Chlorhexidine gluconate-impregnated cloth in prevention surgical site infection: pilot randomized clinical trial

Toalhas impregnadas com gluconato de clorexidina na prevenção da infecção do sítio cirúrgico: ensaio clínico randomizado piloto

Toallas impregnadas con gluconato de clorhexidina en la prevención de infecciones del sitio quirúrgico: ensayo clínico aleatorizado piloto

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Abstract

Objective: To compare the use of 2% chlorhexidine gluconate-impregnated cloth and 2% liquid chlorhexidine gluconate in the preoperative skin preparation to prevent the occurrence of surgical site infections in patients undergoing clean-contaminated elective surgeries.

Methods: Parallel, single-blind, pilot study of the randomized clinical trial (RCT), composed by forty-eight patients underwent clean-contaminated elective surgeries were randomly assigned to the intervention group (n=25, 2% chlorhexidine gluconate-impregnated cloth) and the control group (n=23, pre-operative bathing with 2% liquid chlorhexidine gluconate). The primary outcome was surgical site infection within 30 days after surgery. The patients were instructed to use the products at the night before and at the morning of surgery and received verbal and written instruction on their use. The tests Wilcoxon-Mann-Whitney, Two Sample t-test, Pearson X^2 and Fisher's exact tests, risk relative (RR) and 95% confidence interval (CI) were used. The level of significance for all variables was set at $\alpha = 5\%$.

Results: 48 patients analyzed, eight (16.7%) developed a surgical site infection. There were no statistically significant differences between the groups regarding the incidence of surgical site infection (RR: 0.92; 95% CI: 0.25-3.25; p=0.898), however there were not cases of superficial incisional surgical site infection in the intervention group.

Conclusion: The use of 2% chlorhexidine gluconate-impregnated cloth for preoperative skin preparation did not reveal a statistically significant difference in the prevention of surgical site infection compared to the use of pre-operative bathing with 2% liquid chlorhexidine gluconate.

Resumo

Objetivo: Comparar o uso de toalhas impregnadas com gluconato de clorexidina 2% e gluconato de clorexidina 2% líquida no preparo pré-operatório da pele para prevenir a ocorrência de infecção do sítio cirúrgico em pacientes submetidos a cirurgias eletivas potencialmente contaminadas.

Métodos: Ensaio clínico randomizado, piloto paralelo, simples-cego composto por 48 pacientes submetidos a cirurgias eletivas potencialmente contaminadas que foram aleatoriamente designados para o grupo intervenção (n=25, toalhas impregnadas com gluconato de clorexidina 2%) e grupo controle (n=23, banho pré-operatório com gluconato de clorexidina líquida 2%). O desfecho primário foi infecção do sítio cirúrgico dentro de 30 dias após a cirurgia. Os pacientes foram instruídos a usar os produtos na noite anterior e na manhã da cirurgia e receberam instruções verbais e escritas sobre o uso. Foram utilizados os testes Wilcoxon-Mann-Whitney, teste T para duas amostras, Pearson X^2 e testes exatos de Fisher, risco relativo (RR) e intervalo de confiança de 95%. O nível de significância para todas as variáveis foi estabelecido em $\alpha = 5\%$.

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Conflicts to interest: nothing to declare.

Resultados: Oito (16,7%) dos 48 pacientes analisados desenvolveram infecção do sítio cirúrgico. Não houve diferenças estatisticamente significativas entre os grupos quanto à incidência de infecção do sítio cirúrgico (RR: 0,92; IC 95%: 0,25-3,25; p=0,898), contudo, não houve casos de infecção do sítio cirúrgico incisional superficial no grupo intervenção.

Conclusão: O uso de toalhas impregnadas com gluconato de clorexidina 2% para preparo pré-operatório da pele não apresentou diferença estatisticamente significativa na prevenção de infecção do sítio cirúrgico em comparação com o uso de banho pré-operatório com gluconato de clorexidina 2% líquida.

