

The efficacy of three hand asepsis techniques using chlorhexidine gluconate (CHG 2%)

EFICÁCIA DE TRÊS MÉTODOS DE DEGERMAÇÃO DAS MÃOS UTILIZANDO GLUCONATO DE CLOREXIDINA DEGERMANTE (GCH 2%)

EFICACIA DE TRES MÉTODOS DE DESINFECCIÓN DE LAS MANOS UTILIZANDO GLUCONATO DE CLORHEXIDINA ANTISÉPTICA (GHC 2%)

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ABSTRACT

The scrubbing of hands and forearms using antiseptic agents has been the standard pre-operative procedure to prevent surgical site infection. With the introduction of antiseptic agents, the need to use brushes for pre-operative disinfection has been questioned and it has been recommended that the procedure be abandoned due to the injuries it may cause to the skin. With the purpose to provide the foundations for the efficacy of pre-operative asepsis without using brushes or sponges, the objective of this study was to evaluate three methods of pre-operative asepsis using an antimicrobial agent containing chlorhexidine gluconate – CHG 2%; hand-scrubbing with brush (HSB), hand-scrubbing with sponge (HSS), and hand-rubbing with the antiseptic agent (HRA) only. A comparative crossover study was carried with 29 healthcare providers. Antimicrobial efficacy was measured using the *glove-juice* method before and after each tested method. Statistical analyses showed there were no significant differences regarding the number of colony-forming units when comparing HRA, HSB, and HSS techniques ($p=0.148$), which theoretically disregards the need to continue using brushes or sponges for hand asepsis.

DESCRIPTORS

Handwashing
Chlorhexidine
Infection control
Surgical wound infection
Perioperative nursing

RESUMO

A degermação cirúrgica das mãos e antebraços é um procedimento que integra as atividades de paramentação cirúrgica como uma medida de prevenção de infecção do sítio cirúrgico. Com o advento dos princípios antissépticos degermantes, a necessidade do uso de escovas para a degermação cirúrgica tem sido questionada e recomendado o abandono deste uso devido às lesões provocadas na pele. Com a finalidade de fundamentar a eficácia da técnica da degermação cirúrgica sem o uso de escovas ou esponjas, o objetivo deste estudo foi avaliar três métodos para degermação cirúrgica utilizando a formulação degermante de gluconato de clorexidina – GCH 2%: com escova, com esponja e sem artefato. Foram avaliados 29 profissionais da saúde, utilizando o método de *caldo de luva* para coleta de micro-organismos antes e depois de cada método testado. As análises estatísticas comprovaram não haver diferenças estatísticas significantes na redução microbiana entre os três métodos analisados ($p=0,148$), o que teoricamente descarta a necessidade da continuidade do uso de escovas e esponjas para a realização da degermação das mãos.

DESCRITORES

Lavagem de mãos
Clorexidina
Controle de infecções
Infecção da ferida operatória
Enfermagem perioperatória

RESUMEN

La desinfección quirúrgica de manos y antebrazos es un procedimiento que integra las actividades prequirúrgicas como medida de prevención contra infección del sitio quirúrgico. Con el advenimiento de la antisepsia desinfectante, se cuestiona y se recomienda dejar de lado el uso de cepillos debido a lesiones provocadas en piel. Para fundamentar la eficacia de la técnica de desinfección quirúrgica sin uso de cepillos ni esponjas, se objetiva evaluar tres métodos de desinfección quirúrgica, usando la fórmula desinfectante de gluconato de clorhexidina-GHC 2% con cepillo, con esponja y sin adminículos. Fueron evaluados 29 profesionales de salud, usándose el método de *caldo de guante* para recolección de microorganismos antes y después de cada método probado. El análisis estadístico no comprobó diferencias significativas en la reducción microbiana entre los tres métodos ($p=0,148$), lo que teóricamente descarta la necesidad del uso de cepillos y esponjas para desinfección de manos.

DESCRIPTORES

Lavado de manos
Clorhexidina
Control de infecciones
Infección de herida operatória
Enfermería perioperatoria

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INTRODUCTION

Hospital-acquired infections (HAI) represent a problem both in Brazil and in the world and constitute a risk to the health of hospital services users. Preoperative infections, currently called Surgical Site Infections (SSI), constitute a significant portion of the total of all these infections and are considered the second main cause of HAI⁽¹⁾. SSI prevention and control depends on health care workers adhering to preventive measures.

