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Research Article

Hip Hemiarthroplasty in the Treatment of Femoral Neck Fracture: A Retrospective Analysis of 267 Patients

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Abstract

Purpose: Hip hemiarthroplasty (HA) is considered the best surgical choice in the treatment of femoral neck fracture (FNF) in elderly and low demanding patients, allowing immediate full weight bearing and decreased reoperation rate. HA instability is a serious complication that can lead to revision surgery and dictate lower survival rates. The aim of this study was to identify clinical risk factors associated with an increased risk of dislocation after cemented HA through posterolateral approach.

Methods: Retrospective study of patients with FNF admitted to our institution between 2014 and 2019, treated with bipolar/unipolar cemented HA using a posterolateral approach. Data collected from hospital database included patient demographics, mortality, complications and requirement for revision.

Results: Overall, 267 patients were submitted to HA (84.6% bipolar), with an average age of 84.5 ± 7.1 years and 72% were female. The median hospital stay was 13 days and 43.1% presented medical complications. The prosthesis related complications rate was 13.8% (11.6% instability, 1.1% periprosthetic fracture and 1.1% implant infection) and revision was required in 8.6%. Previous inability to walk [OR 8.55 (95% CI: 3.27-22.38, $p < 0.001$)] and male gender [OR 2.51 (95% CI: 1.11-5.65, $p = 0.026$)] where identified as risk factors for instability. One-year mortality rate was 26.7% and was higher among males ($p = 0.012$).

Conclusion: The instability incidence of cemented HA using posterolateral approach in this study was 11.6%. Previous inability to walk and male gender were identified as risk factors for dislocation after posterolateral approach and may indicate other surgical approaches or treatments.

Keywords: Femoral Neck Fractures; Hip Hemiarthroplasty Dislocation; Complications; Dislocation; Bipolar Hemiarthroplasty; Unipolar Hemiarthroplasty

Abbreviations

HA: Hip Hemiarthroplasty; FNF: Femoral Neck Fracture; PA: Posterior Approach; SD: Standard Deviation; IQR: Interquartile Range; PJF: Periprosthetic Joint Fracture; PJI: Periprosthetic Joint Infection

Introduction

Hip fractures represent a major public health concern with increasing incidence over the years and a predicted global incidence of 4.5 to 6.3 million in 2050.

Hip hemiarthroplasty (HA) is a reasonable treatment choice for displaced fractures of the femoral neck in elderly patients [1]. In general, HA has the advantages of a shorter operation time, less blood loss, less technical demand, less economic burden, and a lower dislocation rate comparing to total hip arthroplasty [2,3]. HA instability is devastating in this frail patient group and has a significant effect on patients' morbidity and quality of life, as it can lead to multiple hospital admissions and revision [4]. The predisposing factors for instability can be divided into patient, surgeon and surgical factors [5]. Posterior approach (PA) for hemiarthroplasty in proximal femoral fractures has been associated with higher dislocation and re-operation rates compared to the lateral and anterior approaches [6]. However, this risk may be reduced by posterior capsule repair and short external rotator reattachment [7]. According to Ninh., *et al.* [8], male gender and mental impairment were shown to be significant clinical risk factors for dislocation, while Salem., *et al.* [9], did not found correlation between mental impair-

ment and instability. Previous studies focused primarily on evaluating predisposing factors for dislocation in the light of different surgical approaches. Therefore, this study was designed to determine the clinical factors leading to an increased risk of dislocation when using the PA in cemented HA.

Materials and Methods

A retrospective study was performed in a single centre, from January 2014 to December 2019. All patients with a displaced FNF submitted to cemented HA were included (n = 276). Patients lost to follow-up due to transfer to other hospitals (n = 9) were excluded. Those who, suffered two FNFs during follow-up (n = 3) were only included once. Hence, a total of 267 FNF submitted to cemented HA through PA were included in the analysis. Patients with post-operative follow-up done outside our institution were also excluded. Revision and approval by the Ethical and Health Committee of our institution were obtained.

