Clinical Results After Arthroscopic Treatment for Septic Arthritis of the Elbow Joint

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Purpose: The purpose of this study was to examine clinical findings of septic arthritis of the elbow joint in a series of immunocompetent patients and to evaluate the outcomes after arthroscopic treatment. Methods: Between October 2006 and January 2012, 11 patients with septic arthritis of the elbow underwent arthroscopic surgery. History, laboratory findings, and radiologic findings were reviewed. Functional outcomes were evaluated using the Mayo Elbow Performance Score (MEPS). Results: The study included 5 men and 6 women with a mean age of 45 years. An underlying medical disease was present in 1 patient (diabetes). Staphylococcus aureus was the most common organism identified (5 patients). There was 1 reoperation and no complications related to the arthroscopic procedure. Eight of 11 patients had excellent results assessed by MEPS at the final follow-up. The mean MEPS was 94.5 at the final follow-up. Conclusions: Septic arthritis of the elbow joint can occur in otherwise healthy patients without pre-existing elbow disease. Arthroscopic irrigation and synovectomy are safe and effective in patients with septic arthritis and result in good functional outcomes. Level of Evidence: Level IV, therapeutic case series.

S eptic arthritis of the elbow joint is relatively uncommon compared with septic arthritis of the knee, hip, or shoulder joint.1,2 The exact cause and epidemiologic factors remain unclear. Previous studies have shown that risk factors for the development of septic arthritis of the elbow joint include old age, intravenous drug abuse, diabetes, an immunocompromised state, and pre-existing elbow disease such as osteoarthritis or rheumatoid arthritis.1-3 To our knowledge, there is limited literature describing the clinical presentation, management, and outcomes of septic arthritis of the elbow joint.3,4 Furthermore, most studies of septic elbows comprise immunocompromised patients or patients with comorbidities or pre-existing elbow disease such as rheumatoid arthritis.2,5

Arthroscopic irrigation and debridement is considered an effective surgical option for septic arthritis. However, there have been few studies addressing the arthroscopic management of septic arthritis of the elbow joint.5 We treated septic arthritis of the elbow in immunocompetent adults using arthroscopy. The aims of this study were to examine the clinical findings of a series of cases of septic elbow in immunocompetent patients and to evaluate the outcomes of arthroscopic treatment. We hypothesized that arthroscopic irrigation and debridement would be effective and safe in treating septic arthritis of the elbow joint.

Methods

A retrospective review based on the symptoms of acute elbow arthritis was conducted to identify patients with suspected septic elbow at 2 different hospitals between October 2006 and January 2012. A total of 21 patients with suspected septic elbow presented to the emergency department or to outpatient clinics with the following symptoms consistent with acute elbow arthritis: joint pain, warmth, effusion, and restriction of range of motion.

Of 21 patients with possible septic elbow preoperatively, 11 patients were diagnosed with septic arthritis and 10 with nonseptic arthritis (4 patients with seronegative reactive arthritis, 3 with rheumatoid arthritis, 2 with adjacent acute osteomyelitis, and 1 with tuberculosis). The 11 patients with septic arthritis of the elbow joint who underwent arthroscopic irrigation and
debridement were retrospectively reviewed. The Institutional Review Board for Human Research approved this retrospective study.

All patients had preoperative measurements of white blood cell (WBC) count, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and joint fluid parameters (WBC count, percentage of neutrophils, crystal analysis). Aspiration of the joint fluid through a soft spot (center of triangle formed by olecranon, radial head, and lateral epicondyle) was performed in all patients to analyze joint fluid. Preoperative simple radiographs and ultrasonography or magnetic resonance imaging were performed in all patients (Fig 1). Blood parameter values were used postoperatively to assess the patient's response to surgery and antibiotics. The definitive diagnosis of septic arthritis was determined retrospectively by examining positive cultures of the joint fluid or suppurative joint fluid analysis (WBC >50,000/μL with/without neutrophils >90%).2,5-8

Patient data were reviewed, and the following variables were recorded: age, sex, side involved, duration of symptoms, involvement of other joints, medical comorbidities (such as diabetes, malignancies), immunologic status, any previous history of elbow disease (osteoarthritis, rheumatoid arthritis), previous steroid injection around the elbow, blood parameters (pre- and postoperatively), synovial fluid analysis, duration of hospitalization, cultured organism, intraoperative arthroscopic findings, and complications. Follow-up evaluations were performed, and functional outcomes were evaluated with the use of the Mayo Elbow Performance Score (MEPS) at the final follow-up (mean, 2.6 years; range, 1 to 4.5 years).9

