

Comparing post-operative outcomes of patients with intracapsular neck of femur fractures treated with hip hemiarthroplasty versus total hip arthroplasty

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Abstract

Aims

To compare post-operative outcomes for patients who had sustained an intracapsular hip fracture and had been treated with either hip hemiarthroplasty(HA) or total hip arthroplasty(THA). Our primary outcome measured was post-operative inpatient mortality.

Methods

Retrospective data was collected from the Irish Hip Fracture Database on all patients treated for intracapsular neck of femur fractures with either THA or HA from January 2013 to December 2015. Data analysis was carried out using SPSS Version 25

Results

4,259 patients were included in this study of which 3,956 (92.9%) underwent treatment with HA and 303 (7.1%) were treated with THA. 4% of the HA group died as an inpatient versus 0.6% of the THA group ($p=0.002$). 23% of the HA group and 17% of the THA cohort were delayed mobilising after surgery ($p=0.029$). Length of stay for those treated with THA was 12.87 days versus 18.88 for HA ($p<0.01$).

Discussion

Patients treated with THA had a lower post-operative mortality rate as an inpatient and more likely to mobilise early after surgery. THA was associated with reduced LOS when compared to HA for treatment of intracapsular NOF fractures. THA should be considered in younger patients with few comorbidities who mobilise well pre-fracture.

Introduction

Neck of femur (NOF) hip fractures are a significant global health problem. Worldwide the numbers of hip fractures are projected to increase from 1.7 million in 1990 to 6.3 million in 2050 because of the aging population¹. They are a leading cause of death in elderly patients, with recorded inpatient mortality rates between 2.1% and 14%²⁻⁴.

There is ongoing debate as to whether patients should undergo treatment with total hip arthroplasty (THA) or hip hemiarthroplasty (HA). The HEALTH study group reported similar mortality with both cohorts and no clinical benefit from THA over HA⁵. Others suggest a lower reoperation rate for patients undergoing THA⁶. The UK's NICE guidelines recommend offering THA to patients who were able to walk independently outside with no more than the use of a stick, who are expected to carry out activities living independently beyond 2 years and are medically fit for the procedure⁷. Similarly, American guidelines advocate for THA in appropriately selected patients⁸. Despite these guidelines and studies, treatment of intracapsular NOF fractures varies from institution to institution with only 30% of those suitable for THA being treated with THA in the U.K⁹.

No study exists from the Republic of Ireland assessing the outcomes of hip fractures treated with HA and THA and there is still no conclusive answer for which type of arthroplasty has the best outcome for patients with an intracapsular NOF fracture.

The aim of this study is to determine if there is any difference in outcomes measured between THA and HA for treatment of intracapsular NOF fractures in Irish patients. The primary outcome measure will be post-operative inpatient mortality. Secondary outcomes examined will be reoperation rate within 30 days of index procedure, if a patient mobilised on day of or day after their index surgery, pressure ulcer development and patient's length of stay.

Methods

This is a retrospective observational cohort study of all patients who were being treated surgically for intracapsular NOF fractures with arthroplasty in the Republic of Ireland between January 1st 2013 and December 31st 2015. Ethical approval for the project was sought by the author and approved by the Research Ethics Committee of the Royal College of Surgeons Ireland, reference number REC 1393

Data was obtained from the Irish Hip Fracture Database (IHFD). The IHFD is a database which commenced nationwide data collection in 2013. The IHFD collects data on all patients who have sustained a hip fracture and were treated in an acute hospital in the Republic of Ireland. These patients are followed up until their discharge or their death in hospital.

Inclusion criteria for this study were all patients in the Republic of Ireland who sustained an intracapsular NOF fracture; treated surgically with either HA or THA; between January 1st

2013 and December 31st 2015. Exclusion criteria included patients diagnosed with any other type of hip fracture; patients managed by any other means other than THA or HA. Follow up was limited to patient's period of hospital stay.

