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RESEARCH ARTICLE

Preoperative Factors Predicting Failure of Hemiarthroplasty after Displaced Subcapital Fractured Neck of Femur in the Active Elderly

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Abstract

Background: Displaced intracapsular hip fractures are a common problem in Australia. The majority of patients with this injury are of low demand. They present with fragility fractures and are treated successfully with a hemiarthroplasty which offers a shorter operative time, less chance of reoperation and less blood loss. In more active individual's acetabular erosion, pain and decreased function limit the success of these implants and a total hip replacement may be beneficial. Patient selection based on preoperative indicators of functionality may help identify which patients are appropriate candidates for either implant.

Methods: This is a retrospective, case-control study, 15 patients who received a hemiarthroplasty that were subsequently revised at a later date due to acetabular pain (*revision group*) and 16 patients (*control group*) who received a hemiarthroplasty that did not require revision were compared. Primary factors assessed were broad indicators of function, namely a patients' ability to independently shower, shop and get dressed. Secondary factors assessed were more specific indicators of function, namely the patients' age, level of mobility, history of previous falls, ability to sign operative consent, level of care and ASA class.

Results: Patients who could independently shop, shower and get dressed were more likely to require a revision secondary to acetabular erosion. The combination of all 3 factors yielded a sensitivity and specificity of 0.800 (95% CI 0.513 - 0.947) and 0.812 (95% CI 0.537 - 0.950) respectively. Patients in the revision group were also younger, more mobile and had less co morbidities. They also were more likely to live at home and less likely to come from a high-level care nursing home.

Conclusion: It may be feasible to objectively identify which patients should receive a hemiarthroplasty or THR following a displaced intracapsular neck of femur fracture. Our study proposes a simple screening tool to assist clinicians with this decision. A prospective follow up study assessing the validity of the screening tool proposed will be of benefit.

Keywords

Hemiarthroplasty, Total hip replacement, Intracapsular femoral fractures, Management

Introduction

Hip fractures are a common problem in Australia and are associated with high mortality and morbidity [1]. Only one third of patients who survive a hip fracture return to previous levels of independence, fifty percent require long-term help with routine activities and a further twenty-five percent require high level care [1]. Careful consideration for definitive treatment of these fractures is essential to avoid the burden associated with unnecessary revision. The optimal surgical treatment of extracapsular fractures is well established and involves internal fixation [2-5].

The treatment of displaced intracapsular fractures is more contentious, with options being internal fixation, hemiarthroplasty or total hip replacement (THR). A hemiarthroplasty is a quick and standardized procedure, with smaller operative time and less blood loss however may require potential revision due to acetabular erosion if patients remain active [3,6,7]. A THR may result in more dislocations, however has a smaller revision rate and better functionality [4-15]. Evidence exists that THA may be a better choice for patients with intracapsular fractures, who live independently and have a long life expectancy as they will have a high risk of acetabular erosion [3,7,11-14].

The decision whether a patient receives a hemiar-

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throplasty or THR appears to be subjective, based on operator preference. Uncertainty in deciding the ideal prosthesis has led to significant variation in the use of each intervention worldwide [11,16]. Scoring systems exist, however the primary function of these is to predict the mortality of hip fractures. *Rogermark, et al*. utilized this scoring system in a randomized control trial to evaluate which patients to treat with a THR or hemiarthroplasty [17]. Factors considered were age, living independence, walking aids and mental status. They found that there were no significant differences in morbidity between patients receiving a THR or hemiarthroplasty indicating that this may be a good system for determining treatment [17].

No studies exist that retrospectively analyse the factors implicated in the conversion of hemiarthroplasties to THR secondary to acetabular pain. The benefit of identifying such factors is to create a tool to standardise the decision making process and ensure that patients receive the correct prosthesis. Ideally, a combination of factors that easily and broadly assess functionality would be ideal for a questionnaire. Therefore the aim of this study is to analyse patient factors associated with failure of hip hemiarthroplasty secondary to acetabular erosion. Ultimately a move towards objective patient selection based on indicators of functionality may help prevent the wrong operation and therefore ameliorate the need for unnecessary revisions.

Methods

This is a retrospective, case-control study from a single academic medical institution in Western Australia. The study was conducted at Fremantle Hospital and included patients who had a primary hip hemiarthroplasty between January 1996 and March 2014. A research request was submitted to clinical coding for hemiarthroplasty of hip (n = 1955) and then revision hemiarthroplasty of hip (n = 365). These cases were reviewed using IMPAX imaging software, to confirm cases of revision hemiarthroplasty to total hip replacement due to acetabular erosion. A total of 21 revision cases were confirmed by imaging. Medical records for these patients were recalled and the revision reason was reanalyzed to confirm acetabular wear. Key words implicated in acetabular wear include “erosion” and “pain on weight bearing”. Cases revised due to infection, loosening of prosthesis and recurrent dislocations were excluded leaving 15 patients (*revision group*). 16 hemiarthroplasty cases of similar age, gender, fracture pattern, ASA grade and premorbid function were selected to compare (*control group*). These cases were reviewed to confirm that they were not subsequently revised at a later date.

