Observational Study

Medicine

OPEN

Incidence of hospital acquired pressure injury in critically ill patients with COVID-19 in prone position admitted to the intensive care unit

Lucas Sato, UGS[a], Letícia Olandin Heck, UGS[b], Karina de Fátima Bimbatti, UGS[b], Bruno Cesar Petroski-Moraes, UGS[a], Christiane Becari, PhD[c], Anibal Basile-Filho, PhD[a], Maria Auxiliadora-Martins, PhD[a], Mayra Gonçalves Menegueti, PhD[b,*]

Abstract

Critical patients have conditions that may favor the occurrence of hospital-acquired pressure injury (HAPI). The objective of this study was to identify the incidence and factors associated with the occurrence of HAPI in patients with coronavirus disease 2019 admitted to the intensive care unit (ICU) who used the prone position. Retrospective cohort study carried out in an ICU of a tertiary university hospital. Two hundred four patients with positive real-time polymerase chain reactions were evaluated, of which 84 were placed in the prone position. All patients were sedated and submitted to invasive mechanical ventilation. Of the prone patients, 52 (62%) developed some type of HAPI during hospitalization. The main place of occurrence of HAPI was the sacral region, followed by the gluteus and thorax. Of the patients who developed HAPI, 26 (50%) had this event in places possibly associated with the prone position. The factors associated with the occurrence of HAPI in patients prone to coronavirus disease 2019 were the Braden Scale and the length of stay in the ICU. The incidence of HAPI in prone patients was extremely high (62%), which denotes the need to implement protocols in order to prevent the occurrence of these events.

Abbreviations: ARDS = acute respiratory distress syndrome, COVID-19 = coronavirus disease 2019, HAPI = hospital-acquired pressure injury, ICU = intensive care unit.

Keywords: COVID-19, critical care, hospital-acquired pressure injury, prone position

1. Introduction

One aspect of relevance in the care of critically ill patients refers to the care in maintaining the integrity of the skin. Hospital Acquired Pressure Injury (HAPI) can be found at all levels of health care and particularly in patients with mobility problems and advanced age, which is frequently observed in the intensive care unit (ICU). Critically ill patients have conditions that may favor the occurrence of HAPI by determining immobility in bed.[1]

HAPI is defined as localized damage to the skin and/or underlying soft tissue, usually over a bony prominence or related to medical equipment or other types of devices. Resulting from intense and/or prolonged pressure or pressure combined with shear.[2]

The occurrence of HAPI can be considered a negative indicator of the quality of care, therefore, professionals are expected to adopt a systematic approach to prevention.[3] In addition, ICU patients are at high risk of developing HAPI, as mobility and activities are reduced or nonexistent, causing greater exposure to high pressures on the skin.[4,5]

The main conditions that may favor the occurrence of HAPI in critically ill patients are hemodynamic instability with the use of vasoactive drugs, use of sedoanalgesia, invasive and noninvasive mechanical ventilation, postoperative conditions requiring complete rest, patients in palliative care, and prolonged hospitalization.[5–7] Immobility in bed results from both the patient's own clinical condition and the therapy. In cases of hemodynamic instability, with the need to use vasoactive drugs, besides

Financial support was provided by Fundação de Apoio ao Ensino, Pesquisa e Assistência (FAEPA) of Clinics Hospital of Ribeirão Preto, São Paulo, Brazil. The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

[a] Division of Intensive Care Medicine, Department of Surgery and Anatomy, Ribeirão Preto Medical School, University of São Paulo, Ribeirão Preto, Brazil,
[b] Ribeirão Preto Nurse School, University of São Paulo, Ribeirão Preto, Brazil,
[c] Division of Vascular and Endovascular Surgery, Department of Surgery and Anatomy, Ribeirão Preto Medical School, University of São Paulo, Ribeirão Preto, Brazil.

**Correspondence: Mayra Gonçalves Menegueti, Ribeirão Preto Nurse School, University of São Paulo, Avenida dos Bandeirantes, 3900, Campus Universitário - Bairro Monte Alegre, Ribeirão Preto - SP - Brazil, CEP 14040-902.*

How to cite this article: Sato L, Heck LO, Bimbatti KdF, Petroski-Moraes BC, Becari C, Basile-Filho A, Auxiliadora-Martins M, Gonçalves Menegueti M. Incidence of hospital acquired pressure injury in critically ill patients with COVID-19 in prone position admitted to the intensive care unit. Medicine 2023;102:18(e33615).

