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Original Research Article

A comparative study between cemented and un-cemented hemiarthroplasty management of fracture neck of femur in elderly patients

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ABSTRACT

Background: Cementation of prosthesis achieves a good initial fix in an osteoporotic bone, however, arthroplasty using a cemented implant may be associated with increased mortality compared with an arthroplasty using an uncemented implant, as it has the risk of bone marrow and fat embolization with resulting intraoperative hypotension and increased incidence of deep vein thrombosis. This aim of the study was to evaluate the complications, morbidity, and mortality rates associated with each of the procedures and study the radiographic changes, recovery to physical independence and advantages encountered in each of the procedures, and achieve stable fixation and early mobilization.
Methods: Pre-operative and a postoperative assessment was done on patients who underwent Cemented and Uncemented for femoral neck fractures. After the procedure, the frequent follow-up was carried out. Clinical evaluation was done for limb length discrepancy, thigh pain, rotation of the limb, gait pattern, and range of movements.
Results: The incidence of postoperative complications was higher in the uncemented group than in the cemented group. The cemented group showed significantly better results than the uncemented group regarding walking distance. There was a statistically significant difference between the two groups regarding Harris hip score.
Conclusions: For elderly patients with a displaced femoral neck fracture a cemented hemiarthroplasty is favorable compared to an uncemented stem. There was no significant overall difference in mortality rate, cardiovascular and cerebrovascular complications, general complications, local complications, and reoperation rate.

Keywords: Hemiarthroplasty, Femoral neck, Cemented, Uncemented

INTRODUCTION

Hemiarthroplasty is a surgical procedure that replaces one half of the joint with an artificial surface and leaves the other part in its natural (pre-operative) state.[1] This class of procedures is most commonly performed on the hip after an intra-capsular fracture of the neck of the femur. The procedure is performed by removing the head of the femur and replacing it with a metal or composite prosthesis.

The most commonly used prosthesis designs are the Austin Moore prosthesis and the Thompson Prosthesis. More recently a composite of metal and HDPE which forms two interphases (bipolar prosthesis) has also been used.[2] The monopolar prosthesis has not been shown to have an advantage over bipolar designs. The procedure is recommended only for elderly and frail patients, due to their lower life expectancy and activity level. This is because with time the prosthesis tends to loosen or erode the acetabulum.[1] Independently mobile older adults with hip fractures may benefit from a total hip replacement instead of hemiarthroplasty.[2] Caring for patients following a hip fracture presents an increasing burden not only on our health care system but also on the patients themselves

as these injuries represent a life-changing event that has a 20% to 30% 1-year mortality rate.[3-5] Additionally, the average lifetime cost incurred by sustaining a hip fracture is as high as incurred at the initial hospitalization and the remainder from subsequent long-term care in nursing homes and lost wages and productivity of the patient's family.[3,6-8]

Although the standard treatment algorithm for extracapsular, intertrochanteric hip fractures is well accepted, the treatment for intracapsular femoral neck fractures is more controversial.[9] Femoral neck fractures in elderly individuals are commonly classified according to the garden classification. Non-displaced fractures (Garden I and II) are usually treated with hip preservation, and displaced fractures (Garden III and IV) are generally treated with arthroplasty in elderly patients.[10]

The primary indication for arthroplasty in patients with displaced femoral neck fractures is to avoid fracture nonunion and avascular necrosis in patients treated with internal fixation, which has been reported to be as high as 39%.[11,12] Many surgeons prefer to treat displaced femoral neck fractures with a hemiarthroplasty, particularly in very elderly patients.[9] However, numerous studies have been published demonstrating that functional outcomes, walking distance, self-reported pain scores, and hip disability indices are superior for patients treated with a total hip arthroplasty (THA) as compared to a hemiarthroplasty.[12] It has similarly been shown that although hemiarthroplasty is less expensive in the short term, total hip replacement is generally more cost-effective in the long term due to the lower revision rates.[11-12] In contrast, the complexities of performing a total hip replacement for femoral neck fracture include an increased rate of dislocation, longer operative times, greater blood loss, and a more technically demanding operation.[9-16]

