Clinical and Experimental Health Sciences

Factors Influencing the Development of Pressure Injuries in Surgical Patients

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ABSTRACT

Objective: Operating room-acquired pressure injuries are those that develop in anatomical locations associated with the patient's surgical position and typically manifest within 48-72 hours postoperatively. This study aims to explore the factors associated with the development of pressure injuries in surgical patients.

Methods: Data were collected in the operating theatre of a research hospital between September 2023-June 2024. Perioperative patient assessment form, 3S Intraoperative Pressure Injury Risk Assessment Scale (3S IPIRAS) and pressure injury staging and recording form were used for data collection. Descriptive tests, chi-square, t-test, one-way ANOVA, and multiple linear regression were used for statistical analysis.

Results: A statistically significant difference was found between gender, alcohol use, chronic disease, intraoperative vasopressor use, body mass index (BMI), and type of surgery and mean scale scores ($p<.05$). It was found that the age, gender, smoking, alcohol consumption, BMI, presence of chronic diseases, type of surgery, preoperative Braden risk score, and duration of surgery variables explained 43% of mean scale scores ($p<.001$, $F=13.960$).

Conclusion: The study identified key factors influencing pressure injury development in surgical patients. These results emphasize the critical role of perioperative nurses in implementing tailored, evidence-based prevention strategies to enhance patient safety and reduce complications.

Keywords: Pressure injury, surgery, operating rooms, nursing care

1. INTRODUCTION

Pressure injuries refer to localized tissue damage involving the skin and/or subcutaneous layers, typically occurring over bony prominences or in association with medical devices, due to sustained pressure alone or combined with shear forces (1). Operating room-acquired pressure injuries are those that develop in anatomical locations associated with the patient's surgical position and typically manifest within 48-72 hours postoperatively (2,3). Pressure injuries are considered among the most complex conditions in healthcare, leading to adverse effects on the personal and social lives of patients and their families or caregivers, while also imposing additional financial burdens on healthcare institutions (3,4). It is noted that the cost of treating an advanced-stage pressure injury is higher than the cost of preventing such injuries (3).

Surgical intervention is considered a major risk factor for the development of pressure injuries, and risk factors specific to the surgical patient population vary depending on the perioperative period (3-5). Surgical patients, especially those susceptible to operating room-acquired pressure injuries, are at high risk due to factors such as the presence of comorbidities, prolonged immobility, and the inability to perceive pain under anesthesia (2). Patients undergoing surgical procedures may struggle to reposition themselves due to the effects of sedation and anesthesia. This immobility can lead to increased pressure over bony prominences, resulting in decreased perfusion, ischemia, necrosis, and ultimately the formation of pressure injuries (6). The incidence of perioperative pressure injuries in

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surgical patients has been reported to range from 0.7% to 66%, indicating a considerably high prevalence (7-9). Similar rates have been reported in studies conducted in Türkiye regarding the incidence of operating room-acquired pressure injuries (10-12).

Pressure injuries are regarded as a key indicator of nursing care quality (13). For surgical patients, pressure injury prevention efforts should begin in the preoperative period and continue throughout surgery and postoperatively, encompassing the entire perioperative period. The foundation of these preventive efforts lies in assessing the risk of pressure injury using risk assessment tools specifically designed for surgical patients (2,3,14). Despite international guidelines and the growing body of evidence on pressure injury prevention, surgical patients remain at high risk for hospital-acquired pressure injuries (4). Surgical nurses, who play a critical role at every stage of the perioperative process, are essential in identifying, assessing, and managing pressure injury risks in patients undergoing surgical interventions, as well as developing preventive strategies tailored to the identified risks (5,13). In light of this information, the present study aims to identify the factors contributing to the development of pressure injuries in surgical patients by using a risk assessment scale specific to this population. The study findings are expected to guide surgical nurses in recognizing and preventing the risks associated with pressure injuries in surgical patients. Within the scope of the study, the research questions to be addressed are as follows:

- What are the perioperative risk factors associated with the development of pressure injuries in surgical patients?
- What are the predictive independent variables for pressure injuries in surgical patients?

