
A study on the incidence of pressure ulcers in the acute orthopaedic setting

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Abstract

As there is a paucity of literature on pressure ulcer incidence in the Australian context, this prospective cohort study was undertaken to determine the incidence of pressure ulcers in a group of orthopaedic patients in an acute care setting. All orthopaedic patients who were free of pressure ulcers on admission and who met the study criteria were invited to participate. Each patient then underwent second daily skin integrity assessments and Braden Scale reviews until discharge.

Ninety patients were invited to participate over a 6 week period, with 100 per cent recruitment achieved. The majority of patients underwent hip or knee surgery and the incidence of pressure ulcers for this group was calculated at 11 per cent (n=10). Fifty per cent of these patients developed a Stage one pressure ulcer that was present on at least two consecutive assessments, while the remainder of the sample developed Stage two pressure ulcers. Ninety per cent of pressure ulcers were located on the heel or sacrum, with the remainder found on the elbow. The majority of patients (n=7) developed their pressure ulcers between days 3-4 post-admission. All patients who developed a Stage two pressure ulcer were found to be on Vaperm mattresses rather than on alternating air mattress or static air overlay as recommended by hospital guidelines for use of therapeutic support surfaces.

Although the Braden Scale for the total group was found to have a high specificity (91 per cent), its sensitivity was low (40 per cent). Of the 10 patients who developed pressure ulcers, only one patient was assessed as being at high risk, three were assessed at a moderate risk, two patients at low risk and the remainder (n=4) were all assessed as being at no risk of developing a pressure ulcer.

Subjects who acquired pressure ulcers were found to be significantly older when compared to the rest of the sample population (mean age 80 years, vs 68 years). Those with pressure ulcers stayed in hospital 2.1 times longer (13.5 days compared to 6.5 days) than the remainder of the study sample who had undergone similar surgical operation/procedures. In view of the lack of Australian data on the incidence of pressure ulcers in acute care settings, further studies using larger samples are warranted to establish national benchmarks and determine risk factors for pressure ulcer development.

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Introduction

The trend worldwide with regard to reporting of pressure ulcers has tended to be in terms of prevalence rather than incidence. The difference between the two measures is that incidence refers to the frequency with which new cases of a disease/condition occur in a population over a period of time, while prevalence includes all cases of the disease/condition at a particular point in time ¹.

Although pressure ulcer prevalence data provide useful information to health providers by showing the extent of the problem, pressure ulcer incidence provides more explicit information on pressure ulcer development by allowing for the identification of major risk factors in a given population ². Principal risk factors that have been identified in pressure ulcer

development are immobility, malnutrition, impaired mental status and incontinence ³.

Several international studies have reported pressure ulcer incidence in acute care settings as ranging between 9- 66 per cent ^{4,11}. A review of the literature did not find any Australian studies focussing on the incidence of pressure ulcers. However, one conference paper did report a pressure ulcer incidence of 5.4 per cent in critically ill patients in an intensive care unit (Tobias T, Breakwell C; unpublished manuscript).

As little published data on incidence rates for pressure ulcer development in Australia were found in our literature search, the impact on this country can best be described in monetary terms. An estimated \$150-200 million being spent on pressure ulcer treatment in one year alone ¹². The enormous cost of treatment further highlights the need for more accurate and detailed data on pressure ulcer development to be collected, especially in the form of incidence studies from patient populations that are most vulnerable.

Orthopaedic patients have long been identified as being susceptible to developing pressure ulcers due to the changes in patient activity, mobility and types of surgical intervention used in this specialty ^{5, 11, 13, 14}. These patients are particularly susceptible to pressure, shear and friction because of their inability to mobilise effectively. This hospital has conducted pressure ulcer prevalence studies for the last 6 years with pressure ulcer prevalence rates of 4-40 per cent reported by the orthopaedic wards, compared to the overall hospital prevalence rates of 8.6-19.2 per cent. This is despite all beds having the required foam replacement mattress, the option of alternating pressure devices also available for susceptible patients and the availability of hospital guidelines for the use of therapeutic support surfaces.