A femoral neck fracture is more common in females and the mean age of onset is 81 years. That with disability and mortality impose high health care costs on the health system. The risk of femoral neck fracture is about 40-50% in females and 13-22% in males.[17] Epidemiologic studies have recognized several risk factors for femoral neck fracture, including BMI<18.5, Insufficient sunlight, low activity, smoking, history of osteoporosis-related fracture, positive history of hip fracture in his or her mother, and treatment with a corticosteroid. The usual cause of this fracture is a simple fall in which force is transmitted from the greater trochanter to the femoral neck.[18] Other mechanism is leg external rotation with increased force on the capsule and iliofemoral ligament.[19] Intra-capsular femoral neck fractures account for about 50% of hip fractures. The union rate is low because of low blood supply and intra-capsular situation; it is also sometimes associated with femoral head necrosis and delayed segmental necrosis. In recent years, the improvement of health services and increased life expectancy has dramatically increased the incidence of this type of fracture.

It is estimated that the incidence of femoral neck fracture with a change of lifestyle will grow from 1.66 million in 1990 to 6.25 million in 2050 in the world.[17] The treatment of displaced femoral neck fracture in people over 60 years is hemiarthroplasty or total hip arthroplasty depending on the activity level before fracture. Hemiarthroplasty is recommended in people with routine activities and THA in highly active people.[20]

An arthroplasty using a cemented implant may be associated with increased mortality compared with an arthroplasty using an uncemented implant. Cementation of prosthesis achieves a good initial fix in an osteoporotic bone, however, arthroplasty using a cemented implant may be associated with increased mortality compared with an arthroplasty using an uncemented implant, as it has the risk of bone marrow and fat embolization with resulting intra-operative hypotension and increased incidence of deep vein thrombosis. The mechanisms involved are not fully understood but involve cardiorespiratory disturbances caused by venous and pulmonary embolization of bone marrow contents and methyl methacrylate particles.[21]

An uncemented implant may be associated with design-specific complications such as stress shielding, thigh pain, and a higher risk of periprosthetic fracture. This may be the result of the inferior method of fixation or the design of the prosthesis. Although hemiarthroplasties are an important treatment for femoral neck fractures, the literature does not provide a clear approach for selecting the implant fixation method.[22]

Whether a specific type of hemiarthroplasty using an uncemented implant could yield the same clinical results as a hemiarthroplasty using a cemented implant for treatment of displaced femoral neck fracture is unclear. The purpose of this prospective study is to compare a hemiarthroplasty using a well-documented cemented implant with a hemiarthroplasty using a well-documented uncemented implant. Considering the good number of fractures in the neck femur encountered in our hospital, I intend to do this clinical study.

This study aims to evaluate the complications, morbidity, and mortality rates. associated with each of the procedures and to study the radiographic changes, recovery to physical independence and advantages encountered in each of the procedures and achieve stable fixation and early mobilization. Another aim is to draw a conclusion based on study results on what type of fixation whether cemented or uncemented implant fixation would be better in the management of fracture neck of femur in an elderly patient.

METHODS

The study was conducted in the Department of Orthopaedics, M. G. M Medical College and L. S. K Hospital. Kishanganj, Bihar India. Institutional ethical committee approval was taken. Patients aged from >55-to

74 years and patients with intracapsular femoral neck fractures were presented in our OPD or admitted to M. G. M Medical College and L. S. K Hospital, Kishanganj. The sample size was estimated at 40. The sample size was divided into two groups. Group- A- cemented and group-B- uncemented, in this analysis, 20 patients each in group. This prospective study was approved by the ethical committee. The duration of the study was over a period of 18 months extending from January 2019 to June 2020.

Inclusion criteria for this study were all patients with fractured neck of femur, closed fracture, and age more than 55 years. Patients who have pathological fractures, open fractures, patients medically unfit for surgery and radiological evidence of extracapsular fracture neck of femur, and Patient with other associated fractures along with fractured neck of femur were excluded from this study.

