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Two-Stage Revision Protocol in Multidrug Resistant Periprosthetic Infection Following Total Hip Arthroplasty Using a Long Interval Between Stages

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ABSTRACT

We retrospectively reviewed the medical records of 31 patients with periprosthetic hip infections attempting to evaluate the outcome of a two-stage revision protocol characterized by prolonged interim period (mean = 9.2 months, range 8–12 months) prior to the final re-implantation. In 3 cases (9.6%) the 1st stage was repeated after a mean period of 12.3 weeks due to relapse of infection. Five spacer dislocations occurred, not affecting the final clinical outcome after reimplantation, as evaluated by the Harris Hip Score. No protrusions or additional acetabular bone loss was noticed. Our proposed protocol is a simple, safe, efficient and reproducible treatment approach that may be successfully utilized predominantly when dealing with multidrug resistant pathogens.

Periprosthetic joint infection (PJI) clinical symptoms vary from acute postoperative septic arthritis or acute late hematogenous episode to late sub-acute or chronic infection [1–4]. Two-stage protocols with implant removal and re-implantation after an adequate period of antibiotic administration and antibiotic free intervals have been established as the standard of care [2,5–9]. Articulated spacers may be used in the interval period [3,8–11]. However, absolute eradication of a periprosthetic infection is difficult to achieve since sensitivity and specificity of current preoperative diagnostic tests cannot reach 100%. Therefore, the optimum duration of antibiotic treatment between 2 stages and the correct timing of re-implantation remain controversial [12–20].

The success rate of eradication for periprosthetic infections after the two-stage procedure ranges from 82% to 91% [3,8,11,14–18,21–36]. Chen et al presented 96% infection control rate of 48 hips at an average follow-up of 5.6 years in two-stage re-implantation of the infected hip arthroplasty with an average 2.6 weeks (range, 2–6 weeks) of intravenous antibiotic therapy after the first-stage procedure [21]. However, to the best of our knowledge, the ideal duration of postoperative antibiotic therapy while in two-stage revision still remains unclear [9,13,26,35,37].

In addition, the increase of the incidence of the antibiotic resistance profile of the pathogenic organisms predisposing to highly virulent microorganisms as well as the arising percentage of individuals with multiple co-morbidities, has increased proportionally the overall need for revision hip arthroplasties [2,16,22,34,38–40]. We hypothesize that short time-intervals between surgical debridement and re-implantation are positively correlated with the increased likelihood of re-infection and failure, predominately in cases of complex multidrug resistant microorganisms.

The aim of this study was to assess the outcome of deep periprosthetic hip infections treated with staged revision arthroplasty using a long interval between stages. We tried to evaluate the safety and efficacy of our protocol.

Materials and Methods

We retrospectively reviewed the outcome of 31 patients with periprosthetic hip infections that underwent two-stage revision hip arthroplasty. There were 6 males and 25 females with a mean age of 64 years (range 32–82 years old) who were admitted to our department between 2007 and 2010. Twenty-seven patients (87%) were referred from other hospitals. These patients had a mean of 2 operations (range 1–5) prior to the present procedure.

Institutional review board approval: obtained before initiating the study.

Informed consent and ethics: The subject permits photographs and information about the case to be published and he understands that his name will not be published.

Proprietary statement: The authors had no financial, commercial or proprietary interest in any drug, device, or equipment mentioned in the submitted article.

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Periprosthetic infection was diagnosed based on clinical symptoms, radiographic imaging, and laboratory exams consisting of inflammatory markers such us erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) and white blood cells (WBC), as well as on sampling from joint fluid. We evaluated our patients for the presence of systemic or local features that could potentially affect their immune response. Therefore, patients' general medical condition was taken into consideration and a detailed medical history including co-morbidities (diabetes, renal function, and immune deficiencies), cardiovascular status, medication and habits (smoking, alcohol) was obtained according to the Cierny–Mader classification [22]. Samples from joint fluid were collected preoperatively under fluoroscopy and sent for culture in order to potentially isolate the causative microorganism, reveal its sensitivity to different antibiotics and select the proper one to be used as a content of the bone cement.

Antero-posterior radiographic view of the pelvis and lateral view of the infected hip joint were also obtained as per our protocol so as to document loosening and migration. According to the classification of Tsukayama et al, all patients were diagnosed with a late chronic infection [41].

Pre-operatively all patients were classified as B-host according to Cierny–Mader classification [22].

Treatment Protocol

In the first stage, we performed a meticulous debridement and removal of all foreign bodies and potentially infected soft tissue. At least 5 samples were collected from capsule, acetabulum, femoral canal and every part of the prosthesis and sent to the lab for cultures. The surgical field was thoroughly irrigated using a low-pressure pulsatile lavage system. Any sign of necrotic tissue was removed as precaution to the possibility of colonization of avascular tissue.

