Review article

Post-arthroscopy septic arthritis: Current data and practical recommendations

T. Bauer\textsuperscript{a,}\textsuperscript{*}, P. Boisrenoult\textsuperscript{b}, J.-Y. Jenny\textsuperscript{c}

\textsuperscript{a} Service de Chirurgie Orthopédique, Hôpital Ambroise-Paré, Hôpitaux Universitaires Paris Ile-de-France Ouest, 9, avenue Charles-de-Gaulle, 92100 Boulogne-Billancourt, France
\textsuperscript{b} Service de Chirurgie Orthopédique, Hôpital André-Mignot, 177, rue de Versailles, 78150 Le Chesnay, France
\textsuperscript{c} Service de Chirurgie Orthopédique, Centre Chirurgical Orthopédique et de la Main, 10, avenue Achille-Baumann, 67400 Illkirch, France

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\textbf{A B S T R A C T}

Septic arthritis develops after less than 1\% of all arthroscopy procedures. The clinical symptoms may resemble those seen after uncomplicated arthroscopy, raising diagnostic challenges. The diagnosis rests on emergent joint aspiration with microscopic smear examination and prolonged culturing on specific media. Urgent therapeutic measures must be taken, including abundant arthroscopic lavage, synovectomy, and the concomitant administration of two effective antibiotics for at least 6 weeks. Preservation of implants or transplants is increasingly accepted, and repeated joint lavage is a component of the treatment strategy. After knee arthroscopy, infection is the most common complication; most cases occur after cruciate ligament reconstruction, and staphylococci are the predominant causative organisms. Emergent synovectomy with transplant preservation and appropriate antibiotic therapy ensures eradication of the infection in 85\% of cases, with no adverse effect on final functional outcomes. After shoulder arthroscopy, infection is 10 times less common than neurological complications and occurs mainly after rotator cuff repair procedures; the diagnosis may be difficult and delayed if \textit{Propionibacterium acnes} is the causative organism. The update presented here is based on both a literature review and a practice survey. The findings have been used to develop practical recommendations aimed at improving the management of post-arthroscopy infections, which are exceedingly rare but can induce devastating functional impairments.

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1. Introduction

Septic arthritis after arthroscopy is rare, their overall frequency being estimated at less than 1\%. As with all uncommon events, the optimal diagnostic and management strategies are unclear. The objective of this update is to review the current literature on infections occurring after any type of arthroscopic procedure, in order to look for specific points of diagnostic or therapeutic interest. Practical recommendations were developed based on both this literature review and a practice survey, with the goal of improving the management of post-arthroscopy infections.

2. Review of the current literature

2.1. Incidence

Overall, septic arthritis is reported after less than 1\% of arthroscopy procedures. The true incidence of deep post-arthroscopy infections is somewhat unclear, however, as it has increased 3-fold between the early case-series (0.04\%–0.86\%) \textsuperscript{[1]} and more recent publications (0.14\%–2.25\%) \textsuperscript{[2–5]}. This increase reflects the growing use of arthroscopy and expansion of interventional arthroscopy (with the introduction of implants and transplants). Furthermore, given the diagnostic challenges raised by post-arthroscopy infections, some cases may be missed and the true incidence therefore underestimated.

2.2. Diagnosis

Septic arthritis is often particularly challenging to diagnose after arthroscopy, as the clinical symptoms may resemble those often
produced by the procedure itself in the absence of complications. The definite diagnosis relies on identification of an organism in deep specimens. Consequently, emergent joint aspiration is in order, followed by microscopic examination of smears and prolonged cultures on specific media. Nevertheless, negative results from these microbiological tests do not completely rule out a deep infection. This situation requires close monitoring and, if appropriate, either a second joint aspiration or arthroscopy to allow joint lavage and the intraoperative collection of multiple deep specimens [6]. The main mistake at this stage is to forego the establishment of a definite diagnosis, instead initiating empirical antibiotic therapy, which may prevent the recovery of a causative organism from all future specimens while allowing a smouldering infection to cause gradual joint damage.

