



Clinical Group

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Key messages:

- (Daily) needle aspirations are advised as initial drainage method in patients with a septic arthritis.
- Except for following situations: (1) inaccessible joints; (2) unsatisfactory clinical response; and (3) inability to aspirate the joint dry.

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Case Report

Septic Arthritis: The drainage controversy

Abstract

Objective: Septic arthritis is a relatively rare disease, which is associated with a high morbidity and mortality. Treatment consists of prolonged antibiotic therapy and removal of intra-articular inflammatory debris. However, there is much controversy about the most effective drainage method. Therefore, we compared the clinical efficacy of (daily) needle aspiration with surgical drainage in adult patients with septic arthritis.

Methods: In this systemic review, all articles describing treatment outcomes based upon the drainage method were retrieved. We also performed a meta-analysis, irrespective of the clinical or methodological heterogeneity.

Results: We included 5 studies, all retrospective in nature, and if combined, with a total number of 450 patients. These studies showed that complete rehabilitation occurred more often in septic arthritis patients treated with needle aspirations (67-76%) compared to surgically treated patients (32-56%). The pooled relative risk (RR) (95% confidence interval (CI)) for complete rehabilitation in needle aspirations compared to surgical drainage was 1.46 (1.22–1.75). On the other hand, the mortality rate was slightly higher in the daily aspiration group (respectively 3-13% versus 2.5-5%). The pooled RR (95% CI) for mortality in needle aspiration versus surgical treatment was 2.23 (0.84-5.91). Noteworthy is the fact that serious underlying illnesses were more frequent in the needle aspiration group.

Conclusion: We recommend (daily) needle aspirations as initial method of drainage in patients with an uncomplicated septic arthritis, except for following more complex/difficult situations, in which surgical drainage is preferred: (1) inaccessible joints; (2) unsatisfactory clinical response; and (3) inability to aspirate the joint dry.

Case

A otherwise healthy 54-year old man presented himself to the emergency department with a painful and swollen right knee for three days. He also had fever of 39°C for one day. The patient did not have a trauma, surgery or skin defect prior to these symptoms. Physical examination showed a warm, swollen and painful right knee. Laboratory findings included a leukocytosis of $14 \times 10^9/L$, and an elevated C-reactive protein of 14.0 mg/L. A diagnostic needle aspiration was performed, with 60 milliliters of purulent fluid being drained. The synovial fluid and blood culture were both positive for *Staphylococcus aureus*, confirming the presumed diagnosis of septic arthritis. Treatment consisted of daily needle aspiration and intravenous antibiotics. Three days after admission to the hospital, the orthopedic surgeon was consulted, since clinical symptoms were not improving substantially. In his opinion, however, surgical (open) drainage is preferred over daily needle

aspiration, given that this method has a better outcome. This discussion led to the following review.

Introduction

Patients frequently present to the emergency department with one or more warm, swollen joints, which has a broad differential diagnosis, but one should never overlook a septic arthritis. The latter represents a relatively rare disease with a reported incidence of 4–10 per 100.000 person-years, but its course may have a significant impact on patients' life, including irreversible joint destruction with subsequent disability and death [1]. Septic arthritis has a mortality of approximately 2–14% [2].

Bacterial joint infections may be caused by hematogenous spread and direct inoculation, occurring with trauma or skin defects, in 67% and 33% of cases respectively [3]. Risk factors for developing septic arthritis are, apart from age, a compromised

immune system (ie. by the use of immunosuppressive drugs), prosthetic joint(s), intravenous drug abuse, diabetes mellitus, skin defect(s) and/or pre-existing joint disease [4]. There is a predilection for the knee and hip joints, that are respectively involved in 48% and 21% of patients with a septic arthritis [5].

The diagnosis septic arthritis is established by detecting bacteria in synovial fluid, but is most often made by integration of history, physical examination and laboratory testing. The predominant causative pathogens in septic arthritis are *Staphylococcus aureus* and *Streptococcus*, accounting for respectively 65% and 25–30% of cases [5]. Treatment consists of prolonged (intravenous) antibiotic therapy and removal of intra-articular pus [1].

