Treatment of Primary Isolated Shoulder Sepsis in the Adult Patient

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Abstract Isolated shoulder sepsis is an uncommon clinical problem with little information in the literature on causative organisms and potential sequelae. We examined the organisms involved, surgical treatments, antibiotic treatments rendered, and complications in these cases. We retrospectively reviewed the records of 19 adult patients (19 shoulders) who underwent operative treatment of isolated shoulder sepsis from 1996 to 2005. Patient age, gender, laboratory studies, previous treatment, surgical procedures, surgical findings, cultured organism, antibiotic treatment, and complications were reviewed. The organisms included methicillin-susceptible *Staphylococcus aureus* (five), *Streptococcus B* beta hemolytic (five), *Staphylococcus epidermidis* (three), negative cultures (two), *Streptococcus viridans* (one), *Escherichia coli* (one), methicillin-resistant *S. aureus* (one), and *Propionibacterium acnes* (one). We treated patients with intravenous antibiotics an average of 4.2 weeks (range, 3–8 weeks). One patient underwent humeral head resection with an antibiotic spacer. Another patient died during hospitalization. Open or arthroscopic débridement in conjunction with appropriate antibiotics appears effective in eradicating infection in most adults who present with shoulder sepsis.

Functional outcome is poor in those patients with irreparable rotator cuff tears and/or cartilage loss.

Level of Evidence: Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

While shoulder sepsis in adults has been reported in several studies [4, 6, 8, 13, 21], none specifically examined isolated adult shoulder sepsis, the organisms involved, and how these patients are treated. Although several studies report postoperative infections in the shoulder [16, 18, 19], it appears the range of causative organisms of these infections may be very different from that seen in primary shoulder infections [4, 6, 8, 12, 13, 16, 18, 19, 23]. Specifically, in reports on infected rotator cuff surgery and infected shoulder arthroplasty, the most common organism has been *Propionibacterium acnes* [16, 18, 19]. Shoulder sepsis has a poor prognosis in patients with rheumatoid arthritis or who are otherwise immunocompromised [1, 17, 22]. Based on our experience we suspect the range of organisms for primary shoulder sepsis may be different than seen in the postoperative setting.

Evaluation of laboratory values in patients presenting with isolated shoulder sepsis can help in making the diagnosis. By knowing which organisms are involved, the treating surgeon can more accurately provide appropriate antibiotic coverage. Examination of the surgical treatments performed gives us an idea of the options available to the orthopaedic surgeon treating these patients. A careful review of complications may help the treating surgeon avoid problems or at least be aware of what problems may arise and how to best treat them.

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Each author certifies that our institution has waived approval for the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.

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The objectives were therefore to describe the: (1) laboratory values at presentation; (2) organisms involved; (3) surgical and antibiotic treatment; and (4) complications in these cases.

Materials and Methods

We retrospectively reviewed the medical records of 19 patients (19 shoulders) with isolated shoulder sepsis. To identify these patients we performed a computer-assisted search of our institution's surgical database for records from January 1, 1996, through December 31, 2005. All had isolated shoulder sepsis without any known trauma or other infection and no history of any joint infections. No patients were on any type of steroid medication or other immunosuppressive. Nine patients had comorbidities, including chronic obstructive pulmonary disease, coronary artery disease, end-stage renal disease, and diabetes. The average age was 75.5 years (range, 49–94 years). One patient died in the hospital within 6 days of hospitalization after subsequently developing multisystem organ failure and was excluded from further review. Two additional patients (two shoulders) died before the initiation of this review. The minimum followup time was 1 month (mean, 6 months; range, 1–38 months). We obtained approval for this study from our Institutional Review Board for Human Research.

All patients had consultation with an infectious disease specialist. We obtained cultures when the shoulder had been aspirated preoperatively; otherwise, cultures were obtained intraoperatively at the time of the first procedure.

We reviewed the patient's medical records and recorded variables in age, gender, laboratory studies, previous treatment, surgical procedures, surgical findings, cultured organism, antibiotic treatment, and complications. Patients treated surgically for these infections had a routine interval of followup and clinical assessment. We used the most recent followup with clinical evaluation as the basis for shoulder function.

