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ORIGINAL ARTICLE

Arthroplasty following a septic arthritis history: A 53 cases series

T. Bauer^{a,*}, S. Lacoste^a, L. Lhotellier^b, P. Mamoudy^b,
 A. Lortat-Jacob^a, P. Hardy^a

^a Orthopedic and Traumatological Surgery Department, Ambroise-Paré Hospital, West Paris-Île-de-France University, 9, avenue Charles-de-Gaulle, 92100 Boulogne, France

^b Orthopedic and Traumatological Surgery Department, Diaconesses Hospital Group, Croix Saint-Simon, 125, rue d'Avron, 75020 Paris, France

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KEYWORDS

Septic arthritis;
 Arthroplasty;
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Summary

Introduction: The most feared complication of arthroplasty after septic arthritis (active or quiescent) on a degenerative joint is septic failure, but this risk is difficult to assess. The aim of the present study was to analyze the results of arthroplasties after septic arthritis of native knee and hip joints, in terms of functional results and infection control and to seek eventual risk factors of failure.

Patients and methods: Fifty-three cases of septic arthritis treated by arthroplasty (31 knees and 22 hips) were retrospectively included. In case of evolutive septic arthritis (30 cases: 17 knees and 13 hips) failing to react to conservative treatment, arthroplasty was performed in a 2-stage procedure (a mean interval of 6 weeks between stages, and an associated antibiotic therapy for a mean 3 months were routinely respected). In case of previous arthritis considered to be cured (23 cases: 14 knees and nine hips), arthroplasty was performed with a 1-stage procedure, observing a mean interval of 5 years after the initial septic arthritis, and antibiotic therapy maintained until definitive microbiological results were obtained from joint cultures samples at surgery. No patients were lost to follow-up; minimum follow-up was 2 years, for a mean of 5 years. The final results were assessed in terms of functional outcome (on PMA functional score for hips and IKS score for knees) and successful eradication of infection.

Results: Two-stage arthroplasty was successful in 26 of the 30 cases of evolutive septic arthritis (87%), while the 1-stage procedure was successful in 22 of the 23 cases of quiescent septic arthritis (95%) (NS). Functional results were very good. No significant difference in functional outcome or successful eradication of infection was found between the 1- and 2-stage procedures. No significant difference in final outcome in terms of infection eradication was found between knees and hips. No clinical, microbiological or treatment-related criteria emerged as risk factors for septic failure.

* Corresponding author.

E-mail address: thomas.bauer@apr.aphp.fr (T. Bauer).

Discussion: Arthroplasty after septic arthritis of the knee or hip using the present protocol (2-stage implantation in case of evolutive septic arthritis and a 1-stage procedure in case of quiescent septic arthritis) achieved very good functional results with a success rate of 87% for sepsis control in evolutive septic arthritis and of 95% in quiescent septic arthritis.

Level of evidence: Level IV retrospective or historical series.

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Introduction

Management of septic arthritis in its initial stage is medico-surgical, treatment strategy being guided by microbiological and imaging data and symptom evolution [1,2]. When septic arthritis with bone involvement, management comprises not only antibiotic therapy but more aggressive surgery associating total synovectomy and joint resection, classically followed by either arthrodesis (particularly in the knee) or resection arthroplasty or coaptation (in the hip) [3–6]. The role of arthroplasty in the management of septic arthritis remains to be clearly defined. Joint replacement provides a much better functional result than arthrodesis or resection arthroplasty, but incurs a risk of septic failure, which is difficult to assess. Moreover, in case of previous joint infection quiescent for long enough to be considered to be resolved, onset of functional joint deterioration raises the question of degenerative joint pathology or late resurgence of infection [7]. The role of arthroplasty and treatment strategy as a whole (pre-operative assessment, 1- or 2-stage surgery, antibioprohylaxis, postoperative antibiotic therapy and follow-up) in this situation of doubt are not clearly established.

The prime objective of the present study was to assess infection results in arthroplasty for septic arthritis of the native knee or hip. Secondary objectives were to highlight clinical, microbiological and treatment-related risk factors for failure.

Patients and methods

This 2-center continuous retrospective series included 53 cases of native joint infection (31 knees and 22 hips) managed by arthroplasty (Table 1). All patients undergoing arthroplasty, associated with either evolutive or quiescent septic arthritis were included. Only septic arthritis implicating pyogenic bacteria were included; those implicating mycobacteria were excluded.

In evolutive septic arthritis (30 cases: 17 knees, 13 hips), 2-stage arthroplasty was performed in case of failure of conservative medico-surgical treatment (joint lavage, synovectomy and drainage with associated adapted antibiotic therapy) diagnosed from persistent clinical and biological inflammatory syndrome, functional deterioration of the affected joint, onset of radiological signs of cartilage and especially bone involvement (evolutive joint-line narrowing and appearance of areas of osteolysis or bone loss) and persistence of microbiologically positive joint samples. The first stage comprised total synovectomy with joint resection and insertion of a cement spacer without antibiotics. Five

deep samples (synovial and bone tissue) were systematically taken. The microbiological diagnosis of infection was established in case of at least two out of five samples positive for the same bacterium. The second stage, comprising repeated synovectomy and total joint replacement, was performed at a mean 6 weeks after step 1 (range, 4 weeks to 4 months). Implantation was indicated essentially on microbiological criteria once CRP assay became normal and stable for at least 2 consecutive weeks. Antibiotic bi-therapy was associated for a mean 93 days (range, 45–180 days) following the first stage.