Among the SSI prevention practices, hand and forearm antiseptics for the surgical team members as a preoperative preparation began when Ignaz Semmelweis recommended the use of germicide to wash hands before examining pregnant women in 1847. Around 1860 Joseph Lister introduced the principles of asepsis in the practice of surgical procedures, substantially reducing the morbidity of patients in the postoperative period⁽²⁻³⁾.

In addition to the fact that some gloves are permeable to bacteria, hand and forearm antiseptics is justified because gloves perforate at a rate of 18% at the end of surgeries and in more than 35% of these cases, perforations are not perceived by surgeons⁽⁴⁻⁵⁾. Initially and for a long time, hand and forearm antiseptics technique included brushing with warm water and mild soap followed by immersing hands and forearms in antiseptic solution of iodine alcohol and then alcohol⁽⁶⁾. However, the discomfort and risk of skin lesions caused by brushing can lead professionals to reduce the time of brushing, consequently reducing time of contact between the antiseptic and area to be cleaned, compromising the process of reducing microbial load. With the advent of antiseptic detergent solutions, the adverse effects of brushing could be minimized through the abolition of such a procedure and rubbing detergent solutions on the skin during the time required for the product to act, was adopted^(3,7).

Despite innumerable international studies^(3,8-14) contraindicating the use of artifacts for performing hand antiseptics, the studies found evaluated the efficiency of mechanical and chemical methods to perform hand antiseptics with the solution of chlorhexidine gluconate at 4% instead of 2%^(4,9,15-17).

Since the brushing technique is still used in many Brazilian health facilities and considering that the chlorhexidine gluconate solution at 2% (GCH 2%) is one of the solutions most used in Brazilian facilities for surgical hand and forearm antiseptics, we decided to conduct this study to compare the efficiency of three antiseptic hand rub techniques to reduce microbial load using GCH 2%: rub-

bing with a disposable brush, a sponge, and without any artifacts.

METHOD

Study's population

A total of 32 health workers were initially recruited. These were volunteers who met the following inclusion criteria: not regularly using antiseptic detergents in their daily activities to avoid causing cumulative or residual effects of any antiseptic active principle; and participating in a training program concerning hand and forearm antiseptics technique prior to data collection through formal theoretical practical teaching using a movie we had developed (TV and video).

Those using antibiotics or similar medication (topical or systemic) two weeks before or during data collection; those reporting previously known sensitivity to GCH; those with skin lesions on hands and/or forearms; those who were not able to reproduce the technique according to the standardized procedure; and those who did not complete the study were excluded.

Hand antiseptics protocol

The standard antiseptics technique was the same for the three tested methods. It was applied on the dominant hand given the belief that the motor skill of the non-dominant hand is diminished. Hence, we wanted to avoid conducting a worse-case scenario investigation. Each volunteer performed the three antiseptics methods, while the first method was defined by a draw at the beginning of data collection. An interval of seven days between the collection of a specific method and another in the same volunteer was

observed to allow skin microbiota to recover after antiseptics^(6,8). Each volunteer took off any jewelry and hands and forearms were assessed to identify potential skin lesions.

The first collection of material for culture was performed on the dominant hand (It) according to the *glove juice* standard technique^(8,18). The technique consisted of immersing the dominant hand of volunteers in sterile surgical gloves without talcum powder, purposely large (nº. 12) containing 150 ml of culture fluid tryptic soy broth with added 0.5% of Tween 80. The first solution is an enriched means to transport microbiological samples and the second is a means to neutralize any residue of GCH. One of the researchers rubbed the volunteers' gloved hands from the outside in a standardized manner for 60 seconds to promote a greater contact of the hands surface and the liquid⁽¹⁹⁾. At the end of the procedure, the

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liquid from inside the glove (150ml) was aseptically transferred to a sterilized container with lid, which was immediately sent to the laboratory for bacteriological analyses. This procedure was repeated before (It) and after (Ft) the hands antiseptics procedure was performed in the three evaluated techniques.

Immediately after the collection of material in the initial time (It), each volunteer performed the standard antiseptics method on the dominant hand and forearm, beginning by the randomly selected method (with a brush, sponge or without any artifact). The antiseptics process was standardized by *counting movements* and not by counting time. The technique used was based on official guidelines⁽²⁰⁻²¹⁾.

After antiseptics was performed on the dominant hand and forearm, the volunteer waited 15 seconds to remove excess rinsing water by keeping the hand above the elbow level. After this period, the volunteers put on their sterilized surgical gowns, with fists pulled up with the middle third of the forearm to avoid accidental contamination during collection of microorganisms in the final time (Ft). Then, we performed microbiological collection from the dominant antiseptic hand, repeating the glove juice technique and the sequential steps already described.