Received: 6 July 2022 / Received in final form: 8 March 2023 / Accepted: 4 April 2023

http://dx.doi.org/10.1097/MD.0000000000033615

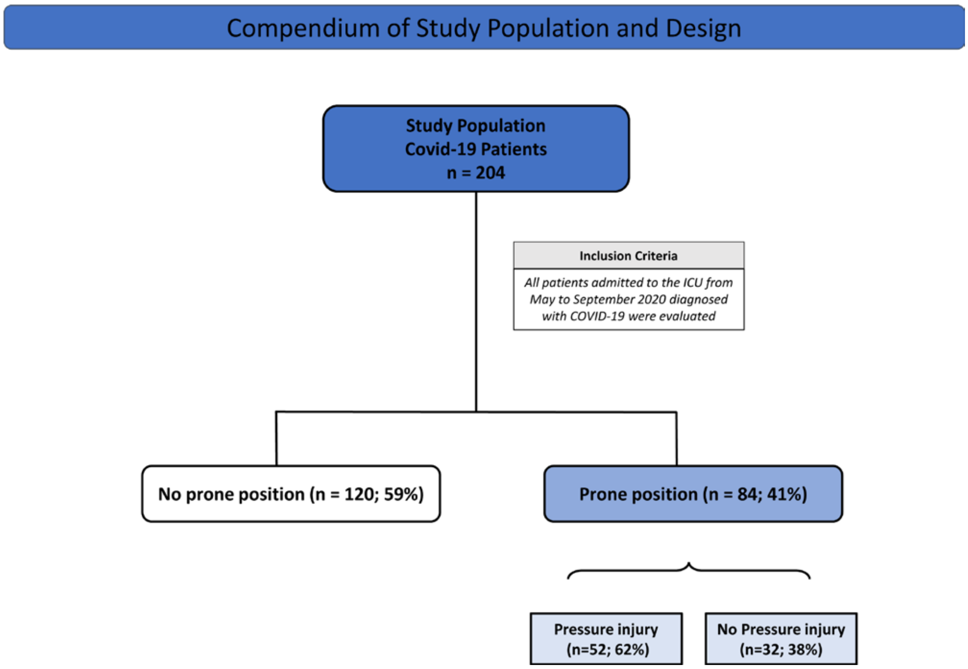

Figure 1. Compendium of study population and design.

Table 1

Hospital-acquired pressure injury (HAPI) classification according to the International Classification System[20].

Stage	Description
Stage 1	Erythema that does not whiten in a region of intact skin
Stage 2	Partial-thickness skin loss with exposed dermis, in which the wound bed has viable pink or red tissue, or there is also an intact or ruptured blister
Stage 3	Full-thickness skin loss and slough and/or eschar may be present; and full-thickness skin loss and tissue loss characterizes
Stage 4	Exposure of fascia, muscle, tendon, ligament, cartilage, or bone, in which slough or eschar may also be present
Unclassifiable HAPI	When there is no possibility of identifying the extent of tissue damage, as in the present case of slough or eschar, but there is a loss of skin in its full thickness
Deep tissue HAPI	When there is a persistent, nonwhitening, dark red, brown, or purple discoloration, which may be a region with intact skin or not, or with the presence of a blister with bloody exudate
HAPI related to medical device	HAPI is caused by the use of devices used for diagnostic and therapeutic purposes

HAPI = hospital-acquired pressure injury.

immobility, there is also a reduction in tissue perfusion, further favoring the occurrence of HAPI.[1]

The work of health professionals was strongly affected, as was the demand for intensive care because of the coronavirus disease 2019 (COVID-19). In a prospective study conducted in Wuhan, China, when following 41 patients admitted to the hospital diagnosed with COVID-19, 32% required ICU beds because of the need for high-flow oxygen.[8] Approximately 15 to 20% of COVID-19 patients who developed fever and severe hypoxemia required some type of ventilatory support, from high-flow nasal cannula to noninvasive and invasive mechanical ventilation which increases the risk of developing HAPI.[9–11]

Decubitus change in patients is used in ICU as a treatment and prevention of HAPI, as they reduce the duration of pressure exerted on tissues, decreasing tissue hypoxia.[12] However, in patients with COVID-19, many challenges are imposed for the prevention of HAPI, such as clinical instability, and decreased tissue oxygenation, often requiring the use of the ventral position, making it difficult to reposition these patients.[13]

The ventral position, commonly known as prone, determines greater expansibility in the dorsal regions, consequently generating improved oxygenation in patients with severe hypoxemia. In addition, it also relates to improved oxygenation in patients with acute respiratory distress syndrome (ARDS).[14,15]

For patients diagnosed with COVID-19 and having severe ARDS, the prone position can be used as a long-term treatment for periods ranging from 16 to 20 hours[16] and can be considered effective in facilitating the redistribution of pulmonary blood flow.[17]

In relation to HAPI, the prone position reduces the pressure on the areas that have a tendency to develop it, when compared to the supine and lateral decubitus positions, but the pressure is present on the frontal and orbicularis regions, as well as the chin, humerus, chest, pelvis, and knees. In addition, it can affect the distribution of blood and lymph flow to the face, which becomes concentrated in the region, as well as causing tissue ischemia and consequent necrosis.[18] When in the prone position and using an endotracheal tube, the most affected sites for HAPI are the lips and tongue, and when related to the use of

Table 2

Risk factors related to the occurrence of HAPI in patients placed in the prone position (n = 84) – univariate analysis.

