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Increased infection risk after hip hemiarthroplasty in institutionalized patients with proximal femur fracture

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ABSTRACT

In patients undergoing hip hemiarthroplasty (HHA) secondary to proximal femur fracture, acute periprosthetic joint infection (PJI) is one of the most important complications. We have detected an increased risk of PJI in chronic institutionalized patients (CIPs), and a higher number of early postoperative infections are caused by Gram-negative bacteria (GNB), not covered by the current prophylaxis (cefazolin in noninstitutionalized patients (NIPs) and cotrimoxazole in CIPs). We sought to compare infection characteristics between NIPs and CIPs, analyzing predisposing factors, causative pathogens, and antibiotic prophylaxis-related microbiological characteristics. We performed a retrospective review of our prospective institutional database to identify all patients consecutively admitted for HHA to treat proximal femur fracture at our centre between 2011 and 2013. PJI was diagnosed in 21 of 381 (5.51%) patients, with 10 of 105 (9.52%) in the CIP group and 11 of 276 (3.99%) in the NIP group, and statistical significance was achieved. GNB accounted for PJI in 14 (66.67%) patients. We detected a single case of methicillin-resistant *Staphylococcus aureus* (MRSA) infection in the NIP group.

We confirm a higher risk of acute PJI among institutionalized patients, commonly caused by Gram-negative microorganisms, which are not covered by the current prophylaxis. New prophylactic strategies should be investigated in order to reduce this problem.

Introduction

Acute postoperative periprosthetic joint infection (PJI) is a serious complication following hip hemiarthroplasty (HHA) performed for treatment of a proximal femur fracture [1,2]. In the last years, several authors have reported an increasing incidence of PJI in total hip arthroplasty (THA), reaching 2.2% in some series [3,4]. The incidence increases further to 5% when HHA is performed [5,6] for treatment of a proximal hip fracture [7–9].

Perioperative antibiotic prophylaxis is a key measure to prevent surgical site infections, and inappropriate antibiotic prophylaxis has been associated with acute postoperative infections [8,10,11]. Theoretically, antibiotic prophylaxis should prevent colonization of bacteria in the skin or the surgical site (area involved in the surgery). Classically, the recommended standard perioperative antibiotic prophylaxis has been cefazolin [12]. This first-generation cephalosporin has a long half-life in bone and serum and exhibits excellent activity against Gram-positive microorganisms excluding methicillin-resistant *Staphylococcus aureus* (MRSA) and some activity against Gram-negative bacilli (GNB). However, the standard antibiotic prophylaxis is not recommended for some subgroups of patients, such as the chronic institutionalized patients (CIPs), due to changes in the normal skin flora [3,11,13–15].

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Some authors have reported a prevalence of MRSA colonization of 17% in CIPs in Spain [16,17]. MRSA colonization is a risk factor for PJI after HHA, representing around 50% of hip PJI in some series [10,18,19]. Therefore, in 2011, after attending CIPs with PJI caused by MRSA, the preoperative antibiotic prophylaxis with cefazolin was changed to cotrimoxazole in all CIPs diagnosed with proximal hip fractures at our centre. Since then, we have detected an increased number of early postoperative infections caused by GNB, maybe not covered by the proposed prophylaxis. This problem has been previously reported in some patients undergoing lumbar spine surgery such that the North American Spine Society evidence-based guidelines on antibiotic prophylaxis in spinal surgery have indicated potential subgroups of patients who require tailored prophylaxis against GNB [20]. To our knowledge, this problem has not been specifically addressed in patients with a proximal femur fracture who are undergoing HHA.

We therefore sought to compare HHA infection characteristics between noninstitutionalized patients (NIPs) and CIPs with proximal hip fractures with respect to acute infection rate, infection predisposing factors, and antibiotic prophylaxis-related microbiological characteristics.

We hypothesized that the fact of being a CIP is a risk factor for acute infection and that a higher rate of infection in this subgroup of patients will be determined.

Material and methods

Study design and population

We performed a retrospective review of our prospective institutional database to identify all patients consecutively admitted for HHA to treat proximal femur fracture at our centre from January 1, 2011 to December 31, 2013. The hemiarthroplasty implants were either unipolar non-cemented (Austin-Moore) or bipolar head cemented. We excluded patients with extracapsular hip fractures as well as those with intracapsular hip fractures treated with hip screws or THA, as these are indicated in more functional patients and with fewer comorbidities. Patients without tracking data until 3 months after surgery were also excluded from our study.