Additionally, all patients undergo a Braden Scale assessment to establish risk status for pressure ulcer development on admission. This is in keeping with hospital policy to ensure the correct allocation of pressure managing equipment. For these reasons, the two orthopaedic wards were chosen for this incidence study.

Aim of the study

The aim of this study was to gain information on hospital acquired pressure ulcers in a group of orthopaedic patients at a major metropolitan teaching hospital in Western Australia.

Objectives

The objectives of this study were to identify:

- the incidence of pressure ulcers in a susceptible orthopaedic population;
- the anatomical location, stage and length of time in which pressure ulcers developed;
- characteristics of orthopaedic patients with and without pressure ulcers;
- the association between Braden Scale scores and pressure ulcer development with regard to specificity and sensitivity;
- the risk category of orthopaedic patients who developed pressure ulcers using the Braden Scale.

Methodology

Design

This research study used a prospective cohort study design. All acute orthopaedic patients who met the study criteria were invited to participate. Patients recruited were then tracked for the duration of their hospital stay.

Sample

The sample consisted of all acute orthopaedic patients who met the following selection criteria:

- were over the age of 18 years;
- were English speaking;
- did not have a pressure ulcer on admission;
- who stayed in hospital more than 48 hours.

In line with the hospital's Ethics Committee's terms of reference for the conduct of non-invasive clinical studies, verbal consent was obtained from all participants. For patients who were cognitively impaired, verbal consent was obtained from their guardian. The total sample recruited for this study over a 6 week period was 90 patients, with no patients declining to participate.

Interrater reliability

All surveyors were senior clinicians who had previously been involved in the hospital's annual pressure ulcer prevalence surveys and were fully experienced in using the Braden Scale. To establish interrater reliability for assessment of pressure ulcers, surveyors attended an education session and reviewed pressure ulcers at various stages using the staging tool endorsed

by the National Pressure Advisory Panel ¹⁵. The surveyors viewed colour photographs of 14 pressure ulcers and attached a staging level to each ulcer. The responses were compared and the overall agreement between scores was 100 per cent. It was not feasible for surveyors to undertake clinically based interrater reliability due to limited staffing resources and the lack of suitably compromised patients.

Data collection tool

The survey tool consisted of 20 items and gathered the following data on pressure ulcers: presence, location, stage and Braden Scale. In addition, information such as diagnosis, co-morbidities, smoking history, pain relief measures, medications, pressure managing equipment in use and demographic information were also collected. Surveyors were given a list of codes for common pressure ulcer sites and types of pressure managing equipment to ensure consistency of reporting.

The Braden Scale was developed to assess the risk of a person developing pressure ulcers ¹⁶. An overall score is achieved by summing of the six sub scales that include pressure ulcer determinants such as: sensory perception, moisture, activity, mobility, nutrition and shear/friction. Lower scores indicate that the person is at higher risk of developing pressure ulcers. Patients are stratified into the following ‘at risk’ groups:

- high risk: total scores of <12;
- moderate risk: total scores of between 13-14;
- low risk: total scores of 15-16 if under 75 years or 15-18 if over 75 years of age.

Predictive validity of the Braden Scale in two trials with over 100 patients achieved sensitivity ratings of 100 per cent and specificity rates of 90 per cent and 64 per cent ¹⁶. Another study also reported similar findings, with sensitivity and specificity results of 91 per cent and 62 per cent respectively for the Braden Scale ⁷. Reliability of the instrument has also been reported as high as 0.99 when used by registered nurses ^{7, 16}.

Data collection

Four senior nursing staff undertook data collection by recruiting and assessing patients three times per week (i.e. every second day) until discharge/transfer. This schedule was expected to capture all suitable patients, as one of the main criteria was an in-patient stay of at least 48 hours. Two clinicians undertook the Braden Scale assessments while the remaining two clinicians performed the skin assessments.