Three primary factors were selected as they assessed the patients functionality; namely the ability to shop, shower and get dressed independently. These factors were chosen as they had some implication in prior studies [6,16]. Secondary factors studied were age, history of previous falls, independent mobility, ASA class and the ability of the patient to sign their own operation consent. Our primary factors were selected, as they require competence in a range of the secondary factors and were therefore broader indicators of function. For comparison the presence or absence of these factors was analyzed in both revision and control groups.

Patient data was de-identified prior to submission for statistical analysis. The sensitivity and specificity for the primary factors was calculated, to ascertain its feasibility in predicting revision. An ANOVA linear regression analysis was performed to determine whether any of the primary variables, ability to shop, ability to shower, ability to dress and all three in unison significant influenced whether a patient required a subsequent revision or not. $P < 0.05$ was set as a statistically significant.

Results

A total of 31 patients were included in the study. 16 patients underwent hemiarthroplasty only, and 15 patients had a subsequent revision of a hemiarthroplasty to a THR secondary to acetabular erosion at a later date. Patient factors are displayed in Table 1 and Table 2 below.

In terms of primary factors, it is evident that patients in the revision group displayed a greater degree of independence in activities of daily living. In terms of shopping, 4 out of 16 patients (25%) were able to shop independently in the control group compared to 12 out of 15 (80%) in the revision group. This result was not statistically significant ($P = 0.083$). In terms of showering, 5 out of 16 patients (31%) were able to shower independently in the control group compared to 14 out of 15 (93%) in the revision group. This result was statistically significant ($P < 0.001$). In terms of the ability to

Table 1: Primary factors.

Patient factor(s)	Hemiarthroplasty only (n = 16) ‘control’	Hemiarthroplasty to THR (n = 15) ‘revision’	P Value
Shop	4	12	P = 0.083
Shower	5	14	P < 0.001
Dress	6	14	P < 0.001
Independently able to do all three (shop shower and dress)	3	12	P < 0.001
Sensitivity	0.800 (95% CI 0.513 - 0.947)		
Specificity	0.812 (95% CI 0.537 - 0.950)		

Table 2: Secondary factors.

Patient factor(s)	Hemiarthroplasty only (n = 16) 'control'	Hemiarthroplasty to THR (n = 15) 'revision'
Median age at admission (yrs)	87.5	77
Able to sign own consent	8	15
Positive history of previous falls	11	6
Independently mobile	4	11
Mean ASA class	2.93	2.46
Level of Care		
Home	8	14
Low level	3	1
High Level Care	5	0

Table 3: Proposed questionnaire (Screening Tool).

Screening questions	Patient response
Age of the patient:	Age (years)
Are you able to do the shopping on your own?	Y/N
Are you able to shower on your own?	Y/N
Are you able to dress yourself without help?	Y/N

Scoring: All three present and age < 85: Total Hip Replacement; Otherwise: Hemiarthroplasty.

get dressed independently, 6 out of 15 patients (33%) were able to do so in the control group compared to 14 out of 15 (93%) in the revision group. Again, this result was statistically significant. Independence in all three areas was concurrently present in the majority (80%) of patients in the revision group whilst only 19% of patients displayed independence in all three in the control group ($P < 0.001$). The sensitivity and specificity of using these factors as a diagnostic tool is 0.800 (95% CI 0.513 - 0.947) and 0.812 (95% CI 0.537 - 0.950) respectively. The positive predictive value of using independence in showering, dressing and shopping as a screening tool is 0.800 (95% CI 0.519 - 0.956) Of note, only 3 patients were able to shop, shower and dress themselves independently in the control group and all three patients were 85 years or older.

In terms of secondary factors, the median age of admission was higher in the control group than the revision group (87.5 years and 77 years respectively). 8 out of 15 patients were under the age of 80 in the revision group, whilst none of the patients who received a hemiarthroplasty only were under the age of 80. The ability of the patient to sign their own consent is a good indicator of cognition 8 out of 16 patients in the control group (50%) were able to do this, whilst all patients in the revision group were able to sign their own consent during their initial hemiarthroplasty admission. Those who were not able to sign their own consent required a guardian to do so.