The latter can be done either surgically, via arthroscopy, or through daily needle aspirations. The drainage method currently seems to depend on the specialization of the attending physician. Thus, rheumatologists prefer daily needle aspirations, whereas orthopedic surgeons are more inclined to surgical drainage [6]. Both drainage methods have their advantages and disadvantages.

Surgical drainage allows better access and exposure of the joint, which facilitates adhesiolysis, debridement and incision of perisynovial abscesses [2]. However, the procedure is associated with more risks/complications. Also it can often be performed only once and it depends on the availability of the operation theatre [2]. Daily needle aspirations on the other hand are relatively noninvasive and can be performed repeatedly and practically everywhere [2]. Disadvantages are that not all purulent material can be evacuated and some joints are inaccessible [2].

Due to abovementioned arguments controversy persists with regards to the most effective drainage method. Therefore, the aim of this review is to compare the clinical efficacy of (daily) needle aspiration versus surgical drainage in adult patients with septic arthritis.

Methods

Search strategy and selection criteria

For abovementioned research question we first looked at (current) (inter)national guidelines, if present. We looked for a preference for either drainage method and their evidential support for it.

Furthermore, we performed a systematic search of the literature using the following databases: Cochrane Library and PubMed. The following search strategy was performed in PubMed: “Arthritis, Infectious”[Mesh] AND (septic OR bacterial) AND surgery AND aspiration AND (“humans”[MeSH Terms] AND English[lang]), and was last executed in January 2018. Articles, which described treatment outcomes based upon the drainage method in adult patients with septic arthritis, were included for this review. To be included in this review, the following criteria had to be met:

- Adult patients with a septic arthritis
- Report of functional status (joint mobility) and/or mortality after treatment.

Outcome and statistical analysis

We identified three major outcomes, namely: (1) percentage of complete rehabilitation in all infected joints, (2) percentage of complete rehabilitation of the knee and (3) mortality. For the meta-analysis we included all studies, which compared both drainage methods in patients with a septic arthritis, irrespective of their clinical or methodological heterogeneity. The treatment effect was estimated using a relative risk (RR) with 95% confidence intervals (CI) for each study independently. Pooled estimates were provided using fixed-effects models with the sample size of each reported outcome per study as weight. Forest plots are given to summarize the results. All statistical analyses were carried out using STATA V.12.0. A p value <0.05 was considered statistically significant.

Results

Guidelines

The Dutch Orthopedic Association and the Dutch Society for Rheumatology do not provide a national guideline for the management of septic arthritis. Also, no guidelines/recommendations are available from the American College of Rheumatology (ACR) and European League Against Rheumatism (EULAR).

However, after our thorough literature search we found the British guidelines for the management of the hot swollen joint in adults [7]. In this guideline, last updated in 2006, no preference to either drainage method was given. However, in the following cases aforementioned guideline recommends surgical drainage over daily needle aspiration: (A) unsatisfactory response to daily needle aspiration, and (B) septic arthritis of the hip. These recommendations are based on data from a few retrospective studies, which will be discussed in the next paragraphs [7].

Articles

The previously described search strategy identified 132 articles for potential selection. After review of the titles and abstracts, 7 articles were found to fulfil the inclusion criteria. Three of the 7 articles were reviews, of these 2 were excluded, because they refer to the remaining studies [2,8]. The study characteristics of the 5 articles, included in this systemic review, are given in table 1 [6,9–12]. The 5 selected, all retrospective, studies will be discussed separately in following paragraphs [6,9–12]. These cohort studies compared the effectiveness of both drainage techniques by complete rehabilitation and mortality. However, in the studies of Goldenberg, Rosenthal and Bynum, it is unclear when these outcomes are measured [6,9–12].

Goldenberg *et al* retrospectively reviewed the outcome of 59 patients seen over a 7-year period in 1 medical center [6] Of those 59 patients, 42 were treated with (daily) needle

Table 1: Studies that compare (daily) needle aspiration and surgery as initial drainage method in patients with septic arthritis.

