

Risk of pressure injury in patients undergoing spine surgery

Risco de lesão por pressão em pacientes submetidos à cirurgia de coluna

Riesgo de lesión por presión en pacientes sometidos a cirugía de columna

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ABSTRACT: Objective: To verify the risk of pressure injury in patients undergoing spine surgery and analyze the associated risk factors. **Method:** This is a descriptive-exploratory, cross-sectional field research, with quantitative analysis carried out in two stages (pre-operative and intraoperative), with 55 patients undergoing spine surgery, in a private hospital in São Paulo, Brazil, through the application of a characterization form of the participant and the surgery and the application of the Risk Assessment Scale for the Development of Injuries due to Surgical Positioning (ELPO). **Results:** According to ELPO, 33 of the 55 patients (60.0%) had a higher risk score for pressure injury. Patients at highest risk had an average age of 50.2 years, classified as overweight and obese, and had a mean surgery time of 2 hours and 45 minutes. There were significant statistical differences between the higher and lower risk groups, related to: age, weight, body mass index, and surgery time. The patient's risk of developing a pressure injury increases proportionally with increasing age, weight, body mass index, and surgery duration. As these factors increase, the patient's risk of developing pressure injury increases. **Conclusions:** The risk of pressure injury related to spinal surgical procedures was significant, evidencing a reality in which the perioperative nurse is responsible for planning preventive measures to mitigate the occurrences of such injuries and ensure patient safety.

Keywords: Patient positioning. Risk factors. Pressure ulcer. Intraoperative period. Perioperative nursing.

RESUMO: Objetivo: Verificar o risco de lesão por pressão em pacientes submetidos a cirurgias de coluna e analisar os fatores de risco associados. **Método:** Pesquisa de campo descritivo-exploratória, transversal, com análise quantitativa, realizada em duas etapas (pré-operatório e transoperatório), com 55 pacientes submetidos à cirurgia de coluna, em hospital privado de São Paulo, por meio da aplicação de um formulário de caracterização do participante e da cirurgia e aplicação da Escala de Avaliação de Risco para o Desenvolvimento de Lesões Decorrentes do Posicionamento Cirúrgico (ELPO). **Resultados:** De acordo com a ELPO, 33 dos 55 pacientes (60,0%) apresentaram escore de maior risco para lesão por pressão. Os pacientes que apresentaram maior risco tinham idade média de 50,2 anos, classificados como sobrepeso e obesidade e tempo médio de cirurgia de 2 horas e 45 minutos. Houve diferenças estatísticas significativas entre os grupos de maior e menor risco, relacionadas com: idade, peso, índice de massa corpórea e tempo de cirurgia. O risco de o paciente desenvolver lesão por pressão aumenta proporcionalmente conforme o aumento da idade, do peso, do índice de massa corpórea e a duração da cirurgia. Com o aumento desses fatores, aumenta o risco de o paciente desenvolver lesão por pressão. **Conclusão:** O risco de lesão por pressão relacionado ao procedimento cirúrgico de coluna foi significativo, revelando uma realidade na qual cabe ao enfermeiro perioperatório planejar medidas preventivas, no intuito de mitigar as ocorrências de tais lesões e garantir a segurança do paciente.

Palavras-chave: Posicionamento do paciente. Fatores de risco. Lesão por pressão. Período intraoperatório. Enfermagem perioperatória.

RESUMEN: Objetivo: Verificar el riesgo de úlceras por presión en pacientes sometidos a cirugía de columna y analizar los factores de riesgo asociados. **Método:** Investigación de campo descriptiva-exploratoria, transversal, con análisis cuantitativo, realizada en dos etapas (preoperatoria e intraoperatoria), con 55 pacientes sometidos a cirugía de columna, en un hospital privado de São Paulo, mediante la aplicación de un formulario de caracterización del participante y de la cirugía y aplicación de la Escala de Evaluación de Riesgos para el Desarrollo de Lesiones Derivadas del Posicionamiento Quirúrgico (ELPO). **Resultados:** Según la ELPO, 33 de los 55 pacientes (60,0%) tuvieron una puntuación de riesgo mayor para lesiones por presión. Los pacientes de mayor riesgo tenían una edad promedio de 50,2 años, clasificados como con sobrepeso y obesidad, y un tiempo quirúrgico promedio de 2 horas y 45 minutos. Hubo diferencias estadísticas significativas entre los grupos de mayor y menor riesgo, relacionadas con: edad, peso, índice de masa corporal y tiempo de cirugía. El riesgo del paciente de desarrollar una lesión por presión aumenta proporcionalmente con la edad, el peso, el índice de masa corporal y la duración de la cirugía. A medida que aumentan estos factores, aumenta el riesgo del paciente de desarrollar lesiones por presión. **Conclusión:** El riesgo de lesiones por presión relacionadas con procedimientos quirúrgicos de columna fue significativo, revelando una realidad en la que corresponde al enfermero perioperatorio planificar medidas preventivas, con el fin de mitigar la aparición de tales lesiones y garantizar la seguridad del paciente.

