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Short term outcomes of UN cemented total hip arthroplasty in sickle cell disease patients

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Abstract

Osteonecrosis of femoral head is a serious, relentlessly progressive and disabling complication of sickle cell patients, majority of whom are in their second to third decades. In this study, the primary objective is to provide risk assessment relating to operative intervention of total hip arthroplasty in sickle cell disease and efficacy of various methods in reducing complications pertaining to the surgery. The secondary objective of the study is to evaluate the effect of total hip arthroplasty on the functional status of the patient in immediate and early post operative period.

Materials and methods: 25 (35 hip replacements) sickle cell patients with advance osteonecrosis of femoral head who underwent uncemented total hip arthroplasty are included in this study. Harris hip score criteria was used to assess the outcome.

Result: Three patients developed intraoperative hypotension with one patient amongst them requiring intensive care unit transfer. Infection was seen in one patient. Revision surgery was required in none of the patients. Mean Harris hip score improved from 44.5 preoperatively to 89.5 Postoperatively. All of the patients reported high to average hip function with increased range of motion in flexion, abduction and external rotation.

Discussion and Conclusion: We recommend uncemented total hip replacement in sickle cell patients with advance osteonecrosis. It is a safe procedure with predictable outcomes in a setting of a fully functional tertiary care unit. The surgery provides the patient with a stable hip and improves functional status and relieves patient's compromised lifestyle.

Keywords: Total hip arthroplasty, sickle cell disease, osteonecrosis

Introduction

Sickle cell disease (SCD) is one of the most common causes for osteonecrosis of femoral head in children¹. Almost half a century ago, this disease had high mortality with average age survival just being 14.3 years^[2]. However, nowadays with the advances in management and current treatment protocol regarding hydration, analgesia has extended the life span of the patients affected by this disease upto their sixties^[3]. Thus, the patients thrive longer but unfortunately are burdened with an intractable pain due to osteonecrosis caused by the disease. Treatment of osteonecrosis of femoral head has been agreed upon in the scientific community as total hip arthroplasty (THA). However, SCD patients report substantially high perioperative complications than reported in the general orthopaedic population^[4]. Also previous studies of THA in SCD report high risk of complications than observed after THA for other conditions. Complications can be attributed to technically challenging surgery due to changes in bone anatomy and morphology by the disease process and medical management in the perioperative period due to the nature of the disease itself. Therefore there has been a reluctance to perform THA as the benefits have been controversial. Survivorship of the prosthesis and inevitable need for early revision along with high medical complications advocates against THA for osteonecrosis of femoral head in patients with SCD. However, in wake of the increased life expectancy, this young population with SCD is willing for a pain free life and frequently seeks treatment by surgery if this provides them with functional pain free life. These findings have a higher relevance in the setting of Indian population with about 1.4 million patients in tribal population and 9 lakh sickle cell trait and 70,000 SCD patients in Gujarat (home state of the research hospital)^[5].

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This prevalence of osteonecrosis in Indian population, in an already high risk group, with preexisting malnourishment and indulgence in traditional Indian lifestyle habits like squatting and cross legged sitting makes the Indian sickle cell patient a considerable challenge for an orthopaedic surgeon.

This study determines short term outcomes of THA for osteonecrosis of femoral head in SCD. It evaluates risk, complications and effects on functional outcome for the patient associated with the surgery.

Materials and Methods

Twenty five patients with SC disease presenting with pain over hip due to osteonecrosis of femoral head confirmed radiologically as Ficat and Arlet grade III/IV were selected for the study [6]. They were operated between 2018 and 2019. The mean age of patients was 25.1 years (range 18–49 years). There were 7 female and 18 male patients. Nineteen patients were homozygous for SC (hemoglobin SS), 1 had hemoglobin (Hb) S/C and 5 had hemoglobin S/beta thalassemia. Bilateral THA was performed in 10 patients (20 hips) and the rest had unilateral involvement (15 hips). Of the bilateral cases, 8 patients were operated in a single admission with an interval of 3-5 days between the surgeries.

On admission, detailed history regarding symptoms was taken and complete systemic and local examination was done. Preoperative hip function was assessed using Harris hip score (mean- 44.5). Preoperative preparation included educating the patients regarding expectations surrounding perioperative complications and post-operative rehabilitation. Additionally, all patients were started injectable hydration therapy with 120 ml/hour/day to prevent dehydration and tablet sodamint was started to maintain mild alkalosis, both necessary to avoid sickling and tissue ischemia. Also tablet hydroxyurea (500 mg) was ensured twice a day to increase fetal hemoglobin concentration and reduce the incidence of sickling crises. Both tablet sodamint and tablet hydroxyurea were continued after patient's discharge as well [7]. Preoperative Haemoglobin (Hb) level was maintained above 10 gm/dl. The preoperative HbS load was determined using.

