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ORIGINAL ARTICLE

Low serum albumin level as an independent risk factor for the onset of pressure ulcers in intensive care unit patients

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Key words
Albumin; Intensive care unit; Pressure ulcer

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Abstract

Critically ill patients are at high risk of developing pressure ulcers (PUs) and patients who develop PUs remain significantly longer in the intensive care unit (ICU) with significantly increased morbidity and mortality. Therefore, the identification of patients at truly increased risk is important. The aim of this study was to examine the association of low serum albumin present at admission in ICU patients with the onset of PUs. We conducted a retrospective cohort study on 610 patients who were admitted to intensive care unit. Level of serum albumin and other biochemical indices, recorded at the time of admission, were collected. We collected information about PU occurrence after admission and conducted a statistical analysis with biomarkers at ICU admission and during hospital stay. The incidence of PU in the ICUs was 31% and about 70% of patients with PUs had hypoalbuminemia at admission. The lowest values of serum albumin in patients with PUs were directly proportional to the severity of ulcers. In this study, we found a close association between serum albumin and PUs. In fact serum albumin was negatively correlated with PU and may be considered one of the independent determinants of PU occurrence in patients admitted to ICUs.

Introduction

Pressure ulcers (PUs) are common among hospitalised patients of intensive care units (ICUs). ICU studies providing prevalence and incidence figures are scarce and their reported incidence in critical care patients varies widely from 1% to 56% (1–7). PU prevalence rate has been found to vary between 14% and 41% (1,8,9). Patients admitted to ICUs, who are sedated, ventilated and almost invariably confined to bed for long periods, are at particularly high risk of developing PUs (2,9).

PUs are associated with negative patient-outcomes in terms of pain, loss of function and independence, increased risk of infection and sepsis, and additional surgical procedures (2,10).

PUs develop as a result of extrinsic and intrinsic factors. Main extrinsic factors are decreased tissue perfusion due to interface pressure, shearing forces, friction and moisture. Intrinsic factors are the nutritional status of the patient, patient age, immobility, incontinence, metabolic and circulatory factors and neurological disease; hypoalbuminemia is also suggested to increase frequency of PUs (11). In fact one study showed that 75% of patients with a serum albumin level below 35 g/l developed PUs compared to only 16% of patients with a higher serum albumin level (12).

Key Messages

- level of serum albumin at ICU admission may predict pressure ulcer onset
- the lowest values of serum albumin in patients with pressure ulcers are directly proportional to the severity of ulcers

As hypoalbuminemia is a frequent condition in patients admitted to ICUs, (13) the aim of this study is to verify the association between hypoalbuminemia and the occurrence of PUs in critically ill patients.

Information on PU risk factors in critically ill patients may be especially useful for the early and appropriate implementation of preventive measures.

Methods

This retrospective cohort study was conducted at the intensive care unit of University Magna Graecia of Catanzaro. Institutional Review Board (IRB) approval was obtained for this study.

All categories of ICU patients were included, such as surgical, internal medicine and cardiovascular.

In the period from 1st January 2000 to 31st December 2010, a total of 610 patients were admitted to ICU (males 380 [62·2%]; females 230 [37·8%]), age ranges: <20 years $n = 2$ (0·32%); 20–40 years $n = 42$ (6·8%); 40–60 years $n = 203$ (33·2%); 60–80 years $n = 312$ (51·1%); >80 years $n = 51$ (8·3%). Full demographics are shown in Table 1.

Criteria for inclusion of patients in this study were as follows: to have been hospitalized in one of the ICUs with a minimum stay of 24 hours, and not to have PU when admitted. Patients were assessed during their stay in the ICU and, after being discharged from this unit, were followed-up until discharge from hospital or death. Collected details included socio-demographic, clinical and hospitalization data and risk of PU. The following variables were studied: age, sex, length of ICU stay, length of hospital stay, co-morbidity and chronic diseases. Patients admitted to the ICUs were mostly from the operating room (46·0%), followed by the emergency room (25·6%). The main reasons for hospitalization in the ICU were postoperative care period (50·0%) or respiratory diseases (22·9%). Characterisation of patients according to clinical and hospitalization data is shown in Table 2.

We reviewed the patients at admission to ICU for their clinical record levels of serum albumin and other biochemical indices, such as serum calcium, phosphate, triglycerides, total cholesterol lipoprotein, low-density lipoprotein and high-density lipoprotein.

Table 1 Demographics

Variable	Whole study group
n (male/female)	610 (380/230)
Age (year)	70 ± 12
Body mass index (kg/m^2)	30·3 ± 5·9
SBP (mmHg)	134 ± 17
DBP (mmHg)	83 ± 10
Fasting glucose (mg/dl)	180 ± 11
Total cholesterol (mg/dl)	202 ± 39
High-density lipoprotein (mg/dl)	51 ± 14
Triglycerides (mg/dl)	128 ± 74
Albuminemia (mg/dl)	2·8 ± 1·6
eGFR (ml/minute per 1·73 m^2)	35 ± 20
EF%(Simpson)	30 ± 20

eGFR, estimated glomerular filtration rate; EF%, ejection fraction percentage; DBP, diastolic blood pressure; SBP, systolic blood pressure.

Table 2 Hospitalization data

Main diagnosis at ICU admission	*n*	%
Complicated cardiac surgery	145	23·77
Subarachnoid haemorrhage	102	16·72
Cardiogenic shock	101	16·29
Complicated neurosurgery	81	13·27
Exacerbated COPD	61	10·00
Polytrauma	53	8·68
Adult respiratory distress syndrome	43	7·04
Haemorrhagic shock	10	1·63
Decompensated myasthenia gravis	7	1·14
Pancreatitis	5	0·82
Decompensated rheumatoid arthritis	2	0·32

ICU, intensive care unit; COPD, chronic obstructive pulmonary disease.

