Surgical glove perforation: cleaning of medical devices versus surgical procedures

Perfuração de luvas cirúrgicas: limpeza de produtos para saúde versus *procedimentos cirúrgicos*

Perforación de guantes quirúrgicos: limpieza de productos sanitarios versus *procedimientos quirúrgicos*

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ABSTRACT: Objective: To compare the surgical glove perforation rates in general surgeries and in the manual cleaning of medical devices. **Method:** This study was developed in a large teaching hospital in Goiânia, Goiás, Brazil. We compared the surgical glove perforation rates obtained from the leak test performed in two groups of gloves: (I) those used during manual cleaning of medical devices and (ii) those used in general surgeries. **Results:** The frequency of perforation was higher in the gloves used for cleaning medical devices (46.1%) than in those used for general surgeries (12.5%) (p=0.047), and the duration of use was associated with increased risk of perforation in both groups. No difference was found regarding perforations in the right and left hands or in the use of single or double gloving. **Conclusion:** The surgical glove perforation rate during manual cleaning reveals a higher risk to the worker who performs this activity and reinforces the contraindication of this type of glove for this purpose.

Keywords: General surgery. Sterilization. Gloves, surgical. Occupational risks. Occupational health.

RESUMO: Objetivo: Comparar os índices de perfuração de luvas cirúrgicas utilizadas em cirurgias gerais e na limpeza manual de produtos para a saúde. **Método:** Estudo desenvolvido num hospital de ensino de grande porte em Goiânia, Goiás. Foram comparados os índices de perfuração de luvas cirúrgicas obtidos por meio de teste de vazamento em dois grupos de luvas: (I) as utilizadas durante a limpeza manual de produtos para a saúde e (II) as utilizadas em cirurgias gerais. **Resultados:** A frequência de perfuração foi superior nas luvas utilizadas para a limpeza de produtos para saúde (46,1%) do que naquelas empregadas em cirurgias gerais (12,5%) (p = 0,047), e o tempo de uso interferiu no aumento do risco de perfuração em ambos os grupos. Não houve diferença nas perfurações das mãos direita e esquerda nem no uso de luvas simples e sobrepostas. **Conclusão:** O índice de perfuração de luvas cirúrgicas durante a limpeza manual revela maior risco ao trabalhador que realiza essa atividade e reforça a contraindicação desse tipo de luva para tal finalidade.

Palavras-chave: Cirurgia geral. Esterilização. Luvas cirúrgicas. Riscos ocupacionais. Saúde do trabalhador.

RESUMEN: Objetivo: Comparar las tasas de perforación de los guantes quirúrgicos utilizados en cirugías generales y en la limpieza manual de productos sanitarios. **Método:** Estudio desarrollado en un gran hospital de enseñanza en Goiânia, Goiás. Se compararon las tasas de perforación de guantes quirúrgicos, obtenidas mediante prueba de fugas, en dos grupos: (I) utilizados durante la limpieza manual de productos sanitarios y (II) utilizados en cirugía general. **Resultados:** La frecuencia de perforación fue mayor en los guantes utilizados para limpieza de productos sanitarios (46,1%) que en los utilizados para cirugía general (12,5%) (p = 0,047) y el tiempo de uso interfirió en el aumento del riesgo de perforación en ambos grupos. No hubo diferencia en las perforaciones de la mano derecha e izquierda y el uso de guantes simples y superpuestos. **Conclusión:** La tasa de perforación de los guantes quirúrgicos durante la limpieza manual revela el mayor riesgo para el trabajador que realiza esta actividad y refuerza la contraindicación de este tipo de guantes para este fin.

Palabras clave: Cirugía general. Esterilización. Guantes quirúrgicos. Riesgos laborales. Salud laboral.

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INTRODUCTION

Gloves became one of the most commonly used personal protective equipment (PPE) after the HIV/AIDS epidemic in the 1980's[1]. Since then, the many recommendations for its utilization have resulted in undesirable consequences, such as misuse and excessive use[2,3]. One example is the inadequate use of procedure/surgical gloves for the manual cleaning of reusable medical devices (RMD) in Central Sterile Supply Department (CSSD)[4] since they have limited resistance to corrosive substances and offer low mechanical protection [5]. The predominance of accidents with sharp objects during RMD cleaning is also noteworthy[6].

