Research Article

Predictors for Readmission up to 1 Year Following Hip Fracture

Gavin John Heyes [1,*]; Adam Tucker [2]; Dominic Marley [2]; Andrew Foster [2]

[1]Department of Orthopedics, Musgrave Park Hospital, Stockman's Lane Belfast, Northern Ireland
[2]Department of Trauma and Orthopedics, Altnagelvin Hospital, County Londonderry, Northern Ireland

Corresponding author: Gavin John Heyes, Department of Orthopedics, Musgrave Park Hospital, Stockman's Lane Belfast, Northern Ireland. Tel: +44-7823333140, E-mail: gjheyes@live.co.uk

Background: At Altnagelvin, a district general hospital in Northern Ireland, we have observed that a significant number of hip fracture admissions are later readmitted for treatment of other medical conditions. These readmissions place increasing stress on the already significant burden that orthopedic trauma poses on national health services.

Objectives: The aim of this study was to review a series of consecutive patients managed at our unit at least 1 year prior to the onset of the study. Also, we aimed to identify predictors for raised admission rates following treatment for hip fracture.

Patients and Methods: We reviewed a prospective fracture database and online patient note system for patient details, past medical history, discharge destination and routine blood tests for any factors that may influence readmission rates up to 1 year. Data were analyzed using SPSS software.

Results: Over 2 years, 451 patients were reviewed and 23 were managed conservatively. There was a 1-year readmission rate of 21%. Most readmission diagnoses were medical including bronchopneumonia, falls, urosepsis, cardiac exacerbations and stroke. Prolonged length of stay and discharge to a residential, fold or nursing home were found to increase readmission rate. Readmission diagnoses closely reflected the perioperative diagnoses that prolonged length of stay. Increased odds radio and risk of readmission were also found with female gender, surgery with a cephalomedullary nail, hip hemiarthroplasty or total hip replacement, time to surgery < 36 hours, alcohol consumption, smoking status, Hb drop > 2 g/dL and also if a blood transfusion was received.

Conclusions: Our results indicate that hip fracture treatment begins at acute fracture clerk in, with consideration of comorbid status and ultimate discharge planning remaining significant predictors for morbidity and subsequent readmission.

Keywords: Hip Fracture; Readmission; Femoral Fracture

1. Background

Hip fractures have been shown to have the largest impact on quality of life of patients with these fractures (1). They are the most common reason for admission onto an orthopedic trauma ward and are responsible for 25% of all fractures that present to hospital (2, 3). In the United Kingdom, a nation with approximately 60 million people, hip fractures account for an estimated 1.1 million inpatient bed stays (2). The length of stay generates the majority of cost, with an estimated cost of stay between £5600 and £12000 per person (4). This is followed by a further £7000 in the following year to treat sequelae following hip fracture (2).

Of these sequelae, exacerbation of comorbid illnesses is the most frequent cause for readmission, with 90-day readmission rates reported at up to 19% and over 65 years readmission rates between 28% to 31% (5, 6). Suggested risk factors for hospital readmission include; age > 75 years, male gender, comorbid illness (COPD, heart failure, history of cancer, renal failure and previous stroke), high ASA, codependence, malnutrition, raised urea, anemia, raised glucose and discharge to long-term care (7-9).

Readmission not only adds pressure on hospital beds and resources, it is a predictor of excess mortality and also potentially preventable (10-12). Subsequently, in England the Department of Health has now introduced a policy of nonpayment to any hospital with a readmission within 30 days. In America, Medicare has gone further by fining hospitals if there is a readmission within 30 days. Northern Ireland currently has no financial incentives for reducing readmission rates.

Guidance exists that directs clinicians on the methods of minimizing mortality, length of stay and sequelae following hip fracture (2, 13). However, there is little to guide clinicians on how to predict and subsequently attempt to reduce readmissions.

2. Objectives

The primary aim of our study was to review our hip fracture population demographics, medical history and hip fracture admission to identify predictors that may contribute to readmission up to 1 year following hip fracture. Ultimately, we aimed to find risk factors that could potentially be modifiable and subsequently generate a hypothesis for reducing hip fracture readmissions.

3. Patients and Methods

This study was performed at Altnagelvin Hospital Londonderry, a district general hospital, in Northern Ireland and was approved by the Western Healthcare and Social Services Trust research and ethics committee. In addition to Altnagelvin Hospital, this unit provides trauma and orthopedic services for two other peripheral hospitals. All fracture admissions are recorded onto a prospective fracture outcome database.

