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Research Article

Prevalence of Nasal Carrying of *Staphylococcus aureus* in Patients Undergoing Total Hip Arthroplasty

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Abstract

Introduction: Prosthetic joint infection (PJI) is one of the most dramatic complications in total hip arthroplasty (THA). Among risk factors, nasal colonization with *Staphylococcus Aureus* (SA) has been described, showing an increasing prevalence of Methicillin-resistant *Staphylococcus aureus* (MRSA) The aim of this study is to determine the prevalence of *S. Aureus*, MRSA nasal colonization before THA and to learn the relation to Charlson comorbidity index (CCI).

Methods: From a sample of patients from the community with osteoarthritis, we selected patients undergoing THA who met inclusion and exclusion criteria and were screened for nasal colonization of SA and antibiotic resistance, prior to surgery. A decolonization protocol with topic mupirocin and soapy chlorhexidine bathing was used in nasal carriers of SA. A new culture was performed two weeks after the treatment was completed. Finally, CCI was calculated.

Results: 106 patients met the inclusion and exclusion criteria. 24.5% (26) of patients were positive to nasal colonization to SA, 1.8% of them were positive to MRSA and all completed treatment. No positive cultures were obtained in the two-week follow-up, no statistically significant difference in the CCI between both groups was revealed and no PJI was reported at 6-month follow-up.

Discussion: In this study, the prevalence of nasal colonization *S. Aureus* and MRSA, was within the range reported in international literature. We suggest a universal detection of nasal carriage of SA in patients who will be undergoing a THA.

Keywords: *Staphylococcus aureus*; Arthroplasty; Infection; MRSA

Abbreviations

PJI: Prosthetic joint infection; THA: Total hip arthroplasty; SA: Staphylococcus Aureus; MRSA: Methicillin-resistant Staphylococcus aureus; CCI: Charlson comorbidity index; THA: Total hip arthroplasty; SSI: Surgical site infection; MSSA: Methicillin-Susceptible Staphylococcus Aureus

Introduction

Total hip arthroplasty (THA) is a frequent surgery and is increasing constantly [1]. It exhibits successful outcomes in pain relieving and improving functional status in patients with osteoarthritis [2].

Prosthetic joint infection (PJI) is one of the most dramatic complications due to the severity and complexity of treatment, with an estimated incidence for primary arthroplasties up to 2% and a high cost for the health system [3]. Multiple risk factors have been described regarding PJI as well as numerous measures to decrease those risks, such as an adequate metabolic control in diabetic patients, an early detection and treatment of urinary tract infections, preoperative antibiotic prophylaxis, among others [4]. One of these risk factors is Staphylococcus aureus (SA) nasal colonization, which increases the risk of PJI related to this pathogen [5]. Since PJI is caused by SA in up to 48% of the cases, preoperative SA detection and decolonization is crucial to diminish PJI risks [6]. This relation has been previously demonstrated in patients with PJI caused by SA who were SA nasal carriers, which have revealed 85% of identical bacterial genotypes between the surgical site infection (SSI) and the nasal strain. Moreover, it has been described that SA nasal carriers have a 5.8 higher risk of developing a SSI [7]. The incidence of SA nasal carrying exhibits different values in the literature, fluctuating between 20.2% and 36.5% in patients undergoing total hip or knee replacement [8].

Numerous risk factors for SA colonization have been described in the literature, such as diabetes, renal failure and immunosuppression among others [9]. An increasing complication is methicillin resistance (MRSA), up to 4.6%, which has been described in several series [10]. In Chile, the incidence and sensitivity of SA nasal carrying in patients who will undergo THA has not been reported.

The aim of this study is to determine the preoperative prevalence of SA and MRSA nasal carriers, and determine the role of the Charlson Comorbidity Index (CCI) as a predictor of carrying and, on the other hand, assess the outcomes of patients with positive SA or MRSA cultures after antibiotic treatment.

Materials and Methods

Observational, prospective, and transversal cohort study. Out of the patients with THA indication, those who met the inclusion criterion were selected. The inclusion criterion was patient with indication of primary THA between January 2018 and June 2019 from the community. The exclusion criteria were pathologic bone and revision hip arthroplasties, reinterventions, and THA performed due to a femoral neck fracture.

Nasal swabs and cultures for SA detection were performed to those in the selected group, after health care providers were trained in the correct technique. A nasal swab for at least 5 seconds, with a different swab in each nostril was taken at least 14 days prior to the surgery and sent to the hospital laboratory for a 48-hour blood agar and DNAsa for SA culture. To determine resistance, agar Mueller Hinton plates with cefoxitin, oxacillin and cefazoline discs were used. In MRSA cases, preoperative antibiotic prophylaxis was done with vancomycin.

In patients with a positive SA test, a topic 2% mupirocin decolonization protocol was prescribed (one application in each nostril every 12 hours) and bathing with chlorhexidine soap once a day, both treatments for ten days. Two weeks after antibiotics, a new culture was performed following the described technique.