The recommendation for RMD cleaning is to use thick long gloves made of latex or other raw materials such as nitrile or butyl[7]. Notwithstanding the benefits of automated methods for RMD cleaning, manual cleaning is mandatory preceding automated cleaning for complex-design RMDs[5].

The use of sterile gloves is indicated as a complement to surgical hand antisepsis, an aseptic technique necessary to protect the patient and the worker. However, its use does not ensure total safety, and (micro)perforations/tears are common[8-11]. Thus, gloves should be replaced at regular intervals or whenever they are perforated[12,13]. Also, double gloving should be adopted in surgeries involving prostheses[2,12], long procedures, in situations with a high risk of perforation[14], or when exposure to body fluids is high[2]. This measure is also recommended for patients with Coronavirus Disease 2019 (COVID-19) in procedures with direct contact with airways, blood, urine, and other body fluids[15].

Surgical gloves are therefore indicated for procedures requiring maximum aseptic barrier, such as surgeries. And, although contraindicated for RMD cleaning, they have been used[4]. This practice led to the guiding question of this study: Are there differences between the surgical glove perforation rates when used by the team during general surgeries and by CSSD workers for manual cleaning of RMD?

The answer to this question may contribute to demonstrating the biological occupational risk of these activities and the need to pay attention to possible protective measures. Also, in the case of RMD cleaning, it can alert to the consequences of worker exposure due to an unrecommended practice and reinforce the need for thick gloves, indicated for this task. In this regard, the research can contribute directly to the work of the nurse who is the technical responsible for the CSSD.

OBJECTIVE

To compare the surgical glove perforation rates when used by the team during general surgeries and by CSSD workers for manual cleaning of RMD.

METHOD

Study site and population

This study was carried out in a large public teaching hospital in Goiânia, Goiás, Brazil. Two groups of surgical gloves were compared. Group I corresponded to surgical gloves used by CSSD workers for manual cleaning of RMD. This group had been previously assessed by Trindade et al.[4] through a sample calculated based on the monthly glove usage in the contaminated area with a 95% confidence interval. The present study extracted data exclusively on surgical gloves (n=128). Group II consisted of a random sample of 200 surgical gloves of the same brand and model as Group I, used by the surgical team (surgeons, assistants, and surgical technicians) to perform general surgeries in the same hospital.

Both groups had controls to identify the integrity of new gloves, from the same batches, which were submitted to pre-wash and analysis — 100 gloves for Group I[4] and 200 for Group II.

Sample collection and analysis

Group II gloves were collected by the researchers in the Surgical Theater in the morning and afternoon shifts. Having the schedule of general surgeries, a researcher donned according to the facility's regulations stayed in the internal corridor of the unit. At the end of each surgery, he approached the team members, requested the gloves in use at that moment, and explained the objective. Whether the professional had knowledge of their integrity was not possible to affirm. The gloves were stored in a white bag, placed directly by the professional at the time of removal. The bag was opened by the researcher, who used procedure gloves. At this moment, the gloves were identified according to surgical procedure, time, surgery duration, batch, size, and category of the professional who used them.

They were then transported to the contaminated area in the CSSD, where an area was reserved for the research. Another researcher, fully donned in the PPE recommended

for access to the contaminated area, received the gloves, pre-washed them in running water, and evaluated them using the same leak test performed in Group I[4]. The gloves were filled with a solution of water and methylene blue, in the proportion of 1.0 mL in 1,000 mL of water. The volume varied according to size (S, M, and L) and was previously established, considering a 2 cm limit below the glove opening. Next, the glove was lightly compressed with the palm and fingers, considered the gold standard test for detecting glove perforations[16]. Afterward, the gloves were emptied and disposed of in a container for infectious waste.

Data analysis

All data were processed using the Statistical Package for the Social Sciences (SPSS), version 19.0. The surgical gloves used in CSSD and in surgeries were compared by the χ^2 test, and p-values<0.05 were considered statistically significant.