Patient records were reviewed using the outcomes database and our online Patient Centre system an electronic database that holds up to date information on patients such as, current residence, whether they are deceased and any discharge scripts from previous admissions or reviews by other specialties. All patient details were reviewed including gender, age, time to surgery, length of stay, operation performed, medical history, alcohol status, smoking status, discharge destination, American Society of Anesthesiologists level (ASA), transfusion requirements, perioperative complications and reason for readmission. In addition, routine blood tests performed including admission hemoglobin (Hb), Hb drop day 1, transfusion, admission random glucose, discharge random glucose, admission total protein, admission estimated Glomerular Filtration Rate (eGFR) and discharge eGFR were reviewed.

For the purpose of this study, consecutive hip fracture patients admitted between 01/06/2010 and 01/06/2012 were analyzed from our fracture outcomes database. This time frame was selected to ensure that at least a 1-year follow-up could be performed with regards to mortality and readmissions. During this study period, the hospital was unable to appoint an orthogeriatrician for regular medical management on the trauma ward.

To demonstrate how each of the patient's variables influences readmission rates within 1-year, odds ratios were calculated using a logistic regression model. A $P < 0.05$ was considered statistically significant. Data were performed using SPSS (IBM).

4. Results

A total of 451 consecutive patients were identified from the database. Of these, 23 of 451 (5.1%) patients were managed conservatively due to comorbid illness. All conservatively managed patients were too unwell to leave hospital or trust care and were subsequently excluded from the study. Four patients received surgery at Altnagelvin Hospital and were transferred home to other areas in the UK for postoperative follow-up. This leaves 424 patients that could be followed up until death or 1 year following surgery for their proximal femoral fracture.

Females were encountered more frequently by a ratio of approximately 3:1, accounting for 303/424 admissions (71.5%). Mean age was 77 ± 12 years (Range 23 - 101). Mean time to theatre was 45.5 ± 35.4 hours (range 0.65 - 285 hours).

From a total of 424 consecutive patients reviewed, 89

patients (21%) were readmitted to an acute hospital bed within 1 year of fracturing their proximal femur. Nine patients were admitted on more than one occasion. There were insufficient numbers to statistically compare predictors influencing a single admission versus predictors influencing recurrent admission. The mean length of stay overall was 23.0 days, for those not readmitted was 20.1 days and for those readmitted was 34.0 days.

Table 1 indicates the reason for readmission following discharge for an acute proximal femoral fracture in the study population. Infections of the respiratory and genitourinary tract, which are frequently encountered in hip fracture patients, accounted for 41% of readmissions alone.

Table 2 demonstrates a summary of the logistic regression outputs for the considered variables affecting readmission within 12 months.

Glucose levels of 7.8 g/dL and above were used when evaluating glucose levels as it may indicate impaired glucose tolerance. An eGFR rate of 45 was used to divide the population into those with normal to mild renal impairment, which is frequently seen in elderly patients and those with moderate to severe renal impairment.

Our results demonstrate domicile and length of stay upon discharge as factors that statistically significantly influence readmission rate up to 1 year. Subgroup analysis of the domicile variable found that although patients discharged to Nursing homes had readmission rates of 31% compared to 18% of Residential home/fold residents,

Table 1. Reasons for Readmission up to 1 Year Following Hip Fracture [a, b]

Reason for Readmission	Incidence
Bronchopneumonia	27.7
Falls	15.8
Urosepsis	13.3
Chest pain/acute coronary syndrome	7.2
Another Fracture (different site)	7.2
Revision of dynamic hip screw	6.0
Confusion	6.0
TIA/CVA	4.5
Intracranial hemorrhage	4.5 [c]
Management of metastatic carcinoma	3.4
Exacerbation of congestive cardiac failure	3.4
Hematuria	3.4
Periprosthetic fracture	2.2
Diverticulitis	1.1
Diabetic ketoacidosis	1.1
Anemia	1.1
Jaundice	1.1
Wound complications	1.1
Dislocation	1.1
Inadequate social care	1.1
Seizure	1.1
Epistaxis	1.1
Above knee DVT	1.1

[a] Abbreviations: CVA, cerebrovascular accident; DVT, deep vein thrombosis; TIA, transient ischemic attack.
[b] Data are presented as (%).
[c] 3.4% following head injury.

there was no statistical difference between the two (Chi Squared^2 = 2.422, P > 0.05). Logistic regression comparing those discharged to their own home versus any other domicile demonstrated almost a two fold increase in risk of readmission if patients were not discharged to their own home (OR 1.71, 95% CI 349 - 0.984, P = 0.043).