Resumen

Objetivo: Comparar el uso de toallas impregnadas con gluconato de clorhexidina 2 % y gluconato de clorhexidina 2 % líquida en la preparación preoperatoria para prevenir casos de infección del sitio quirúrgico en pacientes sometidos a cirugías electivas potencialmente contaminadas.

Métodos: Ensayo clínico aleatorizado, piloto paralelo, simple ciego, compuesto por 48 pacientes sometidos a cirugías electivas potencialmente contaminadas que fueron designados aleatoriamente al grupo experimental (n=25, toallas impregnadas con gluconato de clorhexidina 2 %) y al grupo de control (n=23, baño preoperatorio con gluconato de clorhexidina líquida 2 %). El criterio principal de valoración fue la infección del sitio quirúrgico dentro de los 30 días posteriores a la cirugía. Se instruyó a los pacientes a usar los productos la noche anterior y a la mañana del día de la cirugía y recibieron instrucciones orales y escritas sobre su uso. Se utilizaron las pruebas de Wilcoxon-Mann-Whitney, test-T para dos muestras, χ^2 de Pearson y pruebas exactas de Fisher, riesgo relativo (RR) e intervalo de confianza de 95 %. El nivel de significación para todas las variables fue establecido en $\alpha = 5$ %.

Resultados: Ocho (16,7 %) de los 48 pacientes analizados presentaron infección del sitio quirúrgico. No hubo diferencias estadísticamente significativas entre los grupos respecto a la incidencia de infección del sitio quirúrgico (RR: 0,92; IC 95 %: 0,25-3,25; p=0,898). No obstante, no hubo casos de infección del sitio quirúrgico incisional superficial en el grupo experimental.

Conclusión: El uso de toallas impregnadas con gluconato de clorhexidina 2 % en la preparación preoperatoria de la piel no presentó diferencia estadísticamente significativa en la prevención de infecciones del sitio quirúrgico en comparación con el uso del baño preoperatorio con gluconato de clorhexidina 2 % líquida.

Brazilian clinical trial registry: RBR-8httxs

Registered at ClinicalTrials.gov: NCT03813693

Introduction

Although advances have been made in the practices of prevention and control of healthcare-associated infections (HAIs), the surgical site infection (SSI) still remains as an avoidable adverse event that may affect patients in the perioperative period, causing reversible or irreversible harm, such as increased length of stay and costs, new surgical interventions, physical limitations, decreased quality of life, and high mortality rate.[1,2]

SSI is a multifactorial problem and the factors contributing to its occurrence may be related to patients, surgical procedures, environment, and microorganisms.[3] In particular, the presence of microorganisms from the patient microbiota, especially from the skin,[4] makes it important to identify and implement strategies to reduce this colonization. One method of indisputable importance used to achieve the reduction of patient skin colonization is the surgical site skin preparation by applying antiseptics solutions prior to surgery, and include preoperative bathing or showering and the surgical site skin preparation with an alcohol-based solution immediately before the surgical incision.[2,4]

The preoperative bathing is one stage of preoperative skin preparation intended to reduce the microbial skin count and act as an adjuvant in the prevention of SSI, thereby avoiding complications in the postoperative period.[5,6] Pre-operative bathing is defined as a body wash performed before the surgical procedure, preferably with antiseptics.[7]

International guidelines recommend the preoperative topical use of antiseptic solutions containing chlorhexidine gluconate/digluconate (CHG) to reduce the colonization of the skin by resident and transient microorganisms, which may contribute to the reduction of the risk of SSI. Although there are limitations in the available scientific evidence, it appears that the benefits of CHG outweighed its harms or risks.[5,8]

CHG is a broad-spectrum antiseptic agent with activity against Gram-positive and Gram-negative bacteria, viruses, and fungi, with a residual effect of at least five hours, and it is also not inactivated by body fluids and/or blood.[9] Currently, 2% CHG used for preoperative bathing can also be found impregnated in cloth; however, there is limited scientific evidence regarding this new material.[10]

The 2% CHG impregnated cloth is believed to beneficial to patients compared to the traditional

preoperative bath, since, after its application, the product is not removed from the skin, thus attaining and maintaining adequate concentrations to reduce the microbial skin load and, therefore, contributing to the prevention of SSIs.[11]

The hypothesis of this study was that the use of 2% CHG-impregnated cloth (TICHG) in preoperative skin preparation was more effective than the traditional bathing with 2% CHG liquid (CHGL) for the prevention of SSI.