Ethical aspects

The Research Ethics Committee of the Hospital das Clínicas of Universidade Federal de Goiás approved this study under reference number 3,632,014.

RESULTS

A total of 200 gloves from 17 general surgeries were evaluated in Group II, used by surgeons, residents, interns, and surgical technicians. Out of them, 25 (12.5%) presented perforations, ranging from 1 to 11 perforations.

The surgeries lasted from 2 hours and 30 minutes to 9 hours. Among the nine surgeries performed under 4 hours, perforated gloves were identified in two (2/9; 22.2%); and in the eight that lasted longer, glove perforations were identified in seven (7/8; 87.5%).

Among the 200 gloves in the control group, two from different pairs and batches presented one perforation each, totaling 1.0%.

When comparing the surgical glove perforation rate for the general surgery team (n=200) and CSSD workers (n=128)[4], we found that the value was higher in those used for RMD cleaning (133 perforations in 59 gloves, or 46.1%) than in those used in general surgeries (44 perforations in 25 gloves, or 12.5%) (p=0.047).

DISCUSSION

The professionals provided the gloves for evaluation at the end of the surgeries; therefore, we assume that the perforations went unnoticed during the intraoperative period, posing a risk of cross-contamination to the professional and the patient, who faces a double risk of surgical site infection in the case of perforations[17,18]. We emphasize that perforations were identified in new gloves in this and another study[19], demonstrating the difficulty of having total control of biological risk in healthcare practices. Given this scenario, the use of pairs of colored internal gloves has been proposed to indicate the need for immediate replacement[20].

The higher perforation rate found in gloves used for RMD cleaning compared to those used in general surgeries reinforces the importance of considering the characteristics of the activity performed to define the PPE adequate for the risk[21,22]. It also reveals the fragility of the perceived biological risk inherent in manual cleaning of RMD and the lack of compliance with the legislation, which recommends thick gloves for cleaning these devices[5]. Albeit more flexible, latex gloves are less resistant to chemicals and perforation than nitrile[15].

Although, in some cases, the gloves were used for longer periods in surgeries (up to 9 hours), we noted that the longer the use, the higher the perforation rate, which was also true in Group I[4], similar to the results of other investigations[8,23].

The CSSD nurse must recognize the extent of the biological risk posed to workers to transform the complex factors that contribute to the non-adherence of professionals working in the contaminated area to the use of gloves appropriate for their activities, a situation that synergistically collaborates to increase the biological risk in this group, which operates under the responsibility of the nurse.

This study presented limitations related to the impossibility of equating the duration of use of the gloves among the groups — greater in surgeries — due to the difficulty of knowing in advance the time that would be spent to perform the surgery.

CONCLUSION

In conclusion, the glove perforation rate for RMD cleaning was statistically higher compared to surgeries, allowing us to

infer a higher risk for the worker who mistakenly uses surgical gloves for RMD cleaning. The duration of glove use influenced their integrity in both groups.

These findings can ground the educational processes of nurses who work in CSSD, aiming at adherence to the gloves indicated for the RMD cleaning step and, therefore, at greater work safety.

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None.

CONFLICT OF INTERESTS

The authors declare there is no conflict of interest.

AUTHORS' CONTRIBUTIONS

JPAT: Formal analysis, Conceptualization, Data curation, Investigation, Methodology, Resources, Writing – original draft. DMMG: Methodology, Writing – original draft, Writing – review & editing, Software. ERB: Methodology, Writing – original draft, Writing – review & editing, Software. ESP: Formal analysis, Conceptualization, Data curation, Investigation, Methodology, Resources, Writing – original draft. LRTS: Formal analysis, Conceptualization, Data curation, Investigation, Methodology, Resources, Writing – original draft. VPFNB: Formal analysis, Conceptualization, Data curation, Investigation, Methodology, Resources, Writing – original draft. AFVT: Project administration, Formal analysis, Conceptualization, Data curation, Investigation, Methodology, Resources, Writing – original draft, Writing – review & editing, Software, Supervision, Validation, Visualization.

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