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Treatment of glenohumeral sepsis with a commercially produced antibiotic-impregnated cement spacer

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Background: We report our experience in treating infected shoulder arthroplasty and primary shoulder sepsis using a commercially produced antibiotic-impregnated cement spacer.
Materials and methods: We treated 16 shoulders in 15 patients for infected arthroplasty or osteomyelitis of the proximal humerus with irrigation and débridement, hardware removal, or humeral head resection, or both, and placement of an interval articulating hemiarthroplasty with a commercially made gentamicin-impregnated cement spacer.
Results: Mean follow-up was 20.5 months after spacer placement. At the time of débridement, 12 shoulders had positive cultures; the most common organisms were methicillin-resistant *Staphylococcus aureus* (n = 3) and *S. epidermidis* (n = 3). Twelve patients underwent revision. Four refused revision and have retained antibiotic spacers. White blood cell counts returned to within normal ranges in all patients at the time of revision, the erythrocyte sedimentation rate in 5 of 12 patients, C-reactive protein in 8 of 12 patients, and interleukin-6 in 9 of 11 patients. Mean visual analog pain scale score decreased from 8.4 before spacer placement to 0.5 at the final follow-up. Active forward flexion increased from a mean of 65° to 110°, and active external rotation from −5° to 20°. Mean University of California Los Angeles (UCLA) Shoulder Rating Scale score increased from 7 to 26, Simple Shoulder Test (SST) from 1.2 to 6.6, American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment Form score from 16 to 74, and Constant score from 16 to 57. There was no recurrence of infection.
Conclusions: Treatment of glenohumeral sepsis with a commercially produced antibiotic-impregnated cement spacer appears to be an effective treatment modality, and serum interleukin-6 level appears to be useful in the evaluation of shoulder infection.
Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Glenohumeral sepsis; antibiotic cement spacer; total shoulder arthroplasty

Primary shoulder sepsis and infection after shoulder arthroplasty are rare, with a reported incidence of 0% to 4% for infected shoulder arthroplasty.[9,13,23,24] Staged revision arthroplasty remains a satisfactory treatment modality,[22,23] despite reports of high complication rates.[22,24] Treatment of an infected shoulder arthroplasty with an intraoperatively crafted antibiotic-impregnated cement spacer has been reported to be effective in eradicating infection.[10] This article reports our experience treating infected shoulder arthroplasty and primary shoulder sepsis using a commercially produced antibiotic-impregnated cement spacer.

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Figure 1 Commercially produced antibiotic-impregnated cement spacer implant.

Materials and methods

This study was approved by the Institutional Review Board of Miami Valley Hospital, Dayton, Ohio (Protocol #09-0023).

Between 2006 and 2008, 17 shoulders in 16 patients were treated by 1 surgeon for infected arthroplasty or osteomyelitis of the proximal humerus, of which 16 shoulders were included in the present study. One patient was excluded because of reinfection of the revision total shoulder prosthesis. His prosthesis was presumed to have been seeded from a pelvic abscess that had cultures positive for the same organism as the shoulder reinfection, but different from the previous infection.

Infection was diagnosed by laboratory analysis of aspirated synovial fluid in 3 patients and by the presence of a draining sinus in 4. The infection in 4 patients was diagnosed by the presence of purulence intraoperatively during revision of a painful hemiarthroplasty. The infection in the remaining 5 patients was diagnosed by pain on clinical examination, erythema, and elevated laboratory indices.

All patients underwent extensive irrigation and débridement of the infected shoulder, with collection of intraoperative cultures and bone biopsy. Infection was confirmed in all patients by intraoperative frozen section and pathologic analysis of intraoperative biopsy specimens. Implants and cement were removed from shoulders, and patients with humeral head osteomyelitis underwent humeral head resection. An articulating hemiarthroplasty with the InterSpace Shoulder, a gentamicin-impregnated polymethylmethacrylate cement spacer (manufactured by Tecres S.p.a. Sommacampagna (Verona) Italy, and distributed by Exactech, Gainesville, FL; Fig. 1 and Fig. 2), was then placed. The spacer has a concentration of gentamicin by weight of 2.8%, with a total of 0.8 grams of gentamicin per spacer. The spacer is available in 1 size, with a 46-mm diameter head, 11-mm diameter stem, 125-mm stem length, and 130° stem-neck angle. All spacers were fixed with a vancomycin-impregnated cement collar for stability and broader coverage against methicillin-resistant *Staphylococcus aureus* (MRSA).

All patients received culture-specific intravenous antibiotics postoperatively and were monitored clinically, radiographically, and with white blood cell count (WBC), serum erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and interleukin-6 (IL-6) levels every 2 to 3 weeks after spacer placement.

Patients were allowed to use their operative arms as tolerated with the spacer in place. Most patients underwent a second procedure in which the spacer was removed and a total shoulder arthroplasty was placed. The revision was performed when the patient's serum IL-6 value had returned to normal or was trending down. Intraoperative tissue biopsy was performed at the time of revision arthroplasty, and the surgeon proceeded with revision arthroplasty only if there were fewer than 5 WBCs per high-power field.

All patients were evaluated with the University of California, Los Angeles (UCLA) Shoulder Rating Scale, Simple Shoulder Test (SST), American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment Form, and Constant shoulder score surveys before surgery and at each follow-up visit. At each visit patients were also assessed on shoulder range of motion and a visual analog pain scale.

Results

Of the 16 shoulders included in this study, 6 had an infected hemiarthroplasty, 5 had an infected total shoulder arthroplasty (3 of which were a reverse ball-and-socket prosthesis), 4 had primary osteomyelitis of the humeral head, and 1 had proximal humeral osteomyelitis with retained hardware from previous open reduction and internal fixation of a proximal humerus fracture. The group consisted of 11 right and 5 left shoulders in 12 men and 3 women, and their mean age was 58.9 years (range, 45-89 years) at the time of spacer placement.

Positive cultures were found in 12 of 16 shoulders at the initial débridement. Organisms cultured included 3 with MRSA, 3 with *S. epidermidis*, 2 with *Corynebacterium* spp., and 1 each with methicillin-sensitive *S. aureus*, *Propionibacterium acnes*, *Escherichia coli*, *Enterococcus* spp., *Serratia* spp., or *Klebsiella* spp. (Table I). Intraoperative cultures were sent during 9 of 12 revision procedures, and all 9 were negative.

Five patients had a tissue diagnosis of osteomyelitis at initial débridement. All patients were seen in consultation by an infectious diseases specialist and received culture-specific