2. METHODS

2.1. Ethical Considerations

Before starting the study, ethics committee permission approval (Date: 23.02.2023, Approval no: E-11811414-050.03-227573) was granted by the Balıkesir University Health Sciences Non-Interventional Research Ethics Committee and institutional approval (Date: 28.02.2023, Approval no: E-93559075.044.233017) was obtained from Balıkesir Health Practice and Research Hospital. All patients who volunteered to participate in the study were informed about the study in detail and their verbal and written consent was obtained. Permission was obtained via e-mail from the authors who performed the Turkish validity and reliability of the 3S Intraoperative Pressure Injury Risk Assessment Scale (3S IPIRAS) to be used in the study.

2.2. Design, Population and Sampling

The study was planned and conducted as a descriptive and cross-sectional research. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were followed for reporting the study.

The data of the study were obtained in the operating theatre of a Health Practice and Research Hospital in Balıkesir province between September 2023 and June 2024, and the population of the study consisted of all patients who underwent surgical intervention in this institution within the specified date range. The study included adult surgical patients who were older than 18 years of age, who agreed to participate in the study, who were planned to undergo surgery lasting at least 60 minutes, and who had no pressure injury in any part of the body in the preoperative period. Patients who underwent emergency surgery, surgeries lasting less than 60 minutes, lack of orientation/cooperation, multiple surgeries, and patients with mobility limitations were not included in the study. The sample calculation of the study was performed by using the G*Power (v. 3.1.9.7) program and by referring to similar studies in the literature. The results of a similar study conducted with surgical patients were taken as reference (11). In the power analysis performed with the effect size value determined using the 3S IPIRAS total score mean and standard deviation data in this study, the power of the study was calculated as 99% and the required sample size as 83. This number was considered the minimum required sample size for the study, and data collection continued until the predetermined research period was completed. In addition, when post-hoc power analysis was applied using the current study data, it was determined that the study concluded with a 95% confidence interval, 5% margin of error and 99% power, and according to this result, the sample size was sufficient. Participants were included in the study using the non-probability sample selection method.

2.3. Data Collection Forms

Perioperative Patient Assessment Form, 3S IPIRAS, and Pressure Injury Staging and Recording Form were used for data collection.

2.3.1. Perioperative Patient Assessment Form

This four-section form, prepared based on the literature to identify patients' demographic and clinical characteristics and perioperative risk factors (1,4,8,10-12), is used to assess these variables. In the first part of the form, there were questions to determine the demographic and clinical characteristics of the patients (age, gender, smoking and alcohol use, body mass index [BMI], chronic diseases, type of chronic diseases). In the second part of the form, there were questions to determine the presence of preoperative risk factors (vital signs, saturation level, blood glucose, hemoglobin and hematocrit values, Braden risk assessment scale score) for the development of pressure injury. In the third part of the form, there were questions to determine the

presence of risk factors (vital signs, saturation level, duration and type of surgery, use of vasopressors and vasoconstrictors) in the intraoperative period in terms of the development of pressure injury. In the fourth part of the form, there were questions to determine the presence of risk factors (vital signs, saturation level, Braden risk assessment scale score) in the postoperative period in terms of the development of pressure injury.

2.3.2. 3S Intraoperative Pressure Injury Risk Assessment Scale (3S IPIRAS)

Developed by Gao et al (15), the 3S IPIRAS consists of 9 items, each scored on a scale from 1 to 4. The items included in the scale are overall skin condition, preoperative activity level, height/weight ratio, skin stress status, duration of surgery, intraoperative body temperature, and surgical positioning. For each item, the score that best reflects the patient's condition is selected to assess the risk. The total score that can be obtained from the scale ranges from a minimum of 9 to a maximum of 36. Patients who score above 23 are considered at risk for developing pressure injuries in the operating room (15). The scale was adapted into Turkish by Soyer and Özbayır (2018), and its validity and reliability were tested. The Cronbach's alpha reliability coefficient of the Turkish version was found to be 0.68 (6). In this study, the Cronbach's alpha value of the scale was analyzed as 0.78.