**Surgical Technique**

The patient was placed in the lateral decubitus position under general anesthesia. A tourniquet was routinely applied to the upper arm, which was placed in an arm holder. First, aspiration of joint fluid from the soft spot was performed. To reduce the false-negative rate of culture, reaspiration and analysis were always performed during surgery. The purulent fluid and other materials obtained were used for culture and fluid analysis. Second, the anterior compartment was evaluated and irrigated through the proximal anteromedial portal and anterolateral portal. After irrigation with approximately 2 to 3 L of saline, the debridement procedure involved synovectomy and the removal of debris, scar tissue, and loose bodies in the anterior compartment. The viewing and working portals were exchanged to complete debridement (Fig 2). Next, the posterior compartment, including the medial and lateral gutters, was irrigated with approximately 2 to 3 L of saline through the posterolateral portal, posterior

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**Fig 1.** (A) A 21-year-old male patient's preoperative anteroposterior and lateral radiographs of the elbow joint showing soft tissue swelling and elevation of the posterior fat pad (arrow). (B) Longitudinal ultrasonographic image showing the bulk of hypoechoic fluid (arrow) filling the posterior joint recess. (C) Fat-suppressed T1-weighted image showing enhanced peripheral synovium (white arrow) after contrast and T1-weighted sagittal image showing increased high-signal fluid (black arrow) in the anterior and posterior compartments. (Tm, triceps muscle, OC, olecranon, TR, trochlea.)
portal, and midlateral portal, and similarly debrided (Fig 3). Debridement and synovectomy were performed mainly with a motorized shaver. Radiofrequency ablation was often used for bleeding control. A suction drain was placed in each compartment. Multiple samples obtained from synovium and aspirated purulent fluid were collected for additional culturing and antibiotic sensitivity testing. A bulky dressing or long arm splint was applied.

Suction drains were removed approximately 2 to 4 days after surgery. The patient was encouraged to begin active and passive range of motion approximately 2 to 3 days after surgery. Empirical intravenous antibiotics were initiated in all patients immediately after surgery and were later changed on the basis of antibiotic sensitivity testing. Blood parameters were measured again after 1 week in all patients, and intravenous

**Fig 2.** (A) Arthroscopic view from the proximal anteromedial portal of infected synovitis in the radiocapitellar joint with a shaver from the anterolateral portal. (B) Arthroscopic view from the anterolateral portal of proliferative synovitis in the anterior compartment of the ulnohumeral joint. (C, coronoid; CF, coronoid fossa; RH, radial head.)

**Fig 3.** (A) Synovitis around the proximal radioulnar joint as seen from the posterolateral portal. (B) Clear view after synovectomy around the proximal radioulnar joint as seen from the posterolateral portal. (RH, radial head; RN, radial notch; T, trochlea.)
antibiotics were continued for at least 2 weeks and until resolution of clinical symptoms and normal range of blood parameters (ESR and CRP).

**Results**

All patients were followed for a minimum of 1 year postoperatively (mean, 2.6 years; range, 1 to 4.5 years). The study included 5 men and 6 women. The dominant side was involved in 4 patients, whereas the nondominant side was affected in 7 patients. The mean age of the patients at the time of surgery was 45 years (range, 7 to 83 years). All patients presented with painful limited motion of the elbow joint with redness, swelling, tenderness, and local warmth. The mean duration of symptoms before surgery was 4.3 days (range, 1 to 10 days). One of 11 patients had diabetes; no patient had had previous surgery, acupuncture, or injections in the elbow joint; and none had a history of trauma or pre-existing elbow disease visible by radiography, such as rheumatoid arthritis or degenerative osteoarthritis. One patient with diabetes had multiple joint infections involving the ipsilateral knee joint (Table 1).