Outcomes selected to review for this study were: In-hospital mortality post index surgery; Reoperation within 30 days of index procedure; Mobilised on day of or day after index surgery; Development of pressure ulcers and; Length of inpatient stay.

Specific exposure risk factors of interest were the procedure type; THA or HA. Confounding factors of interest were gender; American Society of Anaesthesiology (ASA) Grade; and patient age.

To address selection bias, we have statistically analysed our data with focus on age, gender and ASA grade of our cohort of patients.

For comparative analysis, independent samples *t*-testing and Analysis of Variance were used to test the null hypothesis. All analysis was carried out using SPSS Version 25

There was no loss to follow up, given that follow up was restricted to time spent in hospital, and this is universally reported for all hip fracture patients on the IHFD. Where data was not recorded, this was not included in statistical analysis.

Results

A total of 4259 patients were included in our dataset for patients treated with either HA or THA for intracapsular NOF fractures between 2013 and 2015. 92.9% (n= 3956), of patients underwent HA (Table 1). 303 patients were managed with THA (7.1%).

Hemiarthroplasty was more frequently used in those with higher ASA grades ($p<0.001$) (Table 2). In terms of gender, 6.5% of males and 7.3% of females underwent treatment with THA (Table 3). There was no significant association between gender and procedure type ($p=0.363$; OR 1.13 95% confidence intervals 0.868-1.47).

The mean age of those treated with HA was 80.58 years, and those treated with THA 67.32 years. This was statistically significant ($p<0.001$). Recoding patient ages in to two groups, '74 years or under' and '75 years and over' (Table 4), younger patients were less than 7 times as likely to undergo a HA as they were a THA ($p<0.001$; OR 0.074, 95% CI 0.055-0.099).

Primary Outcome

Inpatient Mortality

There were 170 inpatient deaths (4.0%) (Table 5). Two patients (0.6%) of the THA group died as inpatients post-operatively. 168 patients (4.25%) of the HA cohort died as inpatients in the post-operative period.

Those who underwent treatment with HA were 6.67 times more likely to die than those undergoing a THA ($p=0.002$; OR = 6.67, 95% Confidence Interval 1.65-27).

When comparing mortality between the two groups, patients with high ASA had a significantly greater risk of inpatient mortality ($p < 0.001$; OR = 4.34, 95% confidence intervals 2.86-6.62).

Secondary Outcomes

Reoperation within 30 days

3,880 patients (91.1%) did not require reoperation within 30 days of index procedure (Table 1). Of the remainder, 64 (1.5%) did require revision surgery. For 15 patients the outcome was recorded as “not known” (0.4%) and the data was missing for 300 patients (7.0%).

The most common cause for reoperation in those treated with HA was for wound washout or debridement ($n=23$), followed by reoperation for dislocation ($n=19$). The most common reason for reoperation in the THA group was for dislocation ($n=2$).

Procedure type (HA and THA) was not significantly associated with likelihood of reoperation ($p=0.80$; OR 1.14 95% confidence intervals 0.41-3.16) (Table 6). Similarly, ASA grade ($p=0.826$) and gender ($p=0.150$) were not associated with likelihood of reoperation.

Mobilisation on day of, or day after surgery

Overall, 2,180 patients (76%), were recorded as having mobilised on day of, or day after surgery (Table 7). 23% ($n=620$) who were in the HA group were not mobilised, whereas 17% ($n=36$) were not mobilised in the THA group ($p = 0.029$; OR = 0.66, 95% confidence intervals 0.39-0.59).

Those with an ASA grade ≥ 3 , were less likely to be mobilised early than those with low ASA grade ($p < 0.001$, OR = 0.48, 95% confidence interval 0.39-0.59) (Table 7). Patients ≥ 75 years were less likely to mobilise early ($p < 0.001$; OR= 0.67; 95% confidence interval 0.55-0.82).

