

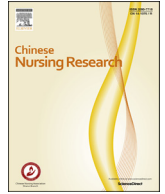
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## Original article

# Logistic regression analysis and nursing interventions for high-risk factors for pressure sores in patients in a surgical intensive care unit

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## ABSTRACT

**Objective:** To investigate the risk factors related to the development of pressure sores in critically ill surgical patients and to establish a basis for the formulation of effective precautions.

**Methods:** A questionnaire regarding the factors for pressure sores in critically ill surgical patients was created using a case control study with reference to the pertinent literature. After being examined and validated by experts, the questionnaire was used to collect data about critically ill surgical patients in a grade A tertiary hospital. Among the 47 patients enrolled into the study, the 14 who developed nosocomial pressure sores were allocated to the pressure sore group, and the remaining 33 patients who met the inclusion criteria and did not exhibit pressure sores were allocated to the control group. Univariate and multivariate logistic regression analyses were employed to examine the differences in 22 indicators between the two groups in an attempt to identify the risk factors for pressure sores.

**Results:** According to the univariate analyses, the maximum value of lactic acid in the arterial blood, the number of days of norepinephrine use, the number of days of mechanical ventilation, the number of days of blood purification, and the number of days of bowel incontinence were statistically greater in the pressure sore group than in the control group ( $p < 0.05$ ). The multivariate logistic regression analysis revealed that the number of days of norepinephrine use and the level of lactic acid in the arterial blood were high risk-factors for pressure sores ( $p < 0.05$ ).

**Conclusions:** The best method for preventing and control pressure sores in surgical critically ill patients is to strongly emphasize the duration of the critical status and to give special attention to patients in a continuous state of shock. The adoption of measures specific to high-risk patient groups and risk factors, including the active control of primary diseases and the application of decompression measures during the treatment of the patients, are helpful for improving the quality of care in the prevention and control of pressure sores in critically ill patients.

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## 1. Introduction

Pressure ulcers are skin lesions that are caused by changes in the interior and exterior environments of the skin and its own condition in response to the effects of various factors. The care of pressure ulcers has always been a focus and a difficulty in the nursing field. Because critically ill surgical patients remain in stressed states due to their critical conditions and exhibit incidences of pressure ulcers up to 14.3%–51.0%,<sup>1,2</sup> they are the key subjects of pressure ulcer prevention and control.

The Braden scale is currently the most commonly used risk assessment scale in clinical practice. This scale focuses on six factors, including perception and sensation, mobility, activity, skin humidity, nutritional status, and friction and shearing forces. However, to benefit from more active risk precautions related to pressure ulcers, the Braden scale must be used in connection the identification of additional risk factors.<sup>3</sup> Foreign investigators have revealed that there are now more than 100 types of risk factors for pressure ulcers<sup>4</sup>; therefore, the present study was designed to identify the indicators that best serve an early warning function for pressure ulcers in critical surgical patients. This study investigated the information related to patients with pressure ulcers and critically ill surgical patients who did not experience pressure ulcers during the same period and further analyzed the strong risk

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factors of pressure ulcers with the purpose of providing evidence for improvements in the prevention and reduction of pressure ulcers.

## 2. Material and methods

### 2.1. Research subjects

The subjects enrolled in this study were critically ill patients who were admitted to the general surgery ICU of a grade A tertiary hospital in Beijing from January 2010 to December 2012. The inclusion criteria were as follows: patients who ① were at least 18 years old, ② did not suffer from pressure ulcers outside the hospital and were deemed to be at extreme risk for pressure ulcers in an initial assessment after admission to the ICU (i.e., a Braden score  $\leq 9$ ), ③ were in critical condition and exhibited acute physiology and chronic health evaluation II scores (APACHE II)  $\geq 20$  within 24 h of entering ICU, and ④ were patients whose ICU stay was  $\geq 14$  days. Among the 47 patients enrolled into this study, 14 cases with pressure ulcers were allocated to the pressure ulcer group, and the remaining 33 patients without pressure sores were allocated to the control group. In the case group there were 12 males and 2 females with an average age of  $70.43 \pm 15.30$  years, an APACHE II score of  $24.29 \pm 5.01$  within 24 h in the ICU and an initial Braden score of  $7.29 \pm 0.99$  in the ICU, including 8 cases with severe acute pancreatitis, 4 with fecal peritonitis and 2 with other severe surgical infections. According to the standard pressure ulcer classification revised by the National Pressure Ulcer Advisory Panel (NPUAP) in 2007, 7 of these patients were classified into Phase II sacral pressure sores, 2 cases with phase III pressure sores, 1 case with a suspiciously deep sore, 3 cases with phase II pressure ulcers in the heels of the feet, and 1 case with phase II pressure ulcers on the knees. The average duration of the patients with pressure ulcers in the ICU was  $38.57 \pm 26.42$  days. There were 24 males and 9 females with an average age of  $69.18 \pm 15.75$  years, an average APACHE II score of  $23.82 \pm 3.38$  within 24 h in the ICU and an average initial Braden score of  $7.04 \pm 1.07$  in ICU, including 20 cases with severe acute pancreatitis, 6 cases with faecal peritonitis, and 7 cases with other severe surgical infections. There were no significant differences in gender, age, APACHE II score within 24 h in the ICU, initial Braden score in the ICU or disease diagnosis between the patients in the two groups ( $p > 0.05$ ). The results were comparable.

