ambient temperature and the lid of the plates was sealed to prevent contamination. After completing each of the 3 steps, the plates were harbored into special boxes and sent to the lab. In the laboratory, a fixed laboratorial expert used the E.M.B Agar Eosin Methylene Blue plates and blood agar to cultivate swabs. The laboratorial expert then kept the culture medium in the incubator for 72 hours at 37 ° C for identification of bacteria.

After 72 hours, the expert begins to count the bacteria types representing the common pathogens that are the main causes of infection in the surgical site: Staphylococcus aureus, Escherichia coli, Klebsiella, Pseudomonas, Staphylococcus coagulase negative, Acinetobacter, Enterobacter, Enterococcus, Micrococcus, Staphylococcus hemolticus, Staphylococcus saprophyticus, Bacillus SP and Fungi. The skin culture containing one or more of these pathogens was considered positive. At the end, the results of the cultures from the laboratory were recorded in the form of information.

All of the information was collected, including demographic information and culture results. Data analysis was done with SPSS version 16 and included descriptive statistics such as frequency distribution, graph, mean and standard deviation, and inferential statistics including the exact test of proportions and paired t-test.

Results

Of the eligible patients, 260 (130 people in each group) were included in the study after complete explanation and justification of the study method and with their consent and willingness. In the group prepped with Povidone Iodine (group I), 53 (56.2%) were male and 57 (43.8%) were female, and in the group prepped with Chlorhexidine 2% in Alcohol 70%, 77.7% (57.7%) were males and females were 53 (42.3%). The mean age of the first group (iodine) was 49.04 and the mean age of the second group (Chlorhexidine 2% in 70% Alcohol) was 51.91, which showed no significant difference in the mean age of males and females (P = 0.165).

Surgical cuts and diagnosed diseases in the first and second groups are presented in **[Figures 1 and 2]**. The highest and lowest incisions in the first group were respectively, Midline (43.8%) and Lower Midline (0.8%), and there was no significant difference in the type of cut in the first and second groups (P = 0.229). Also as to the type of diseases diagnosed in the first group, the highest and lowest was Colon Cancer (17.7%) and Appendicitis (1.3%), and in the second group, Colon Cancer (20.8%) and Appendicitis (0.8%) %, which did not show any significant statistical difference between the two groups (P = 0.159).

