A comparative study of bipolar hemi-arthroplasty and total hip joint replacement for the treatment of grade III Osteonecrosis of femoral head

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Abstract:
Total hip arthroplasty (THA) is considered as gold standard for treatment of advanced (Grade III & IV Ficat Arlet) osteonecrosis (AVN) of femoral head. We conducted this prospective study to compare results of bipolar hemi-arthroplasty against total hip arthroplasty in patients with grade III Avascular necrosis of femoral head.36 patients with Grade III Osteonecrosis of femoral head were included in this study. At an average 4 years, 16 patients with average age of 44 years (21-56 years) in THA group and 15 patients with average age of 43 years (28-45 years) in BHA group were available for analysis. The average increase in HHS in THA group was 47.3points (S.D. - 4.8) and 38.9 (S.D. - 2.7) in BHA group with t value 5.4(P-0.0001). All the patients in BHA group had fair to good results. In THA group eight excellent, five good and one had fair to poor result after the surgery Fair to poor results were seen in one patient in THA with dislocation in early postoperative period. BHA group had one case of superficial infection at operative site. Very higher incidence of groin pain and activity limitation was seen in patients with BHA. THA is a better surgical option for treatment of grade III osteonecrosis of femoral head. Because of risk of groin pain, loosening, proximal migration, progression of disease and compromised function after BHA, we do not recommend it in patients with grade III Osteonecrosis.

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Introduction:

Osteonecrosis of femoral head is a progressive disease that affects patients in 3rd to 5th decade of life and if left untreated leads to complete detoriation of hip joint(1). AVN is the result of loss of blood supply to femoral head due to many causes such as alcohol abuse, sickle cell disease, systemic steroids, caissons disease, Gauchers Disease ,Renal osteodystrophy and trauma. Ficat and Arlet (2) have classified AVN according to radiological changes. Treatment of AVN of femoral head varies according to stage of the disease. Ficat Arlet stage I, II A may be treated with core decompression with or without secondary bone grafting procedure.

The treatment Stage IIB is controversial. They are reports of good results with osteotomies of proximal femur in selected researchers. The results of osteotomies are not that reproducible. Stage III & Stage IV femoral osteonecrosis are treated with total hip replacement and bipolar hemi-arthroplasty(3). There are conflicting reports about success of BHA in stage III AVN(4-5). They quote advantage of bone preservation, less morbidity, less chances of dislocation and chances of conversion to THA at later date. Many researchers have reported complications with BHA like, protrusio acetabulo, anterior thigh pain, loss of mobility in bipolar bearing (6). We conducted this prospective study to compare medium term results of bipolar hemi-arthroplasty and total hip arthroplasty in patients with Stage III osteonecrosis of femoral head. We also analysed average cost of each procedure.

Materials & Method:

The prospective study was conducted at this hospital between Jan 2006 to May 2013. Patients with stage III AVN, consenting to participate in the study was included. Patients with Stage I, II, IV AVN were excluded. All the patients included the study were divided into two groups after explaining them pros and cons of each form of treatment. Patients decided the type of surgery they want to undergo. Group A consisted with who underwent THR and group B consisted of patients who underwent BHR.

Each patient was thoroughly examined preoperatively. Hip function was noted with Harris Hip Score and pain was evaluated with Visual analogue scale (VAS). At the start of the study 36 patients were included in the study, 20 patients in THA group and 16 in BHA group. Patients were allocated to different

groups according to their willingness and affordability for these surgeries. Four patients from THA group and one patient from BHA group lost to follow up at 6 month. They were excluded from the study. At the end of study we had 16 patients in THA group and 15 in BHA group.

Ethics: The study was approved by institutional ethical committee. Written informed consent was obtained from each participant in the study.

Surgical technique: All the surgeries were done under spinal epidural anaesthesia. Epidural catheter was kept for 48 hours for post operative pain relief and early mobilization. Intravenous antibiotics, second generation cephalosporins, were given preoperatively, one hour prior to surgery and for two days thereafter. Sutures were removed at average 10 days. Physiotherapy was started at day one, in the form of static quadriceps, ankle pumps, and chest physiotherapy. Ambulation with support was allowed on day two as per pain tolerance. Early out the bed ambulation was encouraged. Ankle pumps, elastic stockinet and early ambulation were used to prevent development of deep vein thrombosis. Low molecular weight heparin was not used routinely except in high risk patients. Average hospital stay was 14 days.