Variables	Patients who developed HAPI n = 52	95% confidence interval	Patients who did not develop HAPI n = 32	95% confidence interval	*P* value†
Sex					
Male n (%)	30 (58.8)	–	21 (41.2)	–	0.500
Female n (%)	22 (66.7)	–	11 (33.3)	–	
Race					
White n (%)	42 (62.7)	–	25 (37.3)	–	0.786
Not white n (%)	10 (58.8)	–	07 (41.2)	–	
Vasoactive drug use					
Yes n (%)	51 (63.0)	–	30 (37.0)	–	0.555
No n (%)	01 (33.3)	–	02 (66.7)	–	
Use of sedation					
Yes n (%)	41 (66.1)	–	21 (33.9)	–	0.349
No n (%)	00 (0.0)	–	01 (100.0)	–	
NIV need					
Yes n (%)	52 (62.7)	–	31 (37.3)	–	0.381
No n (%)	00 (0.0)	–	01 (100.0)	–	
Presence of tracheostomy					
Yes n (%)	18 (81.8)	–	04 (18.2)	–	0.021
No n (%)	34 (54.8)	–	28 (45.2)	–	
Use of central venous catheter					
Yes n (%)	52 (63.4)	–	30 (36.6)	–	0.373
No n (%)	00 (0.0)	–	01 (100.0)	–	
Use of indwelling urinary catheter					
Yes n (%)	52 (62.6)	–	31 (37.4)	–	0.381
No n (%)	00 (0.0)	–	01 (100.0)	–	
Use of enteral nutrition					
Yes n (%)	52 (62.6)	–	31 (37.4)	–	0.381
No n (%)	00 (0.0)	–	01 (100)	–	
Diabetes					
Yes n (%)	22 (59.5)	–	15 (40.5)	–	0.821
No n (%)	30 (63.8)	–	17 (36.2)	–	
Arterial hypertension					
Yes n (%)	45 (61.6)	–	28 (38.4)	–	1.000
No n (%)	07 (63.6)	–	04 (36.4)	–	
COPD					
Yes n (%)	07 (63.6)	–	04 (36.4)	–	1.000
No n (%)	45 (61.6)	–	28 (38.4)	–	
Neoplasm					
Yes n (%)	07 (70.0)	–	03 (30.0)	–	0.444
No n (%)	45 (61.6)	–	28 (38.4)	–	
Immunosuppression					
Yes n (%)	10 (90.9)	–	01 (9.1)	–	0.045
No n (%)	42 (57.5)	–	31 (42.5)	–	
Death					
Yes n (%)	25 (56.8)	–	19 (43.2)	–	0.372
No n (%)	27 (67.5)	–	13 (32.5)	–	
Age	61.2 (9.8)	(58.4–63.9)	61.9 (13.8)	(57.0–66.9)	0.760
Braden Score*	10.8 (2.8)	(10.0–11.6)	12.6 (4.3)	(11.0–14.2)	0.029
SAPS 3*	60.1 (18.5)	(54.1–66.2)	56.2 (19.9)	(46.6–65.7)	0.459
Risk of death *	45.6 (30.9)	(35.5–55.8)	39.1 (33.2)	(23.1–55.1)	0.465
Length of stay in the ICU (days)*	27.3 (15.7)	(13.0–31.7)	16.8 (9.6)	(13.4–20.3)	0.001
Time spent in prone position (hours)*	48.3 (31.7)	(39.4–57.1)	46.3 (26.3)	(36.8–55.8)	0.770
BMI in (kg/m^2)*	32.4 (7.8)	(30.2–34.6)	33.8 (11.6)	(29.6–37.9)	0.524
Hemoglobin*	12.7 (2.1)	(12.1–13.3)	13.5 (1.8)	(12.9–14.2)	0.078
Leukocytes *	10.4 (4.7)	(9.1–11.7)	10.4 (4.5)	(8.8–12.0)	0.944
Albumin*	3.3 (0.5)	(3.2–3.4)	3.4 (0.4)	(3.3–3.6)	0.290
Dimers D*	4.1 (4.9)	(2.7–5.5)	3.0 (2.4)	(2.1–3.9)	0.655
Fibrinogen*	689.0 (174.3)	(634.0–744.0)	664.5 (129.2)	(604.0–725.0)	0.848
Platelet*	237.5 (111.5)	(206.5–268.6)	202.4 (72.1)	(176.4–228.4)	0.116
Ferritin*	1897.4 (1867.2)	(1047.5–2747.3)	1564.6 (892.2)	(1089.2–2040.0)	0.516

