



Original Contribution

# Retrospective review of predisposing factors for intraoperative pressure ulcer development



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## Abstract

**Study Objective:** To evaluate the comorbidities and surgical factors involved in the genesis of intraoperative pressure ulcers.

**Design:** Retrospective chart review.

**Setting:** Anesthesiology department of a university medical center.

**Measurements:** The charts of 222 patients with varying illness, who underwent an operation of at least two hours' duration, were analyzed retrospectively. Data on surgery type, case length, comorbidities, intraoperative surgical position, and area of ulceration were recorded.

**Main Results:** Risk factors for intraoperative pressure ulcer development include surgical times of 4 hours or longer; comorbidities affecting tissue perfusion (namely, diabetes, hypertension, and nonspecific cardiac issues); supine placement during surgery; and abdominal, noncardiac thoracic, and orthopedic operations. Regions of the body most at risk for ulceration include the coccygeal/sacral region, the buttocks, genitalia, and heels.

**Conclusions:** Pressure ulcers are a costly, debilitating, and avoidable complication of surgery.

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## 1. Introduction

The National Pressure Ulcer Advisory Panel (NPUAP) defines a pressure ulcer as a “localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear” [1]. Shearing involves forces that pull the skin in the opposite direction from the underlying tissue, resulting in damage to the

blood vessels; this damage predisposes the patient to pressure ulceration [2]. In the operative setting, shearing is related to patient positioning, surface material of the mattress, and other complicating factors such as moisture [3].

Friction was once considered a catalyst in the pathogenesis of pressure ulcers, and is defined as an event in which the rubbing of skin across coarse surfaces damages the epidermis, rendering the skin more susceptible to damage from pressure [2]. However, given that skin injuries due to friction are not true pressure ulcers, the most recent NPUAP guidelines omit friction as a factor in pressure ulcer development. Furthermore, friction, and shearing to an extent, do not significantly drive pressure ulcer generation in the intraoperative setting; thus these factors are beyond the

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scope of this paper. Hypoperfusion of tissue under pressure in an immobile patient plays arguably the most significant role in the generation of pressure ulcers in the operating room (OR).

Pressure ulcers contribute to a multitude of patient-related problems. Pressure ulcers are particularly detrimental to the patient by prolonging hospital stay, affecting social lifestyles, and contributing to negative psychological consequences [4–6]. Recent studies have reported that the complication rate stemming from pressure ulcer development is between 16% and 46% [7], with common problems being sepsis, osteomyelitis, poor wound healing, and increased likelihood of death [4,6].

The financial impact of pressure ulcers also is significant. Research has shown that roughly 1.6 million of the pressure ulcers that develop in United States hospitals yearly account for 2.2 to 3.6 billion dollars' worth of care [8]. The hospital cost for treating an individual pressure ulcer ranges from \$2,000 to \$70,000, depending on wound severity and score, and total hospital cost for treating pressure ulcers ranges from \$400,000 to \$700,000 annually [9]. It should be noted that regulations and oversight of reimbursement for pressure ulcer-related care has become increasingly stringent. The Centers for Medicare and Medicaid Services (CMS) generated a list of 28 Serious Reportable Events; the occurrence of these events was considered to be "reasonably preventable through application of evidence-based guidelines" [10]. These guidelines establish that reimbursement is only to be provided for appropriately documented Stage III and Stage IV pressure ulcers [11].

Historically, pressure ulcers have been portrayed as chronic, slow-developing complications that arise from negligent care. However, advances in knowledge have shown that they are acute injuries, developing rapidly, depending on degree of tissue compression, ischemia, and hypoperfusion [12]. Patients are particularly vulnerable in the OR. The incidence of pressure ulcer development in the surgical setting is reported to be between 7% and 17.6%, with much variability in the literature [13]. There are numerous intrinsic (patient-related) and extrinsic (environment-related) factors that implicate the OR as a setting for pressure ulcer development. Intrinsic factors include advanced age, complicating conditions, poor nutritional status, abnormally low or high body mass index (BMI), poor circulation, and lower levels of hematocrit and albumin [14–19]. Extrinsic risk factors relate to type of anesthesia used, length of surgery, use of warming devices, applied moisture, bed type, type of padding, surgical position, type of surgery, use of on-pump cardiac surgery procedures, and degree of exposure to pressure [15,16,20,21].

The combination of recent revisions on pressure ulcer reimbursement rates and the negative impact on patient satisfaction and quality measures has spurred interest in the rates of intraoperative pressure ulcer formation, the associated risk factors, and possible methods of prevention. By elucidating the predisposing risk factors, the authors hope to

establish the need for heightened awareness of all health care members involved in perioperative care, as well as the need for a team-oriented approach in reducing the frequency of pressure ulcer development.

## 2. Materials & Methods

A retrospective chart review was conducted to isolate cases of surgical patients who presented with pressure ulcers in the intraoperative setting since 2006. The cases were analyzed for correlations of pressure ulcer development with type of surgery, length of case, patient comorbidities, and intraoperative position.

This Institutional Review Board (IRB) approved study examined charts of patients at the Wexner Medical Center at The Ohio State University from November 5, 2006 to June 12, 2012. Patient-specific information was obtained from the Surgical Intensive Care Unit (SICU) care team (consisting of a SICU attending, a SICU resident, a primary nurse, and a charge nurse), who monitored patients for the development of pressure ulcers in the immediate postoperative period and every several days thereafter. A total of 812 unique patient encounters were reported, and the following patient-specific parameters were obtained by the SICU: name, medical record number, admit date, age, gender, comorbidities, diagnosis, date that the pressure ulcer was first documented, the location of the pressure ulcer(s), presence of hemodynamic instability, presence of neuromuscular blockade, use of invasive therapies, presence of decreased level of consciousness, Braden scale value, and intraoperative bed type used. The Electronic Medical Records system at Wexner Medical Center at The Ohio State University – (Epic, Madison, WI, USA) – was consulted to obtain: surgical date, surgery type, total time of surgery, surgical position, and use of taping/positioning devices intraoperatively. Study inclusion criteria applied to the 812 unique cases were 1) pressure ulcer development deemed to be related to the intraoperative period, 2) age less than 80 years, and 3) case length longer than two hours. The age parameter was placed to avoid those patients for whom general frailty could be the main cause of ulceration as opposed to the surgical environment. The length of case parameter was used to avoid those cases deemed too short to result in pressure ulceration based on current data [15].

## 3. Results

Based on the inclusion criteria applied to the available data of 812 unique cases, a total of 222 patient records were isolated. Of the 222 patients, 68% were men, with an average age of 57.5 years; all epidemiological data may be found in [Table 1](#). The following sections detail the average length of case, most prevalent patient comorbidities, surgical position

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