NON-PHARMACOLOGICAL PAIN RELIEF METHODS FOR SURGICAL PATIENTS

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Inadequate postoperative pain relief can result in clinical and psychological changes that increase morbidity, mortality, and treatment costs; decrease postoperative life quality; and indicate poor quality of care[1].

Non-pharmacological pain control therapies belong to the Complementary and Integrative Health Therapies field. Although they have been gaining space in the Brazilian public health system (*Sistema Único de Saúde* – SUS) and private health insurances, Nursing hardly uses these therapies. This situation is partly due to lack of knowledge about which interventions are more effective for pain control, part due to lack of training for nurses in this area, in addition to difficulty in acceptance, culture of organizations, or insufficient evidence. Despite the fact that in the past twenty years the idea of pain control as the 5th Vital Sign has been emphasized, postoperative pain remains underdetected and undertreated in many services. Besides, implementing multidisciplinary programs for pain management is still a challenge[2,3]. In these cases, nurses must urge the medical staff to prescribe adequate pharmacological analgesia (strong recommendation, high-quality evidence)[4] for patients, exercise their autonomy of care, and adopt non-pharmacological pain control therapies in surgical units.

For decades, many studies have demonstrated that behavioral methods are effective in decreasing postoperative pain and other symptoms, such as anxiety, and can be taught to patients as a way of self-care since their commitment is important for a satisfactory result.

The American Pain Society, together with the American Society of Anesthesiologists, created an interdisciplinary panel of experts who developed a clinical practice guideline based on an extensive review of evidence that includes non-pharmacological methods. It has 32 recommendations ranging from perioperative planning, patient evaluation, and organizational structure and policies to the transition and education of patients after discharge[4].

The first recommendation concerns the education of patients, relatives, or caregivers (strong recommendation, low-quality evidence) in the preoperative period, and helps patients decide which treatments to have in the postoperative period. Educational interventions can be face-to-face, through printed materials, videos, and digital information, including supervised exercises. However, the evidence does not indicate which measures are more effective.

The panel recommends multimodal analgesia, defined as the use of several analgesics and techniques with different mechanisms of action in the central and/or peripheral nervous system that must be combined with non-pharmacological interventions (strong recommendation, high-quality evidence). The use of transcutaneous electrical nerve stimulation is also suggested (weak recommendation, moderate-quality evidence). There is no recommendation for acupuncture, massage, and use of cold or heat (insufficient evidence), but these practices are not discouraged either, even though they are generally considered safe interventions.

The guideline also indicates cognitive-behavioral interventions, including guided imagery, music, and relaxation techniques (weak recommendation, moderate-quality evidence) as they show some positive analgesic benefits, are non-invasive, and practically free of risks (caution only with patients with a history of psychosis), and underlines the need to train these techniques in the preoperative period for an effective result[4]. More recently, there have been discussions about the use of virtual reality for pain relief[5].

Non-pharmacological interventions are adjuvant to pharmacological treatment and should be discussed with patients and family members as part of perioperative care planning. It is also important to have an organizational structure that allows the development and refining of policies and procedures for postoperative pain control[4]. Nurses are fundamental in promoting evidence-based practice, implementation of these recommendations, and scientific development of pain relief for surgical patients.

Eliseth Ribeiro Leão

Postdoctoral degree from Marc Bloch University, France.
Researcher at Instituto Israelita de Ensino
e Pesquisa Albert Einstein, São Paulo, Brazil.

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COLLECTIVE CONSTRUCTION OF STRATEGIES FOR A PROGRAM OF CONTINUING EDUCATION IN LIVER TRANSPLANTATION

Construcción colectiva de estrategias para un programa de educación permanente en transplante hepático

Construção coletiva de estratégias para um programa de educação permanente em transplante hepático

Elisa Borges Kuze[1], Lúcia Nazareth Amante[2]*, Juliana Balbinot Reis Girondi[2], Luciara Fabiane Sebold[2], Nádia Chiodelli Sallum[2], Neide da Silva Knihs[3]

ABSTRACT: Objective: Find out educational strategies, along with the nursing team, to be able for elaborate a plan of educational actions in liver transplantation for surgical center nursing. **Method:** Exploratory, descriptive, qualitative research, carried out in a school hospital in southern Brazil, approved by the human research ethics committee. **Results:** 16 members of the liver transplantation team took part in this research, and by analyzing the context, three categories emerged: knowledge of the whole liver transplantation process; appropriation of perioperative nursing care in liver transplantation; and integration and qualification of the interdisciplinary team. **Conclusion:** We expect that this research will help other transplantation centers, as it is significantly deep regarding the implementation of services. It is based on a methodological framework to support the practice, configuring it as a scientific instrument for the development of activities and the formation of continuing education programs, according to the needs of the teams working with this reality.

Keywords: Liver transplantation. Continuing education. In-service training. Surgery center nursing.

RESUMO: Objetivo: Identificar, junto à equipe de enfermagem, estratégias educativas para a composição de um plano de ações educacionais em transplante hepático para a enfermagem do centro cirúrgico. **Método:** Pesquisa exploratória, descritiva, qualitativa, realizada em um hospital escola da região sul do país, aprovada pelo comitê de ética em pesquisas envolvendo seres humanos. **Resultados:** Participaram 16 integrantes da equipe de transplante hepático, sendo que na análise de conteúdo emergiram três categorias: conhecimento de todo o processo de transplante hepático; apropriação dos cuidados de enfermagem perioperatória em transplante hepático; e integração e qualificação da equipe interdisciplinar. **Conclusão:** Deseja-se que esta pesquisa sirva de auxílio para outros centros transplantadores, sendo significativo o aprofundamento no que concerne à implantação do serviço com embasamento em um referencial metodológico para alicerçar a prática, configurando-o como um instrumento científico para o desenvolvimento das atividades e a formação de programas de educação permanente, de acordo com as necessidades das equipes que atuam com essa realidade.

Palavras-chave: Transplante hepático. Educação continuada. Capacitação em serviço. Enfermagem de centro cirúrgico.

RESUMEN: Objetivo: Identificar junto con el equipo de enfermería las estrategias educativas para la composición de un plan de acciones educacionales en el trasplante hepático para la enfermería del centro quirúrgico. **Método:** Investigación exploratoria, descriptiva y cualitativa realizada en un hospital escuela de la región sur del país y aprobada por el comité de ética en investigaciones con seres humanos. **Resultados:** Participaron 16 integrantes del equipo de trasplante hepático, siendo que en el análisis del contenido surgieron tres categorías: conocimiento de todo el proceso de trasplante hepático, apropiación de los cuidados de la enfermería perioperatoria en el trasplante hepático e integración y calificación del equipo interdisciplinario. **Conclusión:** Se desea que esta investigación sirva de auxilio para otros centros de trasplantes, siendo significativo el ahondamiento en relación a la implantación del

[1]Nurse at the School Hospital, branch of Empresa Brasileira de Serviços Hospitalares; Master in Nursing Care Management by Universidade Federal de Santa Catarina (UFSC) – Florianópolis (SC), Brazil.
[2]Professor at UFSC; PhD in Nursing by UFSC – Florianópolis (SC), Brazil.
[3]Professor at UFSC; PhD in Nursing by Universidade Federal de São Paulo (UNIFESP) – São Paulo (SP), Brazil.
*Corresponding author: luciamante@gmail.com
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servicio con fundamento en un referente metodológico para cimentar la práctica, configurándola como un instrumento científico para el desarrollo de las actividades y la formación de programas de educación permanente y de acuerdo con las necesidades de los equipos que actúan con esa realidad.
Palabras clave: Transplante de hígado. Educación continuada. Capacitación em servicio. Enfermería de quirófano.

INTRODUCTION

The National Policy of Continuing Education in Health, in force since 2004, was created as a strategy to transform practice[1]. Good health practices require an organizational system related to in-service and continuing education. In this perspective, continuing education enfold to the process, the teaching, and the care management, and should be adopted as a daily practice, in a reflective way[2].

Therefore, continuing education is a tool to update theoretical-practical knowledge of nursing professionals working in transplantation services, and implement upgraded interventions directed to the main needs of patients in liver transplantation. This is understood as the constant search for knowledge, as one of the actions that makes possible the development of the process of change and that aims at the professional nursing qualification and, consequently, the accomplishment of competent, conscious, and responsible professional practice[3].

The nursing team that works in the process of organ and tissue transplantation needs a broad technical and scientific knowledge since the general context of the procedure is complex and constantly updated. In this scenario, it is incumbent upon nurses to participate in the organization and development of an effective and efficient transplantation program, in order to promote quality care through technologies, logistics, and human resources, and improve coordination, assistance, continuing education, and research activities[4].

The preparation of the surgical center (SC) health team promotes patient safety, since it avoids exposure to the risk of incidents and adverse events during surgery, specifically considering the intraoperative period for the liver transplantation process. In this sense, there is a need to create training programs for nursing professionals, establishing dynamic and contextualized educational methods.

Thus, the problem of this study is: Which educational strategies can be part of a continuing education program on care and routines in the intraoperative period of liver transplantation for nursing professionals?

OBJECTIVE

Find out educational strategies, along with the nursing team, to be able for elaborate a plan of educational actions in liver transplantation for SC nursing.

METHOD

This is an exploratory, descriptive, qualitative study[5], developed in the SC of a school hospital in Southern Brazil, from November to December 2016.

This given institution offers a liver transplantation service, implemented in November 2011, with an average of 1.22% transplantations a month, which up to June 2017 carried out 85 transplantations and had 106 patients subscribed to the program[6].

In order to perform the service, there is a routine of actions and care developed by the entire health team, especially by nursing, which is the object of this study. The work routine concerns the aspects of: organization of the liver transplantation team; preparation of the operating room for the surgical procedure; approach of the recipient patient in the hospitalization unit; preparation of the recipient patient; performance of surgical procedures and nursing care at in the immediate postoperative period in the post-anesthetic recovery room.

Participants in this study were nursing professionals who met the following inclusion criteria: being a professional of the nursing team in liver transplantation in the SC, with at least one month of experience in the study scenario. Exclusion criteria were: professionals who were on leave during the data collection period due to medical reasons or vacation.

All participants were invited individually and personally. Those who agreed to participate received explanations on the research objectives, risks, and benefits, as well as the aspects related to confidentiality and anonymity. All those who accepted the invitation signed the Informed Consent Form (ICF).

For data collection, we used audio recorded semi-structured interviews, transcribed by the main researcher and later validated by participants. Data analysis focused on

content and was organized in: pre-analysis; exploration of the material; and treatment, inference, and interpretation of results[7].

The analysis of the interviews was a plan presented to participants, in person and by e-mail, who provided comments that allowed for the diagnosis of theme priorities and the identification of educational strategies for the creation of a continuing education program.

The Research Ethics Committee with Human Beings of *Universidade Federal de Santa Catarina* (UFSC) approved this research, Report No. 1.960.236 and Certificate of Presentation for Ethical Consideration (*Certificado de Apresentação para Apreciação* Ética – CAAE) No. 61511416.0.0000.0121.

In order to respect the confidentiality and anonymity of the research participants, we decided to identify them by the letter P, followed by a sequential number, until completing the number of participants (P1 to P16).

RESULTS

Six nurses, seven nursing technicians, two nursing assistants, and one scrub nurse attended the study, totaling 16 members of the liver transplantation team, 13 females and 3 males. Regarding age groups: 3 participants are between 21 and 30 years old; 6 between 31 and 40 years; 2 between 41 and 50 years; 4 between 51 and 60 years; and 1 with more than 61 years.

Seven of them have been in the transplant team for a year; four from one year and one month to four years; and five have been working with transplants since the inauguration of the service, that is, for six years.

As for the level of education, 12 had completed higher education, 7 of whom in health areas; 4 are nursing technicians; 3 have master's degrees; 7 have specializations; 2 are master's students; and 1 is studying for a different health area.

From the data analyzed, three categories emerged for discussion: knowledge of the whole liver transplantation process; appropriation of perioperative nursing care in liver transplantation; and integration and qualification of the interdisciplinary team.

Knowledge of the whole liver transplantation process

It is important to emphasize the need for the team's knowledge of and approach to the whole process of liver transplantation, as an essential tool for the integrality of actions and care developed, as expressed by the participants.

> It is necessary to know it all... the medical history of the patient, the cause for the need of transplantation. During surgery, we need to be aware of the hemodynamics of the patient, signs of severe bleeding. We must record the start of the surgery, clamping time, ischemia time until the implant of the new liver, laboratory test results, in addition to the origin of the new liver (P11).

> It is essential to know the whole organ donation process and transplant logistics (P12).

The attendants recognize and understand the context of transplant, but they feel the need to further their knowledge of the logistics, the donation and organ procurement processes, and surgical intervention of the transplant itself for the success of the procedures. It should be noted that the implementation of training for all categories of nursing is a rather assertive decision since these professionals are in lack of updates for their scientific knowledge and are very receptive to future training.

Appropriation of perioperative nursing care in liver transplantation

The participants point out the need for the nursing team to be qualified in order to provide care, find out and define priorities during liver transplantation and acting in case of complications and aspects related to the systematization of nursing care, including nursing diagnoses. They also include the management of new technologies for the appropriation of this care and suggest strategies for improvement in professional qualification.

> It is necessary to participate in symposiums, Brazilian Transplant Conference. Courses on pre-, intra-, and post-transplant nursing care, nursing diagnoses (P5).

> We were trained on the use of the autotransfusion machine — a responsibility of the nurse —, which considerably facilitated its handling during transplants considerably (P15).

> For the appropriation of this care, they also highlight the need to know the medical history of the

patient undergoing the procedure. Pertinent information, such as: gender, age, previous and underlying diseases (P7).

We need information, training, courses, lectures, seminars, knowledge on the subject we are developing together with the team; to visit other hospitals and services to be qualified; to offer technical and graduation courses for employees; to make clear the beginning, middle, and end of the procedure; to have meetings to evaluate the work done, patients, and accidents (P9).

Participants in the study indicated the need to increase knowledge about the donation and transplantation processes. They commented on how one is included in the team and how the educational process occurs, regarding the needs of the subjects, and suggested educational proposals aimed at the qualification of professionals for a safe and quality care.

Integration and qualification of the interdisciplinary team

Participants reinforce the relevance of the interdisciplinary team's performance for the success and safety of the liver transplantation process. In order to carry out this safe and competent care, the qualification of members is an essential premise highlighted by all participants in this study, represented by the following statements.

I see my performance in liver transplantation as professional; each team has its importance in the process, and if they are not integrated, it is difficult. They must be harmonious, well-trained, and secure in their ever-evolving roles (P8).

Of course, transplant education has to be improved, because what we have learned has been taught by other colleagues, we have not taken courses, training sessions, or anything like that. We have learned in practice (P2).

Every professional who participates in liver transplantation should attend specific training for the procedure, which includes patient preparation, surgical procedure, and surgical times (P4).

The interviewees also point out that these training sessions should have continuity and be in line with the needs of the team.

I believe that meetings, talks, and training sessions should be carried out routinely. Even for those in the team who are already experienced since we can always learn new things to improve our service, but especially for those who are starting, so they can better understand the work (P6).

In this process, the nursing team highlights the nurse as a link between the entire team, articulating, guiding, supervising, solving problems, and assisting all as needed. Finally, nurses favor the integration and safety of the procedure, both for the team and the patient.

The nurse's role is very important. We are the ones who have the first contact with the patients and their relatives in order to talk to them about the surgery. During surgery, we must be aware of the whole movement in the room to solve possible complications as they arise and to organize the team (P11).

The role of the nurse is essential within the multi-professional team since he or she acts in the prevention, treatment, and rehabilitation of the transplant patient, paying attention to the patient's physical and emotional well-being, as well as making a link between patient, family, and other health professionals. This care, performed in a humanized way, allows patients and their relatives, in a moment of fragility, to feel supported and protected (P6).

All professionals who work in transplantation are important, but I see the role of the nurse, in all processes, aimed at disseminating and demystifying the transplant theme, and the link between surgical and nursing teams, family members, donor, and recipient is of great value (P12).

The exchange between the various successful experiences was pointed out by the attendants as a strategy of continuing education due to shared knowledge and experiences in the area.

> It is good to have the opportunity of experiencing and learning about it and with other realities and institutions that also perform transplants through lectures, courses, training sessions, and simulations (P15).

> I think the hospital could have sent us to other transplantation centers, just to understand how it worked. I see that they do not care about human resources here at the hospital. Even the anesthetic team should have been trained (P1).

DISCUSSION

The qualification of professionals for competent practice in liver transplantation figures as being essential, and there is a need to include educational programs in transplantation services, with the objective of exchanging knowledge and experiences[8]. What we can observe, however, is the existence of several studies focusing on the pre- and postoperative periods, dealing with nursing care, protocol and routines creation, both in nursing and in interdisciplinary areas[4,9-11].

Patient needs are identified based on knowledge about nursing care in the period preceding transplantation, complications in transplantation, and post-transplant care as the greatest one of those needs. There are also other needs, though patients show less interest in them, such as explanations on the medications after transplantation; the workings of the waiting list; indications and contraindications for transplantation; organ distribution system; and the model for end-stage liver disease (MELD). Effective teaching in the perioperative period promotes several benefits for patients throughout the process, namely: decreased hospital stays, reduction of analgesics, and increased patient and relatives satisfaction[12].

Transplant patients' caregivers focus their attention on postoperative care, noting that the ideal information means for learning about these aspects should include consultations with nurses and physicians, manual reading, and discussion groups[9].

Professional qualification involves the preparation and compliance with nursing care protocols, which contribute to the standardization of activities of transplant teams[10]. These protocols may add to the recording of information about the medical history of the patient undergoing the procedure (name, gender, age, previous and current morbid history, origin, medical diagnosis, blood type, weight, name of the family member accompanying them, data on the hospital stay and bed reservation in the intensive care unit – ICU). Nursing care for transplant patients admitted to ICU was restricted to compliance with the medical prescription, and there was no instruction for their care[11]. In this sense, the subjects recommended the implementation of the systematization of nursing care (*sistematização da assistência de enfermagem* – SAE) and the creation/use of nursing care protocols for transplant patients hospitalized in ICU, in order to contribute to the quality of nursing care[10].

The attendants find out the improvement the improvement and understanding of all the logistics of the organ donation process up to the transplant as subjects that need more in-depth studies to improve the quality of care and provide a solid basis. That would make the new knowledge, practices, and attitudes efficient and safe, turning the participants into qualified professionals[13].

In this context, interdisciplinary work favors continuity of care and compliance with the principle of integrality. Thus, different professionals share their knowledge and provide full care[14,15]. It should be emphasized that the multidisciplinary team also performs post-discharge care guidelines and outpatient follow-up, minimizing the risks of adverse effects and hazards to the patient, in the face of the new medications used, preventing and promoting greater patient safety[16]. Subjects in this research perceived interdisciplinary work, as well as continuing training in liver transplantation for all personnel as necessary.

The development of training programs for transplant services is essential. The participants also confirm that the role played by nurses is decisive in relation to the multi-professional team, being a reference in the organization of the whole structure and process[17]. The nurse is the connection between other professionals, patients, and their relatives. The implementation of protocols for nursing care is a technology that translates safety and effectiveness into the professionals' work. The entire team recognized nurses as essential members of the whole process, as they are the ones who plan, coordinate, manage, and organize all the logistics so that liver transplantations can be successful throughout their various stages. Thus, nurses are the link between their team, patients, and their relatives, providing quality nursing care. They are also the

professionals who work in care management, promoting continuing education and improving the quality of care, concerning ethical and social aspects[12,16]. The restrictions imposed by the realities of transplantation centers, and the reduced number of professionals, materials, and financial resources limit the nurse's dynamics in providing safe and quality care[12].

In the national context, Directive No. 356 of March 10, 2014, published by the Ministry of Health, concerns good practices in procedures for the organization and operation of organ transplantation services, including the training of all members of the team and an interdisciplinary work, that is, a team, consisting of several specialties, engaged in a single focus, the patient; seeking work safety[18].

The implementation of continuing education is a good strategy to qualify professionals since all those involved critically analyze their activities, highlighting problems and developing better understanding and appreciation of the practice, with the standardization of care. In this sense, practice is the source of scientific knowledge, understanding that continuing education should be part of the professional health context since it provides the empowerment to turn problems into tools to improve care[19,20]. Parallel to in-service education, the standardization of nursing care, through collective construction and research, makes professional practice safe[21].

Thus, the creation of new technologies for standardization of care, that is, the creation of standardization through a standard operating procedure (SOP), and the organization and implementation of SAE focused on the intraoperative period, have an impact on the work process, structuring the activity and balancing the service. These technologies make the practice more effective and efficient, generating control over the practice of care.

Other strategies also emerge from the statements, such as: implementation of the liver transplantation week in the institution, with the organization of courses and lectures; technical visits to institutions performing liver transplantation, in person or by videoconference, with themes focused on the interaction between transplant teams, interpersonal interaction, and internships in other centers; interdisciplinary and continuing training; preparation of manuals for in-service consultation; technical courses for the nursing team; participation in events (transplant congresses and conferences; symposium of immunosuppression specialists); and creation of an agenda of meetings with the participation of all professionals.

The strategies listed require a cooperative effort between the professionals of the transplant team and the institution since they depend on a reorganization of the service. Thus, it is important to emphasize the need for an institutional change that promotes the preparation of professionals, qualifying them through continuing training based on the needs of the service revealed by the work team[22].

FINAL CONSIDERATIONS

Nursing practice boosts methods that facilitate care; and the implementation of educational activities in the professional's everyday life projects the know-how in a systematic, scientific, and quality way, standardizing nursing behaviors, and providing greater security in the actions performed. The educational proposal serves as a tool to aid the teaching-learning process and scientific research.

The limitation found was the shortage on educational materials in the nursing area for professionals who work in the intraoperative period of liver transplantation.

Due to the complexity of the theme, we expect that this research will serve as an aid to other transplant centers, as it is significantly deep regarding the implementation of services. It is based on a methodological framework to support the practice, configuring it as a scientific instrument for the development of activities and the formation of continuing education programs, according to the needs of the teams working with this reality.

