Journal of Veterinary Science and Public Health

J. Vet. Sc. Public Health, v. 8, n. 1, p. 028-037, 2021

COMPARISON OF ANTIMICROBIAL EFFECTIVENESS OF SURGICAL HAND PREPARATION METHODS BETWEEN SURGICAL SCRUBBING AND THE HAND RUBBING METHOD

COMPARAÇÃO DA EFICÁCIA ANTIMICROBIANA ENTRE O MÉTODO DE DESINQUINAÇÃO POR ESCOVAÇÃO TRADICIONAL E A LAVAGEM CIRÚRGICA DAS MÃOS PELO MÉTODO DE MASSAGEM

Jomara Jordana Smarra[1*]; Monise Cristina Colognesi[1]; Leticia Vasques Alvares[1]; André Fernandes Lúcio[1]; José Erick Galindo Gomes[1]; Leonardo Sanches[1]; Isabela Belei Delmaschio[1]; Giovanna Rossi Varallo[1]

1.Centro Universitário do Norte Paulista
* email: jomarasmarra@hotmail.com
DOI: 10.4025/revcivet.v8i1.52693

RESUMO

A profilaxia da infecção cirúrgica envolve um conjunto de manobras que visa a prevenção das infecções no sítio cirúrgico. Dentre tais técnicas, pode-se citar a desinquinação. O objetivo do estudo foi comparar, por meio da avaliação qualitativa microbiológica, a eficiência dos métodos de desinquinação por escovação e por massagem das mãos. O grupo foi composto por 15 voluntários selecionados aleatoriamente. O preparo cutâneo pelo método da escovação baseou-se na escarificação com clorexidina e escovas descartáveis e o método escolhido foi o número de escovação por área cutânea. Já o método de massagem foi realizado com o mesmo degermante, porém apenas com a fricção das mãos. Ambos os métodos seguiram os protocolos ANVISA. Após a secagem, foram colhidas amostras da superfície da pele das mãos com *swab* estéril. Este foi embebido em dez mL de solução salina 2% por cinco minutos. Após, foi inoculado um mL dessa solução em placas de Petri estéreis, em profundidade, e cultivados em meio de cultura *Plate Count Agar*. As placas foram incubadas em estufa convencional a 35°C por 72 horas. Foi possível constatar que a técnica de escovação cirúrgica apresentou menor crescimento bacteriano que a técnica de massagem. Entretanto, não houve associação entre os métodos de desinquinação e o crescimento de microrganismos. Já na coloração de Gram, observou-se predominância de cocos Gram-positivos e Gram-negativos; bacilos Gram-positivos e Gram-negativos nos dois métodos. Infere-se que ambos os procedimentos de desinquinação são apropriados.

PALAVRAS-CHAVE: antissepsia, bactéria, degermação, pele

ABSTRACT

The prophylaxis of surgical infection involves a set of techniques aimed at preventing infections at the surgical site. Among such techniques is surgical hand preparation. The objective of the study was to compare, through qualitative microbiological evaluation, the efficiency of surgical hand preparation methods between surgical scrubbing and the hand rubbing. The study was composed of 15 volunteers selected at random. Skin preparation using

the surgical scrubbing method was based on scrubbing with chlorhexidine and disposable brushes with a consistent number of passes per skin area. The hand rubbing method was performed with the same degerming agent, but only with hand rubbing. Both methods followed the ANVISA protocols. After drying, samples of the skin surface of the hands were taken with a sterile swab. This was soaked in ten mL of 2% saline for five minutes. Afterwards, one mL of this solution was inoculated in sterile Petri dishes, in depth, and cultured in Plate Count Agar culture medium. The plates were incubated in a conventional oven at 35°C for 72 hours. It was possible to verify that the scrubbing technique showed less bacterial growth than the hand rubbing technique. However, there was no association between surgical hand preparation methods and the growth of microorganisms. Gram staining showed a predominance of Gram-positive and Gram-negative cocci; Gram-positive and Gram-negative bacilli in both methods. It is inferred that both procedures are appropriate.