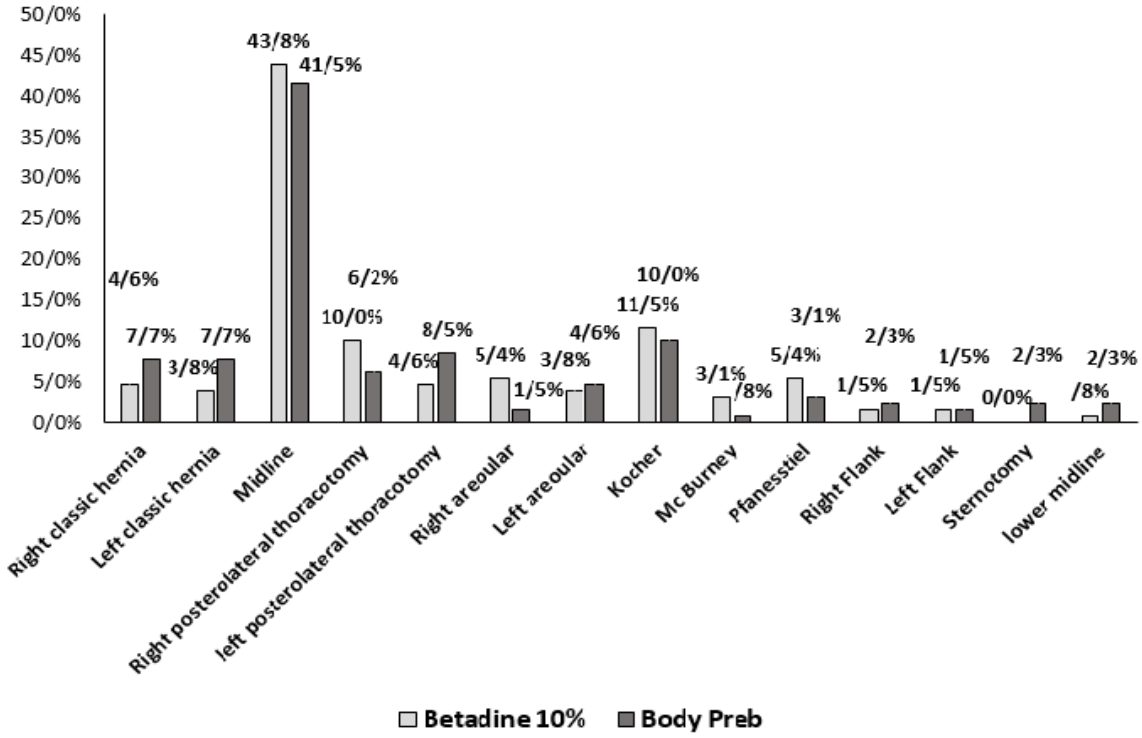

Figure 1. Frequency percentage of incision type of surgery in two groups under study

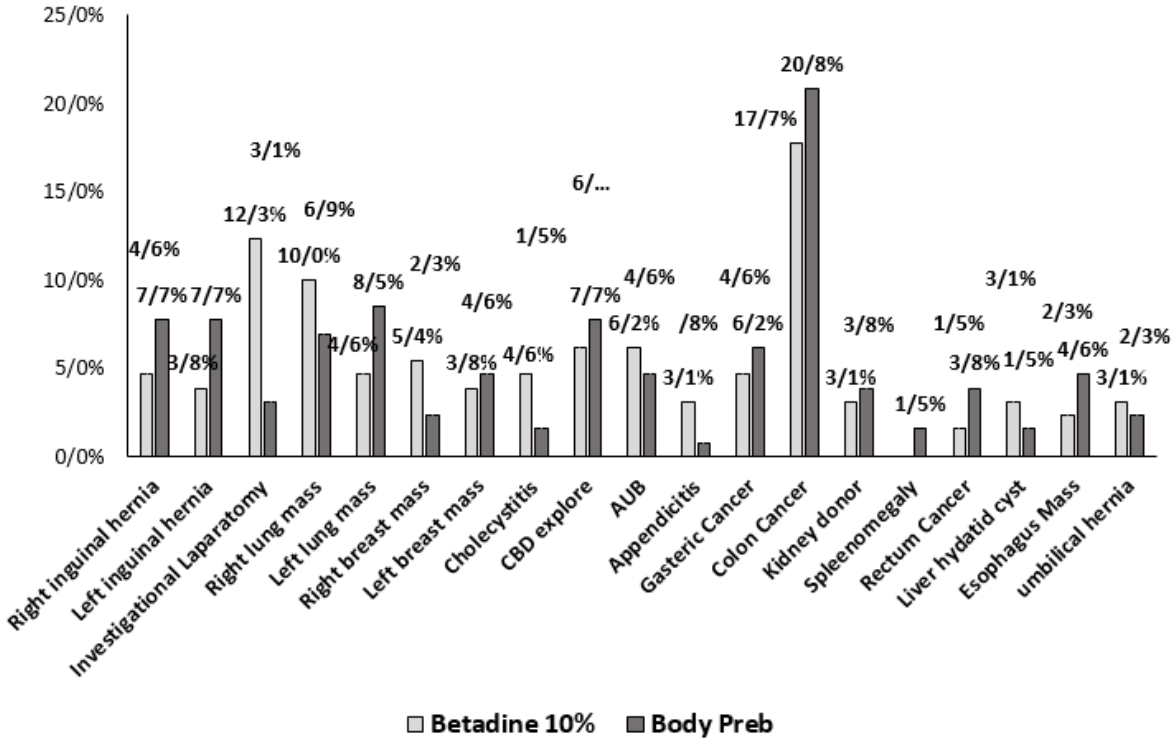

Figure 2. Frequency percentage of diagnosed disease in the two groups under study

Paired t-test showed that the average number of microorganisms on the surgery site before prep in the first group was 36.38 and in the second group was 385.87. There was no significant difference between the two groups from statistical point of view (P = 0.448).

