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Pressure injury risk associated with surgical positioning in patients undergoing robotic urological and gynecological surgeries**

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ABSTRACT

Objective: To assess the risk of pressure injury and the factors associated with surgical positioning in patients undergoing robotic urological and gynecological surgeries. **Method:** Observational, cross-sectional, quantitative study conducted in a private hospital in São Paulo. The sample comprised 65 adult patients selected according to the eligibility criteria, whose risk was assessed using the Risk Assessment Scale for the Development of Injuries due to Surgical Positioning (ELPO). The association between variables was assessed using Pearson's correlation test and Fisher's exact test, with a significance level of 5%. **Results:** Most patients were older men undergoing prostatectomy. The mean score was 20.75, ranging from 12 to 25 points, and 70.77% of patients were classified as being at higher risk of developing pressure injury, which was associated with male sex (p=0.042), Trendelenburg position (p=0.005), and presence of comorbidities (p=0.022), especially diabetes (p=0.003), obesity (p=0.003), and hypertension (p=0.0009). **Conclusion:** The study showed that most patients undergoing robotic urological and gynecological surgeries were at high risk of developing pressure injuries, which was associated with male sex, Trendelenburg position, and presence of comorbidities, notably diabetes, obesity, and arterial hypertension.

KEYWORDS: Risk assessment. Pressure ulcer. Patient positioning. Intraoperative period. Robotic surgical procedures.

Risco de lesão por pressão associado ao posicionamento cirúrgico em pacientes submetidos a cirurgias robóticas urológicas e ginecológicas**

RESUMO

Objetivo: Avaliar o risco de lesão por pressão e os fatores associados ao posicionamento cirúrgico em pacientes submetidos a cirurgias robóticas urológicas e ginecológicas. **Método:** Estudo observacional, transversal, quantitativo, em hospital privado de São Paulo. Amostra composta por 65 pacientes adultos, de acordo com os critérios de elegibilidade, cujo risco foi avaliado segundo a Escala de Avaliação de Risco para o Desenvolvimento de Lesões Decorrentes do Posicionamento Cirúrgico (ELPO). A associação entre as variáveis foi avaliada pelos testes de correlação de Pearson e exato de Fisher, com nível de significância de 5%. **Resultados:** A maioria dos pacientes foi composta por idosos do sexo masculino submetidos à prostatectomia. O escore médio foi de

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20,75, com variação de 12 a 25 pontos, em que 70,77% dos pacientes foram classificados com mais alto risco de desenvolver lesão por pressão, associado com sexo masculino (p=0,042), posição de Trendelenburg (p=0,005) e presença de comorbidades (p=0,022), especialmente diabetes (p=0,003), obesidade (p=0,003) e hipertensão (p=0,0009). **Conclusão:** O estudo evidenciou que a maioria dos pacientes submetidos a cirurgias robóticas urológicas e ginecológicas apresentou alto risco para o desenvolvimento de lesões por pressão, que demonstrou associação com sexo masculino, posição de Trendelenburg e presença de comorbidades, destacando-se o diabetes, a obesidade e a hipertensão arterial.

DESCRITORES: Medição de risco. Lesão por pressão. Posicionamento do paciente. Período intraoperatório. Procedimentos cirúrgicos robóticos.

Riesgo de lesión por presión asociado al posicionamiento quirúrgico en pacientes sometidos a cirugías robóticas urológicas y ginecológicas**

