The Journal of Arthroplasty 31 (2016) 684–687

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Validation of Synovial Aspiration in Girdlestone Hips for Detection of Infection Persistence in Patients Undergoing 2-Stage Revision Total Hip Arthroplasty

Viktor Janz, MD [a], Benjamin Bartek, MD [a,b], Georgi I. Wassilew, MD [a,b], Malte Stuhlert [a,b], Carsten F. Perka, MD [a,b], Tobias Winkler, MD, PhD [a,c]

[a] Orthopaedic Department, Center for Musculoskeletal Surgery, Charité-Universitätsmedizin Berlin, Germany
[b] Charité, Universitätsmedizin Berlin, Orthopaedic Department Berlin, Germany
[c] Charité, Universitätsmedizin Berlin, Orthopaedic Department, Center for Septic Surgery Berlin, Germany

A B S T R A C T

Background: The aim of this study was to assess the diagnostic performance of synovial aspiration in Girdlestone hips, without a Polymethylmethacrylate (PMMA) spacer, for the detection of infection persistence before total hip arthroplasty (THA) reimplantation.
Methods: Seventy-four patients undergoing stage revision THA surgery were included in this retrospective cohort study. Both synovial cultures and serum C-reactive protein values were acquired before explantation of the THA and of the Girdlestone hip before reimplantation.
Results: The diagnostic performance of the synovial aspiration of the Girdlestone hip achieved a sensitivity of only 13% and a specificity of 98%. The determination of the serum C-reactive protein value for Girdlestone hips achieved a sensitivity of 95% and a specificity of only 20%.
Conclusions: Our data show that the Girdlestone aspiration can neither reliably confirm nor exclude a persistence of infection.

Article history:
Received 31 March 2015
Accepted 30 September 2015
Keywords: THA revision, Girdlestone, infection, Synovial aspiration, PJI

Periprosthetic joint infection (PJI) remains one of the most severe complications in total hip arthroplasty (THA). Two-stage revision arthroplasty is an effective treatment option for PJI offering good infection control rates [1]. However, for a successful stage revision procedure, an effective detection or exclusion of infection persistence before the commencement of reimplantation is deemed to be imperative. The preoperative THA aspiration is an accepted standard to establish the diagnosis of PJI and is frequently repeated, as a Girdlestone aspiration, before reimplantation to detect a possible persistence of infection [2,3].

However, the reported sensitivity rates for synovial fluid aspiration vary widely, ranging from 12% to 100% [4]. There are a multitude of factors which contribute to this large variance in sensitivity for synovial aspiration of the hip joint. Firstly, the causative bacterial species in PJI are not evenly distributed throughout the intraarticular space but instead are present mainly at the osseous endoprosthetic interface in the form of a biofilm [5].

Another factor influencing the rate of bacterial detection is the practice of performing a synovial aspiration with in situ Polymethylmethacrylate (PMMA) spacers and not of Girdlestone resection arthroplasty hips. It is possible that the synovial aspiration of a hip with an in situ PMMA spacer can influence the culture results [6].

Whereas multiple studies have investigated the diagnostic performance of synovial aspiration of THA hips or hips with an in situ PMMA spacer, there are little data to assess the performance of synovial aspiration in Girdlestone resection arthroplasty hips [4]. The aim of this study was to assess the diagnostic validity of synovial aspiration in resection arthroplasty hips, without a PMMA spacer, for the detection of infection persistence before THA reimplantation.

Materials and Methods

Seventy-four patients undergoing a stage revision THA surgery between 2006 and 2013 fulfilled the inclusion criteria and were included in this retrospective cohort study. The patient collective was comprised of 38 men and 36 women with an average age of 66.7 years (27-87 years). Inclusion criteria were a stage revision THA without the use of a PMMA spacer, including a synovial aspiration, and determination of the serum C-reactive protein (CRP) value both before the explantation and before the reimplantation.

No author associated with this paper has disclosed any potential or pertinent conflicts which may be perceived to have impending conflict with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2015.09.053.

Reprint requests: Viktor Janz, MD, Charité, Universitätsmedizin Berlin, Orthopaedic Department, Charitéplatz 1, 10117 Berlin, Germany.

http://dx.doi.org/10.1016/j.arth.2015.09.053
0883-5403/

Exclusion criteria included a missing synovial aspiration, aspiration of an insufficient amount of synovial fluid, incomplete acquisition of intraoperative samples, or administration of antibiotics 14 days before surgery. After application of the exclusion criteria, patients were excluded, leaving 69 patients for evaluation.

Before the results of this study, septic THAs were treated according to the following protocol at our department. After the diagnosis of PJI is established, a stage septic THA exchange is performed.

In the explantation procedure, a complete explantation of all arthroplasty components, foreign materials, and PMMA cement was performed to create a true Girdlestone resection arthroplasty. We do not use PMMA spacers at our institution, and therefore, none were included in this study. During the first-stage prosthesis explantation, a synovial fluid and an average of periprosthetic tissue samples were acquired for microbiological diagnostic. In addition, a sonication of the explanted endoprosthetic components was performed for minutes at an intensity of 100% using a BactoSonic 14.2 (Bandelin, Berlin, Germany) sonication unit with subsequent microbiological culture of the sonicate fluid [7].