The frequency of positive skin cultures in the surgical site during the study was shown in **[Figure 3]** in two groups.

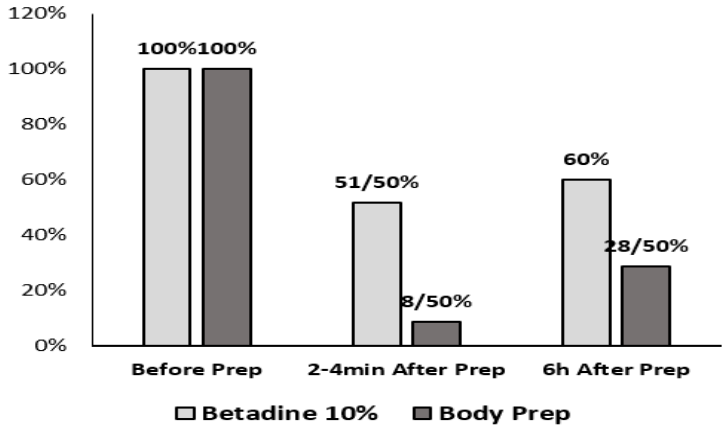

Figure 3. Frequency percentage of Positive Skin Cultures during the study, with two separate groups of Povidone Iodine 2% and Chlorhexidine in Alcohol 70%

Comparison of the average number of microorganisms on the skin of the surgical site 2 minutes and 6 hours after prepping in the first and second groups shows that although the average number of microorganisms on the skin site of the surgery 2 minutes and 6 hours after prepping in the second group is lesser as compared to the first group, this difference is not significant.

Frequency distribution of microorganisms on the skin of surgical site before prep in the first and second groups was not statistically significant (P = 0.493). Frequency distribution of the type of microorganisms on the skin of the surgical site 2 minutes and 6 hours after prepping in the first and second groups is presented in tables 4 and 5 and shows that the frequency distribution of the type of microorganisms on the skin of surgical site 2 minutes and 6 hours after prep in the first and second groups are significant (P = 0.003 and P = 0.001). **(Tables 1, 2)**

Table 1. Determination and comparison of the frequency distribution of the type of microorganisms on the skin of the surgical site 2 to 4 minutes after the use of two types of prepping solutions of povidone and Chlorhexidine 2% in Alcohol 70%

	Group		Chi-Squared	P-value
	Povidon Iodine 10%	Body Prep		
No Microorganism	249 70.1%	305 94.4%		
Acinetobacter	1 0.3%	0 0.0%		
staphylococcus epidermidis	47 13.2%	5 1.5%		
Kelebsiella SP	0 0.0%	1 0.3%		
Staphylococcus Aureus	11 3.1%	2 0.6%		
Enterococcus Sp	8 2.3%	3 0.9%	73.733	0.001*
Fungi	2 0.6%	2 0.6%		
Staphylococcus Haemolyticus	16 4.5%	2 0.6%		
Staphylococcus Saprophyticus	6 1.7%	0 0.0%		
Micrococcus SP	12 3.4%	2 0.6%		
Bacillus SP	3 0.8%	1 0.3%		
Total	355 100.0%	323 100.0%		

Table 2. Determination and comparison of the distribution of the type of microorganisms in the surgical site of the skin 6 hours after the use of two types of prepping solutions of povidone and Chlorhexidine 2% in 70%

	Group		Chi-Squared	P-value
	Povidon Iodine 10%	Body Prep		
No Microorganism	205 57.7%	259 80.2%		
Enterobacter	0 0.0%	1 0.3%		
Acinetobacter	1 0.3%	0 0.0%		
staphylococcus epidermidis	56 15.8%	23 7.1%		
Pseudomonas Aeruginosa	1 0.3%	0 0.0%		
Kelebsiella SP	1 0.3%	2 0.6%	53.448	*0.003
Ecoli	0 0.0%	1 0.3%		
Staphylococcus Aureus	13	7		