(*Continued*)

Table 2

(*Continued*)

Variables	Patients who developed HAPI n = 52	95% confidence interval	Patients who did not develop HAPI n = 32	95% confidence interval	*P* value†
Lactate dehydrogenase*	791.4 (433.8)	(665.4–917.3)	1076.7 (839.8)	(768.6–1384.7)	0.051
C-reactive protein*	14.6 (7.9)	(12.4–16.8)	13.0 (7.5)	(10.3–15.7)	0.366
INR*	1.26 (0.99)	(0.97–1.56)	1.16 (0.26)	(1.1–1.3)	0.719

BMI = body mass index in (kg/m2), COPD = chronic obstructive pulmonary disease, HAPI = hospital-acquired pressure injury, INR = international normalized ratio, NIV = non-invasive mechanical ventilation, SAPS = simplified acute physiology score.

*Values expressed as mean and standard deviation. †*P* value: calculated by Fisher exact test for qualitative variables and Student *t* test for quantitative variables.

Table 3

Factors related to the occurrence of hospital-acquired pressure injury in patients placed in the prone position (n = 84), according to the logistic regression model.

Variables	Odds ratio	*P* value	95% confidence interval
Braden scale	0.84	.031	0.714–0.984
ICU length of stay	1.12	.008	1028–1209
Presence of tracheostomy	0.41	.395	0.052–3209
Hemoglobin	0.80	.278	0.543–1192
Platelets	1.01	.173	0.998–1012
Lactate dehydrogenase	1.00	.271	0.998–1000
Immunosuppression	5.35	.196	0.422–67,794

ICU = intensive care unit.

nasotracheal tubes, they are more common in the nostrils, nose, and tip of the nose.[19]

The literature shows that there is a need to deepen the use of the prone position and its contributions, as well as to carry out studies on the development of HAPI in patients in this position.[18]

In view of the above, this study aimed to identify the incidence and factors associated with the occurrence of HAPI in patients with COVID-19 admitted to the ICU who used the prone position.

2. Methods

Retrospective cohort study, carried out in an ICU of a tertiary university hospital. All patients admitted to this unit from May to September 2020 with a diagnosis of COVID-19 confirmed by molecular examination, real-time polymerase chain reaction positive for severe acute respiratory syndrome coronavirus 2 were evaluated and included all those who were placed in prone position during ICU admission. The detailed flowchart of the study design is shown in Figure 1.

To get the data, we consulted the electronic medical records of the patients in relation to 3 groups of variables. Group 1 relates to patient identification and characterization information, namely: sex, age, skin color (white or nonwhite), comorbidities such as diabetes, chronic obstructive pulmonary disease, and neoplasia, smoking, score on the Braden Risk Scale at the time of hospital admission, Simplified Acute Physiology Score III on admission and length of stay in the ICU. Group 2 is related to risk factors related to the occurrence of HAPI, such as the use of sedation, use of vasoactive drugs, time in hours spent in the prone position, laboratory tests (hemoglobin and albumin), body mass index, need for invasive mechanical ventilation or presence of tracheostomy, oxygen pressure per inspired fraction of oxygen (P/F ratio), use of enteral nutrition, use of central venous catheter and use of indwelling urinary catheter.

Group 3 relates to the occurrence of HAPI and its location. HAPI were classified according to the International Classification System as a way of indicating the extent of tissue damage as shown in Table 1.

We collected patient data at the time of admission, excluding patients who already had HAPI upon admission, and we monitored the evaluation of the development of HAPI daily until the outcome (discharge or death) through the medical record. The research project was prepared under the precepts of Resolution CNS 466/12 and approved by the Research Ethics Committee of the study institution and is part of a broader project that seeks to explain clinical and epidemiological aspects of COVID-19, number CAAE 30816620.0.0000.5440.

2.1. Statistical analysis

Data were entered into a Microsoft Excel® spreadsheet. We performed double typing to check for typing errors. After the spreadsheet was validated, the data were imported and analyzed using the STATA SE program, version 14 (Stata/SE version 14 perpetual license, StataCorp LP, Texas).

The dependent variable in this study was dichotomous (yes or no), the occurrence of HAPI in prone patients. For quantitative variables, mean and standard deviation were calculated. To analyze the association between the quantitative variables and the dependent variable, the Student *t* test was used, as they follow the normal distribution by the Kolmogorov–Smirnov test. Qualitative variables were presented by frequency, and Fisher exact test was used to compare them with the dependent variable. Sequentially, a logistic regression model was developed. The variables that presented a P value < 0.20 in the univariate analysis were included in the final model. For all analyses, a significance level of $\alpha = 0.05$ was adopted.

