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SYMPOSIUM: COMPLICATIONS OF HIP ARTHROPLASTY

Retrospective Analysis of Infection Rate After Early Reoperation in Total Hip Arthroplasty

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Abstract

Background Infection is a devastating complication of total hip arthroplasty (THA). Unavoidable reoperation during the acute recovery phase of hip arthroplasty has the potential for an increased infection rate but the risk is not well established nor is the fate of these infected hips.

Questions/purposes We therefore report the infection rate for patients undergoing THA who returned to the operating room within 90 days of his or her index procedure for any surgical intervention on the same hip.

Methods We identified 60 patients undergoing THA referred to or treated at our institution who required an unplanned and unavoidable return to the operating room during the acute recovery phase. The complications of the initial surgery that resulted in reoperation included instability, periprosthetic fracture, retained hardware, and nerve exploration. We then retrospectively reviewed the medical records to determine the infection rate and implant survivorship. The minimum followup was 1 month (average, 3.7 years; range, 1 month to 7 years) and included all patients who required resection before a minimum 2-year followup.

Results The infection rate for this cohort was 20 of 60 (33%). Six of these 20 retained their implants at 2 years after the reoperation and were considered infection-free. Two-stage reimplantation or resection was eventually performed in 14 of the infected patients.

Conclusions A high percentage of patients undergoing THA developed a deep infection after unavoidable reoperation during the acute recovery phase. The reasons for the reoperations were potentially modifiable complications and situations that deserve further investigation to delineate protocols to minimize the risk of infection in these patients.

Level of Evidence Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

Deep infection after THA continues to be a relatively rare but devastating complication [18]. Many protocols and precautions have been used to decrease deep infection; these include prophylactic antibiotics, ultraclean air systems, antibiotic-impregnated cement, and whole-body exhaust ventilated suits [16]. Despite these efforts, deep infection still occurs at a rate of 0.5% to 3% in primary [3, 7, 13] and 4% to 6% in revision THA [3, 7, 11, 17].

This complication results in considerable morbidity for the patient and also creates a burden for physicians and the healthcare system. The total hip revision burden (17.5%), defined as the ratio of revisions to the number of primaries, reportedly remained constant from 1990 to 2002, but the

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Each author certifies that his or her institution approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.

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overall number of revisions continues to increase [8]. Of these revisions, 14.8% have an International Classification of Diseases, Ninth Revision, Clinical Modification diagnosis code for infection/inflammation (996.66) [2]. In 2003, 202,500 primary THAs were performed in the United States along with 36,000 revision hip procedures. The number of THAs is projected to increase by 174% (572,000) by the year 2030 [8]. If these projections are realized, physicians and hospitals will have a difficult time accommodating the patients. Bozic et al. [3] reported an average hospital length of stay (LOS) of 28.2 days for patients with revision arthroplasty secondary to infection, over three times longer than that for patients revised secondary to aseptic loosening (8.1 days). In addition, the total hospital costs for the two groups were $96,166 and $34,866, respectively, again reflecting nearly a threefold increase [3]. Using the US Nationwide Inpatient Sample, Kurtz et al. [9] recently reported a 2.1 times longer LOS for infected THAs when compared with those that were not infected.

Many studies have focused on comorbidities to identify patients who are at increased risk of infection. Obesity, female gender [12], advanced age, poor nutrition [6], rheumatoid arthritis [14], smoking, diabetes mellitus [4], genitourinary conditions, and multiple medical conditions are all known risk factors for infection [10]. In addition, the literature supports an increased complication rate as more revisions are being done. A recent review reported a three- to eightfold increase in complication rate as reoperation on the same joint is performed [7]. Another study reported an infection rate of 11.9% when an additional procedure was performed after TKA to evacuate a hematoma [5]. The authors only considered a return to the operating room within a 1-month period from the index procedure. Although the infection rate was increased when additional surgery was needed to evacuate a hematoma, it is not possible to determine if the hematoma was a clinical finding secondary to a preexisting infection or the infection occurred secondary to the burden of an additional surgery. Surgeons continue to counsel patients requiring early reoperations on the increased risk of infection although the literature contains no data to support such claims.

We therefore determined (1) the infection rate for patients undergoing THA who returned to the operating room within 90 days of the original procedure; and (2) the treatment for those hips that became infected.

