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Fracture admissions after burns: A retrospective longitudinal study

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ABSTRACT

Background: Severe burn triggers systemic responses that result in reduced muscle mass and changes in bone formation, with recent evidence also suggesting systemic effects on bone after minor burns. The aim of this study was to assess if people hospitalised with a burn have increased admissions for fractures after discharge.

Methods: A population-based longitudinal study using linked hospital morbidity and death data from Western Australia was undertaken of all persons hospitalised for a first burn (n=30,997) during the period 1980–2012. Australian population-based annual rates for fracture admissions for the period 1993–2012 were obtained from the Australian Institute of Health and Welfare. Rates of hospital admissions for fractures in the burn cohort and the Australian population were standardised, using the direct method, to the age and gender structure of the Western Australian population at the 2006. Annual standardised fracture admission rates for the period 1993–2012 were graphed with estimated 95% confidence intervals. Age and gender specific fracture rates were also examined.

Results: A total of 4004 members of the burn cohort had at least one fracture admission for a total of 6096. The median (IQR) time to the first fracture admission after burn was 6.9 years (2.8–13.6) and the median age (IQR) at first fracture admission was 31 years (20–49). The burn cohort experienced admissions for fractures at a rate approximately twice that of the Australian population. While rates were generally higher for males in the burn cohort when compared with males in the Australian population, female burn patients had significantly higher rates over the entire study period when compared with the female Australian population. Elevated rates were observed for those younger than 20 years at the time of the burn admission; however, rates were significantly and consistently elevated during the study period for those 20 years and older at the time of the burn.

Conclusions: Burn patients experienced significantly higher age and gender standardised rates of admissions for fractures after discharge from hospital for their index burn. Further prospective research is indicated to clarify any underlying pathogenic processes linked to

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the burn that may increase a patient's risk of having a fracture serious enough to undergo admission.

1. Introduction

Severe burns trigger an acute inflammatory and hypermetabolic response, effects of which persist for at least three years after the initial injury [1]. The hypermetabolic response leads to loss of lean body mass and reduced bone mineral density [2,3]. Bone formation may also be suppressed as a result of the systemic response to severe burns [4–6], whilst muscle wasting and reduced mobility may contribute to an imbalance between bone synthesis and degradation, resulting in bone loss [4,6–8]. In addition, burn patients are potentially at increased risk of bone loss associated with vitamin D deficiency, both due to decreased sun exposure during and after treatment as well as physiological impacts of the burn on vitamin D synthesis and activation [9–15].

Minor burns also result in impacts on bone metabolism, with non-severe burns found to reduce trabecular bone density long after resolution of inflammation [16]. In both adults and children, these changes to bone metabolism and effects on bone mass and density potentially predispose burn patients to osteoporosis and increased risk of fractures [4,8,11,17–19].

Our previous population-based research found that paediatric and adult burn patients experienced twice the admissions for musculoskeletal morbidity after discharge from hospital for their initial injury when compared with children and adults with no history of injury serious enough to undergo admission [20,21]. However, in our previous research we were not able to examine fracture risk given the nature of the comparison uninjured cohort. The aim of this study was to determine if persons who experienced a burn hospitalization were at increased risk of admission for fractures after discharge from hospital for their burn, to identify specific patient therapeutic needs and possible clinical interventions.

2. Methods

This study used linked de-identified hospital morbidity and death data from the Western Australian Data Linkage System (WADLS) [22]. The study was approved by the human research ethics committees of the University of Western Australia and the Western Australian Department of Health. This study used data of all persons admitted to hospital with a first or index burn (primary or additional diagnosis) from 1 January 1980 and 30 June 2012. Burn admissions were identified using International Classification of Diseases and Related Health (ICD) 9 CM 940–949 or ICD10 AM T20–T31 codes.

Hospital data included age at admission, gender, and indigenous status and dates of admissions and separations. Separation data refer to the process by which an admitted patient completes an episode of care either by being discharged, dying, transferring to another hospital or changing type of care. The mortality data included date of death. Supplementary ICD codes (ICD9-CM 948 or ICD10-AM T31) were used to classify total body surface area (TBSA) of the burn in categories of 10% (0–9%; 19–19% etc.). TBSA was classified unspecified if the code was missing or coded as unspecified.

A separation (discharge) for fracture in the hospital morbidity data was defined as a completed episode of care with a principal or additional diagnosis recorded for a traumatic fracture (ICD10 AM: S02, S12, S22, S32, S42, S52, S62, S72, S82, S92) or a pathologic fracture (Osteopathies ICD10 AM M80-90: M80, M84.3, M84.4, M90.6). ICD-10 codes were mapped to ICD-9 codes [23].

For this study, a separation was used to represent an admission. Underlying causes of pathologic fractures include osteoporosis, cancer and Pagets disease. While these conditions are bone-weakening, the fact that patients may have these conditions does not necessarily mean the fracture is considered (and ICD coded) as pathologic. Due to potential specificity issues with fracture ICD coding [24] and the small numbers of pathogenic fractures in this cohort, combined traumatic and pathogenic fracture counts were used in the analyses. The total number of annual admissions for fractures were used as the outcome measure.

Annual age (10-year age groups) and gender specific fracture admissions rates for the study period were generated for the burn cohort. Australian population-based age and gender specific admission rates for fractures for the period 1993–2012 were obtained from the Australian Institute of Health and Welfare [25]. Rates of hospital admissions for fractures in the burn cohort and the Australian population were standardised, using the direct method, to the age and gender structure of the Western Australian population at the 2006 national census to assess and compare overall trends [26]. Subsets of the burn cohort were analysed to examine fracture admissions by age ($<$20 years; $\geq$20 years at time of burn) and gender. Standardised fracture admission rates for the period 1993–2012 were graphed with shaded bands representing estimated 95% confidence intervals for the annual standardised rates. The 95% confidence intervals (95% CI) were defined under the assumption that the observed number of fracture admissions followed the Poisson distribution [27].

To examine the effects of time and treatment on fracture admissions during the first five years after burn discharge [20], the method of indirect standardisation was applied [26]. The study period from 1980–2004 was divided into 5-year calendar periods (1980–1984; 1985–1989, 1990–1994, 1995–1999 and 2000–2004). The calendar period 1980–1984 and respective 5-year fracture admission rates after burn in the burn cohort were used as the reference. The observed numbers of admissions for fracture and person-years at risk were calculated by age (10-year age groups), gender and 5-year calendar period. The expected numbers of fracture admissions for each 5-year