3. Results

Two hundred 4 patients who had COVID-19 with positive real-time polymerase chain reaction were evaluated, of which 84 were included in the study because they needed to be placed in the prone position. None of the prone patients had HAPI prior to ICU admission. Of the prone patients, 52 (62%) developed

Table 4

Data related to the location of hospital-acquired pressure injury.

Patient	Local and Stage 1	Local and Stage 2	Local and Stage 3	Local and Stage 4	Local and Stage 5	Local and Stage 6
Patient 1	Sacral II	Right thorax II	Left thorax II	Unclassifiable ear	Unclassifiable shoulder	Penis II
Patient 2	Sacral II	Left thorax II	Chin II	Right knee unclassifiable	Unclassifiable left leg	Unclassifiable left malleolus
Patient 3	Chin I					
Patient 4	Unclassifiable external nasal					
Patient 5	Mandible II	Right temporal II				
Patient 6	Sacral II	Trochanter II				
Patient 7	Sacral II	Mamma II				
Patient 8	Calves II					
Patient 9	Sacral II	Left gluteus II	Right knee II	Left knee II	Dorse II	
Patient 10	Unclassifiable nasal					
Patient 11	Unclassifiable sacral	Non-classifiable right calcaneus	Unclassifiable left calcaneus	Left hallux not classifiable	Right elbow not classifiable	Left elbow unclassifiable
Patient 12	Right supraorbital II	Infraorbital left II	Occipital II	Thorax II		
Patient 13	Sacral II					
Patient 14	Sacral IV					
Patient 15	Thorax II	Right gluteus II	Left gluteus II	Inter gluteus not classifiable	Penis II	
Patient 16	Sacral II					
Patient 17	Not classifiable intergluteus II	Occipital I				
Patient 18	Sacral II					
Patient 19	Right gluteus not classifiable					
Patient 20	Sacral II					
Patient 21	Sacral II					
Patient 22	Non-classifiable calcaneus	Unclassifiable sacral	Right elbow not classifiable			
Patient 23	Non-classifiable calcaneus					
Patient 24	Unclassifiable posterior thorax	Non-classifiable scapula	Left gluteus not classifiable			
Patient 25	Unclassifiable sacral					
Patient 26	Unclassifiable nasal					
Patient 27	Supramammary II					
Patient 28	Unclassifiable sacral	Left gluteus II	Inter glúteo II			
Patient 29	Infra mamária II					
Patient 30	Sacral II					
Patient 31	Left mamma I	Sacral II	Inter gluteus III			
Patient 32	Anterior trunk II					
Patient 33	Sacral II					
Patient 34	Right trochanter II	Sacral II				
Patient 35	Sacral II	Non-classifiable calcaneus				
Patient 36	Calcaneus I					
Patient 37	Abdominal not classifiable					
Patient 38	Left gluteus II					
Patient 39	Sacral II					
Patient 40	Anterior thorax II					
Patient 41	Anterior thorax II					
Patient 42	Sacral II	Non-classifiable calcaneus	Frontal II	Penis II		
Patient 43	Left gluteus I	Right gluteus I				
Patient 44	Left calcaneus II	Thorax II				
Patient 45	Sacral II					
Patient 46	Thorax II	Knee II				
Patient 47	Right calcaneus II	Left gluteus II	Right gluteus II	Inter gluteus II		
Patient 48	Right gluteus II	Inter gluteus II				

(*Continued*)

Table 4

(*Continued*)

Patient	Local and Stage 1	Local and Stage 2	Local and Stage 3	Local and Stage 4	Local and Stage 5	Local and Stage 6
Patient 49	Right inframammary II	Face II				
Patient 50	Sacral II					
Patient 51	Sacral II	Mandible I				
Patient 52	Unclassifiable nasal	Left gluteus II				

Figure 2. Cushions used in patients in the prone position.

some type of HAPI during hospitalization. The risk factors related to the occurrence of HAPI are listed in Table 2.

In the univariate analysis, the variables that were associated with the occurrence of HAPI in prone patients, with statistical significance, were tracheostomy, immunosuppression, length of stay in the ICU, serum lactate dehydrogenase dosage, and Braden scale. In addition, the platelets and hemoglobin variables had a *P* value lower than 0.20 and were included in the logistic regression model. The data are presented in Table 3.