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SURGICAL POSITIONING: PREVALENCE OF RISK OF INJURIES IN SURGICAL PATIENTS

Posicionamento cirúrgico: prevalência de risco de lesões em pacientes cirúrgicos

Posicionamento quirúrgico: prevalencia de riesgo de lesiones en pacientes quirúrgicos

Denilse Damasceno Trevilato[1]*, Thaís Camargo de Melo[2], Maria Anobes Bonet Grespan Fagundes[3], Rita Catalina Aquino Caregnato[4]

ABSTRACT: Objective: To determine the prevalence of patients at risk of developing lesions due to surgical positioning. **Method**: A cross-sectional study was carried out in a private hospital in southern Brazil. Randomized sample with 378 adult patients submitted to elective surgeries between January and September 2017. The Risk Assessment Scale for the Development of Injuries due to Surgical Positioning (ELPO) was used after anesthetic induction and a descriptive analysis was performed. **Results**: The prevalence of patients at high risk of developing lesions was 19.05% (n=72). The lithotomic position was identified as the one with greatest risk (59.72%; n=43). The mean ELPO score in the sample was 16.317 (standard deviation=3.6176) and the median was 16, meaning low risk of developing lesions. **Conclusion**: ELPO allowed to determine the prevalence of risk for lesions in patients submitted to elective procedures, identifying that the risk is more related to surgical position than to the size of the surgery.

Keywords: Patient positioning. Risk assessment. Intraoperative period. Perioperative nursing. Wounds and injuries.

RESUMO: Objetivo: Determinar a prevalência de pacientes em risco de desenvolvimento de lesões decorrentes do posicionamento cirúrgico. **Método**: Estudo transversal, realizado em hospital privado localizado na região sul do Brasil. Amostra aleatória com 378 pacientes adultos submetidos a cirurgias eletivas entre janeiro e setembro de 2017. Foi aplicada a Escala de Avaliação de Risco para o Desenvolvimento de Lesões Decorrentes do Posicionamento Cirúrgico (ELPO) após indução anestésica e realizada análise descritiva. **Resultados**: A prevalência de pacientes com alto risco de desenvolvimento de lesões foi de 19,05% (n=72). O posicionamento identificado como de maior risco foi a litotomia (59,72%; n=43). O escore médio da ELPO na amostra estudada foi 16,317 (desvio padrão=3,6176) e a mediana foi de 16, o que significa baixo risco de desenvolvimento de lesões. **Conclusão**: A ELPO permitiu determinar a prevalência de risco para lesões em pacientes submetidos a procedimentos eletivos, identificando que o risco está mais relacionado com a posição cirúrgica do que com o porte da cirurgia.

Palavras-chave: Posicionamento do paciente. Medição de risco. Período intraoperatório. Enfermagem perioperatória. Ferimentos e lesões.

RESUMEN: Objetivo: Determinar la prevalencia de pacientes en riesgo de desarrollo de lesiones derivadas del posicionamento quirúrgico. **Método**: Estudio transversal, realizado em um hospital privado em el Sur de Brasil. Muestra aleatoria con 387 pacientes adultos sometidos a cirugías electivas entre enero y septiembre de 2017. Se aplicó la Escala de Evaluación de Riesgo para el Desarrollo de Lesiones Transcurrentes del Posicionamiento Quirúrgico (ELPO) después de la inducción anestésica y análisis descriptivo. **Resultados**: La prevalencia de pacientes con alto riesgo de desarrollo de lesiones fue del 19,05% (n=72). El posicionamiento identificado como de mayor riesgo fue la litotomía (59,72%, n=43). El score promedio de la ELPO en la muestra estudiada fue 16,317 (desviación estándar=3,6176) y la mediana fue de 16, lo que significa bajo riesgo de desarrollo de lesiones. **Conclusión**: La ELPO permitió determinar la prevalencia de riesgo para lesiones en pacientes sometidos a procedimientos electivos, identificando que el riesgo está más relacionado con la posición quirúrgica que con el porte de la cirugía.

Palabras clave: Posicionamiento del paciente. Medición de riesgo. Periodo intraoperatorio. Enfermería perioperatoria. Heridas y lesiones.

[1]Nurse; Master's student in Health Education at Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA). Nurse at Hospital Moinhos de Vento Surgical Center – Porto Alegre (RS), Brazil.
[2]Nurse at Hospital Moinhos de Vento Surgical Center – Porto Alegre (RS), Brazil.
[3]Nurse; Master in Health Education. Nurse at the Post Anesthesia Recovery Center of Hospital Moinhos de Vento – Porto Alegre (RS), Brazil.
[4]Nurse; Master in Nursing; PhD in Education. Professor of Nursing at UFCSPA – Porto Alegre (RS), Brazil.
*Corresponding author: denilset@hotmail.com
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INTRODUCTION

The ideal surgical positioning for the patient should be as anatomical and physiological as possible, maintaining body alignment with minimum tension and pressure on the tissue, preserving ventilatory and circulatory functions, and avoiding unnecessary exposure, in addition to allowing the surgeon good access to the surgical site, and access to infusion and monitoring lines to the anesthesiologist[1]. All staff (anesthesiologist, surgeon, and nurses) should be involved with this process right after anesthetic induction in order to provide safe and comfortable positioning of the patient.

Skin lesions (SL) due to surgical positioning are considered to be adverse events caused by the surgical procedure. The ideal is to identify and avoid preventable damage by creating metrics and standards. Therefore, the measurement of this event is essential for the improvement of surgical patient care[2].

A study validated a risk assessment scale for the development of lesions due to surgical positioning, which was applied to a sample of 115 patients submitted to surgical procedures, and found SL development in 25 of them (21.7%); 46 of them (40.0%) had pain related to postoperative surgical positioning[3]. Of lesioned patients, 3 had SL prior to the procedure, causing it to evolve; 2 had SL in the period immediately after the surgical procedure; and 20 patients identified SL within the subsequent 72 hours[3].

A discrepancy was observed in the results found in studies on lesions due to surgical positioning. Another retrospective study, which evaluated 38.000 procedures in medical records, found records of 40 lesions, with a prevalence of 0.1%[4]. A longitudinal study with 199 patients showed an incidence of 20.6% of lesions[5]. This issue is worrying, as these lesions may be transient or permanent, increasing the length of hospital stay and delaying the recovery of the patient[6].

Depending on the surgical position, anesthesia, and duration of surgery, the patient may be at increased risk for positioning lesions, added to age and comorbidities. Nurses at the surgical center (SC) should be alert to identify at-risk patients and avoid adverse events resulting from positioning[7,8].

The basic positions which originate surgical positioning are three: supine or dorsal decubitus; prone or ventral decubitus; and lateral. Each position may lead to others, including some changes, such as: elevation of the knees, adduction or abduction of lower or upper limbs, and Trendelenburg position, among others[9]. The prone position is the most challenging one for the surgical team, once the patient is usually placed in this position after being anesthetized, unable to signal any discomfort from the positioning or to rearrange oneself during surgery[1,10].

The final decision on the patient's positioning usually lies with the surgeon, however, the care nurse must participate in this process and act on the patient's best interest whenever any given factor is interfering with their safety[1].

Strategies should be adopted to reduce the risk of positional injury, such as the use of support surfaces, foam, gel and transoperative repositioning, whenever allowed by the procedure[8,11].

The Braden scale predicts the risk of SL, but is used for clinical patients and is not recommended during surgical procedures, since it does not evaluate specific factors such as surgical time, anesthesia and comorbidities[8].

In 2013, an instrument was created and validated to evaluate the risk of developing lesions and to provide subsidies for the improvement of intraoperative nursing care through the development of protocols aimed at patient positioning[3]. The Risk Assessment Scale for Injury Development Due to Patient Surgical Positioning (*Escala de Avaliação de Risco para Desenvolvimento de Lesão Decorrente do Posicionamento Cirúrgico do Paciente* – ELPO) has proven to be a valid instrument for risk assessment in patients, to predict outcomes such as SL and pain in the postoperative period due to surgical positioning. Due to it being a new instrument for assessing risk of positional injury, its scope need to be expanded, with other researches being carried out in different hospital contexts[3].

Thus, the authors of this article, who are nurses working in SC, considered important to know the profile of patients receiving care at a private institution, tracing the research problem, and to investigate the prevalence of patients at risk of developing lesions due to surgical positioning.

OBJECTIVE

To determine the prevalence of patients at risk of developing lesions due to surgical positioning.

METHOD

A cross-sectional study, conducted in a large general private hospital, located in Porto Alegre, Rio Grande do Sul, Brazil.

Its SC has 17 operating rooms, in which 22.129 surgeries were performed in 2016.

A random probability sample was chosen, consisting of 378 patients submitted to surgical procedures. To calculate the sample, the greatest risk of development of intraoperative lesions was considered, using the WINPEPI software for Windows, version 11.43, developed by Paul M. Gahlinger, with a 95% confidence interval, margin of error of 5% and proportion of 50%. Inclusion criteria were: age equal or superior to 18 years and having an elective surgery scheduled, regardless of the surgical specialty.

One of the researchers trained seven nurses from the SC to apply the ELPO scale to the patients seen in the three shifts (morning, afternoon, and night). Data collection period was from January to September 2017.

Data collection took place daily, with the drawing of the patients from the computerized surgical scale. Using the Microsoft® Excel software, a randomly-numbered column for each surgery was created in the scale, which was organized in ascending order, with the first seven patients selected from the list. In the admission room of the SC, the patients previously drawn were approached by the nurse or nurse technician, who explained the research objective and investigated their interest in participating in the study. In case of acceptance, the patient was provided an Informed Consent in two copies, keeping a copy to themselves. The patient was then taken to the operating room (OR), positioned and anesthetic induction was performed. Only after these steps were complete did the nurse evaluate the patient and fill out a manual spreadsheet with data regarding the ELPO scale; later, the data was typed into an Excel worksheet.

The ELPO scale suggests a cutoff point, whereby patients with a score equal to or less than 19 are considered to have a lower risk for the development of lesions due to surgical positioning; and patients with a score equal to or greater than 20 are considered at higher risk[3]. The analysis was performed through descriptive statistics, presented in proportion, median, mean, and standard deviation (SD).

The research was registered in *Plataforma Brasil* and approved by the Institution's Research Ethics Committee, CAAE No. 59023916.6.0000.5330.

RESULTS

Regarding the sample's surgical profile, 259 female patients (68.52%) were identified; 199 as ASA (American Society of Anesthesiology) II in relation to anesthetic risk (52.64%), and 159 were submitted to medium-sized procedures (42.06%) (Table 1).

The mean ELPO score in the investigated sample (n = 378) was 16.317 (SD = 3.6176), median of 16, with a minimum score of 7 and a maximum score of 26.

Table 2 shows that 209 patients (55.29%) remained in the supine or dorsal position during surgical procedure; and for 276 of them (73.01%), the surgery lasted for up to 2 hours. Cotton pads were used in 170 patients (44.97%). The anatomical position was adopted in 70 (18.51%) and the opening of the upper limbs, at a maximum of 90°, in 175 (46.30%). It was found that 234 patients (61.69%) had no comorbidities which could increase the risk of positional lesions.

By the application of the ELPO scale, 72 surgeries with higher risk for lesions resulting from the positioning were identified, being classified according to their surgical size: 22 small, 22 medium-sized and 28 large ones. Of those, regarding positioning: 43 patients (59.72%) were in the lithotomy position, 14 (19.44%) were in the supine position, 9 (12.50%) were prone, 4 (5.56%) were in lateral decubitus, and 2 (2.78%) in Trendelenburg.

Table 1. Distribution of surgical patients (n=378) according to gender, ASA classification, size of the surgery, and Risk Assessment Scale for the Development of Injuries due to Surgical Positioning, treated at the surgical center of a private hospital. Porto Alegre (RS), 2017.

Variables	Frequency n (%)
Gender	
Male	119 (31.48)
Female	259 (68.52)
ASA	
I	162 (42.86)
II	199 (52.64)
III	17 (4.50)
Size of the surgery	
Small	151 (39.95)
Medium	159 (42.06)
Large	68 (17.99)
ELPO classification	
Low risk	306 (80.95)
High risk	72 (19.05)

ELPO: Risk Assessment Scale for the Development of Injuries due to Surgical Positioning.

Table 2. Distribution of the variables assessed though the Risk Assessment Scale for the Development of Injuries due to Surgical Positioning in patients treated at the surgical center of a private hospital. Porto Alegre (RS), 2017.

ELPO variables	Frequency n (%)
Age of the patient (years)	
Between 18 and 39	115 (30.42)
Between 40 and 59	150 (39.68)
Between 60 and 69	75 (19.84)
Between 70 and 79	24 (6.35)
Over 80	14 (3.71)
Comorbidities	
No comorbidities	234 (61.90)
Vascular disease	88 (23.28)
Diabetes mellitus	08 (2.12)
Obesity or malnutrition	47 (12.44)
PU or previously diagnosed neuropathy	01 (0.26)
Duration of surgery (hours)	
Up to 1 hour	139 (36.77)
More than 1h and up to 2	137 (36.24)
More than 2h and up to 4	89 (23.55)
More than 4h and up to 6	12 (3.18)
Over 6h	01 (0.26)
Type of anesthesia	
Local	39 (10.32)
Sedation	71 (18.78)
Regional	42 (11.11)
General	217 (57.41)
General + regional	09 (2.38)
Support surface	
Viscoelastic surgical table mattress + viscoelastic cushions	120 (31.75)
Surgical table foam mattress + viscoelastic cushions	–
Surgical table foam mattress + foam cushions	88 (23.28)
Surgical table foam mattress + cushions made out of sterilization wraps	170 (44.97)
No use of support surfaces or rigid supports without padding or narrow leg support	–
Position of the limbs	
Anatomic position	70 (18.51)
Opening <90º of upper limbs	175 (46.30)
Knee raised <90º and opening of lower limbs <90º or neck without sternal alignment	115 (30.42)
Knee raised >90º or opening of lower limbs >90º	12 (3.17)
Knee raised >90º and opening of lower limbs >90º or opening of upper limbs >90º	06 (1.60)

ELPO: Risk Assessment Scale for Injury Development Due to Surgical Positioning of the Patient; PU: Pressure ulcer.

DISCUSSION

In the sample investigated, a mean ELPO score of 16 was obtained, which means low risk for the development of lesions due to surgical positioning[3]. In the SC studied, an average of 2.000 surgeries are performed monthly, with approximately 80% being small and medium-sized. Of the 72 surgeries identified as having a higher risk for lesions due to positioning, 22 were small, 22 were medium-sized and 28 were large, therefore, it was verified that the risk of injury was not directly related to size.

Positioning is one of the fundamental factors for performing a safe and effective procedure. When positioning the patient, care must be taken with the joints of their hips, knees, and upper and lower limbs, as nerve injuries can occur[6] if the opening or flexing of the extremities is wider than 90º. As for the positioning of limbs, in the evaluation criteria presented in the ELPO, it was identified that 95.23% of the sample was positioned within the accepted opening and flexion limits.

Table 2 shows that the most used surgical positions were supine or dorsal (55.29%) and lithotomic (22.75%). The supine position is more anatomical; it causes an increase in abdominal visceral pressure on the inferior vena cava, which reduces the return of venous blood into the heart[7,12]. Complications related to this position occur due to inadequate positioning and prolonged procedure time[13]. In the lithotomic position, the patient is positioned in supine position, with the abducted lower limbs resting on an elevated leg support, forming an angle of approximately 90º with the hip joint. This position poses a higher risk of complications due to pressure in the sacral and lumbar regions[9]; therefore, specific protection should be used, such as adhesive or viscoelastic support pad[14]. The pressure of the support in legs and feet may damage the fibular nerve, causing the feet to "fall". The greater the flexion of the lower limbs on the hip, the greater the intra-abdominal pressure, decreasing pulmonary expansion[12]. This position may cause complications for any patient, although elderly, malnourished, and obese[6,9] ones are more severely and frequently affected[13]. As for the positioning in the 72 surgeries identified with the highest risk for lesion development, it was evidenced that: 43 patients (59.72%) were in a lithotomic position; 14 (19.44%) in dorsal decubitus; 9 (12.5%) in prone; 4 (5.56%) in lateral decubitus, and 2 (2.78%) in Trendelenburg. This study observed that most patients in lithotomic position were classified with greater risk for injury.

A study carried out with the objective of evaluating the incidence of lesion due to surgical positioning and pointing out its risk factors identified lesions in 12.20% of the 172 patients evaluated. Of the patients with lesions, 90.50% were classified as ASA II and ASA III[15]. The data contained in Table 1 show 57.14% of the sample with an anesthetic risk classification similar to the cited study. Patients classified with ASA III or higher are at increased risk for the development of lesions[8]. In the present study, only 4.5% of the subjects were identified as ASA III.

Positioning lesions occur three times more often among patients undergoing surgeries longer than two hours[15]. With respect to surgical time, 102 procedures (26.99%) lasted longer than 2 hours and, for 276 patients (73.01%), the procedures lasted 2 hours or less, with a lower risk of injury.

Two studies on lesions and risk factors associated general anesthesia with the greater occurrence of lesions, once they reduce sensitivity. This is the technique of choice in large surgeries with a longer duration and an incidence of lesions of 85.70[15] and 75%[4] was found in patients submitted to this anesthetic method. General anesthesia was used in 217 patients (57.41%) in the present study.

Sheets and blankets decrease the effectiveness of support surfaces used in the positioning of surgical patients[8]. In the sample studied, cushions made out of sterilization wraps were used in 170 patients (44.97%), and in 120 (31.75%), a mattress or viscoelastic cushions. These devices offer more benefits to patients, especially elderly ones, and in surgeries lasting more than two hours[9]. The mattresses of all surgical tables in the institution where this study was performed are viscoelastic.

A study on SL risk factors evidenced a higher incidence in the age range between 38 and 58 years (40.60%)[16]. However, in another study, the same outcome occurred among patients aged 45 and 64 years (52.40%)[15]. Research has shown that age has an influence on the risk of developing lesions; however, it should not be an isolated evaluation criterion[16-18]. The majority of patients in the sample were in the range between 40 and 59 years (39.68%).

Vascular diseases predispose to the occurrence of SL; 34% of patients who developed lesions had systemic arterial hypertension[4], and this risk increases when associated with other comorbidities and advanced age[15]. In patients with a body mass index of less than 20 or greater than 30, overweight and underweight increase friction and shear[6,16,19]. In the sample studied, 88 patients (23.28%) had vascular disease and 47 (12.44%) had obesity or malnutrition. However, 234 (61.90%) of them had no comorbidity associated with increased risk of injury, thus, most of them had a lower risk.

Regarding the limitations of the study, it is noteworthy that it was performed in a single institution, and the outcome of the positioning injury was not measured. It is suggested, for future studies, that it be applied in other hospital settings, as well as to monitor and record the occurrence of lesions in patients assessed at high risk by the ELPO scale.

CONCLUSION

The use of the ELPO scale allowed determining a prevalence of 19.05% of patients submitted to elective procedures with higher risk of developing lesions due to surgical positioning, identifying that the risk is more related to the surgical position than to the size of the surgery. The mean ELPO score was 16, indicating that the study sample consisted of patients with lower risk.

This diagnosis is considered important, as it allows nurses to focus the planning of the assistance provided. The scale was proven effective in qualifying intraoperative patient care.

It is suggested that the ELPO scale be used as a lesion risk assessment protocol for all surgical patients, as well as that foam and cotton pads be replaced with viscoelastic cushions. Future research may assess the outcome of musculoskeletal pain and lesions resulting from surgical positioning in the immediate postoperative period, relating these events to risk assessment.

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DEATH OF INTENSIVE CARE PATIENT IN THE POST-ANESTHESIA CARE UNIT: A DECONTEXTUALIZED EXPERIENCE

Óbito do paciente intensivo na recuperação pós-anestésica: uma experiência descontextualizada

Óbito del paciente intensivo en la recuperación pos-anestésica: una experiencia descontextualizada

Lisiane Vidal Lopes Machado[1], Dulcilene Pereira Jardim[2]*

ABSTRACT: Objectives: To identify and characterize the profile of intensive care patients who progressed to death during their stay in the post-anesthesia care unit (PACU), and list the difficulties faced by the nursing staff. **Method:** This is a retrospective study that uses the medical records and PACU record books of five years (from July of 2012 to July of 2017) from a public hospital in Rio Grande do Sul as information source. **Results:** In the period under study, 30 intensive care patients died in the PACU, most of them male, with a mean age of 50.97 years, who remained in bed, on average, for 14.8 hours, and belonged to the neurosurgery specialty. The most frequent cause of death was cardiorespiratory arrest. **Conclusion:** The admission of intensive care patients in the PACU requires adjustments in the physical and operational structure of the unit, staff in sufficient numbers and with appropriate technical training to ensure safe and humanized assistance to intensive care patients, as well as other patients in the postoperative period.
Keywords: Recovery room. Anesthesia recovery period. Postanesthesia nursing. Perioperative nursing. Critical care.

RESUMO: Objetivos: Identificar e caracterizar o perfil de pacientes intensivos que evoluíram a óbito durante sua permanência na recuperação pós-anestésica (RPA) e elencar as dificuldades enfrentadas pela equipe de enfermagem. **Método:** Trata-se de um estudo retrospectivo, tendo como fonte de informação os prontuários e os livros de registros da RPA de cinco anos (de julho de 2012 a julho de 2017), em um hospital público do Rio Grande do Sul. **Resultados:** Durante o período estudado, 30 pacientes intensivos foram a óbito na RPA, sendo a maior parte do sexo masculino, com idade média de 50,97 anos, que permaneceram no leito, em média, por 14,8 horas, pertencentes à especialidade de neurocirurgia, sendo a causa de óbito mais frequente a parada cardiorrespiratória. **Conclusão:** A admissão de pacientes intensivos na RPA requer a adequação da unidade em sua estrutura física e operacional, com uma equipe adequada em número e capacitação técnica para garantir uma assistência segura e humanizada aos pacientes intensivos, bem como aos demais pacientes em pós-operatório.
Palavras-chave: Sala de recuperação. Período de recuperação da anestesia. Enfermagem em sala de recuperação. Enfermagem perioperatória. Cuidados intensivos.

RESUMEN: Objetivos: Identificar y caracterizar el perfil de pacientes intensivos que evolucionaron a óbito durante su permanencia en la recuperación pos-anestésica (RPA) y enumerar las dificultades enfrentadas por el equipo de enfermería. **Método:** Se trata de un estudio retrospectivo, teniendo como fuente de información los prontuarios y los libros de registros de la RPA de cinco años (de julio de 2012 a julio de 2017), en un hospital público de Rio Grande do Sul. **Resultados:** Durante el período estudiado, 30 pacientes intensivos fallecieron en la RPA, siendo la mayor parte del sexo masculino, con edad promedio de 50,97 años, que permanecieron en el lecho, en promedio, por 14,8 horas, pertenecientes a la especialidad de neurocirugía, siendo la causa de óbito más frecuente el paro cardiorrespiratorio. **Conclusión:** La admisión de pacientes intensivos en la RPA requiere la adecuación de la unidad en su estructura física y operacional, con un equipo adecuado en número y capacitación técnica para garantizar una asistencia segura y humanizada a los pacientes intensivos, así como a los demás pacientes en pos-operatorio.
Palabras claves: Sala de recuperación. Periodo de recuperación de la anestesia. Enfermería posanestésica. Enfermería perioperatoria. Cuidados críticos.

