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Medical device-related pressure injuries in critical patients: prevalence and associated factors*

Lesões por pressão relacionadas a dispositivos médicos em pacientes críticos: prevalência e fatores associados

Lesiones por presión relacionadas con dispositivos médicos en pacientes críticos: prevalencia y factores asociados

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ABSTRACT

Objective: To determine the prevalence of medical device-related pressure injuries in critical patients and analyze the associated factors. **Method:** Epidemiological, cross-sectional study. Sociodemographic, clinical and medical device data were collected. Inspection of the skin/mucous membranes was performed to identify and classify the injuries. Analysis using descriptive statistics, Poisson regression and the Spearman correlation coefficient. **Results:** Ninety-three patients were evaluated and 58 developed injuries, with a prevalence of 62.4%. Injuries by the orotracheal tube (50%), nasogastric tube (44.1%) and urinary catheter (28.6%) were the most prevalent, and the most affected regions were, respectively, the auricular (79.5%), nasal ala (86.7%) and urethral meatus (76.9%). Factors associated with injuries were severe edema ($p=0.005$), low Braden ($p<0.001$) and Glasgow ($p=0.008$) scores, length of stay in intensive care ($p<0.001$) and hospitalization diagnosis classified as other causes ($p<0.001$). The use of more than one device ($p<0.001$) and a longer time of use ($p<0.001$) were correlated. **Conclusion:** The high prevalence of injuries and the associated factors indicate the need for preventive measures and risk monitoring.

DESCRIPTORS

Pressure Ulcer; Equipment and Supplies; Critical Care Nursing; Risk Factors; Prevalence.

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INTRODUCTION

The context of Intensive Care Units (ICU) requires a range of instruments and equipment for health care, called medical devices. Such devices are used by the multidisciplinary health team and applied alone or in combination for the purpose of diagnosis, monitoring, treatment or relief of the disease, according to the patient's clinical condition and the manufacturer's recommendation[1–2]. If applied improperly, they can produce deleterious effects, such as medical device-related pressure injuries (MDRPI).

Medical device-related pressure injuries result from the use of devices created and applied for diagnostic and therapeutic purposes, and commonly develop with the same shape of the devices[3], considering that in most cases, they present an incompatible pattern with anatomical structures and have little flexibility[3–4]. These injuries progress rapidly, as they usually occur in areas without adipose tissue in which there is pressure, friction and shear caused by the device, aggravated by changes in the microclimate[5].

International studies[5–9] show that different care scenarios expose patients to the risk of MDRPI, especially ICUs. In a systematic review and meta-analysis involving 29 studies, were identified, respectively, a combined incidence and prevalence of MDRPI of 14% and 11% in adults undergoing health care interventions[6]. An Australian study showed an incidence of MDRPI of 27.9% in adult hospitalized patients, of which 68% in the ICU[5]. Corroborating these data, a study conducted in the ICU in Turkey identified a 40% prevalence of MDRPI[7]. Lower rates were found in critically ill patients in Australia and the United States[8], in which the prevalence of MDRPI was 3.1%, while in India[9] it was 19.2%.

In Brazil, scientific publications focusing on the prevalence and incidence of MDRPI are still incipient. In an integrative review study[10] aimed at adult patients conducted recently by Brazilian nurses, only international research on the subject was identified. At the national level, a study[11] of a pediatric population showed a prevalence of PI of 32.8% in the ICU. In addition, it showed that 94% of patients at risk of developing any type of PI used medical devices, with a prevalence of 25% of MDRPI.

Respiratory devices are those described as the main responsible for causing injuries[6,12–13]. Catheters, immobilization devices, probes, among others, routinely used in critical care, also contribute to trigger MDRPI[6,8,12]. In addition, patients admitted to the ICU have associated factors, such as prolonged hospital stay, altered level of consciousness, physical immobility, organic disorders, use of vasoactive drugs and nutritional losses, which can cause MDRPI[5,14].

Thus, it is imperative to pay attention to the problem of MDRPI in care settings, especially in the ICU, because although they are not a new phenomenon, research on the frequency of these injuries in Brazil is still limited[10,12]. In other countries, there are studies that seek scientific evidence on preventive care with the implementation of clinical guidelines aimed at controlling the factors associated with its development[14].

In view of these considerations, the objective of this study was to determine the prevalence of MDRPI in critical patients and to analyze the associated factors. This study can contribute to improve the quality of care and safety of critical patients and direct effective prevention strategies. In addition, it can collaborate with the advancement of knowledge, considering that it addresses a topic still little explored in the literature, especially at the national level [10,12,15].

