Acta Orthop. Belg., 2010, 76, 598-603

ORIGINAL STUDY

Septic arthritis of the shoulder joint : An analysis of management and outcome

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We retrospectively reviewed the records of 21 patients (23 shoulders) who underwent surgical treatment for septic arthritis of the shoulder joint, between 2000 and 2007. Patients were on average 63.7 (41-85) years old ; they were treated either by arthroscopic debridement (12 shoulders) or by combined arthroscopic and open procedures (11 shoulders). The mean duration of symptoms prior to surgery was 16 (5-76) days. The mean Constant score recorded at the last follow-up – on average 35.3 months (25-43) after surgery – was 73 (46-82) points. Patients with symptoms for two weeks or less prior to surgery had better results and a lower re-operation rate than those with symptoms longer than two weeks. Early infection can be managed arthroscopically, and satisfactory results can be expected. In advanced infection, a more radical approach is more appropriate.

Keywords : septic arthritis ; shoulder ; arthroscopy ; open treatment.

INTRODUCTION

Septic arthritis of the shoulder joint is rare (*2, 6,8,*). Lesle *et al* (*8*) reported that in patients with septic arthritis of the shoulder, haematogenous causes were responsible for 56% of cases, intra-articular procedures for 11 %, and steroid injection for 33%. Septic arthritis of the shoulder joint is relatively uncommon (approximately 3% of all joint infections) (*9*) and relatively few reports regarding diagnosis and (or) therapy have been published (*7,13*). A delay in the diagnosis of septic arthritis may increase morbidity and lead to complications such as bone and cartilage destruction, osteonecrosis, secondary arthritis, and eventually ankylosis (*1*). Septic arthritis of the shoulder represents an absolute indication for urgent surgical intervention, to prevent irreversible local changes and possible mortality (*17*). Shoulder joint sepsis

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No benefits or funds were received in support of this study

has a poor prognosis in immunocompromised patients as in rheumatoid arthritis (*4,13,15*). Esenwein *et al* (*5*) reported two fatal cases due to delayed initiation of treatment. Surgical management for septic arthritis of the shoulder has been discussed in recent literature and may be performed in open fashion or arthroscopically (*6,7,13-15*). However, there is still controversy regarding the best method of joint decompression because good results have been reported for each approach (*6*).

The purpose of our study was to evaluate retrospectively our experience with the management and outcome of septic arthritis of the shoulder joint at our institution.

MATERIALS AND METHODS

This study is a retrospective review of patients admitted to our Medical Centre with septic arthritis of the shoulder between 2000 and 2007. We excluded children (< 18 years) and patients who had developed infection following previous shoulder surgery. Twenty-one patients (23 shoulders) with a mean age of 64.7 years (range : 41-85 years) at the time of surgery were identified. We reviewed each patient's medical records, including associated comorbidities, laboratory results, radiographic imaging, and treatment modalities.

Initial evaluation included a completed history and a physical examination. Standard radiographs (anterior-posterior and axillary view) and MR imaging were performed for all patients. Laboratory studies included a complete blood-cell count, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) level. Preoperatively, all patients underwent aspiration of the affected shoulder. Septic arthritis of the shoulder joint was confirmed by a positive culture of the joint fluid or by demonstration of acute suppurative synovitis by synovial tissue biopsy (*6*). Intraoperative staging of the infection was based on the criteria proposed by Gächter *et al* (*14*). Patients treated surgically for septic arthritis of the shoulder joint were followed-up for clinical assessment. We used the most recent follow-up with clinical evaluation as the basis for shoulder function. The functional outcome was evaluated using the score of Constant and Murley (*3*), and a 10-point visual analogue scale (VAS) to measure pain, where 0 indicates no pain and 10 indicates severe pain.