All operations were performed through a posterior approach by the senior author (GCB). Methylene blue was used to track sinuses, when present. In all 31 cases we used a cement spacer, either with a unipolar hemi-arthroplasty shape (26 cases) or total hip arthroplasty like PMMA spacer (5 cases). Utilization of spacer took place not only for antibiotic delivery reasons but also as a preventive measure for soft tissue contracture related problems, wound closure difficulties during next stage and limp shortening. The choice of antibiotics in the cement was determined according to the results of bacterial cultures obtained from the preoperative joint aspirations. In most of the cases we added 2 g of antibiotic powder to each package of 40 g of cement polymer. If the infecting microorganism could not be isolated pre-operatively, as this happened in three of our cases we used 4 g of vancomycin.

At the end of the first operation two suction drain tubes were inserted in the hip joint.

Although full weight bearing of the ailing limb was restricted in order to protect the cement spacer and the remaining bone stock, 28 of the 31 patients were fit to walk using a walker in the interim period.

After the first operation all 31 patients were regularly evaluated with clinical and laboratory tests. After the first stage all cases received antibiotics intravenously (IV) for a mean period of 5.1 weeks (range, 4–6 weeks) followed by oral administration for a mean period of 17 weeks (range, 12–21 weeks), based on the intraoperative cultures. In-hospital intravenous antibiotic administration was performed as per the recommendation of Infection Control Service. The choice of antibiotics was decided according to the antibiotic sensitivity results (antibiogram and minimal inhibitory concentration) for the microorganism that was isolated from intraoperative cultures.

The criteria to proceed to the second stage, except for the prolonged interim, were the normalization of ESR and CRP values and the absence of any clinical evidence of infection.

We followed a modified 2-stage revision protocol with a mean interim period of 9.2 months (range 8–12 months) prior to final re-implantation. Our protocol included a delay in re-implantation compared to standard protocols, leaving a period of at least 8 weeks of negative clinical findings and normalized inflammatory indexes before re-implantation. Two weeks before the planned second-stage surgery, hip joint aspiration and cultures were repeated to confirm the absence of infection prior to re-implantation. Following these criteria, second stage procedure was performed after a mean time of 9.2 months (range 8–12 months).

During the second-stage operation, the spacer was removed. At least 5 samples were collected for cultures followed by additional debridement. All 31 hips were successfully converted to a total hip arthroplasty with cementless hip prostheses. IV antibiotics were delivered to all of the patients for one week after re-implantation until intraoperative cultures were proved sterile. No oral antibiotics were given to any patient thereafter.

All the patients were evaluated with laboratory, imaging and clinical assessment weekly until the sixth postoperative week and then at 3, 6, 12, 18, 24, 36, and 48 months postoperatively. Clinical assessment was performed using the Harris Hip Score. Clinical signs of recurrent infection (redness, swelling, pain, fistulae) were recorded at follow-up. The mean duration of follow up was 30 months (range 20–48).

Results

At the follow-up period none of the patients was lost. All patients who completed the prolonged interval between two stages had a successful revision arthroplasty with no evidence of recurrence of infection. The success rate of eradication of the causative microorganism was 100% and no kind of further intervention was required after the completion of the second stage. No local or general signs or laboratory data of infection and no need to restart antibiotics at any point were noted. All the patients had negative cultures for the tissues obtained during the second stage procedure. We had no cases of clinical, radiographic or laboratory findings of reinfection after final re-implantation of revision prostheses. No hip dislocation occurred during the follow-up period. Radiographically, there was no migration of the components or progressive radiolucency.

With regard to the interim period between the first stage of debridement and the second stage of re-implantation, we had the following findings: in three cases (9.6%) we had to repeat the 1st stage at a mean period of 12.3 weeks (11, 12 and 14 weeks after surgery, respectively) due to re-infection as documented by CRP elevation and positive cultures from the joint fluid aspiration as well as intraoperative cultures. In all three cases the responsible microorganism was the same as in the first time (MRSA). In 5 cases there was a cement spacer dislocation. No protrusion or additional acetabular bone loss was seen due to prolonged duration of weight-bearing with the spacer. In our cohort, two of the cement spacers broke; one spacer was pre-molded, while the other one was molded intra-operatively. In these cases patients were instructed to limit weight bearing till the second stage of revision surgery. It has to be mentioned that, although the aforementioned complications affected the level of mobility and functionality of the patients during the interim period, they did not alter the final clinical outcome, which was assessed using the Harris Hip Score.

Resistant Gram-positive microorganisms were responsible for the infection in most of the hips (67%). Infection was caused mainly by *Staphylococcus* species. The microorganisms isolated from the intraoperative samples were methicillin resistant *Staphylococcus aureus* (MRSA) in 11 patients (35%) and methicillin resistant *Staphylococcus epidermidis* (MRSE) in 10 patients (32%). Other microorganisms found were *Escherichia coli* in 2 patients, *Streptococcus mitis* in 1 patient and *Staphylococcus warneri* in 1 patient. Multiple organisms were identified in 10 patients (32%) (Table 1).