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Cementless Total Hip Arthroplasty in Drug-Induced Osteonecrosis

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ABSTRACT

Background: Osteonecrosis is a debilitating disease that may progress to collapse the subchondral bone and the articular cartilage of the joint.

Objective: This study aimed to document the clinical and radiographic results of cementless total hip replacement (THA) in patients with osteonecrosis of the femoral head.

Patients and Methods: This prospective clinical trial study was conducted on eighteen patients diagnosed with steroid-induced osteonecrosis of the femoral head at the Orthopedic Department, Zagazig University Hospitals during the period from August 2020 to the end of January 2021. All patients were subjected to Pre and post-operative clinical evaluation, special radiological assessment was applied.

Results We assessed the clinical signs and symptoms using a modified Harris hip score pre and post-operatively. MHHS of 90 points or more was categorized as an excellent result; 80-89 points were good; 70-79 points were fair; less than 70 points were poor results.

Conclusion: Advancements in surgical technique and better designs have greatly improved the long-term survival of cementless implants in young patients with osteonecrosis of the femoral head.

Keywords: Osteonecrosis, Total hip replacement, Osteonecrosis.

INTRODUCTION

Osteonecrosis (ON) of the femoral head is a debilitating and potentially devastating condition that has a poorly understood pathogenesis and a wide range of causes [(1)]. The etiology of osteonecrosis of the femoral head (ONFH) is multifactorial, unclear, and partly unknown but this pathologic entity is the final common pathway of traumatic or non-traumatic factors that compromise and at last interrupt the particular circulation of the femoral head [(2)].

Many risk factors have been identified, but none of them is a certain cause. The estimated frequency of the most frequent risk factors for ONFH is alcohol (20-40%), corticosteroid therapy (35-40%), and idiopathic (20-40%) [(2)]. The most commonly reported laboratory abnormalities include decreased function and concentration of fibrinolytic agents, as well as increased levels of thrombophilic agents [(3)]. Osteonecrosis of the femoral head commonly affects patients in the third, fourth, and fifth decades of life [(4)].

The collapse of the femoral head, accompanied by secondary osteoarthritic changes occurs towards the later course of the disease. When the collapse is beyond salvage by any other means, i.e: drilling, varus derotation osteotomy, or free vascularized graft, three options remain for treatment in young patients: total hip arthroplasty (THA), arthrodesis of the hip joint, and resection arthroplasty of the femoral head [(5)].

Total hip arthroplasty (THA) is indicated for the alleviation of incapacitating hip pain due to trauma or degenerative diseases of the hip joint and when the femoral head has collapsed and the joint shows advanced degenerative changes [(1)].

THA remains the only helpful solution in advanced stages ofosteonecrosis; however, in the long run, this intervention in young individuals is associated with higher failure rates when compared with the same performed in an older population. Moreover, it is believed that there is a difference in the prognosis of THA performed for various etiologies of osteonecrosis. The results of THA for osteonecrosis are less satisfactory compared with those of THA for other sources of osteoarthritis[(6)]**.** There exists a debate about the method of fixation of the implants and the best possible bearing combination for these high-demand young patients. The advances in surgical techniques and prostheses designs over the years have improved the overall survivorship of total hip replacement (THA) in general. However, there are mixed reports about the improvement that occurs in patients with osteonecrosis[(7)]**.**

So, the purpose of this study was to document the clinical and radiographic results of cementless THA in patients with osteonecrosis of the femoral head and to determine the advantages and limitations of this kind of treatment.

PATIENTS AND METHODS

This study included patients diagnosed with steroid-induced osteonecrosis of the femoral head studied prospectively. Patients were covered for six months from the first of August 2020 to the end of January 2021. A sample of eighteen patients was included. Female patients were more than males with a mean age of 36.39 years old.

Ethical consent:

Approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed informed written consent for the acceptance of participation in the study. This work has been carried out following The

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Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion criteria: Surgically fit patients. Patients with drug-induced osteonecrosis of the femoral head.

Exclusion criteria: Patients with femoral head osteonecrosis due to other etiologies such as trauma, myeloproliferative disorders, etc. Surgically unfit patients. Patients with symptoms and /or signs of resistant infection.

Pre-operative:

All patients were subjected preoperatively to history taking, general evaluation, and local hip examination. The patient's hips were evaluated clinically and radiologically both preoperatively and postoperatively, Laboratory investigations as a preoperative assessment in the form of routine laboratory investigations (liver function tests, renal function tests, complete blood picture, coagulation profile, random blood sugar, ESR, CRP, and viral markers) were done for all the patients. An ESR of <30 mm/h (first hour) and CRP <6 mg/l were considered the values for exclusion of infection. ECG was done for some patients. Musculoskeletal evaluation of patients.

Radiological evaluation of patients; all patients were subjected pre and postoperatively to the pelvis and both hips anteroposterior and hip lateral radiographs. MRI hip joint was ordered in some patients.