[1]Nurse; Specialist in Adult and Pediatric Urgency and Emergency Nursing; Nurse at the Surgical Center of Hospital Cristo Redentor do Grupo Hospitalar Conceição – Porto Alegre (RS), Brazil.
[2]Nurse; Master's degree in Science; Professor of the Specialization in Surgical Center, Anesthesia Recovery, and Material and Sterilization Center Nursing at Faculdade Israelita de Ciências da Saúde Albert Einstein - São Paulo (SP), Brazil.
*Corresponding author: dulcijardim@hotmail.com
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INTRODUCTION

Death is an inevitable fact for all, a part of the natural cycle of life. However, nursing professionals are not properly prepared to deal with it, using their academic training as a basis for life care[1-3].

There are some areas in the hospital where professionals are more used to dealing with death, as in the case of the intensive care unit (ICU), indicated for people in a critical state of health, who depend on technological resources for the maintenance of life and, in many cases, without therapeutic possibilities[1,3,4].

Currently, the increase in demand of critical patients is inversely proportional to the rise in number of ICU beds, an issue that has forced institutions to assist intensive care patient in other areas while waiting for a bed to be available.

In this regard, the post-anesthesia care unit (PACU) has become an alternative increasingly present to admit and care for critical surgery patients, due to the unavailability of UCI beds[5-7]. This type of admission does not reflect the main aspect of this area, recognized as a transition unit for patients between awakening after anesthesia and recovering their vital signs, followed by their transfer to a hospitalization unit or discharge[8].

On a daily basis, the care provided in the PACU differs a lot from the ICU's one, due to the high turnover and the need for agility in decision-making in the care of postoperative complications[9]. Nonetheless, the PACU can ensure quality care for intensive care patients, since necessary adjustments are made regarding the number and staff preparation, material, and equipment[5].

The assistance context for intensive care patients involves the possibility of severe, and sometimes fatal, complications. Death is not a common event in the postoperative care offered in the PACU, thus, its occurrence becomes a decontextualized experience and brings some difficulties to the team, that needs to handle the patient's death in a particular way, as well as manage others in immediate postoperative period (IPOP), who could already be in a state of full consciousness.

The scarcity of scientific production related to death in PACU demonstrates the importance of this study, which could collaborate with the reflection and elaboration of measures for structural and personnel preparation in institutions that are experiencing this situation.

OBJECTIVES

- To identify and characterize the profile of intensive care patients who progressed to death during their stay in the PACU;
- To list the difficulties faced by the nursing staff when an intensive care patient dies in the PACU.

METHOD

We conducted a retrospective study, with data collection held in December of 2017, using PACU patient admission record books of five years (from July of 2012 to July of 2017) as the primary information source. These records provided profile data on all intensive care patients who progressed to death in the PACU in this period, including: gender, age, surgical specialty, and length of stay in the unit. The profile also contained the cause of death found in their medical records.

The research was carried out in a large public hospital with 264 beds, a reference in care for multiple-trauma patients in Rio Grande do Sul. It has six operating rooms (OR) in the main surgical center (SC) and one OR in the outpatient SC, where, on average, 525 surgeries are performed every month in the following specialties: neurosurgery, general surgery, orthopedics, plastic surgery, vascular, oral and maxillofacial. The PACU has 12 active beds and receives non-critical patients in IPOP, as well as intensive care patients who are waiting for an available ICU bed.

We organized the research data in an Excel spreadsheet, analyzed them through descriptive statistics and calculation of summary measures, and used tables and graphs to present the results[10].

This research was approved by the Research Ethics Committee of the institution under study, via Plataforma Brasil, under the number CAAE 78636917.8.0000.553, according to recommendations of Resolution no. 466/2012 of the National Health Council, which addresses researches involving human beings.

RESULTS

In the period of study, 717 intensive care patients, who should have been admitted to the ICU, were sent to the PACU, due to lack of beds available. From this group, 30 patients

died in the PACU before a bed in the ICU became available. Figure 1 shows the annual distribution of patients' deaths in the PACU and demonstrates that the percentage of deaths has decreased over time.

Patients' age ranged between 16 and 83 years, with an average of 50.97 years and standard deviation of 18.41 years. Among these 30 patients, 21 (70.0%) were male.

Intensive care patients' length of stay in the PACU varied from 25 minutes to 117 hours. Table 1 and Figure 1 indicate that in the years of 2013, 2015 and 2016, some patients' length of was too high (86, 117 and 37 hours, respectively). Except for these patients, the mean length of stay has not changed over the years.

Neurosurgery was the most representative surgical specialty responsible for intensive care patients who progressed to death in the PACU (13 patients; 43.3%), as shown in Table 2.

The most frequent causes of death in each surgical specialty, according to data from patients' medical records were: cerebral hemorrhage (53.8%), brain death (30.7%), and cardiorespiratory arrest (CRA) (30.7%) in neurosurgery; CRA (70.0%) and hypovolemic shock (30.0%) in general surgery; and CRA (100.0%) in orthopedic and vascular surgeries. Therefore, CRA was the main cause of death. However, in some cases, it was preceded by another cause, such as hypovolemic shock or hemorrhagic shock, both described in Figure 2.

In relation to patients' length of stay in the PACU according to specialty, neurosurgery was the most representative (mean=85.5h), followed by vascular (mean=13.4h), orthopedic (mean=6.8h), and general (mean=6.3h) surgeries.

While assisting an intensive care patient undergoing a serious complication, such as CRA, or in need of resuscitation procedures, PACU's nursing team faces some care and structural difficulties, as presented in Chart 1.

DISCUSSION

The care for severe and fatal complications is not part of the PACU original context but has become increasingly common

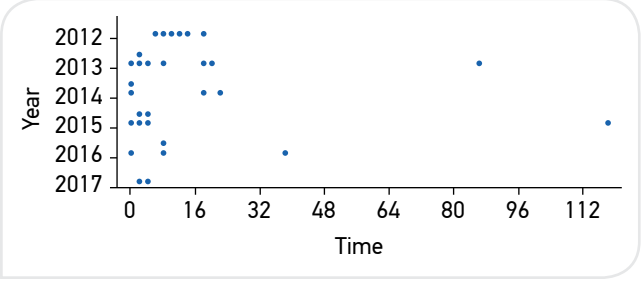

Figure 1. Length of stay distribution of intensive care patients who progressed to death according to year.

Table 2. Profile of intensive care patients who progressed to death in the post-anesthesia care unit, according to medical specialty.

Specialty	n	%
Neurosurgery	13	43.3
General surgery	10	33.3
Orthopedic surgery	5	16.7
Vascular surgery	2	6.7
Total	30	100.0

Table 1. Patients admitted to the post-anesthesia care unit, intensive care patients, number of deaths per year, average and standard error for post-anesthesia care unit length of stay.

Year	Patients admitted to the PACU	Total of intensive care patients	Total of intensive care patients who died		Average length of stay (hours)	Standard error for length of stay (hours)
			n	%		
2012	2,322	58	6	10.3	11.72	1.86
2013	4,642	148	8	5.4	17.80	10.20
2014	4,144	89	4	4.4	10.69	5.78
2015	4,585	169	6	3.5	21.40	19.10
2016	4,398	177	4	2.2	13.75	8.27
2017	2,242	76	2	2.6	3.17	1.41
Total	22,333	717	30	4.1	14.84	4.66

PACU: Post-anesthesia care unit.

due to the need of using its area as backup beds for ICU. Death in the PACU, although a decontextualized experience, needs to be handled and, to accomplish that, the difficulties it causes must be overcome.

In this study, from the 30 patients who died, most of them were male adults, corroborating findings in the literature regarding age and gender of patients assisted in the PACU[9].

The mean PACU length of stay in IPOP is 111.2 minutes[9], which demonstrates high bed turnover, a characteristic of this unit. The length of stay of intensive care patients showed large variation, which also happened in another study with even wider variance — between 3 and 384 hours[5]. The mean length of stay of 14.8 hours in this study was lower than that of a study conducted in 2015, which presented an average of 41.4 hours[5]. The average length of stay in hours of intensive care patients is significantly higher when compared to patients in other categories[11].

The shortest time an intensive care patient had to wait for an ICU bed was only 25 minutes, that is, just enough time to admit the patient to the PACU, give the shift report and adjust bed, material, and equipment required for care. In this case, the patient could leave the OR and go straight to the ICU. Therefore, the communication between SC and ICU must be well aligned to avoid unnecessary strain for PACU's team and provide patient's immediate admission and transfer .

On the other hand, the highest PACU length of stay was 117 hours, resulting in more than 4 days of bed blocking. Death after so much care time is frustrating to the team. After all, death causes

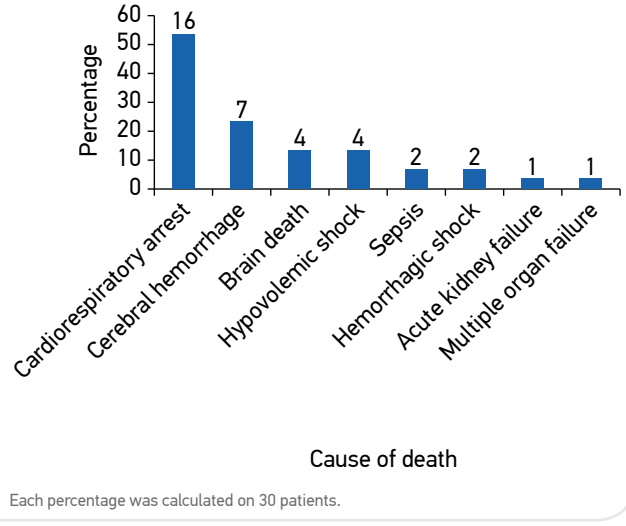

Figure 2. Cause of death of intensive care patients in the post-anesthesia care unit.

Chart 1. Difficulties for the nursing team in relation to death in the post-anesthesia care unit.

Care and operational difficulties
• *Medical care:* there is no physician on duty in the unit on weekends and during night shifts. In emergency situations during these periods, the nurse sends a message, through pager, to the specialty area responsible for the patient, requesting the presence of a doctor and, in extreme circumstances, calls the ICU physician on duty. In both cases, the doctor's arrival in the PACU takes time, causing stress to the nursing team and risks to the patient.
• *Nursing care:* there are no PACU exclusive nurses in night shifts (after 1 a.m.) and on weekends, periods when only one nurse supervises all SB. It is also necessary to adjust technicians' shifts, according to the admission of intensive care patients in the PACU, in order to ensure a proper distribution of professionals and, consequently, quality of care.
• *Body care:* after the confirmation of death, the nursing staff must prepare the body, the identification, and transfer to the appropriate location. In addition, they must fill specific forms, according to the institution's routine, and locate the family so the team responsible for the patient can communicate the death. These procedures demand time for the nurse, who leaves the PACU patients or even all SB unassisted.
• *Environment reorganization:* after removing the body, it is important to clean the equipment used with the patient, sanitize the unit — done by the cleaning staff —, and reorganize the bed for the next patient. The time spent in this procedure affects the bed turnover in the PACU.
Difficulties related to infrastructure and support services
• *Physical space:* PACU's physical space is insufficient to care for intensive care patients. It requires additional space for the CRA trolley and professionals involved in emergency care. Only a curtain separates the beds, and the bed front remains open, allowing the patients in IPOP, often awake and aware, to witness the whole care and death.
• *Medicine supply:* for the supply of medicines that are not in the CRA trolley, such as controlled drugs, a nurse must leave the unit to get them, disrupting the quality of care.
• *Tests:* delays in carrying out tests and delivering their results. For an arterial-blood gas test, the nurse collects the sample, which is processed on equipment located in the ICU or the central laboratory, in another unit of the hospital complex, depending on the day/time of the event. If the use of X-ray equipment is necessary, the radiology technician is contacted by phone and asked to come to the PACU. The professional uses the SC equipment, then leaves to process the film and returns when it is ready to deliver the results.

ICU: intensive care unit; PACU: post-anesthesia care unit; SB: surgical block; CRA: cardiorespiratory arrest; IPOP: immediate postoperative period; SC: surgical center.

feelings of pain, sadness, grief, fear, helplessness and failure, which could be the result of academic training geared to treatment and cure of diseases, leading professionals to believe that healing is always possible[2]. Thus, it is important to understand death as therapy, an outcome necessary to alleviate the suffering of an individual who does not have chances of surviving[1].

Neurosurgery was responsible for most of the patients in this research, a reflection of the institution's core, which is a reference for multiple-trauma patients.

The main cause of death in this study was CRA, considered the most common form of life constraint in critical and terminal patients, resulting in a sudden and unexpected lack of ventricular mechanical activity. This activity is a serious complication and the fastest way to reverse it is through cardiopulmonary resuscitation (CPR)[1].

CRA can influence patients' survival as once it happens in the hospital, a faster CPR start is expected, as well as the return of spontaneous circulation on the patient[12]. This study, however, indicates that delay in medical care is a difficulty during the night and on weekends, when there is no intensivist on duty in the PACU. In this regard, we emphasize how important it is for the institution to fix this scenario and adapt to the PACU demands during its 24 hours of care.

Another important factor for a successful PACU is the training of its team[12]. Therefore, training and updates for the PACU nursing team become necessary for effective assistance in CRA situations and in other intensive care needed to aid ICU patients. In the literature, PACU nursing staff indicates that handling mechanical ventilation, administrating drugs by infusion pump, bed baths and constantly changing diapers are the main difficulties when assisting intensive care patients,[5,7].

In addition to training, the institution needs to adjust the number of members of the PACU nursing staff, another difficulty found in this study. The Brazilian Association of Surgical Center, Anesthesia Recovery, and Material and Sterilization Center Nurses (Associação Brasileira de Enfermeiros de Centro-Cirúrgico, Recuperação Anestésica e Centro de Material e Esterilização — SOBECC)[13] recommends a ratio of one nurse to three or four patients who depend on a ventilator and a nursing technician for every three patients.

As shown above, there are no PACU exclusive nurses in night shifts and on weekends, an issue that the institution under study needs to rectify, in addition to modifying technicians' shifts according to presence and number of intensive care patients in each shift. This adjustment will require effort from the coordinator nurse, since admissions of intensive care patients are unpredictable.

Assistance difficulties also include care of the body after death. Although considered a simple procedure, it carries a strong emotional charge for employees and decontextualizes the type of care provided in the area. We emphasize that this care must be performed not only with technique, but, mainly, with respect and consideration because patient care does not depend on vital status[2].

Other institutions described in the literature experienced difficulties related to the limitation of PACU physical space and access to material, equipment, and tests[5,7]. These issues required readjustments of the environment so there could be enough space between beds to provide secure and private assistance, protecting other patients in IPOP from embarrassing and/or traumatic situations. These institutions also had to realign their internal procedures to collaborate with the proper care of critical patients.

Similarly, administrative processes — considered difficulties by the nursing staff of this and other studies[5,7] — need to be simpler in order to demand less time and effort from an already overworked care team. The presence of an administrative professional in the PACU, with experience in ICU, is valuable, as he or she could expedite the completion of forms and organization of these patients' medical records.

It is also necessary to reflect on death in the PACU from nursing workers' psychosocial point of view. They should look at death with a somewhat calm since it is part of human existence and must be understood as part of the life cycle, and offer the patient a good death, that is, one in which the person is free of pain[4].

A major concern of the nursing team is to offer support, attention, and affection also to the family of critical patients, allowing intersubjective exchanges in the last moments[4]. The visit of relatives is not a common event in the PACU in normal care conditions. However, due to the presence of intensive care patients, some adjustments are made in this unit to allow visits in a pre-established period once a day, which makes significant exchange between the team and the patient's family impossible.

Thus, it is important to value the reception of the family, relaxing hospital rules and routines related to visits to allow more interaction between hospitalized patients and their families, considering their affective bonds. As a result, emotional training becomes necessary to the multi-professional team, so they can deal with suffering and provide comfort[3,4].

It is essential that nursing staff understands death as part of the vital cycle and reconsiders care/caring as the essence of nursing, discussing the topic of death, both in academy and in daily practice[3].

The limitations of this study relate to it being conducted in a single public institution with a reduced number of patients. Nonetheless, it reflects the fact that death is not an event pertaining to PACU. Therefore, sharing this experience can benefit other professionals who are starting to deal with death in their postoperative care.

CONCLUSION

This study demonstrated that, between July of 2012 and July of 2017, 30 intensive care patients died in the PACU while waiting for an available ICU bed in a public hospital in southern Brazil. Most of them were male, with a mean age of 50.97 years. These patients remained in bed, on average, for 14.8 hours. Most of them belonged to neurosurgery specialty, and the most frequent cause of death was CRA.

Due to the need of admitting ICU patients to the PACU, institutions must adapt their physical structure to provide proper space, material, and tests. In addition, PACU must count with medical and nursing teams in sufficient number and appropriate training, 24 hours a day, in order to guarantee quality assistance that ensures humanization of care and safety for both intensive care patients and other patients who are in IPOP in the PACU.

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SELECTION OF MARKERS FOR ACTIVE SEARCH OF ENDOPHTHALMITIS AFTER CATARACT SURGERY

Seleção de marcadores para a busca ativa de endoftalmite após cirurgia de catarata

Selección de marcadores para la búsqueda activa de endoftalmitis tras cirugía de catarata

Reginaldo Adalberto Luz[1]*, Tadeu Cvintal[2], Edney Cabral Silva[2], Maria Clara Padoveze[3]

ABSTRACT: Objective: To identify potential markers to assist in the active search of endophthalmitis after cataract surgery. **Method:** Retrospective, descriptive, and longitudinal study, conducted through review of medical records of patients who underwent cataract surgery. **Results:** The sample included 20 patients (study group - SG) who developed postoperative endophthalmitis and 309 patients (control group - CG) who did not have endophthalmitis. The data were analyzed to identify the clinical and epidemiological markers with a percentage difference ≥30% between groups. In comparison with the CG, the SG demonstrated frequency ≥30% in established postoperative signs and symptoms (pain, anterior chamber reaction, hypopyon, corneal edema, conjunctival hyperemia, and vitreous opacity); more than four postoperative appointments; and administration of an intravitreal antibiotic injection. **Conclusion:** The selected markers are suggested for incorporation into the active search for post-operative endophthalmitis, in order to facilitate the operation of the epidemiological surveillance system.

Keywords: Infection control. Nursing. Cataract Extraction. Endophthalmitis. Surgical wound infection.

RESUMO: Objetivo: Identificar marcadores potenciais para auxiliar na busca ativa de endoftalmite após cirurgia de facectomia. **Método:** Estudo retrospectivo, descritivo e longitudinal, realizado por meio da revisão de prontuários de pacientes submetidos à cirurgia de catarata. **Resultados:** A amostra incluiu 20 pacientes (grupo de estudo — GE) que desenvolveram endoftalmite pós-operatória e 309 pacientes (grupo controle — GC) que não apresentaram endoftalmite. Os dados foram analisados para identificar os marcadores clínicos e epidemiológicos com uma diferença percentual ≥30% entre os grupos. Em comparação com o GC, o GE teve frequência ≥30% em: sinais e sintomas pós-operatórios definidos (dor, reação da câmara anterior, hipópio, edema da córnea, hiperemia conjuntival e opacidade vítrea); mais de 4 retornos pós-operatórios; e realização de injeção de antibiótico intravítreo. **Conclusão:** Os indicadores selecionados são sugeridos para incorporação na busca ativa das infecções pós-operatórias de endoftalmite, visando à facilidade operacional do sistema de vigilância epidemiológica.

Palavras-chave: Controle de infecções. Enfermagem. Extração de catarata. Endoftalmite. Infecção da ferida cirúrgica.

RESUMEN: Objetivo: Identificar marcadores potenciales para auxiliar en la búsqueda activa de endoftalmitis tras cirugía de facectomía. **Método:** Estudio retrospectivo, descriptivo y longitudinal, realizado por medio de la revisión de prontuarios de pacientes sometidos a la cirugía de catarata. **Resultados:** La muestra incluyó 20 pacientes (grupo de estudio — GE) que desarrollaron endoftalmitis pos-operatoria y 309 pacientes (grupo control — GC) que no presentaron endoftalmitis. Los datos fueron analizados para identificar los marcadores clínicos y epidemiológicos con una diferencia porcentual ≥30% entre los grupos. En comparación con el GC, el GE tuvo frecuencia ≥30% en: señales y síntomas pos-operatorios definidos (dolor, reacción de la cámara anterior, hipopión, edema de la córnea, hiperemia conjuntival y opacidad vítrea); más de 4 retornos pos-operatorios; y realización de inyección de antibiótico intravítreo. **Conclusión:** Los indicadores seleccionados son sugeridos para incorporación en la búsqueda activa de las infecciones pos-operatorias de endoftalmitis, buscando la facilidad operacional del sistema de vigilancia epidemiológica.

Palabras clave: Control de infecciones. Enfermería. Extracción de catarata. Endoftalmitis. Infección de la herida quirúrgica.

[1]Master's degree from the Nursing School at Universidade de São Paulo (USP); professor at Faculdade de Ciências Médicas of Santa Casa de São Paulo - São Paulo (SP), Brazil.
[2]Ophthalmologist at Instituto de Oftalmologia Tadeu Cvintal - São Paulo (SP), Brazil.
[3]PhD Professor in the Nursing Department of Collective Health at USP Nursing School - São Paulo (SP), Brazil.
*Corresponding author: reginaldo.enfermeiro@gmail.com
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INTRODUCTION

Cataract surgery is associated with several postoperative complications, including an intraocular infection known as endophthalmitis. Clinical signs of endophthalmitis are frequently observed in the first seven days after surgery[1,2]. The most common signs and symptoms are: anterior chamber reaction, hypopyon, eyelid and corneal edema[3-5], conjunctival hyperemia, and vitreous haze[1,4,6]. In many cases, patients complain of ocular pain or low visual acuity[3-5,7].

The mean incidence of postoperative endophthalmitis (POE) is 0.13%[1,8-11]. However, its occurrence in an outbreak scenario could be devastating, due to the large number of cataract surgeries typically performed in a single day, which would expose the patients to similar risk factors[12-14]. Most patients who develop endophthalmitis evolve to visual disability or blindness[1,5,7,13,14]. In those cases, the need to remove the eyeball or its internal content through procedures of enucleation[14] or evisceration[13,15], respectively, is not rare.

In many health facilities that perform cataract surgery, the professional in charge of the endophthalmitis surveillance system is a nurse. POE surveillance is often challenging for two main reasons: first, many surgeons do not report infection cases; second, characteristics of the clinical presentation of endophthalmitis can be similar to those of the Toxic Anterior Segment Syndrome[16,17]; and some cases may not be correctly diagnosed, leading to inaccurate rates.