All patients underwent radiography of the involved side that showed varying degrees of soft tissue swelling without changes in the bone. Ultrasonography was performed in 9 patients and revealed fluid collection and synovial thickening. Two patients underwent magnetic resonance imaging, which showed significant intra-articular fluid collection and synovial hypertrophy. The mean preoperative WBC count was 10,045 cells/μL (range, 6,400 to 18,600 cells/μL), the mean ESR was 69 mm/h (range, 25 to 120 mm/h), and mean CRP was 98 mg/L (range, 42 to 217 mg/L). In the synovial fluid, mean WBC count was 62,877 cells/μL (range, 22,000 to 113,000 cells/μL) and mean polymorphonuclear neutrophil percentage was 94% (range, 87% to 98%).

The synovial fluid parameters were consistent with a diagnosis of septic arthritis in 9 patients who had a joint WBC count greater than 50,000 cells/μL. Organisms were cultured from 7 patients. The cultured organisms were methicillin-sensitive *Staphylococcus aureus* (MSSA) in 5 patients, and *Klebsiella pneumoniae* and *Streptococcus pyogenes* in the remaining 2 patients, respectively. The mean duration of intravenous antibiotic coverage was 14.1 days (range, 9 to 21 days), whereas the mean duration of hospitalization was 15.1 days (range, 12 to 34 days).

In 10 patients, infection was resolved by an arthroscopic procedure and intravenous antibiotic therapy. Immediately after surgery, all patients experienced subjective relief of their pain. Reoperation was required in one patient because of signs of recurrent infection 4 weeks after the first surgery. The infection in this patient resolved after the second arthroscopic procedure. No other patients reported complications after surgery. The mean MEPS at the final follow-up evaluation was

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CRP, C-reactive protein (mg/L); ESR, erythrocyte sedimentation rate (mm/h); FC, flexion contracture; FL, flexion loss; MEPS, Mayo Elbow Performance Score; MSSA, methicillin-sensitive *Staphylococcus aureus*; PMN, polymorphonuclear neutrophil (%); ROM, range of motion; WBC, white blood cell (cells/μL).
94.5 (range, 70 to 100). Eight of 11 patients had full range of motion and an excellent outcome assessed by MEPS at the final follow-up. Three patients had limited range of motion, scoring 70, 85, and 85 respectively.

**Discussion**

All patients, except one with recurrent infection, had successful treatment of their acute infection and improvement of function with a single arthroscopic debridement.

Septic arthritis of the elbow joint is rare relative to septic arthritis of other joints. There is little data available to address the clinical presentation, management, and outcomes of septic arthritis of the elbow joint. Previous clinical studies were limited to children or included immunocompromised patients.\(^3,4\) The findings of the present study showed that septic arthritis of the elbow can occur in otherwise healthy patients. Causative factors and predisposing conditions to septic elbow were not identified in the majority of cases. Ten patients were immunocompetent and otherwise healthy; one patient had diabetes. The mean age of our patients was 45 years, and no patient had pre-existing elbow problems. This is younger and healthier compared with a previous study in which the mean age of patients was 63 years, and pre-existing elbow problems were present in 67% of patients (8 of 12), and 33% of patients had an immunocompromised status.\(^3\) In that report, the overall mortality rate was high, and it was suggested that septic elbow occurs in patients whose condition is debilitated by other factors. In addition, the best outcomes were found in patients treated within 2 days after the onset of clinical symptoms. Our findings, in contrast, suggest that septic arthritis should be considered in the differential diagnosis of acute painful elbow even in healthy patients without underlying disease. We could not find a correlation between time of surgery and clinical outcomes.

Any delay in the diagnosis of septic arthritis may increase morbidity and lead to complications such as bone and cartilage destruction, osteonecrosis, secondary osteoarthritis, osteomyelitis, and eventually ankylosis.\(^10\) Some patients may present with subtle findings and have inconclusive laboratory results. Moreover, no single test is of sufficient diagnostic accuracy to serve as a definitive test for septic arthritis. Gram stain and culturing are useful for diagnosis but sometimes present a false-negative result and involve a time delay until the results of microbiological cultures are available. In 7 of 11 patients in our series, septic arthritis was confirmed by culturing of organisms after surgery; the remaining patients were diagnosed by joint fluid analysis. The WBC count in joint fluid has been a useful diagnostic test for septic arthritis despite low sensitivity.\(^2,7,8\) Li et al.\(^7\) reviewed 156 cases of suspected septic arthritis and concluded that joint WBC count greater than 50,000 cells/µL had a specificity of 0.88 and was a fairly good test. Margaretten et al.\(^8\) conducted a meta-analysis of 14 studies, with 653 patients meeting their inclusion criteria, and concluded that joint WBC count (>50,000 cells/µL) and percentage of polymorphonuclear cells (>90%) were vital in early diagnosis of septic arthritis before culture results were available. In this regard, early arthroscopic intervention in advance of culture results is a safe and reasonable option in patients in whom septic arthritis of the elbow joint is strongly suspected.