2.3. Treatment principles

Septic arthritis is a therapeutic emergency, whether it affects a native non-operated joint or occurs after arthroscopy. The treatment must combine abundant arthroscopic lavage, with synovectomy as indicated by the stage of the infection [7], and the concomitant administration of two effective antibiotics for at least 6 weeks. There is increasing agreement that implants and transplants can be left in place [8,9]. Repeated arthroscopic lavage is a component of the treatment strategy that should be implemented whenever an unfavourable postoperative event occurs (e.g., persistent fever, painful effusion, laboratory signs of systemic inflammation, or positive drainage fluids), in order to ensure a full recovery [10].

2.4. Knee arthroscopy

Infection is the leading complication after knee arthroscopy, with a frequency of 0.15% to 0.84% [2,3]. The arthroscopic procedure most often responsible for infection is reconstruction of the anterior or posterior cruciate ligament. Males younger than 40 years are also at increased risk for infection after knee arthroscopy [2,3].

After reconstruction of the anterior cruciate ligament (ACL), the frequency of infection has ranged from 0.3% to 1.7% [9,11–13]. The risk of infection after ACL reconstruction is higher in patients with a previous history of surgery on the same knee and in professional athletes (in whom the short time to surgery and skin flora may play a role) [12,14]. The organisms causing infections after arthroscopic ACL reconstruction are staphylococci in 70% of cases and coagulase-negative staphylococci in 40% of cases. Staphylococcus aureus infections are less common than those due to coagulase-negative staphylococci but carry a poorer prognosis [4,9,13,15]. The symptoms of infection after arthroscopic ACL reconstruction are not specific. A persistent effusion with pain and, in some cases, a low-grade fever, is the main presentation. As a consequence, the diagnosis is often made late, 3 weeks on average and up to 2 months after the reconstruction procedure. The corollary is delayed treatment, which is an adverse prognostic factor [4,9,12,13]. Medical and surgical treatment must be provided on an emergency basis. Arthroscopy should be performed to allow abundant lavage, with synovectomy as indicated by the visible damage. In addition, antibiotic therapy (usually with two concomitant drugs) must be given for at least 6 weeks. The antibiotics are selected based on the organisms recovered from the deep specimens collected during arthroscopic lavage. Implants and transplants are almost always left in place [4,8,9,16–19]. When the course is unfavourable, with a persistent painful effusion, a fever, laboratory evidence of systemic inflammation, and/or positive drainage fluids, arthroscopic lavage should be performed as many times as needed, implant exchange should be considered (if readily achievable), and every effort should be made to preserve any transplants when possible [8–10]. With this protocol (arthroscopic synovectomy, transplant preservation, and antibiotics for 6 weeks), eradication of the infection is achieved in 85% to 100% of cases [4,13,15–19]. Despite a slower pace of recovery, the functional outcomes are identical to those seen in the absence of post-ACL reconstruction infection [8,9,11,16,20–22].

2.5. Arthroscopy of the shoulder

After shoulder arthroscopy, infections occur with a frequency of about 0.3%, which is 10 times less than the frequency of neurological complications [5,23,24]. However, the incidence rate of infection after shoulder arthroscopy is probably underestimated, as Propionibacterium acnes is often the causative organism. P. acnes infections develop very slowly: thus, only after several weeks with minimal symptoms does a suggestive clinical picture develop. In addition, P. acnes is difficult to recover using standard culture media. Among arthroscopic shoulder procedures, rotator cuff repair is the main source of infection, with the risk being highest in patients older than 60 years and in those having previously had surgery on the same shoulder [5,25].

2.6. Other joints

The frequency of post-arthroscopy septic arthritis is estimated at 0.15%–0.6% at the ankle and 0.5% at the hip; it is extremely low at the wrist [26–30]. These frequencies may be underestimations, however, and superficial infections may occur also.