RESUMEN

Objetivo: Evaluar el riesgo de lesión por presión y los factores asociados al posicionamiento quirúrgico en pacientes sometidos a cirugías robóticas urológicas y ginecológicas. **Método:** Estudio observacional, transversal, cuantitativo, realizado en un hospital privado de São Paulo. Muestra compuesta por 65 pacientes adultos, de acuerdo con los criterios de elegibilidad, cuyo riesgo se evaluó según la Escala de Evaluación de Riesgo para el Desarrollo de Lesiones Derivadas del Posicionamiento Quirúrgico (ELPO). La asociación entre las variables se evaluó mediante las pruebas de correlación de Pearson y exacta de Fisher, con un nivel de significación del 5%. **Resultados:** La mayoría de los pacientes eran personas mayores del sexo masculino sometidas a prostatectomía. El puntaje medio fue de 20,75, con una variación de 12 a 25 puntos, y el 70,77% de los pacientes fue clasificado como de mayor riesgo de desarrollar lesión por presión, asociado al sexo masculino (p=0,042), a la posición de Trendelenburg (p=0,005) y a la presencia de comorbilidades (p=0,022), especialmente diabetes (p=0,003), obesidad (p=0,003) e hipertensión (p=0,0009). **Conclusión:** El estudio evidenció que la mayoría de los pacientes sometidos a cirugías robóticas urológicas y ginecológicas presentó alto riesgo de desarrollo de lesiones por presión, asociado al sexo masculino, a la posición de Trendelenburg y a la presencia de comorbilidades, entre las que destacan la diabetes, la obesidad y la hipertensión arterial.

DESCRIPTORES: Medición de riesgo. Úlcera por presión. Posicionamiento del paciente. Periodo intraoperatorio. Procedimientos quirúrgicos robotizados.

INTRODUCTION

The integration of robotic surgery into the health system represents an important evolutionary milestone, as it provides highly precise procedures and rapid postoperative recovery. In this system, the procedure is controlled directly by the surgeon through control consoles, using access ports similar to those of conventional laparoscopy. This interface allows meticulous and safe interventions, enhanced by three-dimensional and high-definition imaging resources that optimize the visibility of the operative field, a determining factor in minimizing surgical trauma[1].

The system consists of precise instruments that perform movements similar to those of human hands, with the advantage of inhibiting tremor and fatigue, providing great depth and precision[1]. Its advantages include reduced postoperative pain, scarring, length of hospital stay, and complications associated with the surgical procedure[2].

Currently, robotic surgery can provide patients with outcomes equal to or even better than those of conventional surgery[2,3]. The procedures covered by the robotic system include urological and gynecological interventions, owing to the ease of the local anatomy for port insertion and to the noble areas found anatomically[4].

Among all the care provided by the team for the success of the robotic intervention, special attention should be given to positioning during surgery, so as to ensure comfort, safety, and respect for the physiological and anatomical limits of the patient[3,5]. Several factors require attention, including maintenance of devices for the procedure, assurance of privacy, reduction of unnecessary exposure, airway maintenance, adequate perfusion and circulation, body alignment for correct surgical visualization, and reduced manipulation of organs, often displacing them by gravitational action[3].

The most commonly used positions are the supine position, the lithotomy position with the use of leg holders, and the Trendelenburg position, which may be accentuated to an angle of 45º. During positioning, there is diaphragmatic compression, increased pulmonary and intracranial pressure, impaired venous return and, at times, increased intraocular pressure[3].

During the anesthetic-surgical procedure, the patient will be under the effect of anesthesia, which places them in a condition of total dependence on the team providing care. Adequate positioning is of utmost importance, since it is a crucial factor for a safe surgical intervention and must be performed with competence and precision by the nursing team (nurse and nursing technician/circulating nurse), surgeons, and anesthesiologist. Individual assessment, planning, and the use of material resources, such as appropriate devices and equipment, are essential for the best positioning of the patient[3,5].

Therefore, an engaged and well-grounded nursing team is important to assist in safe positioning that prevents complications, attending to physiological factors, anatomical changes, surgical time, and anesthetic profile. The team should act so as to provide care that adequately meets the patient's needs, promptly recognizing risk factors and adopting assertive and effective measures[3,6].

Studies investigate the relevance of preventing pressure injuries (PIs) resulting from surgical positioning, since this intervention has a direct impact on patient safety and on the quality of nursing care. From this perspective, the implementation of targeted care practices requires a careful assessment of each patient's risk[6-8].

PIs are considered adverse events with harm, which can often be preventable, representing a high cost to the health system, with high prevalence and incidence, in addition to imposing an emotional burden on patients and their families[7-9]. They are characterized as localized damage to the skin and/or underlying soft tissue, usually over a bony prominence or related to a medical device. They may present as intact skin or as an open ulcer, painful or not, resulting from prolonged pressure combined with shear[9].