High Performance Liquid Chromatography and was decreased to <30%. This was done by giving aggressive preoperative transfusion. Additionally two units of cross matched packed cell volumes [PCV (450 ml)] were kept ready on day before surgery. Preoperative medications in form of 1000 mg tranexamic acid (to reduce intraoperative blood loss) [8], 400 mg teicoplanin and 2000 mg cefoperazone-sulbactam combination were given. All patients were operated using Moore posterior approach in lateral decubitus position. After deep dissection through gluteus maximus fibres, a myocapsular flap comprising of short external rotators and posterior part of capsule was created flush along the posterior border of greater trochanter. Femoral head was dislocated posteriorly and if this was found to be difficult then soft tissue release methods in form of release of Ilio-Psoas and circumferential release of capsule as anteriorly as possible were performed. Prior to soft tissue release, any osteophyte incarcerating the femoral head was removed. Still if femoral head was not dislocated, it was removed piecemeal following an in-situ femoral neck osteotomy. Acetabular preparation and component implantation was carried out first in all

patients. For femoral canal preparation, graduated end cutting reamers were used to ream through intramedullary bony islands and hard sclerotic bone. In patients with a sclerotic canal, femoral reaming was done using a guidewire, with sequential intramedullary reaming with hollow flexible reamer under C- arm guidance if required. The canal prepared therefore allowed insertion of an appropriate size stem with an adequate tight bone implant contact.

All patients were operated using uncemented implants. Two hip systems were used as they were tender approved in our hospital setup (LATITUD@ hip system, Meril Healthcare and CORAIL@ hip system, Depuy Synthes). The decision to choose the hip system was made by the senior surgeon based on preoperative templating. In our study, in majority of cases LATITUD@ hip system was used (27 among 35). However, patients in whom femur medullary canal was seen as particularly narrow and sclerosed, CORAIL@ hip system was preferred due to availability of femoral stem with very small diameter i.e Size 6 Dysplasia Stem.

Meticulous closure of posterior soft tissue was done with myocapsular flap being repaired with non-absorbable suture, it was reattached to greater trochanter directly through holes made with a drill. Suction drains were placed in all patients.

Postoperatively, antibiotic protocol was injecting tecoplanin 400 mg once a day for three days with injection ceftioxone-sulbactam 2000 mg twice a day and injection amikacin 500 mg thrice a day for 5 days.

Management of analgesia was given priority in patients with SCD to reduce post-surgery stress in early 24-48 hours. Analgesia was ensured with injection tramadol 50 mg in 100 ml normal saline twice a day and injection paracetamol 1000 mg thrice a day. Intravenous fluids were given at the rate of 120 ml/hour to maintain adequate hydration. Humidified oxygen was given at 2 L/min for 24 hours. Postoperative haemoglobin levels were maintained at >10 gm/dl. Every 24 hourly renal and liver functions were monitored for early detection and correction of any abnormalities.

Injection enoxaparin was started from first post operative day in a dose of 0.6 mg/day subcutaneously for anticoagulation. This was continued till the day of discharge. Post discharge oral formulation of an anticoagulant drug was not continued. Early mobilization in this lean population group was deemed adequate for prophylaxis of deep vein thrombosis.

Static and active quadriceps exercises were started on the evening of the surgery within the limits of comfort followed by high sitting on the first post-operative day. Weight bearing was individualized for each patient and determined by intraoperative fixation of implant to the bone. All patients were advised to be mobilized full weight bearing with the help of a walker from next day.

Criterion for discharge was two consecutive dry, healthy looking suture site on dressing without any episode of fever post operatively. In case of any soakage, swab culture was taken, antibiotics were started according to the sensitivity and surgical debridement of the wound was done. Patients were not discharged until two consecutive dressings were dry.

Every patient was followed clinically and radiologically at 2 weeks, 1 month, 3 months and then 12 months. Postoperative modified Harris hip score was evaluated at 12 months.

