Original Article

Mortality in patients sustaining a periprosthetic fracture following a hemiarthroplasty

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ARTICLE INFO

Keywords:

Periprosthetic fracture
Hemiarthroplasty
Mortality

ABSTRACT

Periprosthetic fractures of the proximal femur after hip hemiarthroplasty are an increasing concern. The aim of this study was to analyse the 30 day mortality of periprosthetic fractures around a hip hemiarthroplasty. A retrospective case review at a single institution. 32 patients. Mean age 76.5, 16 males and 16 females. 13% underwent non-operative treatment, 50% open reduction internal fixation and 38% revision arthroplasty. 30 day mortality was 12.5% and 1 year mortality 28.1%. Time to surgery was the only significant risk factor for 30 day mortality. Periprosthetic fractures following a hip hemiarthroplasty have high 30 day mortality.

1. Introduction

Periprosthetic fractures of the proximal femur after hip hemiarthroplasty are an increasing concern in orthopaedics. There are approximately 65,000 hip fractures per year in the UK.¹ As outcomes continue to improve and mortality rates decrease, patients are surviving longer at a higher functional state. This increases the risk of these patients sustaining a periprosthetic fracture.^{1,2} These patients are usually elderly with a number of medical co-morbidities and pose significant surgical and anaesthetic challenges.

The surgical treatments of these fractures are complex and depend on the patients co-morbidities, the fracture pattern and stem stability.^{3,4} The two commonly used options are open reduction internal fixation of the femoral fracture or revision arthroplasty. Fractures around a stable implant or distal to it are usually treated with open reduction internal fixation. An advantage of this method of treatment is that this can be performed by the majority of orthopaedic trauma surgeons. An unstable stem usually requires a revision arthroplasty procedure which can only be performed by a specialist revision hip surgeon.^{3,4}

Whilst there have been several studies on mortality following periprosthetic fractures in total hip replacements, there have been very few in those following hemiarthroplasty.^{5,6}

The aim of this study was to analyse the 30 day mortality of periprosthetic fractures around a hip hemiarthroplasty. Secondary outcomes included 1 year mortality, the time patients were waiting for surgery and an assessment of other risk factors associated with mortality.

2. Materials and methods

A retrospective case review of all proximal femoral periprosthetic fractures between 1st January and 2008 and 31st March 2015 at a single institution.

Patients were identified by using a hospital database of periprosthetic fractures and by identification through ICD codes, S72.1 Pertrochanteric fracture, S72.2 Subtrochanteric fracture, S72.3 Fracture of shaft of femur, S72.4 Fracture of lower end of femur, S72.7 Multiple fractures of femur, S72.8 Fractures of other parts of femur, S72.9 Fracture of femur, part unspecified. All radiographs of patients with these codes were reviewed for inclusion.

The inclusion criteria were any patient presenting to the Orthopaedic team with a periprosthetic fracture around a hemiarthroplasty. Patients were excluded if they had a total hip replacement, an intra-operative fracture or if the fracture was in the metaphysis or epiphysis of the distal femur.

The Vancouver classification system was used to classify these fractures. The fractures were reviewed by the 2 authors independently and in those with debate about classification, a consensus decision was made.

A retrospective case note review was undertaken identifying patient demographics, living status, mobility, ASA and co-morbidities. Initially the pre-operative AMTS score was to be included. Capacity was presumed if patients had signed a consent form 1 for surgery or had a recorded pre-operative AMTS of 7 or more.

Operation notes were reviewed for operative technique, and time of surgery. Surgery start time was taken as time of the first vital sign

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Received 19 April 2018; Accepted 6 May 2018

Available online 07 May 2018

0972-978X/ © 2018 Published by Elsevier, a division of RELX India, Pvt. Ltd on behalf of Prof. PK Surendran Memorial Education Foundation.

observations taken in the anaesthetic room as recorded in the anaesthetic charts. ASA grade was taken from anaesthetic charts.

Time of diagnosis was collected from emergency admission documentation.

Pre-operative blood results were recorded from the blood results taken immediately prior to surgery.

The Charlson Co-Morbidity score was designed and validated as a tool to assess 1 year mortality. A score is calculated based on patients co-morbidities. It consists of 17 co-morbidities with each being given a certain number of points. These are added to calculate the Charlson co-morbidity score, with the risk of 1 year mortality increasing as the score increases.⁹

The Nottingham Hip Fracture score is a validated scoring system that predicts 30 day mortality in hip fracture patients. The score is based on age, sex, number of co-morbidities, mini-mental test score, admission haemoglobin, living in an institution, and presence of malignant disease.¹⁰

Date of discharge was collected from hospital records from discharge letters.

Primary outcome was 1 year mortality. This was found from hospital records, as was 30 day mortality.

Statistical Analysis was undertaken using Minitab Version 17. The Mann Whitney U Test was used for parametric data and the Chi squared test for non-parametric data. A P value of 0.05 was considered statistically significant.

3. Results

There were 32 patients who sustained a fracture around a hip hemiarthroplasty. All these occurred in previously cemented hemiarthroplasties.