Thus, the objective of this study was to compare the use of 2% chlorhexidine gluconate-impregnated cloth and 2% liquid chlorhexidine gluconate in the preoperative skin preparation to prevent the occurrence of surgical site infections in patients undergoing clean-contaminated elective surgeries.

Methods

This parallel, single-blind, pilot study of the randomized clinical trial (RCT), guided by Consolidated Standards of Reporting Trials (CONSORT), sought to verify the use of TICHG in the prevention of SSI. The scientific literature on the subject is scarce, and the quality of the evidence varied, so it is necessary to conduct a Pilot Study before carrying out a larger scale RCT.

The study was carried out in a public teaching hospital, from May 2017 to August 2018, including a sample of 48 patients underwent clean-contaminated elective surgeries (intervention group (IG): 25; control group (CG): 23), selected according to the World Health Organization definition of clean-contaminated surgeries that refers to procedures performed in respiratory, gastrointestinal, genital or urinary tracts, under controlled conditions, no evidence of infections or major technique break.[2] As this is a pilot study of a pioneer Randomized Clinical Trial in Brazil, sample calculation no was performed. Thus, the sample corresponded to all patients recruited in the period, who met the inclusion criteria and who completed all the follow-up.

The inclusion criteria were: age of at least 18 years; literate; admitted on the same day of the surgical procedure or, at most, with three days of hospital admission prior to surgery; without an infectious or inflammatory process in another site. The exclusion criteria were: patients who did not correctly followed the instructions for the use of TICHG or CHGL; patients who had undergone a previous surgery less than 30 days prior or prosthesis implantation within 90 days; the presence of skin lesions or known allergies to 2% CHG; the presence allergies after the use of 2% CHG; undergoing video laparoscopic or vaginal surgeries; and daily use of antiseptic-containing products, antibiotics, or similar drugs two weeks before and during the data collection period.

Patients who met the inclusion criteria were identified during preoperative outpatient care. Then, they were approached by the researcher and clarified about the research objectives. If they agreed to participate, the randomization was performed. The patients were randomly assigned to two groups: a control group (CG) composed of patients who performed the preoperative bath with CHGL and the intervention group (IG), who used TICHG for the preoperative preparation of the skin.

The randomization was performed using the website *random.org* and the generated sequences were sealed in sequentially numbered opaque envelopes. The randomization procedure was performed by an individual not directly involved in data collection. The envelopes containing the randomization sequence were opened only at the subject allocation to the study groups.

Patients in the IG received two packages, each containing six TICHG and detailed instructions on the form and sequence of application of the cloths (anterior part of the neck, thorax, and abdomen; upper limb and right axilla; upper limb and left axilla; the back of the neck and thorax; right lower limb; the left lower limb); the moment of application, i.e., the previous night and the morning of surgery.

The CG was provided with two, 100 mL bottles of CHGL and a detailed instruction manual regarding timing of application, form, and recommended sequence of CHGL during skin preparation (friction of the product for three minutes, uni-

form application to all parts of the body except for the face, hair, and genital areas, followed by rinsing).

Patients in both groups were instructed to perform the pre-operative skin preparation or bathing the night before surgery (between 20 PM and 22 PM) and on the morning of surgery (between 5 AM and 6 AM).

On the morning of surgery, after the second bath or skin preparation, the researcher questioned the patients from the IG and CG if all the guidelines for the use of the products had been followed correctly; if the answer was affirmative, the participant was included in the sample. If any item had not been properly followed, the follow-up was cancelled.