	3.7%	2.2%		
Enterococcus Sp	12 3.4%	5 1.5%		
Fungi	0 0.0%	2 0.6%		
Staphylococcus Haemolyticus	21 5.9%	8 2.5%		
Staphylococcus Saprophyticus	9 2.5%	0 0.0%		
Micrococcus SP	26 7.3%	12 3.7%		
Bacillus SP	10 2.8%	3 0.9%		
Total	355 100.0%	323 100.0%		

Discussion

Using more efficient prep solutions is one of the challenges that need to be addressed in the Iranian operating rooms. The present study can confirm the results of the study of Obamuyide et al in 2015 [19], which showed that although the average number of microorganisms on the skin 3 minutes prior to the prepping of surgical site with a Povidone Iodine solution 10%, had a significant reduction compared to pre-prep stage, this reduction has not reached zero. Also, in the study of Obamuyide et al, the percentage of post prep negative skin cultures was 46% and 52.1%, and in the present study, it is 48.5% and 40%, which is consistent with the result of the present study, suggesting that Povidone Iodine 10 % is a suitable solution for prepping the site of surgery though it cannot eliminate all microorganisms.

The present study showed that 48.5% and 40% of the skin cultures of the surgical site were negative in samples 2 days and 6 hours after prepping with Povidone Iodine, while in the study of Majidi Pour et al., in 2013 [20], the percentage of negative skin cultures immediately and 2 hours after disinfection with iodine solution was respectively 96.9% and 95.9%. This significant difference could be due to differences in the sampling areas because of the sampling of the abdominal regions and thorax in the present study, but in the study of Majidi Pour et al., sampling was done in the areas of the hands and feet. This difference can also be due to the difference in the type of procedure performed in the two studies, because in the present study, the procedures were surgical and involved more manipulation of the internal organs, and the risk of infection is higher, while in the study by Majidi Poor et al. offensive procedures have not been done. Moreover, this difference can be due to sampling time, which was done in the present study 2, 6 and 6 hours after the sampling, but in the study of Majidi Pour et al., the sampling was done before, immediately and 2 hours after disinfection has taken place.

Yeung et al. in 2013 (21) conducted a study entitled "Comparing Alcohol and Povidone Iodine with Chlorhexidine in destroying the microbial flora of the skin before genital prosthesis surgery in Washington." The results showed that the percentage of positive culture of microorganisms after prepping with Chlorhexidine 80% was significantly higher. The results showed that the results of this study are consistent with this study.

Based on the results of the above studies and the present study, both Povidone Iodine 10% and Chlorhexidine 2% in Alcohol 70% significantly reduce the number of microorganisms in the surgical site. Although the average number of microorganisms in the surgical site 2 minutes and 6 hours after prep with Chlorhexidine 2% solution in Alcohol 70% is lesser than that of Povidone Iodine 10%, this difference is not significant (P = 0.453 and P = 409). In a study by Bibi et al in 2015 (22) that used Chlorhexidine gluconate solution in comparison with Povidone Iodine for prepping the surgical site, it was shown that although the amount of infection in the surgical site differs in the group prepped with Chlorhexidine (7%) and in the group prepped with Povidone Iodine (10%), this was not statistically significant (P = 0.342).

In a study on comparing the effect of Chlorhexidine and Povidone Iodine on disinfection of the central and epidural vascular catheter that was conducted by Rao in 2017 [23] the results of the culture showed no significant difference in the rate of infection in surgical sites in the two groups. The results of this study are consistent with Bibi et al. and Rao's studies.

Darouiche's study in 2010 (11) that used Chlorhexidine in comparison with Povidone Iodine for prepping the surgical site showed that the amount of infection in the surgical site was significantly lower (P = 0.004) in the Chlorhexidine group as compared to the Povidone Iodine group (9.5% vs 16.1%). Furthermore, in a study by Tuuli et al., 2016 (24) on the effect of skin disinfection solutions in cesarean surgical site, the results of microbiological studies showed that the rate of surgical site infection was significantly lower in the Chlorhexidine group than in the Povidone Iodine group (4% vs. 7.3%).

