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Analysis of The Elements Related to The Appearance of Joint Prosthesis Infections in A Hospital Center in Quito, Ecuador

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Abstract

***Aim**: The prosthetic joint replacement procedure is a significant advance in medicine, improving functionality and quality of life in patients with arthropathies. Although it offers many benefits, it is exposed to complications, periprosthetic infection being one of the most worrisome. This infection affects the patient's quality of life; therefore, it is crucial to identify the risk factors associated with this complication. **Material and method**: The objective of this study is to determine the factors linked to the development of this infection in patients undergoing prosthetic joint replacement. A descriptive and retrospective approach was used, analyzed with descriptive statistics, frequency, percentage and chi square, using the SPSS system ver 2.0. Patients operated on in a prestigious Specialty Hospital in the city of Quito, Ecuador, from January 2010 to December 2015 were analyzed. The study included 478 patients, 62.6% being women, with a mean age of 70.3 years. **Statistics and Result:** Hip arthroplasty was the most frequent intervention (59.2%). The overall incidence of periprosthetic infection was 3.8% (n=18). During the analysis, urinary tract infection and smoking were identified as being associated with periprosthetic infection. The NNIS index showed that patients with moderate-high risk are 7.47 times more likely to develop infections.*

Keywords Complication, Prosthetic, Joint, Infection, Quality of Life, Arthropathies

1. Introduction

The advancement of surgical practice has undoubtedly brought immense improvement in our quality of life. For an aging population, arthroplasty or internal joint prosthesis is the treatment of choice in degenerative and inflammatory arthropathies (Baeza et al., 2015); it improves quality of life, provides symptom relief, with recovery of joint function, mobility and independence for patients with a variety of musculoskeletal disorders (Osmon et al., 2013).

Joint prosthesis infection or periprosthetic infection (IPA) is one of the main complications of arthroplasties, but considered the most serious, most feared and catastrophic, which can cause severe physical damage in patients, and generate high economic costs. In general, infection rates are reported during the first 2 years of the postoperative period, in primary hip replacement arthroplasty (PTC) with 1.5%; in total knee prosthesis (PTR) 2.5%; and in revision arthroplasty it is reported up to double. Periprosthetic infection has a relatively low mortality rate of between 2% and 7% in patients over 80 years of age (Sanchez et al., 2020); However, it represents a great morbidity for the patient, impact on the health system, with an additional cost estimated at more than 50,000 dollars for each infected arthroplasty (Sanchez et al., 2020; Bassetti et al., 2019).

Revision procedures due to periprosthetic infection are associated with longer operative time, greater blood loss, greater number of complications, and increased healthcare costs. Successful treatment of IPA is often difficult and often involves multiple surgical interventions, in addition to a prolonged course of antibiotics (Osmon et al., 2013; Bassetti et al., 2019).

Prevention is the most important strategy for dealing with this disabling complication, and should begin with identifying patient-related risk factors such as morbid obesity, malnutrition, hyperglycemia, uncontrolled diabetes mellitus, rheumatoid arthritis, chronic renal failure, smoking, alcohol abuse and other clinical factors that should be evaluated and optimized prior to surgery (Eka & Chen, 2015). Understanding the risk factors of IPA allows the application of strategies that aim to reverse some of these potential risk factors and reduce the burden of infection.

It is for all this that it is necessary to create preventive programs that face this health problem, with studies in each locality that determine the factors that are associated with the development of IPA. Despite the significant progress that has been made in recent decades to identify these risk factors, some uncertainty remains (Ayala et al., 2021).

2. Materials And Methods

The present study represents an analytical, observational and cross-sectional approach that aims to comprehensively analyze and examine the demographic, clinical and microbiological characteristics of patients who have been affected by joint prosthesis infections.

The study population included all patients who underwent prosthetic joint replacement at the Armed Forces Specialty Hospital No. 1 during a period between 2010 and 2015. Inclusion and exclusion criteria were rigorously followed to ensure the integrity and representativeness of the data collected.

To carry out the analysis, a methodology based on descriptive statistics was used, using frequency tables and percentages to present the results in a clear and concise manner. In addition, chi-square analysis was applied in order to identify possible associations between the variables studied.

To ensure the reliability and accuracy of the results, all collected data were entered into the SPSS version 20 system, a widely recognized tool in the scientific community for statistical data analysis.

The analytical and observational approach of this study will deepen the understanding of the factors involved in joint prosthesis infections and will provide a more complete view of the incidence and characteristics of this complication in the population studied. The findings obtained from this analysis may contribute significantly to the development of preventive strategies and improve the clinical management of patients affected by this medical problem.