Regarding surgical technique, cemented stem (Müller Stem, Smith and Nephew®) was used in all patients, with a unipolar or bipolar head according to femoral head size availability (Tandem Hip System, Smith and Nephew®). Surgeries were performed by an orthopaedic surgeon, or an experienced resident under supervision, using a PA. Full weight bearing was allowed as soon as tolerated. Clinical data regarding patient demographics, medical comorbidities and peri or postoperative complications were collected from patient and operative records. Preoperative and postoperative radiographs were analysed for fracture classification, periprosthetic fracture, acetabular erosion, implant loosening.

Categorical data is presented as absolute numbers and percentages. Continuous data is presented as mean and standard deviation (±SD) or median and interquartile range (IQR) is presented, according to their normality test (Kolmogorov-Smirnov test). Chi-squared and Fisher exact tests were performed for categorical data. Non-parametric tests were performed for continuous data without normal distribution. Binary logistic regression analysis was performed to evaluate clinical factors associated with dislocation. A *p value* of <0.05 was considered statistically significant. All analyses were conducted using IBM® SPSS® statistics version 25.

Results

A total of 267 patients were included, with 192 females (71,9%) and 75 males (28,1%) with a mean age of 84.5 ± 7.1 years (Table 1). A bipolar head was used in 226 patients (84.6%) and 41 patients (15.4%) received a unipolar implant. The median follow-up was 22 months (IQR 6 to 47).

The median days between fracture diagnosis and surgery was 4 (IQR 2 to 6), with only 85 patients (31.8%) being operated in the first 3 days after diagnosis. The median days of hospitalization was 13 (IQR 10 to 25) and 15 patients (5.6%) died during hospitalization. The total average blood loss was 2.7g/dL ± 1,3g/dL and 63 patients (23.6%) needed at least one unit of blood transfusion. Comorbidities and inpatient medical complications are presented in table 2. Male patients presented a higher frequency of respiratory disease, chronic kidney disease, dialysis and cancer, as well as higher respiratory infection rate during hospitalization. There were no other statistically significant differences between gender regarding comorbidities and medical complications.

Total number of patients	N = 267
Age (years)	84.5 ± 7.1
Gender	
Female	192 (71,9%)
Male	75 (28,1%)
Living conditions	
Home	186 (69.7%)
Institutionalized	81 (30,3%)
Prefracture mobility	
Unaided	184 (68,9%)
Cane/Walker	60 (22,5%)
Non-ambulant	23 (8,6%)
Implant	
Unipolar	41 (15,4%)
Bipolar	226 (84,6%)

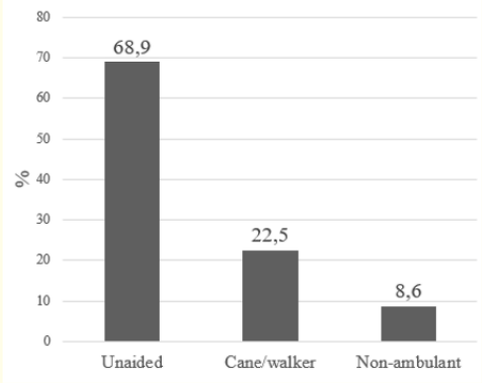
Table 1: Patient demographics.

	Female (n = 192)	Male (n = 75)	*P* value	Total
Comorbidities				
Hypertension	149 (77.6%)	50 (66.7%)	0.065	199 (74.5%)
Diabetes mellitus	42 (21.8%)	18 (24%)	0.563	60 (22.5%)
Cardiovascular disease	45 (23.4%)	24 (32%)	0.151	69 (25.8%)
Atrial fibrillation	29 (15.1%)	13 (17.3%)	0.653	42 (15.7%)
COPD/asthma	23 (12%)	23 (30.7%)	<0.001*	46 (17.2%)
Chronic kidney disease	19 (9.9%)	14 (18.7%)	0.050*	33 (12.4%)
Dialysis	0 (0%)	3 (4%)	0.022*	1.1 (4%)
Stroke with motor deficit	13 (6.8%)	7 (9.3%)	0.475	20 (7.5%)
Parkinson's disease	16 (8.3%)	5 (6.7%)	0.649	21 (7.9%)
Dementia	89 (46.3%)	26 (34.7%)	0.222	115 (43.1%)
Cancer	24 (12.5%)	23 (30.7%)	<0.001*	47 (17.6%)
Active cancer	12 (6.3%)	20 (26.7%)	<0.001*	32 (12%)

