Impact of pre-surgery hospital transfer on time to surgery and 30-day mortality for people with hip fractures

Lara A Harvey[1,2], Ian A Harris[3,4], Rebecca J Mitchell[5], Adrian Webster[6], Ian D Cameron[7], Louisa R Jorm[8], Hannah Seymour[9], Pooria Sarrami[10], Jacqueline CT Close[1,11]

Australians have around 19 000 hip fractures each year,[1] and the estimated cost to the health care system was $445 million in 2015–16.[2] Surgery within 48 hours of initial presentation to hospital is widely accepted as a clinically meaningful indicator of best practice care, and is supported by the Australian Hip Fracture Care Clinical Care Standard when there are no clinical contraindications.[3] However, timely access to emergency orthopaedic hip fracture surgery is difficult in a country as large and geographically diverse as Australia; patients admitted to remote or regional hospitals that do not provide orthopaedic surgery must be transferred to larger regional centres.

In a retrospective population study, we evaluated the impact of pre-surgery hospital transfer and time to surgery on 30-day mortality for people aged 65 years or more who underwent surgical interventions for fall-related hip fractures in NSW public hospitals during 1 January 2011 – 31 December 2018. Hospitalisation data from the NSW Admitted Patient Data Collection and deaths data from the NSW Registry of Births, Deaths and Marriages were linked to provide person-level records. Time to surgery (in calendar days) was estimated from the date of admission for the first episode of care to the date of surgery. Comorbid conditions during the preceding year were identified with the Charlson Comorbidity Index (CCI). Multilevel multivariable logistic regression models were fitted to assess the influence of patient-level factors (age, sex, comorbidity) and process factors (transfer status, time to surgery) on 30-day mortality. Operating hospitals were included as a random effect to account for variation between hospitals. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were calculated and residual variation (variance partition coefficient) assessed. All analyses were performed in SAS Enterprise Guide 7.1 and MLwiN 3.02 (http://www.bristol.ac.uk/cmm/software/mlwin). The NSW Population and Health Services Research Ethics Committee approved the study (HREC/17/CIPHS/45).

Of 36 956 patients who underwent hip fracture repair procedures in 36 hospitals, 3916 (10.6%) were transferred from peripheral hospitals to operating hospitals for surgery; 1579 were transferred on the day of presentation (40.3%), 1875 the following day (47.9%), and 462 patients (11.8%) spent at least two days at the admitting hospital before being transferred. Larger proportions of transferred patients than of patients admitted directly to operating hospitals were men (29.4% *v* 27.8%), under 85 years of age (50.9% *v* 48.4%), or had CCI scores of 1 or more (60.2% *v* 56.3%). The proportion of transferred patients who underwent surgery within 48 hours of presentation was smaller than for directly admitted patients (53.9% *v* 72.4%) (Box).

Characteristics of patients with hip fractures, by pre-surgery transfer, New South Wales, 2011–2018*

	Not transferred	Transferred
Number of people	33 040 (89.4%)	3916 (10.6%)
Sex		
Women	23 866 (72.2%)	2766 (70.6%)
Men	9174 (27.8%)	1150 (29.4%)
Age at admission (years)		
65–74	4684 (14.2%)	535 (13.7%)
75–84	11 311 (34.2%)	1458 (37.2%)
≥ 85	17 045 (51.6%)	1923 (49.1%)
Weighted Charlson Comorbidity Index score		
0	14 437 (43.7%)	1556 (39.7%)
1–2	12 667 (38.3%)	1595 (40.7%)
≥ 3	5936 (18.0%)	765 (19.5%)
Time to transfer (days)		
0		1579 (40.3%)
1		1875 (47.9%)
≥ 2		462 (11.8%)
Time to surgery (days)		
0	12 991 (39.3%)	739 (18.9%)
1	10 939 (33.1%)	1370 (35.0%)
≥ 2	9110 (27.6%)	1807 (46.1%)
Length of stay (days), mean (SD)		
Total	27.5 (21.9)	26.8 (20.5)
Acute care	11.9 (8.5)	12.8 (9.0)
30-day deaths	2172 (6.6%)	288 (7.4%)

SD = standard deviation.
* Linked hospitalisation and deaths data.