It is important to develop structure and work processes for epidemiological surveillance to prevent the underreporting of endophthalmitis, as well as select markers that point to suspected cases and increase the sensitivity and specificity in case detection.

OBJECTIVE

To identify the clinical and epidemiological characteristics of postoperative endophthalmitis after cataract surgery, in order to indicate the most appropriate markers to assist the active search for cases of endophthalmitis.

METHOD

This is a retrospective, descriptive and longitudinal study, conducted through the review of medical records of patients who underwent cataract surgery. The study was conducted at a philanthropic institution that provides medical care solely for patients of the Brazilian public health system (SUS), located in the city of São Paulo, Brazil.

The medical records of 329 patients were classified into two groups: control group (CG; n=309), which included patients who underwent cataract surgery from May to June of 2013 without POE; and study group (SG; n=20), which included patients who underwent cataract surgery from April of 2010 to February of 2013 with POE. SG demanded a greater period of data collection, in comparison with CG, due to the low incidence of POE.

To calculate the sample's size, the diagnosis of POE was chosen as the primary outcome. The number of CG participants needed to be 15 times higher than SG ones, in order to detect clinical variables with a percentage difference greater than or equal to 30% between groups. The researchers arbitrated the value of the percentage difference to select only those variables with greater relevance. With the definition of a significance level of 5% and power of the test of 85%, the sample's size required 20 SG patients and 309 patients in the CG to detect the established difference.

Data Collection

The demographic characteristics of patients were collected from all selected records, using a standard form. Clinical data for group comparisons were collected from the first day after surgery to approximately two months later. In this period, patients come back for three scheduled appointments to monitor cataract surgeries postoperative.

Case definition

POE was defined as an intraocular infection diagnosed in up to six weeks after surgery. Its characteristics include the occurrence of at least three of the following signs or symptoms: reduced visual acuity, ocular pain, hypopyon, anterior chamber reaction, vitreous haze, or conjunctival hyperemia.

The routine of postoperative follow-up

The surgical team evaluated all patients on the first day after surgery, nine days after the first appointment, and one month after the second. A retina specialist confirmed

the clinical diagnosis of endophthalmitis after the differential diagnosis of Toxic Anterior Segment Syndrome. The visual acuity measurement was performed using the Snellen chart. According to this test, 20/20 represents 100% of central vision, 20/40 represents 85%, 20/200 represents 20%, and 20/400 represents 10%. For a central vision worse than 10%, the following categories were applied, from highest to lowest vision acuity: counting fingers (that is, the ability to count fingers at a certain distance, reported in meters), hand movement, perception of light and no light perception[18]. An infection control nurse recorded data from suspected cases of endophthalmitis using a standard form.

Ethical considerations

The Research Ethics Committee of the Nursing School from Universidade de São Paulo, Brazil, approved the study (approval number CAAE 01039912.3.0000.5392). The patient anonymity was maintained.

Statistical analysis

Descriptive analysis was carried out using the software Epi Info, version 7.1.2.0 (Centers for Disease Control and Prevention, Atlanta, Georgia, United States). Data were expressed as averages, minimum and maximum values, and standard deviation (SD). Student's t-test was used to compare means, when applicable.

RESULTS

Control group: characterization

The CG (n=309) consisted of 192 (62.1%) women and 117 (37.9%) men. The mean age was 68.3 years (range, 41-95; SD, 9.6); 140 (45.3%) of them were older than 70 years. The mean number of postoperative follow-up visits for patients without endophthalmitis was 3.2 (range, 3-7; SD, 0.6), with 297 (96.1%) of them requiring, at most, 4 follow-up visits within 2 months after surgery. Three patients needed surgical revision due to postoperative complications other than endophthalmitis, including the repositioning of intraocular lens, corneal suture, or anterior vitrectomy.

Control group: postoperative evolution

On the first day after surgery, more than half of the patients presented anterior chamber reaction, corneal edema, conjunctival hyperemia, and Descemet membrane folds; 138 (44.7%). Cloudy cornea was observed in 138 (44.7%), and 98 (31.7%) had eyelid edema. Another less common complication was ciliary injection (0.3%); less than 2% of patients presented hypopyon; and none showed signs of vitreous haze. 82 (26.5%) patients reported ocular pain (Table 1).

The second follow-up visit occurred, on average, 9 days after surgery (range, 5-17; SD, 2), with patients showing fewer signs and symptoms when compared to the follow-up appointment on the first postoperative day. The most common complications were: Descemet membrane folds (n=108; 35%) and cloudy cornea (n=105; 34%), followed by corneal edema (n=62; 20.1%) and anterior chamber reaction (n=57; 18.4%). Less than 2.5% of patients presented other complications (Table 2). At the end of the postoperative follow-up

Table 1. Observed signs and symptoms reported by patients on the first day after cataract surgery. São Paulo, 2017 (n=329).

Signs and symptoms	Yes		No		NI	
	n	%	n	%	n	%
ACR	251	81	48	16	10	3.2
Ciliary injection	47	15	228	74	34	11
Nebula	138	45	156	51	15	4.9
Conjunctival hyperemia	184	60	119	39	06	1.9
Corneal de-epithelization	22	7.1	270	87	17	5.5
Corneal edema	209	68	98	32	02	0.6
DMF	159	52	148	48	02	0.6
Ocular pain	82	27	221	72	06	1.9
Eyelid Edema	98	32	200	65	11	3.6
Hyphema	04	1.3	302	98	03	1
Hypopyon	05	1.6	303	98	01	0.3
IM in the IOL	06	1.9	297	96	06	1.9
Keratic precipitates	05	1.6	298	96	06	1.9
Seidel	15	4.9	281	91	13	4.2
Vitreous haze	-	-	303	98	06	1.9
Vitreous wick syndrome	01	0.3	303	98	05	1.6
Vitritis	-	-	304	98	05	1.6

NI: not informed; ACR: anterior chamber reaction; DMF: Descemet membrane folds; IM: inflammatory membrane; IOL: intraocular lens.

period, 221 (71.5%) patients presented a final visual acuity (FVA) of 20/50 or better.

Study group: characterization

The SG (n=20) included 12 (60%) women and 8 (40%) men. The mean age was 67.5 years, (range, 47-83; SD, 8.8); 13 (65%) patients were over the age of 65. The average number of postoperative follow-up appointments for patients with endophthalmitis was 14.5 (range, 8-25; SD, 4.6). Among the necessary interventions for endophthalmitis' treatment, all patients received intravitreal antibiotic injection administered at a surgical center. Thirteen (65%) patients needed two surgical revisions, and three needed more than two surgical revisions.

Study group: postoperative evolution

The most common signs and symptoms (>50%) at the time of diagnosis were: anterior chamber reaction, cloudy cornea, corneal edema, conjunctival hyperemia, and hypopyon. Vitreous haze and Descemet membrane folds were present in 50% and 40% of the cases, respectively. Less than 30% of patients presented keratic precipitates, inflammatory membrane in the intraocular lens, eyelid edema, among others. 14 (70%) patients reported ocular pain (Table 2).

The average number of days between the date of surgery and the endophthalmitis diagnosis was 7.5 (range, 1-30; SD, 8.7). Most patients (n=11; 55%) were diagnosed after the third postoperative day. Postoperative visual acuity was better than 20/60 for only 4 (20%) patients, and in 8 (40%) cases, it ranged between 20/60 and 20/200; 8 (40%) patients had visual acuity equal to or worse than the ability to count the evaluator's fingers (CF). The FVA evaluated two months after surgery was worse than 20/50 for 17 (85%) patients. Seven (35%) of all cases had FVA equal to or worse than CF. Vitreous samples were collected from 14 (66.7%) patients. Positive culture results were found in 6 of the 14 vitreous samples, as follows: Coagulase-negative *Staphylococcus* (n=3), *Streptococcus* spp. (n=2) and *Staphylococcus aureus* (n=1).

Table 2. Observed signs and symptoms reported by patients after cataract surgery according to the presence or absence of endophthalmitis. São Paulo, 2017 (n=329).

Signs and symptoms	Patients with endophthalmitis* n=20						Patients without endophthalmitis‡ n=309						Difference§ (%)
	Yes		No		NI		Yes		No		NI		
	n	%	n	%	n	%	n	%	n	%	n	%	
ACR	17	85	01	5	02	10	57	18	236	76	16	5.2	66.6
Ciliary injection	03	15	12	60	05	25	01	0.3	33	11	275	89	14.7
Nebula	17	85	03	15	-	-	105	34	191	62	13	4.2	51
Conjunctival hyperemia	12	60	06	30	02	10	07	2.3	29	9.4	273	88	57.7
Corneal de-epithelization	01	5	15	75	04	20	02	0.6	57	18	250	81	4.4
Corneal edema	14	70	05	25	01	5	62	20	217	70	30	9.7	49.9
DMF	8	40	10	50	02	10	108	35	145	47	56	18	05
Ocular pain	14	70	06	30	-	-	01	0.3	273	88	35	11	69.7
Eyelid Edema	04	20	12	60	04	20	01	0.3	31	10	277	90	19.7
Hyphema	01	5	16	80	03	15	-	-	83	27	226	73	05
Hypopyon	12	60	08	40	-	-	-	-	217	70	92	30	60
IM in the IOL	05	25	12	60	03	15	04	1.3	92	30	213	69	23.7
Keratic precipitates	05	25	11	55	04	20	01	0.3	90	29	218	71	24.7
Seidel	01	5	19	95	-	-	-	-	263	85	46	15	05
Vitreous haze	10	50	10	50	-	-	01	0.3	274	89	34	11	49.7
Vitreous wick syndrome	04	20	16	80	-	-	03	1	131	42	175	57	19
Vitritis	01	5	18	90	01	5	01	0.3	134	43	174	56	4.7

NI: not informed; ACR: anterior chamber reaction; DMF: Descemet membrane folds; IM: inflammatory membrane; IOL: intraocular lens; *related to the day of diagnosis (mean=7.5 days; CI 1-30; SD=8.7); ‡related to the second follow-up appointment (mean=9.1 days; CI 5-17; SD=2); §(% found in endophthalmitis cases) - (% found in control).

Differences between groups

The signs and symptoms observed in the SG with a percentage difference greater than or equal to 30% in the second postoperative follow-up appointment — in comparison with the CG — were: ocular pain, anterior chamber reaction, hypopyon, conjunctival hyperemia, corneal edema, and vitreous haze (Table 2).

Other differences found were: higher number of postoperative follow-up appointments in the SG ($p<0.001$) and the need for intravitreal antibiotic injections, which were only administered in SG patients.

DISCUSSION

Although the clinical presentation of POE is well known, the differential diagnosis of Toxic Anterior Segment Syndrome can be difficult[16] and lead to underreporting of cases. Thus, it is essential to develop tools for the active search of endophthalmitis cases with high sensitivity and specificity for proper epidemiological surveillance.

The endophthalmitis signs observed in the SG are consistent with previous findings of other authors, who also reported the presence of hypopyon, anterior chamber reaction, and corneal edema[3-5] as the most frequent clinical characteristics, followed by conjunctival hyperemia, vitreous haze,[1,4] ocular pain, and low visual acuity[3-5,7]. A mild and transient inflammatory reaction of the anterior chamber observed on the first day after cataract surgery is common, according to the literature[3,4].

Other signs — such as corneal edema, conjunctival hyperemia, Descemet membrane folds, and cloudy cornea — were present in more than 40% of patients on the first postoperative day, making the diagnosis of endophthalmitis difficult when it is mild and in its early presentation. For this reason, it was decided to compare the differences in clinical presentation, based on the results of the second appointment of patients from the CG, avoiding the potential bias of including false-positive cases. The time to onset of symptoms showed great variability. However, diagnoses were made, on average, in up to one week after surgery[1,9]. It is worth mentioning that not all clinically positive cases of endophthalmitis were confirmed by microbial culture. Several studies have indicated that more than 40% of vitreous samples showed no microbial growth[8,9]. Gram-positive microorganisms were the most common etiologic agents among cases in which agent identification was possible, a scenario consistent with the literature[1,8,9].

FVA showed a significant difference between groups. Most patients with endophthalmitis presented poor FVA, characterized as visual disability or blindness, which is consonant with the findings of other studies[1,5,13,14]. After cataract surgery, CG patients needed few surgical revisions, which were not related to infectious complications. In contrast, patients with endophthalmitis underwent one to three surgical revisions as a direct consequence of case evolution, which is in agreement with studies that describe the treatment of endophthalmitis[3,6,7,19]. The number of postoperative follow-up appointments for patients with endophthalmitis (SG) was significantly higher than that of the CG patients. However, we did not identify studies in the literature comparing the number of follow-up visits required for patients with and without POE.

Based on this study's results, the most suitable markers for active search of endophthalmitis after cataract surgery include the presence of three or more of the following postoperative signs and symptoms: ocular pain, anterior chamber reaction, hypopyon, corneal edema, conjunctival hyperemia, and vitreous haze; more than four follow-up appointments within two months after surgery; and medical indication for intravitreal antibiotic injection.

CONCLUSIONS

We suggest the incorporation of the selected markers — presence of three or more postoperatively signs and symptoms (ocular pain, anterior chamber reaction, hypopyon, corneal edema, conjunctival hyperemia, and vitreous haze); more than four follow-up appointments within two months after surgery; and medical indication for intravitreal antibiotic injection — into the active search for postoperative endophthalmitis, with the purpose of promoting operational ease of the epidemiological surveillance system, which could potentially increase its sensitivity and specificity.

Knowing the relevant signs and symptoms of endophthalmitis also favors the performance of nurses in their role of guiding and supporting patients and in their contribution to early diagnosis and treatment of this infection.

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REPROCESSING OF PRODUCTS: STATE OF THE ART IN THE LIGHT OF THE STUDIES OF KAZUKO UCHIKAWA GRAZIANO

Reprocessamento de produtos: estado da arte à luz dos estudos de Kazuko Uchikawa Graziano

Reprocesamiento de productos: estado del arte a la luz de los estudios de Kazuko Uchikawa Graziano

Eliana Auxiliadora Magalhães Costa[1]*

ABSTRACT: Objective: To review the state of the art reprocessing of products in the light of Professor Kazuko Graziano's studies. **Method:** Integrative literature review, with the name of the author as a descriptor and the selection of 34 articles. **Results:** The studies are comprehensive, mainly experimental and outline processes of cleaning and rinsing, disinfection, sterilization and packaging of processed articles and in emblematic areas for the reuse of materials such as orthopedics, ophthalmology, endoscopy and video-assisted surgeries. **Conclusion:** The scientific evidence of these studies is valuable for the field of product reuse and the quality and safety of health care practice insofar as they clarify doubts and support changes in attitudes related to work processes. These studies also contribute to the control of health services by supporting Sanitary Vigilance with theoretical contributions on the risks of product reprocessing, and the Brazilian Health Surveillance Agency (ANVISA) by updating the national policy for the reuse of health products (HP).
Keywords: Equipment and supplies. Sterilization. Retrospective studies.

RESUMO: Objetivo: Revisar o estado da arte sobre reprocessamento de produtos à luz dos estudos da Professora Kazuko Graziano. **Método:** Revisão integrativa de literatura, tendo como descritor o nome da autora e com a seleção de 34 artigos. **Resultados:** Os estudos são abrangentes, majoritariamente experimentais e perpassaram pelos processos de limpeza e enxágue, desinfecção, esterilização e acondicionamento de artigos processados e em áreas emblemáticas para o reúso de materiais como ortopedia, oftalmologia, endoscopia e cirurgias videoassistidas. **Conclusão:** As evidências científicas desses estudos são valorosas para o campo do reúso de produtos e para a qualidade e a segurança da prática assistencial na medida em que clarificam dúvidas e subsidiam mudanças de atitudesprocessos de trabalho. Esses estudos contribuem, também, para o controle sanitário de serviços de saúde ao subsidiar as Vigilâncias Sanitárias com aportes teóricos sobre risco em reprocessamento de produtos e a Agência Nacional de Vigilância Sanitária (ANVISA) na atualização da política nacional de reúso de produtos para saúde (PPS) do país.
Palavras-chave: Equipamentos e provisões. Esterilização. Estudos retrospectivos.

RESUMEN: Objetivo: Revisar el estado del arte sobre reprocesamiento de productos a la luz de los estudios de la Profesora Kazuko Graziano. **Método:** Revisión integrativa de literatura, teniendo como descriptor el nombre de la autora y con la selección de 34 artículos. **Resultados:** Los estudios son abarcadores, mayoritariamente experimentales y pasaron por los procesos de limpieza y enjuague, desinfección, esterilización y acondicionamiento de artículos procesados y en áreas emblemáticas para el reúso de materiales como ortopedia, oftalmología, endoscopía y cirugías video-asistidas. **Conclusión:** Las evidencias científicas de esos estudios son valerosas para el campo del reúso de productos y para la calidad y la seguridad de la práctica asistencial en la medida en que clarifican dudas y subsidian cambios de actitudes-procesos de trabajo. Esos estudios contribuyen, también, para el control sanitario de servicios de salud al subsidiar las Vigilancias Sanitarias con aportes teóricos sobre riesgo en reprocesamiento de productos y la Agencia Nacional de Vigilancia Sanitaria (ANVISA) en la actualización de la política nacional de reúso de productos para salud (PPS) del país.
Palabras clave: Equipos y suministros. Esterilización. Estudios retrospectivos.

[1]PhD in Public Health from the Institute for Collective Health of Universidade Federal da Bahia; assistant professor of Nursing, Department of Life Sciences, Universidade do Estado da Bahia – Salvador (BA), Brazil.
*Corresponding author: costaeliana2003@hotmail.com
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INTRODUCTION

Reprocessing medical devices is the core activity of a Center for Material and Sterilization (CMS) and consists of making a contaminated device ready to use again. It includes cleaning, disinfection and sterilization, but also technical-functional safety practices by means of integrity and functionality tests[1-3]. In order to develop activities related to the reprocessing of products, the CMS depends on a management system that requires structure (physical, material and human), planning, quality and process safety. A group of trained professionals along with the development of technologies related for medical devices decontamination. Thus, the knowledge and training of professionals working at CMS is an indicator of service quality, offering cleaning, disinfection and sterilization practices based on scientific evidence in addition to contributing to the reduction of the residual risk inherent to such practices.

Several authors worldwide have dedicated to study theory and practices of medical devices reprocessing, namely William Rutala, David Weber, Michele Alfa, Lawrence Muscarella, Francesco Tessarolo, Marc Kraft, Axel Krammer, Zvi Fireman, and others.

In Brazil, the Nursing School of Universidade de São Paulo is responsible for the majority of scientific production in this area. The studies are mainly led by Professor Kazuko Uchikawa Graziano, one of the most important researchers in this area. Professor Graziano's scientific production dates from the end of the 1980s and includes individual and partner research, theoretical, methodological and experimental studies, doctoral theses, masters' dissertations and post-graduate studies. In addition to being comprehensive, her work has contributed to advances in knowledge about the subject, clarified myths regarding reprocessing practices of certain devices at CMSs across the country, and provided scientific evidence for decision-making on the reuse of medical products.

In this context, this study was guided by the following questions: What is state of the art reprocessing practice based on Kazuko Uchikawa Graziano's studies? To which extent have her studies enabled advances in knowledge in the area of medical device reprocessing and demystified practices incorporated in day-to-day routine of CMS.

OBJECTIVES

- Review the state of art medical device reprocessing in the light of the studies conducted by Professor Kazuko Uchikawa Graziano;
- Summarize the scientific production of Professor Kazuko Graziano regarding medical device reprocessing;
- Highlight the technological innovations in medical device reprocessing resulting from these studies.

METHOD

An integrative literature review which aims to summarize research results on a particular area of knowledge contributing to evidence-based practice, among other factors[4].

The following steps were used in this study: identification of study object, preparation of guiding questions, definition of inclusion and exclusion criteria, organization and analysis of data, summarization of results and presentation of review.

The articles were selected from the following databases: Virtual Health Library (VHL), PubMed and Scopus portal. The name of the author under study, "Kazuko Graziano" was used as the descriptor.

The inclusion criteria of the publications were: to be primary studies and systematic reviews that deal with the reprocessing and / or reuse of medical devices, published between the years 2006 and 2016 in the English or Portuguese language. Articles written in other languages and which were published outside these periods were excluded, in addition to works published by the author unrelated to the theme of reprocessing and/or reuse of medical devices.

The search for the data was performed online from January to March 2017 and 283 articles were initially obtained. After reading the title and abstract, 208 articles were excluded, as well as 41 repeated studies in the databases. Thus, the final sample of this review consisted of 34 articles.

After the selection, the available full articles were read, and the abstracts were read for those articles which were not available in full. At this stage, the studies were analyzed with a data collection instrument that included: article title, objectives, method, results and conclusion.

In this study, the term medical device is used as a synonym for medical product, device, equipment, material and medical article, according to the Brazilian Health Surveillance Agency (ANVISA). The term decontamination is used to describe the process of inactivation and/or elimination of microorganisms, applied to medical devices in order to provide safety to the users and includes the cleaning, disinfection and sterilization processes. Despite the considered differences, the

terms reprocessing and medical device processing are also used synonymously.

RESULTS

Twelve (35.2%) of the 34 articles analyzed are experimental studies, 10 (29.4%) are literature reviews, 6 (17.6%) are methodological studies, and 6 (17.6%) had varied methodologies (2 exploratory field, 1 multiple case, 1 descriptive, 1 analytical research and 1 pilot study).

Due to diversity and the high number of the selected articles, the present study is presented according to a grouping of the studies by using five related themes in order to improve the organization of the findings, facilitate the production of a review of the author's scientific production and to highlight the scientific innovations as a result of her work. The following is a summary of the articles from this integrative review.

Table 1 presents six studies undertaken by Professor Kazuko Graziano and her collaborators on the reprocessing of medical instruments used in laparoscopy, endoscopy, dialyzers and laryngoscopes.

Table 2 shows studies on the reprocessing of ophthalmic and orthopedic medical instruments, which are known as problematic when it comes to reusing and reprocessing medical devices.

Table 3 lists some studies developed by the author on the reprocessing of medical devices labeled as single use (SU).

Table 4 presents studies related to methods of cleaning, disinfecting, sterilizing and storing reprocessed medical devices (articles 20-31).

Table 5 displays three studies with diverse themes related to the reprocessing of medical devices (articles 32-34).

DISCUSSION

The 34 studies presented in Tables 1 through 5 review the entire field of activities related to the reuse of medical devices with researches that included not only cleaning, rinsing, disinfection, sterilization and packaging methods of reprocessed articles, but also in the principal areas which reprocess and reuse medical devices such as orthopedics, ophthalmology, endoscopy, hemodialysis, video-assisted surgeries as well as single use products. This demonstrates the challenges and the pioneering nature of the research conducted by Professor Kazuko Graziano and her collaborators.