In the multivariate analysis, we associated the Braden Scale and the length of stay in the ICU with the occurrence of HAPI in patients prone to COVID-19, and each day of hospitalization increased the chance of occurrence of HAPI by 1.12 times. The Braden scale was a good predictor of HAPI occurrence, since the lower the scale value, the greater the risk of HAPI occurrence, each point that is increased on the scale decreases the chance of HAPI occurrence.

Regarding the occurrence of HAPI, 52 patients (62%) developed some type of HAPI during hospitalization, 27 (51.9%) patients had only 1 lesion, 13 (25.0%) patients developed 2 lesions, 4 patients (7.7%), 3 lesions, 3 patients (5.8%), 4 lesions, 2 patients (3.8%), 5 injuries and 3 patients (5.8%), 6 injuries. Of the patients who developed HAPI, 26 (50%) had HAPI in sites possibly associated with the prone position.

We can see in Table 4 that 52 patients developed 105 HAPI. The main site of occurrence of HAPI was the sacral region 25 (23.9%) followed by gluteus 13 (12.4%) and thorax 10 (9.5%), calcaneus 9 (8.6%), gluteus 6 (5.7%), nasal 4 (3.8%), knee 4 (3.8%), elbow 3 (2.9%), penis 3 (2.9%), mamma 2 (1.9%), chin 2 (1.9%), occipital 2 (1,9%), mandible 2 (1,9%), infra mammary 2 (1,9%), leg 1 (1%), scapula 1 (1%), ear 1 (1%), shoulder 1 (1%), trochanter 1 (1%), temporal 1 (1%), malleolus 1 (1%), hallux 1 (1%), supraorbital 1 (1%), infraorbital 1 (1%), calve 1 (1%), back 1 (1%), supramammary 1 (1%), abdominal 1 (1%), face 1 (1%), trunk 1 (1%), and front 1 (1%).

Regarding the stage of HAPI, only one of them was classified as stage IV in the sacral region. The others were classified as stage I, II, III, and not classifiable.

4. Discussion

It is known that the prone position is crucial in improving the ratio of oxygen pressure to inspiratory oxygen fraction (P/F ratio), however, it is not the only benefit of this intervention. The prone position also reduces pulmonary hyperinflation in specific areas, while increasing alveolar recruitment,[16] effects that may contribute to recovery from mechanical ventilation-induced lung injury by homogenizing the distribution of stress and strain within the lung.[21]

During the COVID-19 pandemic, the use of the prone position has increased substantially due to cases of associated ARDS.[22] In the institution of the study, the indications adopted for the prone position are consistent with the literature,[23] with a P/F ratio < 150 with inspiratory oxygen fraction > 60% and we observed that many patients with COVID-19 benefited from this intervention.

Studies prior to the pandemic already showed a high probability of HAPI in patients in the prone position[24] as also identified in our study. A systematic review that evaluated 1765 patients identified a 46.3% rate of occurrence of HAPI.[25] Another investigation identified the occurrence of this event at 57.1%.[24] During the pandemic, our research identified a HAPI incidence rate of 61.9%. In a cross-sectional study that followed 87 patients admitted to intensive care, 66 patients developed HAPI, and 53 (80%) developed HAPI in the anterior regions of the body.[26] Another investigation included 170 patients who were placed in the prone position, with 23 (14%) developing HAPI.[27]

We consider that there is great variability in the rate of occurrence of HAPI, which can be explained by the risk of this event not being constant throughout the ICU stay and the studies may have followed the patients at different times of hospitalization. In addition, in some institutions, such as the one in this study, the COVID-19 pandemic led to an overload of work on the nursing team, which impacted implementing preventive measures, such as changing the position. The increase in demand for ICU beds led to the opening of new beds with a tripling of the previous availability, in addition, there was a need to integrate teams with little or no experience in the ICU, which may also have contributed to the high incidence of HAPI found.

In this study, 26 (50%) patients had HAPI in places possibly associated with the prone position, and chest injuries occurred in 10 (9.5%) patients. In another study, the anatomical positions of the HAPI were: face/chin, 5% (n = 8), face/cheekbones, 6% (n = 11), mamma, 2% (n = 3), trochanters, 1% (n = 1), and other locations, 5% (n = 8).[27]

Other investigations show that the sites typically affected by HAPI in prone patients are the region of the face, such as the forehead, cheeks, nose and chin, clavicle, shoulder, elbow, chest, genitalia (breasts and penis), anterior pelvic bones, knees, back of the feet, and toes,[22,28] corroborating the data of our study that also identified the occurrence of this event in most of these places.

A previous study of the pandemic identified factors associated with age >60 years (OR 1.5340, *P* = .0019), female sex (OR 0.5075, *P* = .019), and body mass index >28.4 kg/m2 (OR 1.9804, *P* = .0037),[24] these factors were not significant in this research.