KEY WORDS: infection; microorganisms; skin; surgical site.

INTRODUCTION

Surgical hand antisepsis aims at destroying transient microorganisms and inhibiting the growth of resident microorganisms. Therefore, a routine prior to invasive medical interventions is necessary, as such a technique can reduce the risk of surgical site infections (SSI) in patients (TANNER et al., 2008). SSIs result in delayed healing, increased length of hospital stay and the use of antibiotics, unnecessary discomfort and, in the most severe cases, can be the trigger aggravations leading to morbidity and, in the extreme cases, death. In addition, SSIs are a source of frustration to surgical tutors (TANNER et al., 2008; WEESE et al., 2012; WIDMER, 2013). Although there is less research in veterinary medicine compared to that of humans, the rate of SSI that occurs in small animals is similar to that of humans (WEESE et al., 2012).

The sources of microorganisms capable of causing SSIs come from different areas of a hospital. Within a surgical center, in addition to the patient himself, the fomites, the environment and the surgical team are important elements for this dynamic (AMARAL; da FONSECA, 2013; FOSSUM, 2019). Surgeons' hands are considered the second leading cause of contamination from surgical wounds. As an integral part of ISC prophylaxis strategies, the surgical hand preparation is necessary and mandatory (SILVA et al., 2015; FOSSUM, 2019). In addition, members of the surgical team must wear sterile gloves to prevent bacterial contamination between the surgeon's hands to the surgical site to increase patient safety (TANNER et al., 2016).

As already mentioned, while hand washing removes transient microorganisms, surgical hand antisepsis also aims to inhibit the growth of resident microorganisms, minimizing the risk of a patient developing SSI (WHO, 2009). These cutaneous microorganisms constitute the microbiome of the integument (subcutaneous tissue). Those are easy to remove, as they inhabit the superficial layers of the skin (epidermis and dermis), and are removed with a simple wash and are associated with SSIs. However, residents are difficult to remove, as they colonize the deeper layers of the integument, but are considered less pathogenic in intact skin. The inhibition of these is achieved with the use of degerming antiseptics (WEESE et al., 2012; TANNER et al. 2016; FOSSUM, 2019).

Degerming antiseptics are substances intended for the treatment and antimicrobial prophylaxis of the skin and mucosa, in order to inhibit the reproduction and / or the growth speed of the microorganisms present (RIZZO et al., 2016). For this reason, they are recommended for surgical hand preparation methods (FOSSUM, 2019). Therefore, such

products must have fast action, broad spectrum, residual effect and not irritate the skin, as well as inhibit the rebound effect of bacterial proliferation. The detergents currently most used in skin preparation based on disinfection are chlorhexidine gluconate, iodine-povidone and hexachlorophene. Alcoholic solutions, associated with chlorhexidine or iodine-povidine or other antiseptics, are more recommended for the hand rubbing method for the tegumentary preparation of the surgical team (FOSSUM, 2019).

Hand hygiene consists of an orderly and methodical process that associates the use of antiseptics and the appropriate procedure for the chosen technique (SOUZA; SANTANA 2009). The ideal method of hand preparation should be fast, effective, non-irritating, economical and with residual effect (PELOSI, 2019). Due to the importance, in addition to textbooks, the guidelines on pre-surgical hand preparation were also detailed by the World Health Organization (WHO, 2009) and by the National Health Surveillance Agency (ANVISA, 2009).

In relation to the techniques or maneuvers of surgical hand preparation, methods of exfoliation with surgical scrubbing and hand rubbing have been described (use of brushless and water-assisted antiseptics, or alcoholic brushless and waterless surgical antiseptics) (PELOSI, 2019; FOSSUM , 2019).

The surgical scrubbing technique is used to promote the mechanical and chemical removal of dirt and any material that could be considered contaminant in surgery. Such procedure is performed with the aid of a sterile brush and antiseptic solution, with a focus on reducing the transient and resident microbiota. The method can be chronological or anatomical. In that one the precise and careful scrubbing of the hands and forearms is carried out for ten minutes, which takes this process to be repeated three to four times due to the execution time. The anatomical is based on the number of strokes per surface (from ten to twenty) and follows a careful sequence, repeated twice, from the nails to the elbow (GRUMADAS et al., 1991; SHMON, 2007).