Surgical technique:

Under spinal anesthesia utilizing the modified Hardinge approach, a cementless total hip was performed in 18 patients. The acetabular metallic shell was anatomic and secured by two or three screws or press-fit without screws, while the femoral component was press-fitted. Post-operative enoxaparin was used for prophylaxis against deep venous thrombosis in all cases.

Post-operative follow up:

All patients received DVT prophylaxis for 5 weeks. Active assisted exercises started during the first postoperative day and according to the patient's condition. Partial weight-bearing was allowed using axillary crutches in the first 6 weeks post-operative and full weight-bearing with contralateral elbow crutch started after about 6-8 weeks. Immediate radiographs were obtained.

The MHHS was evaluated preoperatively as well as at 6 months postoperatively. The functional outcome was evaluated according to MHHS. AP pelvic radiograph was taken postoperatively at 6 weeks and 6 months after surgery unless pain or clinical symptoms warrant more early investigation.

Statistical analysis

The collected data was computerized and statistically analyzed using the SPSS program (Statistical Package for Social Science) version 16.0. Qualitative data were represented as frequencies and relative percentages. Quantitative data were expressed as mean ± SD (Standard deviation). The Chi-square test (χ^2) or Fisher's exact test was used to calculate the difference between qualitative variables. The student t-test was used to calculate the difference between quantitative variables. The results were considered significant when the probability (P-value) was less than 0.05, highly significant if it was less than 0.01, and very highly significant if it was less than 0.001.

RESULTS

Table 1 showed that females represented 55.6 % of the studied patients. Age ranged from 23to 52 years with a mean age of 36.39 years.

Table (1): Distribution of the studied patients according to demographic data

	N = 18	**%**
Age (year):		
Mean ± SD	36.39 ± 10.1	
Range	23-52	
Gender:		
Female	10	55.6%
Male	8	44.4%

Table 2; showed that regarding pain, all patients had moderate (88.9%) and marked pain (11.1%) preoperatively while 61.1%, 22.2%, and 16.7% ignore pain, had slight occasional pain, and mild pain postoperatively respectively with statistically significant improvement. Regarding limp, 61.1% and 38.9% of patients had slight and moderate limp preoperatively while 83.3% and 16.7% of them do not limp or had slight limp postoperatively respectively with statistically significant improvement. Regarding support, 11.1%, 66.7%, and 22.2% of patients had a support degree (cane long walk, cane most of the time, and one crutch respectively), while postoperatively 44.4% can move with no support with statistically significant improvement. Regarding walking distance, 55.6% and 44.4% of patients can walk six blocks and 2/3 blocks preoperatively while 50% can walk unlimited with statistically significant improvement. Regarding climbing stairs, 61.1% and 38.9% of patients can ascend stairsnormally with rail or in any manner respectively preoperatively, while 83.3% and 16.7% of them can ascend stairs normally without rail or normal with rail limp postoperatively respectively with statistically significant improvement. Regarding the ability to wear shoes and socks, 1,1.1%, 61.1%, and 27.8% can wear them with ease, difficulty, or are unable to wear them respectively preoperatively, while 83.3% and 16.7% of them wear them with ease or difficulty postoperatively respectively with statistically significant improvement. Regarding sitting on a chair, 38.9%, 11.1%, and 50% of patients can siton an ordinary chair for 1 hour, sit on a high chair for 1 hour, or are unable to sit onany chair respectively preoperatively, while 72.2% and 27.8% of them can sit on an ordinary chair for 1 hour, or sit on high chair for 1 hour postoperatively respectively with statistically significant improvement.

Half of the patients preoperatively can use public transport which significantly increased to include all patients postoperatively.

Table (2): Comparison between components of MMHS pre and postoperatively among the studied patients

Components	Preoperative N=18 (%)	Postoperative N=18 (%)	p
Pain			
None or ignores it	0 (0)	11 (61.1)	
Slight, occasional	0 (0)	4 (22.2)	0.001**
Mild pain	0 (0)	3 (16.7)	
Moderate pain	16 (88.9)	0 (0)	
Marked pain	2 (11.1)	0 (0)	
Limp: None (11)	0 (0)	15 (83.3)	
Slight (8)	11 (61.1)	3 (16.7)	0.001**
Moderate (5)	7 (38.9)	0 (0)	
Severe (0)	0 (0)	0 (0)	
Support:			
None	0 (0)	8 (44.4)	
Cane, long walk	2 (11.1)	10 (55.6)	0.001**
Cane, most of tim	12 (66.7)	0 (0)	
One crutch	4 (22.2)	0 (0)	
Distance:			
Unlimited	0 (0)	9 (50)	
Six blocks	10 (55.6)	9 (50)	0.001**
Two to three blocks	8 (44.4)	0 (0)	
Stair:			
Normally without rail	0 (0)	15 (83.3)	0.001**
Normal with rail	11 (61.1)	3 (16.7)	
In any manner	7 (38.9)	0 (0)	
Shoes and socks:			
With ease	2 (11.1)	15 (83.3)	0.001**
With difficulty	11 (61.1)	3 (16.7)	
Unable	5 (27.8)	0 (0)	
Sitting:			
Ordinary chair for 1hour	7 (38.9)	13 ()	0.001**
High chair for hour	2 (11.1)	5 ()	
Unable to sit on any chair	9 (50)	0 (0)	

P for Friedman test **p≤0.001 is statistically highly significant

Table 3 showed that there is a statistically significant increase in mean MHSS from 42.94 preoperatively to 82.06 postoperatively.

