Total hip arthroplasty for primary septic arthritis of the hip in adults

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Abstract Two-stage total hip arthroplasties (THA) performed after primary septic arthritis of hip were studied to evaluate the surgical outcomes and complications. Of 28 cases, the reinfection rate was 14% and complication rate was 36%. At an average follow-up period of 77 months, the outcome in 22 patients (79%) was rated as good or excellent, 4 as fair, and 2 as poor. Leg length discrepancy improved from a preoperative mean of 2.89 cm to a postoperative mean of 0.61 cm. Despite a higher complication rate, two-stage THA was still deemed a worthy procedure because hip function was significantly improved in patients with primary septic arthritis of the hip.

Résumé L'arthroplastie totale de la hanche en deux temps après arthrite septique primaire a été étudiée à propos de 28 cas. Le taux de récurrence infectieuse était de 14% et celui des complications de 36%. A un suivi de 77 mois le résultat était excellent ou bon pour 22 patients (79%), moyen pour 4 et mauvais pour deux. L'inégalité de longueur des membres s'est améliorée d'une valeur moyenne préopératoire de 2,89cm à une valeur moyenne de 0,61cm. En dépit d'un taux de complication élevé l'arthroplastie en deux temps demeure une méthode valable qui améliore significativement la fonction des patients après une arthrite septique primaire de la hanche.

Introduction

In 1943, Girdlestone described resection arthroplasty for the treatment of septic arthritis of the hip [8]. Although this procedure successfully controlled infection and relieved most pain, variable and poor functional results have been reported [1, 14]. In order to improve the hip function, total hip arthroplasty may be the treatment of choice after resection arthroplasty. Total hip arthroplasty is considered one of the most successful operations today for many hip disorders. The success rate is high and results are excellent in primary cases [17].

Total hip arthroplasty following resection arthroplasty for primary septic hip is different from a revision for an infected total hip arthroplasty or total hip arthroplasty in an old, quiescent infection. The infection that occurs in a previous total hip arthroplasty may involve the medullary canal or external part of the femoral cortex or the pelvis. Additionally, the infection may be confined to the peri-articular or periprosthetic space. The infection in primary septic hip, by definition, involves the soft tissue and capsule of the acetabulum and may result in destruction of the femoral head in the late stage. Bone loss is less in primary septic hip, and the femoral canal usually has not been infected as seen in infected total hip arthroplasty. However, the surgical technique for implantation of the prosthesis after resection arthroplasty may be as difficult as revision total hip arthroplasty because of leg length discrepancy and soft tissue scarring.

Following review of the available literature, we found few studies describe the results of total hip arthroplasty after resection arthroplasty for the primary septic hip. Most studies discuss the result of total hip replacement after resection arthroplasty, including the prior infected total hip arthroplasty. The purpose of this study is to review the

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clinical results of 28 patients who had primary septic arthritis of the hip and received two-stage total hip arthroplasty after resection arthroplasty.

Materials and methods

Thirty-three patients with septic arthritis of the hip who received total hip arthroplasty following a resection arthroplasty between 1994 and 2003 at Chang Gung Memorial Hospital were studied retrospectively. Five patients were excluded from the study because no bacteria were isolated from the hip. Twenty-eight patients with definite infections underwent follow-up to evaluate the results after total hip arthroplasty. Of the study patients, there were 22 men and 6 women. The average age at the time of arthroplasty was 53 years (range: 27–75 years) (Table 1).

The initial evaluation of the patient included a complete medical history with documentation of medical diseases and the duration of infection. Twenty-one associated medical diseases that were noted in 13 patients included liver cirrhosis in 3, diabetic mellitus in 3, peptic ulcer in 3, adrenal insufficiency in 3, gouty arthritis in 2, hypertension in 2, drug addiction in 2, cervical cancer in 1, pulmonary tuberculosis in 1 and skin cancer of the leg in 1 patient. A complete blood count (CBC), erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) and anteroposterior roentgenogram of the pelvis were obtained. The clinical evidence of infection was pain in all patients and fever in six patients. The ESR was elevated to more than 40 mm/h in 22 patients, and measured between 20 to 40 mm/h in 6 patients. Only 15 patients had a leukocyte count more than 11,000 per mm³. Magnetic resonance imaging (MRI), bone scan or computed tomography (CT) of the pelvis was performed in all patients preoperatively if septic arthritis of the hip was suspected. There was no observation of pelvis abscess in the CT or MRI study.

