Two-stage cementless revision THR after infection

5 recurrences in 40 cases followed 2.5–7 years

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We revised 40 infected hip prostheses in 40 patients as a two-stage procedure, including intravenous and oral antibiotics, gentamicin beads, and delayed cementless implantation of porous-coated THR. The duration of antibiotic treatment was 8 weeks. The interval from resection to reimplantation was, on average, 48 (8–108) weeks. 39 patients were followed, on average, 4 (2.5–7) years. 5 patients had a recurrent infection. In patients who did not have a recurrent infection, the Harris hip score exceeded 80 in 32 patients. Radiographically, femoral component migration of 2–6 mm was noted in 3 cases.

The recurrent infection rate, and the functional and radiographic results are comparable with those obtained using a two-stage procedure with antibiotic cement.

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Currently, the two-stage technique using 6 weeks of antibiotics and antibiotic-impregnated cemented arthroplasty appears to have the highest cure rate for an infected hip arthroplasty. However, this view is based more on literature reviews than on prospective comparative studies (Duncan and Masri 1994, Garvin and Hanssen 1995).

Methyl methacrylate has been shown in vitro to inhibit killing of Staphylococci and E. coli by leukocytes (Petty 1978). Lymphocyte response in vitro is also decreased (Panush and Petty 1978). All other factors being equal, avoidance of bone cement may be beneficial in the management of periprosthetic infection. A search of the English language literature showed that apart from the Mayo Clinic series by Fitzgerald et al. (Fitzgerald and Hanssen 1991, Nestor et al. 1994, Fitzgerald 1995), two-stage cementless reimplantation has rarely been discussed.

We report our experience with delayed cementless total hip reimplantation in patients who had an infected prosthetic hip. Since in Taiwan most primary hip replacements are cementless, this series differs from most others because the original infected primary arthroplasties were nearly all cementless.

Patients and methods

The criteria for inclusion were that the patient had had an infected hip prosthesis that was treated by removal of the implant, followed by a period of parenteral antibiotic therapy, and later implantation of a cementless hip prosthesis. From 1988 through 1992, 40 hips in 40 patients at the Cheng Kung University Medical Center met these criteria.

There were 12 women and 28 men in the study, and the average age was 49 (32–65) years. The series included various infected prostheses: 24 cementless THAs, 14 cementless bipolar hemiarthroplasties, 1 cemented THA, and 1 cementless Moore prosthesis. The primary diagnoses were avascular necrosis of the femoral head in 20 patients, subcapital hip fracture in 11, arthrosis in 4, posttraumatic arthrosis in 4, and systemic lupus erythematosus in 1. The patients had the following systemic diseases: diabetes mellitus in 7 patients, liver cirrhosis in 3, and chronic hepatitis, chronic nephritis, and systemic lupus erythematosus in one patient each. A draining sinus was present in 7 patients.

All of the infections were treated with resection arthroplasty. Trochanteric osteotomy was necessary in 6 patients to remove the prosthesis. The joint capsule was excised, and the membrane between the prosthesis and bone was debrided thoroughly. Gentamicin beads (Septopal, Merck, Rahway, NJ) were placed in the femoral canal and acetabulum in 34 patients.

A single organism was isolated in specimens from 29 hips, and more than one organism, in specimens from 7 hips (Table 1). No organisms were isolated from 4 specimens because of preoperative antibiotic

Table 1. Microorganisms of hip prosthesis infection

Organism	Number
Staphylococcus aureus	18
Staphylococcus epidermidis	11
Escherichia coli	3
Bacillus subtilis	2
Proteus mirabus	2
Pseudomonas aeruginosa	2
Pseudomonas cepacia	1
Enterobacter cloacae	1
Enterococcus	1
Unidentified G(+) bacillus	1
Unidentified G(–) bacillus	1
Total	43
Mixed	7
Negative culture	4

therapy given by the referring surgeon. The diagnosis of infection was confirmed by histological evidence.

Adjusted antibiotic therapy was administered parenterally to all patients for 2–6 weeks. After this, oral antibiotic treatment continued until at least 8 weeks postoperatively, when the ESR and C-reactive protein titers returned to normal ranges.

The revision THR was performed at an average of 48 (8–108) weeks after excision. In patients with infections caused by Gram-negative organisms, methicillin-resistant strains of *Staphylococcus aureus* and *Staphylococcus epidermidis*, as well as Group D streptococci (Enterococcus), reimplantation was done at least 12 months after excision (McDonald et al. 1989, Fitzgerald 1995). In patients who had a low-virulence organism, reimplantation was done not before 8 weeks, and only after joint aspiration cultures proved negative.

The following cementless prostheses were used for the revision: 9 BIAS (Zimmer, Warsaw IN), 8 Omnifit (Osteonics, Allendale, NJ), 4 long-stem Osteonics, 6 Harris-Galante (Zimmer, Warsaw, IN), 4 PCA (Howmedica, Rutherford, NJ), 3 long-stem PCA, 3 Optifix (Richards, Memphis, TN) and 3 AML (DePuy, Warsaw, IN). Femoral components longer than 160 mm were necessary in 19 cases. Morsellized autografts or allografts were used for the acetabulum in 1 case, in the femur in 5, and in both in 1 patient. The bone grafts were soaked in antibiotic solution before application.

In the revision, intraoperative tissue specimens cultured positive for the original organisms in 2 cases (1 Pseudomonas, 1 *Staph. epidermidis*). The hip with Pseudomonas became clinically infected once again. Postoperatively, antibiotics were administered to these patients for 2 weeks (limited by health insurance regulations), and then orally for another 2 months.