Preoperative assessment was done which included-detailed informative history of the patient general physical examination, X-ray of the bilateral hip joint in both AP and lateral view, routine laboratory investigation like CBC, ESR, CRP, blood grouping, random blood sugar, serum urea and creatinine, ECG and chest X-ray. All the results obtained were tabulated and analyzed.

All elderly patients who underwent cemented and uncemented for femoral neck fractures were eligible. The participants should be over 55 years old and underwent primary hemiarthroplasty for unilateral femoral neck fractures. The only bipolar prosthesis was used.

Patients who were unfit for arthroplasty according to the anesthesiologist on call, had a previous symptomatic hip disease such as osteoarthritis, had fractures caused by malignant disease, and had an ongoing infectious disease, were excluded.

Randomization was performed separately for the two groups using a computer random number generator, allocation was done by the numbered, opaque envelopes. All patients who were able to provide informed consent did so. Patients who were not able to provide informed consent because of cognitive impairment were included if it was considered to be in their best interest after consultation with their family. The protocol was approved by the regional ethics committee.

The decision for cementing was taken based upon the pre-op X-ray and the condition of the femoral bone. In case the prosthesis was also loose, the canal was cemented. Usually, 40 mg of cement was used.

The appropriate size of the prosthesis was seated in the prepared medullary canal with 10-15 degrees of anteversion and valgus position. The prosthesis was impacted with gentle blows into the medullary canal. After the cement is set properly the prosthesis was reduced into the acetabulum by gentle traction in the extended position of the knee, with minimal external rotation terminally. While reduction, care was taken to prevent dislodgement of the outer head, and there was no dislodgement of the prosthesis in the present study.

The hip was tested for the full range of movements and stability intra-operatively while the closure of the wound, capsule, and external rotators was sutured back. The wound was closed meticulously in layers over a suction drain maintaining hemostasis throughout the procedure and a sterile dressing was applied. The same procedure was followed in the uncemented cases without the cementing step. Duration of surgery from incision to closure was noted, blood loss during the procedure was calculated, and whether prosthesis can be easily reduced and difficulty in reduction was noted. Blood loss was assessed and blood transfusion was carried out if required.

After getting a check X-ray and confirming the prosthesis position, patients were made to ambulate with the help of a walker. In cemented hips, full weight-bearing was done immediately and in the case of the uncemented type, it was progressed from partial weight bearing to full weight bearing over a period of 4-6 weeks. By the time of discharge, patients were made to ambulate with the help of a walker.

The follow-up was carried out at 6 weeks, 3 months, 6 months, 1 year, and every year afterward. At each follow up clinical evaluation was done for limb length discrepancy, thigh pain, rotation of the limb, gait pattern, and range of movements. Harris Hip Score evaluation was done at each follow-up. Radiological evaluation was done at each follow-up for calcar length, and periprosthetic fractures. Other complications like superficial infection, deep infection, urinary tract infection, bedsores, and any medical complications if present were noted.

Depending on the position of the fracture, the range of motion of the knee and hip and the shortening of the femur, and the degree of pain or swelling, the findings were graded as great, decent, average, or bad.

Statistical analysis was done using STATA software version 15. Results on continuous measurements are presented on mean±SD and results on categorical measurements are presented in percentages.

Significance is assessed at 5%. Student's t-test (two-tailed, independent) has been used to find the significance of study parameters on a continuous scale between two groups.

RESULTS

Age distribution of the study subjects of both groups 61-70 years was the commonest age among study subjects. The mean age of cemented and the uncemented group was 66.05 and 62.4 years respectively with no statistically significant difference between the two groups (Table 1).

Table 1: Age distribution.

Age in years	Bipolar cemented (n=20)		Bipolar uncemented (n=20)	
	N	%	N	%
55-60	05	25.0	09	45.0
61-70	11	55.0	10	50.0
>70	04	20.0	01	05.0
Total	20	100.0	20	100.0
Mean SD	66.050±5.22		62.400±5.94	
P	0.216 (NS)			

Age and sex distribution of the study subjects of both groups show, in our study, we observed a female predominance.