In multilevel models adjusted for inter-hospital variation, transfer was associated with higher risk of 30-day mortality than direct admission (aOR, 1.15; 95% CI, 1.01–1.32), but after adjusting for age, sex, and comorbidity, neither transfer (aOR, 1.10; 95% CI, 0.95–1.28) nor delayed surgery (> 2 days *v* ≤ 2 days: aOR, 0.99; 95% CI, 0.89–1.11) significantly influenced mortality. The most

[1] Falls, Balance and Injury Research Centre, Neuroscience Research Australia, Sydney, NSW. [2] University of New South Wales, Sydney, NSW. [3] Whitlam Orthopaedic Research Centre, Ingham Institute for Applied Medical Research, University of New South Wales, Sydney, NSW. [4] South Western Sydney Clinical School, University of New South Wales, Sydney, NSW. [5] Australian Institute of Health Innovation, Macquarie University, Sydney, NSW. [6] Australian Institute of Health and Welfare, Canberra, ACT. [7] John Walsh Centre for Rehabilitation Research, University of Sydney, Sydney, NSW. [8] Centre for Big Data Research in Health, University of New South Wales, Sydney, NSW. [9] Fiona Stanley Hospital, Perth, WA. [10] New South Wales Institute of Trauma and Injury Management, Sydney, NSW. [11] Prince of Wales Clinical School, University of New South Wales, Sydney, NSW. l.harvey@neura.edu.au
• doi: 10.5694/mja2.51083

influential factor was comorbidity (CCI ≥ 3 *v* CCI < 3: aOR, 4.89; 95% CI, 4.32–5.54). The discrimination of our fully adjusted model was adequate (area under the curve, 0.73), and 1.8% of residual variation in 30-day mortality was attributable to differences between hospitals.

In our large study of NSW people with hip fractures, we found that transfer from non-operating to operating hospitals, after adjusting for patient and hospital characteristics, was not associated with higher 30-day mortality, despite increasing the time between initial presentation and surgery. This is contrary to the findings of earlier, single centre studies in Australia.[4-6] However, our study was the first to control for several key person-level factors that increase the risk of death, and our findings suggest that time to surgery may be less important for health outcomes than these factors when other dimensions of care quality are equal. More research is required to understand the interplay between the effects of patient demographic characteristics, pre-injury health status, and the quality of hip fracture care on 30-day mortality for patients.

Acknowledgements: Our investigation was supported by an NSW Agency of Clinical Innovation Research Support Grant and by the National Health and Medical Research Council (1147353). We thank the NSW Ministry of Health and the NSW Register of Births, Death and Marriages for providing the hospital and death data, and the Centre for Health Record Linkage (CHeReL) for providing the unique patient identifiers for linking the datasets.

Competing interests: No relevant disclosures. ■

Received 25 August 2020, accepted 15 February 2021

1 Australian Institute of Health and Welfare. Hip fracture incidence and hospitalisations in Australia 2015-16. Oct 2018. https://www.aihw.gov.au/reports/injury/hip-fracture-incidence-in-australia-2015-16/contents/table-of-contents (viewed Apr 2021)

2 Australian Institute of Health and Welfare. Data tables: disease expenditure in Australia 2015–16. Updated 13 June 2019. https://www.aihw.gov.au/reports/health-welfare-expenditure/disease-expenditure-australia/data (viewed Jan 2021).

3 Australian Commission on Safety and Quality in Health Care. Hip fracture care clinical care standard. Sept 2016. https://www.safetyandquality.gov.au/publications-and-resources/resource-library/hip-fracture-clinical-care-standard (viewed Feb 2021).

4 Marshall T, Suthersan M, Chan MK, et al. Mortality and morbidity of neck of femur fractures: a comparison between Orange and peripheral centres. *Aust J Rural Health* 2016; 24: 253–257.

5 Butler SA, Salipas A, van der Rijt A. Comparative study of outcomes for elderly hip fractures presenting directly to a referral hospital versus those transferred from peripheral centres. *ANZ J Surg* 2019; 89: 1314–1318.

6 Lawless AM, Narula S, D'Alessandro P, et al. Time to surgery and transfer-associated mortality for hip fractures in Western Australia. *ANZ J Surg* 2020; 90: 1750–1753. ■