Efficacy of arthroscopic treatment for resolving infection in septic arthritis of native joints

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ABSTRACT

Background: Septic arthritis is a diagnostic and therapeutic emergency that threatens both life and function. The primary objective of this study was to assess the efficacy on the infectious process of arthroscopic treatment in patients with septic arthritis of native joints. The secondary objective was to identify factors predicting failure to achieve infection resolution after arthroscopic treatment. We hypothesised that arthroscopy was the appropriate treatment strategy.

Material and methods: Forty-six cases of septic arthritis in 46 patients with a mean age of 46 years (range, 18–72 years) were retrospectively reviewed. The cause of the septic arthritis was haematogenous dissemination in 39.1% of patients, surgery in 34.8%, a local injection in 19.6%, and trauma in 6.5%. The involved joint was the knee in 32 patients, the shoulder in 6, the hip in 3, the ankle in 3, and the elbow in 2. All patients underwent arthroscopic joint lavage, with or without synovectomy depending on the Gächter stage. Dual antibiotic therapy was given routinely after the procedure. For each patient, we assessed time to treatment, intraoperative findings according to the Gächter classification, cultures of drainage-fluids, and whether repeat arthroscopic lavage was required. Recovery of the infection was defined as absence of clinical or laboratory signs of infection at last follow-up.

Results: Mean follow-up was 42 months (range, 1–120). Mean time from symptom onset to arthroscopic treatment was 7.5 days. Full recovery of the infection was achieved in 93% of patients, although 25% required more than one arthroscopic lavage. Factors significantly associated with arthroscopic treatment failure were Gächter stage III or IV and positive drainage-fluid cultures after 24 h.

Conclusion: Arthroscopic treatment is indicated in all patients with septic arthritis on natural joints. The procedure should be repeated if the initial course is unfavourable.

Level of evidence: IV. Retrospective study.

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1. Introduction

Septic arthritis of a native joint is a serious condition. Prompt diagnosis and management are essential to avoid functional impairments and life-threatening complications. The incidence of septic arthritis is estimated at 1 to 10 cases per 100,000 population per year and increases after 50 years of age [1].

The knee is the most common site of septic arthritis, followed by the shoulder, hip, and ankle [2]. Mortality is about 10% overall, with rates of up to 30% in patients older than 60 years and in those with involvement of several joints or comorbidities [3–7]. Residual functional impairments have been reported in about half the cases [8–10].

The many treatments advocated to date include repeated non-operative needle aspiration, open surgical synovectomy, and arthroscopic management by joint lavage with or without synovectomy. The indications of arthroscopic treatment in septic arthritis of native joints remain ill-defined, most notably regarding the criteria for performing repeat arthroscopic lavage [11–13]. We nevertheless hypothesised that arthroscopy was the most effective approach in septic arthritis of native joints.

Our primary objective in designing this study was to evaluate the clinical and bacteriological outcomes of arthroscopic treatment in patients with septic arthritis of native joints. Our secondary objective was to identify intraoperative and/or postoperative factors that predicted failure of arthroscopic treatment in providing resolution of the infectious process.
2. Material and methods

Forty-six cases of septic arthritis of native joints managed arthroscopically, in 46 patients, 29 males and 17 females with a mean age at initial management of 46 years (range, 18–72 years) were retrospectively reviewed. Of these 46 patients, 8 (17.4%) had risk factors for immunodeficiency (insulin-dependent or requiring diabetes, n = 3; glucocorticoid therapy, n = 2; lymphoedema, n = 1; cirrhosis of the liver, n = 1; and decline in general health, n = 1).

The cause of the infection was haematogenous dissemination in 39.1% of cases, arthroscopy in 23.9%, surgery in 10.9%, a local injection in 19.6%, and trauma in 6.5% (Table 1). The joint involved was the knee in 32 patients, shoulder in 6, hip in 3, ankle in 3, and elbow in 2.