Author	Study design	Period	Population	Outcome	N (Needle aspiration/ surgical drainage)
Goldenberg <i>et al</i> , 1975	Retrospective	1965 - 1972	<ul style="list-style-type: none"> SA based upon positive synovial fluid cultures, excluding <i>N. gonorrhoeae</i> Symptom duration <14 days 	<ul style="list-style-type: none"> Joint mobility Complications (<i>ie. ankyloses, 2^o osteomyelitis, contracture</i>) and/or death 	42 / 17
Rosenthal <i>et al</i> , 1980	Retrospective	1972 - 1977	<ul style="list-style-type: none"> SA based upon positive synovial fluid and/ or blood cultures, excluding <i>N. gonorrhoeae</i> 	<ul style="list-style-type: none"> Joint mobility Complications (<i>ie. ankyloses, 2^o osteomyelitis, contracture</i>) and/or death 	31 / 40*
Bynum <i>et al</i> , 1982	Retrospective	1970 - 1979	<ul style="list-style-type: none"> SA based upon positive Gram staining or synovial fluid cultures Sufficient follow-up (<i>not specified</i>) 	<ul style="list-style-type: none"> Presence of pain Joint mobility 	25 / 6*
Ravindran <i>et al</i> , 2009	Retrospective	2001 – 2006	<ul style="list-style-type: none"> SA based upon positive synovial fluid cultures, excluding prosthetic joint SA Age >18 years 	<ul style="list-style-type: none"> Functional status at the time of discharge from the hospital 	32 / 19
Broy <i>et al</i> , 1986	Review	1959 - 1984	<ul style="list-style-type: none"> SA based upon positive Gram staining or synovial fluid and/or blood cultures, excluding <i>N. gonorrhoeae</i> and/or infected prosthetic joints Symptom duration <14 days Age >16 years 	<ul style="list-style-type: none"> Functional status, including joint mobility 	242 / 129*

Abbreviations: SA, septic arthritis

*Numbers given are based upon the number of infected joints instead of the number of patients with a septic arthritis.

aspiration and 17 surgically. The cohort included 12 children, who were equally divided between both groups (~20%). A serious underlying illness (*ie. malignancy and liver cirrhosis*) was seen in 26% (n=11) of the daily aspiration patients and none of the surgically treated patients [6]. Complete rehabilitation occurred in 67% (28/42) and 42% (7/17) of patients respectively treated with (daily) needle aspirations and surgical drainage (Table 2) [6]. On the other hand, 12% (n=5) and 6% (n=1) of patients respectively treated with daily needle aspirations and surgical drainage died [6].

Rosenthal *et al* retrospectively analyzed 71 joint infections in 63 patients, of whom 20 were children, seen over a 5-year period [9]. Respectively, 31 and 40 of the infected joints were treated with (daily) needle aspirations and surgical drainage. Follow-up data was available from 64 joint infections (56 patients). Complete rehabilitation occurred in 74% (20/27) and 32% (12/37) of the infected joints respectively treated with (daily) needle aspirations and surgical drainage (Table 2) [9]. If prosthetic joint infections are excluded (n=11), 46% of the surgically treated patients will have a complete rehabilitation. Interestingly, none of the surgically treated adult patients had a complete rehabilitation. The knee was the most frequently involved joint. In the needle aspiration and surgical group complete rehabilitation of septic arthritis of the knee respectively occurred in 75% (9/12) and 12% (2/17) of the joints.(9) (Daily) needle aspirations and surgical drainage respectively had a mortality of 13% (4/31) and 2.5% (1/40) [9].