The mean age was 76.5 (57–96). There were 16 males and 16 females. 29 (90.6%) patients had capacity to consent for surgery. Pre-operatively 9 (28.1) mobilised independently without any walking aids, 14 (43.8%) mobilised with 1 stick, 3 (9.4%) mobilised with 2 aids and 6 (18.8%) mobilised with a frame. 26 (81.2%) lived at home, whilst 6 (18.8%) lived in institutional care prior to fracture.

17 (53.1%) had a Charlson co-morbidity score of 0 or 1, 10 (31.3%) had a score of 2 or 3, 0 had a score of 4 and 5, and 5 (15.6%) had a score of more than 5.

Nottingham Hip Fracture Score was 0–1 in 2 patients, 2–3 in 1 patient, 3–4 in 19 patients and greater than 5 in 10 patients.

The ASA grade of patients was 1 (3.1%) ASA 1, 11 (34.4%) ASA2, 14 (43.8%) ASA 3 and 6 (18.8%) were ASA 4.

The mean pre-operative GFR was 66ml/min/1.73 m². 8 patients had CKD stage 1, 15 CKD stage 2, 7 CKD stage 3, 2 patients with CKD stage 4.

The mean Hb was 118g/L (77–149). In those alive at 1 year the mean was 120g/L and in those that died within 1 year the mean was 114g/L (p = 0.2801).

According to the Vancouver classification there were 6 (18.8%) Vancouver B1 fractures, 10 (31.3%) Vancouver B2 fractures, 9 (28.1%) Vancouver B3 fractures and 7 (21.9%) Vancouver C fractures.

4 (12.5%) underwent non-operative treatment, 16 (50%) underwent open reduction internal fixation and 12 (37.5%) underwent revision arthroplasty.

Of the 6 Vancouver B1 fractures 3 underwent open reduction internal fixation, 1 underwent revision and 2 underwent conservative treatment.

Of the 10 Vancouver B2 fractures 4 underwent open reduction internal fixation, 5 underwent revision and 1 underwent conservative treatment.

Of the 9 Vancouver B3 fractures 2 underwent open reduction internal fixation, 6 underwent revision and 1 underwent conservative treatment.

Of the 7 Vancouver C fractures, all underwent open reduction

Table 1
30 day mortality.

	Alive at 30 days	Dead at 30 days	P Value
Age	78.5	81.3	0.6223
Sex	Males 16	Males 1	0.2281
	Females 12	Females 3	
Time to surgery	248.00	94.12	0.0170
ASA	ASA 1 1	ASA 1 0	0.3904
	ASA 2 10	ASA 2 1	
	ASA 3 13	ASA 3 1	
	ASA 4 4	ASA 4 2	
Capacity	Capacity 26	Capacity 3	0.2517
	None 2	None 1	
Residential Status	Home 26	Home 3	0.7529
	Institutional 2	Institutional 1	
Pre-op mobility	Independent 8	Independent 1	0.907304
	1 aid 12	1 aid 2	
	2 aids 2	2 aids 1	
	Zimmer 6	Zimmer 0	
Charlson co-morbidity score	0-1 16	0-1 0	0.3371
	1-2 8	1-2 2	
	3-4 0	3-4 0	
	> 5 4	> 5 1	
Nottingham Hip Fracture Score	0 2	0 0	0.8794
	1-2 1	1-2 0	
	3-4 16	3-4 3	
	> 5 9	> 5 1	

internal fixation.

The mean time to surgery from admission was 105 h. 7 out of 28 (25%) patients underwent surgery within 36 h. The mean time to surgery in those undergoing open reduction internal fixation was 68.3 h (range 16–280), and those undergoing revision was 150 h (range 7–331). (p < 0.001).

The mean length of stay was 16 days (6–27).

There were 2 (6.3%) in-patient deaths. The 30 day mortality 12.5% (4 patients) was and the 1 year mortality was 28.1% (9 patients).

There were 0 readmissions and 0 re-operations in this group of patients.

Time to surgery was the only significant risk factor for 30 day mortality (p = 0.0170), and lack of capacity was the only significant risk factor for 1 year mortality (p = 0.0036). (Tables 1 and 2).

Table 2
1 year mortality.

	Alive at 1 year	Dead at 1 year	P Value
Age	77.2	83.1	0.5874
Sex	Males 13	Males 4	0.5381
	Females 10	Females 5	
Time to surgery	109.86	103.52	0.8757
ASA	ASA 1 1	ASA 1 0	0.2425
	ASA 2 10	ASA 2 1	
	ASA 3 9	ASA 3 5	
	ASA 4 3	ASA 4 3	
Capacity	Capacity 23	Capacity 6	0.0036
	None 0	None 3	
Residential Status	Home 19	Home 7	0.7529
	Institutional 4	Institutional 2	
Pre-op mobility	Independent 6	Independent 3	0.9073
	1 aid 11	1 aid 3	
	2 aids 2	2 aids 1	
	Zimmer 4	Zimmer 2	
Charlson co-morbidity score	0-1 15	0-1 2	0.1624
	1-2 5	1-2 5	
	3-4 0	3-4 0	
	> 5 3	> 5 2	
Nottingham Hip Fracture Score	0 0	0 2	0.2603
	1-2 0	1-2 1	
	3-4 4	3-4 15	
	> 5 5	> 5 5	