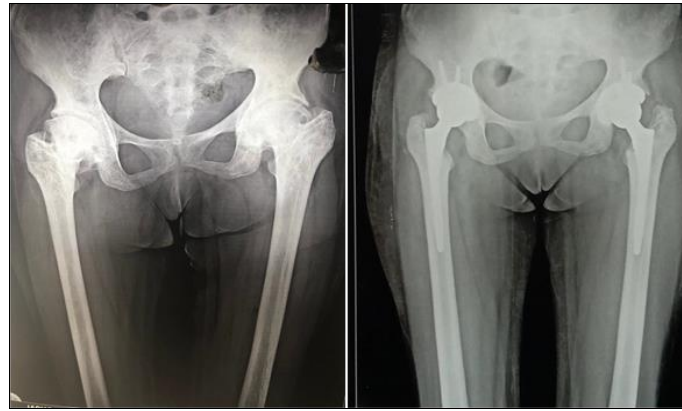


Fig 1: A case of 19 year old female with bilateral osteonecrosis of femoral head treated with bilateral stage total hip arthroplasty. Note: severe degenerative changes of femoral head and acetabulum in patient with narrow medullary canal. Patient was operated with uncemented total hip orthoplasty with specialized femoral stem (size 6 dysplasia stem). Postoperatively patient reported pain free status and was rehabilitated in her daily life activities.

Results

The follow up period was 1 year. The average operating time was 45 min (range 41–80 min). The average blood loss in patients was 506 ml (range 400–1200 ml). The average intraoperative blood transfused were 2 units (range 2-4) for each surgery to maintain a hemoglobin level of above 10 gm% and dilute the HbS load. Average duration of hospital stay was 5 days for unilateral cases and 13 days for bilateral cases operated in two stages.

All the patients showed an improvement in Harris Hip score which improved from average 44.5 points preoperatively to average 89.7 points at last follow up.

Three patients developed hypotension intra-operatively. Two were managed with blood transfusion and vasopressor drugs and one required intensive care unit transfer. One patient developed surgical site infection 12 days after surgery. Microbiological screening was done and patients were given antibiotics according to sensitivity. Patient underwent surgical debridement and recovered uneventfully and no signs of infection were found in later follow up.

No patient developed sickling crisis. No patient had an intraoperative periprosthetic femoral fracture. No patients developed postoperative wound hematoma. No patient developed deep vein thrombosis. None of the cases had aseptic loosening as assessed on serial radiographs. Subsidence was not noticed in any of the cases till the last follow up. There were no early or late dislocations. No heterotopic ossification was seen in any of the cases. There were no cases of sciatic nerve palsy.

In our study, preoperatively 22 out of 25 patients had moderate to severe pain and postoperatively 24 out of 25 patients reported no pain or minimal pain on evaluation. Status of functional activity level improved with majority of the patient reporting more than 1.5 km as their walking distance postoperatively. Preoperatively only 3 out of 25 patients reported this level of mobility. Patients reported greater range of motion in operated hip joint than the preoperative diseased hip joint. Postoperatively, all patients reported to be in average or high hip function group as defined by Davis *et al.* Pre-operatively, all patients qualified as low hip function group^[9]. Additionally, majority of patient had near normal range of motion to that of normal young male individual as defined by Asbjorn Roaas *et al* at final follow up^[10]. Post-operative Harris Hip score is 89.7, increased from preoperative value of 44.5. Nine patients report excellent result, 13 patients report good and 3 patients report fair results.

Discussion

Osteonecrosis of femoral head is one of the common skeletal sequelae of SCD, with prevalence as high as 37%-50%. This could be a bilateral involvement (30%)^[11].

With the advances in THA, many surgeons began to perform arthroplasty in patients with SCD of osteonecrosis of femoral head. Initial studies showed a high rate of perioperative complications with Hanker *et al.* reporting 50% survivorship only by an average time of 5 years^[12]. Gunderson *et al.* reported 11 THA in 7 patients with complication rate of 27%. Complications including haematological crises, infected haematomas, bacteraemia and iatrogenic fracture of femoral shaft with the tip of the stem were noted^[13].

Medical complications can be avoided by strictly adhering to guidelines: (1) perioperative haemoglobin level above 10gm/dl (2) HbS level less than 30% (3) ensuring perioperative hydration and oxygenation during and 48 hours after surgery (4) preoperative availability of average 2 units of PCV in each case to compensate for intraoperative blood loss. These measures reduced the chances of development of postoperative acute sickling crisis.

Al-Mousawi *et al.* have reported an average operative time of 2.2 h and a mean operative blood loss of 1275 ml^[14]. Blood loss encountered in our study was less as surgery was performed in a setup with an experienced arthroplasty team which can be meticulous and quick in technique and can achieve adequate haemostasis during surgery. This led to an overall low complication rate.