Despite being considered an effective method, the use of the scrub brush can cause discomfort and even cutaneous lesions at the time of rubbing, which induces the professional to reduce the time for demining (SILVA et al., 2011). Goulart et al. (2011) reported that the continuous use of a scrub brush, associated with the use of degerming agents can lead to skin deterioration, causing an unwanted modification of the microbiota, thus increasing the number of Gram-negative bacteria.

The hand rubbing technique is performed only through chemical antisepsis, with the application and rubbing of the antimicrobial agent with your own hands, without the use of scrub brushes. This technique can present results similar to those of the surgical scrubbing technique, when compared to the microbiological study (SILVA et al., 2011). The rubbing time is unknown, however studies indicate that five minutes of contact of the degerming antiseptic with the skin is safe and effective (SHMON, 2007). Pelosi (2019) reported that this method, when associated with alcohol-based cleaners, has a reduced scrubbing time, on average, two minutes, maintaining the effectiveness of the procedure. The main advantages of this method include less dryness, erythema and skin roughness (PELOSI, 2019; FOSSUM, 2019).

The objective of the present study is to compare the effectiveness between the techniques of surgical scrubbing and hand rubbing, both with the use of conventional degerming antiseptic, through the skin microbiological assessment of the volunteers' hands after the execution of each method on different days.

MATERIAL AND METHODS

Experimental group

The experimental group consisted of 15 students from the fifth year of the Veterinary Medicine course at Centro Universitário do Norte Paulista - UNORP, São José do Rio Preto, SP. The definition of this population was randomized. Each method was performed by all academics, in the right and left hands. The interval between scrubbing and hand rubbing disinfection was 30 days.

Surgical hand preparation by Scrubbing

The cutaneous preparation using the surgical scrubbing method was based on scrubbing the skin with dry disposable scrub brushes for asepsis, soaked in Rioquimica® brand 2% chlorhexidine gluconate detergent. The method chosen was the number of brushing or strokes per skin area, as described by ANVISA (SOUZA; SANTANA 2009). 20 strokes were standardized in each area of the right and left hands, one hand at a time, in a minimum time of five minutes. When performing surgical antisepsis, the fingers, hands and forearms were covered with four sides and each one was effectively scrubbed. The hands were rinsed with running water at room temperature. Then, the hands were dried with a sterile surgical drape.

Surgical hand preparation by Hand Rubbing

The skin preparation for the hand rubbing method was based on the rubbing of the forearms and hands with the 2% chlorhexidine gluconate degermant as described by ANVISA (SOUZA; SANTANA, 2009). It was also established the time of five minutes for the execution of this method of disinfection, since it was not an alcohol-based solution. The hands were rinsed with running water at room temperature. Then, the hands were dried with a sterile surgical drape.

Microbiological Study

The microbiological evaluation was identical for both methods of surgical hand preparation. A sample was taken for each volunteer, after drying the hands with a sterile compress. The skin samples were obtained with the aid of a sterile swab (Absorve®), which was covered in the right and left hands, covering the nail and subungual regions, the palm and interdigital spaces. Figure 1 summarizes the main sample collection steps performed in the left hand.

