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Total Hip Arthroplasty in Sickle-Cell Disease: Comparing Cemented and Non-Cemented Options

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Abstract

Background: Avascular Necrosis of the Femoral Head (ANFH) is a well-known sequela of Sickle-Cell Disease (SCD), mostly requires Total Hip Arthroplasty (THA) as a salvage procedure for improving the quality of life of the patients. The present study was undertaken to analyze the outcome of cemented versus non cemented total hip arthroplasty in patients with SCD. Methods: From 2007 to 2015 total hip arthroplasty for disabling consequences of ANFH due to SCD hips was carried out for 106 in 70 patients. 36 patients had bilateral ANFH and 34 patients had unilateral disease of hip due to ANFH. Randomization was done blindly for cemented and non-cemented groups with 53 hips in each group. Average duration of follow-up ranged from 4 to 8 years. **Results:** The cemented and cement less group both were same as far as the Harris hip score, Quality of life improvement and hip movements were considered. One intra- operative fractures of the proximal femur and 4 superficial infections were observed in both the groups while 2 deep infections only in cement less group (3.77%), No aseptic shell failure in both groups and 1 aseptic femoral stem failure in cement less group (1.88%). There was no heterotopic ossification developed in current study. All the patients had uneventful postoperative period with no deaths resulting from the operative event. **Conclusion:** Whether cemented or non cemented, total hip arthroplasty is a reliable and safe procedure to improve quality of life in Sickle Cell Disease (SCD) with disabling effects due to hip pain. Cementless and cemented components both are associated with good long term results.

Keywords: Avascular Necrosis, Harris Hip Score, Sickle-Cell Disease (SCD), Total Hip Arthroplasty (THA)

1. Introduction

Sickle Cell Disease (SCD) is very common in Central part of India. It is an inherited disorder of hemoglobin synthesis, the prevalence of sickle cell gene around the world varies between 5% and 25%[1-3]. However, in SCD a vicious cycle of local hypoxia and further sickling of red cells may infarct an area of bone which may lead to arthropathy[4]. Avascular necrosis of the femoral head is a well-known sequel of sickle-cell disease[5,6]. Many patients with the disease develop debilitating degenerative arthritis at a very young age, and involvement of both hips is common[5]. With the development of a successful total joint arthroplasty by Charnley during the 1960s, total hip arthroplasty has become a widely practiced and highly successful operative procedure in the treatment of Avascular Necrosis (AVN) of the femoral head[7].

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Advances in medical treatment have led to improved life expectancy in sickle cell patients, which in turn lead to an increasing number of patients requiring THA. The choice of cemented or cementless hip arthroplasty in SCD and the type of cementless femoral stem is an important issue, which still remains unresolved. It has been suggested that bone in growth is poor in patients with SCD[8,9]. Early series of THA among SCD patients reported a high complication and failure ranging between 18% and 100%[9-13]. Improvement in intra- and postoperative care and possibly of the implant design has resulted in better outcome in reports within the last decade[14,15]. The choice of cemented or cementless fixation in THA for SCD has not been conclusively determined, although recent small studies indicate that cementless THA to be better than cemented prosthesis[10-13,15]. There are increasing experimental and clinical data to suggest that several of the uncemented total hip arthroplasty may provide results equivalent or superior to those of cemented total hip arthroplasty. To date, there have been few studies that directly compare cemented to uncemented total hip arthroplasties. Therefore, present study was carried out to compare the outcome of cemented and non cemented total hip arthroplasty in patients with SCD.

2. Methods and Materials

Approval from the Institutional Ethical Committee was obtained to analyzed 106 primary total hip arthroplasties performed in 70 sickle cell disease patients for avascular necrosis of the femoral head for a period of 2007 to 2015. The data were retrieved from the out- and inpatients records and from the computer based patients care system (Ulticare). Out of 70 SCD patients, 36 patients had bilateral avascular necrosis of femoral head and 34 patients had unilateral disease of hip due to avascular necrosis of femoral head; and randomization was done blindly for cemented and non cemented groups with each group having 53 hips. Mean age of patients were 32 years (range 23 to 36 years). All the patients were operated by same approach and received injection tranexemic acid prior to surgery as per set protocol by surgeon. The approximate blood loss was about 280 ml. Careful perioperative monitoring of patients was done to prevent any untoward or adverse event. The duration of follow-up ranged from 4 to 8 years (Average).

