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Original article

Infections after shoulder arthroplasty are correlated with higher anesthetic risk score: a case-control study in Brazil

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ABSTRACT

Purposes: Shoulder arthroplasty (SA) has been performed by many years for the treatment of several conditions, including osteoarthritis and proximal humeral fractures following trauma. Surgical site infection (SSI) following SA remains a challenge, contributing to increased morbidity and costs. Identification of risk factors may help implementing adequate strategies to prevent infection. We aimed to identify pre- and intra-operative risk factors associated with deep infections after SA.

Methods: An unmatched case-control study was conducted to describe the prevalence, clinical and microbiological findings, and to evaluate patient and surgical risk factors for prosthetic shoulder infection (PSI), among 158 patients who underwent SA due to any reason, at a tertiary public university institution. Risk factors for PSI was assessed by uni- and multivariate analyses using multiple logistic regression.

Results: 168 SA from 158 patients were analyzed, with an overall infection rate of 9.5% (16/168 cases). Subjects undergoing SA with American Society of Anesthesiologists (ASA) grade III or higher (odds ratio [OR] = 5.30, 95% confidence interval [CI] = 1.58–17.79, $p < 0.013$) and presenting local hematoma after surgery (odds ratio [OR] = 7.10, 95% confidence interval [CI] = 1.09–46.09, $p = 0.04$) had higher risk for PSI on univariate analysis. However, only ASA score grade III or higher remained significant on multivariate analysis (OR = 4.74, 95% CI = 1.33–16.92, $p = 0.016$). Gram-positive cocci and Gram-negative bacilli were equally isolated in 50% of cases; however, the most commonly detected bacterium was *Pseudomonas aeruginosa* (18.7%).

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Conclusion: This study provides evidence suggesting that patient-related known factors such as higher ASA score predisposes to shoulder arthroplasty-associated infection. Furthermore, unusual pathogens associated with PSI were identified.

Introduction

Hemiarthroplasty (HA) and total shoulder arthroplasty (TSA) have been increasingly performed for the treatment of several osteoarticular conditions such as osteoarthritis, humeral head avascular necrosis and proximal humeral fractures following traumas.[1,2] Indeed, the annual number of HA and TSA performed in the United States is growing faster, reaching more than 50,000 shoulder replacements per year.[3] The incidence of periprosthetic shoulder infections (PSI) appears to be less than that of periprosthetic hip (THA) and knee (TKA) infections, though there have been reports of higher rates in the surgery literature.[4,5] Periprosthetic shoulder infections, nonetheless, remain challenging as they increase morbidity as well as raise costs.[6] The rate of infectious complication following primary shoulder arthroplasties appears to be as lower as the rates associated with primary hip and knees arthroplasties, while few single-center studies have demonstrated higher rates of PSI.[1,4–6]

There have been few previous studies analyzing risk factors for PSI.[7–9] Patient related-factors and comorbidities such as male gender, younger age, diabetes, morbid obesity, rheumatoid arthritis, and other types of immunosuppression including tumors, have already been implicated.[7,10] Surgical-related factors such as peri-operative hematomas and prior surgeries, especially in the trauma setting, increase the incidence of infection after primary shoulder arthroplasty.[1,7,11]

In addition, the role of biofilm-forming bacteria, such as *Propionibacterium acnes*, but also *Staphylococcus*, and *Streptococcus* in the pathogenesis of orthopedic implant-associated infections, particularly PSI has been widely accepted.[12–16] Although uncommonly implicated in PSI, *Pseudomonas* is an aerobic Gram-negative bacillus expressing the ability to form complex biofilm structures on the surfaces of orthopedic implants.[17,18] In one large study addressing Gram-negative prosthetic joint infections, *Pseudomonas aeruginosa* was by far the most frequently (40%) isolated pathogen.[19]

We herein sought to identify pre- and intra-operative risk factors predisposing subjects to develop deep infections following HA and TSA, and evaluate causative microorganisms associated with PSI.

Methods

Study population

We performed a single-center case-control study with 183 subjects submitted to either HA or TSA that were performed at the Department of Orthopedics and Traumatology of a large urban public teaching hospital, between January 1987 and November 2012. The study included subjects with at least 24 months of follow-up after the surgical implantation of shoulder arthroplasty. Exclusion criteria were age less than 18 years, follow up of less than 24 months, arthroplasties performed for malignant etiologies, prior radiation of the operative site, and patients whose medical records were unavailable. The study was reviewed and approved by the local Institutional Review Board.

Diagnosis of periprosthetic shoulder infection (PSI)

PSI was diagnosed according to IDSA guidelines by the presence of a sinus tract communicating with the prosthesis, histopathological analyses with the presence of inflammatory cells, visible purulence surrounding the prosthesis, and/or identical microorganisms isolated from two or more cultures. PSI was categorized as early when diagnosed before three months after surgery; intermediate when diagnosed between three and 24 months after surgery; and late infection when diagnosed after two years of prosthesis implantation.[20] Subjects who fulfilled the diagnostic criteria for PSI were considered cases for this study. Relapses at the same joint prosthesis were not considered for analysis. Controls were subjects who had undergone shoulder arthroplasty due to any indication except joint infection and did not develop PSI during follow-up.

Potential risk factors

To identify potential risk factors associated with PSI, several variables (patient, microbiological findings, and surgery associated variables) were assessed by reviewing medical, intra-operative, and microbiological records. We searched for demographic variables, comorbidities, American Society of Anesthesiologists (ASA) classification, preoperative diagnosis,

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