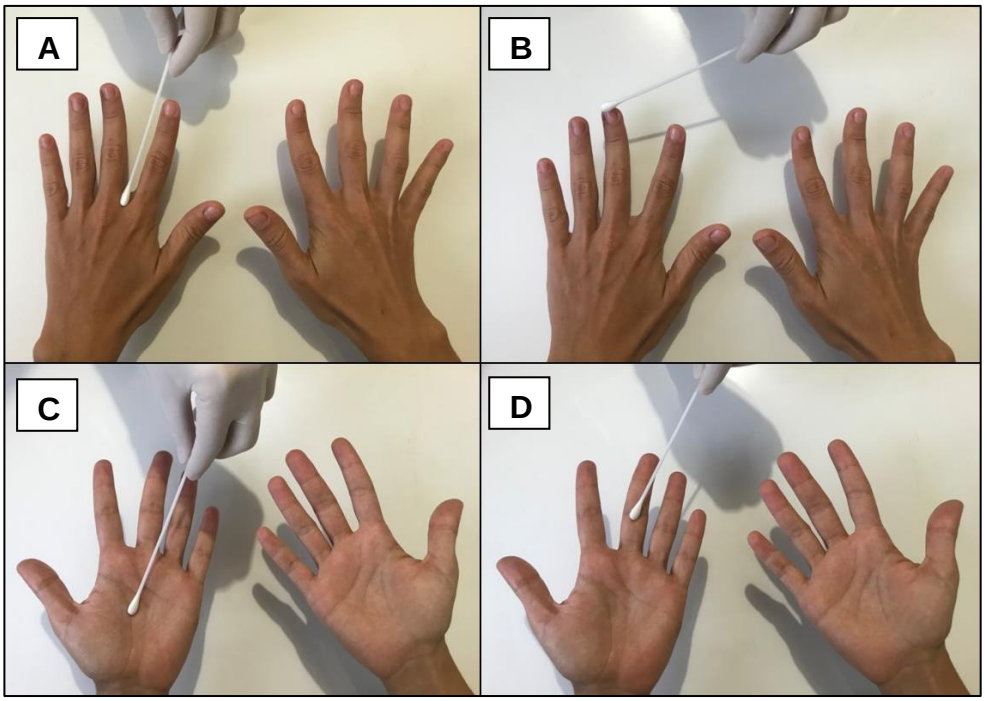
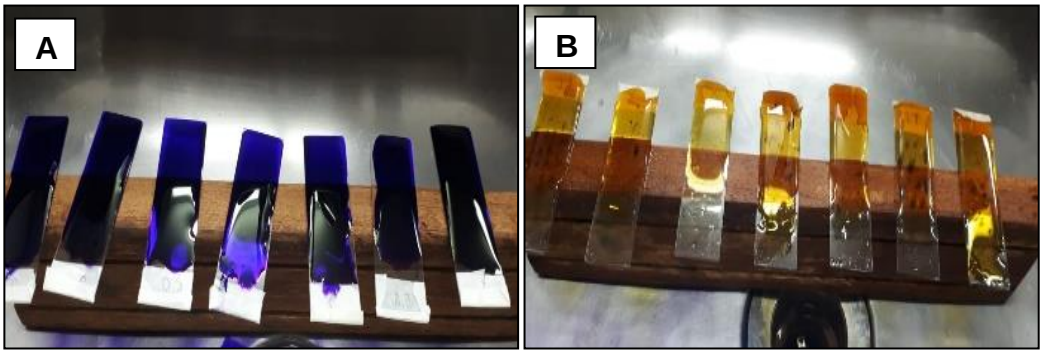


Figure 1: Photograph of the method of collecting skin samples in the left hand. (A) Harvesting in interdigital spaces. (B) Harvest in the subungual and nail regions. (C and D) Harvest on the palm and digits.

Immediately afterwards, the swab was soaked in ten milliliters (mL) of 2% saline contained in a test tube, where it remained for five minutes. Then, 1 ml of this solution was aliquoted in Petri dishes, empty and sterile, sown in depth, to be grown in Plate Count Agar (PCA) culture medium. Therefore, each sample of this solution was deposited in 20 mL of Plate Count Agar (PCA) at a temperature of 46 to 48ºC. At this stage, the microbiological study was conducted in triplicate. The plates were inverted and incubated in a conventional oven at 35 °C for 72 hours. After this period, the colony-forming units (CFU) were quantified with the aid of a manual colony counter.

After the incubation time, the plaque with bacterial growth was identified and separated. With the aid of a sterile swab, samples of the colonies were taken to classify the bacteria into Gram-positive and Gram-negative (Figure 2). The methodology described by the Ministry of Health (MARTINS et al. 2001) was used.



