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Case report

Preoperative joint aspiration in the diagnosis of non-acute hip and knee prosthetic joint infections☆

Ponction articulaire préopératoire dans le diagnostic des infections péri-prothétiques non aiguës de hanche et de genou

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1. Introduction

Periprosthetic joint infection (PJI) is a common complication that may occur any time after prosthesis implantation. Rates of PJI range between 1 and 2% of hip or knee arthroplasties [1,2]. Various clinical presentations of PJI may be observed. Diagnosis is usually easy when the infection is acute, when it develops days or weeks after surgery, or when it is related to bacteremia. It is, however, often challenging when the infection evolves for several months before being diagnosed [3,4].

Numerous preoperative tests are available, but distinguishing chronic PJIs from non-infectious causes of joint failure is difficult [5,6]. Accuracy of preoperative diagnosis is fundamental for an optimal surgical and medical management of the infection.

There is no reference test for preoperative diagnosis [3,7,8]. The optimal preoperative diagnosis currently combines history, physical examination, biological markers, radiographs, scintigraphy, and aspiration. Preoperative joint aspiration (PJA) is recommended and plays a pivotal role in the algorithm of PJI diagnosis [9–12]. However, concordance with intraoperative cultures is inconsistent and ranges from 45 to 90% in the various studies [13–16].

PJA has a higher sensitivity and specificity in acute septic presentations [17–19]. Diagnosis is obvious and treatment consists in washing, debridement, and antibiotic combination therapy.

We were interested in non-acute PJIs as their diagnosis is difficult and the role of aspiration is controversial. We did not find specific studies including patients presenting with chronic PJI suspicion alone. Does PJA modify management? Can we rely on puncture results to guide postoperative antibiotic therapy, especially when prosthesis is changed with a one-stage procedure?

We aimed to evaluate the accuracy of PJAs in suspicions of chronic PJIs. We compared direct examination and bacteriological PJA results with the final diagnosis, essentially determined in light of peroperative bacteriological and histological results, and follow-up.

2. Patients and methods

From 2012 to 2013, we included consecutive patients from our orthopedic department who presented with a suspicion of

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non-acute hip or knee PJI. As defined in the last guidelines of the Infectious Diseases Society of America (IDSA), only suspicions of infection that occurred more than three months after implantation or suspected infections with more than one month since onset of infectious symptoms at the site of a previously well-functioning prosthesis joint were included in the study [10].

Suspicion of prosthesis infection was considered when the following factors were combined: medical history of the prosthesis, type of prosthesis, date of implantation, past surgeries on the joint, delay and type of clinical signs, comorbid conditions, remote infections, plain radiograph of prosthesis, and serum CRP. Data was validated on a weekly basis at multidisciplinary meetings including orthopedists, infectious disease specialists, anesthesiologists, bacteriologists, pharmacists, and radiologists.

Preoperative aspiration was performed a few weeks before arthroplasty revision, and it was stopped more than 14 days before aspiration for patients receiving antibiotic therapy.

Joint aspirations were all performed after strict aseptic precautions were taken and under echography control, except for three knee aspirations performed during outpatient care. For hip PJAs, soft tissues were anesthetized with lidocaine solution. When no fluid could be aspirated, 5 mL of saline was injected and re-aspirated. If the sample volume was less than 2 mL, only bacteriological culture was performed.

We determined synovial fluid white blood cell (WBC) count and synovial fluid polymorphonuclear neutrophil percentage (PMN %).

Using direct microscopic examination, we searched for crystal and bacteria after Gram-staining. Joint fluids were incubated on chocolate and Columbia agar media in both 5% CO_2 atmosphere and anaerobic conditions. They were also inoculated with enrichment broths in aerobic and anaerobic blood culture bottles. All media were incubated and checked daily for 15 days.

Surgical strategies were one or two-stage exchange or debridement, and retention of prosthesis if exchange could not be performed.

On average, five intraoperative tissue specimens were sampled during surgery and labeled with caution to compare the results of the joint fluid aspirated by puncture and that of samples taken during the procedure. These samples were bead-milled, incubated on chocolate agar, Columbia agar, and liquid media. Cultures were checked daily for 15 days.

As per the International Consensus on PJI, the infection was confirmed with two positive periprosthetic cultures with phenotypically identical microorganisms, a sinus tract communicating with the joint, or with three of the following minor criteria: elevated serum CRP, elevated synovial fluid WBC count, elevated synovial fluid PMN %, positive histological analysis of the periprosthetic tissue, and a single positive culture [20]. Definition of PJI could be validated, even if the above criteria were not met, for instance when a patient had only one sample positive for coagulase-negative *Staphylococcus* (CoNS). Clinical judgment and surgeon experience were crucial to confirm the infection.

We measured accuracy, sensitivity, specificity, and positive and negative predictive values. We tested factors associated with puncture accuracy using Fischer's exact test and *t*-test in univariate analysis. We also performed a multivariate analysis using logistic regression.

Table 1
General characteristics and main results of preoperative joint aspirations from patients included for a non-acute periprosthetic joint infection suspicion.
Données générales et résultats principaux des ponctions articulaires préopératoires des patients inclus pour suspicion d'infections de prothèses ostéo-articulaires non aiguës.

General data	Results
Patients (*n*)	74
Hip (*n*)/knee (*n*)	33/41
Sex ratio	0.95
Mean age (range)	69 (39–87)
Median time from first prosthesis implantation to PJA (range)	72 months (5–336 months)
Median time from last arthroplasty surgery to PJA (range)	30 months (4–336 months)
Median time since onset of clinical signs (range)	6 months (2–240 months)
Mean time between PJA and surgery (range)	33 days (1–100 days)
Median PJA volume aspirated (range)	9 mL (1–70 mL)
Median synovial WBC count (range)	1000/mm^3 (0–70,000/mm^3)
Median synovial PMN % (range)	86% (10–99%)

PJA: preoperative joint aspiration; WBC: white blood cells; PMN %: polymorphonuclear neutrophil percentage.

3. Results

3.1. General data

Seventy-four patients presenting with a suspicion of non-acute hip or knee arthroplasty infection were included during the study period (2012–2013) (Table 1). Median time since last surgery was 30 months, and 6 months since first clinical signs. Forty-eight patients had undergone at least one revision procedure before inclusion and some had had up to seven previous prosthetic surgeries.

The main clinical signs were pain (65 patients) and stiffness (49 patients). Seventeen patients had a sinus tract and nine a swelling joint. Fever and local inflammation were each observed in seven patients (Fig. 1). Median serum CRP was 19 mg/L (range: 3–297 mg/L). Aspirations were spontaneously obtained in 67 patients. Fluids were obtained after saline injection in seven patients.

As per the above-mentioned definition, diagnosis of PJI was confirmed for 46 patients and ruled out for 28. Table 2 details the various bacteria isolated from confirmed PJIs.

3.2. Puncture accuracy

Bacteriological results from PJAs and peroperative samples were concordant and accurate with the final diagnosis for 42 of the 74 patients (23 sterile and 19 infected) (Table 3). In two patients fulfilling the definition of PJI (due to *P. acnes* and *Candida* sp.), only PJA, but not peroperative samples, demonstrated growth. In three other patients not fulfilling the definition of PJI, only tissue specimens, but not PJA, demonstrated growth (with

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