In previous septic arthritis considered to be resolved (23 cases: 14 knees, nine hips), arthroplasty was performed in case of functional deterioration in the affected joint. Septic arthritis was considered as resolved on a range of criteria: interval of at least 2 years after treatment of the initial infection, absence of clinical or biological inflammatory syndrome, and negative findings on the joint sample systematically taken before arthroplasty. Total joint replacement, with associated synovectomy, was performed in a 1-stage procedure, at a mean 5 years after the initial septic episode (range, 2–18 years). All cases of previous septic arthritis lacking microbiological data were excluded to improve inter-group comparison. Five deep samples (synovial and bone tissue) were systematically taken. The microbiological

Table 1 Clinical and microbiological characteristics of initial septic arthritis.

	Knee	Hip
<i>n</i>	31	22
Mean age	57 (31–82)	60 (29–92)
Origin of infection		
Postoperative	15	12
Hematogenous	10	10
Secondary to infiltration	6	
Arthritis status		
Evolutive	17	13
Considered resolved	14	9
Pre-operative microbiology		
<i>S. aureus</i>	10	9
Coagulase-negative <i>S.</i>	8	6
<i>Streptococcus</i>	6	3
GNB	4	2
Polymicrobial	3	2

S. aureus: *Staphylococcus aureus*; coagulase-negative *S.*: coagulase-negative *Staphylococcus*; GNB: Gram-negative bacillus.

diagnosis of infection was established in case of at least two out of five samples positive for the same bacterium. Antibiotic therapy adapted to the initially implicated bacterium was initiated after intra-operative sampling and maintained until definitive microbiological results were established. In seven of the 23 cases, the intra-operative sample was positive (at least two out of five samples positive for the same bacterium: *Staphylococcus aureus* in four cases, coagulase-negative *Staphylococcus* in two, and Gram-negative bacillus in one) and adapted antibiotic therapy was associated for a mean 80 days (range, 45–120 days) after arthroplasty.

No patients were lost to follow-up; minimum follow-up was 2 years, for a mean of 5 years (range, 2–13 years). The final results were assessed in terms of functional outcome (on Postel-Merle d'Aubigné [PMA] functional score [8] for total hip replacement and International Knee Society [IKS] score [9] for total knee replacement) and eradication of infection. Resolution of infection was assessed by absence of evolutive clinical or radiological syndrome around the implant, absence of evolutive clinical or biological inflammatory syndrome, and absence of surgical revision for infection.

Statistical analysis used χ^2 and analysis of variance (ANOVA) correlation tests.

Results

In 15 of the 17 cases of evolutive septic arthritis of the knee managed by 2-stage arthroplasty (88%), infection was assessed as resolved at end of follow-up, with a mean IKS knee score of 83/100 (range, 65–100) and mean IKS functional score of 80/100 (range, 40–100). In 13 of the 14 cases of quiescent septic arthritis of the knee managed by 1-stage arthroplasty (93%), infection was assessed as resolved at end of follow-up, with a mean IKS knee score of 91/100 (range, 75–100) and mean IKS functional score of 80/100 (range, 45–100). In 11 of the 13 cases of evolutive septic arthritis of the hip managed by 2-stage arthroplasty (85%), infection was assessed as resolved at end of follow-up, with a mean PMA score of 16.5/18 (14–18). In all nine cases of quiescent septic arthritis of the hip managed by 1-stage arthroplasty, infection was assessed as resolved at end of follow-up, with a mean PMA score of 17.5/18 (range, 16–18). No significant difference emerged in terms of infection control or functional result at end of follow-up between 2-stage joint replacement for evolutive septic arthritis and 1-stage joint replacement for quiescent septic arthritis, or between arthroplasty for septic arthritis of the knee versus the hip in terms of infection control.

Infection was eradicated in 26 of the 30 cases of evolutive septic arthritis of the knee or hip managed by 2-stage arthroplasty (87%), and in 22 of the 23 cases of quiescent septic arthritis managed by 1-stage arthroplasty (95%) (NS). Four cases of evolutive septic arthritis showed evolutive septic recurrence, implicating the same bacterium (*S. aureus* in two cases, coagulase-negative *Staphylococcus* in one case and Gram-negative bacillus in 1 case), at a mean 18 months (range, 8 months to 1 year). Only one case of quiescent septic arthritis showed evolutive septic recurrence (implicating *S. aureus*), at 30 months after arthroplasty. Of the 23 cases of quiescent septic arthritis managed by 1-stage arthro-

plasty, the seven with positive intra-operative samples were free of recurrence of infection at end of follow-up.