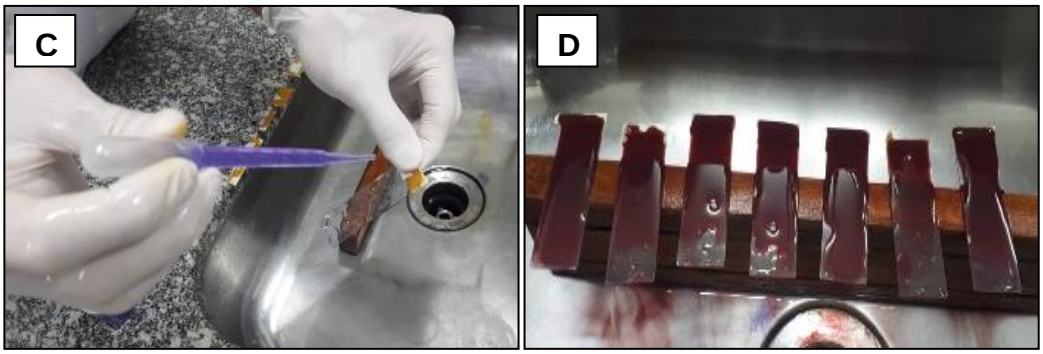


Figure 2: Photograph of the serial Gram staining protocol. A) Blade stained with methyl violet. B) Blade stained with Lugol's Iodine. C) Blade bleached with ethyl alcohol (99.5 °GL). D) Blade stained with Fuchsine.

After performing the staining step, the specimens were interpreted by a veterinary clinical pathologist with the aid of an optical microscope (Bioval®).

Statistical analysis

Statistical analysis was performed using the IBM SPSS software, using the statistical chi-square test of independence ($p < 0.001$), to verify the existence of an association between the methods used in the present study and the growth of microorganisms.

RESULTS AND DISCUSSION

It was observed that the surgical scrubbing technique showed growth in 15.5% of the samples, while the hand rubbing technique 24.4% (Figure 3). However, from the statistical analysis, it was found that there was no association between them and the growth of microorganisms ($p = 0.430$). That is, there is no statistically significant difference between the procedures performed regarding the effectiveness of reducing UFCs.

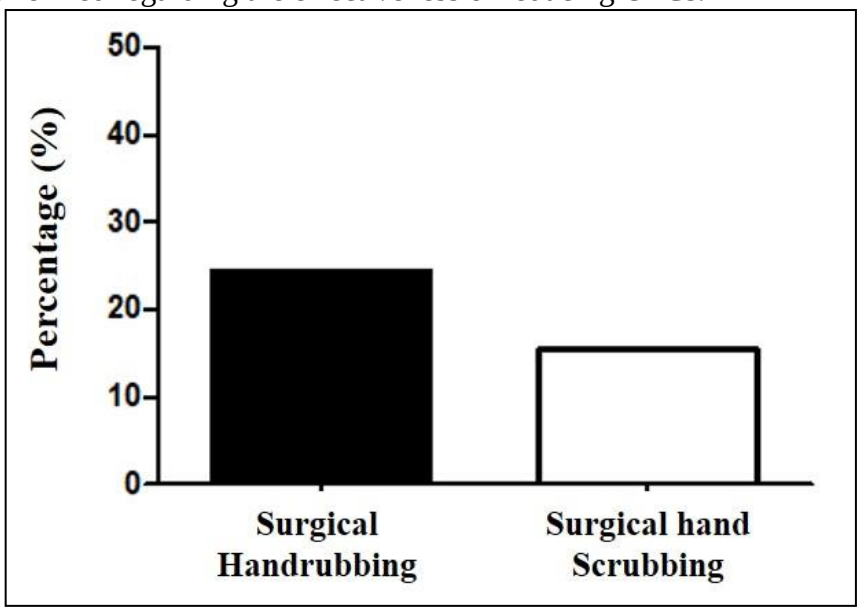


Figure 3: Percentage of plaques with bacterial growth after scrubbing and hand rubbing techniques.

