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Original Study

Hypotension Is a Risk Factor for New Pressure Ulcer Occurrence in Older Patients After Admission to an Acute Hospital

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A B S T R A C T

Background: Pressure ulcer occurrence in older patients admitted to hospital has not been studied thoroughly; yet, pressure ulcers frequently develop among the frail older patients who are hospitalized. Identifying risk factors for pressure ulcer occurrence is of utmost importance in preventing its development in this group of patients. Hypoperfusion, as manifested by hypotension, is theoretically important in the development of pressure ulcer. However, studies on this aspect are scarce.

Objective: To examine whether a hypotensive episode (systolic blood pressure less than or equal to 90 mm Hg) is associated with pressure ulcer occurrence.

Method: This was a retrospective cohort study in a regional hospital. It recruited 259 patients aged 65 or older who were admitted to a convalescence ward and had a hospital stay for more than 5 days. Baseline clinical characteristics and the possible risk factors of pressure ulcer occurrence on admission and any episode of hypotension were recorded. The primary outcome measured was the incidence of pressure ulcer occurrence in the index admission.

Results: Hypotension was strongly associated with incident pressure ulcer occurrence (odds ratio 6.71, $P = .001$).

Conclusions: Hypotension was an important risk factor for incident pressure ulcer occurrence during hospital stay. Every effort has to be taken to try to prevent hypotension. Precautions to prevent pressure ulcer development should be taken on patients who are hypotensive.

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The proposed mechanism for pressure ulcer development is that a mechanical loading, large enough to cause occlusion of capillary blood flow, leads to ischemia, which results in cell death. The normal capillary pressure is usually between 12 and 32 mm Hg.[1] If a pressure greater than 32 mm Hg is persistently applied, oxygenation and microcirculation is compromised, resulting in cell death and tissue necrosis. There is an observed inverse time-pressure relationship. At a lower occlusive pressure, it takes longer for a pressure ulcer to develop. On the contrary, a more rapid development of pressure ulcer happens when the pressure is greater than 70 mm Hg.[2,3] In a study examining the effect of pressure to albino rat muscle tissues, it was found that pressure at approximately 67 mm Hg was sufficient to cause cell death when applied consistently for more than 2 hours.[4] Gawlitta and her colleagues[5] showed that pressure alone could cause development of muscle damage with or without oxygen deprivation in vitro.

Given the evidence, there is little doubt that reduction or cessation of tissue perfusion plays a major role in the pathogenesis of pressure ulcer. However, the mechanism by which sustained pressure leads to pressure ulcer development only in susceptible individuals is not fully known. We hypothesized that low blood pressure in vulnerable older patients could lead to hypoperfusion at pressure points, which results in cell death and tissue necrosis, and thus is associated with pressure ulcer occurrence during hospitalization.

Method

Patient Recruitment

All patients admitted to the convalescence ward of Pok Oi Hospital, Department of Medicine and Geriatrics, Hong Kong SAR, during the study period from May 2011 to July 2011 were included into the study. All these patients were initially admitted to the acute medical wards through the Accident and Emergency Department for various acute illnesses. After resolution of their acute illness, they were transferred to the convalescence wards in the same hospital for continuity of care. Patients were eligible for the study if they were 65 years or older and stayed in the convalescence ward for at least 5 days.

The authors declare no conflicts of interest.

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The study was approved by the New Territories West Cluster Clinical and Research Ethics Committee.

Baseline Data Collection

All medical records for the eligible patients were retrieved. Baseline characteristics for each patient, including demographic, basic physiological parameters, comorbidities, functional status, and nutritional status were obtained.

The medical record over the entire hospital stay for each patient was reviewed. The blood pressure on admission was defined as the first blood pressure reading on admission to the acute ward. The pulse pressure on admission was defined as the systolic blood pressure minus the diastolic blood pressure on admission. Patients were defined as having a hypotensive episode if there was one or more than one systolic blood pressure reading in the blood pressure chart less than or equal to 90 mm Hg during the entire hospital stay. For those who had incident pressure ulcer, the timing of the hypotensive episode with respect to the development of incident pressure ulcer was determined. Any systolic blood pressure reading less than or equal to 90 mm Hg followed by the death of the patient within 24 hours would not be regarded as a hypotensive episode.

Comorbidities were quantified by the Charlson Comorbidity Index (CCI).[6]

Functional status was reflected by the total score of the Modified Barthel Index (MBI).[7]

Patients who were tube fed were recorded. Body weight, albumin, and lymphocyte count on admission were recorded as well. Hemoglobin level on admission and any use of a antihypertensive over the entire length of stay were also retrieved.