The research did not interfere in the usual institutional protocols to prevent surgical site infections, such as antibiotic prophylaxis, hair removal by a clipper and antiseptic solutions to surgical site preparation. All patients were submitted to an antibiotic prophylaxis and surgical site skin preparation immediately before the surgical incision with alcohol-based CHG solution.

Data collection was performed with an instrument developed by the authors that contained information including: sociodemographic data, patient-related factors (age, sex, diabetes mellitus, neoplasia, nutritional status, smoking), factors related to the surgical procedure (preoperative diagnosis, type and duration of anesthesia and surgery, number of professionals in the surgical room, hair removal, antiseptic agent used in skin antisepsis, complications during the surgical procedure, antibiotic prophylaxis, blood transfusion and antimicrobial agents), factors related to hospitalization (length of hospital stay in the pre- and postoperative periods, antimicrobial use), and factors related to post-discharge surveillance (returns or readmissions, information on surgical incision, antimicrobial use).

For the assessment of potential cases of SSI, the researcher accompanied the patients during the preoperative hospitalization period (on the day before the surgery), at the immediate postoperative period (IPOP), and at hospital discharge, by the following strategies: review of medical records associated with the monitoring of patients during outpatient visits that occurred around the 35th postoperative day (PO) and telephone contact between the 30th and 40th postoperative day using a previously validated post-discharge surveillance instrument.[12]

The main researcher carried out all approaches and data collection.

The primary outcome was the diagnosis of surgical site infection following the Center for Diseases Control and Prevention (CDC) defining criteria:[13] SSI occurs within 30 to 90 days after the surgery and involves the skin and subcutaneous tissue of the incision, deep soft tissues or organ, and spaces opened or manipulated during the procedure, and the secondary outcomes were new surgical intervention and hospital readmissions.

The data collected to determine the occurrence of SSI were evaluated by an adjudication committee of three health professionals with experience in SSI surveillance, diagnosis and treatment, according to the criteria proposed by the Centers for Disease Control and Prevention,[13] with a simple majority criterion for establishing SSI classification, as follows:[13] Superficial incisional SSI as that occurs within 30 days after surgery and involves only skin and subcutaneous tissue of the incision; Deep incisional SSI as that occurs within 30 or 90 days after surgery and involves deep soft tissues of the incision; and, Organ/Space SSI as that occurs within 30 or 90 days after surgery and involves any part of the body opened or manipulated during the operative procedure.

Due the nature of the intervention of this study, only data analysis was blinded. The data were analyzed using the software *Statistical Package for Social Sciences (SPSS)* for Windows, Version 18.0. Quantitative, continuous, and discrete variables were evaluated by Wilcoxon-Mann-Whitney tests and Two Sample t-test, categorical variables were evaluated by Pearson X^2 tests, while categorical variables with non-normal distributions were evaluated by Wilcoxon-Mann-Whitney tests. The site of the SSI, as well as the interaction between the dependent and independent variables and the occurrence of SSI by group, were assessed by Fisher's exact tests. Risk relative (RR) and 95% confidence

interval (CI) are presented. Analyses was performed on an intention-to-treat basis.

The level of significance for all variables was set at α = 5%.

The study was approved by a relevant Institutional Ethical Review Board (approval number 2.157.183) (Certificate of Presentation of Ethical Appreciation: 65131617.5.0000.5392). All patients were consulted on their agreement to participate in the study and signed an informed consent form after receiving information about the study goals. This study is registered at Brazilian Clinical Trial Registry (identification number RBR-8httxs; avaiable from: http://www.ensaiosclinicos.gov.br/rg/RBR-8httxs/), and in ClinicalTrials.gov (identification number NCT03813693; available from: https://clinicaltrials.gov/ct2/show/NCT03813693?term=03813693&rank=1).