Patients and Methods

We queried the Operating Room Information System at our hospital using the Current Procedural Terminology codes [1] for total (27130) and revision hip arthroplasty (27132, 27125, 27137, 27134, 27138) and then crossreferencing the medical numbers with the same database looking for a second procedure of any type on the same joint within 90 days for patients treated between years 2000 and 2005. We initially identified 70 patients who had any surgery on the same joint within the 90-day postoperative period of the primary or revision THA after excluding 27 patients who were taken to the operating room to undergo surgery for a known infection (ie, any known irrigation and débridement or excisional arthroplasty) and 17 patients who underwent closed reduction. Of these 70 patients, four had positive intraoperative cultures and five underwent a hematoma evacuation and therefore were excluded from the study. One patient died of causes unrelated to the hip surgery, leaving 60 patients for analysis (Table 1). Of these 60 patients, 20 had a primary THA and 40 had a revision. We recorded comorbidities that are known risk factors for infection (obesity, diabetes, rheumatoid arthritis, and genitourinary disease) (Table 1). The end point for followup was the presence or absence of infection at a minimum of 1 year postoperatively. The minimum followup in the absence of complications was 1 year (average, 3.7 years; range, 1 month to 7 years) and included all patients who required resection before a minimum 2-year followup. We recalled no patients specifically for this study. No patients were lost to followup. The study had prior approval of our Institutional Review Board.

We elected to use the 3-month time period as our cutoff for our definition of the acute recovery phase because we presumed the complication rate after this period would be lower and might be approaching the same rates reported for chronic infections. The appropriate timing for reporting a complication rate in the acute recovery phase continues to

Table 1. Patient demographics

Variable	Number (N = 60)
Average age in years (± SD)	68.6 (± 12.7)
Gender	
Male	27 (45%)
Female	33 (55%)
Race	
White	52 (87%)
Black	8 (13%)
Procedure	
Primary THA	20 (33%)
Revision THA	40 (67%)
Comorbidities present	
Obesity	4 (7%)
Diabetes	8 (13%)
Rheumatoid arthritis	5 (8%)
Genitourinary disease	2 (3%)

be somewhat controversial. One study looked at the complication rate in the first several consecutive months and reported most infections occur in the first month [19]. Their data showed the infection rate dropped off from 64% in the first postoperative month versus 11% in the next month.

Thirty-nine of the 60 patients had repeat surgery for recurrent dislocation, 19 underwent surgical intervention to address a periprosthetic fracture, one patient had surgery to address peroneal nerve palsy, and one patient underwent exploration to retrieve a retained foreign body (Table 2).

Infection was judged present or absent based on physical examination and laboratory workup. White blood cell count with differential, C-reactive protein, and sedimentation rate were obtained on all patients in which infection was suspected based on physical examination. If the C-reactive protein, sedimentation rate, and white cell count were elevated, an arthrocentesis was then performed. One patient was taken to the operating room before undergoing an arthrocentesis and fluid analysis secondary to an overwhelming septic presentation. C-reactive protein level of greater than 1 mg/dL, after 3 weeks from surgery, and an erythrocyte sedimentation rate of greater than 30 mm/hr, after 6 weeks from surgery, are considered abnormal at our institution. An arthrocentesis with fluid analysis was performed on all patients with abnormal laboratory values. The fluid analysis was considered positive if the white blood cell count was greater than 1760 and the differential showed neutrophils to be higher than 73% [18]. If the results of the fluid analysis were equivocal, the patients were observed clinically and cultures were updated daily. If the cultures were positive or the exam was getting worse, then patients were presumed infected.

Data were collected using electronic medical records accessed through the computerized EPIC system (Epic Systems Corporation, Madison, WI). The data collected included age, race, gender, primary procedure, reason for reoperating, and time between surgeries.

Kaplan Meier survival analysis was used to compare the fates of infected and non-infected prostheses. We used t-tests and Fisher's exact tests to compare infected and noninfected implants for continuous and categorical variables, respectively. All statistical analyses were performed using JMP 8.0 (SAS Institute, Inc., Cary, NC).

Table 2. Reason for reoperation

Reason	Number	Incidence of deep infection (%)
Dislocation	39	15 (38.5%)
Fracture	19	5 (26.3%)
Nerve exploration	1	0 (0.0%)
Foreign body retrieval	1	0 (0.0%)

Results

Twenty of the 60 patients (33%) developed a deep infection. The time between reoperation and diagnosis of infection ranged from 1 month to 7 years (mean, 3.7 years, median, 4.0 years). Sixteen of the 20 infected hips had undergone revision THA as their original procedure, whereas four underwent primary THA. The infection rate was similar ($p = 0.15$) in patients with primary and revision index procedures. Staphylococcus aureus was the most commonly identified organism (Table 3).