Hernigou *et al.* performed hip arthroplasty in 244 patients (312 hips) with SC disease and found medullary sclerosis in 46 femora^[3]. This increases the risk of perforation and fractures. Hanker *et al.* and others have described increased perforation rates^[12]. Intraoperative medullary canal sclerosis can be cleared by drilling a 4.8 mm Steinman pin. This is followed by introduction of the guide wire into the femoral canal followed by enlargement of the canal using graduated end cutting reamers. We did not encounter any perforations because of the precautions and techniques used.

Due to chronic anaemia in a setting of SC hemoglobinopathy, growth retardation is observed and these patients tend to have a short stature with narrow bones^[15]. Thus inventory should be kept ready in case of requirement of smaller size femoral stem. This can be assessed during preoperative templating. We ensured specialized stem in the form of Size 6 Dysplasia stem in patients with narrow canal. This stem can only be used in patients who weigh less than 60 kg and this stem was used in patients accordingly. Eight patients received this stem

and rest received Latitud@ hip system with their smallest size (size 0) was used in majority of the patients (15 out of 27).

SCD patients have increased susceptibility for infection due to several causes including impaired splenic function, defects in complement activation, micronutrient deficiencies and tissue ischaemia [16]. Therefore any discharge from suture site should be sent for investigation and positive cultures should be shifted to antibiotics according to sensitivity. We accept the rationale for trial of aggressive surgical debridement and intravenous antibiotic for positive culture patients. If infection still ensued, then implant extraction, debridement and antibiotic impregnated cement spacer was kept in situ as a routine practice in our setup. However this study reported one case of surgical site infection and the patient recovered after trial of surgical debridement. This low rate of incidence of deep infection is in contrast with findings reported in earlier series. We attribute this to shorter operative time and meticulous hemostasis on part of surgical team, laminar air flow with high efficiency particulate air (HEPA) filters, preoperative local site preparation with povidone iodine scrub on previous night of surgery and early morning of the surgery [17] and correction of anaemia preoperatively.

Earlier case series for THA in SCD patients used cemented implants and reported poor results with high rates of aseptic loosening and infection. Hickman and Lachiewicz reported excellent to good short term to mid-term results in patients treated with uncemented implants [18]. Issa *et al.* later advocated that the use of cement was likely to cause thermal necrosis of already fractured bone, contributing to a higher incidence of infection and loosening [19]. Issa *et al.* compared 32 SC patients (42 hips) with 87 non-SC patients with hip osteonecrosis followed for more than 7 years and found no difference in aseptic implant survivorship (95% vs. 97%). They believed that the outcome of THA in SC patients can be improved by optimizing medical management and use of uncemented prosthetic devices.

We report the use of uncemented implants to reduce the operative time and have good short term outcome.

High rates of aseptic loosening in THA in sicklers have been reported in the literature. Hernigou *et al.*, in their review of 312 hip arthroplasties performed in 244 patients with SC disease at mean follow up of 13 years, reported an aseptic loosening rate of 8% cups and 5% stems [3]. We cannot comment on aseptic loosening due to short follow up period and advocate longer follow up for the same.

Osteonecrosis of femoral head alters the biomechanics of hip joint. As the disease process advances, patients are limited by pain and inability to bear weight on the affected limb. THA when performed successfully eliminates these problems and improves patient's lifestyle. This improvement is attributed to increased range of motion which allows the patient to be involved in various activities. An observation noted in our study on latest follow up was that many patients were able to perform deep bending activities and high flexion activities like squatting and cross legged sitting with ease. This was an aberration to our preoperative guidelines of patient education to avoid active high flexion activities. Nonetheless with improvement in hip flexion post surgery, non-compliance was noted in many patients who enjoyed a stable pain free hip and freely indulged in high flexion activities as per traditional and social needs of an Indian population. Effect of these activities on hip prosthesis needs to be evaluated in terms of impingement and wear, but in term of satisfaction, THA was regarded highly in our patient group as many patients were able to return to near normal lifestyle.



Fig 2: Clinical photographs of patients performing squatting and cross legged sitting with ease

Conclusion

THA in SCD disease patients improves their quality of life dramatically with patients leading a pain free functional lifestyle. However, these patients require special attention during surgery. High incidence of perioperative mortality and morbidity has been reported in series of THA for SCD patients. Management requires a multidisciplinary approach. Proper perioperative care with adherence to medical and anaesthetic treatment guidelines, surgery in a well-equipped operation theatre with a skilled arthroplasty team using uncemented implants can reduce the complications and makes THA in these patients a safe procedure with predictable outcomes.

Abbreviations

THA: total hip arthroplasty

SCD: sickle cell disease Hb: Haemoglobin

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