Anti-agregation	77 (40.1%)	29 (38.7)	0.975	29 (39.7)
Hipocoagulation	27 (14%)	11 (14.7%)	0.628	38 (14.2%)
Medical complications				
Blood transfusion	44 (22.9%)	19 (25.3%)	0.676	63 (23.6%)
Urinary tract infection	40 (20.8%)	10 (13.3%)	0.158	50 (18.7%)
Acute renal failure	11 (5.7%)	5 (6.7%)	0.772	16 (6%)
Respiratory failure	12 (6.3%)	6 (8%)	0.608	18 (6.7%)
Respiratory infection	13 (6.8%)	15 (20%)	0.002*	28 (10.5%)
Cardiac failure	8 (4.2%)	4 (5.3%)	0.679	12 (4.5%)
Altered mental state	6 (3.1%)	2 (2.7)	1.000	8 (3%)
Stroke	2 (1%)	0 (0%)	1.000	2 (0.8%)
Thromboembolism	7 (9.3%)	1 (1.3%)	1.000	8 (3%)

Table 2: Comorbidities and Medical complications during hospital stay.

Regarding the best achieved outcome during the follow-up and we observed that 60.9% maintained walking capacity with or without external aid, and the percentage of patients without walking capacity increased from 8.6% to 39.1% (Graph 1). More specifically, in the group of autonomous patients 29.1% loss walking capacity and 43.6% proceeded to need of external aid. One year mortality rate was 26.7%. and was higher among males (38.7% vs 22.1%, p = 0.012).



Graph 1: Walking capacity variation.

Total complication rate was 13.8%. HA dislocations were observed in 31 of 267 patients (11.6%), with periprosthetic joint fracture (PJF) and periprosthetic joint infection (PJI) occurring in 3 patients each (1.1%). Revision surgery was required in 8.6%, with instability being the main cause for revision (18 patients for instability, 3 PJF, 2 for PJI). There was no aseptic loosening or acetabular erosion observed during follow-up. HA dislocation occurred in the first post-operative month in 25 patients (80.6%). In 2 patients, dislocation occurred at day 33 and 34, and in 4 patients was observed at post-operative consultation, without knowing the exact day of dislocation. Successful closed reduction without relapse was achieved in 7/31 patients (22.6%) (Figure 1). Recurrent dislocation occurred in 20/267 patients (7.5%), and 18 of them were submitted to revision (12 converted to constrained total hip arthroplasty, 1 to total hip arthroplasty and 4 to excision arthroplasty). Four patients were not revised due to poor general state and short life expectancy. Prevalence of co-morbidities and medical complications were similar between patients with or without HA dislocation. Although higher rate of dislocation in unipolar group this difference was not statistically significant (unipolar 14.6% vs bipolar 11.1%, p = 0.511). One-year mortality rate was higher among patients with dislocation (47.8% vs 24.0%, p = 0.014).

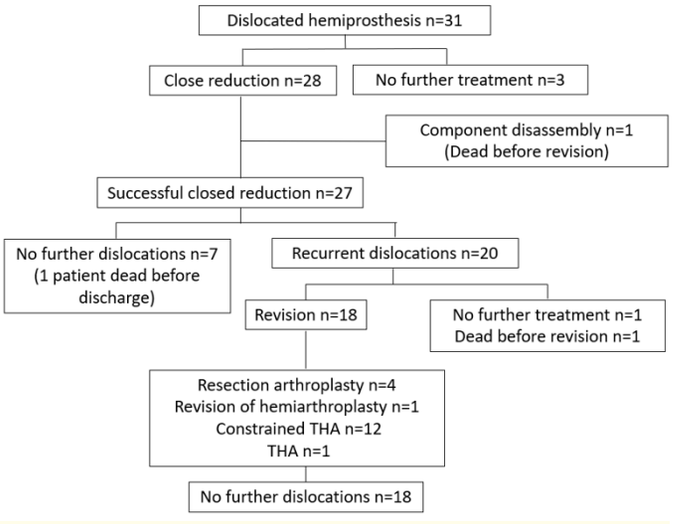
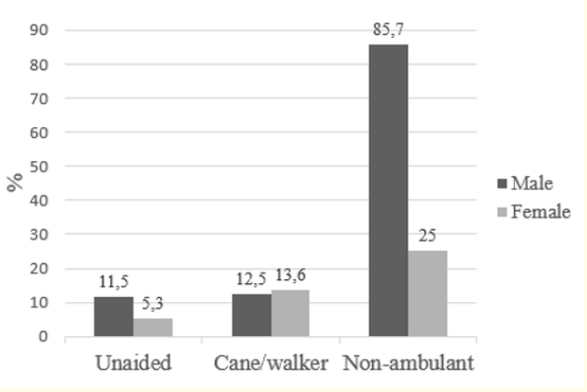


Figure 1: Instability management.