Surgical technique and postoperative management

When the diagnosis of septic arthritis was finally established, the patients underwent immediate surgery. At our institution, arthroscopic shoulder procedures are routinely performed with the patient in beach-chair position and under general anaesthesia. A standard posterior portal was created. Before inflating the glenohumeral joint with fluid, multiple cultures were taken, including samples for real-time PCR. A diagnostic arthroscopic evaluation was subsequently carried out. An accessory anterior working portal was established. An extensive lavage with a minimum of 10 litres of normal saline was used, and we performed a debridement with a motorised shaver. The subacromial space was inspected and debrided as a routine part of the procedure through posterior, lateral and anterior portals.

Based on the clinical extent of infection, the duration of symptoms, the intraoperative staging of infection according to Gächter *et al* (*14*) and preoperative findings revealed by MR imaging like abscesses or septic spread, the procedure was completed with open irrigation, jet lavage and radical debridement using a deltopectoral approach. Suction drains were left in all patients and were removed on the second postoperative day. Our decision to repeat the debridement was based on clinical and laboratory results (persistent pain, persistent limitation of motion, and persistent elevation of ESR and CRP levels). All patients were initially treated with broad-spectrum intravenous antibiotics. Antibiotic therapy was changed according to the result of sensitivity studies and was continued for an average period of 8 weeks (range : 6-16 weeks) until normalization of ESR and CRP levels. In all cases, an infectious disease specialist was consulted to provide guidance on the type, duration, and monitoring of antibiotic therapy.

Postoperatively, a shoulder immobiliser was used permanently for two weeks. Vigorous rehabilita-

Fig. 1. — Turbo Spin Echo (TSE) (fat saturated) transversal images showing increased joint fluid with high signal intensity.

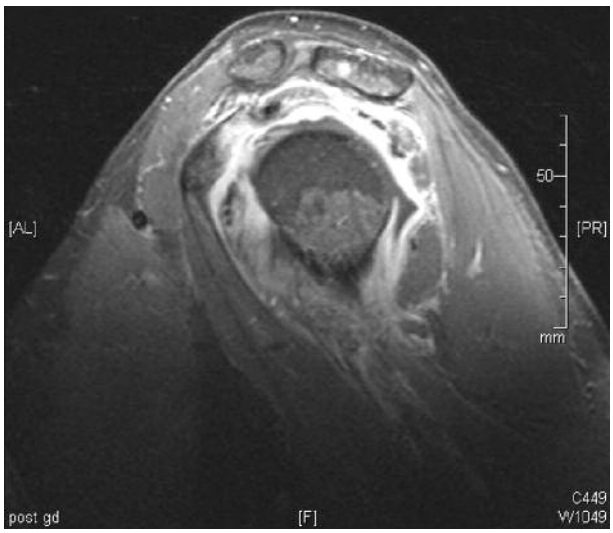

Fig. 2. — T1 (fat saturated) sagittal images. Synovial pannus is noted involving the glenohumeral joint.

tion, beginning with passive range-of-motion exercises, was initiated on the first postoperative day. At four to five weeks, active-assisted range-of-motion exercises and strengthening exercises involving the use of an elastic strap were added.

Statistical Methods

Statistical analysis was performed using SPSS software (13.0) (SPSS, Chicago, IL USA). After the Kolmogorov-Smirnov test was used to assess the normality of distributions, a one-way analysis of variance (ANOVA) and post hoc pair wise comparisons of means were performed. The Pearson correlation coefficients were used to examine the relationships between the parameters. A p value < 0.05 was defined as a significant difference.

RESULTS

There were 10 male and 11 female patients ; 13 right and 10 left shoulders were affected. The mean duration of symptoms before presentation to our clinic was 16 days (range, 5-76 days). Eight patients reported intraarticular corticosteroid injections in the affected shoulder. When the patients were first seen for infection, all except one had fever with temperature ranging from 37.7-39.9°C and all had a feeling of general malaise. Laboratory analysis revealed elevated levels of C-reactive protein with an average of 134 mg/l (range, 76-213), and an average erythrocyte sedimentation rate of 67 mm/1 hr (range, 45-142).