Regarding the morphological characterization of bacterial colonies (Figure 4), the growth of Gram-positive and Gram-negative cocci, as well as Gram-positive and negative

bacilli, was observed in both methods. Gauer, da Silva (2017) carried out a qualitative and quantitative analysis of the microbiota of the hands of the employees of a health unit and, as in this study, observed the presence of Gram-positive cocci and Gram-negative bacilli, but did not identify Gram cocci-negative and Gram-positive bacilli.

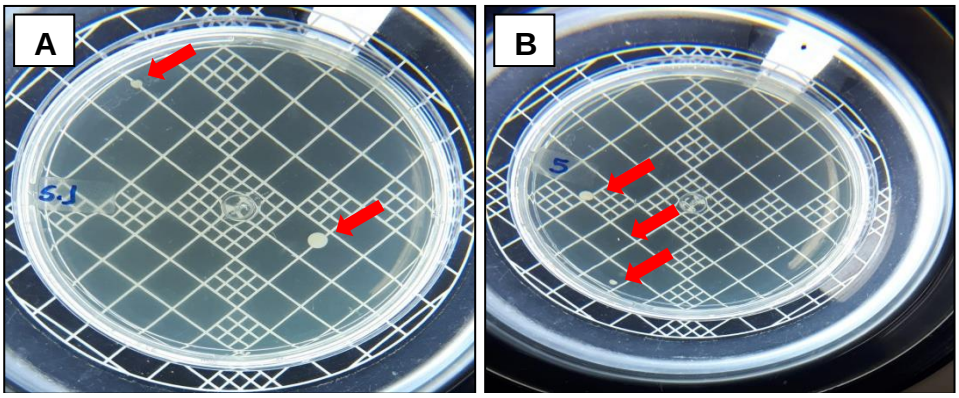


Figure 4: Photograph of the plates with UFCs. (A and B) Plates with PCA culture medium with growth of bacterial colonies.

Carro et al. (2007) conducted a survey to compare the effectiveness of hand rubbing and scrubbing methods. The study was divided into four consecutive periods, each lasting two weeks. Scrubbing was performed during the first and third periods, and hand rubbing during the second and fourth. The fingerprints were removed before and immediately after the surgical hand preparation, and every two hours of the surgical procedure. At the end of the study, the hand rubbing technique resulted in a greater reduction in the bacterial microbiota of the hands, but statistically the difference between the two techniques was not significant. Although the methodology used differs from the present research, the results corroborate the findings of Carro et al.

Silva et al. (2011) carried out a study to compare the effectiveness between scrubbing and hand rubbing methods, using two different antiseptic solutions. The study was divided into four groups: group I used the polyvinylpyrrolidone-iodine deodorant (PVP-I) at 10% and performed the scrubbing technique; group II used the same antiseptic solution as group I, however associated with the hand rubbing technique; group III used a 2% chlorhexidine digluconate degermante associated with the scrubbing technique; group IV used 2% chlorhexidine associated with hand rubbing. The greatest bacterial reduction was noticed after performing the hand rubbing technique, with both antiseptics. Therefore, the researchers showed that hand rubbing, when performed correctly, is a valid strategy for skin preparation of the hands and forearms of surgeons. However, it contradicts the data from the present study.

Lugoch et al. (2016) also carried out a comparative study between the two methods of surgical hand preparation (scrubbing and hand rubbing) and found that there was no statistically significant difference between them. The authors cited that both showed efficacy right after the surgical hand preparation and emphasized that the antisepsis process without the use of scrub brushes is as good as the scrubbing method, because, in addition to reducing the risks of skin lesions caused by the scrub brush, the contact between the antiseptic and the area to be cleaned is greater and more concentrated. Such results are in agreement with the findings of the present study.

Liu, Mehigan (2016), in a systematic review with the aim of evaluating the effect of surgical hand preparation techniques on the skin and on the occurrence of SSI, also found, as

in this study, that hand rubbing methods are as effective as surgical scrubbing methods. In addition, they stressed that the act of rubbing the hands causes less injury to the skin, increasing the tolerability of the procedure by the surgical team. This is extremely important, as it allows repeated processes to be executed, all with the required disinfection.