During the pandemic, 2 investigations pointed out that the longer the time spent in the prone position, the greater the risk of developing HAPI.[22,26] In this research, this finding was not confirmed. Perhaps this can be explained by the use of specific cushions for the ventral regions of the body that were built and used in the patients in this study (Fig. 2).

Thus, we identified that there are still divergences in relation to the factors associated with the occurrence of HAPI. We emphasize the importance of carrying out studies that seek to explain what these factors are in order to stimulate the prevention of these events aimed at-risk groups.

In the present study, the factors associated with the occurrence of HAPI in patients prone to COVID-19 were the Braden Scale and the length of stay in the ICU. We emphasize the relevance of the Braden scale for the assessment and quantification of HAPI and also the need to always use care protocols that can reduce the length of stay in the ICU, thus minimizing adverse events.

The importance of prevention, as one of the most effective forms of HAPI management, has been previously described, reinforcing the findings of our study.[29] Knowing that the Braden scale has already shown effectiveness as a predictor of HAPI, our study statistically reinforces its performance, using skin sensitivity, activity, mobility, nutrition, and friction, to identify patients at greater risk of developing this event, also in the prone patients with COVID-19.

It is noteworthy that the prevention of HAPI in patients who need the prone position is a challenge. Changing positions every 2 hours can be unfeasible in case of staff overload, as occurred in many ICUs during the COVID-19 pandemic.[21] Identifying the factors associated with the occurrence of HAPI in prone patients with COVID-19, as well as the places where these injuries occur, is essential to develop standardized protocols to prevent these adverse events and prioritize patients at higher risk.

The present study has the limitation of having been developed in a single center and using a convenience sample. We also highlight as a limitation that the study is retrospective and that the information was collected from medical records. In this way, there could be a patient who developed HAPI and who was not registered in the medical record. However, in the study ICU, all nurses are trained and carry out the assessment and recording of the patients' skin conditions daily during the bath, as well as there is a notification system that is completed with each new HAPI.

5. Conclusion

Because of the high incidence of HAPI in prone patients (62%), the adoption of prevention protocols that include patients in a dorsal and prone position becomes necessary to reduce the incidence of these injuries in patients with COVID-19 in the ICU.

Author contributions

Conceptualization: Maria Auxiliadora-Martins, Mayra Gonçalves Menegueti.
Data curation: Lucas Sato, Letícia Olandin Heck, Karina de Fátima Bimbatti, Bruno Cesar Petroski-Moraes.
Formal analysis: Christiane Becari, Mayra Gonçalves Menegueti.
Funding acquisition: Anibal Basile-Filho, Maria Auxiliadora-Martins, Mayra Gonçalves Menegueti.
Investigation: Mayra Gonçalves Menegueti.
Methodology: Lucas Sato.
Project administration: Christiane Becari, Anibal Basile-Filho, Maria Auxiliadora-Martins, Mayra Gonçalves Menegueti.
Resources: Anibal Basile-Filho, Maria Auxiliadora-Martins.
Supervision: Christiane Becari, Anibal Basile-Filho, Maria Auxiliadora-Martins, Mayra Gonçalves Menegueti.
Validation: Christiane Becari, Anibal Basile-Filho, Maria Auxiliadora-Martins, Mayra Gonçalves Menegueti.
Visualization: Christiane Becari, Maria Auxiliadora-Martins, Mayra Gonçalves Menegueti
Writing – original draft: Lucas Sato.
Writing – review & editing: Anibal Basile-Filho, Maria Auxiliadora-Martins, Mayra Gonçalves Menegueti.