The data collected were age, sex, type of sickle cell hemoglobinopathy, duration of symptoms related to hip pain, type of prostheses used, fixation method, bearing surface, and intra- and postoperative complications. At follow-up, functional outcome measures was assessed by using Harris hip score[16]. Consecutive postoperative radiographs were assessed for loosening. Acetabular loosening was mapped using the DeLee and Charnley zones[17], while femoral loosening was assessed using Gruen zones[18]. In cementless hips, acetabular component loosening was evaluated according to analysis[19] while femoral component was evaluated using modified grading[20]. The data were entered in the database, and all tests were performed using SPSS version 17.0, with statistical significance of p of <0.05 and CI 95%.

3. Results

All patients of both groups were relieved of pain after surgery and all were available for follow-up, which ranged from 4 to 8 years (mean 6.2±01 years). Patients who underwent cemented THA, being done slight earlier, had longer duration of follow-up (5–8 years, mean 7±2.1), while patients with cementless THA had a 4 to 7 years of follow-up (mean 6.8±3.3). The demographic data of all the patients were given in Table 1. Duration between start of severe symptoms and surgery was 1 to 10 years (mean 5.7±2.4 years).

Thirty-six patients underwent bilateral THA among which 27 were males and 9 were females while thirty-four patients underwent unilateral THA among which 28 were males and 6 were females. Forty-two patients had

Table 1. Demographic data of all analyzed patients

Parameters	Cemented	Non-Cemented
Number of cases done	53 (50%)	53 (50%)
Age in years	23-35 (mean 30±6.4)	24-36 (mean 31±7.2)
Gender male/female	29:24	27:26
Duration of symptoms before surgery years	2–9 (mean 7±4.7)	1–10 (mean 5±2.3)
Duration of follow-up in years	5-8 (mean 7±2.1)	4-7 (6.8±3.3)

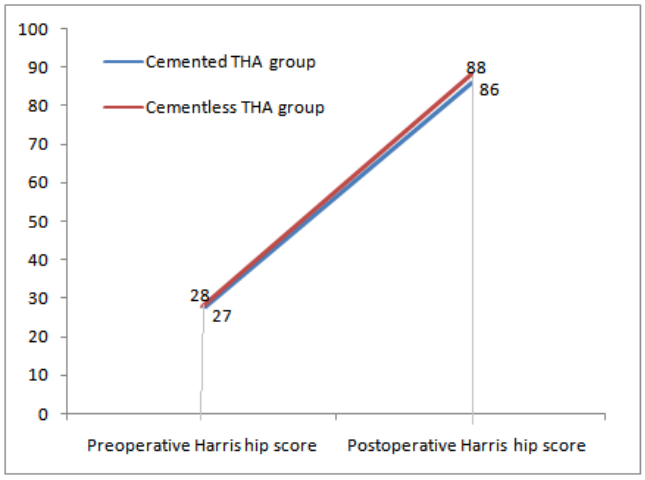

Figure 1. Mean Harris hip score in both the groups.

homozygous hemoglobin SS disease. Fifteen had sickle cell trait (Hgb AS). Two patients had hemoglobin SC disease. Nineteen patients had sickle cell β-thalassemia disease. Mean fetal hemoglobin concentration was 23.9% (range 3.9– 31%).

Harris hip score improved in cemented THA group from mean of 27 (20–34) preoperatively to mean of 86 (83–91) postoperatively while it improved in cementless THA group from mean of 28 (22–35) to mean of 88 (84–92), (Figure 1). Thus, the cement less and cemented group both were same as far as the Harris hip score, Quality of life improvement and hip movements were considered. In the present study both the procedures were comparable because of relatively low demands of SS patients.