One of the limitations of this research was the number of samples evaluated. However, it is a pilot project, with promising results.

CONCLUSIONS

There is no statistically significant difference in the efficacy of reducing CFUs between the methods of surgical hand preparation evaluated in the present study immediately after antisepsis.

It is inferred that both methods are effective for surgical hand preparation of the surgical team.

Authors' Contributions

Jomara Jordana Smarra: elaboration of the research, obtaining and processing of samples, identification of the genera of bacteria, elaboration of the scientific article.

Monise Cristina Colognesi: assistance in obtaining and processing samples and editing the scientific article.

Letícia Vasques Alvares: assistance in obtaining and processing samples.

André Fernandes Lúcio: assistance in obtaining and processing samples and editing the scientific study.

José Erick Galindo Gomes: technical support in the statistical evaluation of the study.

Leonardo Sanches: identification of the genera of bacteria.

Isabela Belei Delmaschio: obtaining and processing samples, identification of bacterial genera, editing the scientific study.

Giovanna Rossi Varallo: elaboration of the research, elaboration and editing the scientific study.

REFERENCES

AMARAL, L. G.; da FONSECA, A. F. B. Profilaxia da infecção. In: OLIVEIRA, A. L. A. **Técnicas cirúrgicas em pequenos animais**. 1.ed. Rio de Janeiro: Elsevier, 2013, s.p.

ANVISA. **Segurança do Paciente em Serviços de Saúde: Higienização das Mãos**. Brasília, DF: Agência Nacional de Vigilância Sanitária, 2009, 104 p.

CARRO, C.; CAMILLERI, G.; TRAORE, O.; BADRIKIAN, G.; LEGAULT, B.; AZARNOUSH, K.; DUALÉ, C.; DE RIBEROLLES, C. An in-use microbiological comparison of two surgical hand disinfection techniques in cardiothoracic surgery: hand rubbing versus hand scrubbing. **Journal of Hospital Infection**, v. 67, p. 62-66, 2007. <DOI: 10.1016 / j.jhin.2007.06.016>.

FOSSUM, T. W. Preparation of the surgical team. In: FOSSUM, T. W. **Small Animal Surgery**. 5.ed. Philadelphia: Elsevier, 2019, p. 42-50.

GAUER, D.; da SILVA, G. K. Análise qualitativa e quantitativa da microbiota das mãos dos funcionários de um posto de saúde. **Revista Brasileira de Análises Clínicas**, v. 49, n. 2, p. 206-212, 2017. <DOI: 10.21877/2448-3877.201600522>.

GOULART, D. R.; ASSIS, E. A.; DE-SOUZA, M. T.; Avaliação microbiológica da antissepsia pré-operatória das mãos. **Revista cirúrgica traumatológica buco-maxilo**, v. 11, p. 103-112, 2011.

GRUMADAS, C. E. S.; RAISER, A. G.; PAIVA, M. G. S.; WOUK, A. F. F.; ALBUQUERQUE, A. J. D.; SOUZA, F. P.; BADKE, M. R. T. Comparação entre dois métodos de escovação para antissepsia das mãos dos componentes da equipe cirúrgica. **Ciência Rural**, v. 21, p. 379-391, 1991. <DOI: 10.1590/S0103-84781991000300006>.

LIU, L. Q.; MEHIGAN, S. The Effects of Surgical Hand Scrubbing Protocols on Skin Integrity and Surgical Site Infection Rates: A Systematic Review. **AORN Journal**, v. 103, p. 468-482, 2016. <DOI: 10.1016/j.aorn.2016.03003>.

LUGOCH, G.; MAGRINI, F.; DICHETE, C.; BECKMANN, D. V. Avaliação dos métodos de antissepsia cirúrgica das mãos. In: **Anais do VII Salão Internacional de Ensino, Pesquisa e Extensão**. Salão Internacional de Ensino, 2016, Rio Grande do Sul., 2016.