2.3.3. Pressure Injury Staging and Recording Form

Based on the updated 2019 pressure injury stages by international pressure injury prevention organizations (1), this form also includes images of body areas commonly considered at risk for pressure injury development to guide researchers and minimize errors. For surgical patients, details such as the stage, location, day of occurrence, and unit of any developed pressure injuries are recorded on this form.

2.4. Data Collection

The data collection phase of the study was conducted in a way that would not disrupt the treatment and care processes of the patients, nor the workflow of the operating room and surgical clinics. Preoperative consultations were held with patients on the day's surgical schedule who met the inclusion criteria. After providing detailed information about the study, informed consent was obtained from those who agreed to participate. After this process, data in the first section of the Perioperative Patient Assessment Form were collected via face-to-face interviews with patients who volunteered. The data of the patients in the second part of the form were obtained from patient records and risk assessment was performed according to the Braden scale. In the perioperative periods of the patients, the 3S IPIRAS items of skin condition in the whole body, preoperative activity status, BMI, body temperature at the time of surgery, and at the end of the surgery, duration of the surgery were recorded. In the intraoperative process, vital signs in the third section of the Perioperative Patient Assessment Form were monitored and recorded, and data on the drugs administered to the patient were obtained from the patient records. In the intraoperative period, standard operating table and support surfaces were used for all patients, and special equipment was used only for overweight patients. In addition, the same heating method was applied to all patients (use of a heating device with hot air blow). Patients were positioned according to the type of surgery performed and the researchers did not intervene during the surgery except for data collection and observation. At the end of the surgery, vital signs were obtained from the patient records, risk assessment was performed according to the Braden scale and recorded. All patients in the sample were evaluated for pressure injury as soon as the surgical intervention was completed, before the patient was transferred from the operating theatre to the surgical clinic. After transfer to the clinic and during inpatient treatment, skin integrity was evaluated every 24 hours for the development of pressure injury. When pressure injury development was observed during these assessment processes, it was recorded on the Pressure Injury Staging and Recording Form with the stage, localisation and the day of development.

2.5. Statistical Analysis

The data obtained from the study were analysed using SPSS software (v. 22). The results were evaluated at 95% confidence interval and statistical significance was considered at $p<.05$. The normality assumption of continuous variables was evaluated by skewness and kurtosis values. Descriptive statistical methods (number, percentage, mean and standard deviation) were used in the statistical analysis of the descriptive and clinical characteristics of the patients and the development of pressure injury. The t-test and analysis of variance were used to compare normally distributed variables, and the chi-square test was used to compare categorical variables. Correlation analysis was used to determine the factors thought to have an effect on the development of pressure injury and multiple linear regression analysis was performed to determine the factors affecting the results. Before applying multiple linear regression, it was confirmed that the normality, covariance, and multicollinearity assumptions were not breached.

3. RESULTS

The mean age of the patients was 50.98±17.51 years, 62.7% were female and the mean BMI was 29.19±5.86. According to Braden risk scoring, 90% of the patients who would undergo surgery had no risk of pressure injury (Table 1). Descriptive and preoperative characteristics of the patients are given in detail in Table 1. The mean score of the patients on the 3S IPIRAS was 13.22±1.51, and the mean duration of surgery was 115.48±49.46 (minutes). Also, 86.7% of the patients had not received vasopressors and 96% had not received

vasoconstrictor drugs (Table 2). When the postoperative data were analysed, it was found that the most common site of pressure injury was the lower extremities (14.7%). According to the postoperative Braden risk scale assessment, 82% of the patients were risk-free and 81.3% did not develop pressure injury. In the study, all pressure injuries developed in patients were classified as Stage I (Table 3).