METHOD

Design of Study

This is an epidemiological, observational, cross-sectional, quantitative study.

Scenario

Developed in the adult ICU of a public teaching hospital located in Florianópolis, Santa Catarina, which had (during the study period) ten beds for the hospitalization of adults in clinical and surgical situations. There was no specific MDRPI prevention protocol in this scenario. It is important to conduct this type of study in investigations related to PI, as recommended by the National Pressure Injury Advisory Panel (NPIAP)[3], in order to measure the prevalence and conduct actions for the prevention and treatment of injuries.

Sample Definition

The sample consisted of 93 patients, according to the calculation performed with the WINPEPI® program, version 2011. A prevalence of 40% MDRPI was estimated a priori, based on a previous study with adult patients hospitalized in intensive care[7]. An margin of error of 10% and a 95% confidence interval (CI) were considered.

The inclusion criteria for patients were: age equal to or over 18 years; admission to the ICU for at least 48 hours for clinical or surgical treatment; use of at least one medical device chosen for the study: orotracheal tube, tracheostomy tube, non-invasive ventilation mask (NIV), nasogastric/Levine® tube, nasoenteric /Dobb-Hoff® tube, indwelling urinary catheter and pulse oximeter. The minimum ICU stay of 48 hours was determined based on a study[8], in which the time elapsed from the beginning of the use of the device until the detection of an MDRPI ranged from three to 13 days. The sampling was done by convenience, and in the selection of devices, the characteristics of patients attended in the studied ICU were considered, as well as the literature on the subject, which points to respiratory devices, tubes, probes and catheters in general as the main risk devices[4,13,16].

Data Collection

Data were collected between September 2017 and April 2018 by one of the researchers, a specialist nurse in intensive care, using an instrument built for the study. The medical records were consulted to obtain the variables of age, race, presence of comorbidities, smoking, diagnosis and length of hospital stay, body mass index – BMI (calculated from the estimate of body weight using the body composition

technique), level of sedation by the Richmond Agitation Sedation Scale (RASS)[17], level of consciousness by the Glasgow coma scale (GCS)[17], Braden score[18], hematocrit, Simplified Acute Physiology Score 3 – SAPS 3 prognosis[19], and use and time of use of vasoactive drugs.

Careful observation/inspection of some regions of patients' skin and mucous membranes and evaluation of the presence of edema (classified by the Sign of Godet) were also performed. The oral mucosa, lips, labial commissure, auricular region, face and cranial region were evaluated in patients using an orotracheal tube. In tracheostomized patients, the stoma, peristomal area and anterior and posterior cervical region were inspected. In those using non-invasive ventilation mask, the face (jugal region, frontal region and alar base), cervical and auricular region were evaluated. When using a nasogastric/nasoenteric tube, the nasal mucosa, nasal ala and alar base were evaluated, in addition to the nasal columella. In patients using indwelling urinary catheters, the urethral meatus, perineum, genital region, buttocks and thighs were inspected. Finally, patients using a pulse oximeter had their fingers, toes and ear region evaluated. The patients' skin and mucous membranes were evaluated only once for the purposes of the study.

The MDRPI were categorized at the moment they were identified in the skin evaluation, based on the NPIAP pressure injury classification system: Stage 1 – non-blanchable erythema of intact skin; Stage 2 – partial thickness skin loss with exposure of dermis; Stage 3 – full thickness skin loss; Stage 4 – full thickness skin loss and tissue loss. Pressure injuries can still be classified as Unstageable Pressure Injury and Deep Tissue Pressure Injury. Pressure injuries in mucous membranes, given the anatomy of the tissue, cannot be categorized[3].

Data Analysis and Treatment

Data were entered into a Microsoft Excel® 2010 spreadsheet and exported to the Statistical Package for the Social Sciences for Windows® (SPSS), version 20.0, for statistical analysis. Categorical variables were presented by frequencies and percentages. The quantitative variables with symmetrical distribution were described by the mean and standard deviation and those with asymmetric distribution by median and interquartile range. The prevalence ratios were described with their respective 95% confidence interval.

For the association of possible factors and the outcome, Poisson Regression with robust variance was used and the prevalence ratio and 95% confidence interval were presented. In the univariate analysis, Poisson Regression with robust variance was used for each of the variables alone. To fit a multivariate regression model, $p < 0.20$ was considered. Correlations between quantitative variables were evaluated using Spearman's correlation coefficient, considering a significance level of 5% for the established comparisons. To interpret the magnitude of correlations, the following classification was adopted: coefficients <0.3 (weak correlation), > 0.3 to 0.5 (moderate correlation) and > 0.5 (strong correlation)[20]. The calculation of the period of prevalence of MDRPI was performed based on the ratio of the number of patients with MDRPI by the number of patients who composed the sample.