Length of stay was found to influence readmission rate. A reference range of 7 days was considered acceptable time frame for uncomplicated inpatient admission or hip fracture surgery and effective discharge planning according to unit policy. An inpatient stay > 7 days was associated with a statistically significant 3-fold increased risk of readmission (OR 3.13, 95% CI 0.123 - 0.623, P = 0.002).

Further subgroup stratification identified particular groups at significantly increased risk of readmission. Patients with an inpatient stay of 7 - 14 days had a statistically significant increased risk of readmission (OR 7.04, 95% CI 0.058 - 0.348, P < 0.001). A similar result was observed for an inpatient stay of 14 - 21 days (OR 2.90, 95% CI 0.184 - 0.646, P < 0.001). Increasing length of stay beyond this up to 35 days, whilst increasing the risk of readmission, was not found to be statistically significant. However, an admission of > 35 days was associated with a 3 fold increase in readmission within 12 months compared to those discharged within a week of admission (OR 3.00, 95% CI 0.115 - 0.968, P = 0.043).

All readmissions were reviewed to identify the cause for prolonged stay. Table 3 Demonstrates the reason for length of stay greater than > 7 days during fracture admission. The diagnoses for prolonged admission are similar to those reported for readmission in Table 1 where infections and falls management accounted for 66.8% of readmission, and similarly 64.8% of prolonged admissions.

Table 2. Influence of Variables on Readmission Rates [a]

Variables	Odds Ratio	Lower 95% CI	Upper 95% CI	P Value
Gender				
Male (reference)	1			
Female	1.34	0.653	2.766	0.422
Treatment				
DHS/Asnis	1			
Cephalomedullary nail	1.51	0.407	1.081	0.099
Hip hemiarthroplasty/THR	3.10	0.193	1.802	0.355
Time to surgery				
< 36 h (reference)	1			
36 h - 6 d	1.62	0.156	2.449	0.493
> 6 d	1.29	0.198	3.02	0.711
Length of stay, day				
< 7 (reference)	1.00			
7 - 14	7.04	0.058	0.348	< 0.001 [b]
14 - 21	2.90	0.184	0.646	0.001 [b]
21 - 28	1.83	0.256	1.167	0.119
28 - 35	2.11	0.191	1.179	0.108
+ 35	3.00	0.115	0.968	0.043
OR overall > 7 d	3.13	0.123	0.623	0.002 [b]
Alcohol consumption				
None (reference)	1.00			
Moderate alcohol	1.36	0.311	1.736	0.483
Alcoholic	1.52	0.26	1.667	0.378
Affected side				
Right (reference)	1.00			
Left	1.10	0.572	1.457	0.703
ASA				
1 (reference)	1.00			
2	3.68	0.064	1.154	0.077
3	1.95	0.178	1.482	0.218
4	2.14	0.163	1.335	0.155
Smoking				
Nonsmoker (reference)	1.00			
Ex-smoker	1.14	0.643	2.009	0.661
Smoker	1.24	0.564	2.728	0.591
Domicile				
Own home (reference)	1.00			
Residential home/fold/nursing home	1.71	0.349	0.984	0.043 [b]

HB drop				
< 2 g/dL drop (reference)	1.00			
> 2 g/dL drop	1.29	0.485	1.249	0.299
Admission glucose				
< 7.8 mmol/L (reference)	1.00			
> 7.8 mmol/L	1.18	0.661	2.095	0.579
Discharge glucose				
< 7.8 mmol/L (reference)	1.00			
> 7.8 mmol/L	1.05	0.53	1.702	0.862
Total protein				
> 64 (reference)	1.00			
< 64	1.13	0.536	1.46	0.63
Admission eGFR				
> 45 (Reference)	1.00			
< 45	1.04	0.505	1.831	0.906
Discharge eGFR				
> 45 (Reference)	1.00			
< 45	1.04	0.472	1.96	0.914
Transfusion status				
None (reference)	1.00			
< 2 units	1.12	0.312	4.008	0.864
> 2 units	1.85	0.486	7.048	0.367

[a] Abbreviations: ASA, American society for anesthesiologist's score; DHS, dynamic hip screw; HB, haemoglobin; THR, total hip replacement.
[b] Highlights statistically significant variables.