Yeung et al. [21] in a study in which they assayed the effect of Chlorhexidine Alcohol with iodine on the elimination of skin microbial flora in prosthetic surgeries on genitourinary system, the results of microbiology showed that the amount of

colonization of the surgical site was significantly (P = 0.0091) lower in the Chlorhexidine group than in the Povidone Iodine group (8% versus 22%). The results of the present study are inconsistent with the results of the studies of Darouiche and Tuuli. This difference may be due to different concentrations of Alcohol and Chlorhexidine in the solutions used in the above studies. Study of Obamuyide et al. [19] showed the lack of growth in microorganisms on the skin of surgical site after being prepped with Povidone Iodine was 40% of skin cultures. The lack of growth of microorganisms in the skin of surgical site after prepping with Povidone Iodine in skin cultures in the present study is more than the study of Obamuyide et al. This difference can be due to the quality of solutions or the level of individual health and the difference in the sampling environment. In this study, the frequency of Staphylococcus epidermidis was higher than other studied species.

The study by Yeung et al. [21], entitled "comparing the effect of Chlorhexidine with Povidone Iodine on eliminating microbial flora of the skin before genitourinary system prosthetic surgery", showed that the highest culture infections were caused by Staphylococcus coagulase negative (81.25%). In this study, the most contamination was caused by Staphylococcal epidermidis microorganisms, which is consistent with the results of Jung study.
In the study of Savage et al., 2012 [25], entitled “the efficacy of surgical prep solutions in spinal surgery” it was shown that the highest infection rates in cultures appeared after prepping with Alcohol Chlorhexidine belonged to negative coagulase. The present study was also the most contamination with Staphylococcus epidermidis. Therefore, the results of this study are consistent with the results of study by Savage et al. The study of Yeung et al. [21], titled "Comparison of the effect of Chlorhexidine and Povidone Iodine on eliminating the microbial flora of the surgical site of the genitourinary system prosthetic surgery" showed that the highest infectivity after prepping with Chlorhexidine was produced by propioni bacter 75%. In this study, the highest contamination with Staphylococcus epidermidis was found, which contradicts the results of the Jung study. In a study by Yeung et al. [21], "Comparison of the effect of Chlorhexidine and Povidone Iodine on eliminating the microbial flora of the surgical site of the genitourinary system prosthetic surgery", the percentage of positive culture in the group prepped with Chlorhexidine 8% and the percentage of positive cultures in the group prepped with Povidone Iodine were 32%, which was statistically significant and consistent with the results of this study.

In the study of Savage et al. [25], bacterial species drawn from both groups prepped with Povidone Iodine and Chlorhexidine 2% in Alcohol 74% consisted of propionic bacteria, micrococcus, coagulase negative, and Corynebacterium, and no significant difference was seen between the two groups from the point of view of frequency of bacterial type after the closure of the surgical wound. While in the present study, the distribution of microorganisms after prep with two Povidone Iodine and Chlorhexidine 2% in Alcohol 70% solutions was significantly different. This difference can be due to the use of a Chlorhexidine-containing Alcohol solution in the study of Savage.

Final Conclusion

Although the effect of Chlorhexidine 2% solution in Alcohol 70%and iodine Povidone Iodine solution 10% for reducing the number of microorganisms on the skin of the surgical site 2 minutes and 6 hours after prepping did not significantly differ (P> 0.05), the effect of Chlorhexidine 2% solution in Alcohol 70% in reduction of the type of microorganisms in the surgical site 2 minutes and 6 hours after prep was higher than iodine. Therefore, according to this study, Chlorhexidine 2% solution in Alcohol 70% compared to Povidone Iodine 10% solution has been more effective in abdominal and thoracic surgery.
Among the research limitations, one can refer to the probability of contamination of the sampling area in hospitalized areas, because despite the maximum caution exercised during the surgical dressing, due to patient mobility, touching and manipulating the position or care measures, the probability of contamination out of the researcher’s sight is pretty high. Research on a wider scale with more samples in several care centers is suggested in other specialized procedures. Also, a comparison of these two solutions in different concentrations and the identification of surface and deep infections in body organs is recommended.

Moral Remarks

This article is the result of a thesis for obtaining a master's degree in the perioperative care with a code of ethics of 395647 and informed consent of the participants.

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