Serial radiological examination showed that there was one (1.88%) intra- operative fractures of the proximal femur in cemented groups and one (1.88%) in cement less group, 4 (7.54%) superficial infection in both groups each and 2 (3.77%) deep infections in cement less group, No aseptic shell failure (0.0%) in both groups, and 1 (1.88%) aseptic femoral stem failure in cement less group. Up to 4 years after surgery, 3 patients suffered at least 1 hip-related complication, 1 in the cemented group and 2 in the uncemented group, (Table 2). No heterotopic ossification developed in our case series. All the patients had uneventful postoperative period with no deaths resulting from the operative event.

4. Discussion

Sickle cell disease is most common among people of African, Arabian and Indian origin and it is widespread among many tribal population groups in India with prevalence of heterozygotes varying from 1-40 percent. Co-inheritance of the sickle gene with β-thalassaemia, HbD Punjab and Glucose-6-Phosphate Dehydrogenase (G6PD) deficiency has also been reported[21]. However the avascular necrosis of the femoral head is the most frequent sequela of SCD, followed by avascular necrosis of the humeral head.

The cemented total hip arthroplasty has been one of the most successful operations performed by orthopaedic surgeons, as the duration of follow-up study increases it is becoming apparent that this procedure has shortcomings. Although quite successful in osteoarthritic patients older than 50 years, cemented total hip arthroplasties have significantly higher failure rates in younger patients[22-24]. Patients undergoing revision arthroplasty represent another large group with similarly poor cemented total hip arthroplasty results[25,26]. Although there has a considerable effort expended to research the biologic and/or mechanical reasons for this deterioration, no method of specifically preserving the bone-cement interface over

Table 2. Complications observed in both the groups

Complications	Cemented	Uncemented
Dislocation	0	0
Periprosthetic fracture femur intraoperatively	1	1
Late periprosthetic fracture	0	1
Superficial infection	4	4
Deep infections	0	2
Aseptic femoral stem failure	0	1
Aseptic shell failure	0	0
Total number of hip complications	1	1
No. of patients with any hip complication	1	2

time has been developed. To be sure, advancements in cementing techniques, such as pressurization, use of canal plugs, and minimization of cement voids, has lowered the failure rate, but there would seem to be an irreducible minimum of failures attributable to alterations at the bone-cement interface over time. This state of affairs has helped to ignite the tremendous interest in cementless prostheses. The underlying hypothesis is that by achieving "biologic fixation" of the prosthesis to the surrounding bone, long-term loosening of the prosthesis might be reduced or eliminated. While there is some theoretical justification for this concept, with very encouraging short-term data, there are no long-term data that either support or refute the use of the modern uncemented prosthesis. The importance of requiring such long-term data is obvious[7].

To ascertain the utility of the uncemented prosthesis, it would seem critical to compare it to results obtained using cemented prostheses. Ideally such a study would involve concurrent patient groups receiving either cemented or uncemented prostheses, in an environment providing for detailed follow-up study and evaluation of these patients. It would seem evident, therefore, that one would like to test the uncemented prosthesis in a setting in which the results of the cemented hip replacement are the worst[7].

In present study, out of 106 THA, 53 THA was cemented Charnley hip prosthesis: stainless steel polished stem with a 22.25-mm-diameter head (Charles F. Thackray, Leeds, Great Britain) and an Ultra-High Molecular Weight Polyethylene (UHMWP) acetabular component, with third generation cementing technique. Remaining 53cases were cementless thirty-four of them had JRI-Furlong HA-coated femoral stem and a threaded acetabular component with an UHMWP insert and a modular ceramic head (JRI Instrumentation Ltd, London, UK). The rest 19 cases were proximally non-circumferentially coated Bi-metric stem with Ring Loc Cups and an UHMWP insert and a 28-mm-diameter cobalt–chromium head (Biomet, Warsaw, IN, USA). Choice of implant used was mainly based on availability.