Table 1. *Demographic and clinical characteristics of the patients (N = 150)*

Variables	Mean ± SD (Min-Max)	
Age	50.98 ± 17.51 (18-79)	
BMI (kg/m²)	29.19 ± 5.86 (16.79-47.65)	
Pulse rate	78.87 ± 9.92 (57-106)	
Diastolic blood pressure (mm/Hg)	71.07 ± 9.26 (50-96)	
Systolic blood pressure (mm/Hg)	121.48 ± 13.26 (90-180)	
Saturation (SpO_2)	96.95 ± 2.47 (83-100)	
Body temperature (Cº)	36.42 ± 0.21 (36.0-37.0)	
Hemoglobin (gr/dl)	13.91 ± 1.57 (9.7-15.1)	
Hematocrit (%)	41.29 ± 2.73 (33.10-49.5)	
Blood glucose level (mg/dl)	109.82 ± 37.21 (72-304)	
	n	**%**
Gender		
Female	94	62.7
Male	56	37.3
BMI (kg/m²)		
18.4 and below	4	2.7
18.5 – 24.9	30	20.0
25.0 – 29.9	60	40.0
30.0 – 34.9	34	22.7
35.0 – 39.9	14	9.3
40.0 and above	8	5.3
Smoking status		
Yes	45	30.0
No	105	70.0
Alcohol consumption		
Yes	9	94.0
No	141	6.0
Chronic disease		
Yes	64	42.7
No	86	57.3
Type of chronic disease* (n=64)		
Hypertension	41	27.3
Diabetes mellitus	26	17.3
Heart failure	7	4.7
Arthritis	4	2.7
Asthma	3	2.0
Thyroid diseases	3	2.0
Others	3	2.0
Braden scale score (preoperatively)		
No risk (above 18 points)	135	90.0
Low risk (between 15-18 points)	15	10.0

**More than one option is selected. BMI: Body mass index, SD: Standard deviation*

Preoperative and intraoperative variables and development of pressure injury were compared with chi-square test. There was a statistically significant difference between the use of vasopressors during surgery, type of surgery and duration of surgery and the development of pressure injury (Table 4) ($p<.05$). Preoperative and intraoperative variables and mean 3S IPIRAS scores were compared using t-test and variance analysis. A statistically significant difference was found between gender, alcohol use, chronic disease, intraoperative vasopressor use, BMI, and type of surgery and mean 3S IPIRAS scores (Table 4) ($p<.05$).

Multiple regression analysis was performed to determine the factors affecting 3S IPIRAS. Regression analysis was performed to explain the factors affecting the 3S IPIRAS score, including age, gender, smoking, alcohol consumption, BMI, presence of chronic diseases, type of surgery, preoperative Braden risk score, and duration of surgery. It was found that the adjusted R^2 of the independent variables explained 43% of 3S IPIRAS. When the model was examined, it was found to be statistically significant with a value of $p<.001$ ($F=13.960$) (Table 5).

Table 2. *Intraoperative outcomes of the patients (N = 150)*

Variables	Mean ± SD (Min-Max)	
3S IPIRAS score	13.22 ± 1.51 (10-18)	
Pulse rate (in a min)	80.57 ± 15.13 (43-149)	
Diastolic blood pressure (mm/Hg)	73.37 ± 13.75 (44-112)	
Systolic blood pressure (mm/Hg)	117.31 ± 23.88 (74-207)	
Saturation (SpO_2)	98.43 ± 1.87 (86-99)	
Duration of surgery (min)	115.48 ± 49.46 (60-312)	
	n	**%**
Duration of surgery (min)		
60-89	50	33.3
90-119	34	22.7
120-149	28	18.7
150 and above	38	25.3
Type of surgery		
Gynecological surgery	38	25.3
Orthopedic surgery	30	20.0
Urological surgery	30	20.0
General surgery	21	14.0
ENT surgery	15	10.0
Neurosurgery	9	6.0
Plastic and reconstructive surgery	7	4.7
Use of vasopressors		
No	130	86.7
Yes	20	13.3
Use of vasoconstrictors		
No	144	96.0
Yes	6	4.0