Patients undergoing surgical procedures are more prone to the risk of PI because of intrinsic factors (blood pressure fluctuation during anesthesia, dehydration and impaired nutritional status due to fasting, chronic health problems, age, and weight) and extrinsic factors (absence of sensory perception, long period of immobility, and tissue ischemia due to decreased capillary blood flow)[7,9-11]. To assess the skin of surgical patients, the Risk Assessment Scale for the Development of Injuries due to Surgical Positioning (ELPO)[12] was created by a Brazilian nurse and is being widely applied in Brazil and abroad.

According to the Practice Recommendations for Perioperative Patient Positioning proposed by the *Association of periOperative Registered Nurses* (AORN) and by the Associação Brasileira de Enfermeiros de Centro Cirúrgico, Recuperação Anestésica e Centro de Material e Esterilização (SOBECC), a preoperative assessment of each patient's needs is required in order to anticipate tolerance to the planned type of position, including age, weight, height, skin condition, nutritional status, pre-existing diseases, immunosuppression, and physical and mobility limitations[3,10].

In pursuit of quality care for surgical patients, it is essential that the multidisciplinary team evaluate evidence for adequate care, with planning and individuality, encompassing the best experience and respecting the fundamental principle of doing no harm. The nursing team is responsible for continuous monitoring and for excellence in the quality of care provided to each patient, promoting safety through the prevention and management of complications, implementing strategies, and minimizing adverse events, such as PIs associated with surgical positioning, through prevention and support mechanisms[3,7,8,10-13].

In view of the above, and considering the benefits to patients arising from the incorporation of robotic technology into surgical procedures, the motivation for the present study emerged, with the aim of investigating the risks for the development of PIs in patients undergoing robot-assisted urological and gynecological surgeries.

OBJECTIVES

To assess the risk of pressure injury associated with surgical positioning in patients undergoing robotic urological and gynecological surgeries, as well as the associated factors.

METHODS

This is an observational study with a cross-sectional design and a quantitative approach, following the criteria established by the *STrengthening the Reporting of OBservational studies in Epidemiology* (STROBE)[14].

The convenience sample consisted of 65 surgical patients from a large private general hospital located in the South Zone of São Paulo. From February to July 2021, when data were collected, the monthly average of robotic procedures at the study institution was 130. The following eligibility criteria were adopted:

- Inclusion: patients older than 18 years, of both sexes, undergoing robotic urological and gynecological surgeries;
- Exclusion: patients whose surgeries were performed on an urgent or emergency basis.

Two instruments were used in the study. The first, developed by the authors, was intended to characterize the patient (age, sex, weight, height, body mass index (BMI), and comorbidities) and the surgery (anesthesia and surgery performed, patient position, support surfaces, resources used to protect the skin, and duration of anesthesia and surgery). The second instrument, the ELPO, was applied at the beginning of surgery, when the patient was positioned on the operating table, to assess the risk of developing PI associated with intraoperative positioning.

The ELPO consists of seven items: type of surgical position, length of surgery, type of anesthesia, support surface, limb position, comorbidities, and patient's age. Each item has five subitems scored from 1 to 5 points. At the end of the assessment, the points are summed and may range from 7 to 35. The scale is interpreted as follows: from 7 to 19 points, patients at low risk of developing PI; from 20 to 35 points, patients at high risk of developing PI[12].

Data collection was carried out in two stages:

- Preoperative period: review of the daily surgery schedule, selecting patients according to the eligibility criteria, who were approached individually in their respective hospital rooms to explain the objective of the research and invite them to participate. Those who voluntarily agreed to participate were presented with the Informed Consent Form for reading and signing in two copies, one for the participant and the other for the researchers.

- Intraoperative period: the patient was observed during anesthetic-surgical positioning (non-participant observation), when the first researcher applied the two data collection forms.