For nonmicrobiological samples, a histological analysis of the periprosthetic membrane was performed. Postoperatively, systemic antimicrobial therapy was initiated for weeks in accordance with the microbe-specific antibiotic susceptibility testing. After completion of the week antibiotic regimen and resolution of the clinical signs of infection, all antibiotic therapy was discontinued for weeks, and a synovial aspiration of the Girdlestone hip was performed. In addition, the systematic inflammation parameters, in the form of erythrocyte sedimentation rate (ESR) and serum CRP, were determined at the time of the Girdlestone aspiration. If the patient remained clinically inconspicuous, systematic inflammation parameters were either negative or constantly falling the explantation procedure, and the synovial culture of the Girdlestone hip remained negative, THA reimplantation was commenced. During the reimplantation procedure, the previously listed intraoperative microbiological and histological samples were acquired again, with the exception of sonicate fluid culture due to lack of explantation material.

If the patient developed clinical symptoms of infection persistence, such as a sinus tract, local erythema, or hyperthermia, or if the synovial culture of the Girdlestone hip produced a positive bacterial culture, this was interpreted as a persistence of infection and followed by a second surgical debridement as well as an extended interval of antibiotic therapy.

Nine patients were treated with a permanent resection arthroplasty after undergoing multiple revisions due to clinical signs of infection persistence. Four patients received an aspiration of their Girdlestone hip and presented a positive bacterial isolation. These cases represented the only positive bacterial isolations produced by a Girdlestone aspiration. Five of these patients did not receive a Girdlestone aspiration. Because of the lacking Girdlestone aspiration, these patients were not included in our study.

A PJI was defined according to the following criteria: intraarticular presence of pus or a sinus tract, a periprosthetic membrane indicative of infection in the histological analysis, or a positive microbiological isolation in a minimum of samples [1]. If none of the above-mentioned parameters were present, a PJI was excluded and the case was classified as aseptic. Because this study was commenced before the routine determination of synovial white cell count and polymorphonuclear percentage at our department, it was not possible to use the new definition of PJI according to the Musculoskeletal Infection Society [8].

All synovial aspirations were performed in a standardized fashion in an operating theater with laminar airflow. The patient was in a supine position, and an anterior approach was used. The aspiration site was disinfected times covered in sterile drapes, and a skin incision was made before insertion of the aspiration cannula. The intraarticular position of the cannula was confirmed by image intensifier. If no synovial fluid can be aspired, then a lavage and reaspiration are not performed. The synovial fluid and all other microbiological samples acquired in this study were cultivated for 14 days to ensure the detection of slow-growing bacterial species [9].

The diagnostic performance of both the THA synovial fluid aspiration and the serum CRP values for the preoperative diagnosis PJI was expressed using the statistical values of sensitivity and specificity.

Results

All of the 69 included patients in our study had a preoperative suspicion of PJI, through clinical presentation such as a sinus tract or positive bacterial growth in a preoperative synovial aspiration, leading to a stage revision THA therapy. From these 69 patients, 66 met our strict criteria for PJI through the intraoperative samples acquired during the THA explantation procedure. The patients who did not fulfill our criteria for PJI all had positive preoperative synovial aspirations, whereas the intraoperative microbiological samples remained culture negative and the respective histological samples also were not indicative of PJI. This led to a prevalence of 96% (66 of 69) for PJI in our cohort.

The sensitivity, specificity, negative predictive value (NPV), and positive predictive value (PPV) for the preoperative synovial aspiration and serum CRP as well as the Girdlestone aspiration and serum CRP in Girdlestone resection arthoplasties are displayed in Table 1. When comparing the initial preoperative synovial aspiration of the THA, before the endoprosthetic explantation, to the intraoperative samples of the explantation procedure for detection of PJI, the synovial aspiration achieved a sensitivity of merely 68% and a specificity of 50%. This led to a PPV of 95% and an NPV of merely 10%. Both of these values were surpassed by the preoperative serum CRP values, which yielded a sensitivity of 95% and a specificity of 91% for the detection of PJI in our cohort. The PPV and NPV of the preoperative synovial aspiration were both surpassed by the PPV and NPV of the serum CRP values with 98% and 77%, respectively.

A synovial aspiration was performed at different points in time, before THA explantation, during THA explantation, during Girdlestone aspiration, and at THA reimplantation, during the course of this study. The isolated bacterial species from these different synovial aspirations are displayed in Table 2. Fifty-nine of the 69 cases had a positive bacterial isolation either in the preoperative synovial aspiration before THA explantation or in the microbiological samples during THA explantation. In 36 cases, the synovial aspiration before THA explantation produced a positive bacterial isolation, and in 27 cases, the synovial aspiration during THA explantation produced a positive bacterial isolation.

In 24 cases, the bacterial species detected in the synovial aspiration before THA explantation was concordant with the bacterial species isolated in the synovial aspiration during THA explantation, a concordance of 67% (24 of 36 cases, respectively). The concordance between the positive bacterial isolation during THA reimplantation and the synovial aspiration of the Girdlestone hip was worse with only of the cases (33% concordance) with a positive bacterial isolation during THA reimplantation being detectable through the synovial aspiration of the Girdlestone hip.

The diagnostic performance of both the serum CRP value and the synovial aspiration of the Girdlestone hip before reimplantation was just as poor or worse. The synovial aspiration of the Girdlestone hip was only able to produce positive bacterial cultures in our patient cohort. Three of the positive Girdlestone aspirations were interpreted

Table 1
Sensitivity, Specificity, PPV, and NPV for Both Synovial Aspiration and Serum CRP at the Time of the Initial Preoperative Synovial Aspiration and the Girdlestone Aspiration.

	Preoperative Aspiration	Preoperative CRP	Girdlestone Aspiration	Girdlestone CRP
Sensitivity	68%	95%	13%	95%
Specificity	50%	91%	98%	20%
PPV	95%	98%	75%	36%
NPV	10%	77%	70%	90%