In the cleaning process, the author and her collaborators developed criteria for the evaluation of single use products regarding the possibility of cleaning and subsequent reuse (Article 17)[17]. They verified the absence of toxicity and Toxic Anterior Segment Syndrome (TASS) associated with enzyme detergent residues and supported the routine cleaning of ophthalmic instruments with enzymatic detergent (Article 7)[7]. They also confirmed the failure of the cleaning and sterilization processes of single-use vitrectomy probes, contraindicating the reuse of these products (Article 8)[8], and identified that when the cleaning process of critical products is performed with validated procedures, the type of water used in the final rinse has little influence on the cytotoxicity of these products (Article 22)[22].

Regarding video-assisted surgery, a study is evidenced that microbiologically proved that the sterilization of previously assembled laparoscopic instruments is safe. This evidence breaks the classic paradigm of sterilizing only disassembled materials, as recommended in the literature (Article 1)[1].

Regarding the area of endoscopy, Article 3 proved to be innovating by proposing an evaluation method for the decontamination efficacy of automated flexible endoscope processors, operational method, and management and decision-making instrument at the time of purchase of an automated endoscope disinfection equipment, due to the diversity of brands and models in the market[3]. Article 4 identified that the automated method, including the initial cleaning step and consecutive disinfection using 2% glutaraldehyde solution was the most efficient at removing biofilms from endoscopes and emphasized the importance of the process, as the agents have a greater ability in biofilm detachment[4].

Article 5 analyzed the decontamination of dialyzers and identified the risk of pathogen transmission in manual and automated methods. Thus, it contributed to renal therapy services by reflecting on the practice of reusing hemodialysis capillaries[5].

Article 6 showed that the handle and the blade of the laryngoscope are a single set and should be classified as semi-critical products. Therefore, they require high level cleaning and disinfection to ensure proper reuse[6].

Regarding orthopedic surgery, the author and collaborators demonstrated that domestic drills, although not

Chart 1. Synthesis of studies selected in databases. Kazuko Graziano, Brazil, from 2006 to 2016.

Theme 1. Processing of laparoscopic, endoscopic, dialyzing and laryngoscopy instruments				
Article	**Authors/journal**	**Objective**	**Methods**	**Conclusion**
1. Microbiological evaluation of the steam sterilization of assembled laparoscopic instruments[5]	Camargo et al. Rev Latino-Am Enferm. 2016	To evaluate the safety of steam sterilization of assembled laparoscopic instruments with contamination challenge.	Experimental study.	Saturated steam sterilization under pressure from assembled laparoscopic instruments is microbiologically safe, breaking the classic paradigm of autoclaving only unassembled materials.
2. Steam sterilization of previously assembled laparoscopic instruments[6]	Camargo et al. Acta Paul Enferm. 2008	To describe the state of the art of the basic studies in search of safety in the autoclaving of previously assembled laparoscopic instruments, considering the difficulties to assemble at the time of surgery.	Literature review.	Although the studies allowed favorable conclusions for the practice of processing the assembled laparoscopic instruments, this study concludes by recommending a new experimental study using contamination challenge.
3. Methodological proposal for the evaluation of the disinfection efficiency of the automatic flexible endoscopes processor[7]	Graziano et al. Rev Latino-Am Enferm. 2016	To propose a method to evaluate the effectiveness of automated flexible endoscope processors by analyzing the feasibility and results applied to a specific make and model.	Methodological research applied in a domestic manufacturing equipment. The disinfectant used was 0.2% peracetic acid.	The proposed method proved to be feasible and reliable as to the rigor of the imposed challenge, being able to serve as an evaluation model for similar equipment and to assist in the acquisition of this type of product.
4. Removal of biofilms in endoscope canals: evaluation of currently used disinfection methods [8]	Bálsamo et al. Rev Esc Enferm USP. 2012	To evaluate the action of high level disinfection after previous cleaning with brushing to remove biofilms in sample bodies simulating the channels of flexible endoscopes, as well as comparing the available methods in health services.	Experimental, laboratory and comparative study, where the efficiency of five high-level disinfection methods for the removal of biofilms were tested.	Although the aldehydes had fixed properties, the most efficient method was 2% glutaraldehyde in automated equipment that included a preliminary cleaning step to disinfection, and the least efficient was acid electrolytic water in automated equipment. This study suggests that cleaning is more important in biofilm removal than consecutive disinfection. It shows and warns the ability of microorganisms to form biofilms in just 1 hour after contamination, reinforcing the need to clean the endoscope as soon as possible after use in order to avoid an environment conducive to its development.
5. Evaluation of the effectiveness of manual and automated dialyzers reprocessing after multiple reuses[9]	Toniolo et al. Am J Infect Control. 2016	To evaluate methods of manual and automated reprocessing of dialyzers in relation to microbiological contamination.	Experimental study. Fluid thioglycollate culture medium was injected into the hemodialysis capillaries after reprocessing 12 times by manual method and 20 times by automated method, as permitted by Brazilian Legislation.	In both methods, microorganisms were identified in the dialysate and in the blood chambers. It was concluded that reprocessing of dialyzers may pose a safety risk because of exposure of microorganisms to the patient.
6. Laryngoscope handles reprocessing: integrative review[10]	Bruna et al. Rev SOBECC. 2016	To identify the classification of laryngoscope cables according to the risk of causing infection and highlight the type of reprocessing required.	Integrative review.	This study showed that laryngoscope cables and blades should be understood as a single set, however cables normally neglected in processing should also be classified as semi-critical articles that require cleaning followed by high level disinfection.

Chart 2. Synthesis of selected studies in databases. Kazuko Graziano, Brazil, 2006 to 2016.

Theme 2. Processing of ophthalmic and orthopedic instruments				
Article	**Authors/Journal**	**Objective**	**Methods**	**Conclusion**
7. Cytotoxicity of cannulas for ophthalmic surgery after cleaning and sterilization: evaluation of the use of enzymatic detergent to remove residual ophthalmic viscosurgical device material[11]	Tamashiro et al. J Cataract Refract Surg. 2013	To evaluate the cytotoxicity of reusable cannulas for ophthalmologic surgery after being filled with ophthalmological viscoelastic product and cleaned with enzymatic detergent.	Experimental Study.	The cleaning protocol adopted in this study reached the potential to minimize the occurrence of Toxic Syndrome of the Anterior Segment of the Eyes (TASS), associated with residues of viscoelastic solution and enzymatic detergent.
8. Evaluation of microbial growth in reprocessed single use probes for vitrectomy in care practice [12]	Pinto et al. Rev Esc Enferm USP. 2012	To evaluate microbial growth in reprocessed single use vitrectomy probes in care practice.	Exploratory field study.	The reprocessed vitrectomy probes in this study showed microbial growth, pointing to the related risk as this practice is performed. It was concluded that the reprocessing of single-use vitrectomy catheters is not safe under the conditions of this study and, therefore, this practice is not recommended.
9. Evaluation of the sterilization efficacy of domestic electric drills used in orthopedic surgeries[13]	Goveia et al. Braz J Microbiol. 2009	To evaluate the efficacy of ethylene oxide (ETO) sterilization in new domestic drills subjected to contamination challenge.	Experimental, laboratory and randomized study.	Demonstrated effective sterilization of drills with ETO. However, it does not intend to support the improvised use of domestic drills in surgeries, although the results confirm the effectiveness of ETO sterilization.
10. Analysis of the microbial load in instruments used in orthopedic surgeries[14]	Pinto et al. Am J Infect Control. 2010	To determine the microbial load in instruments used in orthopedic surgeries.	Exploratory field study.	Most of the microorganisms evidenced in the analyzed instruments (78%) were vegetative bacteria, characterizing in a low challenge of the cleaning and sterilization process correctly employed in CMEs. However, the microbial recovery in surgical instruments used in clean surgeries, evidenced the importance of antibiotic prophylaxis.
11. Is ventilation of electric drills a source of contamination for surgery? [15]	Goveia et al. Acta Ortop Bras. 2009	To evaluate micribiologically the air generated by the motor drive of electric drills in orthopedic surgery.	Experimental, laboratory and randomized study.	It was concluded that although the air from the drill motor ventilation mobilizes contaminants to the operative field, the microbial amount does not present a risk of surgical site infection.
12. Use of electric drills in orthopedic surgery [16]	Goveia et al. Acta Ortop Bras. 2007	To describe the state of the art of research on the use of domestic electric drills in orthopedic surgeries, in view the difficulties of cleaning and sterilizing the equipment.	Literature Review.	There were no studies evaluating the risks of using drills in orthopedic surgery. It concludes by suggesting investigations to confirm the effectiveness of sterilization of this equipment and if the activated motor produces contaminated aerosols during surgery.

Chart 3. Synthesis of selected studies in databases. Kazuko Graziano, Brazil, from 2006 to 2016.

Theme 3. Processing of single use health products				
Article	**Authors/Journal**	**Objective**	**Methods**	**Conclusion**
13. Calculation of the reprocessing costs of single-use tongs used in video assisted surgeries[17]	Psaltikidis et al. Rev Esc Enferm USP. 2006	To develop a methodological proposal to calculate the reprocessing of disposable forceps used in video-assisted surgery.	Methodological study.	A flow chart was developed for each phase of reprocessing, which allowed the subsequent identification of cost components in terms of labor, materials and overhead expenses.
14. Analysis of the cost of reprocessing single-use tweezers used in video-assisted surgery [18]	Psaltikidis et al. Rev Latino-Am Enferm. 2006	To analyze the cost of reprocessing single use medical products used in video-assisted surgery, adopting methodology proposed by Psaltikidis.	Multiple case study.	It concluded that the methodological proposal allowed the calculation and cost analysis of the reprocessing of the studied tweezer.
15. Efficacy of sterilization of reprocessed single-use diathermy pencils [19]	Batista Neto et al. Rev Latino-Am Enferm. 2010	To evaluate the efficacy of reprocessing single-use diathermy pencils (ESUs) using two different methods of cleaning (manual or automated), followed by sterilization by low temperature methods: hydrogen peroxide plasma, ethylene oxide and steam at low temperature and formaldehyde.	Experimental, laboratory and randomized study.	It has been shown that the probability of sterilization of the reprocessed SSUs is highly dependent on the cleaning and sterilization methods applied. From the microbiological point of view, the findings indicate that SUTC present the same problems as reusable pencils. The main contribution was to provide support for the revision of the concept of single use products and to contribute to demystify the idea that reusable products are always safe in terms of sterility.
16. Single-use label analysis for sternotomy blade [20]	Bulgarelli et al. Rev SOBECC. 2015	To evaluate and legitimize the single-use sternotomy blade label, focusing on the risk of infection and the risk of inadequate performance of the reprocessed product.	Analytical study.	Sternotomy blade marketed as single -use (UU) does not justify the single -use recommendation because it is a product capable of consecutive cleaning and sterilization by saturated steam. The analysis of the risk in reusing the blade for sternotomy marketed as UU provided an opportunity to reflect on the urgent need for stricter criteria for the registration of products as one-time use by ANVISA.
17. Criteria for assessing difficulties in cleaning single-use items [21]	Graziano et al. Rev Latino-Am Enferm. 2006	To identify in the University Hospital the products of single use products in the University Hospital indicated for reprocessing, according to criteria to evaluate the difficulties in cleaning; to classify the SOPs according to the criteria established in the instrument elaborated and to evaluate their applicability.	Methodological research.	Nine criteria were elaborated in order to evaluate the difficulties in cleaning up PUU. The application of these criteria allowed a diagnosis of the degree of risk involved in the cleaning of each evaluated PUU.
18. Reprocessing of cardiac catheters: a review [22]	Ribeiro et al. Braz J Cardiovasc Surg. 2006	To describe the state of the art in the reuse of cardiac catheters in relation to the reprocessing effect on the physical, mechanical and functional integrity of the catheters. Evaluate the effectiveness of the cleaning and sterilization techniques of these catheters, as well as risks for patient users.	Literature review.	This study evidenced that there is clear evidence of the occurrence of physical and mechanical alterations after reprocessing of cardiac catheters. Doubts persist about the safety of reuse in the area of cleaning and sterilization of hemodynamic catheters.

Continue...

Chart 3. Continuation.

Theme 3. Processing of single use health products				
Article	**Authors/Journal**	**Objective**	**Methods**	**Conclusion**
19. Evaluation of sterility of reprocessed single use laparoscopic instruments [23]	Lopes et al. Rev Latino-Am Enferm. 2011	To evaluate the efficacy of sterility of single use laparoscopic instruments used in video laparoscopic surgery after contamination challenge.	Experimental study	Absence of microbial growth in the studied samples. This study allowed us to confirm the initial hypothesis that it is possible to sterilize single-use products used in video laparoscopic surgery. It clarifies that the reuse of single-use medical products may be possible if the processing is of a good quality. It reinforces the need to establish maximum acceptable parameters for organic residues.

Chart 4. Synthesis of selected studies in databases. Kazuko Graziano, Brazil, from 2006 to 2016.

Theme 4. Studies related to methods of cleaning, disinfecting, sterilizing and packaging health products				
Article	**Authors/Journal**	**Objective**	**Methods**	**Conclusion**
20. The practice of disinfection of high-speed hand pieces with 70% w/v alcohol: an evaluation[24]	Pinto et al. Am J Infect Control. 2016	To analyze the effectiveness of the processing of high-speed dental hand pieces with 70% alcohol without prior cleansing.	Experimental study.	This study concluded that 70% alcohol disinfection of high-speed dental hand pieces without prior cleansing is not a safe decontamination method.
21. The impact of the use of different types of gloves and bore hands for preparation of clean surgical instruments[25]	Bruna et al. Rev Latino-Am Enferm. 2016	To determine whether there is a difference in safety in the use of different types of gloves and bare hands during inspection and disposal of the instruments after cleaning and to identify / quantify the microbial load after handling these instruments without gloves.	Experimental study divided into two stages: cytotoxicity analysis of samples handled using gloves and bare hands and microbiological analysis of samples handled with bare hands.	The different types of instrument handling with various glove types were equivalent in relation to cytotoxicity. The study concluded that the preparation of instruments with bare hands (without gloves) seems to be the ideal recommendation.
22. The impact of the last rinse on the cytotoxicity of critical products capable of processing	de Souza et al. Rev Esc Enferm USP. 2015	To evaluate the cytotoxicity of products submitted to contamination challenge, cleaning based on standard operating procedure validated and final rinse in different types of water: tap, deionized, distilled, reverse osmosis and ultra-purified, in order to demonstrate their ability to cause injury and cell death.	Experimental study.	The results did not demonstrate cytotoxicity, independent of the water quality used in the last rinse. This result was only achieved through a validated cleaning operating procedure, based on scientific literature, legislation and official recommendations.
23. Efficacy and effectiveness of alcohol in the disinfection of semi-critical materials: systematic review [27]	Ribeiro et al. Rev Latino-Am Enferm. 2015	To discuss effectiveness of semi-critical (SC) disinfection with and without previous cleaning.	Systematic literature review.	It was found that disinfection with 70% alcohol was satisfactory in products such as nasopharyngoscopes, laryngoscopes, tonometer tip, products with low structural complexity. The results of this study demonstrate that the disinfection of SC products can be achieved in products with or without previous cleaning. The lack of product complexity may be a factor contributing to satisfactory disinfection.

Continue...

Chart 4. Continuation.

Theme 4. Studies related to methods of cleaning, disinfecting, sterilizing and packaging health products				
Article	**Authors/Journal**	**Objective**	**Methods**	**Conclusion**
24. Cytotoxicity of PVC tubes sterilized in ethylene oxide after exposure to gamma radiation [28]	de Souza et al. Rev Esc Enferm USP. 2013	To investigate the potential cytotoxic effect of gamma radiation sterilized PVC materials and re-sterilization in ethylene oxide (ETO), with a mechanical aeration process.	Experimental study.	The results show safety in the use of PVC materials previously sterilized in gamma radiation and re-sterilized in ETO. However, three factors may limit these findings: 1) Type of aeration conducted by companies providing sterilization; 2) Product characteristics; 3) Test for the detection of residues of ETO and its by-products ethylene glycol and ethylene-chiridrine.
25. Temperature and humidity in the storage of autoclaved materials: integrative review [29]	Bruna e Graziano. Rev Esc Enferm USP. 2012	To identify and analyze the theoretical foundations that led to the establishment of temperature parameters(T) and relative humidity (RH) of the air of the storage sector of sterilized materials as possible sources of contamination of the stored materials.	Integrative review of the literature.	The studies of this review reinforce the thesis that T and UR of the environment have little or no impact on maintaining the sterility of adequately packaged materials, confirmed by an experimental laboratory study published in Bruna CQM, Pinto FMG, Graziano KU. The influence of environmental temperature and air humidity on the maintenance of sterility of surgical instruments in different wraps. Infection Control and Hospital Epidemiology 2012; 33: 1277-80.
26. Periodic sterility assessment of materials stored for up to 6 months at continuous microbial contamination risk: laboratory study[30]	Moriya et al. Am J Infect Control. 2012.	To test the hypothesis that the storage time of sterile packets has no effect on the susceptibility of the contamination, even under conditions of deliberate bacterial exposure.	Experimental study.	No microbial growth was identified in the experimental group, which consisted of test pieces packed in cotton, SMS, crepe paper and surgical grade intentionally contaminated in its external part, in any time interval analyzed. (7, 14, 28, 90 e 180 days). Guideline recommendations suggest that contamination of a sterilized product occurs only because of an event and this study supports these recommendations.
27. Low Temperature Sterilization Methods and New Technologies [31]	Goveia et al. Rev Latino-Am Enferm. 2007	To identify in the literature evidence of antimicrobial activity, toxicity, adverse events and the applicability of sterilization technologies at low temperatures.	Literature review.	This review has identified a limited number of publications and that these consist of basic laboratory research with over-dimensioned challenges that do not reflect clinical practice. Presence of salt and serum in the tested material presented a protective action against the microorganisms in the sterilization process. Materials with narrow lumens are more challenging than longer lumens in relation to the success of sterilization The current literature available is not sufficient enough to elect the low temperature method in place of ethylene oxide.
28. Evaluation of maintenance of sterility of moist / wet materials after steam sterilization and storage for 30 days [32]	Moriya e Graziano. Rev Latino-Am Enferm. 2010	To evaluate the maintenance of the sterility of moist/wet products after being submitted to the steam sterilization process and stored for 30 days.	Experimental, laboratory and randomized study.	The presence of moisture inside surgical boxes packed with an SMS sheet and intentionally contaminated after undergoing steam sterilization did not interfere in the maintenance of content sterility even after 30 days of storage.

Continue...

Chart 4. Continuation.

Theme 4. Studies related to methods of cleaning, disinfecting, sterilizing and packaging health products				
Article	**Authors/Journal**	**Objective**	**Methods**	**Conclusion**
29. Compatibility and incompatibility between gamma radiation and ethylene oxide as successive methods of sterilization [33]	de Souza e Graziano. Rev Esc Enferm USP. 2010	To analyze the literature and show compatibilities and incompatibilities between gamma and ethylene oxide (ETO), with successful methods of sterilization.	Integrative literature review.	This study concludes by recommending new studies with more sensitive analytical methods such as gas chromatography, biological reactivity test in cell cultures to resolve the chronic doubt of the compatibility/incompatibility of ETO sterilizing previously pre-irradiated materials.
30. Ozone in the sterilization of health care products: an integrative literature review [34]	Souza et al. Rev Esc Enferm USP. 2011	To evaluate whether there is sufficient data in the scientific literature that supports the incorporation of ozone as a sterilizing physical-chemical agent of health products.	Integrative Litererature review.	Ozone is shown as a promising method of sterilization. However, further experimental studies are still needed to substantiate evidence of its possibilities and limitations.
31.Flash Sterilization from the Perspective of Empirical Evidence[35]	Rocha et al. Rev SOBECC. 2008	To evaluate the main differences between the conventional and flash steam sterilization regarding the achieved physical parameters.	Pilot study.	From the technical point of view, the two cycles resemble each other and the major difference lies in the number of pulse vacuum in relation to the physical parameters reached. Flash sterilization can only be performed if all the fundamental steps of reprocessing are met.

Chart 5. Synthesis of selected studies in databases. Kazuko Graziano, Brazil, from 2006 to 2016.

Theme 5. Various studies related to the processing of health products				
Article	**Authors/Journal**	**Objective**	**Methods**	**Conclusion**
32. Reprocessing of medical products: a proposal for a regulatory model for Brazilian hospitals [37]	Costa et al. Rev Esc Enferm USP. 2011	To propose an alternative model of reprocessing of medical products in order to contribute to the formulation of policies aimed at controlling improvements in the quality of health services in the country.	Descriptive study developed with Consensus Conference technique.	The proposition of a regulatory model for reprocessing medical products, self-explanatory and presented in 2 flowcharts. The first classifies medical products into reprocessable and non -reprocessable. The second describes the steps necessary for reprocessing, normalizing the processes involved.
33. Micro-organisms of the subclass Coccidia: resistance and implications for the processing of health care materials [38]	de Souza et al. Rev Esc Enferm USP. 2012	To provide reflection on the need for disinfection or sterilization of endoscopes that come in contact with the digestive tract, based on the risks related to the subclass Coccidia.	Literature review.	He recommended that health services adopt measures to control the quality of the water used for the final rinsing of endoscopes. High-level chemical germicides are urgently needed against Cryptosporidium, ensuring the use of standard precautions in the processing of endoscopes.
34. Evaluation indicators of dental-medical-hospital articles processing: elaboration and validation [39]	Graziano et al. Rev Esc Enferm USP. 2009	To elaborate and validate evaluation indicators for the processing of dental and medical articles.	Methodological research.	Product processing indicators were developed. Each indicator presents components to be evaluated, how information is obtained and the formula for calculating compliance measures.

recommended for use in health services, are subject to sterilization in ethylene oxide (Article 9)[9]. In addition, they showed that the air produced by the motor of this equipment does not mobilize sufficient amounts of contaminants that could cause surgical site infections (Article 11)[11].

Single use medical devices were also studied by the author and her collaborators. They developed a proposal for calculating the cost of reprocessing disposable tweezers used in laparoscopic surgeries, whereby the manager was responsible for the decision to reuse these medical devices in view of the cost-effectiveness (Articles 13 and 14)[13,14]. Three studies confirmed the possibility of sterilizing diathermy pencils, sternotomy blades and laparoscopic instruments, all of which are single-use (Articles 15, 16 and 19)[15,16,19], raising questions regarding the criteria that manufacturers follow regarding labelling products, registered with ANVISA, as single use products. Article 18 described the state of the art regarding the reuse of cardiac catheters and concluded that it implies physical and mechanical alterations, however there are still doubts surrounding the subject[18].

