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Original article

Optimal timing for elective total hip replacement in HIV-positive patients

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ABSTRACT

Introduction: Evidence about the optimal timing for total hip replacement (THR) in HIV-positive patients is scant.
Hypothesis: Preoperative criteria: cluster of differentiation 4 (CD4) counts > 200 cells/mm^3 and an undetectable HIV virus load before THR, improve infection rates, aseptic loosenings, and functional outcomes.
Materials and methods: We recruited 16 HIV-positive patients who had undergone 25 THRs between 2003 and 2015. None had hemophilia, and none were intravenous drug users (IVDUs).
Results: Their mean age was 41.2 years (range: 24–60); minimum follow-up was 12 months (mean: 64.6); mean duration of prophylactic antibiotics was 2.9 days (range: 1–5); and mean hospital length of stay was 6.0 days (range: 4–11). No patients were treated with subsequent oral antibiotics. The mean preoperative CD4 count was 464.1 ± 237.0 (range: 235–904) cells/mm^3. There were no early superficial surgical site infections, late periprosthetic joint infections, or aseptic loosenings. Post-surgery Harris Hip score was significantly ($p < 0.001$) better.
Discussion: A preoperative CD4 count > 200 cell/mm^3 and an undetectable HIV virus load might indicate optimal timing for elective THRs in HIV-positive patients without hemophilia and not IVDUs.
Level of evidence: IV, retrospective or historical series.

1. Introduction

HIV was detected and reported in 1983 [1]. HIV infection destroys the immune system and induces AIDS, which, in turn, increases disastrous opportunistic infections and cancer [2]. The development of highly active antiretroviral therapy (HAART) in 1997, however, transformed HIV infection from a rapidly fatal condition into a chronic disease [3]. This significantly reduced the number of HIV-related comorbidities, reduced mortality, and gave patients a nearly normal lifespan [4]. In 2015, about 45% of HIV-infected Americans ($n = 428724$) were more than 50 years old [5].

Both HIV infection and HAART treatment are risk factors for osteonecrosis of the femoral head (ONFH) [6]; the risk is about 100 times higher for HIV-infected patients than for the general population [7]. One magnetic resonance imaging (MRI) study [8] reported a 4.4% prevalence of asymptomatic ONFH in HIV-positive (HIV$^+$) patients. Therefore, orthopedic surgeons faced the problem of total hip replacement (THR) for end-stage ONFH in HIV$^+$ patients.

During the 1980s, others [9–11] reported a relatively high level of superficial infections, periprosthetic joint infections (PJIs), and early aseptic loosenings after total joint replacement (TJR). However, most of these were in patients with hemophilia and a secondary HIV infection from blood transfusions when there was a lack of novel antiretroviral medicines for HIV. Currently, more HIV infections develop from sexual contact and intravenous drug use than from hemophilia. Recent studies [6,12–15] have reported better outcomes and fewer PJIs than before. However, no published studies have suggested optimal surgical timing for elective THR based on well-controlled HIV infection in patients without hemophilia and not intravenous drug users (IVDUs).

We evaluated the clinical efficacy of strict preoperative criteria for infection rates, aseptic loosenings, and functional outcomes based on cluster of differentiation 4 (CD4) counts > 200 cells/mm^3

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and an undetectable HIV virus load before THR in patients without hemophilia and not IVDUs.

We hypothesized that if we followed these strict preoperative criteria, clinical outcomes for these patients would have a low infection risk.

2. Material and methods

2.1. Study design

This study was approved by our hospital's Institutional Review Board. We retrospectively reviewed the medical records and images of all HIV$^+$ patients who had undergone a THR in our hospital between 2003 and 2015. The inclusion criteria were: (1) a preoperative CD4 count > 200 cells/mm^3 and an undetectable HIV load, and (2) a minimum one-year follow-up. Patients with an HIV infection because of hemophilia or intravenous drug use were excluded. However, no one with these latter two characteristics had undergone a THR in our hospital. Patients with a poorly controlled HIV infection had their THR delayed until they met the criteria.

2.2. Cohort

The demographic and clinical data collected were gender, operation side, body mass index (BMI), preoperative CD4 count, duration of prophylactic antibiotics, operation time, length of hospital stay, and comorbidities: hepatitis A, B, and C virus infections, *Pneumocystis jiroveci* pneumonia infection, hypertension, diabetes mellitus, chronic kidney disease, congestive heart failure, depression, and alcohol abuse. Alcohol abuse was defined as units exceeding current National Institute on Alcohol Abuse and Alcoholism recommendations: females ≥ 3 units per day and 7 units per week; males ≥ 4 units per day and 14 units per week [16].

2.3. Perioperative algorithm and protocol for total hip replacement

The THRs in HIV$^+$ patients at our hospital require a definite diagnosis of ONFH, which was based on a valid Ficat stage III, or IV ONFH diagnosis [17]. After a diagnosis of end-stage ONFH, an HIV$^+$ patient is referred to our experienced infection physician to check their CD4 count, HIV load, and excluded active opportunistic infections. The infection physician will schedule the THR based on a CD4 count > 200 cells/mm^3 and an undetectable HIV load [11,14,18,19], or else prescribe HAART. The CD4 count and HIV load are rechecked every three months until the criteria are met.

