ORIGINAL ARTICLE
Hip Pelvis 28(1): 24-28, 2016
http://dx.doi.org/10.5371/hp.2016.28.1.24

Print ISSN 2287-3260
Online ISSN 2287-3279
Hip & Pelvis

# Total Hip Arthroplasty in Patient with Aplastic Anemia

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**Purpose**: Patients with aplastic anemia (AA) are now living longer and therefore are at increased risk for the development of osteonecrosis of the hip. However, studies on the results of total hip arthroplasty (THA) are lacking. The purpose of this study is to present the result of THA in patients with AA.

**Materials and Methods**: We retrospectively reviewed the data for a group of 29 patients (45 hips) with AA who presented to our institution for THA between May 2008 and May 2012. All hips were replaced because of osteonecrosis of the femoral head. A specific prospective protocol was followed for the perioperative transfusion of platelets and blood. The clinical and radiographic evaluations were done, and the minimum follow-up period was 3 years (mean, 49.2 months; range, 36 to 84 months).

**Results**: Three hips had excessive perioperative bleeding and hematoma formation, and then hematoma evacuations were done; one hip was finally revised because of infection of acetabular component. One patient with poorly controlled AA died due to delayed infection on the hip joint. All hips showed stable fixation, and the mean Harris hip score was improved from 54.2 points (range, 42 to 69 points) preoperatively to 90.8 points (range, 73 to 97 points) at the time of the latest follow-up.

**Conclusion**: In the present study, the durability of implant fixation was maintained and the clinical results demonstrated a sustained increase in function of the hip. Postoperatively, paying attention to bleeding and infection should be needed.

**Key Words**: Aplastic anemia, Osteonecrosis, Hip replacement arthroplasty

Submitted: October 17, 2015 1st revision: November 24, 2015
2nd revision: December 16, 2015 Final acceptance: December 29, 2015
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## INTRODUCTION

Aplastic anemia (AA) is a rare hematologic disorder characterized by hypocellularity of fatty marrow, and severe AA is defined as a cellularity less than 25% of normal cellularity. During treatment of AA, osteonecrosis is a potentially persistent and debilitating complication after allogenic bone marrow transplantation (BMT)[1-4]. Incidences of osteonecrosis in populations range from 3.9% to 44.2%[1,2,4]. These lesions can progress and eventually lead to collapse of the affected joints[4,5], resulting in joint replacement surgery.

Only a few investigators have reported operating on patients with AA[4,6]. Most of the operations in these patients were confined to the abdomen. Special medical management is required in order to avoid complications in patients with AA who are managed with hip arthroplasty. Because far more perioperative blood loss is expected during hip arthroplasty than during abdominal surgery, and hip arthroplasty in AA is associated with the additional risk of periprosthetic infection. Also, the fatty marrow conversion in the proximal femur and the pelvis that is characteristic of the disease can potentially limit the durability of the implant.

To our knowledge, a few articles have reported the results of hip arthroplasty in patients with AA. The purpose of the present study was to evaluate the perioperative management and the intermediate-term clinical and radiographic results of hip arthroplasty in patient with AA.

## MATERIALS AND METHODS

We retrospectively reviewed the data for a group of 29 patients (45 hips) with AA who presented to our institution for total hip arthroplasty (THA) between May 2008 and May 2012, and divided into two groups based upon the severity of AA: (1) mild and moderate AA (12 patients, 16 hips) or (2) severe AA (17 patients, 29 hips). AA was considered to be severe if bone marrow examination revealed cellularity of <25%. All patients had osteonecrosis of the femoral head due to the use of steroid. This study was approved from the institution review board of College of Medicine, The Catholic University of Korea (KC14RISI0750). All data for this study were retrieved from our institution's database, and we did not see or contact the patients specifically for this study.