The data obtained through the application of the instruments were organized and presented as graphs and tables to facilitate visualization, provide clarity, and aid understanding of the results. Numerical variables were described by mean, median, and standard deviation. Categorical variables were described by absolute frequency and percentage. Fisher's exact test and Pearson's correlation test were applied to assess the associations between the variables and the patient's risk of developing PI, adopting a significance level of 5%.

In compliance with the ethical and legal precepts of Resolution No. 466/2012 of the Conselho Nacional de Saúde (National Health Council), which addresses the Guidelines and Regulatory Standards for Research Involving Human Beings, the project was submitted to and approved by the Research Ethics Committee (REC) of the institution where the study was conducted, via Plataforma Brasil, under Opinion No. 4.528.631.

RESULTS

In the preoperative period, 73 patients were approached, of whom 65 agreed to participate in the research. Among the 65 patients who underwent robotic urological and gynecological surgical procedures and made up the final study sample,

age ranged from 26 to 80 years, with a mean of 60.9 years (SD=11.58); most were male (80.00%, n=52). A significant increase in PI risk was found in male patients (76.92%, n=49) compared with female patients (46.15%, n=29; p-value=0.042).

Regarding surgical interventions, 56 patients underwent urological surgeries: prostatectomy (67.69%) and nephrectomy (18.46%). Nine patients underwent gynecological surgeries: hysterectomy (10.77%), endometriosis treatment (1.54%), and myomectomy (1.54%).

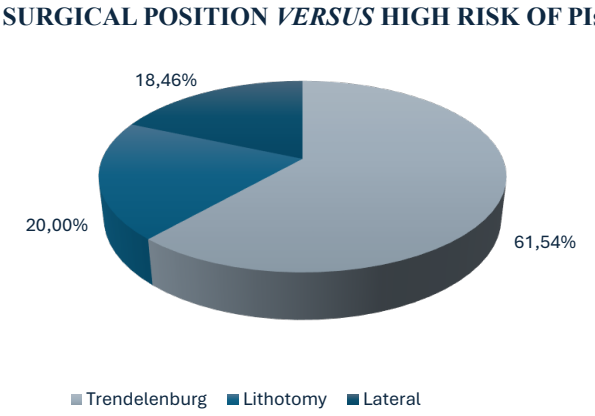
As for the ELPO score, applied to assess the patients' risk of developing PIs, the mean score was 20.75, ranging from 15 to 25 points. Regarding risk classification, 70.77% of patients were at high risk of PI (Table 1).

Table 1. Scores of the items assessed using the Risk Assessment Scale for the Development of Injuries due to Surgical Positioning.

Scale item	n	Mean	Standard deviation	Minimum	Median	Maximum
Type of surgical position	65	4.046	1.255	2.000	5.000	5.000
Length of surgery	65	3.0308	0.6840	1.0000	3.0000	5.0000
Type of anesthesia	65	4.5385	0.5326	3.0000	5.0000	5.0000
Support surface	65	1.400	0.806	1.000	1.000	3.000
Limb position	65	2.6462	0.7792	1.0000	3.0000	4.0000
Comorbidities	65	2.200	1.148	1.000	2.000	4.000
Patient's age	65	2.800	0.870	1.000	3.000	5.000
Final scale score	65	20.754	2.525	15.000	21.000	25.000

Source: Authors: 2026.

The most prevalent position was Trendelenburg (61.54%), followed by lithotomy (20.00%) and lateral decubitus (18.46%). A significant correlation was found, in which the risk of developing PIs was associated with surgical positioning (p=0.005), as shown in Figure 1.