The diagnosis of septic arthritis relied on a set of converging arguments including suggestive local clinical features (joint pain and effusion, local warmth, and functional impairment) with or without systemic signs of infection (fever and/or chills) and laboratory evidence of systemic inflammation (leucocytosis and C-reactive protein [CRP] elevation). Joint aspiration and blood cultures were performed routinely in all patients before the arthroscopic procedure. The identification of micro-organisms in the joint aspirate confirmed the suspected diagnosis of septic arthritis.

Mean time from the onset of local infectious symptoms to arthroscopy was 7.5 days (range, 1–25 days) overall, 4 days in the group with haematogenous septic arthritis, and 13 days in the group with post-arthroscopy septic arthritis (Table 2).

2.1. Operative technique

The first step of the arthroscopic procedure was aspiration of the joint fluid, of which samples were sent to the microbiological laboratory. Next, the stage of the septic arthritis was assessed using the Gächter classification system [14]. A second portal was then created for introduction of the instruments and irrigation. At the knee, a third supero-lateral portal was created routinely for irrigation and drainage.

High-volume arthroscopic lavage of the joint was performed with saline to remove all fibrin deposits and false membranes (using a powered shaver). The joint was irrigated until the fluid was clear. No antibiotics or antiseptics were added to the irrigation solution. Synovial-membrane biopsies were collected routinely for microbiological studies. In all, five joint fluid and synovial-membrane samples were sent to the laboratory for each joint. Staphylococcus aureus was identified in nearly half the cases (22/46) (Table 3).

Table 1

<table>
<thead>
<tr>
<th>Cause of the infection</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haematogenous</td>
<td>18 (39.1)</td>
</tr>
<tr>
<td>After arthroscopy</td>
<td>11 (23.9)</td>
</tr>
<tr>
<td>After surgery</td>
<td>5 (10.9)</td>
</tr>
<tr>
<td>After a local injection</td>
<td>9 (19.6)</td>
</tr>
<tr>
<td>Post-traumatic</td>
<td>3 (6.5)</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Time to arthroscopic treatment</th>
<th>Days with symptoms before the first arthroscopic procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gächter I</td>
<td>2 ± 1.2</td>
</tr>
<tr>
<td>Gächter II</td>
<td>7.3 ± 6.3</td>
</tr>
<tr>
<td>Gächter III</td>
<td>13 ± 5.4</td>
</tr>
<tr>
<td>Gächter IV</td>
<td>15 ± 4.3</td>
</tr>
</tbody>
</table>

Synovectomy was performed in 33 of the 46 patients. The criterion for synovectomy was gross involvement of the synovial-membrane (Gächter stage II, III, or IV). Synovectomy was as complete as possible to maximise the reduction of the bacterial burden.

The portals were closed using non-absorbable nylon suture. A drain was routinely placed in the joint at the end of the procedure, and the drainage-fluid was cultured on the first, third, and fifth days after the procedure. Two systemic antibiotics were started immediately after intraoperative sample collection then adjusted based on the microbiological findings and a multidisciplinary discussion among infectious-disease specialists, microbiologists, and orthopaedic surgeons.

2.2. Follow-up and assessments

Joint mobilisation was started immediately to avoid stiffness. For lower-limb joints, weight bearing was deferred for several days or weeks depending on the time-course of the local signs of inflammation and on the intraoperative appearance of the cartilage.

Dual antibiotic therapy was continued for 45 days, either parenterally or orally depending on the antibiotics used. An infectious-diseases specialist monitored the safety of the antibiotic treatment.

We defined full recovery from the infectious process as the concomitant presence of the following criteria: apyrexia, decrease in joint effusion size, decrease in CRP levels with special attention to the changes in results of serial assays (and without requiring a return to normal), and negative drainage-fluid cultures.

Patients with an unfavourable course after 48–72 hours underwent a second arthroscopic procedure involving joint lavage, synovectomy if not performed initially, and drainage of the joint.