Thirteen patients had an underlying medical disease, including diabetes, rheumatoid arthritis, cardiovascular disease, end-stage renal disease, and malignant tumour. In all 23 shoulder joints MR imaging showed joint effusion (figs 1, 2) ; abscess formation was found in 6 shoulder joints. During the operations, we found grade II infection in 10 shoulders, grade III infection in 9 shoulders and grade IV infection in 4 shoulders. In all cases, treatment of the infection was successful.

Twelve shoulders were treated with arthroscopic debridement and irrigation. A combined arthroscopic and open procedure using a deltopectoral approach and arthrotomy was performed in 11 shoulders. Overall, a mean of 1.4 operations were required (range, 1-4). Four patients had 2 operations, one patient had 3 operations, and one patient required

4 operations. Of these 4 patients that underwent one revision, 3 had initially an arthroscopic procedure. The initial procedure in both patients (grade IV infection) with more than 2 revisions was a combined procedure.

The causative organism was identified in 20 patients (table I). *Staphylococcus aureus* was the organism most commonly identified in tissue culture obtained during surgery and isolated in 17 patients. Methicillin-resistant *Staphylococcus aureus* (MRSA) was identified in two of these 17 cases, resulting in 11.6% prevalence of MRSA in culture-positive cases. Another 3 patients had *Staphylococcus epidermidis*. Three patients had no growth on intraoperative culture, but histological analysis of the intraoperative biopsy specimens of the synovial tissue demonstrated acute active inflammation, consistent with septic arthritis. At initial follow-up, all patients were free of infection. Normalisation of CRP was seen in all patients after a mean period of 7 weeks (range : 5-13 weeks). All patients had well-healed wounds. No reinfection occurred up to the time of final follow-up.

The mean duration of follow-up was 35.3 months (range : 25-43). All patients had pain before surgery. On a visual analogue scale (VAS), the mean preoperative level of pain was 8.1 (range : 3-10). At the time of follow-up, no patient was completely free of pain, but the mean level improved to 2.9 (range : 1-9). The Constant score (*3*) for the functional outcome at the time of the last follow-up was 73.0 points (range : 46-82). Patients (8 shoulders) with symptoms before surgery of 14 days or less had a better mean score (77.8 points, range : 66-82) than those patients (15 shoulders) with symptoms longer than 14 days (70.5 points, range : 46-79).

Rotator cuff tears were observed in 14 shoulders with a mean Constant score of 72.9 points (range : 46-81), whereas the patients (9 shoulders) with an intact rotator cuff had a mean 73.3 points (range : 57-82). There was no significant correlation between the values of Constant Score and the size of the tear rotator cuff. The patients (6 shoulders) who had the best value of the Constant score at the time of follow-up had no underlying general disease and were treated with only one arthroscopic debridement. These shoulders were classified as grade II according to Gächter (*14*), meaning that they possessed intact rotator cuffs, and had experienced symptoms for no longer than 14 days. There was a significant correlation between the values of the Constant score and the intraoperative staging of infection according to Gächter ($p < 0.002$).

Table I. — Causative organism

Organism	Number of patients
Negative cultures	3
Staphylococcus aureus	17
MRSA	2
Staphylococcus epidermidis	3

DISCUSSION

The main conclusion of our study is that delay in diagnosis and operative treatment plays a crucial role in the outcome of septic arthritis of the shoulder joint. Treatment should always be based on a structured protocol that includes surgery and the use of antibiotics.

Septic arthritis of the shoulder joint is a challenging problem. The principles of management comprise eradication of infection, restoration of joint function, and relief of pain. Early diagnosis is imperative for optimal treatment results before further cartilaginous and soft-tissue damage occurs (*2,6,10,14*). Studies have shown persistent pain and limitation of motion after delayed diagnosis (*8,14*). A delay in diagnosis plays a crucial role in the outcome of septic arthritis of the shoulder. In a recent study Kirchhoff *et al* (*7*) demonstrated a significant correlation between the time elapsed after the first appearance of symptoms and the subsequent duration of hospitalisation. Moreover, this study observed a significantly better Constant score in patients with an interval of < 10 days before diagnosis. In our series, all patients who had had symptoms for ≤ 14 days before surgical treatment had a better functional outcome, as measured by the Constant score.