Palabras clave: Posicionamiento del paciente. Factores de riesgo. Úlcera por presión. Período intraoperatorio. Enfermería perioperatoria.

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INTRODUCTION

Currently, diseases that affect the spine have become frequent. In this context, disc herniation represents one of the most common diagnoses and, often, a surgical approach is necessary as treatment, whether conventional or endoscopic¹.

Spine surgery is usually performed with the patient in the prone or jackknife / Kraske position. These positions require nurses to have technical-scientific knowledge and specialized care, as these professionals are responsible, together with the surgery team and the anesthesiologist, to position and align the patient's body, assess the integrity of the tissues, distribute pressure to areas at greatest risk, in addition to installing protective resources with the aim of preventing the occurrence of pressure injury (PI)^{2,3}.

These positions are considered risky, as the compensation mechanisms are impaired by the hemodynamic changes generated when rolling the patient from the supine to the prone position, after general anesthesia².

In the surgical positions in question, the radial nerve can be compressed, causing a reduction in blood flow, which, added to the increased pressure exerted on areas such as the face, chest, elbows, costal margin, iliac crest, knees and toes, can favor the appearance of PI².

Thus, positioning the patient on the operating table becomes a challenge for perioperative nursing, considering that, among the complications arising from the anesthetic-surgical procedure, PI represents an important problem in health institutions, as it is directly linked to the quality and safety of the patient^{2,3}.

According to the National Pressure Injury Advisory Panel (NPIAP), PI is defined as localized injury to the skin and/or underlying soft tissues, usually over a bony prominence or related to the use of a medical device. PIs are classified into stages, with the aim of determining the degree of tissue involvement, that is, the depth of the injury:

Stage 1: intact skin with non-whitening erythema;

Stage 2: partial thickness skin loss, with exposure of the dermis;

Stage 3: full thickness skin loss, with exposure of subcutaneous tissue;

Stage 4: full thickness skin loss and tissue loss, with exposure of fascia, muscle, tendon, ligament, cartilage, or bone;

Unclassifiable: full thickness skin loss and non-visible tissue loss;

Deep tissue: dark red, brown, or purple discoloration, persistent and non-whitening;

Related to medical device: injury that results from the use of devices created and applied for diagnostic and therapeutic purposes (it describes the etiology of the injury);

Mucous membranes: found when there is a history of using devices at the site of the injury²⁻⁴.

PI is directly linked to the quality of the provided care, whether within the hospital or not. Surgical patients are inserted in this context, in which professionals must have a precise and detailed view due to the extrinsic risks to which patients are exposed, such as type of anesthesia, which inhibits sensory perception, immobilization for a long period on the operating table, lack of appropriate resources for positioning, in addition to intrinsic factors such as age, comorbidities, nutritional status, and smoking habit^{2,3,5}.

Considering these factors, an effective nursing intervention is necessary, as this condition can cause pain and discomfort, prolong hospitalization time, increase the cost and overload of nursing work⁶. Therefore, nurses must be aware of the anatomical and physiological changes that occur due to positioning, as well as what equipment and materials are available to assist in adequate positioning, encompassing risk aspects to which the surgical patient is exposed^{2,6}.

To support the adoption of preventive measures, it is recommended to use a structured risk assessment, which allows the identification of the patient's potential risk of developing PI^{2,4}. The nurse, as a fundamental player in PI prevention, must be trained to apply the assessment instrument, in addition to using evidence-based preventive measures^{2,4,6}.

Taking this into consideration, the justification for carrying out this research is the occurrence of PI in patients undergoing spine surgery, even with due care and the diversity of protective resources used. Furthermore, there is a lack of studies specifically aimed at patients undergoing spine surgery.