References

[1] Zimmermann GDS, Cremasco MF, Zanei SSV, et al. Predição de risco de lesão por pressão em pacientes de unidade de terapia intensiva: revisão integrativa. Pressure injury risk prediction in critical care patients: an integrative review. Texto Contexto Enferm. 2018;27:e3250 017–e3250017.
[2] Edsberg LE, Black JM, Goldberg M, et al. Revised national pressure ulcer advisory panel pressure injury staging system: revised pressure injury staging system. J Wound Ostomy Continence Nurs. 2016;43:585–597.
[3] Lima AFC, Castilho V. Mobilização corporal para prevenção de úlceras por pressão: custo direto com pessoal. Movilización para la prevención de úlceras de presión: costo con Body mobilization for prevention of pressure ulcers: direct labor costs. Rev Bras Enferm. 2015;68:930–6.
[4] Jackson D, Sarki AM, Betteridge R, et al. Medical device-related pressure ulcers: a systematic review and meta-analysis. Int J Nurs Stud. 2019;92:109–20.
[5] Strazzieri-Pulido KC, González CVS, Nogueira PC, et al. Pressure injuries in critical patients: incidence, patient-associated factors, and nursing workload. J Nurs Manag. 2019;27:301–10.
[6] Cox J. Pressure injury risk factors in adult critical care patients: a review of the literature. Ostomy Wound Manage. 2017;63:30–43.
[7] Alencar GSA, Silva NM, Assis EV, et al. Lesão por pressão na unidade de terapia intensiva: incidência e fatores de riscos. Nursing (São Paulo). 2018;21:2124–8.
[8] Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet (London, England). 2020;395:497–506.
[9] Angelo H, Batista LM, Vasconcelos AS, et al. Mudanças da atuação multiprofissional em pacientes com COVID-19 em unidades de terapia intensiva. Health Residencies J. 2020;1:32–51.
[10] Baptista AB, Fernandes LV. COVID-19, análise das estratégias de prevenção, cuidados e complicações sintomáticas. DESAFIOS-Revista Interdisciplinar da Universidade Federal do Tocantins. 2020;7:38–47.
[11] Marchon RM, Modesto FC, Rodrigues CCL, et al. Physiotherapy care in oncology patient with COVID-19. Rev Bras Cancerol. 2020;66:e-1031.
[12] Catania K, James P, Moran M. PUPPI: the pressure ulcer prevention protocol interventions. Am J Nurs. 2007;107:44–52.
[13] Ramalho AO, Freitas PSSF, Moraes JT, et al. Reflexões sobre as recomendações para prevenção de lesões por pressão durante a pandemia de COVID-19. ESTIMA Braz J Enterostomal Ther. 2020;18:e2520.
[14] Paiva KCA, Beppu OS. Posição prona. J Bras Pneumol. 2005;31:332–40.
[15] Carneiro MAA. Efeitos da posição prona no paciente com síndrome da angústia respiratória aguda (SARA): Metanálise. Rev Interdiscip Estudos Experimentais-Animais e Humanos Interdisciplinary Journal of Experimental Studies. 2009;1:97–104.

[16] Guérin C, Reignier J, Richard JC, et al. Prone positioning in severe acute respiratory distress syndrome. N Engl J Med. 2013;368:2159–68.
[17] Gattinoni L, Chiumello D, Rossi S. COVID-19 pneumonia: ARDS or not? Crit Care. 2020;24:154.
[18] Araújo MS, Santos MMP, Silva CJA, et al. Prone positioning as an emerging tool in the care provided to patients infected with COVID-19: a scoping review. Rev Lat Am Enfermagem. 2021;29:e3501.
[19] Filgueira R, Farias EVN, Castelianno MER, et al. Manejo da posição prona em pacientes com COVID-19: revisão integrativa. Revista de Ciências da Saúde Nova Esperança. 2020;18:135–42.
[20] Silva D, Trentini VA, Hey AP. Atualizações em lesão por pressão baseadas nas diretrizes de 2016. Anais do EVINCI-UniBrasil. 2016;2:220–220.
[21] Lucchini A, Russotto V, Barreca N, et al. Short and long-term complications due to standard and extended prone position cycles in COVID-19 patients. Intensive Crit Care Nurs. 2022;69:103158.
[22] Zhu J, Ji P, Pang J, et al. Clinical characteristics of 3062 COVID-19 patients: a meta-analysis. J Med Virol. 2020;92:1902–14.
[23] Ibarra G, Rivera A, Fernandez-Ibarburu B, et al. Prone position pressure sores in the COVID-19 pandemic: the Madrid experience. J Plast Reconstr Aesthet Surg. 2021;74:2141–2148.
[24] Girard R, Baboi L, Ayzac L, et al. The impact of patient positioning on pressure ulcers in patients with severe ARDS: results from a multicentre randomised controlled trial on prone positioning. Intensive Care Med. 2014;40:397–403.
[25] Sud S, Friedrich JO, Adhikari NKJ, et al. Effect of prone positioning during mechanical ventilation on mortality among patients with acute respiratory distress syndrome: a systematic review and meta-analysis. CMAJ. 2014;186:E381–90.
[26] Challoner T, Vesel T, Dosanjh A, et al. The risk of pressure ulcers in a proned COVID population. Surgeon. 2022;20:e144–8.
[27] Lucchini A, Bambi S, Mattiussi E, et al. Prone position in acute respiratory distress syndrome patients: a retrospective analysis of complications. Dimens Crit Care Nurs. 2020;39:39–46.
[28] Moore Z, Patton D, Avsar P, et al. Prevention of pressure ulcers among individuals cared for in the prone position: lessons for the COVID-19 emergency. J Wound Care. 2020;29:312–20.
[29] Bassam A, Sim J, Middleton R. Nursing interventions for pressure injury prevention among critically ill patients: a systematic review. J Clin Nurs. 2021;30:2151–68.