In terms of independent mobility, 11 out of 15 (73.3%) were able to ambulate independently in the revision group. Patients in the control group did not display the same level of independence; with 4 out of 16 (25%) being independently mobile. 5 out of 16 patients (31.2%) in the control group required a four wheel walker (4ww) or wheelchair to ambulate, however none of the patients in the control group required this level of assistance. Of the four patients unable to ambulate in the revision group, three required a walking stick and one required a zimmer frame. Patients in the control group had a comparatively higher history of previous falls than the intervention group. As such 11 of 16 patients (69%) in the control group recorded have had one or more falls previous to their admission, whereas 6 patients (40%) had a fall in the revision group at the time of their initial hemiarthroplasty.

ASA class is a system of assessing fitness before surgery, completed by the anesthetist. It was also used by *Rogermark, et al.* as a representation of patient comorbidities [16]. Patients in the control group had a mean ASA class of 2.93, compared to 2.46 in the revision group.

A patients level of care can correspond with their functional status. A total of 14 patients in the revision group lived at home, whereas only one came from a low level care home. This was not the case with the revision group, where 8 patients lived at home, 3 from a low level care home and 5 from a high level care home.

Discussion

This study analyses underlying factors that correlate with acetabular pain leading to revision after hemiarthroplasty. The goal is to identify factors that allow for better allocation of patients to either hemiarthroplasty or THR as a primary replacement method following intra-articular neck of femur fractures. The revised hemiarthroplasty cases 180 analysed comprised mechanical failure or unsatisfactory complications arising from the acetabulum either through erosion of the articular surface or fracture through the acetabulum. These are all precipitated by mechanical use of the joint, which conversely is one of the primary reasons for performing the hemiarthroplasty in the first place. Other studies have found similar causes for revision of hemiarthroplasty with rates varying but always high [8,18]. High-level evidence exists that THR gives better functional outcomes and lower reoperative rates, especially in the active independent senior citizen but has a higher rate of dislocation [4-14,16-18]. Hemiarthroplasty is still a valid

option, as it is a standardized procedure that has lower operative time and less blood loss, however acetabular erosion limits the life of the implant [6,7].

Our database search for hemiarthroplasty yielded over 1955 patients. Of these, only 21 patients required a revision (1%). The small number of revisions encountered in our data is indicative that operator preference is still a sound means of allocating patients. Our primary factors, namely the ability to independently shop, shower and dress were chosen as they are easily assessable and are broad indicators of function. As such, the presence of all three in a patient yielded a high sensitivity and specificity, 0.800 (95% CI 0.513 - 0.947) and 0.812 (95% CI 0.537 - 0.950) respectively. Of note, only one patient in the revision group required assistance with all three parameters, and two required assistance with one of the parameters. Of equal note, all 3 patients in the control group who were independently able to shop shower and dress themselves were over the age of 85-years-old when they received their hemiarthroplasty. Even though these patients had a high level of functionality, their advanced age limits the time spent walking on the prosthesis. Therefore a hemiarthroplasty may have still been the appropriate prosthesis for these patients. It follows, that a potential screening tool to be implemented for analysis in prospective studies will incorporate these 4 areas. Patient's younger than 85 with independence in all 3 areas in may benefit from a Total Hip Replacement (Table 3).

Patients who require assistance in any of the 3 parameters may benefit from hemiarthroplasty. Potential confounders in our data are inaccurate responses regarding the level of assistance patients receive, as some patients lived with their spouse or children. The responses do not take into account rails or modifications to the patient's home, therefore helping them perform tasks independently. Small patient numbers and the lack of data available retrospectively also limited the scope of the study.

Secondary factors in the study, namely the patients age during their initial hemiarthroplasty, level of mobility, history of previous falls, the ability to sign own consent and ASA class were also explored. Patients who required a revision of their initial hemiarthroplasty were more likely to be mobile, younger, sign their own consent and have less comorbidities. This result is consistent with a number of other studies [4-7,11-14]. Additionally, patients who are likely to require revision were more likely to live at home.

This is not particularly surprising as one of the primary mechanisms of failure of hemiarthroplasty is through acetabular erosion. The results indicate that those more active and aware pre-operatively are likely to wear out their prosthesis as opposed to those with a lower baseline level of mobility with multiple comorbidities. The implication here is that those who have greater mobility pre-operatively are well suited for a primary THR to avoid the impact of failure and revision whereas those who have reduced baseline mobility can have a good outcome with hemiarthroplasty.

Therefore it may be feasible to objectively identify which patients should receive a hemiarthroplasty or THR. Due to the small patient numbers in this study, it would be beneficial to incorporate data from other tertiary hospitals in Western Australia to validate existing trends. Other factors that need to be explored closely is the patients baseline level of activity and the ability of drive, both of which were not routinely assessed and therefore data could not be retrospectively obtained. Future studies would also benefit from prospectively assessing the validity of our primary factors as a screening tool.

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