Binary logistic regression was performed to detect any risk factors for dislocation. Previous inability to walk [OR 8.55 (95% CI: 3.27-22.38, p < 0.001)] and male gender [OR 2.51 (95% CI: 1.11-5.65, p = 0.026)] were identified as risk factors for instability. No other risk factors were identified (Table 3). When dividing patients into subgroups, according to the identified risk factors, we observed that females with previous walking capacity had the lowest dislocation rate (5.3%), while previously non-ambulatory males had the highest dislocation rate (85.7%) (Graph 2).

Risk factors	OR (95% CI)	*P* value
Male gender	2.51 (1.11-5.65)	.026*
Age	1.02 (0.96-1.08)	.537
Unipolar HHA	1.38 (0.53-3.60)	.513
Non-ambulant	8.55 (3.26-22.38)	.000*
Delay to surgery (>3 days)	1.20 (0.34-4.24)	.770
Hypertension	0.58 (0.26-1.28)	.177
Diabetes mellitus	1.08 (0.55-2.13)	.819
Cardiovascular disease	0.517 (0.19-1.40)	.195
Atrial fibrillation	1.034 (0.37-2.87)	.948
COPD/asthma	1.22 (0.78-1.90)	.377
Chronic kidney disease	0.64 (0.20-2.06)	.451
Stroke with motor deficit	1.38 (0.38-5.00)	.624
Parkinson's disease	0.79 (0.17-3.56)	.756
Dementia	1.23 (0.71-2.11)	.452
Cancer	1.76 (0.73-4.21)	.207
Active cancer	1.94 (0.73-5.16)	.185
Anti-agregation	0.70 (0.39-1.25)	.229
Hipocoagulation	0.96 (0.40-2.29)	.922

Table 3: Logistic regression analysis of patient related factors for dislocation.



Graph 2: Rate of dislocation within gender and walking capacity.

Discussion

Postoperative dislocation is a key issue when treating displaced FNF with HA. We observed a total dislocation rate of 11.6% in our study, which is comparable with previous reports when using PA (Table 4). PA has been associated with higher dislocation risk comparing to direct lateral or anterior approaches [10-13], nonetheless, it is frequently used owing to its better exposure, shorter operative time, and less risk of damage to the hip abductors or intraoperative fractures[6]. Kristensen et al. concluded that despite the increased risk for dislocations, the posterolateral results in a favorable quality of life, but this should be specified for mentally competent patients who comprehend their movement restrictions [14]. Ultimately surgeons should use the approach with which they have more experience and comfort as this approach is more frequently used at our institution.

As in other studies most dislocations occurred in the first postoperative month [15,16], which could be explained by postoperative altered mental state and muscle control, as well as inability to cooperate with position restrictions and insufficiency of the incised hip short external rotator. We observed that most of dislocations occurred in previously non-ambulant patients, which have poor conditioning, weakness of soft tissues and frequently are unable to cooperate with postoperative positioning instructions and to perform rehabilitation exercises. Recurrent dislocation rate was comparable to previous studies (Table 4), and as in other studies most recurrent dislocators required revision surgery [5,15,16].

We also observed a tendency to higher dislocation rate in patients treated 3 days after diagnosis although not statistically significant (first 3 days 10.6% vs 12.1%). Delay to surgery was generally due to operative room capacity and patient related factors, as most of the patients had advanced age and medical conditions that precluded general anaesthesia, medications that prevented neuroaxis block and medical conditions requiring treatment prior surgery. This delay contributes to loss of muscular function and coordination, and according to Salem., *et al*. [9] a delay in surgery of >24 hours was associated with a fourfold increase in the dislocation.