Ethical Aspects

In the study, were followed the guidelines and provisions of Resolution number 466/12 of the National Health Council. The study was approved by the Research Ethics Committee of the Universidade Federal de Santa Catarina under number 1,957,843 of 2017.

RESULTS

Of all patients using medical devices evaluated (N = 93), most were male (n = 61; 65.6%). The mean age was 55.3 years (SD = 15.3). White race/color patients (n = 68; 73.1%), with arterial hypertension (n = 45; 48.4%) and nonsmokers (n = 51; 54.8%) predominated. Most patients had edema evidenced by the Sign of Godet 2+ (n = 40; 43.0%), diagnosis of respiratory failure (n = 41; 44.1%) and median length of hospital stay and in the ICU of seven and five days, respectively (Table 1).

The medical devices most frequently used by patients were, in sequence, the pulse oximeter (n = 93; 100.0%), indwelling urinary catheter (n = 91; 97.8%) and orotracheal tube (n = 78; 83.9%). Of the total number of patients evaluated, 58 developed MDRPI, corresponding to an overall prevalence of 62.4% (95% CI). Injuries caused by orotracheal tube, nasogastric tube and indwelling urinary catheter were the most prevalent, and represented 50.0%, 44.1% and 28.6%, respectively (Table 2).

Considering the patients who developed MDRPI (n = 58; 62.4%), some had more than one injury in different regions of the body caused by the same device. The most affected regions were the auricular region, urethral meatus and nasal ala, affected by the use of orotracheal tube, urinary catheter and nasogastric tube, respectively. As for the stages of injuries, there was a predominance of stage 2. Stage 4 injuries, unstageable pressure injuries and deep tissue pressure injuries were not identified. The table shows stages 1, 2, 3 and unstageable when related to the mucous membrane (Table 3).

The median number of devices used by patients was one device (interquartile range 0–2). The median of injuries was four (interquartile range 4–5 injuries). The median time of patient use of devices was 19 days (interquartile range 15–34 days). When the number of injuries was correlated with the number of devices, there was a positive and moderate correlation, statistically significant between them (Spearman's rho coefficient = 0.42, $p < 0.001$). When the number of injuries was correlated with the number of days of use of the device, a positive and moderate correlation, statistically significant, was also detected between them (Spearman's rho coefficient = 0.40, $p < 0.001$).

By univariate analysis, patients with edema 3+ have a higher prevalence of injury compared to those with edema 1+. As the Braden score and GCS score increase, the prevalence of MDRPI decreases. The increase in the length of stay in the ICU increases the prevalence of injuries. There

Table 1 – Demographic and clinical characteristics of patients selected in the study – Florianópolis, SC, Brazil, 2018.

Characteristics	Descriptive measures*
Age	55.3 ± 15.3
Sex	
Male	61 (65.6)
Female	32 (34.4)
Race/color	
White	68 (73.1)
Black	7 (7.5)
Mixed race	17 (18.3)
Indigenous	1 (1.1)
Presence of comorbidities	
Diabetes Mellitus	26 (28.0)
Arterial hypertension	45 (48.4)
Pulmonary diseases	22 (23.7)
Vascular diseases	12 (12.9)
Smoking	
Active smoker	25 (26.9)
Ex-smoker	17 (18.3)
Nonsmoker	51 (54.8)
Edema	
Sign of Godet 1+	19 (20.4)
Sign of Godet 2+	40 (43.0)
Sign of Godet 3+	29 (31.2)
Sign of Godet 4+	5 (5.4)
Diagnosis and length of hospital stay	
Sepsis	24 (25.8)
Liver diseases	7 (7.5)
Respiratory failure	41 (44.1)
State of shock	21 (22.6)
Cardiovascular diseases	3 (3.2)
Decompensated diabetes	3 (3.2)
Surgery	28 (30.1)
Other causes†	54 (58.1)
Length of hospital stay (days)	7 (4 to 15)
Length of ICU stay‡ (days)	5 (4 to 9)
Other clinical data	
BMI§	26.9 ± 8.9
Sedated patient	72 (77.4)
RASS sedation scale‖	–5 (–5 to –3)
Glasgow scale	15 (11 to 15)
Braden scale	10.5 ± 1.8
Hematocrit	30.7 ± 8.5
SAPS 3¶	64.4 ± 13.3
Use of vasoactive drugs	57 (61.3)
Time of use of vasoactive drugs (days)	4 (3–6)