All the patients were evaluated clinically at every three month till 12 months, every year thereafter. HHS and VAS were determined at each visit.

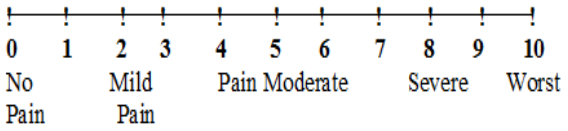
Statistical Analysis:

The data obtained was analysed by calculating mean, standard deviation. The results were compared between two groups by using paired t test to calculate p value and t value. The difference was considered significance if $p<0.005$.

Results:

THA group had 20 patients initially. Four patients were lost to follow up so 16 patients were available for analysis at average 48 months (12-60 months) postoperatively. THA group had 12 male and four 4 female patients with average age of 44 years (21-56 years). The BHA group had 16 patients initially and fifteen were available at average follow up of 48 months (12-60 months). BHA group had 12 male and 3 females with average age of 43years (28-45 years). THA group had average operative operating time of 133minutes (110-145 minutes) with 737 ml of average blood loss. BHA group had average operating time of 89 minutes (80-95 minutes) with 360 ml average blood loss.

Pain – V.A.S. (Visual Analogue Scale)



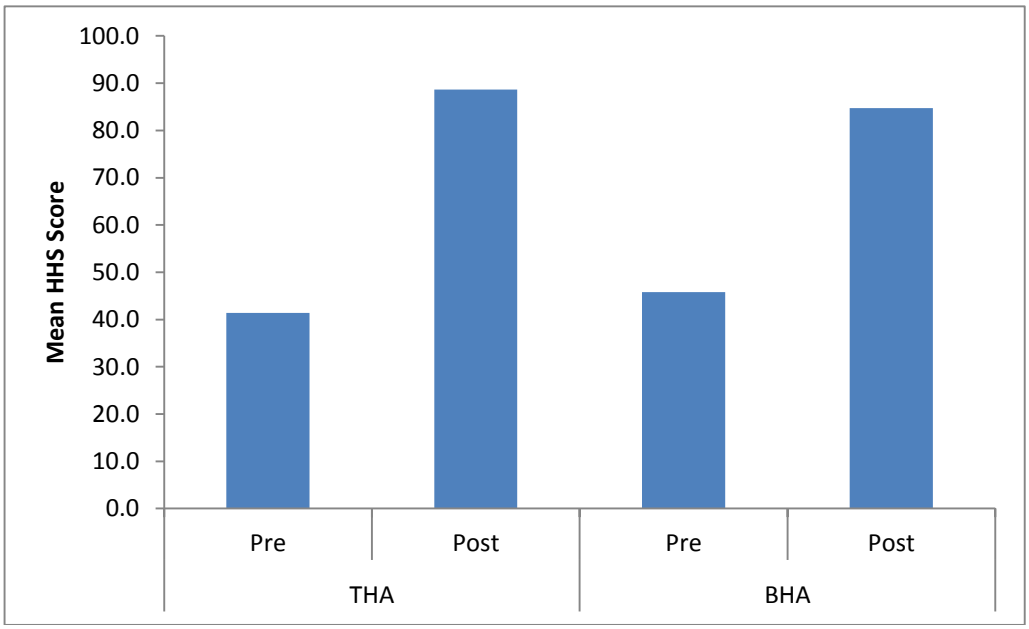
VAS scores in THA group improved from 6.125 to 0.5. VAS scores in BHA group improved from 5.625 to 2.375. Average postoperative flexion in THA group was from 116.875 degrees as compared 129.375 degrees in BHR group. Average rotation in THA group was 25.625 degrees and 30.625 degrees in BHA group. The average HHS in THA group increased from 41.4(Standard deviation 7.3) to 88.6(Standard deviation 5.6) (T value 6.5, p- 0.ooo1) after the surgery. The average HHS in BHA group increased from 45.8(S.D. -2.4) to 84.7(S.D.-1.4) after the surgery (t value 5.4, p-0.0001). The average increase in HHS in THA group was 47.3points (S.D. - 4.8) and 38.9 (S.D. - 2.7) in BHA group with t value 5.4(P-0.0001). The THR group had statistically significant improvement as compared to BHA group. (Table no.1) The results graded according to Harris Hip Score: (91 to 100) – Excellent (81 to 90) – Good (71 to 80) – Fair (61 to 70) – Poor. All the patients in BHA group had good results. In THA group eight excellent, five good and one had fair to poor result after the surgery. Fair to poor results were seen in one patient in THA with dislocation in early postoperative period. The hip was reduced under anaesthesia and flexion at hip was restricted for first month in this patients. This patient had pain in the operated hip limiting their activities. BHA group had one case of superficial infection at operative site, which was managed with debridement and antibiotics without any residual sequele. (Chart No.1).