The patients were followed regularly. Function was determined using the Harris (1969) hip score. Presence of pain at rest, elevation of ESR greater than 30 mm/hr and elevation of CRP greater than 20 mg/L were closely monitored as indicators of recurrent infection (Sanzen and Carlsson 1989). When suspected, Gallium scan, joint aspiration, and needle biopsy were used to confirm the diagnosis of recurrent infection.

Results

1 patient died 15 months after revision THR of hepatic failure which was complicated by septic arthritis of the ipsilateral knee, but the THR was not infected. The remaining 39 patients were followed for an average of 4 (2.5–7) years.

5 patients had a recurrent infection, all detected within 6 months after reimplantation. In 4 of the 5 patients, the organism was the same as at least one of the organisms that caused the primary infection. These included 1 case of methicillin-resistant *Staph. aureus*, 1 case of *Enterobacter cloacae*, 1 case of Pseudomonas, and 1 case of Enterococcus. The recurrent infection was caused by *Pseudomonas aeruginosa* instead of the original *Staph. aureus* in 1 patient. 1 patient refused to undergo repeat excision and was treated with suppressive antibiotics. The other 4 underwent re-resection arthroplasty, and of them 3 had successful re-reimplantation.

3 of 6 patients who underwent resection without placement of Septopal had a recurrence of the infection. Of the 33 patients who had received interim placement of gentamicin beads, only 2 became re-infected (1 with Enterococcus, 1 with *Enterobacter cloacae*).

24 patients received less than 4 weeks of parenteral antibiotics, 8 patients received 4–6 weeks, and 7 (all with Gram-negative infections) received 6 full weeks. In these subgroups, the respective numbers of patients who became reinfected were 2, 1, and 2.

In the 6 cases where bone grafts were used, there were 2 recurrent infections; one with Pseudomonas, the other with Enterococcus. Of the 7 patients who had diabetes mellitus, none had a recurrent infection.

Complications of the treatment included ototoxicity, secondary to aminoglycosides, transient sciatic nerve palsy, ectopic calcification, hip dislocation, and trochanteric nonunion (Table 2). 1 patient developed an intraoperative periprosthetic fracture of the femur, which was treated with cerclage wiring.

The Harris hip scores in the 34 cases without recurrent infection averaged 91; 21 cases had excellent, 11

Table 2. Complications

Reinfection	5
Toxicity of antibiotics	4
hearing impairment	3
renal function impairment	1
Transient nerve palsy	3
Ectopic ossification (Brooker class II & III)	5
Dislocation	1
Trochanteric nonunion	1
Total	19

good , and 2 a fair result. 29 patients suffered no pain or slight pain, the other 5 had moderate pain. None had marked pain or was disabled. Walking distance was not limited in 23 patients. Only 1 patient needed a cane for walking. No patient had such a reduced range of motion severe enough to interfere with their activities of daily living. A Trendelenburg limp was noted in 5 cases.

Radiographically, 3 femoral components were definitely loose, with subsidence of more than 2 mm. In addition, isolated nonprogressive radiolucent areas at the bone-implant interface were noted around 7 acetabular and 5 femoral components, without component migration.

Discussion

Our series differs considerably from most series described in the Western literature. The primary diagnosis was avascular necrosis of the femoral head in 20 of the 40 cases. In Taiwan, the majority of total hip replacements are done using cementless techniques. Only one of the original infected prostheses was a cemented THR. The average age of the patients in this series was 49, more than a decade younger than the patients in most other series. Collins and McKenzie (1991) noted that patients with successful outcome after an infected hip arthroplasty averaged 52 years, while those with unsuccessful outcomes averaged 65 years. Current reviews have 7–24% rates of recurrent infection after revision for infected THRs. The average success rate for two-stage exchange arthroplasty was given as 91% (Colyer and Capello 1994, Garvin and Hanssen 1995).

We are aware of only one other large series where uncemented porous-coated prostheses were used in two-stage revisions (Nestor et al.1994). In that study, 6 of 34 had a recurrence of the infection at an average of 4 years' follow-up, similarly to our results.

In a large series by Went et al. (1995), the infection rate after apparently successful septic revision was 10% at 3 years and 26% at 10 years. The revision was done using gentamicin-loaded bone cement in almost all cases, and 47/98 were one-stage replacements.

Colyer and Capello (1994) emphasized the need for routine second-look surgical debridement 1 week after the initial resection arthroplasty, and formal debridement again at the time of reimplantation. They gave intravenous antibiotics for 2 weeks following reimplantation and oral antibiotics for another 3 months and suggested a 4-week interval between resection and reimplantation. It was not evident from the article how many of the reimplants were cemented. The infection was controlled in 31/37 cases.

The optimum duration of intravenous antibiotics is not known (Garvin and Hanssen 1995). There is little evidence in the literature to recommend a certain time interval between resection and reimplantation in a two-stage plan. The average interval in our series was almost 1 year, with a wide range. This agrees with the recommendation by McDonald et al. (1989), but opinion still varies considerably (Colyer and Capello 1994, Lieberman et al. 1994).

6 of our patients required bone grafts, and in 2 of them the infection recurred. Others have suggested that bone grafts do not increase the risk of recurrent infection (Berry et al. 1991, Nestor et al. 1994).

The fact that 5/39 of our patients had a recurrent infection suggests that avoidance of bone cement does not improve the rate of resolution of an infection. The functional and radiographic results of noncemented revisions are comparable or slightly better than with cemented techniques.

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