Resection arthroplasty was indicated upon observation of destruction of the hip joint or femoral head. Aerobic and anaerobic culture from the synovial fluid and soft tissue was performed after the arthrotomy. Gentamycin-impregnated cement beads (Septopal®, E. Merck, Darmstadt, Germany) were used in 14 hips at the time of resection arthroplasty. Skeletal traction for pain relief and maintenance of leg length was used for 2 weeks postoperatively. Histological examination of the surgical specimens from all of the hips showed acute and chronic inflammation. A combination of oxacillin and gentamycin was used empirically at infection onset until the results of culture indicated sensitivity. Antibiotics then were changed accordingly. Parenteral antibiotics were generally used for at least 2 weeks. This regimen was followed by oral antibiotics

for an additional 2 to 4 weeks if there was a proper oral antibiotic and the patient showed a good clinical response. Otherwise, parenteral antibiotics were administered for 4 to 6 weeks. The causative microorganisms were oxacillin-resistant *Staphylococcus aureus* in eight patients, oxacillin-sensitive *Staphylococcus aureus* in six and mixed flora in three. Additionally, specimens revealed *Salmonella* species in three, *Escherichia coli* in three, *Pseudomonas aeruginosa* in one, Viridans streptococcus in one, *Prevotella melaninogenica* in one, *Enterococcus* species in one and *Enterobacter cloacae* in one (Table 2). Intravenous antibiotics were given in all patients after resection arthroplasty for an average of 28 days (range: 14–64 days).

Before total hip arthroplasty (THA), the antibiotics were discontinued for at least 2 weeks in the study patients then preoperative ESR to the body response was evaluated. Indications for THA were ESR less than 20 mm/h or negative culture from hip aspiration if ESR was more than 20 mm/h. The ESR was less than 20 mm/h before total hip arthroplasty in all but three patients. Preoperative aspiration of the affected hip joint was performed in these three patients, and the bacterial cultures of the aspirate were negative. After total hip arthroplasty, reinfection did not develop in these three patients. The interval between resection arthroplasty and total hip arthroplasty was 3.64 months (range: 1–7 months). Aerobic culture and anaerobic culture from the synovial fluid and soft tissue were completed after arthrotomy. All the antibiotic beads were removed at the time of artificial joint implantation. Eighteen patients had cementless replacements of both components. Ten patients had a hybrid total hip arthroplasty with antibiotic-impregnated cement for the fixation of the femoral component. The powdered antibiotics impregnated with cement were vancomycin in seven, Kefline in one, ampicillin and Kefline in one and Pipril, Kefline and ampicillin in one. Deep frozen allografts were used in three hips for acetabular deficiency. Antibiotic treatment according to the previous infecting microorganism was given until the postoperative culture result was obtained, then the antibiotic was changed if necessary. The culture was positive in 3 of 28 hips at the time of total hip arthroplasty. One hip had the same bacterial infection and the other two had different bacterial infection. All of these patients received systemic antibiotics for 6 weeks postoperatively and no recurrent infection developed at the time of writing.

All patients returned to the orthopaedic clinic for clinical and radiographic follow-up regularly at 3 months, 6 months, 12 months and every year after total hip arthroplasty. The functional outcome was evaluated using the modified Harris hip score for total hip arthroplasty [10]. According to this system, 85 to 100 points indicate an excellent result, 70 to 84 points a good result, 60 to 69 points a fair result and less than 60 points a poor result. Radiological

Table 1 Patient characteristics and outcomes of total hip arthroplasty for primary septic arthritis of hip