*Descriptive measures = n (%) used for categorical variables; mean±standard deviation used to describe the quantitative variables with symmetrical distribution; median (interquartile range) used to describe variables with asymmetric distribution; †Other causes = respiratory, renal, neurological, hematological, metabolic, digestive tract diseases, infectious diseases and external causes; ‡ICU = Intensive Care Unit; §BMI = Body Mass Index; ‖RASS = Richmond Agitation Sedation Scale; ¶SAPS 3 = Simplified Acute Physiology Score 3. Note: (N = 93).

Table 2 – Prevalence of medical device related injuries – Florianópolis, SC, Brazil, 2018.

Dispositivos	Patients evaluated N(%)	Prevalence n(%)	95%CI*
Overall prevalence	93 (100)	58 (62.4)	52.2–71.8
Orotracheal tube	78 (83.9)	39 (50.0)	38.5–61.5
Tracheostomy tube	13 (14.0)	1 (7.7)	0.2–36.0
Non-invasive ventilation mask	24 (25.8)	4 (16.7)	4.7–37.4
Nasogastric tube	34 (36.6)	15 (44.1)	27.2–62.1
Nasoenteric tube	60 (64.5)	12 (20.0)	10.8–32.3
Urinary cateter	91 (97.8)	26 (28.6)	19.6–39.0
Pulse oximeter	93 (100)	11 (11.8)	6.1–20.2

*CI = Confidence Interval
Note: (N = 93).

Table 3 – Description of the frequency of injuries by medical devices, affected body region and stage of evolution – Florianópolis, SC, Brazil, 2018.

Device/region	n(%)*	Staging*		
		1	2	3
Orotracheal tube (N = 39)				
Lip/labial commissure	15 (38.5)	NC†		
Face	2 (5.1)		2 (100.0)	
Auricular region	31 (79.5)	3 (9.7)	15 (48.4)	13 (41.9)
Tracheostomy tube (N = 1)				
Cervical region	1 (100.0)		1 (100.0)	
NIV mask‡ (N = 4)				
Front region	2 (50.0)	1 (50.0)	1 (50.0)	
Jugal region	1 (25.0)		1 (100.0)	
Face	2 (50.0)		2 (100.0)	
Auricular region	1 (25.0)		1 (100.0)	
Nasogastric tube (N = 15)				
Nasal ala	13 (86.7)		8 (61.5)	5 (38.5)
Nasal mucosa	4 (26.7)	NC†		
Nasoenteric tube (N = 12)				
Nasal ala	8 (66.7)		6 (75.0)	2 (25.0)
Nasal mucosa	6 (10.0)	NC†		
Urinary catheter (N = 26)				
Urethral meatus	20 (76.9)	NC†		
Thighs	3 (11.5)	1 (33.3)	2 (66.7)	
Perianal region	4 (15.4)		4 (100.0)	
Pulse oximeter (N = 11)				
Fingers	9 (81.8)	4 (44.4)	5 (55.6)	
Auricular region	3 (27.3)		2 (66.7)	1 (33.3)

*Percentages of body region and stages calculated on the number of patients who developed medical device-related pressure injuries; †UN = Unstageable; ‡NIV = Non-Invasive Ventilation.

was no statistically significant association between the other variables examined and the presence of MDRPI (Table 4).

After adjusting a multivariate regression model, including the factors associated with the outcome with $p < 0.20$ in the univariate analysis, except for those that presented collinearity with others, was reached the conclusion that as the Braden score increased, the prevalence of injury and the diagnosis of hospitalization classified as other causes decreased, and the prevalence of device-related injuries increased (Table 4).

Table 4 – Factors associated with medical device-related pressure injuries according to Poisson Regression – Florianópolis, SC, Brazil, 2018.