One-year mortality rate was comparable to literature and higher mortality in man observed in our study was also reported by Hedbeck., *et al*. and Veronese., *et al*. [17-19]. The additional mortality in man could be explained by higher prevalence of respiratory disease, chronic kidney disease, haemodialysis, cancer and active cancer, as well as higher incidence of instability. Dislocation is a major complication which results in increased mortality with rates up to 65% following hip dislocation [18], in this study mortality in patients with HA dislocation was 47.8%.

Previous studies reported mental dysfunction being an important risk factor for dislocation [8,10]. However, similarly to some previous reports [9,15], we did not find this association. Nonetheless, these results should be interpreted with caution since information regarding mental capacity may be partially inaccurate, as this factor was not quantified using standardised questionnaires but rather dependent on registry of this comorbidity or follow-up in neurology consultation.

This study aimed to identify risk factors associated with HA dislocation following PA. We found that non-ambulatory patients who

received an HA after a FNF were 8.5 times more likely to suffer a dislocation, while males had an increased risk of 2.5 times. No other risk factors were identified. In other studies, male gender was found to be a risk factor for dislocation [5], predictive of revision surgery [20] and, associated with increased mortality at 6 months after bipolar HA [21]. In our cohort of patients, the higher risk of dislocation in male gender could be explained by higher prevalence of comorbidities that may contribute to poor physical condition predisposing to dislocation. In total, there were 23 (8.6%) non-ambulant patients treated with hemiarthroplasty (patients with limited walking capacity or with some standing capacity to help in transfers but with locomotion mostly dependent on wheelchair). These patients are at more risk of dislocation since their hip are in a flexed position, have depleted muscle mass and poor coordination. This may raise attention to choose other treatments options for these patients. Although a difficult treatment decision to make, some of these patients may benefit from excision arthroplasty ad initium. This procedure is a proven and effective treatment allowing pain relieve and orthostatic position, although a 4.27 cm limb shortening on average [22]. This procedure also avoids the need for revision surgery for failed implant, which can be very detrimental in this frail population. On the other hand, those patients with some limited walking capacity, if the decision is made to proceed with hip hemiarthroplasty, they may benefit from using an anterior or lateral approach [13] or use of total arthroplasty with constrained liner, which have good results in preventing further dislocations after failed hemiarthroplasty [23]. In our study none of the 12 patients submitted to revision surgery with constrained acetabular liner had further dislocations.

In one study with 51 patients treated with bipolar HA mostly through direct lateral approach, 89.2% of them either returned to the previous functional level before the fracture or used only a cane, which they had not needed before [24]. In another study, 26/118 (22%) patients submitted to unipolar HA using the PA were able to ambulate without aids 1 year after hip fracture [25]. In our study, 60.9% returned to the previous functional level or proceed to need of external aid and only 19.4% were able to ambulate without aids, which was close to the value mentioned before although, in that study, non-ambulant patients were excluded from analysis. This difference could be explained by more advanced age of our patient cohort, as well as inclusion of previously non-ambulatory patients in our analysis.

This study has some limitations and the results should be interpreted with caution. Being a retrospective study, information is limited to electronic medical records, which are sometimes lacking. As so, some variables were not consistently available, and were not possible to evaluate, such as intraoperative and morphologic data. Functional scores were not measured, with walking capacity being, the only functional data evaluated.

Being a single centre with a large cohort of patients treated with the same approach with the same implant constitutes a strength to this study. To our knowledge this is the largest reported cohort of patients with FNF treated with modular HA in our country and allowed to get a general picture of the natural history of these patients in our institution. Although no clinical risk factors for instability other than gender and walking capacity were identified, this study denotes the frailty of these patients. Previous functional level assessment is of paramount importance, and hemiarthroplasty should not be considered for patients with extremely limited to non-ambulatory capacity. Different approaches or implants may be selected for specific cases where resection arthroplasty is not preferred, to minimize instability.

Conclusion

As posterolateral approach is known to conferee higher dislocation rate, with this study we concluded that patients without walking capacity may benefit from other approaches or other treatments in order to lower dislocation rate.

Detecting the factors that affect the outcomes and taking protective measures are essential in these elderly patient groups in order to avoid multiple procedures and improve quality of life and survival rates.

Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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