Characteristics and outcome of 27 elbow periprosthetic joint infections: results from a 14-year cohort study of 358 elbow prostheses

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Abstract

Elbow arthroplasty is increasingly performed in patients with rheumatic and post-traumatic arthritis. Data on elbow periprosthetic joint infection (PJI) are limited. We investigated the characteristics and outcome of elbow PJI in a 14-year cohort of total elbow arthroplasties in a single centre. Elbow prosthesis, which were implanted between 1994 and 2007 at Schulthess Clinic in Zurich, were retrospectively screened for infection. PJI was defined as periprosthetic purulence, the presence of sinus tract or microbial growth. A Kaplan–Meier survival method and Cox proportional hazard analysis were performed. Of 358 elbow prostheses, PJI was identified in 27 (7.5%). The median patient age (range) was 61 (39–82) years; 63% were females. Seventeen patients (63%) had a rheumatic disorder and ten (37%) had osteoarthritis. Debridement and implant retention was performed in 78%, followed by exchange or removal of the prosthesis (15%) or no surgery (7%).The relapse-free survival (95% CI) was 79% (63–95%) after 1 year and 65% (45–85%) after 2 years. The outcome after 2 years was significantly better when patients were treated according to the algorithm compared to patients who were not (100% vs. 33%, p <0.05). In 21 patients treated with debridement and retention, the cure rate was also higher when the algorithm was followed (100% vs. 11%, p <0.05). The findings of the present study suggest that the treatment algorithm developed for hip and knee PJI can be applied to elbow PJI. With proper patient selection and antimicrobial therapy, debridement and retention of the elbow prosthesis is associated with good treatment outcome.

Keywords: Elbow arthroplasty, microbiology, periprosthetic joint infection, surgical intervention, treatment outcome
Original Submission: 3 January 2010; **Revised Submission:** 5 April 2010; **Accepted:** 6 April 2010
Editor: D. Raoult
Article published online: 15 April 2010
Clin Microbiol Infect 2011; **17:** 432–438
10.1111/j.1469-0691.2010.03243.x

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Introduction

Elbow arthroplasty is increasingly used for treatment of post-traumatic arthritis and chronic inflammatory joint disease, such as rheumatic and psoriatic arthropathy [1]. After first successful implantation in the early 1970s [2], elbow prostheses underwent continuous refinements with respect to the implant design and surgical techniques. Currently, aseptic (mechanical) prosthesis loosening, joint instability, ulnar neuropathy and periprosthetic joint infection (PJI) remain a continuous challenge [1,3,4].

Data on elbow PJI are limited because only small case series were published, and non-uniform definitions and variable follow-up periods were used [5–10]. The incidence of elbow PJI is reported to be in the range 3–11%, which is higher than for hip or knee arthroplasties. Moreover, elbow joints have several distinctive differences, such as no weight-bearing function, and hence they seldom develop degenerative arthritis, and have scarce surrounding soft tissue with a higher risk for contiguous infection extending from tissue dehiscence [5].

The optimal surgical and antimicrobial treatment approach for elbow PJI has not yet been determined. Therefore, we investigated the characteristics and outcome of elbow PJI in a 14-year cohort of total elbow arthroplasties in a single centre. We specifically focused on the appropriateness of the

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treatment algorithm, which was developed for hip and knee PJI [11]. In this algorithm, the type of surgical procedure (debridement and retention vs. a one or two stage exchange) and the antimicrobial therapy (type of antibiotic and duration) are defined by a combination of clinical, radiological and microbiological criteria.

Patients and Methods

Study population

The Schulthess Clinic is a specialized 160-bed orthopaedic centre and a reference institution for elbow surgery, including primary and revision arthroplasties. A total of approximately 7500 surgical procedures are performed annually. All elbow arthroplasties performed at the Schulthess Clinic, Zurich, Switzerland, are consecutively included in the elbow cohort. For the present study, all elbow prostheses implanted between January 1994 and December 2007 were retrospectively reviewed. All episodes, which fulfilled the predetermined criteria for PJI (below) were included. In patients with suggestive signs or symptoms for elbow PJI, at least one invasive diagnostic attempt to detect the potential pathogen was performed. The Infectious Diseases Service was consulted throughout the study duration. The study protocol was approved by the Institutional Review Board.

