Analysis of the Characteristics and Influencing Factors of Medical Device Pressure Injury in ICU Patients

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Abstract: Objective To understand the characteristics of medical device pressure injury in intensive care unit patients and explore its related influencing factors. Methods A total of 280 patients in ICU of Baoding First Central Hospital from August to December 2022 were selected and divided into the occurrence group and the non-occurrence group according to whether MDRPI occurred. The general data, clinical data and device use were compared between the two groups. Multivariate logistic regression was used to analyze the influencing factors of MDRPI in ICU patients. Results Fifty-five patients developed MDRPI, with an incidence of 19.6%. Age, prone position ventilation and APACHEII score were the influencing factors of MDRPI in ICU patients (P<0.05). Conclusions Patients in ICU are prone to develop MDRPI due to old age, prone position ventilation, critical condition, large number of medical devices and use of non-invasive ventilation masks. In order to reduce the incidence of MDRPI, nursing staff should make a comprehensive evaluation of patients and give preventive measures in advance.

Keywords: Intensive Care Unit; Pressure Injuries from Medical Devices; Influencing Factors

Introduction

Medical device related pressure injury is local damage to the skin or mucosa of patients caused by medical devices used for diagnosis or treatment. The resulting pressure injury usually conforms to the pattern or shape[1] of the device, and the current prevalence is 0.85% to 34%[2]. The occurrence of pressure injury will increase medical costs and the workload of nurses. In severe cases, it may also cause secondary infection, resulting in sepsis and [3]septicemia. At present, domestic large sample surveys mostly focus on pressure injuries at bone carina, even including pressure injuries caused by medical devices, but the related influencing factors have not been analyzed. The purpose of this study is to understand the occurrence characteristics of MDRPI in critically ill patients, explore the influencing factors of MDRPI, and provide a basis for early prevention of MDRPI.

1. Objects and Methods

1.1 Subjects

A total of 280 ICU patients admitted to our hospital from August to December 2022 were selected. Inclusion criteria: age ≥18 years old; The length of ICU stay ≥24 hours; Use of at least 2 medical devices; Informed consent was obtained from the patients or their families. Exclusion criteria: patients with skin-related diseases affecting observation; MDRPI developed before ICU admission. This study was reviewed and approved by the ethics committee of the hospital.

1.2 Research methods

1.2.1 Instruments

① General information: age, gender, body mass index, etc.; ② Clinical data: length of ICU stay, type of ICU, history of surgery, level of consciousness, Braden scale score, acute physiology and chronic health evaluation II score; ③ Use of

medical devices: respiratory support equipment, indwelling catheter, monitoring equipment. Data collection was carried out by two research members, and the location of MDRPI, the degree of injury, and the device causing the injury were recorded.

1.2.2 Staging and prevention

The staging of pressure injury was judged according to the 2019 edition of the Prevention and Treatment of Pressure Ulcers/Pressure Injuries: Clinical Practice Guidelines[4].

1.3 Statistical Methods

SPSS 26.0 software was used for data analysis. Measurement data conforming to normal distribution were expressed as mean ± standard deviation and compared by t test. The data that did not conform to the normal distribution were expressed as median and quartile, and the rank sum test was used for comparison. The count data were expressed as the number of cases or percentage, and the comparison was analyzed by x^2 test. Rank sum test was used for ranked data. logistic regression was used to analyze the influencing factors of MDRPI. $P < 0.05$ was considered statistically significant.

2. Results

2.1 General Information

Among 280 ICU patients, 186 were male and 94 were female. The mean age was (55.55±12.26) years (range, 18-86 years). MDRPI occurred in 55 patients (19.6%).

2.2 Comparison of clinical data between the two groups

There were statistically significant differences in age, Braden scale score and APACHEII score between the two groups ($P < 0.05$). See Table 1.

Table 1 Comparison of clinical data between the two groups

The project	Occurrence group	Non-occurring group		
	(55 cases)	(225 cases)	t/χ2 /Z values	P-value
Age (years)	59.55 + / - 10.75	54.57 + / - 12.42	2.731	0.007
Braden Scale score	11.76 + / - 0.96	12.96 + / - 2.05	4.209	< 0.001
APACHEII score	13.96 + / - 1.85	9.31 + / - 2.88	11.429	< 0.001
Type of ICU [case (%)]			11.172	0.004
Cardiac surgery	39 (70.9)	106 (47.1)		
General surgery	11 (20.0)	61 (27.1)		
Internal medicine	5 (9.1)	58 (25.8)		
Surgery [case (%)]			9.782	0.002
is	49 (89.1)	153 (68)		
no	6 (10.9)	72 (32)		
Prone position ventilation [n (%)]			58.287	< 0.001
is	17 (30.9)	3 (1.3)		
no	38 (69.1)	222 (98.7)		
Disturbance of consciousness [example (%)]			18.667	< 0.001
is	55 (100.0)	165 (73.3)		

no	0 (0)	60 (26.7)		
Use of sedative medication [example (%)]			10.462	0.001
is	49 (89.1)	151 (67.1)		
no	6 (10.9)	74 (32.9)		
Enteral nutrition [example (%)]			34.718	< 0.001
is	49 (89.1)	101 (44.9)		
no	6 (10.9)	124 (55.1)		
Hemoglobin [g/L, example (%)]			29.435	< 0.001
< 90	6 (10.9)	9 (4.0)		
90 ~ 120	29 (52.7)	48 (21.3)		
> 120	20 (36.4)	168 (74.7)		
Length of ICU stay (d)	18.29 + / - 7.13	7.13 + / - 4.88	13.93	< 0.001