60% patients of cemented group and 65% patients of in the uncemented group were females. Regarding sex distribution, we found no statistical difference between the two groups (Table 2).

Pre-operative assessment

The mode of injury among study subjects in both groups shows accidental fall was the commonest mechanism of injury in cemented groups involving 65% of patients. in the uncemented group RTA was the commonest mechanism involving 55% of patients with no significant difference between the two groups.

The side of injury among study subjects in both groups, analysis shows right-sided injury was the commonest finding in cemented groups involving 55% of patients.

While in the uncemented group left-sided injury was the commonest finding involving 60% of patients with no significant difference between the two groups.

Abrasion was the commonest associated injury in both groups involving 40% of cemented and 65% of uncemented groups respectively with no significant difference between the two groups.

Table 2: Age and sex distribution.

Age in year	Bipolar cemented (n=20)				Bipolar uncemented (n=20)			
	Male	%	Female	%	Male	%	Female	%
55-60	02	10	03	15	03	15	06	30
61-70	04	20	07	35	04	20	06	30
>70	02	10	02	10	00	00	01	05
Total	08	40	12	60	07	35	13	65
Chi-square	3.65480							
P	0.723(NS)							

Table 3: Walking distance.

Walking distance	Bipolar cemented (n=20)		Bipolar uncemented (n=20)	
	No. of cases	Percentage	No. of cases	Percentage
Unlimited	13	65.0	4	20.0
6 blocks	3	15.0	6	30.0
2-3 blocks	3	15.0	4	20.0
Indoor only	1	5.0	5	25.0
Bed and chair	0	0	1	5.0
Total	20	100	20	100
Chi-Square	9.574			
P value	0.04 (S)			

Table 4: Harris hip score.

Harris Hip Score	Bipolar cemented (n=20)		Bipolar uncemented (n=20)	
	No. of cases	Percentage	No. of cases	Percentage
Excellent (91 – 100)	15	75.0	6	30.0
Good (81 – 90)	3	15.0	5	25.0
Fair (71 – 80)	1	5.0	5	25.0
Poor (<70)	1	5.0	4	20.0
Total	20	100	20	100
Chi-square	8.823			
P value	0.03(S)			

There was no significant difference between the two groups regarding true length shortening. The majority of the patients had no comorbidity. The comorbidities we found among study subjects were HTN, DM, HTN with DM, COPD, and IHD.

There was no statistical difference between the two groups regarding comorbidity between two groups. The commonest duration was 1-2 weeks in both groups involving 60% of cemented and 65% of uncemented groups respectively with no statistically significant difference.

Intra operative assessment

The mean duration in cemented and uncemented groups was 100.75 minutes and 96.25 minutes respectively. The duration of surgery was significantly more in the cemented group than in the uncemented group (p=0.04). Regarding intra-operative blood loss, there was no statistically significant difference between the two groups (p=0.184).

Postoperative assessment

The incidence of postoperative complications was higher in the uncemented group than in the cemented group. Fat embolism and superficial infection were found in the cemented group while in the uncemented group posterior dislocation, fat embolism, bedsore, superficial infection, and deep infections were found. There was no statistically significant difference between the two groups regarding leg length deformity (p=0.164). We have found only two patients who had 0.5 cm and 1.0 cm leg length deformity respectively.

Table 3 shows the comparison of walking distance between the two groups mentioned. The cemented group showed significantly better results than the uncemented group regarding walking distance.

Table 4 shows the comparison of the Harris hip score between the two groups. The cemented group had 15 patients with excellent outcomes while in the uncemented group only 6 patients had an excellent outcome. There was a statistically significant difference between the two groups regarding Harris hip score (p=0.03).

DISCUSSION

The study present was conducted in the department of orthopaedics, M. G. M Medical College and L. S. K Hospital. Kishanganj, Bihar, upon patients with intracapsular femoral neck fractures presented in our OPD or admitted to M. G. M Medical College and L. S. K Hospital, Kishanganj. A total of 40 patients were selected for the present study. The sample size was divided into two groups. Group- A- cemented and group B- uncemented, in this analysis, 20 patients each in group. All elderly patients who underwent Cemented and Uncemented for femoral neck fractures were eligible. The participants should be over 55 years old and underwent primary hemiarthroplasty for unilateral femoral neck fractures. The only bipolar prosthesis was used.