Table 3. Indication for Prolonged Length of Stay During Fracture Admission [a, b]

Reasons for Prolonged Length of Stay	Incidence
Post op chest infection	37.8
Social/physiotherapy/falls management	16.2
Urosepsis	10.8
Kidney injury	8.1
TIA/CVA	8.1
Palliative care	5.4
Postoperative AF/cardiac complications	5.4
Subarachnoid hemorrhage	2.7
Anemia	2.7
Bacteremia	2.7

[a] Abbreviations: AF, atrial fibrillation; CVA, cerebrovascular accident; TIA, transient ischaemic attack.
[b] Data are presented as No. (%).

5. Discussion

Our results demonstrate that the vast majority of re-admissions were secondary to medical conditions as outlined in Table 1. These conditions were also similar in type and incidence to those that led to prolonged length of stay during the patient's fracture admission, as detailed in Table 3. For both the reason for prolonged stay and readmission diagnoses nearly two thirds were due bronchopneumonia, urosepsis and recurrent falls/fall management. These are well- known issues regarding hip fracture postoperative complications and are common comorbidities in the aging population. Our unit would never knowingly discharge a patient without fully treating all active medical issues however we believe a joint discharge plan with an orthogeriatrician, as per BOA Blue Book guidance, would likely minimize recurrence of medical complications and subsequent readmission. We noted that very few patients had subsequent follow-up with medical physicians after fracture discharge that included perioperative management of medical exacerbations. Other studies have demonstrated that follow-up upon discharge, particularly of the elderly, has been shown to reduce readmission rates (14).

Length of stay and discharge destination were found to significantly influence the probability of readmission. Lengths of stay subgroups greater than seven days demonstrate an increased risk of readmission with statistical significance in all but 21 - 35 days. This may be related to subgroup number size. Our findings differ from Kahn et al. 2012 findings that found with longer length of stays lower readmission rates were reported. They believed that early readmissions are lower as patient's early postoperative complications were treated in hospital during original admission (7).

According to the National Hip Fracture database, the average length of stay in hospital for treatment of a hip fracture is 26 days (15). Our length of stay (mean 23.0 days) does not significantly differ from the literature, yet, we have found that with longer length of stay comes a greater risk of readmission. This may reflect an elderly, frail population, which are physiologically labile and have a higher comorbid risk attributing to their risk of readmission.

Location of patient's discharge destination appears to be crucial. We demonstrate that with increasing dependence

on discharge comes an increased risk of readmission. Those that are care- dependent often have greater comorbid illness, poorer mobility and poorer rehabilitation potential. They are therefore more likely to suffer an exacerbation or recurrence of a medical illness and be less likely to recover from treatment confined to the community.

Increased odds radio and risk of readmission were found with other factors although not statistically significant as detailed in Table 2. These included female gender, surgery with a cephalomedullary nail, hip hemiarthroplasty or total hip replacement, time to surgery greater than 36 hours, alcohol consumption, smoking status, Hb drop > 2 g/dL and also if a patient received a blood transfusion during admission.

The study is limited in its design by relatively low numbers for some of the variables considered in the wider literature and in this study. Larger studies would possibly allow for more significant data to be reported. Similarly, the study was performed as a retrospective review of a single center, which limits its strength and limits the applicability of the results to a larger scale. There is some evidences that mental scores and pressure sores may influence mortality and readmission; however, these were not fully recorded on the database and therefore could not analyzed as part of the study (2, 16). Blood glucose control would also have been more accurately evaluated using HbA1C during admission; however, testing this was not routine practice on the trauma ward.

An extended multicenter study at a regional level would be warranted to allow for stronger reporting of results applicable at a regional level. However, these results indicate that aftercare following hip fracture begins at the acute fracture clerk in, with consideration of comorbid status and ultimate discharge planning remaining significant predictors for morbidity and subsequent readmission.