The authors analyzed the effectiveness of the disinfection of dental handpieces with 70% alcohol without previous cleaning. They concluded that the method is not suitable for these materials (Article 20)[20].

The handling of clean instruments during the preparation of the instrument boxes was analyzed according to the use of different types of gloves and handling without gloves (bare hands). In these cases, the authors recommended that clean instruments should ideally be prepared without gloved hands, with the idea of reducing the amount of health care waste. This is considered a financial advantage for the institutions as well as reducing potential allergies for the workers who work in CMS due to frequent contact with latex. The conclusion is contrary to the prevailing norm that recommends the use of non-sterile gloves for the preparation of products after cleaning[36] (Article 21)[21].

The influence of temperature and relative humidity on the storage rooms for sterilized products was studied and the data showed that these conditions have no impact on maintaining the sterility of adequately packaged products (Article 25)[25]. In addition, the research showed that storage time and effect on product contamination were determined under deliberate bacterial exposure conditions and no microbial growth related to exposure time was identified, confirming the literature data that confirms that the validity of products depends on an event that may break the integrity of the packaging and consequently contaminate the product (Article 26)[26].

Article 27 concluded that ethylene oxide sterilization is the gold standard among low temperature sterilization methods[27]. Article 30 recommends further studies in order to clarify evidence on possibilities and limitations of ozone as a sterilizing agent[30].

The cytotoxicity of PVC materials sterilized in gamma radiation and resterilized in ethylene oxide with a mechanical aeration process was also evaluated and the results provided safety in the use of these (Article 24)[24].

It was concluded that flash sterilization can only be performed if all the fundamental steps of reprocessing are fulfilled (Article 31) [31].

Article 32 proposed an alternative regulatory model for the reprocessing of medical devices[32], which aims to fill existing gaps in the current Brazilian normative framework[40,41], in particular RE 2,605 / 2006, by eliminating the need of a list of products which are prohibited from being reprocessed in the country. Article 34 elaborated evaluation indicators for the processing of studies, providing support for the measurement of the adequacy of the reprocessing stages of medical devices [34].

In view of its particular resistance to chemical disinfectants, the microbial resistance of the subclass Coccidia was analyzed in article 33. The data showed that these microorganisms are more resistant than the microbacteria and are only eliminated with 6-7% hydrogen peroxide, which raises questions about the indicated method for the decontamination of medical devices contaminated with this pathogen, especially the colonoscopes.[33]

Technological innovations in the reprocessing of medical devices as a result of Professor Kazuko Graziano's studies

Analyzing the previously classified and detailed production of Kazuko Graziano, and considering technological innovation as a "process of designing or aggregating new functionalities or characteristics of a product, process or method"[42], we identify the following technological innovations in the medical device reprocessing field:

1. Evidence of microbiological safety in the sterilization of assembled laparoscopic instruments;
2. Evidence of the sterilization capacity of some products labeled by the manufacturers as single use, such

as laparoscopic instruments, diathermy pencils and sternotomy blades;
3. Proposition of a methodology to evaluate the effectiveness of automated flexible endoscope processors;
4. Considerations regarding methods for the removal of biofilms from endoscope channels;
5. Technical considerations regarding the reprocessing methods of dialysers;
6. Proposition regarding the risk classification of the laryngoscope as a semi-critical device for both the handle and the blades;
7. Proposition of a cleaning protocol for ophthalmic instruments with potential to minimize Toxic Anterior Segment Syndrome (TASS);
8. Evidence regarding the contraindication of the reuse and reprocessing of single-use vitrectomy probes;
9. Evidence of the sterilization capacity of domestic drills used in orthopedic surgeries, although contraindicated due to bone damage;
10. Evidence of the absence of microbiological risk arising from the air of the motor of electric drills used in orthopedic surgeries;
11. Construction of a methodology to calculate the cost of reusing and reprocessing single-use instruments used in video-assisted surgery;
12. Production of criteria to evaluate the difficulties regarding cleaning single-use medical devices;
13. Evidence of the contraindication of disinfecting high speed dental pens with 70% alcohol, without previous cleaning;
14. Recommendation for the preparation of clean instruments with bare hands (without the use of gloves);
15. Evidence that validated cleaning procedures contribute to the absence of cytotoxicity of critical products;
16. Evidence that the disinfection of semi-critical products with alcohol 70% is achieved with greater safety when these products have simple conformation;
17. Evidence regarding the safety of the use of PVC materials previously sterilized in gamma radiation and resterilized in ETO;
18. Evidence that temperature and relative humidity do not have an impact on the sterility of adequately packaged medical products or devices;
19. Evidence that the validity of product sterilization is a related event, not time related;
20. Considerations related to ETO as gold standard among low temperature sterilization methods and the need for further studies to incorporate ozone as a sterilizing agent;
21. Evidence that flash sterilization can be effective as long as the fundamental steps of product reprocessing are met;
22. Proposition of an alternative regulatory model for medical device reprocessing;
23. Considerations regarding the need for the provision of high-level disinfectant for the elimination of Coccidia subclass micro-organisms;
24. Creation of evaluation indicators for medical device reprocessing.

CONCLUSION

This study showed the significant increase in the national scope of publications on reprocessing of medical devices by Professor Kazuko Graziano and her collaborators, during the analyzed period (between 2006 and 2016).

The scientific evidence from studies is not only valuable to the field of reprocessing reusable medical devices by filling gaps in the knowledge but it is also valuable to the quality and safety of health care practice as it clarifies not only doubts and myths about these processes, but, above all, uncovers old routines implanted by common sense, supporting changes in practices that are sometimes obsolete within Brazilian CMSs.

In addition, their research has contributed to the sanitary control of health services by providing the Sanitary Surveillance of the country with theoretical contributions on risks regarding product reprocessing. Their research is also relevant regarding their work with ANVISA through their methodological and critical proposals regarding the agency's conduct in updating the country's policy on reprocessing reusable medical devices.

Finally, the technological innovations in product reprocessing highlighted in this research reveal the advance in knowledge made possible by the research of the author that evidence her transforming role in the scenario of product reprocessing in the country.

DECLARATION

We declare that Professor Kazuko Uchikawa Graziano was informed about the production of this article and agreed to it.

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WHAT TO USE IN PREOPERATIVE SKIN PREPARATION: POVIDONE-IODINE OR CHLORHEXIDINE?

O que usar no preparo cirúrgico da pele: povidona-iodo ou clorexidina?

¿Qué usar en la preparación quirúrgica de la piel: povidona-iodo o clorhexidina?

Adriana Cristina de Oliveira[1], Camila Sarmento Gama[2]*

ABSTRACT: Objective: To discuss the efficacy of chlorhexidine gluconate and povidone-iodine in aqueous or alcoholic solutions in reducing surgical site infections and skin bacterial counts in the preoperative preparation of the patient. **Method:** Reflective study about the best antiseptic to use in preoperative skin preparation. **Results:** We found that chlorhexidine and povidone-iodine are equally safe and effective and that international guidelines for good practices have recommended their use in alcoholic solutions. We observed a trend in recommending alcoholic chlorhexidine and an emergence of studies that have evaluated the sequential or concurrent use of chlorhexidine and povidone-iodine with favorable results for this practice. **Conclusion:** There is a global trend that favors the use of alcoholic chlorhexidine over povidone-iodine. However, the decision about the best antiseptic agent to use should be based on each clinical case, (contra)indications, and situation.

Keywords: Local anti-infective agents. Antisepsis. Chlorhexidine. Povidone-iodine. Ethanol.

RESUMO: Objetivo: Discorrer sobre a eficácia do gluconato de clorexidina e do povidona-iodo em soluções aquosas ou alcoólicas na redução de infecções do sítio cirúrgico e na contagem bacteriana da pele, no preparo pré-operatório do paciente. **Método:** Estudo de reflexão acerca do melhor antisséptico a ser usado no preparo cirúrgico da pele. **Resultados:** Verificou-se que tanto a clorexidina quanto o povidona-iodo são igualmente seguros e efetivos e que os manuais de boas práticas internacionais têm recomendado a sua utilização em soluções alcoólicas. Observou-se uma tendência na indicação da clorexidina alcoólica e a emergência de estudos que têm avaliado o uso sequencial ou concomitante da clorexidina e do povidona-iodo com resultados favoráveis a essa prática. **Conclusão:** Há uma tendência mundial mais favorável ao uso da clorexidina alcoólica em detrimento ao povidona-iodo. Contudo, a decisão pelo melhor agente antisséptico deve considerar cada caso clínico, (contra) indicações e situação.

Palavras-chave: Anti-infecciosos locais. Antissepsia. Clorexidina. Povidona-iodo. Etanol.

RESUMEN: Objetivo: Discutir sobre la eficacia del gluconato de clorhexidina y del povidona-yodo en soluciones acuosas o alcohólicas en la reducción de infecciones del sitio quirúrgico y en el recuento bacteriano de la piel en la preparación preoperatoria del paciente. **Método:** Estudio de reflexión acerca del mejor antiséptico a utilizarse en la preparación quirúrgica de la piel. **Resultados:** Se ha comprobado que tanto la clorhexidina como el povidona yodo son igualmente seguros y efectivos y que los manuales de buenas prácticas internacionales han recomendado su utilización en soluciones alcohólicas. Se observó una tendencia en la indicación de la clorhexidina alcohólica y la emergencia de estudios que han evaluado el uso secuencial o concomitante de la clorhexidina y del povidona-yodo con resultados favorables a esa práctica. **Conclusión:** Hay una tendencia mundial más favorable al uso de la clorhexidina alcohólica en detrimento del povidona-yodo. Sin embargo, la decisión por el mejor agente antiséptico debe considerar cada caso clínico, (contra) indicaciones y situación.

Palabras clave: Antiinfecciosos locales. Antisepsia. Clorhexidina. Povidona yodo. Etanol.

[1]Nurse; postdoctoral degree from New York University, United States; associate professor at the School of Nursing of Universidade Federal de Minas Gerais; leader of Núcleo de Estudos e Pesquisas em Infecção Relacionada ao Cuidar em Saúde/Conselho Nacional de Desenvolvimento Científico e Tecnológico – Belo Horizonte (MG), Brazil.
[2]PhD student in Nursing at the School of Nursing of Universidade Federal de Minas Gerais; member of Núcleo de Estudos e Pesquisas em Infecção Relacionada ao Cuidar em Saúde – Belo Horizonte (MG), Brazil.
*Corresponding author: camilasarmentogama@gmail.com
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INTRODUCTION

Surgical site infection (SSI) is a common adverse event responsible for up to 77% of all deaths of patients with infection[1], and regarded as the most frequent, costly, and studied healthcare associated infection[1,2].

The adoption of measures to prevent SSI is of fundamental importance for the patient safety and to provide quality care. Among these measures, one that stands out is patient skin antisepsis, also known as preoperative skin preparation, responsible for reducing the microbial load on the skin, which, consequently, influences the occurrence of SSI[2].

Antisepsis is the process of eliminating or inhibiting the growth of microorganisms on the skin or other living tissues. Products used for this purpose are the antiseptics[3,4].

Antiseptic selection should take the following criteria into account: significant reduction of microorganisms on the intact skin, non-irritating antimicrobial preparation, broad spectrum of activity, fast and persistent action. Meeting the requirements proposed by national and international associations, as well as regulatory agencies for health products, the antiseptic agents available on the market are formulated based on aqueous, alcoholic (tincture) and degerming solutions, in addition to active ingredients. The active ingredients used include alcohol, chlorhexidine gluconate (CHG), iodine, iodophors, parachlorometaxylenol, and quaternary ammonium compounds[3,5].

The antiseptic agents commonly recommended for preoperative skin preparation are CHG, iodine/iodophors, alcohol, triclosan, and chloroxylenol (also known as parachlorometaxylenol), being the first three the most frequently used[3,6,7].

Although they have proved to be efficient in antisepsis, many studies still compare CHG and iodophors in an attempt to determine which one is the best choice for preoperative skin preparation, and there have been even some suggestions of their associated use[8-12].

OBJECTIVE

Considering the relevance of antisepsis in SSI prevention and the search for the best evidence-based practice, this study aims to discuss the efficacy of CHG and povidone-iodine (PVP-I) in reducing SSI and skin bacterial counts, when used in aqueous or alcoholic solutions for skin, separately or sequentially/concurrently.

METHOD

Reflective study, mediated by the search for evidence-based studies about the best antiseptic to use in preoperative skin preparation, considering the reduction of microbial counts and occurrence of SSI.

DEVELOPMENT

Povidone-iodine versus chlorhexidine gluconate

CHG and iodophors are frequently used in aqueous, alcoholic, and degerming solutions[6].

Aqueous iodophors, such as PVP-I, contain iodine complexed with a solubilizing agent that, when in solution, releases free iodine. Iodine destroys microbial proteins and deoxyribonucleic acid (DNA). These products have widespread use, due to their properties, efficacy, and broad-spectrum antimicrobial safety in almost all skin surfaces, including mucous membranes, regardless of age. In aqueous solution, most iodophors require an application in two steps — smear technique and application —, and their action is limited to the contact period of the agent with the skin[6].

Aqueous CHG breaks the membrane of bacterial cells, and its action depends on concentration. In low concentrations, it has a bacteriostatic effect, changing the osmotic balance of bacterial cells; in high concentrations, it is a bactericide, precipitating their cytoplasmic contents. CHG has a broad spectrum of activity that comprises gram-positive and gram-negative microorganisms, non-spore-forming bacteria, fungi, and lipid-enveloped virus, including human immunodeficiency virus (HIV). When compared to PVP-I, CHG residual activity lasts longer and is more resistant to blood products. Its application is similar to PVP-I, except for being contraindicated in genital, ocular conjunctiva, external acoustic meatus, and meninges areas, due to the potential harm it can cause in these body parts[1,3,6,13].

CHG and iodophors diluted in alcoholic solution have quick start action due to the alcohol and prolonged sustained antimicrobial activity. Alcohol enhances the activity of each compound through protein denaturation. Its fast evaporation from the skin facilitates the application in a single step, unlike aqueous solutions. A limitation to the use of solutions based on alcohol in the operating room

(OR) is their flammability and contraindication in mucous membranes[6].

Taking into account the properties of each compound, some questions are pertinent in the daily routine of the surgical center, such as: which is the most effective antiseptic in reducing bacterial counts and SSI: CHG or PVP-I? Is the sequential or concurrent use of CHG and PVP-I possible?

We investigated the literature to find the answer to these questions, with the purpose of facilitating the adoption of evidence-based practices and, consequently, improving the quality of care provided to surgical patients.

What is the most effective antiseptic in reducing bacterial counts and surgical site infections?

The literature shows several ways to evaluate the efficacy of CHG and PVP-I. Some of them relate to the verification of skin microbial counts, while others involve the outcome variable of SSI[8]. The effectiveness of these two compounds has been compared by collecting samples from the surgical site and the hands in which these products have been used and carrying out microbiological culture to quantify the bacteriostatic and bactericidal effects triggered by them. Surgical patients have also been followed to compare the occurrence of SSI with the use of each product[8,14].

However, both the methodology of these studies and their results have been quite diverse, hindering a precise conclusion based on high-quality evidence about the most effective antiseptic (CHG or PVP-I) in reducing bacterial counts and SSI[15].

Regarding the outcome of SSI, some studies compared the use of alcoholic CHG with aqueous PVP-I, in different sample sizes, populations, product concentrations, and methodological designs, and concluded that SSI was lower with the use of alcoholic CHG[7,8,16,17]. However, for most of them, even though the SSI rate was lower, it was not statistically significant[7,16,17]. The authors of a study found similar SSI rates among patients who used alcoholic CHG and aqueous PVP-I[10].

In a systematic review[18], only three studies described the comparison between alcoholic PVP-I and alcoholic CHG. Two of them found higher reductions of bacterial counts with alcoholic CHG, but there was no difference between CHG and PVP-I in the outcome of SSI; the third showed a greater decrease of SSI with alcoholic CHG.

Another literature review[19], which considered only randomized controlled clinical trials to evaluate the effectiveness of antiseptics, described a meta-analysis with no statistical significance between alcoholic and aqueous PVP-I in reducing SSI; and another meta-analysis, in which 0.5% alcoholic CHG was more effective than 10% alcoholic PVP-I in preventing SSI.

However, there are doubts regarding the validity of the comparison of these studies since alcoholic formulations have an advantage over aqueous solutions as the first has two active agents and the second only has one[11]. Thus, in order to eliminate this difference, some studies compared alcoholic CHG with alcoholic PVP-I and found similar SSI rates between them[9,11], or lower in the group that used alcoholic PVP-I[14].

Another debatable fact in studies that concluded that CHG was more effective than PVP-I is that none of them reported the use of neutralizing substances, fundamental in eliminating the effect of some antiseptics with continuous bactericidal action after sampling. In the absence of these substances, the highest reductions in colony-forming unit (CFU) rates may not be consistent with microbial counts that would be found in their presence. CHG is an antiseptic that depends on neutralizers to eradicate its continuous effect[15].

Considering the existing evidence, international guidelines for good practices have been unanimous in recommending the use of antiseptic in alcoholic solutions[1,2,20], but they do not specifically indicate the use of PVP-I or CHG. Only the guideline for good practices on SSI prevention of the World Health Organization (WHO), released in 2016, suggested the use of alcoholic CHG, underlining, however, that the recommendation was based on evidence of low to moderate quality[2].

Although the findings favor the use of alcoholic over aqueous solutions, more specifically alcoholic CHG, it is important that the professional takes into consideration each clinical case, (contra)indications, and the experienced situation. Some religions, for example, do not accept the use of alcohol. Therefore, it should be avoided if the patient refuses it. Its availability is more limited in low- and middle-income countries, which can make its use more difficult. Furthermore, its use is not recommended on mucous membranes / cornea / ear or areas with a lot of hair, as they can compromise evaporation, which could cause an accident due to its flammability[2,21]. Iodophors are not indicated for patients with thyroid disorders, and CHG is contraindicated in mucous membranes and ear, as it could result in deafness[21].

Is it possible to combine the use of antiseptics?

CHG and PVP-I have different cellular targets and distinct mechanisms of action that complement each other, a fact that enables the effectiveness of combining them in practice.

However, there is not enough evidence regarding the effectiveness or incompatibility of combining these two agents[22].

Studies have compared microbial counts after application of CHG and PVP-I alone and in sequential combination and concluded that the latter was more effective in reducing skin microbiota during preoperative preparation of the area of surgery[12,23,24]. Another study, conducted with 1,146 patients undergoing clean cranial surgeries, concluded that the combination of PVP-I and CHG contributed more to SSI reduction than the use of PVP-I and CHG alone[25].

We also found records of the concurrent use of these two substances in aqueous solution to evaluate the interaction potential between 3% aqueous CHG and 5% aqueous PVP-I, and the effect of their combination on antimicrobial activity. The results of these experiments indicated the absence of negative impact on antisepsis and a potential benefit from their combination[22].

The emergence of evidence on the combined use of these two products is clear. However, we need more high-quality studies to support this practice in the OR. According to a systematic review of the combined use of CHG and PVP-I, out of four trials elected for a meta-analysis, only one had SSI as an outcome, the other three investigated only bacterial colonization[26].

CONCLUSION

CHG and PVP-I have a broad spectrum of activity, are equally safe and effective for use in preoperative skin preparation and are the most frequently recommended and employed antiseptics in the world.

They are used in aqueous and alcoholic solution, and international guidelines for good practices recommend their use in alcoholic solution if there are no contraindications. There is a global trend that favors the use of alcoholic CHG over PVP-I, even though the methodological performance of some studies is questionable.

Studies on their sequential or concurrent use have shown positive results in reducing microbial counts and in SSI occurrence, since their mode of action is complementary and not antagonistic. Nevertheless, the evidence is still scarce and fragile to support this practice in the OR.

In general terms, we emphasize how important it is for the professional to consider each clinical case, (contra)indications, and situation experienced before deciding which antiseptic agent to use. Also, it is essential to conduct more robust studies that could contribute to best practices, aiming at quality care for surgical patients.

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COMPLICATIONS IN THE POST-ANESTHESIA CARE UNIT: AN INTEGRATIVE REVIEW

Complicações na sala de recuperação pós-anestésica: uma revisão integrativa

Complicaciones en la sala de recuperación pos-anestésica: una revisión integrativa

Maria Pontes de Aguiar Campos[1], Daniele Vieira Dantas[2], Luciana Santana Lobo Silva[3], Joyce Francielle Nei Bomfim Santana[4], Drielle Carvalho Oliveira[5], Lucyane Leite Fontes[5]*

ABSTRACT: Objective: To analyze production of knowledge about postoperative complications and nursing interventions at the Post-Anesthesia Care Unit (PACU). **Method:** Integrative review based on studies published from 2006 to 2016 in the following databases: Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), Medical Literature Analysis and Retrieval System Online (MEDLINE), Scientific Electronic Library Online (SciELO), Base de Dados de Enfermagem (BDENF), United States National Library of Medicine (NLM), and National Institutes of Health (PubMed). **Results:** The sample was composed of 30 articles. The most common surgical complications were pain, nausea, hypothermia, urinary retention, desaturation, and hypertension. Two studies mentioned nursing interventions, which encompassed drug administration, oxygen therapy, installation of thermal blanket, observation, vital signs monitoring, and application of dressings. **Conclusion:** This review shows the need for further studies with scientific evidence about this theme and more focus on nursing interventions (Nursing Intervention Classification) when it comes to postoperative complications.

Keywords: Postoperative complications. Anesthesia recovery period. Recovery room. Post-anesthesia nursing. Nursing care.

RESUMO: Objetivo: Analisar a produção do conhecimento sobre as complicações pós-operatórias e as intervenções de enfermagem na Sala de Recuperação Pós-Anestésica (SRPA). **Método:** Revisão integrativa, mediante consulta às bases de dados Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), *Medical Literature Analysis and Retrieval System Online* (MEDLINE), *Scientific Electronic Library Online* (SciELO), Base de Dados da Enfermagem (BDENF) e *United States National Library of Medicine* (NLM) *and National Institutes of Health* (PubMed) no período de 2006 a 2016. **Resultados:** A amostra resultou em 30 artigos. As complicações cirúrgicas mais prevalentes foram dor, náuseas, hipotermia, retenção urinária, dessaturação e hipertensão. As intervenções de enfermagem foram citadas em dois estudos, expressas por administração de medicamentos, oxigenioterapia, instalação de manta térmica, observação, monitoramento de sinais vitais e realização de curativos. **Conclusão:** Esta revisão demonstrou que há necessidade de estudos com evidências científicas sobre a temática e maior enfoque nas intervenções de enfermagem (*Nursing Intervention Classification*), diante das complicações pós-operatórias.