Table 1: Harris Hip Score.

	Harris hip score in THA group				Harris Hip Score in BHA group		
	Pre	Post	Increased HHS		Pre	Post	Increased HHS
1	49	95	46		49	86	37
2	49	95	46		49	83	34
3	34	89	55		44	83	39
4	34	86	52		44	83	39

5	49	93	44		49	83	34
6	34	77	43		44	86	42
7	49	89	40		44	84	40
8	36	89	53		44	86	42
9	49	93	44		46	86	40
10	49	93	44		49	86	37
11	34	86	52		49	86	37
12	34	86	52		44	83	39
13	49	93	44		44	86	42
14	34	76	42		44	84	40
15	43	89	46		44	86	42
16	36	89	53				
Mean	41.4	88.6	47.3	Mean	45.8	84.7	38.9
s.d.	7.3	5.6	4.8	s. d.	2.4	1.4	2.7
t value	6.5		5.9	t value	5.4		
p value	0.00001		0.00001	p value	0.0		

Chart: 1



Discussion:

Bipolar hemi-arthroplasty has been in been used as treatment for advanced cases of AVN femoral head. The published literature is full of conflicting results with this procedure. Alonge TO et al (5) evaluated results of cementless bipolar hemi-arthroplasty done for secondary osteoarthritis resulting from Oste-onecrosis of femoral head in sickle cell disease in six patients. They reported good results with this procedure with advantage of avoiding damage to acetabulum and ease of revision surgery if needed in future. We had six patients with sickle cell disease in our group, two in BHR group and four in THR. All this patients had good to fair results at last follow up. The patients with sickle cell disease usually presents late with advanced changes of arthritis warranting THA in most of the cases.

Nagai I et al(8) from Japan the long-term results of bipolar endoprosthetic replacement in 12 patients (12 hips) 12 to 18 years after surgery. These patients had Ficat stage III nontraumatic osteonecrosis of the femoral head. 11 of 12 patients did not required any

revision surgery for first ten years. Three patients underwent revision to THR at 3, 17 and 17 years for prosthesis migration. They concluded that the original Bateman endoprosthesis was effective in delaying the need for total hip replacement for more than 10 years in patients with Ficat stage III nontraumatic osteonecrosis of the femoral head.

Tsumura H (9) studied 36 hips in 30 patients with osteonecrosis of the femoral head who were treated with bipolar hip arthroplasty followed up for average 7.7 years Radiographically, there was minimal migration in group I. There was a statistical significance in superior migration between subgroups with and without osteolysis in group II ($P < .01$).They emphasized that bipolar hip arthroplasty is indicated for Ficat stage II or III in osteonecrosis of the femoral head. We did not analyse the radiological osteolysis routinely in our study. We did not have any case of superior migration of prosthesis at 48 month follow up.