Data analysis

Analysis of the data was performed using SPSS for Windows[®] Version 9. Descriptive statistics and t-tests were used to analyse the data and the incidence was calculated as the number of patients who developed a pressure ulcer divided by the total number of patients meeting the selection criteria. Sensitivity and specificity of the Braden Scale in predicting the development of pressure ulcers were also calculated.

Results

Demographic data

Forty eight per cent (n=43) of admissions were traumatic injuries and were admitted via the Emergency Department, 43 per cent (n=39) were elective surgery patients admitted via the pre-admissions clinic as day of surgery patients and 6 per cent (n=5) were direct transfers from other hospitals. For three patients, data was not available (3 per cent).

The mean age of the sample was 68 years and ranged from 15-91 years. Those patients who acquired pressure ulcers whilst in hospital had a mean age of 80 years (62-90 years) which was found to be significantly older than for the rest of the study group (p=0.01). The majority of patients were female (68 per cent) and suffered from a variety of co-morbidities, with cardiac and hypertension problems the most frequently mentioned (Table 1).

Incidence and characteristics of pressure ulcers

The incidence of pressure ulcer development for this sample was calculated at 11 per cent with 10 patients out of the 90 developing pressure ulcers over the 6 week period. Ninety per cent of pressure ulcers were located on the heel or sacrum, with the remainder found on the elbow. Fifty per cent of these

Table 1. Co-morbidities of patients with and without pressure ulcers (PU) (%).

Co-morbidities	Patients with PU		Patients without PU	
	(n)	(%)	(n)	(%)
Hypertension	2	20	15	18.8
Cardiac problems	4	40	15	18.8
Asthma	2	20	9	11.3
Cancer	2	20	6	7.5
Diabetes	1	10	8	10.0
PVD	1	10	6	7.5

patients developed a Stage one pressure ulcer that was present on at least two consecutive assessments while the rest of the sample had Stage two pressure ulcers.

The overall sample consisted of a large proportion of patients who had undergone total hip surgery (42.2 per cent; n=38) or total knee replacements (16.7 per cent; n=15). The remainder of patients had arm, back, foot or shoulder operations. Six patients who developed pressure ulcers were admitted after dislocating or fracturing their femur. The remaining four patients were admitted for elective orthopaedic surgery such as arthroscopy, shoulder or foot operations.

For those patients who sustained traumatic injuries and developed pressure ulcers, the mean time from incident to presentation at the Emergency Department was 63 minutes (3.5hrs for patients without pressure ulcers) and the mean time spent in the Emergency Department was 7 hours (6hrs for patients without pressure ulcers). No significant difference was found in the length of time to presentation or duration in the Emergency Department with regard to pressure ulcer development.

Demographic differences between patients with and without pressure ulcers

Fifty three per cent (n=48) of patients stated they were taking medications such as nitrates, anticoagulants, narcotic analgesia, non-steroidal anti-inflammatories and/or steroids which may influence pressure ulcer development. Only three patients out of the ten who developed pressure ulcers were found to have used an epidural or femoral nerve block for pain relief. Table 2 outlines the types of analgesia used by patients in this study. Most patients both with and without pressure ulcers received intramuscular or oral analgesia.

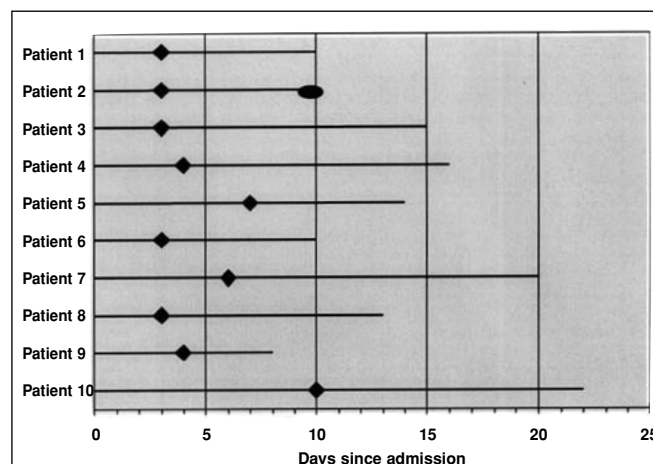
All patients in the total sample were found to be using Vaperm mattresses, including those patients with a Stage two pressure ulcer. Vaperm mattresses are the standard mattresses used for all patients throughout the hospital. Additional pressure management equipment such as heel elevators and sheepskins were found not to be in use.