At the 2-year postoperative followup, 14 of the 20 infected prostheses had been removed, whereas the six that remained implanted were being treated with long-term suppressive oral antibiotics under the care of an infectious disease specialist. The survival rate was lower ($p < 0.001$) than that of the patients who were not infected (Fig. 1).

Discussion

Despite advances in patient selection and techniques, infection continues to be the most devastating complication after THA. Unavoidable reoperation during the acute

Table 3. Causative organisms identified

Type of bacteria	Number of deep infections (%)
Staphylococcus aureus	12 (60%)
Escherichia coli	4 (20%)
Enterobacter	3 (15%)
Pseudomonas	1 (5%)

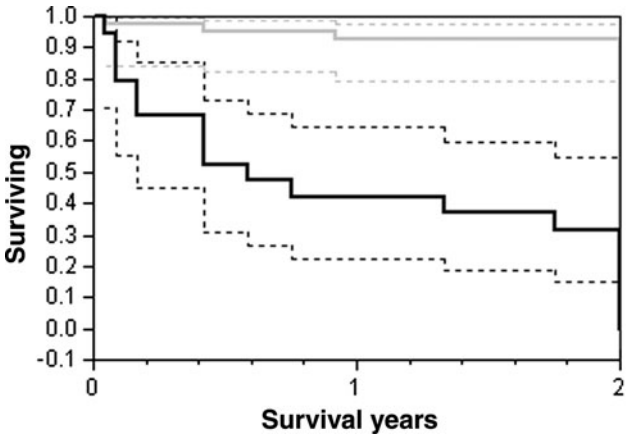

Fig. 1 Kaplan-Meier survival analysis of retained implants in patients with infection (black) and without infection (grey) at 2 years postoperatively. Implants without infection demonstrated a higher ($p < 0.001$) survival rate. Dotted lines indicate 95% confidence intervals for each group.

recovery phase of hip arthroplasty has the potential for an increased infection rate but prior to this study, the risk is not well established nor is the fate of these infected hips. The goals of this project were to determine the infection rate for patients who undergo a reoperation within 90 days of his/her index procedure, and examine how these patients were treated.

We recognize certain limitations of this study. First, we had no uniform protocol at the time of reoperation. For example, no guidelines had been established for the duration of antibiotics used postoperatively. Thus, the likelihood of a patient becoming infected could be influenced by variations in choice of treatments. Second, the number of patients is somewhat small since reoperation in the acute recovery phase, with our exclusion criteria, is a relatively uncommon event. However, there are enough patients to suggest the infection risk is relatively high in this group of patients.

We found a 33% risk for infection if a reoperation was performed in the first 3 months after the index procedure. Obesity, female gender [12], advanced age, poor nutrition [6], rheumatoid arthritis [14], smoking, diabetes mellitus [4], genitourinary conditions, and multiple medical conditions are all known risk factors for infection [10]. A three- to eightfold increase in complication rate as reoperation on the same joint is performed has been reported [15].

The fate of infected prostheses was analyzed using a Kaplan Meier survival analysis. Six of these 20 retained their implants at 2 years after the reoperation and were considered infection-free. Two-stage reimplantation or resection was eventually performed in 14 of the infected patients.

Prior to our study, cultures were obtained on only revision hip patients. Our results influenced our practice to take cultures on all patients who are undergoing a reoperation for any reason (ie, fracture, dislocation, nerve exploration) in the acute phase. Each patient will have at least three tissue samples collected in surgery and sent for cultures. All cultures are incubated for at least 1 week. We have adopted a policy of extended antibiotic prophylaxis until cultures are finalized as negative, typically at 1 to 2 weeks. Due to the potential for creating antibiotic resistance, patients are closely monitored with a physical examination at 2, 4, 6, and 12 weeks postoperatively. If patient CRP and WSR continue to trend up, or the wound remains erythematous and indurated, we would assume that the organism is resistant to the present antibiotic coverage. In these cases, a repeat aspiration would be completed to further delineate any changes in antibiotic coverage needed. Sedimentation rate, C-reactive protein, and complete blood count with differential are obtained prior to reimplantation to assess infection along with the findings of a thorough physical examination.

With future studies, we may be able to better determine a minimum amount of time, if acceptable, that would better serve the patient before returning to the operating room. Although we recognize that urgent return to the operating room may be unavoidable for some patients, we do believe proper counseling is important in managing their expectations for the postoperative course. Although we have no data to support our treatment plan described above, we are hopeful it will reduce infection. Further study is clearly necessary to determine whether our new approach has any effect on the rate of infection.

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