Microbiological analyses

In the microbiological analysis laboratory, each collected sample was homogenized and quantitatively seeded with the aid of a calibrated loop; the plates contained blood agar and MacConkey agar. After sowing, the blood agar plates were incubated in a CO₂ stove at 36°C to promote the growth of anaerobic microorganisms, and the MacConkey agar at 36°C for the growth of aerobic microorganisms, for 48 hours. After the incubation period, the colonies present in the plates were counted and the total number of colonies was multiplied by the factor of dilution (1:100) to define the total of colony-forming units per milliliter of sample (CFU/ml).

The equivalence of sample collection using a calibrated loop in place of a pipette was assessed using the Wilcoxon test and the Mann-Whitney test. No statistically significant differences were found between the two methods ($p < 0.05$), which validated the laboratory method of analysis.

Data analysis

The level of significance was fixed at 5% for the statistical analyzes. Statistics with $p \leq 0.05$ were considered significant. The dependent variable (microbial count) did not present normal distribution in the sponge antiseptics technique. These were normalized for the analysis and re-transformed in their measurement scale to present the results.

The analysis of variance for repeated measures using the GLM (generalized linear model) was used as a para-

metric statistical technique, which is a statistical procedure that incorporates normally distributed dependent variables and categorical or continuous independent variables.

To verify whether the microbiological counts of the three analyzed methods differ among them, the 2 x 2 multiple comparison was used. In this case, the level of significance takes into account the model's number of comparisons.

The power as a function of the sample size ($n=49$) for ANOVA with repeated measures, a continuous dependent variable (microbial count), $\alpha=0.05$, bi-tailed test and continuity correction was 0.979.

Because this is a laboratory test, the study was exempted from submitting the project to the Ethics Research Committee. The opinion of the Ethics Research Committee at the University of São Paulo, School of Nursing is presented: *In response to your request we inform you that the study entitled: 'Efficacy of three hands antiseptics techniques using chlorhexidine gluconate (GCH 2%)' does not require the approval of the Ethics Research Committee since it is of a laboratory nature with analysis of microorganisms, not involving human beings, in accordance with Resolution 196/96, National Council of Health.*

RESULTS

Data collection was initially conducted using 32 professionals: 24 (75%) women and eight (25%) men, on average 43.3 years old ($SD=7.4$ years). Three of these were excluded: one was allergic to the antiseptic solution and the other two could not reproduce the antiseptic technique, totaling a sample of 29 volunteers. The samples of volunteers who presented initial microbial count equal to zero were also excluded because these did not allow establishing a parameter to compare microbial reduction after the antiseptic procedure. Similarly, those samples whose final microbial count (after antiseptics) was greater than the initial count (before antiseptics) were also excluded from the sample analyzes because they indicated accidental contamination of samples. This measure was based on the literature⁽²²⁾ to avoid compromising the results of the analyzes.

The total number of analyzed samples was 49: 19 samples refer to the antiseptic technique with a brush, 10 refer to the antiseptic technique with a sponge, and 20 samples refer to the antiseptic technique without any artifact.

No statistically significant difference was found between the three tested methods ($p=0.664$), when the microbial load, measured by the number of colony-forming units, was compared before antiseptics of hands (It), suggesting the groups were homogenous (Figure 1).

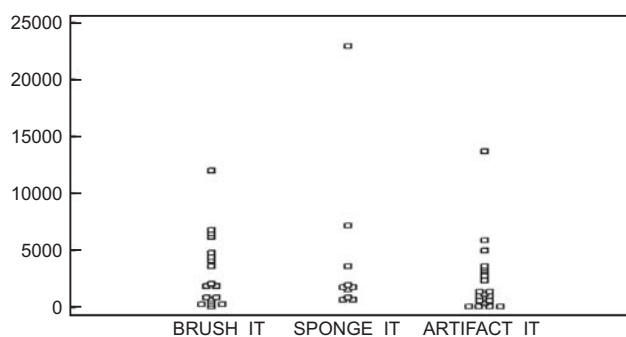


Figure 1 – Comparison of values of bacterial load in the initial time between the three hand and forearm antiseptic methods with GCH 2%.

The microbial load measured before and after each of the antiseptic methods was compared and a statistically significant ($p < 0.05$) reduction was observed in the number of colony-forming units, suggesting the three techniques were efficacious in reducing the microbial count on hands and forearms (Table 1). This reduction was equivalent across methods, which can be verified in Table 2.