The majority of patients (n=7) developed their pressure ulcers between days 3-4 post-admission (shown in Figure 1 where a continuous line indicates the patients' hospital admission from day zero until discharge, with a diamond indicating the day the pressure ulcer was first observed and an oval shape indicating if the pressure ulcer had healed). One exception was patient ten, a 90 year old woman who, on day 6, developed a pressure

Table 2. Administration route of analgesia used by patients.

Administration route	Patient with PU (n)	Patient with PU (%)	Patient without PU (n)	Patient without PU (%)
Epidural block	2	20	16	20
Femoral nerve block	1	10	12	15
Patient/nurse controlled analgesia	2	20	19	23.8
Intramuscular/oral	4	40	33	41.3

Figure 1. Development of pressure ulcers in relation to days since admission.



ulcer on her heel. A pressure ulcer on the elbow of patient two was healed by day 8. All remaining patients with pressure ulcers were reported as still having their Stage one or Stage two pressure ulcer on discharge/transfer.

The overall mean length of hospital stay was calculated at 7.4 days, ranging from 2-23 days. Length of stay for patients with pressure ulcers ranged from 8 to 22 days with a median of 13.5 days. There was a significant increase in length of hospital stay for those patients with pressure ulcers who stayed in hospital on average 2.1 times longer than patients without pressure ulcers (13.5 days compared to 6.5 days; $p = <0.001$).

Assessment of risk factors using the Braden Scale

For patients who developed pressure ulcers, the Braden Scale was found to have low sensitivity (40 per cent). However, a high specificity in predicting the proportion of true negatives (i.e. patients who were less likely to develop pressure ulcers) was found (91 per cent). Of the ten patients who developed a pressure ulcer, four were assessed using the Braden Scale as

being at high/moderate risk of developing pressure ulcers, two were assessed as being at low risk and the remainder of patients were assessed as not being at risk.

Discussion

The incidence of pressure ulcer development in orthopaedic patients who stayed longer than 48 hours at this hospital was calculated at 11 per cent over a 6 week winter period. These findings are similar to those cited by Clark⁵ who, in an English study, reported a pressure ulcer incidence of 11 per cent for orthopaedic patients. The heel and sacrum were found to be the main sites for the development of pressure ulcers in these patients which is also consistent with findings in the literature^{5, 17}.

Stage 1 or 2 pressure ulcers only were reported in this study sample with no Stage 3 or 4 pressure ulcers acquired during the 6 week data collection period. This finding may be partly due to the ward policy of mobilising patients within 24 hours post surgery. Also, this research study may have heightened ward staff's awareness to perform continual skin assessments during the data collection phase.

Patients who acquired pressure ulcers whilst in hospital were found to be significantly older than the remainder of the study population, with a mean age of 80 years. Similar results with regard to age and pressure ulcer development were also cited by Bergstrom⁴ and Olson⁸.

Predisposing factors such as diagnosis, type of admission, smoking status, incontinence, analgesic nerve blocks, medications and the presence of certain co-morbidities were not found to be associated with pressure ulcer development in this sample of patients. However, the study sample was small and therefore may have been insufficient to clearly identify specific predisposing factors in the development of pressure ulcers.