No clinical (location, arthritis status as evolutive or quiescent considered to be resolved, or interval between infection and arthroplasty), microbiological (bacterium, or positive intra-operative samples in case of quiescent septic arthritis considered to be resolved) or treatment-related criteria (1- vs. 2-stage implantation, or duration of antibiotic therapy) emerged as a risk factor for failure of management of septic arthritis by arthroplasty.

Discussion

Management of septic arthritis by arthroplasty using the present protocol (2-stage total joint replacement in case of evolutive arthritis and 1-stage total joint replacement in case of quiescent arthritis) gave very good functional results in both knee and hip, with an infection control rate of 87% in evolutive septic arthritis and of 95% in quiescent arthritis (NS).

Arthrodesis or joint resection are classically recommended in evolutive septic native joint arthritis with osseous involvement and in sequelae of quiescent infantile or adult septic arthritis considered to be resolved, whatever the implicated bacterium (pyogenic or mycobacterium). The role of arthroplasty in such indications remains to be clearly defined, and there is a risk of complications and especially of failure due to infection (by peroperative contamination in evolutive septic arthritis, or by resurgence of quiescent septic arthritis) which is difficult to assess [4–6,10,11].

In quiescent septic arthritis, resolution of infection remains uncertain even after several years free of symptoms. Pre-operative joint biopsy is mandatory to screen for any low-level background infection, but the rate of false negatives is high (seven out of 23 in the present series). Intra-operative deep samples (joint fluid, synovial tissue, bone section) are thus required: they may either confirm the absence of evolutive osteoarticular infection or, on the contrary, detect bacteria despite negative pre-operative biopsy results [7,12–14]. Given this possibility, arthroplasty in quiescent septic arthritis considered to be resolved should include total synovectomy and associated antibiotic therapy adapted to the bacteria implicated in the initial infection (if such microbiological findings are available). The antibiotic therapy should be initiated after intra-operative deep sampling and maintained until definitive results are obtained on late culture, and be adapted to any bacteria identified intra-operatively. Standard antibioprophyllaxis is thus not performed in these circumstances. Where initial microbiological data are lacking for quiescent septic arthritis, the molecules of standard arthroplasty antibioprophyllaxis may be prescribed, but with treatment beginning after intra-operative deep sampling and being maintained until definitive results are obtained.

Arthroplasty to manage evolutive septic arthritis provides 77 to 100% resolution of infection, depending on the report, although series were few and often small [4,8,15–18]. In quiescent septic arthritis considered to be resolved, arthroplasty provides 90 to 100% resolution [6,7,11–13,15,19–21]. In the present series, treatment strategy depended on evolutivity as assessed on basically clinical, biological and

microbiological criteria, with pre-operative biopsy in all cases. Two-stage arthroplasty, applied in cases of evolutive septic arthritis, provided resolution in 87% of cases, and 1-stage arthroplasty, applied in quiescent septic arthritis, in 95%. According to several authors, however, arthroplasty, whether for evolutive or quiescent septic arthritis, can be performed in a one stage procedure with results comparable to those obtained with a 2-stage procedure [7,10,12,13,15]. Our 2-stage joint replacement attitude was mainly due to foreseeable difficulties of excision and the uncertainty of microbiological findings in evolutive septic arthritis despite various medico-surgical treatment modalities. Positive findings from intra-operative samples despite negative pre-operative biopsy did not seem to be risk factors for failure in infection control (no failure in terms of infection control in the seven cases in the present series) as long as the 1-stage joint replacement was performed as in our protocol, with total synovectomy and associated antibiotic therapy maintained until the definitive microbiological findings.

No risk factors for failure or arthroplasty to manage septic arthritis emerged in the present study. From the literature, however, it would seem that comorbidity in the broad sense (associated defects, immunodepression) is a factor of increased risk of recurrence of infection following arthroplasty [11,13,22,23]. The stage of joint infection evolution and the degree of bone involvement are certainly also to be taken into account in assessing the risk of failure. Jerry et al. [12] reported a 4% rate of recurrence of infection after arthroplasty for simple septic arthritis and 15% for septic arthritis with bone involvement. According to Kim et al. [21], the longer the symptom-free interval between initial joint infection and implantation, the higher the success rate.

The present study had certain limitations due to a sample size providing insufficient statistical power. Moreover, it was in some cases difficult to specify quiescent septic arthritis considered to be resolved on purely clinical, biological and microbiological criteria. Scintigraphy and histological and microbiological analysis with molecular biology of deep samples might clarify criteria of success or failure of implantation in these situations [24].

Conclusion

Management of septic arthritis by arthroplasty following the present protocol (2-stage implantation in evolutive and 1-stage in quiescent arthritis) gave very good functional results in both knee and hip, with 87% of eradication of infection in evolutive septic arthritis and 95% in quiescent septic arthritis. No clinical, microbiological or treatment-related risk factors for failure emerged.

Conflict of interest statement

None.

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