The operative treatment of septic arthritis of the shoulder has been discussed in the literature and may be performed with open (*8,9*) or arthroscopic approaches (*6,14,15*). In the series by Vispo Seara *et al* (*15*), who reported on arthroscopic lavage, six of eight patients were free from infection after this procedure. Jeon *et al* (*6*) reported that arthroscopic procedures could be effective when performed early in the disease process, at no more than two weeks after the onset of early-stage infection. Rhee *et al* (*12*) found it difficult to access the posteroinferior joint space where the humeral head, the infraspinatus, and the teres minor meet, which rendered complete debridement impossible. Therefore these authors prefer open debridement. Stutz *et al* (*14*) concluded that the number of arthroscopic procedures needed to achieve resolution of infection correlated with the stage of infection. There were ten stage II infections in our series ; six of them were treated successfully by a single arthroscopic debridement. These results compare favourably with those of Jeon *et al* (*6*). In our series a combination of arthroscopic and open surgery was needed in 12 shoulders (nine stage III and three stage IV infections). Further surgical intervention was dictated by the patient's response to the operative treatment (*13*). In our study a mean of 1.4 operations was required with a maximum of four operative procedures. Duncan and Sperling (*4*) reported that functional outcome was poor in patients with irreparable rotator cuff tears and (or) cartilage loss. In our series the 6 patients with the best functional outcome had intact rotator cuffs.

In addition to surgical debridement, organism-specific antibiotics are an integral part of the eradication of infection. With regard to the choice of antibiotic, a multidisciplinary approach guided by microbiologists is essential (*7*). *Staphylococcus aureus* was the most common organism causing infection in septic arthritis of the shoulder joint (41-87% of cases) (*2,4,10,11*). In our series 17 of 22 (77%) patients were positive for *Staphylococcus aureus* ; MRSA was identified in 9% of patients. A recent study of septic arthritis of the shoulder found an MRSA prevalence of 17% (*2*). Furthermore, in our series of 23 shoulders no *Propionibacterium acnes* could be isolated. 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 (*2,4,6,10,13,15*). *Propionibacterium acnes* is the most common organism found in infection after shoulder surgery (*4,13*).

Septic arthritis of the shoulder joint is commonly associated with rheumatoid arthritis, diabetes mellitus, immunosuppressive drugs, and tumours. Cleeman *et al* (*2*) reported comorbidities in 87% of their patients. Duncan and Sperling (*4*) reported that 47% of their patients had at-risk comorbidities. In our series 65% of the patients had underlying medical disease.

Our study has some limitations. As septic arthritis of the shoulder joint is relatively rare, the study sample was small. Therefore correlations between certain variables and outcomes may have been obscured due to a lack of statistical power.

MR imaging may be helpful in cases of chronic infections as well as septic spread. Compared with other imaging modalities, including sonography, scintigraphy and positron emission tomography [PET]), MR imaging is probably the most important diagnostic modality in the exclusion of a septic shoulder joint. MR imaging may be useful to determine the presence and amount of joint effusion. In cases of additional soft-tissue infection, MR provides a precise overview of the extent of the infection and the development of complications such as abscesses and osteomyelitis (*16*).

CONCLUSION

Our recommendations for the management of septic arthritis of the shoulder joint include appropriate preoperative and intraoperative assessment and standardized decision-making. The key to infection control is radical debridement of infected necrotic tissue and appropriate antibiotics. The treatment regimen described here yields reliable results for the treatment of septic arthritis of the shoulder joint. Early infection can be managed arthroscopically, and satisfactory results can be expected. A more radical approach is more appropriate in advanced or chronic infection.

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