The Braden Scale for predicting pressure ulcers in this sample was found to be less sensitive than that reported in previous studies as it only identified 40 per cent of patients who subsequently developed a pressure ulcer as being at high to moderate risk. Two patients who developed a pressure ulcer were assessed as being at low risk and four patients at no risk. These results contradict the findings of Mei-che Pang⁷ and Braden¹⁶ who reported high sensitivity/specificity of the Braden Scale with regard to pressure ulcer development.

Strategies to prevent or minimise pressure ulcer development are only effective if continual surveillance is carried out by staff.

For example, all patients who developed a Stage two pressure ulcer were found to be using Vaperm mattresses rather than using the recommended alternating air mattress or static air overlay. Other pressure management equipment such as heel elevators and sheepskins were also not found to be in use. The failure to use such equipment on high or moderate risk patients further highlights the difficulty in the transference of knowledge into practice.

As pressure ulcers can develop within 60 minutes¹⁸, the time the patient sustained the injury and length of time in the Emergency Department were measured to see what bearing these factors had on pressure ulcer development. No significant difference was found between the mean time from incident to presentation or the mean amount of time spent in the Emergency Department between patients who did or did not develop pressure ulcers. Once again, insufficient sample size may have masked this result.

The majority of patients (n=7) developed their pressure ulcers between day 3-4 post-admission. This finding is similar to that reported by Bergstrom⁴ who reported that pressure ulcer development occurred within the first 72hrs of admission. Other studies, however, have reported a slightly longer development phases with pressure ulcers occurring within 5-14 days of admission^{10, 11}.

A significant difference in length of hospital stay for patients who developed pressure ulcers was found. On average, these patients stayed in hospital 2.1 times longer than the remainder of the study sample who had undergone similar surgical operation/procedures. This finding must be viewed cautiously so as not to interpret that the Stage one and two pressure ulcers reported in this study directly caused the longer hospital stay. It is possible that other factors such as patient co-morbidities could have influenced length of stay. However, further analyses using multivariate statistics were not attempted due to the relatively small sample size and the large number of potential factors associated with pressure ulcers and length of stay. In a study of patients over 55 years with hip fractures, Allman¹³ reported that length of stay was a significant factor in pressure ulcer development, with the hospital stay of these patients 2.4 times greater than for the rest of the study population. Patients with pressure ulcers had a mean length of stay of 30.4 days compared to patients who did not develop pressure ulcers (mean 12.8 days). One reason for the discrepancies in length of stay between the two studies could be due to this hospital's policy of transferring elective patients to a secondary hospital for rehabilitation.

Conclusion

This study has provided important baseline data on the incidence of pressure ulcers in a sample of orthopaedic patients in an acute care setting in Perth, Western Australia. The incidence of pressure ulcers was relatively low and was associated with older age and increased length of stay. However, the small number of patients developing pressure ulcers limited the extent to which further statistical analyses on potential risk factors could be undertaken for this sample. The location of the pressure ulcers on the heel or sacrum reflects the vulnerability of these sites after surgery to the hip and lower limbs.

Two findings in relation to the Braden scale and its use are worth noting. First, although the scale's specificity was relatively high (91 per cent), its sensitivity (40 per cent) was considerably lower than values previously reported. Thus, 60 per cent of patients who developed pressure ulcers in this study were rated as being at low or no risk. Further studies with larger samples are required to determine the significance of this result.

Secondly, the study revealed that despite their availability, pressure management devices were not being used for patients identified as high risk. This questions the value of conducting risk assessments if appropriate interventions are not subsequently implemented. Such findings indicate the need for studies on how nurses could be encouraged and supported in the use of appropriate interventions based on nursing assessments.

In view of the lack of Australian data on the incidence of pressure ulcers in acute care settings, further studies using larger samples are warranted to determine risk factors for pressure ulcer development. Given the enormous cost in treating pressure ulcers and the huge impact this condition has on hospital resources, it makes good economic sense to target the most vulnerable groups, such as orthopaedic patients. Appropriate benchmarking among similar hospitals will facilitate the development, implementation and further evaluation of strategies that have the potential to prevent or minimise pressure ulcer development.

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