Characteristics	Gross PR* (95%CI†)	p-value‡	Adjusted PR* (95%CI†)	p-value‡
Age	0.7 (0.4–1.3)	0.729		
Male sex	1.3 (0.9–1.8)	0.212		
Race/color				
White	1.5 (0.9–2.5)	0.154		
Black	0.9 (0.3–2.5)	0.854		
Mixed race	Ref			
Indigenous	Insufficient nr			
Presence of comorbidities				
Diabetes Mellitus	1.1 (0.8–1.5)	0.701		
Arterial hypertension	0.9 (0.6–1.2)	0.381		
Pulmonary diseases	0.9 (0.6–1.4)	0.725		
Vascular diseases	0.8 (0.4–1.4)	0.405		
Smoking				
Active smoker	1.2 (0.8–1.7)	0.330		
Ex-smoker	1.2 (0.8–1.8)	0.276		
Nonsmoker	Ref			
Edema				
Sign of Godet 1+	Ref			
Sign of Godet 2+	2.5 (1.1–5.4)	0.024		
Sign of Godet 3+	3.0 (1.4–6.5)	0.005		
Sign of Godet 4+	3.0 (1.3–7.3)	0.012		
Diagnosis				
Sepsis	1.2 (0.9–1.6)	0.285		
Liver diseases	0.9 (0.5–1.8)	0.780		
Respiratory failure	0.9 (0.7–1.3)	0.807		
State of shock	1.1 (0.8–1.6)	0.630		
Cardiovasculary diseases	0.5 (0.1–2.6)	0.434		
Decompensated diabetes	1.1 (0.5–2.4)	0.868		
Surgery	0.9 (0.6–1.3)	0.512		
Other causes§	1.6 (1.1–2.3)	0.013	1.8 (1.3–2.5)	0.001
Length of hospital stay	1.01 (1.00–1.03)	0.120	1.01 (1.00–1.03)	0.138
Length of ICU stay‖	1.03 (1.02–1.05)	<0.001		
Other clinical data				
BMI¶	1.01 (1.00–1.02)	0.283		
Sedated patient	1.3 (0.8–1.9)	0.328		
RASS scale**	0.9 (0.8–1.1)	0.303		
Glasgow scale	0.9 (0.8–1.0)	0.008		
Braden scale	0.8 (0.8–0.9)	<0.001	0.8 (0.8–0.9)	<0.001
Hematocrit	1.01 (0.98–1.02)	0.941		
SAPS 3††	1.01 (1.00–1.02)	0.173	1.01 (1.00–1.02)	0.173
Use of vasoactive drugs	1.1 (0.8–1.6)	0.533		

*PR = Prevalence Ratio; †CI = Confidence Interval; ‡p-value = p value from Poisson Regression; §Other causes = respiratory, renal, neurological, hematological, metabolic, digestive tract diseases, infectious diseases and external causes; ‖ICU = Intensive Care Unit; ¶BMI = Body Mass Index; **RASS = Richmond Agitation Sedation Scale; ††SAPS 3 = Simplified Acute Physiology Score 3.

The use of tracheostomy tube ($p < 0.001$) and pulse oximeter ($p < 0.001$), as well as the times of use of orotracheal tube ($p < 0.001$), nasogastric tube ($p = 0.024$), nasoenteric tube ($p = 0.002$), urinary catheter ($p < 0.001$) and pulse oximeter ($p < 0.001$) are associated with a higher prevalence of PI resulting from the use of the respective device (Table 5). It was not possible to fit a Regression model for all these factors, since they are highly correlated.

DISCUSSION

The general prevalence of MDRPI (62.4%) was higher than findings (3.1%-40%) in the international literature[7–8] obtained in intensive care settings. Injuries caused by orotracheal tube, urinary catheter and nasogastric tube were, in this order, the most prevalent.

Respiratory devices are considered the main responsible for MDRPI in critical patients, with rates ranging from 30%

Table 5 – Association of the use of medical devices and pressure injuries from the Poisson Regression – Florianópolis, SC, Brazil, 2018.

Devices	Gross PR* (95%CI†)	p-value‡
Orotracheal tube	1.7 (0.9–3.2)	0.117
Orotracheal tube time	1.07 (1.04–1.10)	<0.001
Tracheostomy tube	1.7 (1.3–2.1)	<0.001
Tracheostomy tube time	0.99 (0.975–1.01)	0.472
Non-invasive ventilation mask	0.7 (0.4–1.1)	0.094
Non-invasive ventilation mask time	0.8 (0.5–1.3)	0.406
Nasogastric tube	1.2 (0.9–1.7)	0.197
Nasogastric tube time	1.03 (1.00–1.05)	0.024
Nasoenteric tube	1.3 (0.9–1.9)	0.138
Nasoenteric tube time	1.03 (1.01–1.04)	0.002
Urinary catheter	1.3 (0.3–5.1)	0.752
Urinary catheter time	1.05 (1.03–1.07)	<0.001
Pulse oximeter	0.6 (0.5–0.7)	<0.001
Pulse oximeter time	1.03 (1.02–1.05)	<0.001