Previous reports showed high failure rate of THA in patients with SCD[8-12], ranging from 31% to 66%. More recent studies showed promising results for cement- less THA[13,27,28]. Reported[27] better results of cementless over cemented THA, and this was supported by other workers[13,28]. Also they found a loosening rate of 94% in cemented hips, compared with a rate of 39% in uncemented hips in patients with SCD. The use of cement is likely to cause thermal necrosis of already infracted bone, contributing to a higher incidence of infection and loosening. In our study, there was no statistically significant difference in distribution of hemoglobinopathy in cemented and cementless group. Hickman and Lachiewicz[13] reported excellent short-term to midterm results in a small group of patients treated with uncemented implants. Among 15 hips (10 patients) undergoing THA for SCD, there were 7 primary and 8 revision hip arthroplasties. The patients were monitored for a mean of 6 years. They had no superficial or deep infections and no loosening of cementless components. The reasons for such good results might have been the young age and high activity level of the patients.

We found excellent long-term results for both cemented and cementless femoral stems: After long-term follow-up of 6.2±01 years, there was no statistically significant difference in failure rate between cemented and cementless arthroplasties. We observed no aseptic shell failure in both groups but 1 (1.88%) aseptic femoral stem failure in cement less group, ($p>0.05$). This excellent outcome may be because of the extensive bone growth that occurs on the prosthesis. The canals are narrow but are metabolically active. Many canals have a thin cortical lining inside the outer cortex, a feature for which we have coined the term “femur within femur” (Figure 2). We believe that in this setting, the bones keep remodeling and fixation occurs throughout the stem even if it is only proximally coated, which may be why stems show excellent fixation over the long term. Another reason may be that most of our patients were very young at the time of the index procedure.

Although the safety of THA was once questionable in patients with SCD improvements in anesthesia and surgical techniques have made the procedure safe and effective. We now advocate even simultaneous bilateral THA in these patients if both arthritic hips cause them disabling pain[28]. An infection rate as high as 20% has been reported

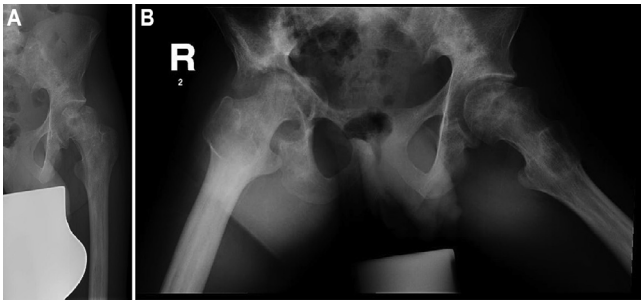

Figure 1. Mean Harris hip score in both the groups.

for patients with SCD[27]. This may be because these patients are immune compromised and have had multiple blood transfusions. There is also a high incidence of osteomyelitis in these patients, and a high percentage of them have occult infection of the femoral head and capsule[29]. It is our routine practice to send cultures of the bone and the capsule to a laboratory for histopathology studies. The risk of periprosthetic infection remains higher for these patients than for those without SCD. Our patients' infection rate was 3.21%, which was comparable to the 3% reported[30]. In patients with SCD, long-term results of THA using cemented femoral stems and noncemented shells are very encouraging. Though complications are more frequent in these patients, they may be avoided by careful surgical technique, correct implant selection, and meticulous hydration and oxygenation in the perioperative period.

5. Conclusion

The present study concluded that whether cemented or non cemented, total hip arthroplasty is a reliable and safe procedure to improve quality of life in SCD with disabling effects due to hip pain. Careful preoperative planning is required for avoiding the complications in preoperative and postoperative period associated with SCD, which can lead to a successful outcome after THA. Cementless and cemented components both are associated with good long term results.

Implicit in this analysis is the assumption that comparison studies between cemented and uncemented prostheses are needed to define further appropriate uses of these prostheses. We suggest that it is appropriate for academic orthopaedic centers to design, conduct, and report on the results of such trials. In the absence of this, it will be very difficult, if not impossible, to determine the advantages and disadvantages of cemented and uncemented total hip arthroplasties.

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