3. The SFA/SOF/COT/ORTHISQ practice survey

Among SFA, SOFCOT and/or ORTHISQ members invited to participate in the practice survey, 264 responded. They constituted a fairly uniform population of experienced surgeons, of whom three-quarters had been performing arthroscopic procedures for over 10 years, with over 50 and over 100 arthroscopic interventions of the same type per year for 85% and 50% of respondents, respectively. The respondents reported 293 confirmed and 288 suspected post-arthroscopy infections, underlying the diagnostic uncertainty that exists in many cases. The patients were predominantly young males (46% were younger than 40 and 33% were 40 to 60 years of age). Among risk factors for infection, smoking was noted in 61% of patients, obesity in 21%, and diabetes in 20%. Elite athletes contributed 15% of the patient population and were at high risk for infection, confirming previously published data [12,14]. The knee was predominantly affected (n = 167), followed by the shoulder (n = 40). The ankle, hip, and elbow were rarely involved. The most common arthroscopic procedures were ligament reconstruction at the knee (60% of post-arthroscopy knee infections) and rotator cuff repair at the shoulder (over 70% of post-arthroscopy shoulder infections). In half the cases, an implant or transplant had been introduced. The procedures were considered simple by the surgeons in 87% of cases and the operative time was less than 1 hour in 68% of cases. Onset of the symptoms of infection was abrupt in about two-thirds of cases and usually occurred early, within the first month in nine-tenths of cases. Three-quarters of patients exhibited prominent manifestations with highly suggestive local changes, constitutional symptoms, and laboratory test results. However, in about two-thirds of cases, the healing process was recorded as having proceeded smoothly during the immediate postoperative period. Joint aspiration was usually performed, and a further operation was done in 183 patients, in some instances without previous joint aspiration. The leading organism was S. aureus (71%), followed by P. acnes (12%), and coagulase-negative staphylococci (11%). Over three-quarters of patients were managed by a multidisciplinary team including an orthopaedic surgeon, a microbiologist, and an infectious diseases specialist. In 85% of cases,
the treatment combined surgery, which was performed arthroscopically in four-fifths of cases, and two concomitant antibiotics, usually given for 6 weeks. The surgical procedure always consisted in joint lavage and synovectomy and confirmed Gächter stage I or II arthritis in 86% of cases. Transplant removal, because of changes suggesting necrosis, was required in only 3% of cases and implant removal in 10% of cases. In 10% of cases, a second arthroscopic lavage procedure was carried out because of unfavourable clinical and laboratory findings. The infection was fully eradicated in all patients but 1. At last follow-up, the functional outcome was considered good or very good in 71% of cases, fair in 19%, and poor in 10%.

Overall, the findings from this survey of practices regarding post-arthroscopy infections are consistent with previously published data. They confirm a growing awareness among surgeons that post-arthroscopy infection, although rare, is extremely severe and requires a combination of appropriate medical and surgical measures on an emergency basis, with the involvement of a multidisciplinary team and improved information to the patient. Nevertheless, persisting diagnostic challenges can result in inappropriate treatments such as empirical antibiotic therapy before microbiological sample collection in patients with suspected infection. These treatment errors are ascribable to mistaken or missed diagnoses and must be eliminated, as they complicate the situation (by precluding a definite microbiological diagnosis and allowing a low-grade infection to cause functional deterioration) and can result in litigation. Clearly, there is a need for practical recommendations regarding the optimal management of post-arthroscopy infections.

4. Practical recommendations

This in-depth review of the available literature establishes that the diagnosis of post-arthroscopic septic arthritis is an emergency. An early diagnosis is a prerequisite, not only to eradication of the infection, but also to the achievement of good functional outcomes. In some cases, however, the challenge is to rule out post-arthroscopy infection, which may prove difficult. The clinical manifestations, which consist chiefly in pain, are often ill-defined and of unclear significance in postoperative patients. Thus, normal pain due to the surgical procedure may be difficult to differentiate from pain indicating a complication. Therefore, the possibility of infection must always be borne in mind in patients with a troubled postoperative course marked by unusually severe pain, delayed range-of-motion recovery, or any other untoward event.

Many investigations are available for confirming or supporting a diagnosis of septic arthritis. However, none can definitively rule the diagnosis in or out. Furthermore, sophisticated tests often have long times to results and may therefore delay the initiation of an effective treatment strategy. Therefore, in practice, the wisest course of action consists in performing a single investigation, namely, joint aspiration with microbiological studies of the collected fluid. Presence of a joint effusion is required but is the rule in this setting. Aspiration of superficial joints (knee, ankle, shoulder, elbow, and wrist) is easy to perform on an outpatient or inpatient basis. Aspiration of the hip is also possible under these conditions, although more likely to be successful when ultrasound guidance is used. Joint aspiration is a rapid procedure that requires no special preparation and is fairly inexpensive. It is performed at the slightest doubt and usually provides the diagnosis while also protecting the physician in the event of litigation.