It is recommended to use modular bipolar prosthesis with possibility of future conversion to THA using same femoral stem. Sulaiman Alazzawi et al (10) in their study of concluded that conversion to total hip replacement from bipolar replacement for femoral neck fracture is low. In their study out of 164 patients only one patient underwent conversion to THA at the end of one year. Rest three patient underwent conversion to THA for infection, dislocation and fracture. None of the patient in our study underwent revision to THR at average follow up of four year.
Kim et al (4) conducted to a study to effect of bipolar arthroplasty on Acetabular erosion, joint motion and osteolysis in 134 patients. The mean degeneration rate of acetabular cartilage was 0.34 ± 0.35 mm/year. They observed that the outer bearing motion was dominant, but decreased over time. In addition, the degeneration rate of cartilage and the decline rate of outer bearing motion of the osteolysis group were significantly higher than those of the control group. They recommended close observation is needed in cases of high degeneration rate of cartilage and rapid decline of outer bearing motion due to possibility of osteolysis. We did not analyse the movement of bipolar bearing in all patients, we did in three patients. All these three patients showed loss of movement in inner bearing at an average 2 years without affecting good clinical outcome.

Moriya M et al (6) evaluated results of BHA done for steroid -induced Osteonecrosis of femoral head in 27 patients followed for ten years, Japan Orthopaedic Association (JOA) hip score. Kaplan-Meier survivorship was calculated to examine revision arthroplasty failure rate. Radiographic analysis of loosening included radiolucent lines and osteolysis of the acetabulum or femur. JOA hip score increased from 53 points (preoperative) to 87 points (final follow-up). Survival rates were 96.8 % and 78.6 % at ten and 15years, respectively. Prosthesis loosening occurred on the acetabular side in five hips (13.5 %). No femoral-component loosening was observed. BHA had poor results in patients with Association Research Circulation Osseous (ARCO) stage IV ONFH and in patients' over 40 years of age. They recommended BHA for patients with ARCO stage IV ONFH or for patients under 40 years of age. These findings are consistent with our study. None of the patient in our study had femoral stem loosening in both the groups. Acetabular loosening was seen in two patients in THR group but was not significant enough warranting revision.

Cao CF et al (11) reviewed clinical and radiological results of bipolar hip arthroplasty with a cementless porous-coated anatomic femoral component in 86 hips at mean of 5.2 years utilizing Harris hip score and radiographic evaluation based on the criteria of the Hip Society. At the mean follow-up of 5.2 years, the average Harris hip score was 96.1 ± 2.1 (range, 67-100) points, pain score 42.6 ± 6.3 (range, 32-54) points and functional score 45.5 ±4.7 (range, 29-56) points. They reported pain in the anterior part of the thigh in five hips (5.81%), revision of the femoral component because of aseptic loosening and periprosthetic fracture in two hips (2.33%). Twenty-seven femoral components (31.4%) had associated slight pedestal formation. No osteolytic lesions of the femur were identified. Nonprogressive pelvic osteolysis was identified in four hips, none of the lesions being ≥2mm in diameter. They concluded that an anatomically designed prosthesis can provide good clinical results, with low incidence of thigh pain and loosening of the component. IN our study, VAS scores improved better in THA group as compared to BHA group. Four patients in BHA group complained of anterior thigh pain, but were able to carry out their routine activities.

Lee SB et al (12) from Japan in their prospective study compared the results of cementless bipolar arthroplasty to cementless total hip replacement for Ficat Stage III osteonecrosis of femoral head, age, gender matched group of patients. They found better postoperatives scores with total hip replacement group as compared to bipolar group. They recommended total hip replacement because of more incidences of gluteal and groin pain and migration in these patients with bipolar hemi-arthroplasty. We had more incidence of groin pain in patients with BHA as compared to THA. The overall patient satisfaction was more in patients in total hip arthroplasty. The activity limitation was more in bipolar group.

The limitation of the present study is small sample size, shorter duration of follow up, lack of radiological follow up and lack of randomisation. However this study highlight that even today in this subcontinent cost of prosthesis remains the deciding factor. BHA is still commonly used as a cheaper alternative to THA.

Conclusion:

Bipolar arthroplasty in patients with Grade III Osteonecrosis of femoral head gives fair to good results as compared to good to excellent results with THA. Because of risk of groin pain, loosening, proximal migration, progression of disease and compromised function after BHA, we do not recommend it in patients with grade III Osteonecrosis. THA remains the gold standard for treatment of advances Osteonecrosis of femoral head. We however recommend long term randomised trial to compare the results of this two procedure.

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