*PR = Prevalence Ratio; †CI = Confidence Interval; ‡p-value from Poisson Regression.

to 70%[6,13]. The orotracheal tube was the device that most caused MDRPI, with a prevalence of 50%. Comparatively, in ICUs in Australia, United States and Turkey, in samples of 132, 351 and 175 patients, respectively, this device was the cause of most MDRPI, with prevalence rates that reached 45%[7–8]. The prevalence of PI due to non-invasive ventilation masks (16.7%) was lower than the findings of other investigations that showed an occurrence of 20% in a study with 146 seriously ill patients in medical, cardiothoracic and neurosurgical ICUs[9] and of 50% in health institutions in the United States and Canada, according to a retrospective analysis of a database including 99,876 adult patients[21].

The rate of PI by tracheostomy tube (7.7%) evidenced in the present study was similar to others found in the literature[22], with a 5–10% prevalence of injuries associated with this device. The appearance of these injuries may be associated with the mechanical leverage effect of the tracheostomy tube on oropharyngeal structures and the trachea with friction and persistent pressure. In addition, this device requires fixation that is generally adapted, thereby increasing the risk of damage to adjacent structures[7,22]. Specific preventive measures must be implemented when using respiratory devices such as assessment, hygiene, protection and cushioning of the structures involved, as well as the exchange, repositioning and rotation of their fixation[3,5,15,22].

The prevalence of PI due to nasogastric tube (44.1%) differed from the rates evidenced in other studies conducted with critically ill patients, and was higher than that revealed in a hospital in northern India (12.3%)[9] and lower than that identified in a hospital in Israel, in which 100% of patients evaluated had PI in the extranasal region[23]. Still referring to these devices, in this study, although a greater number of patients used a nasoenteric tube (polyurethane), when compared to those who used nasogastric tube (polyvinyl), the prevalence of PI for the former was lower. This phenomenon may be related to the type of material, as many devices are made or fixed with rigid material and this rigidity and/or inelasticity causes pressure and may lead to MDRPI[22,24].

The prevalence of PI related to indwelling urinary catheter (28.6%) was higher than that evidenced in a study conducted with 304 patients admitted to three hospitals in the United States, in which prevalence was 15%[16]. Pressure injuries related to pulse oximeter had a prevalence of 11.8%, which is a closer result to that identified in another study with a prevalence of 8% of PI by the same device[7]. In both surveys, injuries to the fingers stood out. In a study on the nursing actions prescribed by nurses to prevent PI and its occurrence in the ICU, the prescription of the oximeter sensor rotation proved to be statistically associated with the prevention of these injuries[25].

As for body regions most affected by MDRPI, there was a predominance of the auricular, urethral meatus and nasal ala regions. Auricular injuries were caused mainly by the fixation of the orotracheal tube. The urethral meatus was injured by the use of indwelling urinary catheter, while nasal ala injuries were associated with the use of nasogastric and nasoenteric tubes. Thus, nurses need to ensure the exchange and/or fixation of the orotracheal tube and/or nasogastric/nasoenteric tube, and the observation of their positioning and fixation, since these interventions were associated with the prevention of PI[15,25].

Medical device-related pressure injuries must be evaluated and classified according to tissue impairment. Regarding the stage of injuries, in line with the findings of the present study, other studies on MDRPI in intensive care patients[7–8] and in traumatized adults[26] showed a higher prevalence of these injuries categorized as stage 2, corresponding to 42.6% of MDRPI[7].

In the present study, the presence of marked edema, low Braden and Glasgow scores, longer length of hospital stay in intensive care, some hospitalization diagnoses, use of tracheostomy tube and pulse oximeter and longer periods of use of orotracheal tube, nasogastric tube, nasoenteric tube, indwelling urinary catheter and pulse oximeter, and the use of more than one device were associated with the presence for MDRPI.

Patients with severe edema had a higher prevalence of MDRPI compared to those with mild edema. A study conducted in Brazil[25] evaluated 104 patients admitted to the ICU and found that 64.7% had edema, which was considered a statistically associated factor ($p = 0.012$) with the development of PI. The formation of edema is a problem that affects critical patients and is conditioned by the reduction of hemoglobin and albumin, which leads to interstitial leakage and increases the pressure and deterioration of the exchange of nutrients in the tissues. Edema can also be the result of circulatory and lymphatic damage caused by the compression of the fixation of devices themselves[7].