3S IPIRAS: 3S Intraoperative Pressure Injury Risk Assessment Scale, SD: Standard deviation, ENT: Ear-nose-throat

Table 3. *Postoperative outcomes of the patients (N = 150)*

Variables	Mean ± SD (Min-Max)	
Pulse rate (in a min)	81.67 ± 12.11 (50-127)	
Diastolic blood pressure (mm/Hg)	76.67 ± 12.36 (40-108)	
Systolic blood pressure (mm/Hg)	118.98 ± 18.30 (76-195)	
Saturation (SpO_2)	97.79 ± 2.34 (83-100)	
	n	**%**
Braden scale score (postoperatively)		
No risk (above 18 points)	123	82.0
Low risk (between 15-18 points)	27	18.0
Pressure injury site (Stage 1)* (n=28)		
Lower extremities	22	14.7
Back area	5	3.3
Gluteal area	3	2.0
Upper extremities	2	1.3
Day of pressure injury development		
POD 0	13	8.7
POD 1	15	10.0
None	122	81.3

*SD: Standard deviation, POD: Postoperatif day, *Multiple areas*

Table 4. *Comparison of pressure injury development and 3S IPIRAS score averages with some clinical characteristics (N = 150)*

	Development of pressure injury			3S IPIRAS score	
Gender	**PI (n)**	**No PI (n)**		**Mean ± SD**	
Female	21	73	p = .135	13.53±1.50	**p = .002**
Male	7	49	X^2 = 2.238	12.75±1.33	t = 3.219
Smoking status					
Yes	5	40	p = .120	13.26±1.48	p = .805
No	23	82	X^2 = 2.417	13.20±1.52	t = – 0.247
Alcohol consumption					
Yes	1	8	p = .549	11.88±1.16	**p = .006**
No	27	114	X^2 = 0.360	13.30±1.49	t = 2.789
Chronic disease					
Yes	16	48	p = .086	12.90±1.39	**p = .002**
No	12	74	X^2 = 2.949	13.68±1.54	t = – 3.205
BMI (kg/m^2)					
18.4 and below	2	2		15.25±2.44	
18.5 – 24.9	3	27		12.20±1.12	
25.0 – 29.9	10	50	p = .366	12.93±1.33	**p = .000**
30.0 – 34.9	7	27	X^2 = 5.428	13.85±1.32	F = 10.606
35.0 – 39.9	4	10		14.00±1.24	
40.0 and above	2	6		15.25±1.16	
Use of vasopressors					
Yes	7	13	**p = .044**	13.85±1.78	**p = .045**
No	21	109	X^2 = 4.055	13.12±1.44	t = – 2.025
Use of vasoconstrictors					
Yes	2	4	p = .347	13.83±2.04	p = .312
No	26	118	X^2 = 0.886	13.19±1.48	t = – 1.016
Type of surgery					
Gynecological surgery	7	31		13.71±1.20	
Orthopedic surgery	12	18		13.23±1.47	
Urological surgery	4	26	**p = .011**	13.53±1.04	**p = .000**
General surgery	1	20	X^2 = 16.535	12.33±1.52	F = 9.981
ENT surgery	1	14		11.86±1.06	
Neurosurgery	3	6		15.22±1.30	
Plastic and reconstructive surgery	0	7		12.14±1.57	
Duration of surgery (min)					
60-89	3	47		13.26±1.45	
90-119	7	27	**p = .035**	13.08±1.42	p = .690
120-149	8	21	X^2 = 8.590	13.48±1.57	F = 0.490
150 and above	10	27		13.08±1.63	

X2: Chi-square test, p: Significance, t: t-test, F: One-way ANOVA test, PI: Pressure injury, 3S IPIRAS: 3S Intraoperative Pressure Injury Risk Assessment Scale, ENT: Ear-nose-throat surgery, BMI: Body mass index
Statistical significance was evaluated at p < .05 level.
Bold values indicate statistical significance.