Results

Eight patients presented with fever greater than 100.5°F. Three patients had a leukocyte count greater than $14 \times 10^9/L$ (mean, $10.5 \times 10^9/L$; range, 2.4 – $16 \times 10^9/L$). Fifteen patients had an erythrocyte sedimentation rate mean of 66 mm/hr (range, 8–146 mm/hr). We found negative Gram stains in three of 19 shoulders. Positive cultures were obtained in 17 of 19 shoulders (Table 1). Five shoulders had methicillin-sensitive *Staphylococcus aureus*. There were five *Streptococcus B* beta hemolytic-positive cultures. There were three *Staphylococcus epidermidis*-

Table 1. List of culture results

Organism	Number of patients
Methicillin-susceptible <i>Staphylococcus aureus</i>	5
<i>Streptococcus B</i> beta hemolytic	5
<i>Staphylococcus epidermis</i>	3
Negative cultures	2
<i>Streptococcus viridans</i>	1
<i>Escherichia coli</i>	1
Methicillin-resistant <i>S. aureus</i>	1
<i>Propionibacterium acnes</i>	1

positive cultures. We found *Streptococcus viridans* in one patient. *Escherichia coli* was also cultured in one patient. We observed methicillin-resistant *S. aureus* and *Propionibacterium* in one patient each. Two patients who had negative cultures were noted to have frank purulence before surgery.

Nine patients (nine shoulders) were treated with open irrigation and débridement using a deltopectoral incision and arthrotomy. Ten patients were treated with arthroscopic débridement and no patients underwent aspiration only. All nine patients treated with open techniques had eventual primary wound closure. The average number of débridements was two (range, 1–3 procedures) with 14 patients having one débridement. Four patients had two débridements each. The type of surgical intervention was based on surgeon preference. We evaluated the proximal humerus during the procedures and noted cartilaginous erosions in 12 patients. Twelve patients had a full-thickness rotator cuff tear that was irreparable (all patients with rotator cuff tears were treated with débridement only and none of these were repaired).

We treated patients with broad-spectrum intravenous antibiotics initially followed by a microbe-specific intravenous regimen for an average of 4.2 weeks (range, 3–8 weeks). Twelve patients were also treated with an oral regimen after their intravenous treatment. No patient required chronic suppression. There were no cases of recurrent shoulder sepsis. However, one patient did require resection of his humeral head to contain the infection.

At the last followup of the surviving patients, three patients were pain-free, three patients had mild pain, 10 had moderate pain with activities, and two had constant pain. One patient had further surgery (hemiarthroplasty) for his humeral head resection (Fig. 1) [5, 14, 15, 22]. A 64-year-old male presented with a 5-day history of shoulder pain and swelling. We performed open débridement and irrigation and the cultures grew MRSA. He was on IV vancomycin at discharge, but had recurrence at 3 weeks. He had two more washouts with placement of antibiotic

Fig. 1 The radiograph demonstrates humeral head resection with an antibiotic spacer.

beads (and removal 3 weeks after the last washout). Nine weeks after his bead removal he had recurrence and underwent resection arthroplasty. Patients with rotator cuff tears and cartilage loss had less than 60° of forward flexion and 30° of external rotation. No patients were treated with arthrodesis.

Discussion

Isolated shoulder sepsis, in an otherwise healthy patient, is uncommon. This study examined the organisms involved, the type of surgery and antibiotic treatment, the outcomes and complications. The number of patients in this study is relatively small despite it being one of the largest in comparison to that published in the literature. The short followup of a minimum of 1 month (mean 6 months) precludes identifying possible late recurrences or the long-term sequelae of shoulder sepsis.

Prompt attention is needed to address joint infections before further cartilaginous and soft tissue damage occurs [4, 8, 12, 13, 20, 21, 23]. When surgery is indicated, open and arthroscopic techniques appear equally accepted [8, 20, 21, 23]. Within the limits of followup we successfully treated 14 of 18 patients with only one surgery. Repeat surgery was needed in five patients as determined by the

patient's response (clinically the patients should have improvement in pain with passive and active range of motion, normalization of body temperature, and improvement in WBC, CRP, ESR values) to the initial operative treatment as well as the broad-spectrum intravenous antibiotics. In the two patients with negative cultures (both had been on oral antibiotics for over 3 days), these patients had isolated shoulder sepsis with frank purulence at the first procedure and all were treated with broad-spectrum antibiotics for 4 weeks with resolution of the infection.

The bacterial organisms in patients with native shoulder sepsis appear considerably different from those seen in patients with infected rotator cuff repair or shoulder arthroplasty [16, 18, 19]. *P. acnes* is the most common organism present in the setting of infection after shoulder surgery [16, 18, 19]. However, in our series of primary infections, only one of 19 shoulders had *P. acnes*. There has also been debate whether *P. acnes* represents a true organism or a contaminant. The low incidence of *P. acnes* in this study suggests *P. acnes* is likely not a contaminant from the laboratory results, and represents a true pathogen that is introduced into the shoulder at the time of shoulder surgery.