Definitions

Elbow PJI was diagnosed, if one or more of the following criteria were fulfilled: (i) visible purulence of a preoperative aspirate or intraoperative periprosthetic tissue (as determined by the surgeon); (ii) presence of a sinus tract communicating with the prosthesis; (iii) microbial growth in a preoperative joint aspirate, intraoperative periprosthetic tissue or sonication fluid of the removed implant; or (iv) synovial fluid with >1700 leukocytes/μL or >65% granulocytes, as determined in previous studies for knee PJI [12]. Similar diagnostic criteria for PJI were used in studies involving various types of joint prostheses [11,13–17]. Acute inflammation in periprosthetic tissue sections was not used as diagnostic criterion in the present study as a result of a high prevalence of underlying rheumatologic joint disorders, which may mimic infection. For low-virulent organisms, such as coagulase-negative staphylococci or Gram-positive anaerobes, growth of the same organism in at least two independent specimens was required.

According to the route of infection, episodes were classified as contiguous, perioperative or haematogenous [18]. Contiguous infection was determined if skin breakdown overlying the elbow prosthesis or preceding open trauma occurred. Perioperative infections were classified into early (within 3 months after surgery) or delayed (3–24 months). A haematogenous infection was diagnosed if blood cultures were positive with a distant source or haematogenous seeding was suspected by acute clinical presentation with fever, pain and redness of the elbow joint in late infections.

Microbiological diagnosis

Aspirated fluid and intraoperative periprosthetic tissue specimens were cultured on aerobic and anaerobic blood agar plates, and incubated at 35°C for 7 days (until July 2006) or for 10 days (after July 2006). In addition, thioglycollate broth was cultured for 10 days. Isolated microorganisms were identified and their antimicrobial susceptibility tested using standard microbiological techniques.

In addition, elbow prostheses explanted after January 2007 were sent for sonication to improve the detection of biofilm bacteria [15]. In brief, the explanted elbow prostheses was aseptically removed in the operating room and transported to the microbiology laboratory in air-tight polyethylene containers (Lock & Lock, Vetrag AG, Stäfa, Switzerland). In the microbiological laboratory, Ringer's solution was added in the containers and the prostheses were processed within 48 h of removal by vortexing (30 s) and sonication (1 min) using an ultrasound bath (BactoSonic, Bandelin GmbH, Berlin, Germany; http://www.bactosonic.info) at a frequency of 40 ± 2 kHz and a power density of 0.22 ± 0.04 W/cm^2. The resulting sonication fluid was vortexed again to homogenously distribute the sonication fluid, which was plated in aliquots of 0.1 mL onto aerobic and anaerobic sheep blood agar plates and 3 mL in 7 mL in thioglycollate broth. Cultures were incubated at 37°C for 7 days and inspected daily for bacterial growth.

Surgical treatment

The approach was individually determined at surgeon's discretion. In the case of PJI, the type of revision was chosen among three potential approaches: (i) debridement and implant retention; (ii) one-stage; or (iii) two-stage exchange of the implant. We retrospectively determined whether the surgeon's decision was in agreement with the treatment algorithm for hip and knee PJI [11]. According to this algorithm, the least invasive surgical treatment should be used, whereas retention of the implant is allowed only if all of the following four conditions were fulfilled: (i) short duration of infection, including early postoperative infection (within 3 months after surgery) or acute haematogenous infection; (ii) short duration of clinical signs (not longer than 21 days); (iii) not severely damaged surrounding soft tissue; and (iv) the availability of antimicrobial agents active against biofilms (e.g. rifampin for staphylococci and quinolones for Gram-neg-

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