Case	Age (yr ^a / sex)	Bacteria	Interval between GS to THA ^f (months)	Antibiotic beads	Pre- THALLD ⁱ (cm)	Cemented	Post-THA evaluation		
							Bacteria during THA	F/U ^j (yr +m ^k)	Complication
1	48/M ^b	ORSA ^d	3	GM ^g	4	vancomycin	N	12+7	0 N
2	45/M	<i>Salmonella paratyphi</i>	3	N ^h	3.5	N	N	11+ 10	86 N
3	41/M	OSSA ^e	2	N	2	N	N	11+2	88 N
4	65/M	<i>Salmonella choleraesuis</i>	3	N	3	N	N	10+6	92 N
5	66/M	<i>E. coli</i>	3	N	4	N	N	9+5	97 N
6	47/M	ORSA	3	GM	3	Vancomycin	N	8+0	50 Reinfection
7	69/M	<i>Enterobacter cloacae</i>	4	N	2	N	<i>Enterococcus, Klebsiella pneumoniae, Enterob. cloacae</i>	7+8	87 N
8	62/M	OSSA	4	GM	4	N	<i>Enterococcus</i>	7+7	80 N
9	54/M	<i>Salmonella group B</i>	3	N	3	N	N	7+6	94 N
10	67/F ^c	<i>E. coli</i>	3	GM	2	Kefline Pipril	N	6+10	81 N
11	46/M	<i>Peptostreptococcus anaerobicus, Prevotella intermedia</i>	5	N	2	Ampicillin	N	6+9	95 N
12	69/M	<i>Prevotella melanogenica</i>	6	GM	3	N	N	6+7	68 Aseptic loosening of cup
13	75/F	ORSA	7	N	2	Vancomycin	ORSA	6+5	92 Periprosthetic fracture
14	27/F	OSSA	4	GM	4	N	N	6+1	86 Aseptic loosening of cup
15	51/M	PS	4	N	3	N	N	6+1	93 N
16	60/F	OSSA	5	GM	3	Y	N	5+7	67 Dislocation
17	51/M	ORSA	4	GM	2	Vancomycin	N	5+7	92 Aseptic loosening
18	51/M	<i>E. coli</i>	3	GM	2	Ampicillin	N	5+6	67 N
19	43/M	ORSA	3	GM	3	Vancomycin	N	5+5	87 N
20	45/M	Viridans streptococcus	5	GM	3.5	Vancomycin	N	5+1	84 Stem broken
21	52/M	OSSA	1	N	4	N	N	5+0	87 Periprosthetic fracture
22	44/M	OSSA	5	N	3	N	N	4+6	72 Periprosthetic

defect. This patient had one dislocation 1 month after arthroplasty. Following permanent resection arthroplasty, the infection was under control. The second case of infection occurred in a diabetic patient with hypertension. Two years after total hip arthroplasty, recurrent infection developed. The same bacteria, oxacillin-resistant *Staphylococcus aureus*, was isolated from the surgical specimens at the time of debridement. Revision total hip arthroplasty was performed with a two-stage procedure. Unfortunately, reinfection developed, which finally required the patient to receive permanent resection arthroplasty. The third patient, a 44-year-old male drug abuser, had an oxacillin-sensitive Staphylococcal infection. Periprosthetic fracture occurred following a traffic accident that happened 1 month postoperatively. The patient received fixation with multiple wires and allograft reconstruction. Five months after open-reduction internal fixation for periprosthetic fracture, a recurrent infection developed. Following a two-stage exchange of the total hip prosthesis, no recurrent infection was noted at 4-year follow-up. The fourth case, a gouty arthritis patient, was infected with oxacillin-resistant *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Two weeks after total hip arthroplasty, infection with oxacillin-resistant *Staphylococcus aureus* recurred. The patient received two two-stage revisions and one one-stage revision after the first total hip arthroplasty. At 3-year follow-up the infection was under control, but occasional dislocation of the total hip prosthesis was noted. No further operation was performed at the time of last follow-up, since there was no recurrent of infection.

Aseptic loosening of the cup was noted in follow-up radiographs in two hips. Both hip transplants were cementless porous cup. One patient received revision total hip arthroplasty 5 years after primary total hip replacement due to groin pain while walking. In the other patient, aseptic loosening of the cup with a 2-mm radiolucent line in the interface of the bone and cup was noted 6 years postoperatively, but the patient refused revision surgery due to advanced age and mild clinical symptoms.

Complications other than infection recurrence included cerebellar hemorrhage in one patient, stem fracture in one patient, posterior dislocation in two patients and periprosthetic fractures in three patients. An early postoperative complication developed in a 55-year-old liver cirrhosis patient who had cerebellar hemorrhage 3 days postoperatively. The patient received craniotomy and had mild sequelae at 2 1/2-year follow-up. One patient had femoral stem fracture 3 months postoperatively. A large femoral stem was exchanged without any complications. At 5-year follow-up, the patient was free of infection and had a good result (Fig. 1).