Cleeman et al. [4] reported comorbidities in 87% of their patients (Table 2). However, Lossos et al. [11] reported 56% of their patients had an at-risk comorbidity. This is more in line with our findings of 47% (nine of 19). In the literature review performed by Lossos et al. [11], 13% of patients with shoulder sepsis had another source of infection. Cleeman et al. [4] had a 52% rate and Gelberman et al. [7] also reported a 50% rate. Given that our study is on isolated shoulder sepsis, our rate was zero. The review of Lossos et al. [11] suggests positive culture rates of 88%. This compares favorably with our rate of 89% (17 of 19). If Gram stains and cultures are negative, then synovial biopsy is recommended [4].

The most common organism reported in the literature as the cause of infection in shoulder sepsis is *S. aureus* (41%

Table 2. A comparison of published demographics from previous studies

Reference	Year	# of Patients (male/female)	Age range in years (avg.)
Kelly et al. [9]	1965	6 (3/3)	33–71 (61)
Master et al. [12]	1977	7 (all male)	45–80 (63)
Gelberman et al. [7]	1980	16 (ND)	27–80 (57)
Leslie et al. [10]	1989	18 (4/4)	42–89 (65)
Brancos et al. [2]	1991	4 (3/1)	21–27 (24)
Chaudhuri et al. [3]	1993	5 (all female)	51–74 (62)
Cleeman et al. [4]	1998	6 (4/2)	56–87 (76)
CR	2008	19 (11/8)	49–94 (75)

ND = not differentiated in the study; CR = current report.

Table 3. A comparison of organisms cultured in previous studies

Causative organism	Reference	Number of patients
Staphylococcus aureus	Brancos et al. [2]	4
	Kelly et al. [9]	6
	Leslie et al. [10]	11
	Master et al. [12]	4
	Gelberman et al. [7]	8
	Chaudhuri et al. [3]	2
	Cleeman et al. [4]	4
Staphylococcus epidermidis	CR	6
	Chaudhuri et al. [3]	1
	CR	3
Escherichia coli	Leslie et al. [10]	3
	Gelberman et al. [7]	1
	Master et al. [12]	1
Streptococcus group beta hemolytic	CR	1
	Gelberman et al. [7]	3
Streptococcus group B	CR	5
Streptococcus group C	Chaudhuri et al. [3]	1
Streptococcus viridians	Chaudhuri et al. [3]	1
	CR	1
Streptococcus pneumonia	Leslie et al. [10]	1
	CR	1
Pseudomonas aeruginosa	Gelberman et al. [7]	1
Proteus mirabilis	Cleeman et al. [4]	1
Aeromonas hydrophila	Leslie et al. [10]	1
	Gelberman et al. [7]	2
Propionibacterium acnes	Master et al. [12]	1
	CR	1

CR = current report.

of cases) [4, 11]. In our series six of 19 (32%) were positive for *S. aureus* (one was MRSA), which is slightly less than previously published findings (Table 3). Long-term sequelae following septic arthritis of the shoulder include arthropathy, rotator cuff tear, and osteomyelitis. Wick et al. [24] reported on 15 patients who underwent arthrodesis of the shoulder after sepsis, 33% of whom had complications including nonunion and persistent draining sinus. Mileti et al. [14] reviewed 12 postinfectious arthritic shoulders treated by shoulder arthroplasty. No patients in their series had reinfection. One patient underwent resection arthroplasty for recurrent MRSA after numerous attempts with more limited surgery.

Treatment of isolated shoulder sepsis can be challenging. Gram-positive organisms are the most common cause of infection and initial antibiotic coverage should consider this. The patient should be thoroughly examined for any other potential sources of infection as well as any other systemic problems. Cartilage loss and/or irreparable rotator

cuff pathology are potential sequelae from shoulder sepsis. Patients may require a resection arthroplasty and, even when aggressively treated, death is an unfortunate but possible outcome.

We found open or arthroscopic débridement in conjunction with appropriate antibiotics appears effective in eradicating infection in most adults who present with shoulder sepsis. Gram positive organisms caused the majority of isolated shoulder sepsis infections in this study. Over half the patients in our series had no known risk for developing joint sepsis per se. Functional outcome was poor in patients with irreparable rotator cuff tears and/or cartilage loss.

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