At last follow-up, the following outcome measures were recorded: positive drainage-fluid cultures after arthroscopic treatment, need for repeat arthroscopy, and number of deaths during the immediate post-arthroscopy period.

2.3. Statistical analysis

The statistical analysis was done using Prism software (GraphPad, La Jolla, CA, USA). Values of P<0.05 were considered significant. We used Chi² tests to look for significant differences among qualitative variables and to compare outcomes across Gächter stages. Pearson’s linear correlation coefficients were computed to assess potential correlations linking infection severity to the need for repeat arthroscopy and absence of infection resolution to time to management.


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3. Results

All 46 patients were re-evaluated after a mean of 42 months (range, 1–120 months).

Resolution of the infection was achieved at last follow-up in 93% of patients. However, one-fourth of these patients required a second arthroscopic procedure, which was performed a mean of 5 days after the initial procedure (range, 3–8 days).

All 13 patients with Gächter stage 1 disease achieved a full recovery after a single arthroscopic procedure. All 21 Gächter stage 2 patients also achieved a full recovery, but among them, 5 (23.8%) required a second arthroscopic procedure, after a mean time from the first procedure of 5.2 days (range, 3–8 days). Of the 9 patients with Gächter stage 3 arthritis, 5 (55.5%) required a second arthroscopic procedure and 7 (78%) achieved a full recovery. Finally, all 3 patients with Gächter stage 4 disease required a second arthroscopic procedure and 2 achieved a full recovery (Table 4).

Failure to achieve resolution of the infection was managed by revision surgery, in one stage or two stages (with an antibiotic-impregnated spacer), after a mean of 17 days (range, 30–300 days).

The following factors did not predict failure of the arthroscopic treatment to resolve the infection: age, sex, comorbidities, time to management, cause of the septic arthritis, and causative microorganism (Table 3). In contrast, factors significantly predictive of failure were Gächter stage 3 or 4 and positive cultures of drainage-fluid sampled 24 hours after arthroscopy (P < 0.05) (Table 4). Thus, the proportion of patients who recovered with a single arthroscopic procedure was 93% when the 24-hour drainage sample was negative and 35% when it was positive (P < 0.001). Thus, positive cultures of the 24-hour drainage-fluid sample had a very high positive predictive value (PPV) for arthroscopic treatment failure (0.82; CI, 0.65–0.93).

4. Discussion

In our experience, arthroscopic management of septic arthritis on native joints ensured resolution of the infection in 93% of patients. This result is consistent with the main previous studies and confirms the superiority of arthroscopic treatment over repeated needle aspiration or arthroscopy, for which the reported recovery rates are only 79% and 84% [8]. Arthroscopic treatment eradicated the infection in over 93% of our patients, although in one fourth of cases a second arthroscopic procedure was required. Repeat arthroscopic treatment should be widely used and constitutes an integral part of the management of septic arthritis. All patients with septic arthritis and no marked improvement immediately after the first arthroscopic procedure should have the procedure repeated. This aggressive treatment strategy considerably increases the recovery rate (from 70% in our population after a single arthroscopic procedure to over 90% after two arthroscopic procedures) and is associated with only minimal adverse effects [10,12,14–17]. Arthroscopic treatment of septic arthritis provides good functional outcomes in 80% of cases [10,13].

The severity stage as assessed according to Gächter was the strongest prognostic factor in our study. All patients with Gächter stage 1 or 2 disease experienced full resolution of the infectious process, compared to 78% and 67% of patients with stage 3 and 4 disease, respectively. Symptom duration or time to management, which directly influence the Gächter stage, is also among the main predictors of treatment outcomes in septic arthritis [9,13,18]. However, this factor was not statistically significant in our study. S. aureus (particularly when resistant to methicillin) as the causative organism has been associated with poor outcomes of septic arthritis, so that presence of this organism, in itself, may indicate repeat arthroscopic treatment in nearly every case [6,10]. In our study, none of the microbiological factors, including the presence of S. aureus, significantly predicted failure of arthroscopic treatment for septic arthritis.