That joint aspiration can cause septic arthritis is a widely held misconception. As with all invasive procedures, there is some risk, but published estimates range from 1/10,000 to 1/100,000 aspirations. Thus, any risk associated with joint aspiration is far lower than the risk associated with allowing a joint infection to evolve.

A positive joint aspiration, defined as purulent fluid or a positive culture, confirms the diagnosis of infection, as false-positive results due to sample contamination are exceedingly rare. Once the diagnosis is confirmed and the causative organism identified, effective treatment can be started immediately. The treatment strategy is now well-standardised and will be described below. Effective and early treatment provides the best chance of success and minimises both the treatment duration and any residual abnormalities. The expected outcome is eradication of the infection.

Although the patient may interpret the infection as indicative of malpractice, the physician is unlikely to be found liable, except in the tiny number of cases in which there is evidence of suboptimal care. The liability falls on the healthcare institution. The surgeon is usually subpoenaed to attend the expert review but can, in most cases, prove that no mistakes were made and that the diagnosis and treatment occurred as early as possible.

Negative joint aspirate cultures usually indicate that there is no infection. Unfortunately, the diagnosis cannot be completely ruled out. The patient should be monitored more closely than usual. If the clinical manifestations are still present after a few days, a second joint aspiration should be performed to allow further microbiological studies. The treatment at this stage should be confined to symptomatic measures. There is an absolute contra-indication to probabilistic antibiotic therapy, as this course of action, far from improving patient safety, can make the definite diagnosis impossible to establish while failing to provide optimal therapeutic effectiveness.

If a definite diagnosis of infection is established, the patient may consider malpractice litigation. However, the surgeon is unlikely to be found liable, as the times to diagnosis and treatment were as short as possible.

Failure to perform joint aspiration leaves the diagnosis in doubt for several weeks. In the absence of infection, treatment delay is not an issue and the surgeon may feel justified in not having performed an unnecessary procedure. On the other hand, if a diagnosis of infection is confirmed, the substantial delay in treatment initiation will put the patient at risk for increased functional impairments. The patient may be more likely to litigate and, more importantly, the court will find the surgeon guilty of malpractice, consisting in failure to investigate all possible diagnostic hypotheses.

When the diagnosis of septic arthritis is confirmed, treatment must be started on an emergency basis. A prompt treatment response increases the chances of a full recovery. Consequently, a radical multipronged treatment strategy must be applied from the outset. This strategy has three components.

Systemic antibiotics selected based on susceptibility test results should be given routinely, as early as possible, and in sufficiently high dosages. The intravenous route is used initially then the oral route. Well-standardised protocols are now available, and the prescription of antibiotics usually raises no special challenges. Joint lavage should be performed routinely in post-arthroscopy septic arthritis. Needle irrigation is inadequate, and surgical lavage must be performed instead. Arthroscopic lavage is the preferred technique, as it is less aggressive and potentially more effective for complex joints such as the knee. However, open surgical lavage remains an option. Large amounts of sterile saline should be used. Adding antiseptic or antibiotic agents to the lavage fluid has not been proven effective or, most importantly, safe.

Synovectomy is indicated in patients with marked synovial hypertrophy and intra-synovial abscesses. The optimal extent of the procedure is unclear, however, and is largely decided based on subjective factors. Synovectomy should probably be as complete as possible to maximally decrease the bacterial load. Excessive synovectomy is less harmful than insufficient synovectomy, which may delay the treatment response. Broad criteria should therefore be used to select patients for synovectomy. Again, the arthroscopic
The best management of foreign material introduced into the joints is less clear. Foreign material that is well-fixed within the joint and continues to fulfill its function is unlikely to prevent eradication of the infection and can be left in place. In contrast, if the foreign material is not effective (e.g., ligament transplant that has been destroyed or markedly weakened, ineffective sutures, or mobile metallic material), removing it is reasonable. If appropriate, it can be replaced by new material, depending on the situation and potential difficulties.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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