Two patients had posterior dislocation of the hip. One dislocation developed 1 month postoperatively and was

successfully treated with closed reduction. This patient finally received another resection arthroplasty due to septic loosening 3 years postoperatively. Another dislocation developed in a patient who had received three revision operations for reinfection after primary total hip replacement. The recurrent dislocated hip was treated with closed reduction and hip brace immobilisation. This patient refused further treatment since there was no recurrent infection. Three hips had periprosthetic fractures. Two cases were successfully treated with dynamic compression plate and wire fixation. The fractures underwent union without complications (Fig. 2). Another fracture developed infection after wire fixation and allograft reconstruction. A two-stage revision total hip replacement was performed, and there was no further complication at 4-year follow-up.

The total complication rate including recurrent infection was 36%. The average leg length discrepancy improved from a preoperative mean of 2.89 cm (range: 2–4 cm) to a postoperative mean of 0.61 cm (range: 0–2.5 cm).

Discussion

Septic arthritis of the hip usually is encountered in children as an acute febrile illness induced either by septicemia or the local inoculation of a joint caused by trauma or adjacent osteomyelitis. Primary septic arthritis of the hip in an adult is relatively uncommon. Destruction of articular cartilage or resorption of subarticular bone is a late presentation in the septic hip. Resection arthroplasty resolves the problem, but early results reported in the literature were varied with some studies citing disappointing results [8, 9, 16]. Most patients with a resection arthroplasty will be left with a significant leg length discrepancy due to abductor strength weakness and piston effect, which sometimes require ambulatory aids. Therefore, Marchetti et al. recommended that resection arthroplasty should be considered a salvage procedure only in the elderly patient with poor bone stock after a failed total hip arthroplasty [13]. Arthrodesis of the hip is rarely necessary, and a total hip arthroplasty may be undertaken when the infection has been controlled [6].

Although total hip arthroplasty provides a chance for good functional results, the reconstruction of a stable, functional joint is technically challenging when there is excessive soft tissue scarring, distorted anatomy and deficient bone stock. After a period of time following resection arthroplasty, the soft tissues invariably become tight, making proper testing of hip stability difficult during total joint replacement surgery. Therefore, immediate implantation of a total hip prosthesis and combined antibiotic treatment can be considered when the surgeon believes the infection can be eradicated in the presence of a total hip prosthesis [4]. All patients in our series received a

Fig. 1 Radiograph of a 45-year-old man with Viridans streptococcus infection of the left hip. **a** Preoperative radiograph showing acetabular erosion and joint space narrowing of left hip. **b** Radiograph showing resection arthroplasty and implantation of gentamycin-loaded cement beads. **c** At 3-month follow-up, breakage of the femoral stem was noted. **d** Radiograph taken 5 years after revision of total hip arthroplasty showing no loosening of the prosthesis. The patient was free from infection and had a good result

two-stage procedure because we believed the recurrence of infection after total hip arthroplasty would be less with a period of antibiotic treatment after resection arthroplasty.

Four of 28 hips (14%) in our patients had recurrent infection, which confirmed our concern about a high risk of

reinfection after total hip arthroplasty in the patient with prior septic arthritis of the hip. Although infections from haematogenous spread may be more readily curable [4] and the femoral canal may not be infected in primary septic arthritis of the hip, the infection rate after total hip

Fig. 2 Radiograph of the pelvis in a 52-year-old man with staphylococcal infection. **a** Radiograph showing right periprosthetic fracture. **b** Radiograph taken 3 years after plating and wire fixation shows good bone healing. The patient was free from infection and had an excellent result after a 6-year follow-up

arthroplasty for primary septic hip is still higher than noninfected cases.

Because recurrent infection is a major concern in patients who have received total hip replacement to treat a previous septic hip, every effort should be made to reduce the infection rate and identify the infecting organism. Cherney et al. reported the difficulties of reliance on the preoperative erythrocyte sedimentation rate (ESR) and white cell count, aspiration and culture of aspirated material, tissue inspection and culture at surgery and even histological analysis of inflammation as indicators of the eradication of infection by previous debridement and antibiotic therapy [4]. Nevertheless, far more reliance has been placed on ESR as an indicator of persisting infection [2]. Wang reported that the preoperative ESR must be considered significant for THA in old, quiescent infection of the hip if the ESR was 40 mm/h or higher [18]. In our patients, elevated ESR was noted in three patients before joint replacement without reinfection at the time of follow-up. All patients with recurrence of infection had normal ESR before total hip replacement. Among them, three of four patients were immuno-compromised. We do think patients with diabetes mellitus, liver cirrhosis, drug abuse or gouty arthritis carry a relatively high risk for recurrent infection. Therefore, preoperative repeat aspiration should be conducted after the discontinuation of antibiotics for at least 2 weeks with clinical and laboratory work-up to exclude occult infection. An intraoperative specimen with frozen resection can also be used to exclude the current infection before THA in immuno-compromised patients.