OBJECTIVE

To verify the risk of pressure injuries in patients undergoing spine surgery, by applying the Risk Assessment Scale for the Development of Injuries due to Surgical Positioning (*Escala de Avaliação de Risco para o Desenvolvimento de Lesões Decorrentes do Posicionamento Cirúrgico – ELPO*), and analyzing the associated risk factors.

METHOD

This is a descriptive-exploratory, cross-sectional field study, with quantitative analysis, carried out in a large private hospital in São Paulo, state of São Paulo – Brazil. This institution has more than 700 active beds, two surgery centers, which have 33 operating rooms and 41 anesthetic recovery beds. An average of 3,500 anesthetic-surgical procedures are performed monthly.

The research followed the ethical-legal precepts established by Resolution 466/2012 of the National Health Council, which consists of the Guidelines and Regulatory Norms for Research Involving Human Beings⁷. It was submitted and approved by the management of the surgical unit in which the data were collected and by the Research Ethics Committee (CEP) of the proposing institution, via *Plataforma Brasil* (Certificate of Presentation for Ethical Consideration — CAAE 05778218.4.0000.007 and Opinion 3.415.232).

The sample was acquired by convenience, with the aim of obtaining the largest number of participants during the collection period, consisting of 55 patients, who were included because they met the following criteria: adult patients, undergoing elective spine surgeries, in prone or jackknife/Kraske position, carried out from July to August 2019.

Two data collection instruments were used. The first is composed of items to characterize the sample (age, sex, weight, height, body mass index — BMI, comorbidities) and the surgery (performed surgery, patient's position, type of anesthesia, beginning and end of surgery, surgery time, protective resources used). The second instrument is the ELPO, which was applied immediately after positioning the patient for surgery, with the purpose of verifying the risk of developing PI.

The ELPO consists of seven items: type of surgical position, surgery time, type of anesthesia, support surface, limb position, patient's comorbidities, and patient's age. Each item has five subitems, which have a score between 1 and 5 points. At the end, these points are added together and the ELPO score is obtained, which can vary from 7 to 35 points; the higher the score, the greater the risk of developing PI. A score between 7 and 19 points is considered a lower risk; and a score between 20 and 35 points, a higher risk of developing PI resulting from surgical positioning⁸.

This scale represents a reliable instrument for assessing risk of developing PI in patients in the surgical context and

has been used in the national and international surgical context, demonstrating effectiveness in its applicability.

Data collection took place in two stages:

1. First stage: in the immediate preoperative period (24 hours before surgery), the Surgical Scheduling sector carried out a survey of spine surgeries scheduled for the following day and prior contact was made with the patient in the Inpatient Unit. Each patient was approached individually in the room and invited to participate in the research. Those who accepted to participate were presented with the Informed Consent Form, duly read and signed in two copies, one for the participant and the other for the researchers.
2. Second stage: during the intraoperative period, the first author followed each of the surgical procedures, with prior authorization from the patient, management, and medical team, and applied both data collection forms before the start of the surgery (characterization of the patient and the surgery) and after positioning the patient for surgery (application of the ELPO).

The obtained results were analyzed quantitatively through the use of statistical resources. Categorical variables were delineated by absolute and relative frequencies, and numerical variables were described by mean and standard deviation. The data were associated using the Student's t-test for numerical risk factors (age, BMI, surgery time) and chi-square for categorical risk factors (classification). A 95% confidence interval and a 5% significance level were adopted.

RESULTS

Among the 55 patients who composed the sample, 33 (60.0%) were at higher risk of developing PI, with an ELPO score greater than 19 points. The mean score was 20.4 points, with a minimum of 16 and a maximum of 28 points.

We followed up the 55 patients undergoing spine surgery, who remained in the prone or jackknife/Kraske position. We identified that, among the study patients, 46 (83.6%) were positioned in the prone position and nine (16.4%) in the jackknife position.

Of the participants, 31 (56.4%) were women and 24 (43.6%), men. The mean age was 45.5 years, with a prevalence between 34 and 43 years (22/40.0%), followed by the range from 44 to 53 years (13/23.6%). Among those at higher risk of developing PI, the mean age was 50.2 years,

with a standard deviation ±12.4. There was a higher risk in the group with a higher mean age, that is, as age increases, the risk of PI increases ($p < 0.001$) (Table 1).