### 2.2. Research methods

The methods of a retrospective study were adopted. The questionnaire regarding the pressure ulcer risk factors was self-designed based on the related literature from all countries of the world and proceeded through 2 rounds of assessment by 6 clinical nursing specialists prior to its application. The content validity of the questionnaire was 0.91. The authors collected data regarding the 47 participants that included the following 22 indicators: gender, age, body weight, length of ICU stay, APACHE II score within 24 h in the ICU, initial Braden score, the lowest blood albumin value, the highest lactic acid value in the arterial blood, the administration of vasoactive agents (e.g., noradrenaline), the maximum dose and the total number of days on noradrenaline, the efficacy and number of days on mechanical ventilation, the consciousness of the patient, the administration and number of days on sedatives, the condition and the total number of days of blood purification therapy, the conditions of skin oedema and severe oedema (severe oedema referred to severe oedema in the systematic tissue with tension and lustre of the skin where it drooped on the body), and the number of days of incontinence. Based on the medical records and primary

laboratory sheets, the data were investigated and recorded item-by-item and examined via statistical descriptions and analyses following collection.

### 2.3. Statistical methods

All data were analyzed with SPSS version 18.0 after completing the input into a computer by specially assigned persons. The main statistical analysis methods included rank sum tests, chi-square tests, and single factor and multiple factor non-conditional logistic regression analyses, and  $p < 0.05$  was considered to indicate statistical significance.

## 3. Results

### 3.1. Comparisons of the indicators between the two groups

By comparing the clinical data between the 14 patients with pressure ulcers and the 33 patients without pressure ulcers, the peak level of lactic acid in the arterial blood, the number of days on noradrenaline, the number of days of mechanical ventilation, the number of days of blood purification therapy, and the number of days of incontinence in the pressure ulcer group were found to be statistically greater than those in the control group (z values of  $-2.865$ ,  $-2.879$ ,  $-2.224$ ,  $-1.988$  and  $-1.930$ , respectively,  $p < 0.05$ ). There were no significant differences in the remaining 17 indicators between the two groups, which indicate that the 5 indicators were the ones that were potentially related to the development of pressure ulcers.

### 3.2. Single-factor logistic regression analyses of pressure ulcer risk factors

Using the development of pressure sores as the dependent variable and the 22 indicators as the independent variables in single-factor non-conditional logistic regression analyses revealed that the 5 indicators that were significantly different between the two groups were closely related to the development of pressure ulcers ( $p < 0.05$ ). No significant differences were observed in the remaining variables as listed in [Table 1](#).

### 3.3. Multivariate logistic regression analysis of the risk factors for pressure ulcers

According to the above analytic results, the factors with significant effects in the single-factor logistic regression analyses were introduced into the multivariate logistic regression model. As shown in the results, the peak level of lactic acid in the arterial blood and the number of days taking noradrenaline contributed as the independent risk factors for pressure ulcers ( $p < 0.05$ ) as listed in [Table 2](#).

## 4. Discussion

### 4.1. Substantial emphasis should be placed on the durations of patients' critical conditions in the prevention and control of pressure ulcers

It has been shown that the risk of developing pressure ulcers increases as the APACHE II score increases; therefore, use of pressure ulcer risk assessment scales (e.g., the Braden score) is needed in clinical practice to predict and prevent pressure ulcers.<sup>5</sup> The 47 cases in this study were relevant to the prevention and control of pressure sores because all cases conformed to the inclusion criteria in terms of critical conditions, extremely high risks for pressure

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