4. Discussion

Over a 7 year period there were 32 periprosthetic fractures around at hemiarthroplasty at a single institution that treats approximately 500 hip fractures per year.¹ The 30 day mortality of 12.5% and the 1 year mortality of 28.1% is similar to previously published data, and puts this slightly higher than patients with hip fractures presenting to the same institution.^{1, 5}

Hip fractures have an approximate 6% 30 day mortality.¹ The NICE guidance for the treatment of fractured neck of femurs and the introduction of a best practice tariff which includes a number of targets including surgery within 36 and orthogeriatric review in 72 h have improved outcomes for this group of patients.^{1, 11, 12} Despite being a similar population group, with arguably more significant injuries, there is no guidance on the treatment for patients who have suffered a periprosthetic hip fractures as there are few papers on their incidence or mortality. The majority of research in the mortality of periprosthetic fractures has been in patients with a previous total hip replacement.^{13–19}

This study demonstrates that only 1 in 4 patients received surgery within 36 h. This was significant for 30 day, but not 1 year mortality. Of the 5 patients that died within 30 days, only 2 underwent operative surgery, and therefore it is difficult to draw strong conclusions. As well as mortality; a delay to surgery for these patients will expose them to the risk of complications such as pressure sores, thromboembolic disease and respiratory infections.

Periprosthetic fractures following hemiarthroplasties present a number of surgical challenges.^{3–6} Those that were treated with open reduction internal fixation had a significantly shorter wait to surgery than those that underwent revision arthroplasty. This demonstrates the difficulties of undertaking revision arthroplasty in a timely fashion with issues such as specialist revision hip surgeon and clean air theatre availability.

A study by Phillips et al looking at periprosthetic fractures in hemiarthroplasties identified 79 patients, of which 72% were female with a mean age of 86 years. The majority of these fractures occurred around an uncemented prosthesis. They had mortality rates of 11% at 1 month, 23% at 3 months and 34% by 1 year. 28 of these patients underwent ORIF, 36 revision, one required fixation and simultaneous revision and 14 were treated non-operatively. This proportion of non-operatively treated patients is a lot higher than in our study. Phillips also reported a high incidence of medical complications.⁵ A further study by McGraw found an overall complication rate following surgery for periprosthetic fractures of 42%.⁶ Again this figure is considerably higher than in our study.

This study also surprisingly found that a large number of these patients still lived independently following a previous hip fracture, and had a low incidence of dementia. This indicates that periprosthetic fractures following hemiarthroplasty occur in those elderly individuals who remain independent and ambulatory following the initial fracture.

The mean length of stay in these patients was 16 days. This is actually below the national length of stay as quoted in national hip fracture database report for hip fractures.¹ This may reflect the fact that most of these patients had low numbers of co-morbidities and nearly all had capacity pre-operatively.

There is limited evidence on the incidence of these fractures, but both McGraw and Phillips found much higher rates in those with uncemented stems. McGraw found 15 patients with a fracture and all occurred around uncemented stems.⁶ An incidence of 4%. Phillips study included 62 fractures around uncemented stems, and 17 around cemented stems.⁵ With NICE guidelines advising cemented stems, this could reduce future rates of periprosthetic fractures.

The surgical management for these patients is complex. There are small number of studies on the surgical treatment.^{5, 6, 20} The majority of studies have been undertaken in periprosthetic fractures of total hip replacements. The treatment of these fractures is based on the

Vancouver classification. Those distal to the implant are usually treated with open reduction internal fixation, as was the case in this study. Vancouver B1 fractures with a stable stem are treated with open reduction internal fixation.^{21, 22} The current recommendations for B2 and B3 fractures where the stem is loose is to undergo revision arthroplasty. Some studies have suggested that open reduction internal fixation is a sufficient option for B2 fractures.²³ Despite the current recommendations more patients currently undergo open reduction internal fixation. This may be due to the lack of specialist hip surgeons who can undertake revision surgery. The current evidence though is lacking and a recent systematic review was unable to make treatment recommendations based on the current literature.⁴

A further unanswered question is whether to undertake revision of the acetabulum. In this study 3 patients underwent revision of the hemiarthroplasty and also arthroplasty of the acetabulum. Currently the recommendation would be to assess this on a case by case basis, both on patient characteristics and intra-operative findings.

The limitations of this study include its retrospective nature, but all efforts were made to get complete datasets. Another limitation of this study is that it is impossible to comment on the exact incidence of periprosthetic fractures following hip hemiarthroplasties. This study did also not assess the time from index procedure to periprosthetic fracture. Further multicentre studies should be undertaken to assess risk factors for mortality with an aim to improve outcomes in these vulnerable patients.

5. Conclusions

Periprosthetic fractures following a hip hemiarthroplasty present a number of medical and surgical challenges. These fractures should be treated in the same manner as hip fractures with regular orthogeriatric review and early time to surgery to help improve their outcomes. Further prospective multicentre studies should be undertaken to understand the true incidence of these fractures and the mortality rates associated with this.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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