This study was approved by the Ethics Committee of Vall d'Hebron Research Institute (VHIR).

The following data were recorded: demographics, habitual residence (home or healthcare centre), comorbidities (Charlson index, diabetes, chronic renal disease (glomerular filtrate rate $<$50 mL/min), liver disease, and rheumatoid arthritis), urinary incontinence defined as involuntary urinary leakage, obesity (body mass index $>$30 kg/m^2) and chronic steroid treatment (cumulative dose $>$15 mg of prednisone/day), immunosuppressant agents, and antithrombotic and anticoagulant therapy. Preoperative clinical data: date of admission, all infections during hospital stay (urinary tract infection, catheter-associated infection, pneumonia, abdominal infection, or another type of infection with/without bloodstream infection). Intraoperative data (antibiotic prophylaxis, duration of surgery, The American Society of Anesthesiologists (ASA) scale, type of prosthesis, transfusions intraoperative or immediately after surgery) and postoperative events were also included. We recorded the date of diagnosis of PJI, type of sample used for diagnosis, microbiological isolation, and susceptibility pattern of the microorganism.

Antibiotic prophylaxis protocol included administration of 2 g of cefazolin during anaesthesia induction followed by two further doses of 1 g each 8 h in non-beta-lactam allergic patients. Allergic patients were administered a single dose of 600 mg of clindamycin along with 240 mg of gentamicin. CIPs were administered 800/160 mg of cotrimoxazole during anaesthesia induction followed by another dose at 12 h.

Definitions

(a) CIPs were defined as people whose habitual residence was a health-care centre.
(b) We used the Zimmerli's criteria [21] for defining acute postoperative PJI cutoff: the onset of infection occurs in the first 3 months following the index procedure.
(c) According to the Infectious Disease Society of America (IDSA) criteria, patients were finally diagnosed with a PJI if they had at least two positive valuable cultures yielding the same microorganism with the same antimicrobial susceptibility or if pus was intraoperatively identified [22]; we consider that other IDSA infection criteria, for example, the presence of chronic sinus or a positive intraoperative histologic evaluation are not valid in acute conditions.

Outcome

A minimum of 3-month follow-up after surgery was required. The main outcome was the occurrence of PJI in the first 3 months after the index procedure. Patients who died during the follow-up period due to PJI were excluded from our cohort for incomplete follow-up.

Microbiological methods

Samples were transferred to the microbiology laboratory in dry, sterile, plastic containers. They were inoculated into conventional media for aerobic and anaerobic bacterial growth (blood agar plate enriched with 5% of sterile bovine blood and thioglycolate broth). Blood agar cultures were incubated at 37 °C in a 5% CO_2 atmosphere, with daily readings of the plates. Thioglycolate broth cultures were incubated at 37 °C in an aerobic atmosphere. If any growth was suspected in an anaerobic liquid culture, it was subcultivated on Schaedler medium (Schaedler agar with 5% sheep blood), with and without antibiotics, and incubated in an anaerobic atmosphere. Cultures were deemed negative if no growth was visible at 10 days. Microorganisms isolated were identified by conventional biochemical and metabolic tests or using an automatic system (Vitek or API System from bioMérieux Inc., Marcy-l'Etoile, France). Antimicrobial susceptibility was assessed by disk diffusion susceptibility test (Neo-Sensitabs™, ROSCO Diagnostica A/S, Denmark), E-test (bioMérieux Inc.), or microdilution technique (MicroScan WalkAway System from Siemens Healthcare Diagnostics, Germany). Susceptibility testing was performed and results were interpreted according to the Clinical and Laboratory Standards Institute (CLSI) recommendations.

Statistical analysis

Categorical variables were reported as numbers and percentages and quantitative variables as a median and interquartile range (IQR) or a mean and standard deviation (SD), as appropriate. Comparative analyses were performed with X^2 or Fisher's test for categorical variables, when appropriate, and with Student's *t*-test or Mann–Whitney *U*-test for continuous variables. All statistical tests were two tailed and the significance value was $p < 0.05$. Predictors of acute HHA infection were determined by logistic regression analysis. Odds ratios and 95% confidence intervals (CIs) were used to quantify the strength of these associations. Statistical analysis was performed using Stata version 12.0 (StataCorp, TX, USA).

Results

The study included 381 HHAs performed in 381 patients with proximal femur fracture. Overall, we considered 234 (61.4%)