We defined the presence of congestive heart failure (CHF) if the patient had previous admission due to signs and symptoms of CHF, and echocardiogram showed left ventricular ejection fraction of less than 40%.

We defined the presence of use of restraint if the patient was prescribed with a safety vest or limb holder.

Length of stay was defined as the total number of days the patient was in the hospital, including both the acute and convalescence wards.

Outcome Data Collection

A pressure ulcer was staged according to the National Pressure Ulcer Advisory Panel.[8]

We defined the presence of incident pressure ulcer as the development of new pressure ulcer, in any stage, during the entire hospital stay. The number, stage, and site of incident pressure ulcer were recorded. Any pressure ulcer that was present on admission to the acute wards was regarded as a preexisting pressure ulcer.

Results

During the 3-month study period, there were a total of 259 patients admitted to the convalescence ward via the acute wards. Twenty-seven patients were excluded because they were younger than 65 years. Three others were excluded because they had a hospital stay of fewer than 5 days. The remaining 229 patients were included in this study.

Table 1 shows the characteristics of the included patients.

Analyses on Incident Pressure Ulcer

During the study period, there were 17 patients (8 women and 9 men) who developed incident pressure ulcer. The cumulative incidence of pressure ulcer occurrence during hospital stay over the study period was 7.4% (17/229). The prevalence of preexisting pressure ulcer on admission was 39.3% (90/229). Of these 90 patients, 7 (7.8%) developed incident pressure ulcer, which was similar to the incidence of the whole group.

Table 1
Demographics and Clinical Characteristics of the Included Patients

	Patients (n = 229)	
	Number	Percent
Men	109	47.6
Nursing home resident	132	57.6
Preexisting pressure ulcer	90	39.3
On antihypertensive(s)	97	42.4
On long term Foley	21	9.2
	Mean	SD
Age, y	83.35	7.69
Body weight, kg	48.59	12.79
Length of stay, d	24.02	17.65
No. of rehospitalizations at 6 months	2.37	2.37
Charlson Comorbidity Index	3.05	2.89
Modified Barthel Index	34.93	32.58
Norton score	13.18	3.54

The mean and median duration from admission to acute ward to the development of an incident pressure ulcer was 20.6 and 17.0 days, respectively.

A total of 24 incident pressure ulcers developed in these 17 patients. Among them, 25.0% (6/24) were stage I, 66.7% (16/24) were stage II, and 8.3% (2/24) were suspected deep tissue injury. Of the incident pressure ulcers, 70.8% (17/24) developed over the sacral region; 12.5% (3/24) developed over the knee; and the pinna, back, greater trochanter, and foot each developed 4.1% (1/24).

Among the 17 patients who developed incident pressure ulcer, 10 of them had a hypotensive episode. All the hypotensive episodes preceded the development of an incident pressure ulcer. The actual duration from the hypotensive episode to the occurrence of incident pressure ulcer for each of these patients was 4, 4, 4, 7, 9, 10, 13, 15, 36, and 44 days. The mean and median were 14.6 and 10 days, respectively.

Table 2 shows the characteristics of patients according to incident pressure ulcer status and the odds ratios of developing a pressure ulcer for each variable.

The factors that were found to be significantly associated with incident pressure ulcer were entered into multiple logistic regression models, as shown in Table 3. It was found that the presence of a hypotensive episode and longer length of stay independently predicted the occurrence of incident pressure ulcer with an odds ratio of 6.71 (95% confidence interval [CI] 2.07–21.7, $P = .001$) and 1.03 (95% CI 1.002–1.05, $P = .03$), respectively. After adjusting for preexisting pressure ulcer status, age, and sex, the presence of a hypotensive episode, longer length of stay, and the use of a restraint were independently associated with the development of incident pressure ulcer with an odds ratio of 6.80 (95% CI 2.07–22.34, $P = .002$), 1.03 (95% CI 1.002–1.06, $P = .03$), and 3.61 (95% CI 1.04–12.51, $P = .004$), respectively, as shown in Table 4.

Preexisting pressure ulcer was not associated with the risk of incident pressure ulcer in both bivariate ($P = .87$, Table 2) and multivariate analysis ($P = .97$, Table 4).

Analyses on Hypotensive Episode

In view of the strong predictive relationship between hypotensive episode and pressure ulcer occurrence, bivariate analyses were performed to identify factors that were associated with hypotensive episodes.

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