Pressure Ulcer Development

The majority of patients (3,914 patients, or 91.9%) did not experience pressure ulcers (Table 2). The majority of pressure ulcer development arose from the HA group ($n= 189$) cases with 11 cases in the THA cohort but no association recognised between procedure and ulcer development ($p=0.33$). (Table 8)

Length of Stay

The overall mean LOS was 18.5 days but the median LOS was 13.0 days. When comparing LOS with procedure, mean LOS for HA was 18.9 days and 12.9 days for THA.

HA was significantly associated with increased LOS ($p<0.001$; OR=2.76; 95% confidence intervals 2.08-3.67). For further analysis, LOS was coded as a categorical variable with low LOS being 14 days or less, and high LOS being 15 days or more (Table 9).

Comparing LOS and ASA grade, those with low ASA grade were more likely to have a shorter LOS than those with higher ASA ($p<0.001$; OR 2.11; 95% confidence interval 1.85- 2.40).

Those aged ≥ 75 years were 1.73 times more likely to require longer LOS, compared with younger patients ($p<0.001$; OR=1.73 95% confidence interval 1.50-1.99)

Male gender was also significantly associated with LOS longer than 14 days ($p=0.005$; OR = 1.21 95% confidence interval 1.06-1.38).

Discussion

Intracapsular NOF fractures carry a significant morbidity, mortality and loss of mobility and independence⁶. The superiority of THA over HA for traumatic intracapsular NOF fractures has not been clearly demonstrated from previous studies^{5, 10}. Outcomes of mortality, morbidity and mobility were examined in this study to assess if THA or HA resulted in superior outcomes for patients in this Irish cohort.

We identified that THA is used largely to treat patients of younger age and lower ASA, indicating that it is reserved for the medically fitter patient. However, relative to other studies, we identified that there is a disproportionately lower number of patients being managed with THA relative to HA which needs to be taken in to account^{11, 12}.

Our overall mortality rate is low in both groups who were treated with THA and HA when compared with other studies^{4, 13}. Our results are also in keeping with both the systematic review by Parker et al and the HEALTH trial investigators which found no significant difference in mortality rates between HA and THA^{5, 14}. Our results suggest that inpatient mortality was more likely in patients who were older (≥ 75 years), with high ASA grades (≥ 3) and with delayed post-operative mobilisation. These factors are similar to those reported by Hailer et al¹⁵ and highlights the need for perioperative optimisation for our older comorbid patients to reduce their risk of mortality. It also highlights how important early mobilisation on the day of or day after surgery is for this group of patients, reflecting previous literature by Handoll and Kirstensen^{16, 17}.

When examined against our parameters, there was no significant difference with reoperation within 30 days, in keeping with findings by Goh and Avery who also found no association with

arthroplasty choice and revision surgery^{10, 13}. There was no significant difference with procedure type and pressure ulcer development which was relatively low at 4.7%^{4, 18}.

Our overall mean LOS was longer than reported by other studies¹⁹. LOS was significantly prolonged in those treated with HA over THA. Patients treated with HA were 2.76 times more likely to stay longer in hospital than those treated with THA. This may be explained by THA being used when treating younger, healthier and more mobile patients.

This is the first Irish study which has examined the outcomes of patients with intracapsular NOF fractures treated with THA and HA. Overall, this study's findings are in keeping with other important international papers including systematic reviews and meta-analysis which could not identify many differences in the outcomes of HA and THA. We recommend considering THA for medically well patients who will mobilise early post-operatively, in keeping with international guidelines.

Several limitations are recognised by the authors.

The study design is retrospective in nature leading to limitations in incomplete data. We have accounted for this missing data in the analysis. We acknowledge that missing data especially with reoperation rates within 30 days can impact accurate analysis and highlights the importance of accurate data collection and completion.

Also, there are variables which could be important in determining which procedure has better outcomes but which were not assessed in this study include pre-fracture mobility, cemented or un-cemented implant use, time to surgery from injury, grade of surgeon and intraoperative complications as well as patient variables which affect decision making including BMI, pre-operative degenerative disease clinically and radiographically, nutritional status. It would be a recommendation that these other variables be included in future research on the topic. Similarly, as the HEALTH trial demonstrated minimal clinical difference with hemiarthroplasty or THA at 2 years post-operatively, collecting patient reported outcome measures and long term follow up is recommended⁵.