The postoperative radiographs were followed-up monthly for the first six months, then every three months during the first year, and then annually. During each postoperative visit, we evaluated functional and radiographic outcomes. We checked plain films of hips for signs of implant loosening, subsidence, and other complications. A research assistant evaluated functional scores before surgery and during each postoperative visit. A diagnosis of PJI was based on mainstream American Academy of Orthopaedic Surgeons criteria before 2011 [20] and Musculoskeletal Infection Society criteria after 2011 [21].

2.4. Statistical methods

Clinical outcomes after a THR procedure for an HIV$^+$ patient were evaluated. Continuous variables are presented as the mean and standard deviation, and categorical data are presented as number and percentage. Independent two-sample *t*-tests were used for continuous variables. All statistical analyses were done using SPSS 17.0. Significance was set at $p < 0.05$.

Table 1
Demographics.

Variable	Value
Total hip replacements (*n*)	25
Age (years)	41.2 ± 9.4 (range: 24–60)
Gender (*n* [%])	
Male	25 (100.0)
Female	0 (0.0)
Side (*n* [%])	
Right	12 (48.0)
Left	13 (52.0)
Body mass index (kg/m^2)	23.2 ± 3.1 (range: 19–30)
Cause of HIV (*n* [%])	
Sexual contact	25 (100.0)
Intravenous drug user	0 (0.0)
Hemophilia	0 (0.0)
Comorbidities (*n* [%])	
Hepatitis A virus	5 (20.0)
Hepatitis B virus	7 (28.0)
Hepatitis C virus	2 (8.0)
Pneumocystis jiroveci pneumonia	10 (40.0)
Alcohol abuse	3 (12.0)
Hypertension	3 (12.0)
Diabetes mellitus	3 (12.0)
Chronic kidney disease	2 (8.0)
Congestive heart failure	1 (4.0)
Depression	6 (24.0)
Preoperative CD4 (cells/mm^3)	464.1 ± 237.0 (range: 235–904)
Duration of prophylactic antibiotics (days)	2.9 ± 1.3 (range: 1–5)
Operation time (min)	89.5 ± 32.5 (range: 50–180)
In-hospital length of stay (days)	6.0 ± 1.4 (range: 4–11)
Follow-up (months)	64.6 ± 41.7 (range: 12–153)
Perioperative complications (*n* [%])	0 (0.0)
Surgical site infections (*n* [%])	0 (0.0)
Periprosthetic joint infections (*n* [%])	0 (0.0)

CD4: cluster of differentiation 4. Values are mean ± standard deviation (range) unless otherwise indicated.

3. Results

Between 2003 and 2015, the four senior surgeons in our hospital performed 26 HIV$^+$ THRs. One was excluded due to followed-up for < 1 year. Finally, the medical records of 16 patients with 25 THRs were reviewed in this study. All were males and HIV$^+$ because of sexual contact. Their average age was 41.2 years (range: 24–60), and the average follow-up was 64.6 months (range: 12–153) (Table 1).

Three THRs in our study were delayed 6 months because of inadequate HIV control. The patients were treated with first-generation cephalosporin for prophylaxis (mean duration: 2.9 days; range: 1–5) and then discharged without a routine oral antibiotic. Twenty-two of the 25 THRs were done using a modified direct lateral approach with a cementless porous cup and a coated metaphyseal primary stem (Secur-Fit^{TM} Max; Stryker, Mahwah, NJ, USA) and 3 THRs were done using a posterior approach with a cementless cup and stem components (Versys$^{®}$; Zimmer, Warsaw, IN, USA). The choice of approach and implant type was based on each surgeon's preference.

The mean preoperative CD4 count was 464.1 ± 237.0 cells/mm^3 (range: 235–904). The mean preoperative BMI was 23.2 ± 3.1, mean operation time was 89.5 ± 32.5 min, and mean in-hospital length of stay was 6.0 ± 1.4 days. Associated comorbidities included HAV ($n = 5$, 20.0%), HBV ($n = 7$, 28.0%), and HCV ($n = 2$, 8.0%) infections, *P. jiroveci* pneumonia infection ($n = 10$, 40.0%), alcohol abuse ($n = 3$, 12.0%), hypertension ($n = 3$, 12.0%), diabetes mellitus ($n = 3$, 12.0%), chronic kidney disease ($n = 2$, 8.0%), congestive heart failure ($n = 1$, 4.0%), and depression ($n = 6$, 24.0%).

We used the preoperative criteria of CD4 > 200 cells/mm^3 and an undetectable HIV load. No post-THR superficial surgical site infections, periprosthetic joint infections, or aseptic loosenings were detected (mean follow-up: 64.6 months). The functional

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