Table 1- Comparison of the quantity of colony-forming units (CFU) before and after each of the three antiseptic hand and forearm methods with GCH 2% was performed.

Antiseptic method	Before		After		p
	Average	SD*	Average	SD*	
With brush	3380	1188.86	300	207.36	0.002
With sponge	1980	445.42	140	140.00	0.007
Without artifact	2540	536.28	340	227.16	0.006

*SD= standard deviation

Table 2 – Distribution of values of the difference of averages of bacterial count in the initial and final times of the antiseptic hand and forearm with GCH 2% in the three tests methods

Two-by-two comparison, Initial time (It)						
Method	Method	Differences of averages (delta)	Standard error	p ^a	95% confidence interval ^a	
					Lower limit	Upper limit
1	2	1400	1049.285	0.759	-2755.996	5555.996
	3	840	1171.153	1	-3798.688	5478.688
2	3	-560	733.894	1	-3466.796	2346.796
Two-by-two comparison, Final time (Ft)						
Method	Method	Differences of averages (delta)	Standard error	p ^a	95% confidence interval ^a	
					Lower limit	Upper limit
1	2	160	81.240	0.361	-161.776	481.776
	3	-40	40	1	-198.431	118.431
2	3	-200	104.881	0.388	-615.411	215.411

Estimated marginal averages: a. Adjustment for multiple comparisons: Bonferroni; 1- Antisepsis of hands with brush; 2- Antisepsis of hands with sponge; 3- Antisepsis of hands without any artifact

The analyses to evaluate the three tested methods, performed through parametric tests (GLM repeated measures), showed there was no statistically significant differences across the methods ($p = 0.148$), permitting us to infer that the antiseptics methods are equivalent.

Similarity was observed among the different techniques in relation to the microbial agents isolated in the samples obtained after the antiseptic procedure. The main identified agent was negative *Staphylococcus coagulase*, followed by *Corynebacterium spp* and *Micrococcus spp*, which represent normal skin microbiota.

DISCUSSION

The results obtained in this study showed that the three tested antiseptic methods (rubbing with disposable brush, rubbing with sponge, and rubbing without any artifact) presented equivalent efficacy in reducing microbial

contamination. Similar results were found in the literature concerning comparison of efficacy of the antiseptic method with or without the use of artifacts^(3,8-15,23).

In addition to indicating that there are no additional advantages in the results of antisepsis performed with brush or sponge, there are studies also evidencing that rubbing hands without the use of artifacts is most cost-effective^(4,9-10,24-25), describing better tolerance of skin when the antiseptic procedure is performed only using hands^(10-17,24-29), and emphasizing that the active principle of the solution used and the rubbing movements performed with hands are the main factors in reducing the microbial load, regardless of the use of artifacts^(3-4,8-9,17,24,26,28-30).

The laboratory investigation permitted controlling the variables, which conferred greater confidence in the results obtained. In spite of the methodological references used in this investigation, this study supports the possibility of excluding the use of artifacts in the antisepsis of

hands and forearms of surgical teams using chlorhexidine gluconate at 2% within the scrub procedure, corroborating the cited international studies.

Even though there are innumerable international studies that do not recommend the use of artifacts while performing antiseptics of hands^(4,9,15,17,26,28-29), there is still a large number of Brazilian professionals who do not adhere to the practice supported by this evidence.

We expect this study will contribute to a change in the Brazilian practice of hand antiseptics. To change such a practice, it is important to invest in continuing education programs, human resources training and in new scientific research^(4,16,23,25); a lack of studies developed in the Brazilian context motivated this study.

CONCLUSION

The quantitative analyses of microorganism after surgical hand antiseptics (Ft) matched the efficacy of the three analyzed methods, which supports the possibility of ex-

cluding the use of disposable brushes in the preoperative antiseptic surgical hand scrub with GCH 2%, which was the active principle chosen in this experiment.

STUDY'S LIMITATIONS

A limitation in this study related to putting the investigation method into operation is the possibility of error during the manipulation of samples in the scope of the microbiology laboratory when the initial microbial count was equal to zero or when the final count was greater than the initial count.

Another aspect that does not constitute a limitation in this study but raises questions is related to the residual effect of the studied surgical antiseptics and also the generalization of results for other detergent active principles such as polyvinylpyrrolidone iodine. The scope of this study was not broad given its focus, which was the need to investigate whether the use of artifacts such as brushes were indispensable for the studied practice.

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