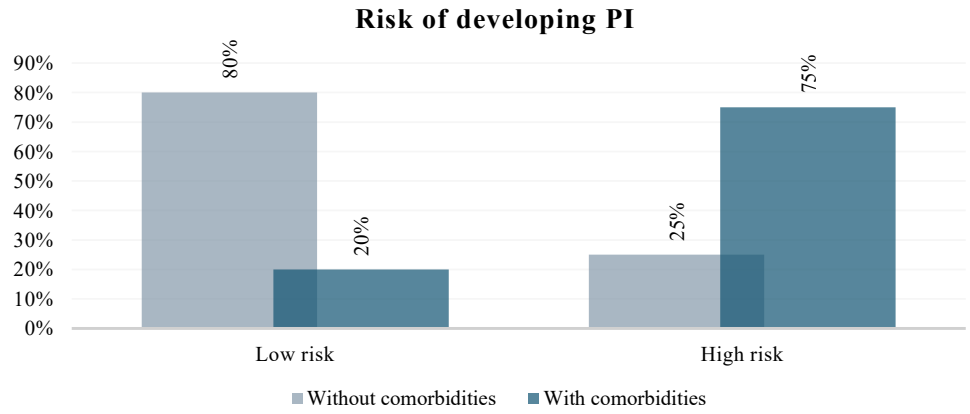
Source: Authors: 2026.
PIs: pressure injuries.
Figure 1. Surgical position of patients classified as being at high risk of developing pressure injuries.

Surgical time, from incision to skin closure, had a mean duration of 3 hours and 3 minutes, ranging from a minimum of 1 hour to a maximum of 7 hours. Ten (15.38%) patients underwent procedures lasting between 1 and 2 hours, whereas 55 (84.61%) surgeries lasted more than 2 hours.

Most participants underwent general anesthesia combined with regional block/spinal anesthesia (55.38%), followed by general anesthesia (43.08%) and regional block combined with sedation (1.54%).

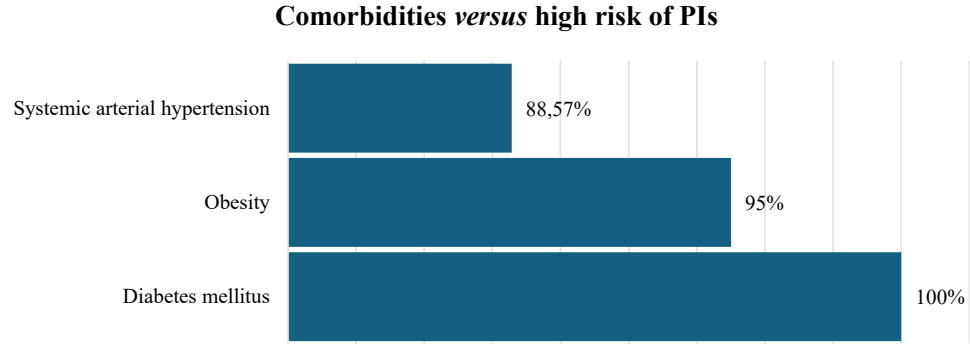
Regarding the support surfaces used to assist surgical positioning and redistribute pressure, all patients used an operating table mattress, arm boards, and viscoelastic leg holders, which are standard at the study institution. Multilayer foam dressings were also applied to bony prominences to prevent PIs in 28 (43.08%) patients.

Among the 65 research participants, 60 (92.31%) had some comorbidity — 35 (53.85%) had systemic arterial hypertension (SAH), 20 (30.77%) obesity, and 16 (24.62%) diabetes *mellitus* (DM). The presence of any comorbidity was significant for these patients' high risk of developing PIs (75.00%, n=48) compared with those without comorbidities (20.00%, n=13; p-value=0.022) (Figure 2).



Source: Authors: 2026.
PIs: pressure injuries.
Figure 2. Risk of developing pressure injury according to the presence of comorbidities.

Analyzing comorbidities separately, patients with DM had a higher risk of developing PIs (100.00%, n=65) compared with non-diabetic patients (61.22%, n=39; p-value=0.0030); obese patients (95.00%, n=61) compared with non-obese patients (60.00%, n=39; p=0.003); and patients with SAH (88.57%, n=57) compared with non-hypertensive patients (50.00%, n=32; p-value=0.0009) (Figure 3).



Source: Authors: 2026.
PIs: pressure injuries.
Figure 3. Comorbidities associated with high risk of developing pressure injury.