Bynum *et al* retrospectively described 32 joint infections in 24 adults, seen over a 9-year period, of which 25 were treated with (daily) needle aspiration, 6 had a surgical intervention and 1 drained spontaneously [11]. Of the 25 joint infections treated with (daily) needle aspiration, 15 subsequently required surgical drainage. The authors only reported the outcomes of

the 10 remaining joint infections in the needle aspiration group. Complete rehabilitation occurred in 30% (3/10) and 50% (3/6) of the infected joints respectively treated with (daily) needle aspirations and surgical drainage (Table 2) [11]. Two medically treated patients died (=50% of the infected joints), while none of the surgically treated patients died [11].

Ravindran *et al* retrospectively reviewed 32 and 19 septic arthritis patients, who were respectively treated with (daily) needle aspiration and surgical drainage over a 6-year period [10]. There was no difference in co-morbidity between both groups. Complete rehabilitation occurred in 69% (22/32) and 53% (10/19) of patients respectively treated with (daily) needle aspirations and surgical drainage (Table 2).(10) Of the patients with a septic arthritis of the knee respectively 71% (17/24) and 38% (5/13) treated with (daily) needle aspirations and surgical drainage had a complete rehabilitation. One death was reported in each treatment group (respectively 3% and 5%) [10].

Broy *et al* pooled and analyzed all published articles between 1959 and 1984 on outcome of treatment of septic arthritis according to type of initial drainage [12]. A total of 80 articles describing 371 joint infections in 336 patients were included in this review. Respectively, 242 and 129 of the infected joints were treated with (daily) needle aspirations and surgical drainage. A serious underlying illness was seen more often in the patients treated with (daily) needle aspirations compared to the surgically treated patients (respectively 36% versus 4%) [12]. Complete rehabilitation occurred in 66% (160/242) and 57% (73/129) of patients respectively treated with (daily) needle aspirations and surgical drainage (p<0.05, table 2) [12]. In the needle aspiration and surgical group complete rehabilitation of septic arthritis of the knee respectively occurred in 75% (45/60) and 65% (35/54) of the infected joints. On the other hand, 7.3% (n=16) and 3.4% (n=4) of patients respectively

Table 2: Initial drainage method and functional status

Author	Complete rehabilitation	Died	No.
	(daily) needle aspiration versus surgical drainage		
Goldenberg et al, 1975	67% vs. 42%	12% vs. 6%	42 vs. 17
Rosenthal et al, 1980	74% vs. 32%	13% vs. 2.5%	27 vs. 37*
Bynum et al, 1982	30% vs. 50%	50% vs. 0%	10 vs. 6*
Ravindran et al, 2009	69% vs. 53%	3% vs. 5%	32 vs. 19
Broy et al, 1986	76% vs. 56%	7% vs. 3%	120 vs. 91*

*Numbers given are based upon the number of infected joints instead of the number of patients with a septic arthritis.

treated with (daily) needle aspirations and surgical drainage died [12].

In our meta-analysis we excluded the studies from Goldenburg and Bynum, because both studies are included in the review from Broy [6,9-12]. The results of the meta-analysis are given in figure 1. The pooled relative risk (RR) (95% confidence interval (CI)) for complete rehabilitation in patients treated with (daily) needle aspirations compared to patients treated with surgical drainage was 1.46 (1.22 – 1.75). We also performed a subgroup analysis, including all patients with a septic arthritis of the knee, because this is the most frequently involved joint. In this subgroup, the pooled RR (95%) for complete rehabilitation in the daily aspiration group compared to the surgical group was 1.45 (1.14 – 1.84). On the other hand, the mortality rate is slightly higher in the daily aspiration group. The pooled RR (95% CI) for mortality in daily aspiration versus surgical treatment was 2.23 (0.84 – 5.91).

Discussion

Septic arthritis is a relatively rare but severe disease, which is associated with high morbidity and mortality.(1) Early recognition and appropriate treatment is paramount to a better outcome [13]. Treatment consist of prolonged (intravenous) antibiotic therapy and drainage of the involved joint(s) [1]. However, there is much controversy about the most effective drainage method. In general, orthopedic surgeons are in favor of surgical drainage, where rheumatologists prefer (daily) needle aspirations [6].