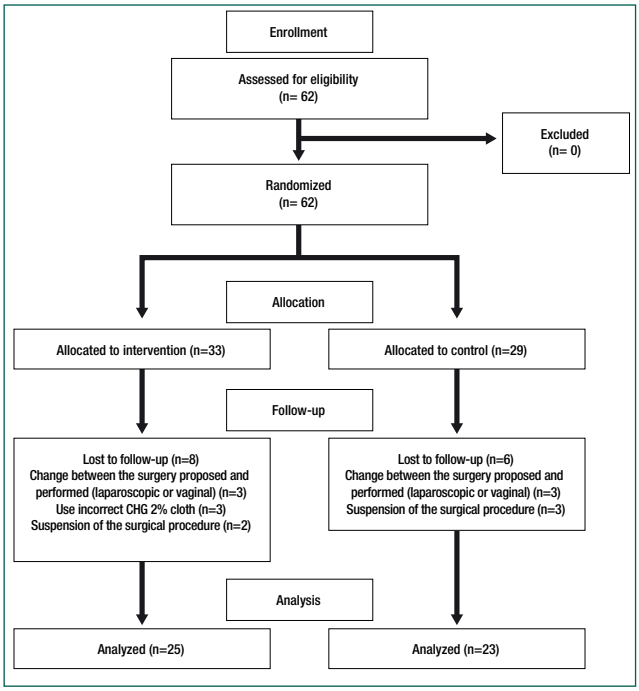

Figura 1. Clinical trial overview

Results

During the collection period, 62 patients were considered eligible according to the inclusion and exclusion criteria proposed; however, only 48 patients completed the study, 25 and 23 of whom were allocated to the IG (TICHG) and CG (CHGL), respectively (Figure 1).

The patients assigned to both IG and CG were similar with regard to all clinical and surgical variables (Table 1).

Table 1. Patient clinical characteristics and surgical procedures characteristics

Variables	Intervention group (n=25)	Control group (n=23)	p-value
Age (years), mean (SD*)	46.7 (9.3)	46.8 (12.2)	0.702‡
BMI† (kg/m²), mean (SD*)	36.3 (9.4)	35.5 (9.7)	0.613‡
Anesthesia duration (minutes), mean (SD*)	201.9 (50.6)	210.9 (54.9)	0.373‡
Surgery duration (minutes), mean (SD*)	161 (38.1)	171.4 (51.2)	0.371‡
Professionals in the surgical room, mean (SD*)	4.1 (0.9)	4 (0.9)	0.612‡
Preoperative hospitalization (days), mean (SD*)	1.0 (0.2)	1.2 (0.8)	0.269‡
Postoperative hospital stay (days), mean (SD*)	2.7 (1.4)	2.4 (0.9)	0.473‡

*SD - standard deviation; †BMI - body mass index; ‡Teste de Wilcoxon-Mann-Whitney

Of the 48 patients analyzed, eight (16.7%) developed SSI, including four (16%) in the IG and four (17.3%) in the CG. There was no significant difference between the study groups and the outcome of the SSI (Table 2). A tendency of reduction around 8% on SSI occurrence was observed among patients allocated to the IG (TICHG), however statistical significance was not observed (RR: 0.92 [95%, CI: 0.25–3.25] p=0.898). There were no statistically significant differences between the groups with regard to the use of drains (p=0.711), need for blood transfusion (RBC) in the IPOP (p=0.914), new surgical interventions (RR: 2.76 (95% CI: 0.11-64.76); p=0.167), or complications in the intraoperative period (p=0.191). A tendency of lower risk of hospital readmissions was observed among patients on IG (RR: 0.92; 95% CI: 0.92–13.87; p=0.925), however it cannot be concluded as the CI 95% included the value 1 (Table 2).

Regarding the location of SSI in the two groups, the highest incidences were for organ/space SSI (SSI-OC) (IG: n=2; 8%; GC: n=1; 4.3%) and deep incisional SSI (SSI-DI) (IG: n=2; 8%; GC: n=1; 4.3%), followed by superficial incisional SSI (ISC-IS) (GC: 2; 8.7%). SSIs were identified during hospitalization in two (25%) cases, including one each in the IG (12.5%) and CG (12.5%), while six (75%) cases were identified in the post-discharge surveillance period. All SSI cases were identified between the third and 13th postoperative day.