As for the Braden score, in line with the results of the present study, another study in intensive care units showed that patients who developed PI had a mean score of 10, which corresponds to high risk[25]. In this study, the Braden score proved to be a sensitive marker for assessing the risk of MDRPI, since the prevalence of injuries was higher in

patients who had a lower Braden score. We emphasize the effectiveness of using risk prediction scales, such as the Braden's, even when they are not exclusive to MDRPI[10].

Neurosensory impairment and decreased level of consciousness are persistent clinical manifestations among critically ill patients, evidenced by the GCS alteration, which was a factor associated with MDRPI development in the present study. The reduction in activity, immobility and shear are aspects that aggravate neurological damage and considered as risk factors for the development of PI[3]. Patients under the effect of psychoactive drugs also have these limitations, but in this study, the level of sedation was not statistically significant for the development of MDRPI.

As for the length of stay in the ICU and the time of use of devices, a cohort[7] conducted with 175 patients in anesthetic resuscitation, cardiovascular surgery, medical clinic, neurosurgery and chest disease treated in five ICUs, showed that in the first 24 hours of observation, there was an occurrence of MDRPI of 11.8%. On the fourth day, the number rose to 48.0% and on the eleventh day to 82.3%, showing that the occurrence of MDRPI increased as patients remained hospitalized and using medical devices.

The use of tracheostomy tube and pulse oximeter, as well as the time of use of orotracheal tube, nasogastric tube, nasoenteric tube, urinary catheter and pulse oximeter were also associated with a higher prevalence of MDRPI. Research recommends that institutional reports of adverse events of MDRPI specify the medical device and the total days of use of the device related to the formation of the injury[24]. This may contribute to future investigations on this type of injury associated with the total number of days with the device, for example, to produce knowledge for establishing effective prevention strategies[6].

A positive correlation between the number of devices and the occurrence of MDRPI was also identified, and the more devices the patients used, the more injuries they developed. The same correlation was observed with regard to the time of use. The use of multiple devices and the presence of edema exposes patients to a higher risk of PI, in these cases, more frequent skin inspection is recommended to prevent such injuries[22,27]. The recommendation is that professionals always ask themselves if maintaining the device is essential for the patient, considering that removal when there is no more indication of use is still the best measure to prevent PI[15].

If it is necessary to maintain the device, the following are recommended: regular monitoring of the tension of device fixations and whenever possible, request patients' self-assessment of comfort; evaluation of the skin below and around the device to identify signs of pressure injury at least twice a day, with special attention to more vulnerable patients with marked weight loss, decreased skin turgor and/or edema; reduction or redistribution of the pressure at the interface of the device with the skin, regularly rotating or repositioning the device and/or the patient and removing the device as soon as possible; and use prophylactic dressing under the device to reduce the risk of injury. Other equally important recommendations for preventing MDRPI, such as training the team and implementing protocols for practical care guidance focused on the prevention and treatment of these injuries, should be considered[3].

The general prevalence of MDRPI identified in the present study stood out when compared to the findings in the literature, a result that leads to reflection on the institutional context in which these injuries occurred. In the case of a teaching hospital, a lower prevalence was expected. However, one must consider the scarce public resources, deficit of materials and professionals, especially in the ICU of that institution. Research has shown an association between the workload and the incidence of PI, and a 1.5% higher risk for injuries for each point recorded in the Nursing Activities Score[28]. A systematic literature review[29] on the influence of the nursing workload on the occurrence of adverse events in adult patients admitted to the ICU also revealed that the nursing workload required by critically ill patients is a risk factor for the occurrence of events adverse events, such as PIs. This requires analysis of the load to adjust the relationship between the number of professionals and patients, in search of injury prevention and safety of critical patients.

The relevance attributed to continuing education in relation to the prevalence of MDRPI also stands out. In the United States, after reducing the occurrence of this type of injury with the implementation of a quality improvement project aimed at creating an evidence-based guideline for the prevention of MDRPI and adoption of a new catheter fixation device for feeding, the continuing education of professionals was advocated to sustain the positive results[30]. The use of information technology can be extremely useful. A study[31] by Brazilian researchers described the construction and validation of a website for the prevention and management of PI composed of contents, pictures and figures addressing patient safety, the occurrence of injuries and interventions for their prevention, treatment and management. This type of educational resource can be used online as a complement to the educational process.

The limitations of this study are related to the temporality bias that does not allow conclusions about the causality of results, since the exposure and the results were collected simultaneously. In addition, the fact of including the analysis of the prevalence of injuries related to seven specific devices, disregarding the possible occurrence of PI caused by other devices.