MARTINS, C. R. F; FERREIRA, J. A. P.; SIQUEIRA, L. F. G.; FERREIRA, L. A. P.; BAZZO, M. L.; FRANCHINI, M.; BERRO, O. J.; VALLE, S. **Técnica de colocação de Gram**. Brasília, DF: Ministério da Saúde, Programa Nacional de Doenças Sexualmente Transmissíveis e AIDS, 2001, 63 p.

OMS. **WHO Guidelines on Hand Hygiene in Health Care: First Global Patient Safety Challenge Clean Care is Safer Care**. Genebra: Organização Mundial da Saúde, 2009, 262 p.

PALOS, M. A. P; SILVA, D. V. B; GIR, E.; CANINI, S. R. M. S; ANDERS, P. S.; LEÃO L. S. N. O; PIMENTA, F. C. Microbiota das mãos de mães e de profissionais de saúde de uma maternidade de Goiânia. **Revista Eletrônica de Enfermagem**, v. 11, p. 573-578, 2009.

PELOSI, A. The operation room. In: JOHSTON, S. A.; TOBIAS, K. M. **Veterinary Surgery: Small Animal**. 2.ed. Missouri: Elsevier, 2019, sp. Ebook. ISBN: 978-0-323-32065-8.

RIZZO, M. S.; PAULINO, C. A.; GÓRNIAK, S. L.; Antissépticos e desinfetantes. In: SPNOSA, H. S.; GÓRNIAK, S. L.; BERNARDI, M. M. **Farmacologia aplicada à medicina veterinária**. 6.ed. Rio de Janeiro: Guanabara, 2016, p. 687-713.

SHMON, C. Avaliação e preparação do paciente e da equipe cirúrgica. In: SLATTER, D. **Manual de cirurgia de pequenos animais**. 3.ed. São Paulo: Manole, 2007, v. 1, p. 162-176.

SILVA, D. R.; LIMA, P. C; NUNES, M. R. C. M.; CRAVINHOS, J. C. P. Comparação de dois métodos de Antissepsia pré-operatória de mãos em cirurgia bucal. **Revista cirúrgica traumatológica buco-maxilo**, v. 11, p. 45-54, 2011.

SILVA, M. R.; MATTOS, A. M. Ignazsemmelweis e a febre puerperal: algumas razões para a não aceitação de sua hipótese. **Filosofia e história da biologia**, v.10, p.85-98, 2015.

SOUZA, F. C; SANTANA, H. T. Higienização das mãos. In: **Segurança do Paciente em Serviços de Saúde: Higienização das Mãos**. Brasília, DF: Agência Nacional de Vigilância Sanitária, p. 63-73, 2009.

TANNER, J.; DUMVILLE, J. C.; NORMAN, G.; FORTNAM, M. Surgical hand antisepsis to reduce surgical site infection. **Cochrance Database Systematic Reviews**, v. 1, p. 1-79, 2016. <DOI: 10.1002/14651858.CD004288.pub3>.

TANNER, J.; SWARBROOK, S.; STUART, J. Surgical hand antisepsis to reduce surgical site infection. **Cochrance Database Systematic Reviews**, v. 1, p. 1-39, 2008. <DOI: 10.1002/4651858.CD004288.pub2>.

TAVOLACCI, M. P.; PITROU, I.; MERLE, V.; HAGHIGHAT, S.; THILLARD, D.; CZERNICHOW, P. Surgical hand rubbing compared with surgical hand scrubbing: comparison of efficacy and costs. **Journal of Hospital Infection**, v. 63, p. 55-59, 2006. <DOI: 10.1016 / j.jhin.2005.11.012>.

WEESE, J. S.; FAIRES, M. C.; FRANK, L. A.; REYNOLDS, L. M.; BATTISTI, A. Factors associated with methicillin-resistant versus methicillin-susceptible Staphylococcus pseudintermedius infection in dogs. **Journal of the American Veterinary Medical Association**, v. 240, p. 1450-1455, 2012. <DOI: 10.2460/javma.240.12.1450>.

WIDMER, A. F. Surgical and hygiene: scrub or rub? **Journal of Hospital Infection**, v. 83, p. 35-39, 2013. <DOI: 10.1016/S0195-6701 (13) 60008-0>.