There were 12 men and 17 women with a mean age of 37.2 years (range, 20-61 years) at the time of the THA. The mean body mass index was 23.5 (range, 15.4-23.5). The minimum follow-up was 3 years (mean, 49.2 months; range, 36-84 months). All surgeries were performed through a modified posterolateral approach with preservation of short external rotator muscles[7]. Prophylactic antibiotic (1st generation cephalosporin) was routinely administered intravenously 30 minutes before incision and continued to be applied until 24 hours after surgery as in a surgery with other patients (non-AA). All surgeries were done with BENCOX® hip system (Corentec, Seoul, Korea), and all had a neck taper of 12/14 mm and a 32 or 36 mm ceramic head (Table 1).

Before surgery, transfusions of packed red blood cells and/or platelet concentrate were done under the guidance of hematologic department. The target level of hemoglobin was 10 g/dL, and that of platelet was over $80 \times 10^6$/mL, and these has been maintained until 1 week after operation (Table 2). We identified the presence of early post-operative complications including hematoma formation, prosthesis infection, pneumonia, and urinary tract infection which is more common for the patient of AA.

**Table 1.** Patients Data

| | Mild and moderate AA | Severe AA | *P*-value |
|---|---|---|---|
| Patients/hips | 12/16 | 17/29 | |
| Age (yr) | 37.1 (25-61) | 31.5 (20-54) | 0.657 |
| Sex (male/female) | 5/7 | 7/10 | 0.584 |
| BMI (kg/m$^2$) | 24.2 (17.3-32.0) | 21.3 (15.4-31.6) | 0.633 |
| BMT | 2/12 | 8/17 | 0.072 |

Values are presented as number only or mean (range).
AA: aplastic anemia, BMI: body mass index, BMT: bone marrow transplantation.

**Table 2.** Laboratory Findings of Patients

| | Admission | Preoperative | Postoperative 1 week |
|---|---|---|---|
| Hemoglobin (g/dL) | 7.5±2.3 (5.7-12.3) | 10.5±1.1 (9.4-12.3) | 8.6±2.6 (6.9-10.8) |
| Absolute neutrophil count ($10^6$/mL) | 2,331±2,006 (115-8,758) | 2,779±2,104 (624-8,758) | 2,228±1,393 (357-5,131) |
| Platelet ($10^6$/mL) | 78±66.8 (6-284) | 105.9±39.7 (32-284) | 82.7±54.7 (17-240) |

Values are presented as mean±standard (range).

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Clinical results were evaluated at 3, 6, and 12 months postoperatively, and every 1 year thereafter. Hips with a score of ≥90 points were defined as excellent, 80-89 as good, 70-79 as fair, and <70 as poor[8]. The presence of postoperative thigh pain was also examined. The relationship of thigh pain with radiolucent lines observed on radiographs, cortical hypertrophy, and pedestal formation was investigated. For radiological assessment, subsidence of femoral components, stress shielding, cortical hypertrophy, periprosthetic reactive lines, and osteolysis were examined by dividing the proximal femur into Gruen zones[9] on anteroposterior and lateral radiographs around the femoral components. Femoral component fixation was graded as bony stable, fibrous stable, or unstable according to the criteria described by Engh et al.[10]. For the femoral component, subsidence of >5 mm was classified as loosening according to the method of Callaghan et al.[11]. Cortical hypertrophy was defined as an increase in the diameter of the cortex measured at the point of maximum hypertrophy. A reactive line was defined as a parallel radiolucent line adjacent to the prosthesis. Movement of the acetabular cup was compared using radiographs taken in the immediate postoperative period and at the final follow-up based on the anteroposterior view of the hip. According to the method of Dorr et al.[12], the distances between the acetabular component, Kohler's line, and the teardrop were measured. The acetabular cup was defined as loosening if there was movement in the position of the cup of more than 2 mm vertically, medially, or laterally, if the radiolucent lines were widened more than 2 mm on anteroposterior, or lateral radiographs of the acetabular cup, or if the inclination angle changed by more than 5°. Osteolysis around the acetabular cup was presented as DeLee and Charnley zones[13].