Hypoalbuminemia was defined by serum albumin concentration lower than 3·3 g/dl.

We collected information about PU occurrence after admission.

For clinical classification and PU assessment, National Pressure Ulcer Advisory Panel's (NPUAP) Pressure Ulcer Stages/Categories were used (14).

Categorical variables were compared by χ^2 test. Unpaired *t* was used to compare differences of continuous variables between two groups (patient with PUs and patient without PUs). Assessment of the predictive discrimination of the various quantitative variables was made by using the receiver operating characteristic curve analysis. $P < 0{\cdot}05$ was considered statistically significant. All analyses were performed using SPSS 12·0 for Windows.

Results

Mean length of ICU stay was 13·6 days (SD = 14; min. = 2, max. = 82), of which 40·5% stayed up to 7 days hospitalised in these units, followed by 25% who stayed between 8 and 14 days, whereas the mean length of hospital stay was 30·0 days (SD = 24·7; min. = 4 and max. = 115).

The incidence of PUs in the ICUs was 31% (189 out of 610 patients) (Table 3), of which the majority (61·38%) of cases was observed to appear in the first week of ICU stay (Table 4).

Analysis of quantitative variables divided by gender (Tables 5 and 6) showed that 67·82% of PUs in male patients and 71·68% in female patients were associated with hypoalbuminemia ($P = 0{\cdot}00001$, OR = 2·08 for males and

Table 3 Frequency of PU during ICU stay

NPUAP Pressure Ulcer Stages/Categories	Presence of PU		Albuminemia
	n (male/female)	%	
Stage I	19 (11/8)	10·05	2·8 ± 0·4
Stage II	37 (21/16)	19·58	2·6 ± 0·5
Stage III	105 (66/39)	55·56	2·3 ± 0·4
Stage IV	28 (17/11)	14·81	2·5 ± 0·5
Total	189 (115/74)	100	2·5 ± 0·5

ICU, intensive care unit; PU, pressure ulcer; NPUAP, National Pressure Ulcer Advisory Panel.

Table 4 Length of time until pressure ulcer

Days	*n*	%
Until 7	116	61·38
From 8 to 14	33	17·46
From 15 to 21	19	10·05
22 or more	21	11·11
Total	189	100

Table 5 Statistic analysis of main clinical characteristics in male patients with pressure ulcers

Variables	*n* (%)	*P* (0·05)	Odds ratio
Hypoalbuminemia	78 (67·82)	0·00001	2·08
Diabetes mellitus II	65 (56·52)	0·0017	2·04
Congestive heart failure	60 (52·17)	0·018	0·48
Obesity	46 (40·00)	0·8	1·07
Malnutrition	64 (55·65)	0·01	2
CKD	51 (44·34)	0·3	1·26

CKD, chronic kidney disease.

Table 6 Statistic analysis of main clinical characteristics in female patients with pressure ulcers

Variables	*n* (%)	*P* (0·05)	Odds ratio
Hypoalbuminemia	53 (71·62)	0·00001	5
Diabetes mellitus II	48 (64·86)	0·047	2·25
Congestive heart failure	48 (64·86)	0·0047	2·25
Obesity	37 (50·00)	0·018	2
Malnutrition	47 (63·51)	0·04	2·25
CKD	31 (41·89)	0·9	0·94

CKD, chronic kidney disease.

$P = 0{\cdot}00001$, OR $= 5{\cdot}0$ in females). Diabetes mellitus II and congestive heart failure were also positively associated with the occurrence of PUs as shown in Tables 5 and 6.

Albumin values were also lower for increasing ulcer stages as shown in Table 3.

Discussion

Critical care patients show peculiar characteristics due to the severity of their clinical conditions, association with complex therapies and the need for more frequent and rigorous surveillance and control. Thus, they are more exposed to invasive procedures and a greater need for handling, causing them to be more susceptible to complications and resulting in greater length of hospital stay (1). In ICUs, the demand for specialized care using complex technology is high, given the need and concern of the health team to prioritise the stabilisation of the patient's critical condition, thus causing procedures to maintain body health, including skin and emotional integrity and family bonds, to be compromised or hindered (2). In this context, whether because of the difficulty to perform preventive measures to maintain skin integrity or patient severity, the appearance of PU, a commonly occurring complication, is observed in critical patients who are hospitalised (3). As regards the appearance of PUs in patients admitted to ICUs, it is important to consider both the severity of their clinical condition and the nursing workload, as these aspects have direct implications for the quality of care provided to patients, quality of life of professionals and hospital costs (5–13).

Albumin is the most abundant visceral protein in the blood synthesized in the liver, and its levels are therefore considered to reflect protein synthesis and it also plays other physiologic roles, including the maintenance of oncotic pressure which may influence tissue tolerance (15).

In fact, oncotic pressure serves as the main driving pressure (together with hydration status) for vascular refill, and subsequent lowering of albumin levels may be responsible for decreasing skin perfusion (16).

A recent study on wound healing showed that in the management of patients in an acute care setting, PU healing was improved by providing protein supplements to keep serum albumin level greater than 2·8 g/dl (17).

Diminished circulating level of albumin is a common condition in seriously ill patients and a study reported that the frequency of hypoalbuminemia was 21% at the time of admission in this type of patients (18).

Results from this study revealed a high incidence of PU (31%) in patients admitted to ICUs.

In this study, there was a close association between serum albumin and PU: (i) serum albumin was negatively correlated with PU; (ii) serum albumin was one of the independent determinants of PU; (iii) in univariate correlation analysis, we found that PU was negatively associated with serum albumin, but positively correlated with diabetic status and congestive cardiac failure; (iv) marked hypoalbuminemia was correlated with more severe stages of ulcer.

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