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## Pressure ulcer development in trauma patients with suspected spinal injury; the influence of risk factors present in the Emergency Department

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### ABSTRACT

**Objectives:** To explore the influence of risk factors present at Emergency Department admission on pressure ulcer development in trauma patients with suspected spinal injury, admitted to the hospital for evaluation and treatment of acute traumatic injuries.

**Design:** Prospective cohort study setting level one trauma center in the Netherlands participants adult trauma patients transported to the Emergency Department on a backboard, with extrication collar and headblocks and admitted to the hospital for treatment or evaluation of their injuries.

**Methods:** Between January and December 2013, 254 trauma patients were included. The following dependent variables were collected: Age, Skin color and Body Mass Index, and Time in Emergency Department, Injury Severity Score, Mean Arterial Pressure, hemoglobin level, Glasgow Coma Score, and admission ward after Emergency Department.

**Results:** Pressure ulcer development during admission was associated with a higher age ( $p$  0.00, OR 1.05) and a lower Glasgow Coma Scale score ( $p$  0.00, OR 1.21) and higher Injury Severity Scores ( $p$  0.03, OR 1.05). Extra nutrition decreases the probability of PU development during admission ( $p$  0.04, OR 0.20). Pressure ulcer development within the first 48 h of admission was positively associated with a higher age ( $p$  0.01, OR 1.03) and a lower Glasgow Coma Scale score ( $p$  0.01, OR 1.16). The proportion of patients admitted to the Intensive Care Unit and Medium Care Unit was higher in patients with pressure ulcers.

**Conclusions:** The pressure ulcer risk during admission is high in patients with an increased age, lower Glasgow Coma Scale and higher Injury Severity Score in the Emergency Department. Pressure ulcer risk should be assessed in the Emergency Department to apply preventive interventions in time.

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### 1. Introduction

In the international pressure ulcer (PU) guideline, a PU is defined as ‘localized injury to the skin and/or underlying tissue, usually over a bony prominence, resulting from sustained pressure (including pressure associated with shear)’ (Haesler, 2014). It is clear that a PU results from pressure, but not all patients exposed to pressure develop PUs. The tissue response on mechanical load (pressure) varies for each individual and multiple risk factors appear to play a role in PU development (Haesler, 2014). Trauma patients may have a particular risk for developing PUs too. A specific high-risk group are trauma patients with suspected spinal injury. Until recently, in the Netherlands, all of these patients were

immobilized at the scene of accident, with a backboard, cervical collar and headblocks. Immobilization ends after evaluation in the Emergency Department (ED) and continues in case of diagnosed injury. Furthermore, their injuries can lead to prolonged periods of immobility and reduced perfusion and oxygenation. Above that, they are frequently exposed to immobilizing and medical devices. Following the most recent international guideline, adult patients with devices should be considered at risk for PU development (Haesler, 2014). And third, all trauma patients are admitted to a Emergency Department, which increases PU risk (Denby and Rowlands, 2010; Dugaret et al., 2014).

The evidence to substantiate the increased PU risk in trauma patients is sparse. There are only three (older) studies that describe PUs in trauma patients (Baldwin and Ziegler, 1998; Watts et al., 1998; O’Sullivan et al., 1997). One of these was retrospective, and described a PU incidence of 0.4% in 7492 trauma patients

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(O'Sullivan et al., 1997) and two were prospective. The latter studies described a PU incidence of 30.6% in a small sample of 36 severe trauma patients, (Baldwin and Ziegler, 1998) and a PU prevalence of 20.3% in 148 trauma patients (Watts et al., 1998). Length of admission (Baldwin and Ziegler, 1998) and limitation in mobility (Baldwin and Ziegler, 1998; Watts et al., 1998) were described as possible risk factors for PU development in trauma patients.

A recent systematic review which focused on device related PUs that may occur in trauma patients with suspected spinal (cord) injury reviewed 13 studies. Of these, nine studies included healthy volunteers and only four studies included trauma patients. The latter described PU development specifically related to cervical collars (Ham et al., 2014). Collar-related PU incidence is described as 6.8–38% in two retrospective (Ackland et al., 2007; Chendrasekhar et al., 1998) and two prospective studies (Ackland et al., 2007; Powers et al., 2006). Length of time in the collar (Ackland et al., 2007; Chendrasekhar et al., 1998; Powers et al., 2006; Molano Alvarez et al., 2004), admission to the Intensive Care Unit (ICU) and mechanical ventilation (Molano Alvarez et al., 2004) were described as significant risk factors for collar related PU.