Table 5. *Regression analysis of 3S IPIRAS total scores*

Variables	β	t	p	SE	VIF
Constant		7.191	.000	1.016	
Age	.143	1.917	.057	.006	1.478
Gender	-.024	-.336	.738	.221	1.338
Smoking status	.171	2.517	**.013**	.223	1.222
Alcohol consumption	-.178	-2.676	**.008**	.422	1.181
BMI	.478	7.276	**.000**	.017	1.148
Chronic disease	.131	1.775	.078	.225	1.452
Type of surgery	.363	5.713	**.000**	.055	1.072
Braden scale score (preoperatively)	.034	.519	.605	.328	1.137
Duration of surgery	.103	1.595	.113	.002	1.099
Dependent variable: 3S IPIRAS total score F= 13.960, p= .000, R^2= 0.473, Adjusted R^2= 0.439, Durbin-Watson= 2.196					

β: Standardized coefficients beta, SE: Standard error, BMI: Body mass index, 3S IPIRAS: 3S Intraoperative Pressure Injury Risk Assessment Scale, VIF: Variance inflation factor, p: Significance
Statistical significance was evaluated at p < .05 level.
Bold values indicate statistical significance.

4. DISCUSSION

Studies have investigated the prevalence and etiological factors of pressure injuries in surgical patients. In this study, it was determined that 17.4% of surgical patients developed pressure injuries. Previous studies have reported prevalence rates ranging from 5.8% to 24.2% (5,12,16,17). Variations in prevalence rates may be attributed to differences in study methodologies, patient populations, and care practices. The relatively high prevalence observed in this study could be explained by factors such as prolonged surgical durations,

insufficient use of pressure-relieving devices, or inadequate adherence to prevention protocols. Additionally, individual patient characteristics – such as age, nutritional status, comorbidities, and medications administered during surgery – may also have influenced the outcomes and should not be overlooked.

International guidelines and research emphasize that surgical duration is a significant determinant in the development of pressure injuries (1-3). Similarly, the present study identified a statistically significant association between surgical duration and the development of pressure injuries. This finding aligns with previous studies in the literature, highlighting that the time a surgical patient spends in the operating room is a critical risk factor for pressure injury development (5,10,12,16). Prolonged surgeries may cause patients to remain in an immobile position, increasing pressure on the skin and tissues and impairing blood circulation. This risk is further exacerbated in situations where pressure-relieving surfaces are inadequately utilized or perioperative care is suboptimal. Evidence in the literature suggests that surgeries lasting longer than two hours significantly elevate the risk of pressure injuries (5,14,16,18-20). The findings of this study underscore the importance of close monitoring during surgeries exceeding this threshold and highlight the necessity of implementing measures to ensure even pressure distribution throughout the procedure.

The study found a statistically significant association between the type of surgical procedure and the development of pressure injuries, with patients undergoing orthopedic surgery being more likely to develop pressure injuries. Additionally, patients who underwent neurosurgery had significantly higher 3S IPIRAS mean scores. These findings suggest that certain surgical procedures may carry a higher risk of pressure injury development. Consistent with these results, the literature also reports that prolonged or complex procedures may increase the risk of such injuries (3,5,16,19). Surgeries involving prolonged immobilization, such as orthopedic, cardiovascular, and neurosurgical procedures, may predispose tissues to pressure and circulatory impairments, creating favorable conditions for the development of pressure injuries (5,17,19). These findings highlight the need for developing tailored pressure injury prevention strategies for specific types of surgical procedures. In conclusion, considering the impact of surgical procedure type on pressure injury risk is critical for preventing complications in these patients.