In both, groups 61-70 years was the commonest age among study subjects. The mean age of cemented and the uncemented group was 66.05 and 62.4 years respectively with no statistically significant difference between the two groups. In our study, we observed a female predominance. 60% patients of cemented group and 65% patients of in the uncemented group were females. Regarding sex distribution, we found no statistical difference between the two groups. In another study by Igor Movrin et al23 total of 135 patients were analyzed. 56 patients were treated with CHA and 79 were treated with UCHA. No statistically significant difference between CHA and UCH groups was observed comparing the gender (62.5% versus 60.7% female), and the patient's age (86±5 versus 84±4 years). Accidental fall was the commonest mechanism of injury in cemented groups involving 65% of patients. in the uncemented group, RTA was the commonest mechanism involving 55% of patients with no significant difference between the two groups.

The right-sided injury was the commonest finding in cemented groups involving 55% of patients. While in the uncemented group left-sided injury was the commonest finding involving 60% of patients with no significant difference between the two groups. Abrasion was the commonest associated injury in both groups involving 40% of cemented and 65% of the uncemented group respectively with no significant difference between the two groups. There was no significant difference between the two groups regarding true length shortening. The majority of the patients had no comorbidity. The comorbidities we found among study subjects were HTN, DM, HTN with DM, COPD, and IHD. There was no statistical difference between the two groups regarding comorbidity between two groups. 7 trials reported the complications in both CH and UCH groups. Indicating that implanted-related complications rates in the CH group were lower than that in the UCH group. However, there was no significant difference between the two groups in cardiovascular and cerebrovascular complications (OR=1.30, 95%CI=0.72-2.36; p=0.38), local complications (OR=1.29, 95%CI=0.78-2.15; p=0.32) and general complications (OR=0.68, 95%CI=0.45-1.03; p=0.07).[24]

The commonest duration was 1-2 weeks in both groups involving 60% of cemented and 65% of the uncemented group respectively with no statistically significant difference. The mean duration in the cemented and uncemented groups was 100.75 minutes and 96.25 minutes respectively. The duration of surgery was significantly more in the cemented group than in the uncemented group (p=0.04).

A total of 9 trials reported the operation time.[25-28] The random-effects meta-analysis of all 9 trials showed an

increased time of surgery for cemented hemiarthroplasty in comparison with uncemented hemiarthroplasty, with a pooled WMD of 8.03 (95%CI=4.83-11.23). The results were statistically significant (p<0.00001). Evidence showed that the heterogeneity was high (χ2=26.44; I2=70%; p=0.0009). Regarding intra-operative blood loss, there was no statistically significant difference between the two groups (p=0.184).

Data regarding blood loss were reported in 6 studies.[25-28] all 6 studies reported intraoperative blood loss and 2 studies reported postoperative blood loss.[25-29] The random-effects meta-analysis showed no significant difference in intraoperative blood loss between the 2 groups, with a pooled WMD of 22.41 (95% CI=-26.07-70.89; p=0.36). Concerning the large statistical heterogeneity, the I2 value was 80%. To compar0e the difference and evaluate the sensitivity of the meta-analyses, a sensitivity analysis was performed to evaluate the stability of the meta-analysis. When 2 studies was excluded from the meta-analysis, the I2 dropped to 56% and the sensitivity analysis is consistent with our previous analysis (WMD=-11.19; 95%CI=-54.29 to 31.91, p=0.61; χ2=6.79; I2=56%; random-effects model).[25-29] The random-effects meta-analysis showed no significant difference in postoperative blood loss between the 2 groups, with a pooled WMD of 0.24 (95%CI=-30.89 to 31.37; p=0.99) and no heterogeneity (χ2=0.88; I2=0%; p=0.35).