We also acknowledge that there the cohort of patients who underwent THA is very small and leads to bias in results favouring THA for younger fitter more active patients.

We recommend further robust data collection with longer term outcomes beyond the acute hospital admission.

This study reports a significantly higher likelihood of inpatient mortality in those treated with HA versus THA. There was no difference between THA and HA in terms of reoperation within 30 days or pressure ulcer development. Patients treated with THA were significantly more likely to mobilise early. We identified a significantly longer LOS in those treated with HA. We noted that older patients (≥ 75 years) with higher ASA grades (≥ 3) were significantly more

likely to undergo treatment with HA. THA should be considered in younger, medically fit patients who mobilise well pre-fracture.

Declaration of Conflicts:

None declared.

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Tables:

Variable	Value	Frequency	Percent	Cumulative %
Gender	Male	1236	29.0	29.0
	Female	3023	71.0	100.0
	Total	4259	100.0	
Procedure	HA	3956	92.9	92.9
	THA	303	7.1	100.0
	Total	4259	100.0	
Inpatient Mortality	No	4089	96.0	96.0
	Yes	170	4.0	100.0
	Total	4259	100.0	
Pressure Ulcer Development	Missing	94	2.2	2.2
	No	3914	91.9	94.1
	Not known	51	1.2	95.3
	Yes	200	4.7	100.0
	Total	4259	100.0	
Reoperation within 30 days	Missing	300	7.0	7.0
	No	3880	91.1	98.1
	Not known	15	0.4	98.5
	Yes	64	1.5	100.0
	Total	4259	100.0	
Mobilisation on day of, or day after surgery	Missing	1389	32.6	32.6
	No	656	15.4	48.0
	Not known	34	.8	48.8
	Yes	2180	51.2	100.0
	Total	4259	100.0	
Variable	Value	Frequency	Percent	Cumulative %
ASA Grade	Missing	85	2.0	2.0
	1	192	4.5	6.5
	2	1616	37.9	44.4
	3	1868	43.9	88.3
	4	181	4.3	92.6
	5	5	0.1	92.7
	9	312	7.3	100.0

	Total	4259	100.0
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Table 1: Demographic Analysis: Descriptive analysis of quantitative variables

ASA Grade	Hemiarthroplasty	Total Hip Arthroplasty	Total
1	80	5	85
2	145	47	192
3	1458	158	1616
4	180	1	181
5	4	1	5
Not documented	285	27	312
Total	3956	303	4259

Table 2: ASA grade and Procedure Type

Procedure	Male	Female	Total
Hemiarthroplasty	1155	2801	3956
Total Hip Arthroplasty	81	222	303
Total	1236	3023	4259

Table 3: Gender and Procedure Type

Procedure	74 years or under	75 years and over	Total
Hemiarthroplasty	896	3060	3956
Total Hip Arthroplasty	242	61	303
Total	1138	3121	4259

Table 4: Age and Procedure Type

	INPATIENT MORTALITY		Total	Pearson chi-square	p-value	Odds Ratio	95% Confidence Interval	
Procedure	YES	NO					Lower	Upper
HA				9.447	0.002	6.67	1.65	27.04
	168	3788	3956					
THA	2	301	303					
Total	170	3089	4259					
ASA	YES	NO						

HIGH ASA				55.238	0.000	4.34	2.86	6.62
	127	1927	2054					
LOW ASA	27	1781	1808					
Total	154	3708	3862					
Age	YES	NO						
AGE >=76				20.229	0.000	2.63	1.69	4.07
	146	2855	3001					
AGE <=75	24	1234	1258					
Total	170	4089	4259					
Gender	YES	NO						
MALE				6.396	0.011	1.50	1.09	2.06
	64	1172	1236					
FEMALE	106	2917	3023					
Total	170	4089	4259					