We identified the presence of complications including sciatic nerve palsy, infection, dislocation, fracture in the ceramic head or liner, and heterotopic ossification. Statistical analyses were performed using IBM SPSS Statistics (version 21.0; IBM Co., Armonk, NY, USA). Mann Whitney *U*-test was performed to compare the groups in terms of age and body mass index, and Fisher's exact test was used to compare the groups with regard to gender distribution and BMT. The differences in occurrence of each post-operative complication between the two groups were analyzed using a Fisher's exact test. A *P*-value <0.05 was considered to be statistically significant.

## RESULTS

The hematoma formation which needed evacuation

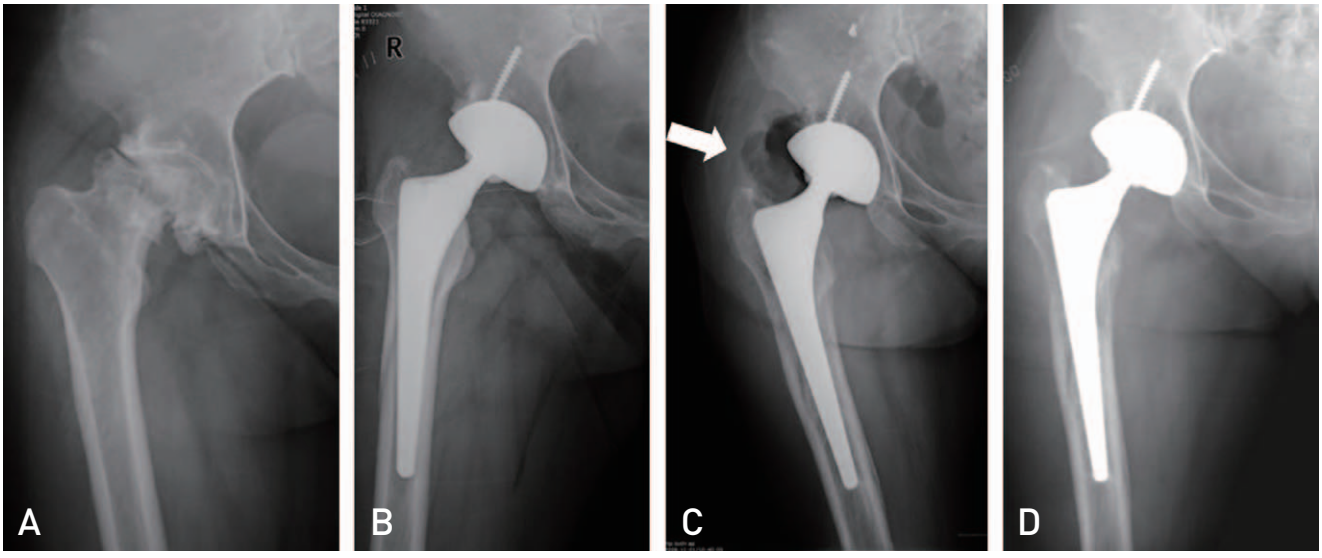


**Fig. 1.** Radiographic images. (**A**) Anteroposterior radiograph of the pelvis of a 43-year-old female with severe aplastic anemia, showing osteonecrosis of the femoral head and consequent joint destruction. (**B**) An immediate postoperative radiograph showing total hip arthroplasty with good positioning of the prosthesis. (**C**) The patient visited the emergency room due to acute onset severe right hip pain, and a follow-up radiograph showed an extensive gas formation around acetabular and femoral components (arrow). (**D**) A postoperative radiograph after debridement and irrigation. Removal of prosthesis was not performed due to the deteriorated hematologic status of the patient.

occurred in 3 hips, pneumonia in 6 hips, and urinary tract infection in 2 hips postoperatively; all were in patients with severe AA except one pneumonia with moderate AA. Among the 3 hips of hematoma formation, one hip was developed into prosthesis infection. Comparing mild to moderate AA with severe AA, the incidence of complication was not statistically significant; hematoma ($P$=0.542), pneumonia ($P$=0.542), and urinary tract infection ($P$=0.531).