The incidence of post-operative complications was higher in uncemented group than cemented group. Fat embolism and superficial infection was found in cemented group while in uncemented group posterior dislocation, fat embolism, bed sore, superficial infection and deep infections were found. Eleven studies reported complications. Our findings show that significantly fewer implant-related complications occurred in the cemented group than in the uncemented group (OR=0.20, 95%CI 0.13-0.30, p<0.001), with small heterogeneity (χ2=13.63; I2=41%, p=0.09). However, there was no significant difference between the cemented group and uncemented group in terms of cardiovascular complications (OR=1.41, 95%CI=0.90-2.21, p=0.13, χ2=3.88; I2=0%, p=0.79), local complications (OR=1.45, 95%CI=0.96-2.18, p=0.07, χ2=6.04; I2=0%, p=0.74) and general complications (OR=0.84, 95%CI=0.62-1.14, p=0.26, χ2=6.05; I2=0%, p=0.53).[23]

There was no statistically significant difference between the two groups regarding leg length deformity (p=0.164). The cemented group showed significantly better results than the uncemented group regarding walking distance. The cemented group had 15 patients with excellent outcomes while in the uncemented group only 6 patients had an excellent outcome. There was a statistically significant difference between the two groups regarding Harris hip score (p=0.03). In a retrospective study involving 447 patients with 451 displaced fractures of the femoral neck treated by Bateman bipolar hemiarthroplasty, Lo et al found that the cemented prostheses brought better functional results in the early stage.[30] Khan's study using validated scoring systems for pain and functional ability assessment demonstrated that there was a significant deterioration in pain (p=0.003), walking ability (p=0.002), and daily activities (p=0.009) in the UCH group during the follow-up of 32-36 months.[31] Other researchers suggested that there was no clinically or statistically significant difference in the postoperative hip function recovery.[32,33] Despite an obvious tendency for CH in postoperative function recovery, it was difficult to pool and compare other parameters due to the inconsistency of outcome parameters applied. Further research with large samples and standardized hip function scoring systems is warranted to confirm these findings and elucidate the potential advantages of CH in postoperative hip function recovery.

Three studies reported the HHS at different times, such as at 3 months, 6 months, 1 year or 5 years.[25-27] The random-effect meta-analysis of 3 trials showed no significant difference in HHS at 3 months (WMD=1.63; 95%CI=-1.89 to 5.14; p=0.36; heterogeneity: χ2=4.20; I2=52%; p=0.12), 6 months (WMD=2.31; 95% CI=–1.81 to 6.43; p=0.27; heterogeneity: χ2=2.62; I2=62%; p=0.11), or 1 year (WMD=1.93; 95%CI=-1.34 to 5.19; p=0.25; heterogeneity: χ2=4.09; I2=51%; p=0.13). However, Langslet et al showed that the HHS at 5 years in the cemented group was lower than that in the uncemented group (WMD=-9.90; 95% CI=-17.75 to -2.05; p=0.01).[11]

Limitations

This study had several limitations. Selection bias and surveillance bias may be a reason for surprising results we observed. As with all observational studies, limitations include chance, bias and unmeasured confounders.

CONCLUSION

With the trend of global aging, femoral neck fracture has become an increasingly serious problem for senior patients. Hemiarthroplasty, as an effective treatment, can help resume the walking ability as soon as possible, there has been controversy regarding the use of cement for a long time. Some surgeons prefer to apply the uncemented technique since it can reduce operation time, intraoperative blood loss, and peri-operative cardiovascular complications, while others believe that the Cemented technique can achieve better postoperative hip function recovery and less prosthesis loosening. Elderly patients with a displaced femoral neck fracture treated with an uncemented hemiarthroplasty had more periprosthetic fractures, loosening, reoperations, and lower quality of life compared to patients with a cemented stem. Cemented technique, compared with uncemented, is related to better hip function recovery, lower residual pain, less implant-related complications. Based on these findings, we conclude that in elderly patients with a displaced femoral neck fracture a cemented hemiarthroplasty is favorable compared to an uncemented stem. There was no

significant overall difference in mortality rate, cardiovascular and cerebrovascular complications, general complications, local complications, and reoperation rate.

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