Table 5: Univariate Analysis Inpatient Mortality

	REOP WITHIN 30 DAYS		Total	Pearson chi- square	p- value	Odds Ratio	95% Confidence Interval Lower Upper	
Procedure	YES	NO						
HA	60	3606	3666	0.063	0.801	1.14	0.41	3.16
THA	4	274	278					
Total	64	3880	3944					
ASA Grade	YES	NO						
HIGH ASA	25	1652	1677	0.414	0.519	0.84	0.50	1.42
LOW ASA	34	1894	1928					
Total	59	3546	3605					
Age	YES	NO						
AGE >=76	44	2731	2775	0.081	0.776	0.92	0.54	1.58
AGE <=75	20	1149	1169					
Total	64	3880	3944					
Gender	YES	NO						
MALE	23	1117	1140	1.565	0.211	1.39	0.83	2.32
FEMALE	41	2763	2804					

Total	64	3880	3944				
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Table 6: Univariable analysis of reoperation within 30 days as outcome against procedure, ASA, age and gender.

	MOB ON DAY OF, OR DAY AFTER SURGERY		Total	Pearson chi- square	p- value	Odds Ratio	95% Confidence Interval	
	YES	NO					Lower	Upper
Procedure	YES	NO						
HA	2005	620	2625	4.723	0.029	0.66	0.46	0.96
THA	175	36	211					
Total	2180	656	2836					
ASA Grade	YES	NO						
HIGH ASA	1041	397	1154	53.294	0.000	0.48	0.39	0.59
LOW ASA	982	182	1438					
Total	2023	579	2602					
Age Group	YES	NO						
AGE >=76	1479	497	1976	14.963	0.000	0.67	0.55	0.82
AGE <=75	701	159	860					
Total	2180	656	2836					
Gender	YES	NO						
MALE	633	204	837	1.029	0.310	0.91	0.75	1.09
FEMALE	1547	452	1999					
Total	2180	656	2836					

Table 7: Univariable analysis of mobilisation on day of, or day after surgery against procedure, ASA, age and gender

	PRESSURE ULCER		Total	Pearson chi- square	p- value	Odds Ratio	95% confidence interval	
	YES	NO					Lower	Upper
Procedure	YES	NO						
HA	189	3628	3817	0.928	0.332	1.35	0.73	2.51
THA	11	286	297					
Total	200	3914	4114					
ASA Grade	YES	NO						
HIGH ASA	141	1840	1981	39.288	0.000	2.82	2.01	3.94
LOW ASA	47	1727	1744					
Total	188	3567	3755					

Age Group	YES	NO						
AGE >=76	151	2749	2900	2.535	0.111	1.31	0.94	1.81
AGE <=75	49	1165	1214					
Total	200	3914	4114					
Gender	YES	NO						
MALE	73	1118	1191	5.826	0.016	1.44	1.07	1.93
FEMALE	127	2796	2923					
Total	200	3914	4114					

Table 8: Univariable analysis of pressure ulcer development against procedure, ASA, age and gender

	LOS > 14 DAYS		Total	Pearson chi- square	p- value	Odds Ratio	95% confidence intervals Lower Upper	
Procedure	YES	NO						
HA	1683	2273	3956	53.379	0.000	2.76	2.08	3.67
THA	64	239	303					
Total	1747	2512	4259					
ASA Grade	YES	NO						
HIGH ASA	1005	1049	2054	124.568	0.000	2.11	1.85	2.40
LOW ASA	565	1243	1808					
Total	1570	2292	3862					
Age Group	YES	NO						
AGE >=76	1345	1656	3001	60.621	0.000	1.73	1.50	1.99
AGE <=75	402	856	1258					
Total	1747	2512	4259					
Gender	YES	NO						
MALE	548	688	1236	7.922	0.005	1.21	1.06	1.38
FEMALE	1199	1824	3023					
Total	1747	2512	4259					

Table 9: Univariable Analysis of Length of Stay > 14 days against procedure, ASA, age and gender.