Positive cultures of the first drainage-fluid sample, collected after 24 h, was a strong predictor of treatment failure (PPV, 0.82). Thus, 93% of patients with a negative 24-h sample achieved eradication of the infection after a single arthroscopic procedure, compared to 35% of those with a positive 24-h sample, in our study focussed specifically on septic arthritis of native joints. The result of the first drainage-fluid culture (24 hours after the procedure) reflects the quality of the joint lavage and amount of residual intra-articular bacteria. The results of routine drainage-fluid cultures after arthroscopic treatment of septic arthritis have prompted us to modify our postoperative management strategy: patients with a positive 24-h drainage-fluid culture now routinely undergo a second arthroscopic procedure, without waiting for the results of the day-3 and day-5 samples. In addition, we administer the antibiotics intravenously until the drainage-fluid cultures become negative. Thus, the switch to oral antibiotic therapy occurs only after the drainage-fluid is negative, to avoid the risk of emerging bacterial resistance, particularly in patients with S. aureus infection.

Post-arthroscopic septic arthritis runs a more indolent course and is often due to slowly growing bacteria (e.g., coagulase-negative staphylococci or anaerobes), two facts that explain the longer time to treatment [19,20]. Nevertheless, the management strategy is the same, with first-line arthroscopy for an evaluation of the joint, lavage, and synovectomy. There is no reason to remove a transplant used for ligament reconstruction or fixation material, and the most important procedure is synovectomy, which must be as complete as possible [21,22]. The immediate course is rarely favourable, and repeat arthroscopic treatment is often needed (half the cases in our study), although the final infection eradication rate is greater than 85%.

The main limitations of our study are the single-centre design, small number of patients, and retrospective design, which precluded the identification of other factors predicting treatment failure, as well as the analysis of specific subgroups. Finally, we did not collect data allowing an evaluation of functional outcomes.

5. Conclusion

Arthroscopy is the most appropriate procedure for treating septic arthritis on native joints. By allowing an extensive evaluation of the joint, arthroscopy provides prognostic information by indicating the Gächter stage. Arthroscopy allows joint lavage, synovectomy, and joint drainage. Treatment-related complications are minimal. In the treatment of septic arthritis, arthroscopy provides better outcomes compared to repeated needle aspiration or arthroscopy, in terms of both infection eradication and joint function. The need for repeat arthroscopy should be recognised promptly in patients without immediate marked improvements and, in particular, in those whose drainage-fluid cultures are positive. This

Table 4 Outcomes of arthroscopic treatment by Gächter stage.

<table>
<thead>
<tr>
<th>Gächter stage</th>
<th>n (% positive Redon drains on D1)</th>
<th>n (% repeat arthroscopies)</th>
<th>n (% definitive recoveries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I (n = 13)</td>
<td>1 (7.7)</td>
<td>0 (0)</td>
<td>13 (100)</td>
</tr>
<tr>
<td>Stage II (n = 21)</td>
<td>9 (42.8)</td>
<td>5 (23.8)</td>
<td>21 (100)</td>
</tr>
<tr>
<td>Stage III (n = 9)</td>
<td>6 (66.7)</td>
<td>5 (55.6)</td>
<td>7 (77.8)</td>
</tr>
<tr>
<td>Stage IV (n = 3)</td>
<td>1 (33.3)</td>
<td>3 (100)</td>
<td>2 (66.7)</td>
</tr>
</tbody>
</table>

* Repeat lavage rates differed significantly between Gächter stages 1 and III (P = 0.0048) and between Gächter stages I and IV (P = 0.0018)
strategy saves time and increases the chances of eradicating the infection.

Even in patients with septic osteoarthritis (Gächter stage 4), arthroscopic treatment can eradicate the infection in some instances, thereby avoiding or postponing the need for joint resection and replacement [23].

Disclosures of interest

Ph Hardy is a consultant for Arthrex. FA, JD, and TB declare having no conflicts of interest related to this article.

References