Table 2. Patient and procedure factors according to the development of surgical site infection and allocation to the intervention and control groups

Variables	Intervention group (n=25)		Control Group (n=23)		RR*** (95% CI¶¶)	p-value
	NSSI* (n=21) n(%)	SSI† (n=4) n(%)	NSSI* (n=19) n(%)	SSI† (n=4) n(%)		0,898**
Age (years), mean (SD‡)	47.7(9.7)	41.8(5.5)	46.1(11.9)	50.5(14.8)		0.849††
BMI§ (Kg/m²), mean (SD‡)	37(9.5)	32.5(9.3)	34.6(10.3)	39.8(4.4)		0.933††
Sex						
Female	21(100)	4(100)	15(78.9)	2(50)		0.247‡‡
Male	0(0)	0(0)	4(21)	2(50)		
Comorbidities						
DM‖	6(28.6)	1(25)	4(21)	3(75)		0.160‡‡
Cancer	2(9.5)	1(25)	5(26.3)	1(25)		0.614**
Smoking	1(4.8)	0(0)	3(15.7)	0(0)		0.571**
Hair removal	10(47.6)	3(75)	9(47.4)	2(50)		0.482‡‡
ASA¶ classification						0.071**
ASA¶ I	3(14.3)	0(0)	2(10.5)	0(0)		
ASA¶ II	11(52.4)	1(25)	12(63.2)	1(25)		
ASA¶ III	7(33.3)	3(75)	5(26.3)	3(75)		
Preoperative hospitalization (days), mean (SD‡)	1.0(0.2)	1.0(0.0)	1.2 (0.9)	1.2(0.5)		0.448§§
Postoperative hospital stay (days), mean (SD‡)	2.4 (0.8)	4.0(2.8)	2.2 (0.9)	3.2(0.9)		0.067‖‖
Duration of anesthesia (minutes), mean (SD‡)	206(51.5)	172(37.5)	199 (51.9)	269(23.9)		0.261††
Duration of surgery (minutes), mean (SD‡)	163(38.7)	152(39.3)	161 (48.4)	214(45)		0.227††
Professionals in the surgical room, mean (SD‡)	4.2(0.9)	3.5(0.5)	3.8(0.9)	4.7(0.9)		1.000§§
Surgery						0.687**
Gastrointestinal	11(52.4)	0(0)	9(47.4)	3(75)		
Gynecological	8(38.1)	3(75)	9(47.4)	0(0)		
Gynecological + gastrointestinal	2(9.5)	1(25)	1(5.2)	0(0)		
Urologic	0(0)	0(0)	0(0)	1(25)		
Anesthesia						1.000‡‡
Epidural/spinal + general	14(66.7)	2 (50)	14(73.7)	2(50)		
Spinal	5(23.8)	2 (50)	4(21)	0(0)		
General	2(9.5)	0(0)	1(5.3)	1(50)		
Antibiotic prophylaxis						0.206**
First-generation cephalosporin	21(100)	4(100)	17(89.5)	3(75)		
Third-generation cephalosporin	0(0)	0(0)	0(0)	1(25)		
None	0(0)	0(0)	2(10.5)	0(0)		
Blood transfusion	3(14.3)	0(0)	2(10.5)	1(25)		1.000‡‡
Drains	3(14.3)	0(0)	1(5.3)	1(25)		1.000**
New surgical intervention	0(0)	1(25)	0(0)	0(0)	2.76(0.11- 64.76)	0.167**
Hospital readmissions	0(0)	1(25)	0(0)	1(25)	0.92(0.06-13.87)	0.025**
Intraoperative complications	2(9.5)	1(25)	0(0)	1(25)		0.191**