The mean weight of patients was 82.18 kg, with a minimum of 50 kg and a maximum of 114 kg. The mean weight of patients classified as being at low risk for PIs (71.80 kg, SD=12.90 kg) was significantly lower than that of patients classified as being at high risk (86.50 kg, SD=16.20 kg). Pearson's correlation analysis showed a positive, statistically significant, moderate correlation between weight and the final ELPO score (r=0.396; 95%CI 0.170–0.582; p<0.001) (Table 2).

Table 2. Correlation between weight, body mass index, and the final score of the Risk Assessment Scale for the Development of Injuries due to Surgical Positioning.

Variable	Pearson's r	95%CI	p-value
Weight	0.396	0.170–0.582	<0.001
BMI	0.511	0.307–0.670	<0.001

r: Pearson's correlation coefficient; CI: confidence interval; BMI: body mass index.
Source: Authors: 2026.

Participants' BMI ranged from 19.50 kg/m^2 to 45.80 kg/m^2, with a mean of 27.76 kg/m^2, above the normal weight range. The mean BMI of patients at low risk was 24.48 kg/m^2 (SD=3.16 kg/m^2), whereas that of patients at high risk was 29.11 kg/m^2 (SD=5.26 kg/m^2). A positive, statistically significant, moderate correlation was also observed between BMI and the final ELPO score (r=0.511; 95%CI 0.307–0.670; p<0.001). The magnitude of the correlation observed for BMI was numerically higher than that found for weight (Table 2).

DISCUSSION

Pressure injury (PI) is considered an adverse event (AE) with harm, which may range from mild to severe according to the degree of tissue involvement, according to the Agência Nacional de Vigilância Sanitária[15]. The deepest stages of PI are considered *never events*, that is, AEs that should not occur in health institutions. Therefore, early detection of the risk of developing PI as a result of surgical positioning is an extremely relevant point for the prevention of such an event.

The use of the ELPO as a risk assessment instrument for PI in the surgical context proves essential, since studies show that surgical patients have several characteristics that place them at risk of developing PI. This risk may be exacerbated when associated with intrinsic factors, such as the presence of comorbidities, and extrinsic factors, such as surgical position. Thus, it becomes the responsibility of the multiprofessional team, in the moments preceding the procedure, to adopt measures that minimize the risks caused by intraoperative positioning[7,8].

The application of the ELPO showed that, of the 65 patients assessed during robotic urological and gynecological procedures, most were at high risk of developing PIs, with a score equal to or greater than 20. The sample was predominantly male, given that most interventions were urological prostatectomy procedures.

The type of positioning adopted in a surgical approach takes into account factors such as ease of access for the surgical team to the target organ of the procedure, in addition to maintaining a position that resembles the natural one, in order to cause minimal harm[16].

Among the patients studied, most were placed in the Trendelenburg position. In this position, the patient remains at an angle in which the head is lower than the hips[4], which proved to be significantly relevant in increasing the risk.

In accordance with the institutional policy of the study hospital, all patients used a viscoelastic mattress as a support surface during the intraoperative period. This material combines viscous and elastic components, showing immediate deformation and structural adaptation according to the pressure exerted and body temperature, minimizing the risk of PIs[17]. Support surfaces should maintain patient stability, provide comfort, and maintain the conformity required for the operative field during the procedure.

In a comparative study of high- and low-technology support surfaces, the authors found statistically significant effectiveness of the interventions investigated[18].

Furthermore, multilayer foam dressings were applied to bony prominences in 43.08% of patients in the present study. A cross-sectional study of 40 nurses showed that this type of dressing provides additional benefits in PI prevention when combined with other prevention strategies, since it helps reduce shear, pressure, and friction, as well as improve the ability to manage the tissue microclimate by absorbing skin moisture[19].

Regarding age group, the study showed a predominance of older adults. In a study of 138 adult patients who developed PIs during hospitalization, PIs were found to occur in the population aged ≥60 years, since elastic fibers and tissue collagen decrease with advancing age, with consequent changes in thickness and impaired perfusion[20].

The mean duration of procedures was 3h03min, ranging from 1 to 7 h. The literature indicates that the surgical time variable is associated with increased risk of PIs, since increased exposure to immobilization resulting from positioning may progress to tissue hypoxia, ischemia, and necrosis, with consequent worsening[4,7,8,21]. Research has shown that, for each additional hour of surgical procedure, the risk may increase by 1.07%[7].