Epidemiologic data were obtained from the hospital clinical records. Each patient's chronic diseases were registered and CCI was calculated. Then, the results of CCI were separated into two groups: SA carriers and not carriers. An Excel® (Microsoft®) database was created. Mann-Whitney U test was used to calculate statistical significance.

Prior to inclusion, the characteristics of the study were explained to each patient, and they signed an informed consent form. Hospital ethics committee approval was obtained.

Results

106 patients met the inclusion criteria, 58 were female (55%) and 48 male (45%), with an average age of 67.4 years (20-85 years).

24.5% (26 cases) obtained a SA positive culture, of which 1.8% (2 cases) were MRSA and 22.6% (24 patients) were Methicillin-Susceptible Staphylococcus Aureus (MSSA). The rest of the patients (80 cases) exhibited a negative initial culture.

26 SA positive patients completed the previously described decolonization mupirocin treatment. After that, 11 patients were tested preoperatively with a nasal swab and the results were all negative. The other 15 patients who had a SA positive culture did not attend the appointment for a post treatment culture.

Regarding comorbidities, 31.3% (33 patients) did not have any pathologies. The rest possessed at least one chronic comorbidity,

being the most frequent arterial hypertension (53.7%, 57 patients) and type 2 diabetes (17.9%, 19 patients). CCI was calculated for each patient, exhibiting a general mean of 2.86 points, 3 points in the group of positive culture and 2.8 in the negative culture group. The Mann-Whitney U test revealed no statistical significance between both groups ($p = 0.532$).

Urine culture was assessed in every patient, being positive only 5.6% (6 cases) which were prescribed with oral antibiotics and after that, a post-treatment urine culture was performed (all negative). Preoperative glycated hemoglobin A1c in diabetic patients was 6.7% (5.5-9.1%).

Every patient in this research underwent THA and none reported SSI or PJI during a 6-month follow-up.

Discussion

The results obtained in this MSSA and MRSA nasal carrying research stayed within the range previously reported in the international literature for total hip or knee arthroplasty. Weiser., *et al*. reported a SA nasal colonization between 20.2 to 36.5% and MRSA colonization between 0.6 and 2.6% [8]. Chen., *et al*. [10], in a study of 106 patients, reported a MRSA prevalence of 4.6%.

The relation between the results in this research and those outcomes in studies of nasal carrying in the same country between pediatrics population in patients with other pathologies is variable. Dossi., *et al*. [11]. performed a nasal carrying research in 80 pediatric patients with oncologic pathologies, revealing a SA carrying of 21.2%, which is slightly lower than the results of the present publication. In another investigation, a case control study of children with anterior epistaxis, Sedano., *et al.* [12] demonstrated a SA nasal carrying of 39% within the cases and 37% within the control group, with no statistical difference between both groups, being that prevalence greater than which was exhibited in this work.

On the other hand, when CCI was analyzed between SA nasal carriers with or without comorbidities, no significant difference was found. Numerous risk factors for SA nasal carrying have been described, however, no study has revealed statistical significance between a comorbidity index and the risk of nasal carrying [10].

Regarding the results of SA post treatment cultures, the findings of this research were better than previous reports. Moroski., *et al.* detected the presence of SA in 5.6% of the post-treatment cultures [13].

To assess cost efficiency of searching and treating SA carriers, the authors believe that the lower expense of these interventions must be emphasized, especially when compared with the total cost of PJI management, as well as the decrease of infection rate with SA decolonization. SA nasal carrying screening is simple and low-priced. The total cost of this test in the hospital where this research was performed was US$ 3.1 and the treatment for SA carriers was US$ 11.1. Jeans., *et al*. [5]. (United Kingdom) reported a cost of 21,937 pounds for each patient with PJI and a decrease of the infection rate from 1.92% to 1.41% ($p < 0.05$) on average for all patients who would have a THA, after the universal screening of SA nasal carrying. Based on the United States hospital admission records, Kurtz., *et al.* [3] reported a cost of treatment of US$ 30,300 for every patient with a PJI. Spoerer., *et al*. [14] recruited 9,690 nasal swabs for detection of SA carrying and compared SSI before and after the implementation of this measure, revealing a decrease from 1.11 to 0.34%. Therefore, taking into consideration the low cost of the screening test, the reduction of at least 0.5% of the infection risk described in the literature and the large expense of each patient with a PJI, the authors of this study strongly suggest the use of the SA nasal carrying screening test before a THA. Despite these arguments, there is a lack of cost efficiency studies to justify this measure with stronger support.

Conclusion

The present study exhibits two valuable strengths, such as being the first study of SA nasal carrying in patients undergoing THA in Chile and the first one which relates a comorbidity index with the risk of SA nasal carrying.

The authors are aware this research has at least two evident drawbacks. First, the low number of patients who met the inclusion criteria limited to establishing a correlation between the infection rate in this group and the historical infection rate of the hospital without the intervention, to determine the effectiveness of this measure in diminishing the risk of infection. Second, the lost in follow-up of patients who did not attend the appointment for post-treatment nasal swab and they were still operated without this result, which was done in only 42% of the cases.

Conflict of Interest

None of the authors have conflicts of interest.

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