In the literature, both low and high BMI values are recognized as significant risk factors for pressure injuries (9,21,22). Low BMI is thought to increase the risk due to insufficient subcutaneous fat, which fails to provide adequate protection against pressure, while high BMI is associated with increased mechanical load and limited mobility, both of which predispose individuals to pressure injuries (1). In this study, patients with low and high BMI values had higher 3S IPIRAS scores, and BMI was identified as an independent variable influencing the risk of pressure injuries. These findings are consistent with the U-shaped relationship between BMI and pressure injury development reported in the literature, indicating that both very low and very high BMI values pose a risk (20,23). A study conducted with both surgical and non-surgical patients identified low BMI as a significant risk factor for pressure injuries (9). Similarly, studies involving surgical patients have reported high BMI as an independent and significant factor in the development of pressure injuries and higher risk scale scores (5,16,17). However, some studies have found no significant association between BMI and pressure injury development (10,12). These discrepancies may be attributed to differences in study populations, methodological variations, and interactions between BMI and other factors. Additionally, it is important to consider that BMI reflects only body weight and does not account for critical factors such as muscle-fat distribution or skin health.

Smoking is also recognized as a risk factor for pressure injuries (1,14). In the present study, smoking was identified as an independent variable affecting the total scores patients received on the pressure injury risk scale. However, some studies have reported no statistically significant association between a history of smoking and the development of pressure injuries (5,9,12,24). Additionally, some studies have not addressed this relationship (10,17,18,23). Methodological variability in studies assessing the impact of smoking on pressure injuries complicates the ability to draw definitive conclusions. Specifically, differences in the scales used may play a critical role in shaping outcomes. Similarly, in the present study, while no significant difference was observed between smoking and pressure injury development in pairwise comparisons, smoking was identified as a predictive factor increasing risk scale scores. Smoking may influence the development of pressure injuries through physiological mechanisms. Nevertheless, the limited number of studies evaluating the impact of smoking on pressure injuries highlights the need for further research to more comprehensively explore its effects in this domain.

5. CONCLUSION

This study highlights the significance of identifying and addressing risk factors for pressure injuries in surgical patients. The findings reveal that variables such as intraoperative vasopressor use, type and duration of surgery, and patient characteristics like BMI and presence of chronic diseases are critical determinants of pressure injury risk. The low mean 3S IPIRAS score suggests that the overall risk of pressure injury was low in the studied population; however, specific subgroups of patients remain vulnerable. Notably, all pressure injuries observed were classified as Stage I, underscoring the importance of early detection and intervention to prevent further progression.

From a perioperative nursing perspective, the study underscores the importance of implementing individualized, evidence-based strategies to minimize pressure injury risk. Perioperative nurses play a crucial role in identifying high-risk patients, optimizing positioning techniques, ensuring proper

use of pressure-relieving devices, and closely monitoring patients receiving vasopressors or undergoing prolonged or complex surgical procedures.

Future research should explore the development of standardized, procedure-specific pressure injury prevention protocols and examine the long-term outcomes of early-stage pressure injuries in surgical patients. Further studies are also needed to evaluate the effectiveness of educational programs and interventions aimed at improving perioperative pressure injury prevention practices. These efforts can contribute to enhanced patient safety, better outcomes, and reduced healthcare costs in surgical care settings.

This study was conducted in a rural hospital, which limits the generalizability of its results. Additionally, the inclusion of only patients undergoing elective surgical procedures represents another limitation, as patients undergoing planned interventions may have less complexity compared to those undergoing emergency surgeries. Lastly, due to routine hospital procedures, postoperative follow-up of patients was limited to 48 hours. Extending the follow-up period, especially for high-risk patients, could have been beneficial, as pressure injuries may develop beyond this timeframe.

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