The present study showed the importance of BMI within the normal range, with a significant increase in PI risk as BMI increased. Obese patients are more prone to tissue damage, since excess adipose mass causes compression of blood vessels and nerves, leading to tissue hypoperfusion and the consequent onset of injuries[22]. Studies have reported

data consistent with the results of the present research, showing that extremes of BMI are important factors for the development of PIs[3,7,8].

General anesthesia combined with regional block/spinal anesthesia was the most commonly used in the patients in the study sample, followed by general anesthesia. Authors highlight that general anesthesia is an important factor in the development of PIs, since it causes central nervous system depression, muscle relaxation, and systemic vasodilation, events that lead to hypoperfusion of peripheral tissues and impaired defense mechanisms against variations in tissue pressure[23,24]. Spinal anesthesia, although it significantly reduces pain in the immediate postoperative period, causes loss of the patient's compensatory mechanisms for detecting discomfort associated with pressure on tissue in contact with the operating table surface[3].

Among patients who reported any comorbidity, most were at high risk of PIs, with SAH and DM being the most frequent. Studies show that the presence of these comorbidities increases the risk of PIs by compromising tissue perfusion and affecting blood flow. SAH decreases blood supply by reducing cardiac output, causing systemic hypoperfusion and, consequently, increasing susceptibility to tissue injury[23,24]. DM, in turn, impairs wound healing, in addition to reducing tissue oxygenation due to low cardiac output, with difficulty in replacing endothelial cells[25]. Corroborating this finding, one study provided evidence that patients with DM (59.3%) developed more PIs than non-diabetic patients[25].

Accordingly, the ELPO proved to be important and effective for the adequate classification of the risks presented by the patients studied.

The present research gathered information on the profile and risk for the development of PIs in patients undergoing robot-assisted urological and gynecological procedures, reinforcing the importance of assessing risk in patients in the surgical context.

Study limitations

The limitations of the present study include its single-center design and small sample size, factors that may restrict the generalizability of the results presented. Therefore, further research with longer data collection periods and larger samples is suggested, preferably conducted in a multicenter setting in order to correlate and expand the findings described here.

Recommendations

Given the implications identified — that most of the patients studied were at high risk of developing pressure injury —, it is hoped that this study will provide support for future investigations and contribute to professional improvement, aiming to ensure safe positioning and the appropriate use of preventive resources based on individual risk. It is also expected to encourage the development of institutional protocols in the robotic context and to strengthen a patient safety culture grounded in quality care integrated into daily intraoperative practice.

CONCLUSION

Of the 65 patients followed up in the intraoperative period to identify their risk of developing PIs through the application of the ELPO in robotic urological and gynecological surgeries, 70.77% were at high risk of such injuries.

The classification of patients at high risk of developing PIs was related to male sex; Trendelenburg position; presence of comorbidities, especially hypertension and diabetes; and body mass index. All these factors showed a statistically significant correlation, indicating an increased risk of surgical patients developing PIs.

Thus, the ELPO proved to be a feasible tool for assessing the risk of PIs in the surgical context, allowing the needs of each patient to be measured. The use of this instrument supports the clinical practice of perioperative nurses and guides the implementation of best practices to prevent these injuries.

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Authors' contributions: PGOLA: Project administration, Conceptualization, Data curation, Writing – original draft, Methodology, Resources, Validation, Visualization. WAF: Formal analysis, Data curation, Writing – review & editing, Methodology, Validation, Visualization. RC: Project administration, Conceptualization, Data curation, Writing – review & editing, Methodology, Software, Validation, Visualization.

Research data availability: All data were generated or analyzed in the present study.

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Conflict of interest: None declared.

Research ethics committee approval: Approved by the Research Ethics Committee of Hospital Israelita Albert Einstein-SP, Opinion No. 4.528.631, Certificate of Presentation for Ethical Consideration (Certificado de Apresentação para Apreciação Ética – CAAE) No. 41184220.4.0000.0071.

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