Harris hip score was improved from 54.2 points (range, 42-69 points) preoperatively to 90.8 points (range, 73-97 points) postoperatively. There were 28 excellent cases (62.2%), 15 good cases (33.3%), 2 fair case (4.4%), and no poor cases. No patient complained of sciatic nerve palsy and thigh pain. At the final follow-up, all hips showed stable fixation. Of these, no hip had osteolysis, loosening of components, and subsidence around the implants.

Prosthesis infection occurred in two hips (4.4%); one hip was due to the postoperative hematoma formation, and two-stages of revision surgery for infection control were performed successfully. Another hip was spontaneously developed delayed infection after 40 months from operation due to the poorly controlled AA. Because of hematologic status (platelet $10 \times 10^3/\mu$m, hemoglobin 5.2 g/dL), only debridement and irrigation were performed without removal of implant (Fig. 1). At 1 month after debridement, the patient died with pneumonia and subsequent septic shock due to the uncontrolled infection.

## DISCUSSION

This study evaluates a cohort of 29 patients with AA who later underwent THA. Especially, in severe AA patient, the early complications (hematoma, pneumonia, and urinary tract infection) commonly occurred despite the massive transfusion. If early complications did not occur, we found that the survivorship of these hip reconstructions was generally good.

An important issue for this specific subset of patients is perioperative management to decrease morbidity and mortality. Idiopathic AA is characterized by pancytopenia. Potential complications are caused by a decreased number or impaired function of blood cells; this condition is aggravated by the cell damaging properties of extracorporeal circulation. In addition to meticulous surgical hemostasis, substitution of various blood products is important to reduce the risk of bleeding complications. Total amount of the blood product transfused to this patient is regarded to be acceptable considering the higher risk of bleeding in these specific subset of patients. A high risk of spontaneous bleeding can be expected when the platelet count is less than $200 \times 10^3/\mu$m. Thus, severe AA (a platelet count of less than $200 \times 10^3/\mu$m) is associated with a high risk of perioperative hemorrhagic complications. For patients undergoing a major operation, a platelet count of more than $700 \times 10^3/\mu$m is recommended[6,14]. In our study, hematoma evacuation was needed in 3 hips regardless of transfusion in severe AA patients. Therefore, careful attention and closed monitoring were needed.

Another important aspect of perioperative care in these patients is the increased risk for infections. It is of great importance to perform surgery in aseptic conditions and to avoid transmission of pathogenic microorganisms during the perioperative period. If necessary, granulocyte colony stimulating factor would be administered perioperatively for leukopenia. Not only early infection, but late infection may be occurred if pancytopenia was poorly controlled (Fig. 1). Therefore surgeon should inform this point to the patients.

Thrombocytopenia, if not corrected preoperatively, can lead to serious intra and postoperative hemorrhage. Platelets have a very short half- life and therefore, in order to achieve maximum benefit, it is important to carefully time the platelet transfusion. These patients are receiving regular transfusions of both red cells and platelets, but their counts fall rapidly and adequate amount of blood and blood products must be available for the immediate perioperative period. Presence of neutropenia makes the patient prone to infection, therefore, it is mandatory to take aseptic precautions for all anesthetic maneuvers including intravenous cannulation, endotracheal intubation etc. For the same reason perioperative antibiotic cover is essential. Regional anesthesia (spinal/epidural) is absolutely contraindicated in the presence of thrombocytopenia.

Kim et al.[4] reported that THA can be performedsafely in patients with AA and the durability of implantfixation was maintained and the clinical resultsdemonstrated a sustained increase in function of the hip if pancytopenia was controlled appropriately. In our study, the durability of implant was also well maintained and functional outcome was improved.

There are several limitations to the study. The fist, this study is a retrospective one performed in a small cohort

observed patient with short-term follow-up. The long term follow up must be necessary. The second, it does not have control group of primary THA due to idiopathic osteonecrosis of femoral head.

## CONCLUSION

Total hip replacement in patients with AA requires close collaboration between the hematologist and surgeon, and surgeons must be very careful about early complications. The durability of implant fixation was maintained and the clinical results demonstrated a sustained increase in function of the hip.

## CONFLICT OF INTEREST

The authors declare that there is no potential conflict of interest relevant to this article.

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