The patients' weight varied between 50 and 129 kg, with a mean of 79.9 kg and standard deviation ±17.2. Considering the inconsistency of values, we decided to use the classification of patients according to their BMI to verify the prevalence of risk of developing PI. Among the highest risk patients, the mean BMI was 29.1 kg/m², with a standard deviation ±4.2 and, among the lowest risk group, the mean BMI was 24.77 kg/m², with a standard deviation ±2.9. In Figure 1^{9,10} we

Table 1. Characterization of patients undergoing spine surgery, according to age group and risk of pressure injury.

Age group (years)	Number	Percentage (%)
24-33	08	14.6
34-43	22	40.0
44-53	13	23.6
54-63	05	9.1
64-73	07	12.7
Total	55	100.0
Higher risk	Lower risk	p-value
33 (60.0%)	22 (40.0%)	p<0.001
Mean=50.2 years SD=12.4	Mean=38.3 years SD=6.5	

SD: standard deviation. Categorical variables described by absolute value and, in parentheses, percentage. p-values for Student's t-tests.

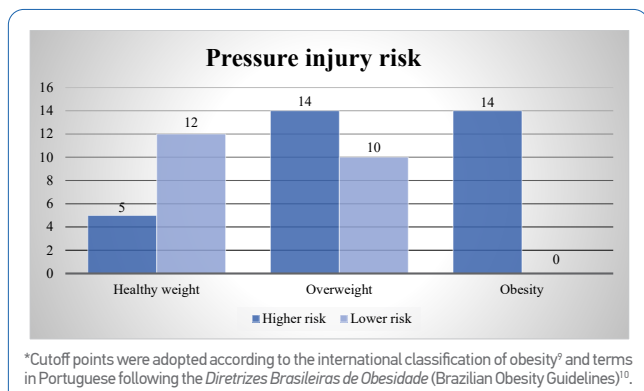


Figure 1. Risk of developing pressure injury, according to body mass index.

can observe that the majority of patients who presented a higher risk were classified as overweight (14/25.5%) and obese (14/25.5%), showing that the risk of developing PI increases proportionally as the patient's weight and BMI increase ($p < 0.001$).

The mean duration of the surgeries was 2 hours and 21 minutes, with a minimum time of 1 hour and 5 minutes and a maximum time of 5 hours. Regarding the risk of developing PI, we verified that the longer the surgery time, the greater the risk ($p < 0.001$). Thus, patients whose surgeries lasted an average of 2 hours and 45 minutes had a higher risk; and those with an average duration of 1 hour and 45 minutes had a lower risk (Table 2).

DISCUSSION

The early identification of patients at risk of developing PI due to surgical positioning using a specific instrument, such as the ELPO, is an important gain for the prevention of this condition, considering that several factors can contribute to its occurrence^{2-4,7}.

Among the spine surgeries followed up from July to August 2019 at the research institution, after applying the ELPO scale, we observed that most patients presented a higher risk of developing PI, with scores greater than 19 points.

Thus, we verified that the surgical patients who composed the sample are capable of presenting a high risk of developing PI, which may be associated with several factors and/or the sum of them^{2-4,7}.

Surgical positioning must allow surgeons to have easy access to the region to be operated on and must be performed appropriately, ensuring patient safety and preventing possible complications^{2,4}.

Studies demonstrate that, among the complications arising from the position adopted during the surgical procedure, PI represents an important concern^{2,5,11}.

We carried out this study on patients undergoing spine surgery in the prone position and in the jackknife / Kraske position.

In these positions, patients remain with their face and abdomen supported on the operating table, so that the exerted

Table 2. Characterization of patients undergoing spine surgery, according to surgery time and risk of pressure injury.

Minimum time	Maximum time	Mean	Mean Higher risk	Mean Lower risk
1h05min	5h	2h21min	2h21min	2h21min

pressure is greater on the frontal, zygomatic, chin, inframmary, iliac crests, knees, and dorsum of the feet regions^{2,3}.

This position presents, as an additional challenge, the fact that the patient undergoes the anesthetic procedure in the supine position and is then rolled to the prone position, requiring strength and dexterity from the entire perioperative team^{2,3}.

The research showed that the mean age range was higher among patients at higher risk, when compared to the lower risk group. Older adult surgical patients are at higher risk of developing PI, due to frailty, skin texture, loss of elasticity, altered circulation, and differentiation in cell replacement^{12,13}.

Another important condition is body weight, as changes in BMI increase the risk of PI^{12,13}. In this sense, in this investigation we demonstrated that patients at higher risk were in the overweight and obese range. Furthermore, it was noteworthy the finding that all obese patients were classified as having a higher risk of developing PI.