Palavras-chave: Complicações pós-operatórias. Período de recuperação da anestesia. Sala de recuperação. Enfermagem em pós-anestésico. Cuidados de enfermagem.

RESUMEN: Objetivo: Analizar la producción del conocimiento sobre las complicaciones pos-operatorias y las intervenciones de enfermería en la Sala de Recuperación Pos-Anestésica (SRPA). **Método:** Revisión integrativa, mediante consulta a las bases de datos Literatura Latinoamericana y del Caribe en Ciencias de la Salud (LILACS), *Medical Literature Analysis and Retrieval System Online* (MEDLINE), *Scientific Electronic Library Online* (SciELO), Base de Datos de la Enfermería (BDENF) y *United States National Library of Medicine* (NLM) *y National Institutes of Health* (PubMed) en el período de 2006 a 2016. **Resultados:** La muestra resultó en 30 artículos. Las complicaciones quirúrgicas más prevalentes fueron dolor, náuseas, hipotermia, retención urinaria, desaturación e hipertensión. Las intervenciones de enfermería fueron citadas en dos estudios, expresadas por administración de medicamentos,

[1]Nurse, PhD in Nursing from Faculdade de Medicina de Ribeirão Preto (USP); professor of the Nursing Graduate Program at Universidade Federal de Sergipe (UFS) – São Cristóvão (SE), Brazil.
[2]Nurse, postdoctoral degree in Nursing from UFS; Visiting Professor of the Nursing Graduate Program, PhD in Health Sciences from Universidade Federal do Rio Grande do Norte (UFRN) – Natal (RN), Brazil.
[3]Master's student from the Nursing Graduate Program at UFS – São Cristóvão (SE), Brazil.
[4]Nurse, Master's student from the Nursing Graduate Program at UFS, professor at Faculdade Estácio de Sergipe – São Cristóvão (SE), Brazil.
[5]Nurse graduated from UFS – São Cristóvão (SE), Brazil.
*Corresponding author: lucys_lobo@yahoo.com.br
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oxigenoterapia, instalación de manta térmica, observación, monitoreo de señales vitales y realización de curativos. **Conclusión:** Esta revisión demostró que hay necesidad de estudios con evidencias científicas sobre la temática y mayor enfoque en las intervenciones de enfermería (*Nursing Intervention Classification*), ante las complicaciones pos-operatorias.

Palabras clave: Complicaciones posoperatorias. Periodo de recuperación de la anestesia. Sala de recuperación. Enfermería posanestésica. Atención de enfermería.

INTRODUCTION

The Post-Anesthesia Care Unit (PACU) is meant for patients under anesthesia effects. The assistance given to the patient at the PACU is required until full consciousness and homeostasis are recovered, with constant monitoring and prevention of complications[1].

The recovery period encompasses the moment when the patient is discharged from the operating room until they leave the PACU. The multi-professional team must take an active role and assist patients who need continuous observation and specific care[2].

The immediate postoperative (IPO) period requires attention from the health team as the patient can present physiological changes associated with: age, anesthetic interventions, comorbidities, surgical complication, and efficiency of therapeutic measures applied[1,2]. Therefore, the main postoperative complications are related to the respiratory, circulatory, digestive, nervous, and urinary systems.

During the IPO period, the nurse is in charge of planning actions for the prevention and treatment of complications, observing organic functions, and contributing to knowledge production by giving subsidies to improve patient care in this period.

The high incidence of postoperative complications that occur at the PACU[1], and the need to build a knowledge foundation for clinical practice that aids in the development of future investigations justify this study.

Thus, the question to be answered was: what is the national and international scientific production on postoperative complications from 2006 to 2016 and which interventions are mostly adopted by the nursing team at a PACU?

OBJECTIVE

To analyze the production of knowledge about postoperative complications and nursing interventions at the PACU.

METHOD

This is an integrative literature review based on national and international scientific production from the past ten years and conducted in six stages: theme identification, research question; studies inclusion and exclusion criteria; sampling; categorization; evaluation, discussion of results; and review presentation[4].

Inclusion criteria were: original articles, available in full on indexed databases, written in Portuguese, English, and Spanish, published between 2006 and 2016. Review studies and meta-analyses, dissertations and thesis, editorials and experience reports were excluded.

The databases used to search the articles were: Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), Medical Literature Analysis and Retrieval System Online (MEDLINE), Scientific Electronic Library Online (SciELO), Base de Dados de Enfermagem (BDENF), United States National Library of Medicine (NLM), and National Institutes of Health (PubMed). The descriptors used for search were: postoperative complications, care unit, anesthesia recovery period, post-anesthesia nursing, and nursing care. For quantitative increase, we used six associations between descriptors (Figure 1).

The final sample had 30 articles selected by perusal of headings, abstracts, and full texts, and application of inclusion and exclusion criteria. To categorize the studies, the instrument developed by Ursi and Galvão[5] was adapted with the purpose of systematically recording the data collected. The analysis started by searching the following aspects: year of publication, country of origin, methodology, sample, name of journal, postoperative complications that happened at the PACU, nursing interventions, and results, all recorded in an instrument adapted for this study. Afterwards, a synthesis of the selected studies was made according to author, country/year, databases, name of journal, methodology, and results (postoperative complications and nursing interventions).

The analysis was conducted through systems, and data were processed in Microsoft Office Excel®, followed by a descriptive statistics and presentation in the form of tables.

RESULTS

Of the 30 articles selected, 18 (60.0%) were published in MEDLINE, 8 (26.7%) in LILACS, 3 (10.0%) in SciELO, and 1 (3.3%) in PubMed. Articles had been published in 11 countries, and the predominant language was English. The country with most studies was Brazil, (13 articles; 43.3%), followed by the USA (5; 16.7%) and Portugal (3; 10.0%). Most Brazilian publications were available in both English (14; 46.66%) and Portuguese (13; 43.33%).

We observed that, for ten years, there was no increase in publications, with oscillations: in 2008 and 2010, the number of publications on the theme was larger, but decreased after 2011.

Regarding the type of periodical, 14 (46.6%) articles had been published journals of the medical field, 5 (16.6%) in general nursing, 5 (16.6%) in perioperative nursing, 3 (10.0%) in general medicine, and 3 (10.0%) in other health areas.

The methodological design of studies was: eight descriptive, seven prospective, five retrospective, four exploratory/observational, three cohort, two case studies/cross-sectional, one desk, one analytical, and one interventional case-control.

There were 28 quantitative studies, 1 qualitative, and 1 quasi-experimental. This shows the low score of scientific evidence of papers, according to the Oxford Centre for Evidence-Based Medicine, since most articles had level 5[6].

Chart 1 presents an overview of the selected studies according to author, country and year of publications, database, method, postoperative complications, and nursing interventions.

Of the 30 articles included, 27 (90.0%) analyzed events that occurred with adults, and 3 (10%) with children.

The most frequent postoperative complications addressed in studies were pain and hypothermia; hypertension and

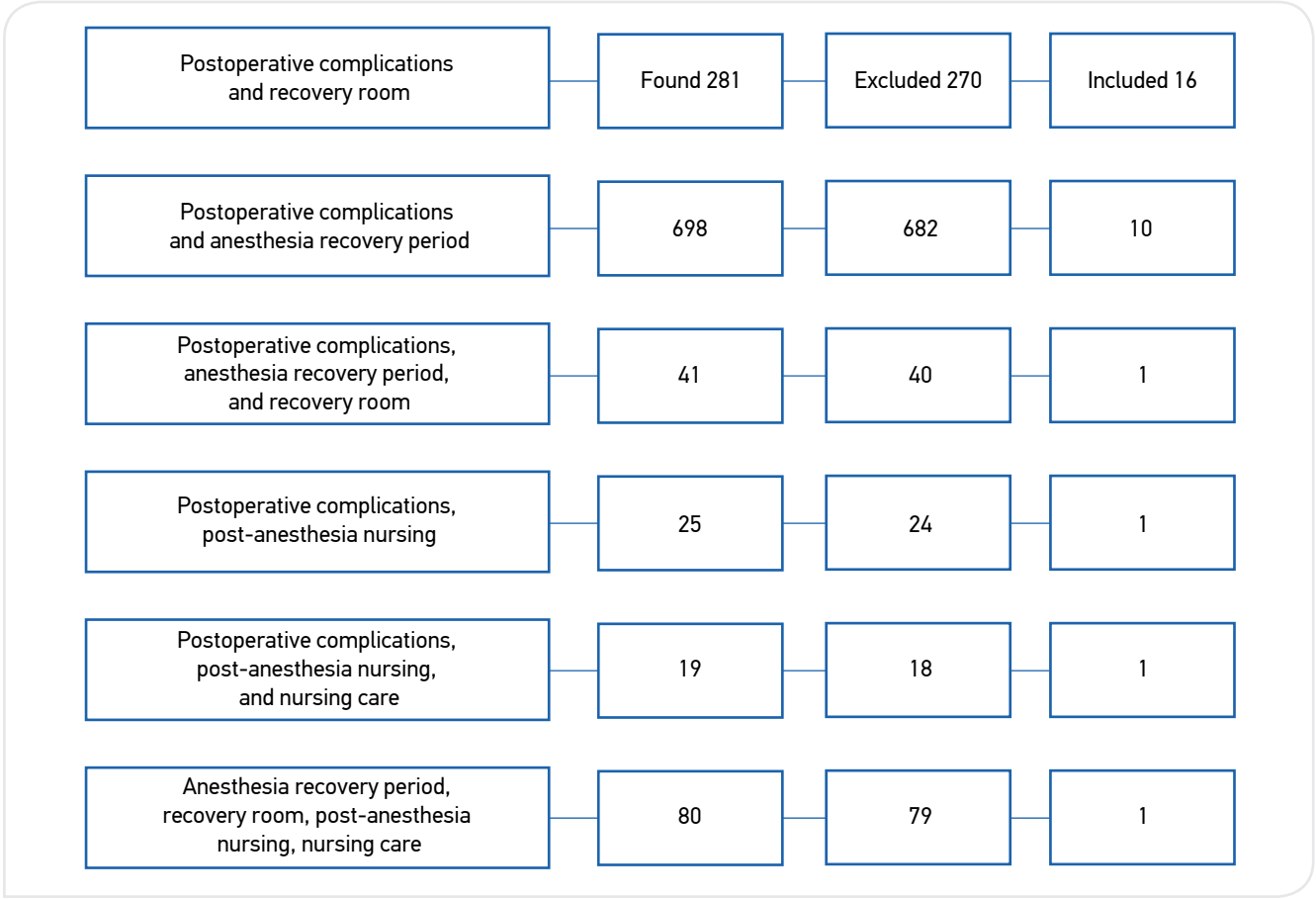

Figure 1. Article selection according to the association between descriptors. Aracaju, Sergipe, Brazil, 2016.

Chart 1. Summary of studies included in sample. Aracaju, Sergipe, Brazil, 2016.

Reference	Country (year)	Database	Periodical	Method	Post-anesthesia complications	Nursing interventions
3	Brazil (2009)	SciELO	Rev. Esc. Enferm. USP	Exploratory, descriptive, with quantitative approach	- Pain - Nausea - Vomiting - Hypoxemia - Hypothermia	- Analgesia - Oxygen therapy - Dressing - Hydration - Additional tests - Observation - Thermal blanket - Urinary catheterization
7	Brazil (2008)	SciELO	Revista da Escola de Enfermagem da USP	Retrospective, with quantitative approach	- Pain - Desaturation - Tachycardia	Analgesia administration
8	Brazil (2010)	LILACS	Revista Dor	Descriptive, with quantitative approach	Pain	Analgesia administration
9	Spain (2012)	MEDLINE	Rev Esp Anestesiol Reanim	Clinical Case	- Erythematous rash - Pruritus - Nausea/vomiting - Mild chest discomfort	Drug administration
10	Portugal (2015)	MEDLINE	Archivos em Broncopneumologia	Observational, prospective, with quantitative approach	- Inability to breathe deeply - Hypoxemia - Difficulty in breathing, swallowing, and talking	Not reported
11	Brazil (2012)	MEDLINE	Cient. Ciênc. Biol. Saúde	Descriptive, cross-sectional, with quantitative approach	Hypothermia	Not reported
12	Scandinavia (2011)	MEDLINE and PubMed	Acta Anaesthesiol Scandinavia	Exploratory, with quantitative approach	Urinary retention	Urinary catheterization
13	Brazil (2014)	LILACS	Revista SOBECC	Prospective, with quantitative approach	- Hypothermia - Pain - Hypoxemia - Bradycardia - Hypotension	Not reported
14	USA (2008)	MEDLINE and PubMed	Journal of Perianesthesia Nursing	Exploratory, with quantitative approach	Urinary retention	Not reported
15	Brazil (2015)	LILACS	Salusvita	Qualitative, using Bardin's methodology	Pain	Identification and measures for pain relief
16	Canada (2013)	PubMed and LILACS	Journal of Clinical Anesthesia	Exploratory, with quantitative approach	Desaturation	Not reported
17	Brazil (2010)	SciELO	Enfermeria Global	Descriptive, with quantitative approach	- Hypothermia - Pain - Tachypnea - Hypertension - Nausea - Anxiety	Specific care for each complication
18	Brazil (2008)	LILACS	Arquivos Catarinenses de Medicina	Cross-sectional	Hypothermia	Not reported

Continue...

Chart 1. Continuation.

Reference	Country (year)	Database	Periodical	Method	Post-anesthesia complications	Nursing interventions
19	USA (2016)	SciELO	Revista Brasileira de Anestesiologia	Case Report	Non- epileptic seizures	Not reported
20	Japan (2013)	MEDLINE and PubMed	Journal of Perianesthesia Nursing	Descriptive, with quantitative approach	Urinary retention	Stimulation of spontaneous micturition and urinary catheterization
21	Germany (2008)	MEDLINE and PubMed	British Journal of Anesthesia	Observational, with quantitative approach	Delirium	Testing of instruments to assess delirium
22	USA (2010)	MEDLINE and PubMed	Journal of Perianesthesia Nursing	Retrospective, with quantitative approach	Arrhythmia	Not reported
23	Portugal (2013)	MEDLINE and PubMed	Journal of Clinical Anesthesia	Prospective, with quantitative approach	Delirium	Not reported
24	Egypt (2013)	MEDLINE and PubMed	Anaesthesia	Quasi-experimental	- Delirium - Agitation - Vomiting	Not reported
25	Switzerland (2015)	MEDLINE	BMC Anesthesiology	Prospective, with quantitative approach	Delirium	Not reported
26	Portugal (2014)	MEDLINE	Revista Portuguesa de Pneumologia	Case-control	- Hypoxia - Difficulty in breathing deeply	Not reported
27	Korea (2015)	MEDLINE and PubMed	Journal of International Medical Research	Retrospective, with quantitative approach	- Agitation - Pain	- Pain management - Urinary catheterization
28	USA (2015)	MEDLINE and PubMed	British Journal of Anesthesia	Cohort	Delirium	Not reported
29	Brazil (2012)	MEDLINE and SciELO	Revista Brasileira de Anestesiologia	Cohort	- Nausea/vomiting - Pain - Thrombophlebitis	Not reported
30	Germany (2010)	MEDLINE and PubMed	European Journal of Pain	Cohort	Pain	Application of scales
31	Brazil (2008)	LILACS and SciELO	Revista Brasileira de Anestesiologia	Observational, with quantitative approach	Nausea/vomiting	Drug administration
32	Brazil (2010)	LILACS and SciELO	Revista Brasileira de Anestesiologia	Descriptive, prospective, with quantitative approach	Urinary retention	Urinary catheterization
33	Brazil (2010)	MEDLINE and SciELO	Investigación y Educación en Enfermería	Descriptive, retrospective, with quantitative approach	- Hypothermia - Pain - Hypertension - Nausea/vomiting - Dyspnea/tachypnea - Bradycardia	Not reported
34	USA (2009)	MEDLINE and PubMed	Journal of Perianesthesia Nursing	Prospective and randomized	- Delirium - Agitation	Allow parents at the PACU
35	USA (2009)	MEDLINE and PubMed	Journal of Perianesthesia Nursing	Prospective and randomized	- Delirium - Agitation	Allow parents at the PACU

hypotension; desaturation and hypoxemia; nausea and vomiting; and urinary retention, which involved the nervous, circulatory, respiratory, digestive, and urinary systems, respectively, as shown in Table 1.

The surgical specialties that had more complications were: general surgery, orthopedics, and gynecology. The higher incidence was for general anesthesia, as displayed in Table 2.

DISCUSSION

Nineteen studies reported complications of the nervous system at the PACU. The studies[8,30] that evaluated pain intensity using a numerical scale showed scores 3 and 4 as the most frequent. Among children who had undergone surgical interventions at a hospital of São Paulo and reported pain while at the PACU, the mostly cited intensity scores were 3 and 4, for those who spent more time in the unit[8]. Similarly, a study conducted in Germany identified that pain incidence and score were lower than 4 in the majority of the population studied and higher than 4 in the remaining[30].

When correlating pain and type of surgical intervention, musculoskeletal surgeries had the highest incidence (38.2%)[30].

A qualitative research using Bardin's method of content analysis demonstrated that pain, in most cases, is identified by the professional and the patient, so the results were grouped in nurse-patient verbal communication and non-verbal communication[15].

The most frequent neurological complication was hypothermia, identified in 80[8], 55.5[13] and 43%[3] of patients. Although not statistically significant, it was the most common event in patients who had been submitted to general, proctological or gynecological surgery with both inhalation or spinal anesthesia[18].

As for surgery complexity and body temperature in the IPO period, patients undergoing major and intermediate surgeries presented mild and moderate hypothermia, but not severe[11].

Table 1. Postoperative complications at the Post-Anesthesia Care Unit, according to body systems. Aracaju, Sergipe, Brazil, 2016.

Systems	Complications	n=30	%
Nervous	Pain	12	40.0
	Hypothermia	08	26.7
	Delirium	06	20.0
	Agitation	04	13.3
	Seizure	01	03.3
Circulatory	Hypertension	04	13.3
	Hypotension	02	06.7
	Tachycardia	02	06.7
	Bradycardia	01	03.3
	Thrombophlebitis	01	03.3
	Arrhythmia	02	06.7
	AMI*	01	03.3
	Bleeding	01	03.3
Respiratory	Desaturation (O_2)**	05	16.7
	Hypoxemia	03	10.0
	Hypoxia	01	03.3
	Difficulty in breathing deeply	02	06.7
	Dyspnea	01	03.3
	UA obstruction***	01	03.3
	Tachypnea	01	03.3
Digestive	Nausea	08	26.7
	Vomiting	08	23.3
Immune	Anaphylactic reaction	01	03.3
Urinary	Urinary retention	06	20.0

*AMI: acute myocardial infarction, **O_2: oxygen, ***UA: upper airways.
Source: published articles.

Table 2. Type of anesthesia and surgical specialties of postoperative complications. Aracaju, Sergipe, Brazil, 2016.

		n=30	%
Anesthesia	General	24	80.0
	Spinal	08	26.7
	Combined*	06	20.0
	Epidural	04	13.3
	Local	02	06.7
	Brachial plexus block	01	03.3
Surgical specialty	General surgery	12	40.0
	Orthopedic	11	36.7
	Gynecological	10	33.3
	Head/neck	05	16.7
	Otolaryngology	04	13.3
	Neurosurgery	02	06.7
	Plastic	02	06.7
	Vascular	02	06.7
	Urologic	07	23.3
	Gastroenterological	01	03.3
	Proctological	01	03.3
	Cardiothoracic	01	03.3

Combined*: regional and general.

Regarding length of stay at the PACU and hypothermia, 80% of patients remained hypothermic for up to 30 minutes, and 60% of them returned to normal temperature in 60 minutes[34]. However, a similar study showed that the average incidence of hypothermia was 33.6% of patients at the time of admission to the care unit (minute 0)[13].

The most common manifestations of hypothermia were tremors (66.6%) and hypoxemia (73.3%), with mean of 1.83 per patient[34].

Delirium was identified in 19% of the 400 patients studied. Signals were detected upon admission, after 30 minutes, 1 hour, and upon discharge in 124 (31%), 59 (15%), 32 (8%), and 15 (4%) patients, respectively[28]. In a similar study, 4.3% of patients presented delirium while at the PACU (138.4±55.2 min)[25].

A research with 266 patients showed that 8.6% of them experienced emergence delirium and 6.4% had an episode of hypoactive delirium[23]. In another study, hypoactive delirium occurred in 56% of patients at the time of admission and in 92% during their stay at the PACU[28].

Risk factors identified for emergence delirium were: prolonged preoperative fasting, higher surgical risk, higher scores in pain scale, frequent nausea and vomiting[23], and administration of opioids in the care unit[28].

By correlating age and surgical specialty, a study with 287 patients reported 30 individuals aged up to 70 years (28.7%) diagnosed with delirium. Orthopedics and urology were the specialties with the most cases of delirium[25].

Regarding the circulatory system, the most prevalent complications at the PACU were: hypertension[17,33], tachycardia[7], and bradycardia[33]. At two surgical centers in the USA, among 185 patients classified by the American Society of Anesthesiologists (ASA I) and who had undergone surgery, 16 had arrhythmias while at the PACU, including tachycardia and sinus bradycardia[22].

The most common adverse events observed were: inability to breathe deeply, mild and moderate hypoxemia, weakness, obstruction of upper airways (UA), signs of respiratory distress or imminent respiratory failure[10], severe hypoxemia[3], dyspnea and tachypnea[17,33], and desaturation[7].

Incidence of desaturation upon arrival at the PACU was 19.12% when patients had been transferred without oxygen supplementation, and 0.8% with supplementation. The results suggest that the most important predictor of desaturation at the care unit was transportation without oxygen[16], and hypoxemia was statistically significant when related to routine and oxygen therapy[3].

In a study with obese patients, the incidence of respiratory complications in the postoperative period and the length of stay at the PACU were higher compared to a group of non-obese patients. Inability to breathe deeply was the most common complication in 26% of obese patients and 4% of non-obese patients. Obesity and residual neuromuscular blockade after surgery were considered significant risk factors for respiratory complications[26].

Nausea and vomiting were the most common gastrointestinal complications seen at the PACU[17,29,33]. A research conducted in Brazil reported 35 patients experiencing postoperative nausea and vomiting (PONV). The most prevalent risk factors were: smoking abstinence, female gender, use of opioids, and previous history of PONV. Comorbidities with possible impact were detected in 26.2% of patients and included diabetes, chronic renal insufficiency, and previous chemotherapy and/or radiotherapy[31].

In the urological field, studies have shown patients admitted to the PACU with urinary volumes greater than or equal to 400 mL presenting with post-anesthesia urinary retention[12,14,20,32].