*NSSI - non-surgical site infection; †SSI - surgical site infection; ‡SD - standard deviation; §BMI - body mass index; ‖DM - diabetes mellitus; ¶ASA - American Society of Anesthesiologists; **Fisher test; ††Two sample t-test; ‡‡Pearson X^2 tests; §§Wilcoxon-Mann-Whitney test; ‖‖Brunner-Munzel test; ¶¶CI – confidence interval; ***RR – risk relative

Discussion

The hypothesis of this study, that TICHG was more effective than the CHGL for the prevention of SSI, was refuted. Analysis of the use of TICHG for preoperative bathing did not reveal a statistically significant difference in the prevention of SSI compared to the use of CHGL; that is, in this study, the interventions were equivalent in the prevention of SSI, possibly because both are based on the same antiseptic product, and the application type did not result in different effects on the control of SSI.

Of the 48 patients who completed the study, 16.7% developed SSI, with equal numbers of cases between groups. However, there were differences in the locations of SSIs as there were no cases of SSI-IS in the IG. The groups also had similar sociodemographic and clinical-surgical characteristics.

Preoperative bathing is an important process for SSI prevention or reduction; a large number

of antiseptic solutions and application techniques exist. Although there are limitations regarding the available scientific evidence, it seems that the benefits of its use exceed its potential harm or risks.[6,8-9,14,15]

Due to its cumulative antiseptic effect on the skin, TICHG is assumed to be associated with a reduced rate of SSI compared to that for antiseptic liquid or common soap;[16] however, the methodologies and results of studies assessing its use vary considerably.

An RCT that examined patients undergoing lower extremity total joint arthroplasty surgery, comparing the use of TICHG to bathing with soap and water both the night before and in the morning of surgery, reported a lower infection rate in the group that used the antiseptic agent, while the risk factors between the groups were similar.[17]

The same results were observed in a retrospective analysis of total knee arthroplasty that compared 991 patients who used TICHG (the night before surgery and the morning of surgery) to 2,726 patients who did not apply any antiseptic agent. The use of TICHG was associated with a reduced risk of SSI.[17] This study differs from the current one because it compared the use of an antiseptic-based intervention to a traditional showering with soap and water.

In contrast, retrospective analyses comparing the use of TICHG to that of CHGL in pre-operative bathing reported different results.

A retrospective investigation of the effect of the implementation of TICHG as an antiseptic preparation among patients undergoing elective vascular surgery did not reveal a reduction in the rates of SSI between the group that used TICHG in preoperative bathing and the group that used the liquid formulation.[18]

Another retrospective analysis compared the use of pre-operative bathing to TICHG (n=335) conducted with the aid of the nursing team immediately before the transfer of patients to the operating room, who performed two preoperative baths with conventional/liquid 4% CHG (n=284) prior to hospital admission, reporting a statistically significant reduction of SSI cases in the group that used the towels.[11] Unlike the other studies, the study included a professional trained to collaborate with the patients in the application of the product.

Considering that SSI is a relevant adverse event related to the surgery and should be controlled, the scientific literature on the no-rinse TICHG is limited, and the quality of the evidence is varied,[19] this pilot study adds evidence that supported that TICHG and CHGL were equivalent in preventing SSI. This pilot study could be a methodological guide for larger studies. Besides that, the results could be applied to ambulatory surgeries that are difficult to guarantee adequate preoperative bathing, and the TICHG could be an alternative.[20,21]

Conclusion

There was no significant difference between the use of 2% chlorhexidine gluconate-impregnated cloth and traditional bathing with 2% liquid chlorhexidine gluconate in the prevention of the occurrence of SSI. The number of SSI cases identified between the CG and IG were quantitatively equivalent but differed qualitatively, according to the location of the infection, because there were no cases of SSI-SI in the IG.

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Collaborations

Andrade FO and Poveda VB contributed to the study design, data analysis and interpretation, writing of article, relevant critical review of intellectual content and approval of the final version to be published.

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