Although adequate debridement of necrotic bone and soft tissue is important, other factors, such as type of bacteria and effectiveness of antibiotic therapy, may also play important roles. Evrard and Soudrie reported that *Staphylococcus* is the usual organism found in patients with primary septic hip [6], the most common organism isolated in this series of patients. Single bacterial species infection is thought to have a higher treatment success rate than mixed infections. It has been reported that single bacterial species infection are easily controlled by systemic antibiotic therapy [4]. Additionally, the treatment success rate of a gram-positive organism is noted to be better than gram-negative organism infection, especially with *Pseudomonas* infection [4]. However, these results were different from our study. Recurrent infection after total hip arthroplasty was noted in four patients in our series. The original infections were oxacillin-sensitive *Staphylococcus aureus* in two, oxacillin-resistant *Staphylococcus aureus* in one and mixed infection in one. Two patients had definite recurrences of the original bacterium; two were infected with an organism different from the original one. Three of four patients had an underlying medical disease, which indicates the recurrence rate in the immuno-compromised patient was

higher than in the normal population. On the other hand, two of the hips with *Pseudomonas* infection in our patients experienced no recurrent infection after total hip arthroplasty with successful results.

Femoral stem fracture is rare after the introduction of a high-strength metal alloy. However, the occurrence of fracture has not been eliminated totally [7]. Undetectable metallic defects can still occur and, under the appropriate circumstances, can lead to fatigue failure. Sporadically, such fractures occur and can be traced back to a change in manufacturing techniques or other production events [7]. The early femoral stem fracture in one of our study patients might be the result of the placement of a relatively small stem in a young, active male patient. The surgeon should always be careful to use the appropriately sized femoral stem of adequate strength with assessment of the patient's body weight and activity level.

In a series of 1,693 primary total hip arthroplasties and 277 revision procedures, Khatod et al. reported that the overall dislocation rate was 1.7% for primary total hip arthroplasties and 5.1% for revision procedures [11]. Dislocation usually results from inadequate component positioning, soft tissue tension or both factors. The primary problem seems to be related to difficulty in the evaluation of intraoperative hip stability during implantation. At implantation, the soft tissues are invariably tight, which makes proper testing of hip stability difficult. Because of the high rate of dislocation (7%) seen in this series of patients, proper tension of soft tissue and adequate component positioning cannot be overemphasized. Otherwise, a constrained acetabular component may be a useful choice to combat this problem as Charlton et al. suggested [3].

A more recent approach in the treatment of an infected total hip arthroplasty is an articulating antibiotic depot prosthesis of antibiotic acrylic cement as an interim in a two-stage exchange [5]. However, this method may not be useful in primary septic hip after resection arthroplasty because the femoral canal may not be infected along with the hip. Milgram et al. [15] reported that osteomyelitis in the septic hip of the adult was never documented within the central bone marrow of the head or the femoral neck bone marrow. Therefore, it was a surface phenomenon. Based on this finding, we chose to fill the joint space with gentamycin-loaded antibiotic beads to combat infection after resection arthroplasty in the primary septic hip.

The patients' clinical evaluation scores showed significant improvement in motion, pain and function compared with those after resection arthroplasty. Leg length discrepancy of more than 1 cm was noted in two patients. The average Harris hip score improved after total hip arthroplasty in all of the patients. Despite significant improvements in clinical evaluation scores, some patients still were not

satisfied with the results because of a leg length discrepancy or dependency on walking aids.

The results of this study indicate that total hip arthroplasty for the adult patient with septic arthritis of the hip provides a good chance of infection control with a significant improvement in functional outcome. However, the complication rate remains high, occurring in 36% of our patients. Although the results from this series showed a high complication rate, two-stage THA remains a worthwhile procedure in patients with primary septic arthritis of the hip.

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