In a study conducted in the USA, factors related to urinary retention in the postoperative period included infusion of fluids in intraoperative period and volume of the bladder at the time of admission to the PACU. There was no association between urinary retention and age, gender, surgical complexity, anesthesia level, and surgical service[14].

In a study in Japan, 7 out of 34 patients developed urinary retention. Among the risk factors listed, the most significant ones were: clinical history, type and length of surgery and anesthesia. However, there was no sufficient data to establish a relationship between anesthetic technique, medication, and amount of fluids administered[20].

In regard to surgical specialty, 19 patients developed post-anesthesia urinary retention. Orthopedic and vascular surgeries had a higher incidence of retention, with odds ratio of 4.33[32].

In this integrative review, only two studies described the nursing interventions used in the event of postoperative complications at the PACU. For pain relief, the nurses administered oxygen therapy and analgesics and changed dressings. For agitation and anxiety, the interventions were oxygen therapy and administration of anxiolytics[3]. The mostly used preventive actions for hypothermia were warmed intravenous infusion and use of thermal blankets[34].

In an American research on children agitation in the IPO period, parents declared feeling useful in providing

care and reducing anxiety when present at the PACU[35]. This study showed the relevance of comfort to individuals and their relatives.

Nursing interventions for hypotension were: hydration, referrals to additional tests, and observation. For hypertension, the only intervention highlighted was observation; to reduce bleeding, nurses applied compression dressings[3].

Hypoxemia was significant when related to the routine (vital signs monitoring, safety measures, physical and neurological evaluation) and oxygen therapy[3]. The higher frequency was a consequence of the need to use an oxygen mask to keep saturation above 91%[8].

With respect to nausea and vomiting, the nursing care depended on specific protocols of each institution and on the administration of antiemetics[3].

To optimize the implementation of nursing interventions, the nursing team working at the PACU must be trained to plan and execute actions that reduce complications related to anesthesia and surgical procedures or prevent such events, mindful of each patient's safety, comfort, and characteristics.

The limitations of the present study include the scientific evidence level of the articles selected, low statistical correlation — including length of surgery, type of anesthesia, surgical intervention, and post-anesthetic complication at the PACU —, in addition to the specific approach of restricting the identification of other complications. It is also important to consider the lack of studies encompassing nursing interventions, which are so relevant and indispensable to a full and immediate recovery of surgical patients.

CONCLUSION

After analyzing 30 articles, objects of this study, the most frequent complications related to anesthesia and surgery were: pain, nausea and vomiting, hypothermia, urinary retention, and hypertension. The nursing interventions that stood out were: drug administration, oxygen therapy, observation, installation of thermal blanket, and vital signs monitoring.

We highlight the importance of prior awareness by the nursing team about early identification of complications and implementation of preventive measures. This highlights the need for studies based on a specific nursing intervention system.

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DEVELOPMENT OF A HANDBOOK OF SURGICAL POSITIONING: EXPERIENCE REPORT

Criação de um manual para posicionamento cirúrgico: relato de experiência

Creación de un manual para posicionamiento quirúrgico: relato de experiencia

Cristina Silva Sousa[1]*, Daniela Magalhães Bispo[2], Andrea Alfaya Acunã[3]

ABSTRACT: Objective: To report the experience of developing a handbook of surgical positioning. **Method:** Experience report on the development of a handbook of surgical positioning to guide nursing professionals, based on theoretical foundation and clinical practice of the nursing staff in a large philanthropic hospital located in the city of São Paulo. We developed the guide as an opportunity to improve prevention of injuries caused by surgical positioning. **Results:** The handbook comprises 64 pages in landscape orientation, colored, and illustrated, validated by the surgical block manager and coordinator. It includes an introduction, risk assessment, devices, and recommended practices. For each surgical position, it demonstrates how to place the patient and the risks involved. The end of the document brings information about prevention devices used by the institution. **Conclusion:** The development of a handbook of positioning allows the perioperative nursing team to have proper guidance on surgical positioning and, consequently, prevent pressure ulcers caused by mistaken positioning.

Keywords: Perioperative nursing. Patient positioning. Pressure ulcer.

RESUMO: Objetivo: Relatar a experiência da criação de um manual de posicionamento cirúrgico. **Método:** Relato de experiência da construção de um manual de posicionamento cirúrgico para direcionar os profissionais de enfermagem, com base no fundamento teórico e na prática clínica da equipe de enfermagem de um hospital filantrópico de grande porte localizado no município de São Paulo. O guia foi desenvolvido como oportunidade de melhorar a prevenção de lesões por posicionamento cirúrgico. **Resultados:** O manual é composto de 64 páginas, em apresentação paisagem, colorido e com ilustrações, validado pela gerente e coordenadora do bloco operatório. Contém introdução, avaliação de risco, dispositivos e práticas recomendadas. Para cada posição cirúrgica, é demonstrado como realizar o posicionamento e os riscos envolvidos. Ao final do documento, são informados os dispositivos de prevenção utilizados pela instituição. **Conclusão:** A criação de manual de posicionamento permite à equipe de enfermagem perioperatória o direcionamento adequado para o posicionamento cirúrgico e, consequentemente, para a prevenção de lesões por pressão decorrentes do posicionamento equivocado.

Palavras-chave: Enfermagem perioperatória. Posicionamento do paciente. Lesão por pressão.

RESUMEN: Objetivo: Relatar la experiencia de la creación de un manual de posicionamiento quirúrgico. **Método:** Relato de experiencia de la construcción de un manual de posicionamiento quirúrgico para direccionar los profesionales de enfermería, con base en el fundamento teórico y en la práctica clínica del equipo de enfermería de un hospital filantrópico de grande porte localizado en el municipio de São Paulo. La guía fue desarrollada como oportunidad de mejorar la prevención de lesiones por posicionamiento quirúrgico. **Resultados:** El manual está compuesto por 64 páginas, en presentación paisaje, colorido y con ilustraciones, validado por la gerente y coordinadora del bloque operatorio. Contienen introducción, evaluación de riesgo, dispositivos y prácticas recomendadas. Para cada posición quirúrgica, es demostrado como realizar el posicionamiento y los riesgos involucrados. Al final del documento, son informados los dispositivos de prevención utilizados por la institución. **Conclusión:** La creación de manual de posicionamiento permite al equipo de enfermería perioperatoria el direccionamiento adecuado para el posicionamiento quirúrgico y, consecuentemente, para la prevención de lesiones por presión decurrentes del posicionamiento equivocado.

Palabras clave: Enfermería perioperatoria. Posicionamiento del paciente. Úlcera por presión.

[1]Nurse; Ph.D. in Health Sciences from the School of Nursing of Universidade de São Paulo; Surgical Center Attending Nurse at Hospital Sírio-Libanês – São Paulo (SP), Brazil.
[2]Nurse; Master's degree in Collective Health from Instituto Sírio-Libanês de Ensino e Pesquisa; Surgical Block Coordinator at Hospital Sírio-Libanês – São Paulo (SP), Brazil.
[3]Nurse; Surgical Block Manager at Hospital Sírio-Libanês – São Paulo (SP), Brazil.
*Corresponding author: crissousa@usp.br
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INTRODUCTION

Surgical positioning is a procedure performed by nursing professionals, together with anesthetic and surgical teams, during the intraoperative period[1]. It must take into account the patient's anatomy and movement limitations, and the access area for the surgeon and his or her assistants[2].

The objectives of positioning include: offering adequate access to the surgical site; maintaining the dignity of the patient during body exposure; providing ventilation and maintenance of patent airways; allowing venous access; monitoring and controlling physiological elimination, according to the position, and easy access to evaluate and measure the output; observing and protecting fingers and genitals; keeping the circulation; and protecting muscles, nerves, and bony prominences[3].

Surgical positioning complications are described mainly as pressure ulcers (PU)[4], but they can also result in musculoskeletal pain, joint dislocation, damage to peripheral nerves, cardiovascular and pulmonary involvement, and even compartment syndrome[1].

Appropriate surgical positioning ensures efficiency and safety during the procedure and is one of the main indicators of quality care in perioperative assistance[5]. The recommended devices to assist and prevent PU are viscoelastic positioners, prophylactic adhesive dressings, specific positioners, and foams. The use of fabric is contraindicated[2].

The perioperative nursing staff has been using risk assessment scales — instruments that determine the predisposition risk of positioning injury — to predict the risk of patients developing PU. Among these instruments, we have the Munro Scale[6], which consists of three evaluation periods (pre, intra, and postoperative), but has not been validated in Portuguese yet; and the Risk Assessment Scale for Development of Injuries Resulting from Surgical Positioning (*Escala de Avaliação de Risco para o Desenvolvimento de Lesões Decorrentes do Posicionamento Cirúrgico* - ELPO)[7], which covers intraoperative application and a number of assessment items to establish the lower and higher risk score for developing positioning injury based on a 19 points minimum score. Thus, it is possible to define the risk score of the patient developing PU and warn the professional about higher risk patients, in order to find better prevention strategies.

In a systematic review of surgical adverse events (AE), the authors describe PU as the most common and potentially preventable occurrence[8]. An integrative review of nursing care in the transoperative period details skin complications caused by surgical positioning, and its results showed studies with an incidence of stage I PU[9].

Surgical positioning injuries are classified as events with damage to the patient and require preventive measures performed by perioperative nurses. In this regard, the conception of a handbook of surgical positioning aims at guiding the nursing team to perform the positioning correctly and prevent surgical AE associated with PU.

OBJECTIVE

To report the experience of developing a handbook of surgical positioning in a highly complex hospital in São Paulo.

METHOD

This is an experience report on the production of a handbook of surgical positioning based on theoretical foundation and clinical practice of the nursing staff in a large highly complex philanthropic hospital located in the city of São Paulo, in the period between September and October of 2017.

A perioperative nurse with over ten years of experience developed this handbook, as an opportunity to improve prevention of injuries caused by surgical positioning.

Among the care indicators of the surgical center (SC) are positioning injury events. Despite not being a specific indicator, as the report of this event is part of the PU record, the presence of the AE in low and moderate risk is noticeable.

Therefore, to minimize PU incidence, the development of a handbook of surgical positioning to guide the nursing team in the implementation of best practices to prevent positioning injuries was proposed.

Phase I: content of the handbook of positioning

Material collection started by reading recommendations from American, European, and Brazilian perioperative nursing associations, as well as integrative reviews, and national and international literature, in association with the clinical

practice performed at the institution. The purpose was to find national and international recommendations of best practices to prevent positioning injury.

Next, general points were listed for the introduction of the material, such as risk assessment, evaluation scale, positioning devices, and common practices for any surgical position.

Subsequently, surgical positions and the sequence for proper positioning were identified, as well as the risks involved. In a meeting with the coordinator and manager of the surgical block (SB), it was decided to include images — drawings — of surgical positions, and pictures — photographs — of injury prevention devices, available at the institution.

Phase II: material production

The concept of material production should cover different professional levels. Therefore, the language of the handbook is simple and oriented in topics to facilitate the identification of the steps for each surgical positioning. The manual was designed in Microsoft PowerPoint, font size 22, in presentation format.

After finalization of the content and format of the proposed handbook, the SB coordinator and manager, who have vast professional experience in perioperative nursing, validated the material by analyzing its content, format, and layout.

At the end of the process, the established handbook was printed in color, on bond paper with landscape orientation, and bound in a spiral. It was then presented to the nursing staff for reading and made available as reference material at the SC nursing station for daily access to all professionals.

RESULTS

The handbook of positioning comprises 64 pages, with each topic consisting of one color. The "Risk Assessment" topic presents the objective, assessment items, and the ELPO risk scale.

The "Surfaces and devices" item recommends checking the devices available in the institution and use them according to the weight and capacity necessary to safely move the patient; position the patient on a smooth surface that redistributes the pressure; and use prophylactic dressings in bony prominences and other areas subject to pressure, friction, or cutting. Also, it warns not to lay the patient on the thermal mattress without protection and not to use towels, sheets, or blankets as positioning devices.

The topic "General positioning practices" indicates to keep the patient's body alignment; have a sufficient number of people to move the patient; protect the patient's body from metallic surfaces and pressure areas; proceed with eye protection; avoid cervical hyperextension; use the safety strap; and monitor the positioning during the intraoperative period.

For each surgical position, a drawing representing the positioning precedes the description — by topics — on how to proceed. After each description, there is a box with a reminder of attention to the positioning, followed by the risks involved.

Chart 1 presents the surgical positions with their corresponding risks.

After the production of the handbook, the file was sent to SB perioperative nurses (manager and coordinator) for evaluation, with a presentation of the proposed content, material, and layout. They saw no need for amendments, validating the material and forwarding it to color printing and binding. The nursing staff received two copies of the handbook to use as a guide for positioning and strategies to prevent skin injuries.

Staff was requested to read the material during working hours, according to the activities of their shift, a task that took about three days to cover the whole team on multiple shifts. At the end of the process, the booklet became available for consultation at the nursing station.

The handbook, in file form, was also sent to the quality area of the institution, as a product of the plan of action, a measure to prevent surgical positioning injury.

DISCUSSION

There is no description of the development of handbooks of surgical positioning in the literature. In general, professionals learn about the topic during training, and some publications have an orientation about surgical positions and care.

Nurses are responsible for planning and implementing interventions that prevent complications caused by anesthetic-surgical procedure. They assist the patient together with

Chart 1. Surgical positions, positioning, and risks described in the topic "Surgical positions" of the handbook of surgical positioning.

Surgical position	Positioning	Risks involved
Supine	Position the patient's upper limbs according to the needs of the surgical team or the limitations of the patient. If the upper limbs are alongside the body: place the upper limbs in neutral position, with the palms of the hands facing the body; do not hyperextend the elbows; fasten the fabric surrounding the upper limbs between the patient's body and arm; ensure that the fabric holding the patient's upper limbs is tight enough to protect them, but not so tight to create a pressure point. If the upper limbs are in braces: put the brace at surgical table level; keep the upper limbs in an angle lower than 90º; position the upper limbs with the palm upwards; keep the alignment of the upper limbs. Bend the knees of the patient in approximately 5 to 10º. Place the safety strap about 5 cm above the patient's knees. Raise the patient's heels out of the underlying surface. Redistribute the pressure on the heels with positioning devices. The use of adhesives devices in pressure areas is recommended in case of long procedures.	Lumbago due to the loss of normal lumbar curvature. Ulnar and radial nerve injury. Brachial plexus injury. Cervical plexus or spinal cord injury caused by hyperextension of the head. Alopecia caused by compression of hair follicles. Ischemic pressure ulcer.
Prone	Place the patient's head in a neutral position, without excessive bending, extension, or rotation. Use a head positioner when the patient's head is in the midline. Monitor the position of the patient's face. Avoid direct pressure on the patient's eyes. Position the upper limbs according to the needs of the surgical team and the physical limitations of the patient. If the upper limbs are alongside the body: place the upper limbs in neutral position, with the palms of the hands facing the body; do not hyperextend the elbows; fasten the fabric surrounding the upper limbs between the patient's body and arm; ensure that the fabric holding the patient's upper limbs is tight enough to protect them, but not so tight to create a pressure point. If the upper limbs are in braces: put the brace lower than the thorax, abducting the upper limbs in less than 90º with elbows bent and palms facing downwards; keep the upper limbs in neutral alignment; do not position the upper limbs above the head. Place the patient's thorax on two roll positioners from clavicle to iliac crest. Position the breasts, abdomen, and genitals, so they are free of pressure or torsion. Put a roll positioner under the iliac crest. Protect the patient's knees. Raise the patient's feet and place protectors under the legs so the feet can be higher and freer. Evaluate the patient's wrists after positioning and aligning the body. Lay the patient in a 5 to 10º Trendelenburg position. The use of adhesives devices in pressure areas is recommended (chin, clavicle, thorax, iliac, knees).	Cervical injury caused by neck rotation. Eye edema or blindness. Compression or ischemic injury of facial structures. Abdominal compression with decreasing venous return. Brachial plexus injury. Ulnar and radial nerve injury. Compression of genitalia in men, causing edema, hematoma, and ischemia. Breast compression in women.

Continue...

Chart 1. Continuation.

Surgical position	Positioning	Risks involved
Lateral	Place a head positioner or pillow under the patient's head. Assess and monitor the patient's dependent ear after positioning. Support and protect the upper limbs in two levels and with parallel braces, laying a member on each brace with an angle lower than 90º. Put a roll positioner under the patient's dependent thorax between the seventh and ninth rib. Check the bilateral radial pulse of the patient after placing the axillary roll. Keep the patient's physiological spinal alignment. Fasten the safety strap on the patient's hip. Bend the patient's dependent lower limb on the hip and knee. Position the patient's upper lower limb and place a pillow between the legs. Minimize the degree of flexion of the surgical table and the side elevation at kidney level as much as possible. Put the safety strap on the iliac crest for thoracic and orthopedic procedures. For renal procedures, add a strap on the thorax.	Cervical injury caused by excessive bending, extension, or rotation of the neck. Brachial plexus injury presented as paresis, pain, paresthesia, and decreasing strength in the upper limbs. Corneal abrasions, eye edema, partial and total loss of sight. Ischemic necrosis of the ear. Peroneal nerve injury caused by compression of high weight on the knee. Necrosis of the femur caused by the lateral fixing tape compressing the femoral head or positioners compressing the femoral artery.
Trendelenburg	Place the upper limbs alongside the body. Minimize the Trendelenburg degree as much as possible. Implement measures to prevent the patient from slipping on the surgical table. Avoid the use of shoulder pads, if possible. Avoid this position for extreme morbidly obese patients.	Ulnar nerve injury. Ischemic pressure ulcer. Increasing intracranial pressure. Respiratory changes caused by abdominal viscera compressing lung bases.
Reverse Trendelenburg	Use a footboard to prevent the patient from slipping and reduce the potential for nerve injury and flexion of the ankle. Monitor the patient's feet and implement corrective actions.	Brachial plexus and ulnar nerve injury. Ischemic pressure ulcer. Patient slips or even falls from the surgical table. Venous embolism.
Lithotomy	Position the patient's buttocks on the end part of the surgical table, so that the table surface supports the sacral region. Protect the patient's hands and fingers from injury when the leg rests are placed or while moving the lower limbs. Position the patient's hips in order to avoid excessive bending, rotation, or abduction. Place the leg rests at a uniform height. Lay the patient's lower limbs on the leg rests slowly and at the same time. Support the patient's lower limbs on the widest surface possible. Place the patient's heels at the lowest point possible. Prevent the patient's lower limbs from becoming support for the leg rests. At the end of the procedure, lift the lower limbs out of the leg rests slowly and bend them before laying them on the surgical table.	Paresthesia in the affected nerve distribution is the most common complication, and injuries may occur on the obturator nerve, lateral femoral cutaneous nerve, sciatic nerve, peroneal nerve, and femoral nerve. Deep venous thrombosis. Compartment syndrome of the lower extremities.
Fowler or sitting	Keep the patient's head in a neutral position, without excessive bending, extension, or rotation. Bend and protect the patient's upper limbs or limb that will not undergo surgery, keeping them alongside the body. Support the patient's sacral region. Bend the knees of the patient in 30º. Prevent the patient's abdomen from resting on the lower limbs. Fasten the safety strap on the patient's thigh.	Excessive cervical flexion, which can block arterial and venous blood flow, causing cerebral hypoperfusion or venous congestion of the brain, in addition to torsion of the tube, and face and tongue edema. Brachial plexus, ulnar, and sciatic nerve injury. Blindness. Air embolism.

the multi-professional team, and decide on the best positioning for the patient, in order to facilitate activities during the anesthetic-surgical procedure[4].

Any patient undergoing a surgical procedure has a risk of suffering a positioning injury. These injuries can be a result of stretching or compression of tissues — which leads to ischemia —, friction and shearing, or prolonged pressure[2].

In a study conducted in Minas Gerais, the incidence of injuries caused by surgical positioning was 74%. They were characterized as stage I ulcers, more frequently located in the sacral region, followed by the calcaneus[9]. In São Paulo, a study with only cardiac surgeries had 19% of positioning injuries, most of them also of stage I[10]

Preventing positioning injuries is a responsibility of the surgical team, which includes the nursing staff, anesthesiologist, surgeon, and assistant. It is necessary attention to support conditions, time of use during the procedure, and any condition that might interfere with patient positioning[2,11]

At times, understanding pressure areas for each surgical position and basic interventions to prevent PU is not something the nursing staff masters, which makes the handbook of positioning a care guide.

Effective interventions to prevent skin injuries relate to pressure relief during and immediately after the patient stay on the standard mattress of the surgical table[11]

The use of illustrative images of each surgical position and devices available in the institution helps the nursing team to better understand how to proceed and which resources to apply.

While reading the material, some nursing technicians reported being unaware of some topics elucidated and that they would be more attentive to the recommendations during their daily activities.

Another characteristic is the insufficient number of attending nurses in SC, which makes it impossible for these professionals to be present during the performance of every positioning. In this case, the nursing technician (OR circulating nurse) and the medical team are the ones in charge of this activity.

Thus, during the training of the team, the perioperative nurse has the opportunity of developing educational actions to ensure the safety of the surgical patient and reduce the risk of surgical positioning injuries[5].

We did not find studies that verify the knowledge of professionals members of the nursing staff about pressure areas or how to perform different types of surgical positioning. Nevertheless, these processes can have flaws for lack of knowledge.

Recently, the authors of a study on positioning for robotic urological surgeries described the positioning protocol for this patient profile, which includes the use of recommended devices for injury prevention[5]. However, we need more studies related to risk and recommendations.

Nursing professionals did not oppose the use of the handbook of positioning and considered reading the content acquisition of professional knowledge.

Systematization and greater use of resources to improve the process are still goals to achieve, but having a guiding content is the first step toward awareness of professionals acting in perioperative nursing.

We expect that this research contributes to the knowledge of nursing professionals so as to promote adequate surgical positioning and prevent possible damages caused by AE.

Among the limitations of this study, we have the adjustment of available resources to the demand for service in the institution, in order to cover a large number of nursing professionals with different knowledge levels. Systematizing the process of surgical positioning with regard to risk score is still a challenge to be overcome.

FINAL CONSIDERATIONS

The handbook of surgical positioning developed in a highly complex hospital institution in São Paulo, based on current literature, encompasses risks, different surgical positions, and available support surfaces. Its purpose is to guide nursing professionals in providing proper surgical positioning, with the use of protection resources to prevent injuries. Illustrations elucidate the positions and their care, and the color arrangement draws the reader's attention.

After the team read and acquired the knowledge of the handbook, it became available at the SC nursing station so that any staff member could consult it at any time.

With the nursing team mastering different surgical positions, and active in PU prevention, the rates of AE related to PU tend to decrease.

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