2.3 Location and stage of MDRPI

A total of 58 pressure injuries occurred in 55 MDRPI patients, all of which were stage 1 and 2 pressure injuries. There were 41 stage 1 lesions, including 8 on the lip, 19 on the nose, 5 on the ear, 7 on the fingers, and 2 on the neck. Seventeen lesions were in stage 2, including 14 on the lip and 3 on the nose.

2.4 Influencing factors of MDRPI in ICU patients

The occurrence of MDRPI was taken as the dependent variable, and the variables with statistically significant differences were taken as independent variables, and the respective variables were assigned. The results showed that they were the influencing factors of MDRPI in ICU patients (P < 0.05). See Table 2.

Table 2 Analysis of influencing factors for the occurrence of MDRPI in ICU patients

Independent variables	B	S.E.	chi-square	P-value	OR value	95%CI
Age	0.057	0.027	4.527	0.033	1.059	1.005 ~ 1.116
Ventilate in the prone position	3.544	1.222	8.408	0.004	34.613	154 ~ 379.858
APACHE II score	0.502	0.116	18.643	< 0.001	1.653	1.316 ~ 2.076
Hemoglobin (g/L)			4.997	0.082		
90 ~ 120	1.154	0.932	1.531	0.216	0.315	0.051 ~ 1.961
> 120	1.154	0.941	4.096	0.043	0.149	0.024 ~ 0.942
Total number of medical devices used	0.65	0.228	8.122	0.004	1.915	1.225 ~ 2.994
Use a non-invasive ventilation mask	1.474	0.73	4.077	0.043	4.366	1.044 ~ 18.258

3. Discussion

3.1 The incidence of MDRPI was high

The incidence of MDRPI in ICU patients in this study was 19.6%, which is consistent with the results of Koo et[5] al. In many cases, MDRPI [6] was not detected early due to the large number of medical devices used, the lack of cognition of

nurses or the fear that lifting medical devices during the evaluation process would cause changes in the patient's condition and the need for doctors' consent.

3.2 The most common sites of MDRPI were nose and lips

The results of this study showed that the most common site of MDRPI was the head and face. The head and face are prone to pressure injury due to the weak fat layer. Therefore, for patients with intubation, the appropriate caliber of the cannula should be selected to ensure that it is worn properly. At the same time, it is also necessary to adjust the position of the cannula to redistribute the pressure and avoid direct contact between the device and the patient's skin, so as to prevent the occurrence[7] of MDRPI.

3.3 Influencing factors of MDRPI in ICU patients

Older age, prone position ventilation, critical illness, a large number of medical devices, and the use of non-invasive ventilation masks are prone to MDRPI, which is consistent with the results of previous studies[8]. With the increase of age, the atrophy of subcutaneous fat and the decrease of elasticity make elderly patients prone to pressure injury. APACHEII score is a widely used scoring method [9]to reflect the severity of disease in ICU patients, predict the prognosis of disease and the mortality of patients. The greater the number of medical devices used, the greater the risk of developing MDRPI. The risk of pressure injury increased by 2.4 times [10]for each additional medical device used by the patient. Patients with non-invasive ventilation masks are prone to develop MDRPI. During the treatment, the mask is close to the skin to avoid air leakage, and the fat is thin, which leads to the occurrence of MDRPI. Therefore, nurses should choose appropriate non-invasive ventilation equipment, evaluate the surrounding skin in time, keep clean and moderately moist, and reduce the occurrence [11]of MDRPI. High level of hemoglobin is a protective factor for MDRPI, which is consistent with the results of [12]previous studies. Malnutrition and protein deficiency have been recognized as independent risk factors [13]for pressure injury. Therefore, it is suggested that nursing staff should pay attention to the nutritional status of patients and carry out nutritional intervention according to the doctor's advice in a planned way to prevent the occurrence of MDRPI.

Conclusion

The incidence of MDRPI in ICU patients is high, which needs to be paid attention to by nursing staff. Age, prone position ventilation, APACHEII score, the number of devices used and the use of non-invasive ventilation masks are the risk factors for the occurrence of MDRPI in ICU patients, while high level of hemoglobin is the protective factor for the occurrence of MDRPI in ICU patients. ICU nurses should master the risk factors of MDRPI, evaluate the patients timely and accurately, and give predictive intervention measures to reduce the occurrence of MDRPI. The representativeness of the sample investigated in this study is limited, and further research, exploration and analysis are needed in the future to provide reference for clinical nursing practice.

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