Table (3): Comparison between MHHS among the studied patient's pre and postoperatively

	Preoperatively	Postoperatively	p
Mean ± SD	42.94 ± 6.975	82.06 ± 5.896	**<0.001****
Range	24 – 54	69 – 91	

**p≤0.001 is statistically highly significant

DISCUSSION

A sample of eighteen patients was included. Female patients were more than males with a mean age of 36.39 years old.

This study demonstrates that there is no significant difference between both groups regarding socio-demographic data and this is consistent with **Danielle *et al.*[8]. Osawa *et al.* [9]** included 78 patients with a mean age of 51.4 ± 11.8 years. There were 40 men and 38 women.

Danielle *et al.* [8] included 43 patients with a mean age of 51.2 ± 12.3 years. patients were predominantly males (88.4%).

In our study, cementless total hip arthroplasty was performed on Ficat stage 3 and 4 patients whose severe pain could not be managed with conservative treatment. No significant differences were found between the stage 3 and 4 patients in terms of pre and postoperative hip scores andimprovements in the hip scores. The following conclusions can be deduced from these results. First, there are no significant differences between stages 3 and 4 according to Ficat staging, which is mainly an anatomical staging system. Second, cementless total hip arthroplasty creates no significant differences as regards postoperative healing between stage 3 and 4 patients.

Dudkiewics *et al.* [10] evaluated the effect of the etiology of avascular necrosis on the results, and reported that the final functional outcomes were not affected by the etiology; however, the lifespan of the implant in avascular necrosis related to the use of corticosteroids was shorter. We did not see any evidence indicating this. This may be due to the short period of our study.

The incidence of infection following THA ranges from 1% to 3% in the literature.[11,12] The infection rate for THA in corticosteroid-induced osteonecrosis ranges from 1.3% to 19% in various studies[13,14].

In the present study, the infection rate was 16.7%; this only represents 3 hips, and from our small sample size, it is difficult to draw any firm conclusions about the incidence of periprosthetic infection in patients with corticosteroid-induced osteonecrosis compared with the general THA population.

In the literature, the prevalence of postoperative periprosthetic fractures ranges from 0.1% to 2.1% depending on the series reviewed[15,16]. In the present study, the prevalence of periprosthetic fracture was 0%. Our sample size was too small to generalize or

comment on the incidence of the periprostheticfracture among cementless fixation. Most of the patients in our study received long-term corticosteroid therapy and were at higher risk for decreased bone density. Thus, the risk of periprosthetic fracture may be greater among patients on long-term corticosteroid therapy.

Another problem that might be encountered following total hip arthroplasty applications in avascular necrosis of the femoral head is dislocations in early and late periods.

Kim *et al.*[17] reported that dislocations occurred in the early period in three cases out of 116 that performed cementless total hip arthroplasty because of avascular necrosis of the femoral head, and dislocation occurred in another one in the 49th month postoperatively. Dislocation in the late period has been attributed by the researchers to the over-abduction positioning of the acetabular component. In our study, we encountered 2 cases of dislocation. We can attribute this to liner breakdown in one case and weak abductors in the other case.

Fye *et al.*[18] used the Harris hip score which improved from 31 (preoperatively) to 96 (2 years) and was maintained at 93 (final).

Gupta *et al.*[19] used a modified Harris hip score whichimproved from 28 preoperatively to 86 points at 6 months follow-up.

Kumar *et al.*[20] used a modified Harris hip score which improved to 78.97 points at the final follow-up.

In this study, we used a modified Harris hip score which showed improvement in all of its components. The mean MHHS improved from 42.94 preoperatively to 82.06 postoperatively. The results were excellent in 5.5 % of patients, good in 66.6 % of patients, fair in 22.2 % of patients, and poor in 5.5 % of patients. This poor result was due to mild pain and limping that patient has.

CONCLUSION

Advancements in surgical techniques and better designs have greatly improved the long-term survival of cementless implants in young patients with osteonecrosis of the femoral head.

This study evaluated the clinical and radiographic results of cementless total hip arthroplasty in young adults with drug-induced osteonecrosis of the femoral head.

Despite the technical challenges, in our series, there were few serious orthopedic complications and the clinical outcomes were acceptable.

Based on this study, the results of cementless hip arthroplasties are satisfactory and encouraging in treating this challenging group of patients.

There were some limitations in our study that we needed a largernumber of patients and a longer period of follow-up. The management of drug-induced osteonecrosis of the femoral head in young and active patients continues to be a challenge.

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