For the management of septic arthritis of the elbow joint, previously published clinical studies have described intravenous antibiotic therapy and simple aspiration, arthrocentesis with irrigation, open drainage, and arthroscopic procedures.\(^2,4,11\) Bowakim et al.\(^4\) reported excellent outcomes in 7 cases of pediatric septic arthritis that were treated using arthrocentesis with irrigation combined with intravenous antibiotics. Weston et al.\(^1\) reported that old age, multiple joint involvement, and open surgical drainage were associated with poor outcomes. A recent clinical study by van den Ende et al.\(^3\) reported successful outcomes of arthroscopic intervention in the majority of patients, although the overall patient mortality rate remained high.

Arthroscopic procedures have recently come into favor in the treatment of various disorders of the elbow.\(^12,13\) Compared with open techniques, arthroscopic procedures have advantages that include a more thorough inspection of the elbow joint, minimal morbidity, and a shorter rehabilitation time. However, nerve injuries and incomplete synovectomy have been considered surgical complications.\(^14,15\) During debridement of inflamed synovium, thin fragile capsule and diffuse synovitis might impair the prediction of nerve anatomy. To avoid nerve injuries, we take care not to ressect capsule during shaving of the synovium by controlling suction power.

The infected synovium can be easily accessed by an arthroscope and removed by an instrument from the medial and lateral gutters, as well as the anterior and posterior compartments of the elbow joint. However, in some cases, we found that complete synovectomy in the medial gutter was technically difficult because of the ulnar nerve being in proximity. We used a retractor from the posterolateral portal to protect the ulnar nerve. In addition, suction was used minimally; the tip of the shaver should be visualized at all times. Some of our patients had diffuse synovitis extending to the deep lateral gutter and the posterior aspect of the radio-capitellar joint. With a view from the posterolateral portal, synovectomy was performed effectively from the midlateral portal with a shaver.

Appropriate antibiotic treatment is another mainstay therapy in septic arthritis. Evidence on which to base choice or duration of antibiotics is scarce; no randomized
trials have been done. In principle, an antibiotics regimen is based on likely causative organisms and modified by results of culture and sensitivity testing. Because *S. aureus* is the most common pathogen in general, initial recommended antibiotics before organism identification are the class of broad-spectrum β-lactamase–stable penicillins or cephalosporin. We used second-generation cephalosporin as an empirical antibiotic choice. At least 2 weeks of intravenous antibiotics followed by oral treatment for 2 to 4 weeks was given under the recommended guideline. In our series, the mean duration of intravenous antibiotic coverage was 14.1 days (range, 9 to 21 days). Duration of antibiotic administration depends on the causative organism and the response to antibiotics. In cases of typical gram-positive infection (MSSA), we found that 2 weeks of intravenous antibiotic administration was enough to restore clinical symptoms and signs and blood parameters. We have not used home intravenous therapy. However, if it is available, shorter hospitalization and cost-effectiveness are advantageous.

**Limitations**

The primary limitations in this study are the small number of patients and the retrospective design. The small numbers prevented a formal analysis of factors associated with outcome, and the retrospective review may have contributed to the cause of the infection not being identifiable in all cases because of lack of documentation. However, considering the low incidence of septic arthritis of the elbow joint, this represents one of the largest series of septic arthritis of the elbow in which clinical features and the outcomes of arthroscopic treatment were analyzed. Another limitation of the study is that the causative organism was not identified in all cases. However, joint fluid analysis, in combination with history, clinical features, and serum parameters, was sufficient to confirm the diagnosis of septic arthritis. In particular, positive joint fluid analysis (WBC count >50,000/μL with/without neutrophils >90%)—an inclusion criterion in this study—is considered a vital test for the early diagnosis of septic arthritis before culture results are available.

**Conclusions**

Septic arthritis of the elbow joint can occur in otherwise healthy patients without pre-existing elbow disease. Arthroscopic irrigation and synovectomy are safe and effective in patients with septic arthritis and result in good functional outcomes.

**References**