The hospitalization diagnoses evaluated were limited to associating the occurrence of MDRPI with sepsis, liver disease, respiratory failure, states of shock, cardiovascular disease and decompensated diabetes. Although restricted to the ICU of a public teaching hospital, the representative sample of the population allows the generalization of results, which can contribute to the development of strategies to prevent MDRPI in similar contexts.

This study advances in relation to the knowledge produced on a little explored theme, especially in the Brazilian reality. However, further studies with different designs are recommended.

CONCLUSION

The overall prevalence of MDRPI was 62.4%. The highest prevalence of medical device related pressure injuries was identified in patients using an orotracheal tube, nasogastric tube (polyvinyl) and an indwelling urinary catheter hence, these devices offer more risk for this type of injury. The most affected regions of the body were the auricular, urethral meatus and nasal ala, with a predominance of stage 2 injuries.

The factors statistically associated with the prevalence of MDRPI were severe body edema, longer ICU length of stay, low Braden and Glasgow scores, diagnosis of hospitalization classified as other causes, use of tracheostomy tube and pulse oximeter, as well as the times using orotracheal tube, nasogastric tube, nasoenteric tube, indwelling urinary catheter and pulse oximeter. The number of devices in use and the longer time of use were correlated with a higher prevalence of injuries. The high general prevalence of MDRPI, the associated factors and affected body regions indicate the need for preventive measures and monitoring of the risk of these injuries.

RESUMO

Objetivo: Determinar a prevalência das lesões por pressão relacionadas a dispositivos médicos em pacientes críticos e analisar fatores associados. **Método:** Estudo epidemiológico, transversal. Dados sociodemográficos, clínicos e dos dispositivos médicos foram coletados. Realizou-se inspeção da pele/mucosas para identificação e classificação das lesões. Análise mediante estatística descritiva, regressão de Poisson e coeficiente de correlação de Spearman. **Resultados:** Foram avaliados 93 pacientes e 58 desenvolveram lesões, com prevalência de 62.4%. Lesões pelo tubo orotraqueal (50%), cateter nasogástrico (44.1%) e vesical (28.6%) foram as mais prevalentes, e as regiões mais afetadas foram, respectivamente: auricular (79.5%), asa do nariz (86.7%) e meato uretral (76.9%). Fatores associados às lesões: edema acentuado ($p = 0.005$), baixo escore de Braden ($p < 0.001$) e de Glasgow ($p = 0.008$), tempo de internação em terapia intensiva ($p < 0.001$) e diagnóstico de internação classificado como outras causas ($p < 0.001$). Correlacionou-se o uso de mais de um dispositivo ($p < 0.001$) e maior tempo de utilização destes ($p < 0.001$). **Conclusão:** A elevada prevalência de lesões e os fatores associados indicam a necessidade de medidas preventivas e da monitorização de risco.

DESCRITORES

Lesão por Pressão; Equipamentos e Provisões; Enfermagem de Cuidados Críticos; Fatores de Risco; Prevalência.

RESUMEN

Objetivo: Determinar la prevalencia de lesiones por presión relacionadas con dispositivos médicos en pacientes críticos y analizar los factores asociados. **Método:** Estudio epidemiológico, transversal. Se recogieron datos sociodemográficos, clínicos y de dispositivos médicos. Se realizó una inspección de la piel/membranas mucosas para identificar y clasificar las lesiones. Análisis mediante estadística descriptiva, regresión de Poisson y coeficiente de correlación de Spearman. **Resultados:** Se evaluaron 93 pacientes y 58 desarrollaron lesiones, con una prevalencia del 62.4%. Las lesiones por sonda orotraqueal (50%), sonda nasogástrica (44.1%) y sonda vesical (28.6%) fueron las más prevalentes, y las regiones más afectadas fueron, respectivamente, la auricular (79.5%), el ala de la nariz (86.7%) y el meato uretral (76.9%). Los factores asociados a las lesiones fueron edema severo ($p = 0.005$), puntuaciones bajas de Braden ($p < 0,001$) y Glasgow ($p = 0.008$), tiempo de estancia en cuidados intensivos ($p < 0.001$) y diagnóstico de hospitalización clasificado como otras causas ($p < 0.001$). Se correlacionó el uso de más de un dispositivo ($p < 0.001$) con un mayor tiempo de uso ($p < 0.001$). **Conclusión:** La alta prevalencia de lesiones y los factores asociados indican la necesidad de medidas preventivas y monitoreo de riesgos.

DESCRIPTORES

Úlcera por Presión; Equipos y Suministros; Enfermería de Cuidados Críticos; Factores de Riesgo; Prevalencia.

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