In contrast to the paucity of studies on risk factors for PU development in trauma patients, there are multiple studies on risk factors for pressure ulcer development within other patient populations. In a systematic review, Coleman et al. (2013) included 54 studies with a wide range of study populations, variables and methodologies (Coleman et al., 2013). After evaluation of the study quality, the risk factors were described under twelve domains: 'impaired activity/mobility', 'skin status', 'perfusion and oxygenation', 'nutritional status', 'skin moisture', 'body temperature', 'advanced age', 'sensory perception', 'hematological measures', 'general health status', 'gender' and 'race' (Haesler, 2014; Coleman et al., 2013). Of these, 'impaired activity/mobility', 'skin status' (presence of pressure ulcers), and 'perfusion and oxygenation' are considered major risk factors (Haesler, 2014; Coleman et al., 2013).

These risk factors are applicable for a wide range of patients, but it is unclear to what extent these risk factors are applicable for the specific population of trauma patients with suspected spinal injury. Risk factors for PU development in trauma patients with suspected spinal injury should therefore be assessed in order to identify patients vulnerable to PU development during hospital admission. We expect the PU risk to be at its highest in the acute phase; during ED stay and first days of admission. In the acute phase, injuries are recent and acute treatment is needed; this may lead to immobility and a decreased general health status. The identification of trauma patients at risk should start from admission to the ED, before hospitalization. Accordingly, appropriate preventive interventions can be applied in an early stage (Haesler, 2014). The aim of this study was to explore the influence of risk factors present at ED admission on PU development in trauma patients with suspected spinal injury, admitted to the hospital for evaluation and treatment of acute traumatic injuries.

## 2. Methods

### 2.1. Design, setting and participants

Between January and December 2013, we conducted a prospective cohort study in a level one trauma center in The Netherlands. All consecutive trauma patients transported to the Emergency Department on a backboard, with extrication collar and headblocks, were eligible for participation. Inclusion criteria were: (1) trauma patients aged  $\geq 18$  years; (2) standard prehospital spinal immobilization (i.e. backboard, headblocks and extrication collar); (3) admitted to the hospital through the ED for treatment of acute traumatic injuries. Exclusion criteria were: (1) existing skin

breakdown before admission; (2) severe burn wounds ( $>10\%$  body region); (3) transferred from the ED to another hospital.

### 2.2. Immobilization procedure

In the ED, the backboard was removed directly after arrival in the resuscitation room, before the initial assessment (Lubbert et al., 2005). Trauma patients remained immobilized, with an extrication collar and headblocks and in supine position. Injury of the spine was excluded or diagnosed by radiology (Computed Tomography scans) in combination with clinical examination. In intoxicated, unconscious or sedated patients, clinical examination was postponed until patients regained consciousness. Meanwhile, the extrication collar and headblocks were replaced by a semi-rigid collar (Philadelphia® Philadelphia cervical collar co, NJ). In case of deep sedation (and thus not moving independently) and admission to the Intensive Care Unit, the cervical spine was immobilized with straps on the forehead and lateral support.

### 2.3. Study outcomes

#### 2.3.1. Pressure ulcers

Pressure ulcer incidence comprised the number of patients that developed pressure ulcer(s) during their hospital stay. Because we expect the pressure ulcer risk to be at its highest during ED stay and first days of admission, the number of patients with 'early' pressure ulcer development (within 48 h after Emergency Department admission) was also described. Pressure ulcers were categorised using the International Pressure Ulcer Classification System (European Pressure Ulcer Advisory Panel (EPUAP), National Pressure Ulcer Advisor Panel, 2009). If redness was identified, a transparent disc was pressed onto the redness. If the skin under the transparent disk did not blanch, it was considered to be a category 1 PU (EPUAP working group).

#### 2.3.2. Potential risk factors

To explore the association of potential risk factors with pressure ulcer development, the following variables were collected: Age, Skin color and Body Mass Index (BMI), and Time in ED, Injury Severity Score (ISS), Mean Arterial Pressure (MAP), hemoglobin level, Glasgow Coma Scale (GCS), and admission ward after ED. ISS is a scale to measure injury severity (Copes et al., 1988), and GCS is a scale to measure the level of consciousness (Teasdale and Jennett, 1974). All potential risk factors were based on ten out of the twelve domains as described by Coleman et al. (2013) and the international PU guidelines (Haesler, 2014; Coleman et al., 2013).

#### 2.3.3. Preventive interventions during admission

To adjust for possible confounders, we collected data on the application of preventive interventions. Preventive interventions were: application of a Pressure Redistributing (PR) mattress, frequent repositioning in bed, and extra Nutrition. The application of preventive interventions was scored until PUs were identified. If no PUs appeared, preventive interventions were scored until discharge or death.

All hospitalized patients were on a standard PR mattress. The PrePurse screening tool was used to assess PU risk (Schoonhoven et al., 2006). Risk Scores were calculated on admission, in case of changed conditions or every week. If nurses identified pressure ulcer risk (PrePurse scores  $> 20$ ) or discovered pressure ulcers, patients were placed on the appropriate dynamic air mattresses (Promatt®, or Auto Sure Float®). During an Intensive Care Unit stay, all patients were on a high-risk dynamic air mattress; next to pressure distributing functions, these mattresses were equipped with mechanisms to achieve various body-positions.

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