Corroborating this research, authors of a study carried out on 278 patients undergoing elective surgeries identified that the majority of patients who presented high risk, predominantly, were classified as overweight, followed by obesity¹².

Another study, carried out on 239 patients undergoing elective surgeries, considered that the body composition of patients, with extreme BMI, is an important risk of developing PI⁵.

In this study, surgery time lasted an average of 2 hours and 21 minutes. Regarding the high risk of developing PI, the average time was 2 hours and 45 minutes. One of the variables that increases the risk of the occurrence of PI, resulting from positioning during the intraoperative period, is the surgery duration. The patient exposed in an exacerbated manner to the same position and immobilization presents increased pressure and can progress to tissue hypoxia, ischemia, and tissue necrosis, with consequent damage to the skin¹⁴⁻¹⁶.

Moreover, with each additional hour of surgery, the patient's risk of developing a PI is likely to increase. Surgical procedures that last longer than 2 hours can impair the transport of oxygen to compressed tissues, leaving them prone to risk and to the occurrence of some injury^{3,14-16}.

Conversely, studies that also focused on the application of ELPO demonstrated a low risk of surgical patients developing PI resulting from positioning. A survey carried out on 31 surgical patients, most of whom underwent debridement and fracture reduction, found a lower risk of developing PI related to age group, type of surgery, and presence of comorbidities¹⁷.

Another study, in which the authors carried out 930 assessments on 305 patients, in the preoperative, intraoperative, and immediate postoperative periods, randomly, also resulted in a low risk of developing PI regarding the type of anesthesia, the surgery duration, and surgical position¹⁸.

It is noteworthy, however, that follow-up is essential to reduce and prevent the development of PI, contributing to patient safety¹⁸.

In the present study, the obtained results and the statistical analyses carried out lead us to consider that the risk of developing PI was present in 60.0% of the sample patients undergoing spine surgery. There were significant statistical differences between the higher and lower risk groups related to: age, weight, body mass index, and surgery time. As these factors increase, the patient's risk of developing PI increases.

Study limitations

The ELPO proved to be an effective tool in classifying the risk of patients in the surgical context, and it is worth understanding that the risk of developing PI is associated with the patient's characteristics and the surgical procedure. However, limitations stand out related to the fact that the data were collected in a single institution, which has the best protection resources and the relatively small sample, as it is a specific surgical procedure. We suggest that research be carried out to compare different realities and gather a greater number of participants.

Contributions to perioperative nursing

This research comprises relevant information on the risk of developing PI related to the surgical positioning of patients undergoing spine surgery in the prone or jackknife/Kraske positions. Through the obtained results, we expect to contribute support to future studies, as well as to the development of PI prevention protocols in the surgical setting, based on patient safety and quality of care.

CONCLUSIONS

According to the ELPO classification, the prevalence of patients at risk of developing PI during spinal surgical procedures in the prone or jackknife/Kraske positions was 60.0%, or 33 patients out of the 55 who composed the sample.

The results demonstrate that patients who were at higher risk of developing PI had a mean age of 50.2 years, most were classified as overweight and obese, and an average surgery

time of 2 hours and 45 minutes. The patient's risk of developing PI increases proportionally with increasing age, weight, and BMI and the surgery duration.

The risks and factors associated with patient characteristics for developing PI have multiple causes. Therefore, a holistic and individual assessment of each patient is necessary.

The importance of risk assessment to screen patients vulnerable to the development of PI is undeniable. Hence, nurses must be able to apply the instrument and accurately identify the risk that the patient presents, in order to plan and organize excellent care, promoting well-being, satisfaction and safety for the surgical patient as well as for everyone involved in the anesthetic-surgical process.

This research favors the development of knowledge and practices of surgical nurses for intraoperative care, as it highlights the factors contributing to the greater risk of PI resulting from positioning. The management instrument is essential to guide the improvement of care, patient safety, and the decision-making process.

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CONFLICT OF INTERESTS

The authors declare no conflicts of interest.

AUTHORS' CONTRIBUTIONS

GGBS: Project administration, Data curation, Investigation, Methodology, Resources, Software. WAF: Data curation, Writing – original draft, Supervision, Validation, Visualization. RC: Project administration, Formal analysis, Conceptualization, Data curation, Investigation, Methodology, Resources, Writing – original draft, Writing – review & editing, Software, Supervision, Validation, Visualization.

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