Great efforts have been made to reduce mortality following fracture admission, with time to surgery being one of many key factors; however, there is less to guide clinicians on how to minimize readmission rates (2, 16). We demonstrate several factors that influence readmission rates including length of stay, ASA level, domicile, gender, type of surgery, time to surgery, alcohol status, smoking status, Hb drop and transfusion requirement during fracture admission. Although only some were statistically significant, it is clear that in order to reduce readmission rates all factors should be addressed. A further larger study would increase statistical validity; however, multidisciplinary teams including orthogeriatricians will be vital in reducing the risk of readmission associated with the aforementioned variables. To minimize readmission following a fractured hip we recommend a pragmatic approach to ensure all variables are optimized prior to discharge in hospital.

Acknowledgements

Authors' Contributions

Gavin John Heyes contributed to study concept and design acquisition of data, analysis and interpretation of data, drafting of the manuscript, critical revision of the manuscript for important intellectual content and statistical analysis. Adam Tucker and Dominic Marley contributed to acquisition of data, analysis and interpretation of data and critical revision of the manuscript for important intellectual content. Andrew Foster contributed to study design and concept, critical revision of the manuscript for important intellectual content's administrative support and supervision.

Financial Disclosure

References

1. Kanis JA, Johnell O. The burden of osteoporosis. *J Endocrinol Invest*. 1999;**22**(8):583–8.
2. National Collaborating Centre for Acute Care . *Hip fracture: Costing report, implementing NICE guidance.* London: National Collaborating Centre for Acute Care; 2011.
3. Torgerson DJ, Iglesias CP, Reid DM. The economics of fracture preventio. In: Barlow DH, Francis RM, Miles A editors. *The Effective Management of Osteoporosis.*. London: Aesculapius Medical Press; 2001.
4. Hollingworth W, Todd C, Parker M, Roberts JA, Williams R. Cost analysis of early discharge after hip fracture. *BMJ*. 1993;**307**(6909):903–6.
5. Reed RL, Pearlman RA, Buchner DM. Risk factors for early unplanned hospital readmission in the elderly. *J Gen Intern Med*. 1991;**6**(3):223–8.
6. Fitzgerald JF, Smith DM, Martin DK, Freedman JA, Katz BP. A case manager intervention to reduce readmissions. *Arch Intern Med*. 1994;**154**(15):1721–9.
7. Khan MA, Hossain FS, Dashti Z, Muthukumar N. Causes and predictors of early re-admission after surgery for a fracture of the hip. *J Bone Joint Surg Br*. 2012;**94**(5):690–7.
8. Hoekstra JC, Goosen JH, de Wolf GS, Verheyen CC. Effectiveness of multidisciplinary nutritional care on nutritional intake, nutritional status and quality of life in patients with hip fractures: a controlled prospective cohort study. *Clin Nutr*. 2011;**30**(4):455–61.
9. Silverstein MD, Qin H, Mercer SQ, Fong J, Haydar Z. Risk factors for 30-day hospital readmission in patients >/=65 years of age. *Proc (Bayl Univ Med Cent)*. 2008;**21**(4):363–72.
10. Ashton CM, Kuykendall DH, Johnson ML, Wray NP, Wu L. The association between the quality of inpatient care and early readmission. *Ann Intern Med*. 1995;**122**(6):415–21.
11. Balla U, Malnick S, Schattner A. Early readmissions to the department of medicine as a screening tool for monitoring quality of care problems. *Medicine (Baltimore)*. 2008;**87**(5):294–300.
12. French DD, Bass E, Bradham DD, Campbell RR, Rubenstein LZ. Rehospitalization after hip fracture: predictors and prognosis from a national veterans study. *J Am Geriatr Soc*. 2008;**56**(4):705–10.
13. Marsh D, Currie C, Brown P, Cooper A, Elliott J, Griffiths R, et al. *Blue book: The care of patients with fragility fracture.*London: British Orthopaedic Association; 2007.
14. Naylor MD, Brooten D, Campbell R, Jacobsen BS, Mezey MD, Pauly MV, et al. Comprehensive discharge planning and home follow-up of hospitalized elders: a randomized clinical trial. *JAMA*. 1999;**281**(7):613–20.

15. Boulton C, Currie C, Plant F, Roberts J, Wakeman R, Williams A. *National Hip Fracture Database National Report 2012.* Edinburgh: The National Hip Fracture Database; 2012.

16. NHS Information Centre for Health and Social Care.. *Hospital Episode Statistics.* Leeds: Information Centre for Health and Social Car; 2011.