In this review we discussed the available literature on the clinical efficacy and safety of both drainage methods. Unfortunately, randomized controlled trials (RCTs) are lacking and, the best available evidence comprises a handful of retrospective studies with a total number of 450 patients [6,9-12]. These retrospective studies showed that complete rehabilitation was more often established in septic arthritis patients treated with (daily) needle aspirations (67-76%) as compared to patients that underwent surgical drainage (32-56%) [6,9-12]. Moreover, the pooled relative risk (RR) (95% confidence interval (CI)) for complete rehabilitation in (daily) needle aspirations compared to surgical drainage in any septic arthritis was 1.46 (1.22-1.75), and with regards to septic arthritis of the knee the pooled RR (95%) was 1.45 (1.14-1.84).

On the other hand, the mortality rate was slightly higher

in the (daily) needle aspiration group (respectively 3-13% versus 2.5-5%) [6,9-12]. Furthermore, the pooled RR (95% CI) for mortality in the patient group that was treated with daily needle aspirations versus surgical treatment was 2.23 (0.84 – 5.91).

Apparently, all these retrospective studies run the risk of bias by indication, since daily aspiration techniques were used in the relatively simple and uncomplicated cases of septic arthritis, and the surgical (open) techniques in the more difficult and complicated cases, such as inaccessible joints (ie. the hip), unsatisfactory response with (daily) needle aspirations and inability to aspirate the joint dry.

On the other hand, (daily) needle aspirations tend to occur in cases with extensive underlying diseases, suggesting that surgical procedures are relatively contraindicated in individuals with severe comorbidity. Our review confirmed that (daily) needle aspirations occurred more frequently in individuals with extensive underlying diseases [6,12].

Another point is of course the cost of treatment, the costs of daily drainage by a rheumatologist should be compared to the surgical procedure, including operating room, nurses, anesthesia, and the orthopedic surgeon.

In conclusion, there is a lack of high quality data, preferably derived from RCTs, that address the clinically relevant question with regards to the optimal synovial drainage in septic arthritis. Plausible explanations for the absence of these RCTs are the low incidence of septic arthritis, the strong belief by rheumatologists as well as orthopedics that their strategy is superior, and finally the lack of interest of pharmaceutical companies. We suggest that, probably, independent organizations that financially support multicenter RCTs, over some years, may or should be able and willingly to fill this important knowledge gap.

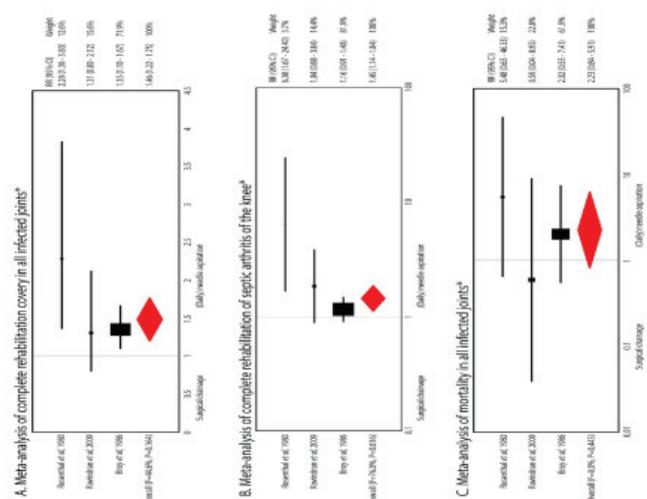


Figure 1: Forest plot of meta-analysis on initial drainage method and functional status (A+B) and mortality (C)

Abbreviations: CI, confidence interval; RR, relative risk

*The studies from Goldenburg and Bynum et al are excluded, because both studies are included in the review from Broy et al.

As for now, we recommend (daily) needle aspirations as preferred drainage method in patients with an uncomplicated septic arthritis. The following more complex cases, may demand surgical drainage over (daily) needle aspirations: (1) inaccessible joints (ie. the hip); (2) unsatisfactory clinical response after 3–5 days; and (3) inability to aspirate the joint dry.

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