Importantly, due to the cross-sectional nature of the study, the results obtained will be a representative snapshot of the period analyzed, which will allow a valuable comparison with future research to assess possible changes and trends over time. Consequently, this study has the potential to provide substantial and relevant knowledge for the medical and scientific community, thus improving the care and quality of life of patients with joint prosthesis infection.

3. Results and Discussion

For this study, a rigorous analysis of 478 patients who underwent prosthetic joint replacement was performed, of which 62.6% (n=299) were women. Analysis of the average age showed that the patients had an average age of 70.34±13.63 years, with a fairly wide age range, ranging from 20 to 102 years. When evaluated by gender, it was found that women had an average age of 72.2±12.37 years, while in men the average was 67.22±15.04 years, this difference being statistically significant with a value of $p<0.01$.

Regarding the incidence of prosthetic infection, a total of 3.8% (n=18) of patients with infection were registered. The analysis of the average age of the affected patients revealed a value of 71.22±19.44 years, being notorious that 66.7% (n = 12) of the cases corresponded to women. This suggests that women might have a higher risk of infection compared to men.

Regarding the nature of the germs involved in prosthetic infections, it was found that Gram-negative were the most frequent, representing 40% of cases (n=9). Next, Gram-positive people ranked second

with 22.2% (n=4) of infections. It is relevant to mention that E. coli bacteria was the most recurrent among the identified Gram-negative germs. It is important to note that in 2 cases of infection, specific germs could not be identified. In addition, a considerable number of infections (n=15) were found to be caused by resistant germs, indicating the relevance of antimicrobial resistance as a factor to be considered in the prevention and treatment of these infections.

These results provide valuable information on the incidence and characteristics of prosthetic infections in patients undergoing prosthetic joint replacement in this hospital. The identification of the risk factors associated with these infections, as well as the prevalence of the germs involved, will be fundamental for the development of more effective preventive and therapeutic strategies. The knowledge gained from this study will contribute to improving medical care, quality of life and clinical outcomes of patients undergoing prosthetic joint replacement, thus strengthening medical practice in this field.

Variables Associated with Joint Prosthetic Infection: When comparing age, gender, surgical time and body mass index between infected and non-infected patients, no significant differences were found, see Table 1.

Table 1: **Relationship of Age, Surgical Time and Body Mass Index with the development of periprosthetic infection**

n=478	Infection Prosthesis	No Infection	Statistical Test t-student
Age	71.22±19.44	70.30±13.38	p=0.77
Surgical Time	151.89±74.68	126.72±46.20	p=0.17
BMI1	27.35±5.62	04.28±0.4	p=0.6

BMI: Body mass index 1

Source: Statistical data of the study. Prepared by: Authors, 2017

Clinical variables and presence of prosthetic infection: When comparing the clinical history and the presence of prosthetic infection, it was found that smoking and the presence of urinary tract infection (UTI) are associated with periprosthetic infection, see Table 2.

Table 2: **Clinical variables and their relationship with periprosthetic infection**

n=478	No Infection	Infection Prosthesis	Statistical Test Chi-square
Smoking	N=47	N=5	p=0.01
Alcoholism	N=15	N=1	
Diabetes	N=52	N=4	p=0.15
IRC	N=16	N=1	
Liver	N=4	N=0	
Preliminary procedure	N=87	N=5	p=0.35
Rheumatoid arthritis	N=29	N=2	p=0.41
Cancer	N=21	N=2	p=0.20
Immunosuppression	N=22	N=2	p=0.22
IVU	N=24	N=5	p=0.001
Intravenous Drugs	N=0	N=1	

Source: Statistical data from the study, 2017

Variables related to surgery and presence of prosthetic infection

When comparing the type of Arthroplasty (Total, Partial or Revision) and the presence of prosthetic joint infection, no statistically significant differences were found X^2 (2, 1.48) p = 0.47, proportionally the presence of infection is the same according to the type of arthroplasty performed.

11.3% (n=54) of the surgeries were performed in patients with surgical risk ASA greater than II. When comparing the presence of infection with the ASA value divided into two groups (ASA I and II versus ASA III, IV, V) a statistically significant difference was found, X^2 (1, 9.06) p=0.003; proportionally patients with ASA III or more, have a greater presence of IPA with an OR 4.29 (95% CI 1.54-11.95), see Graph 1**.**

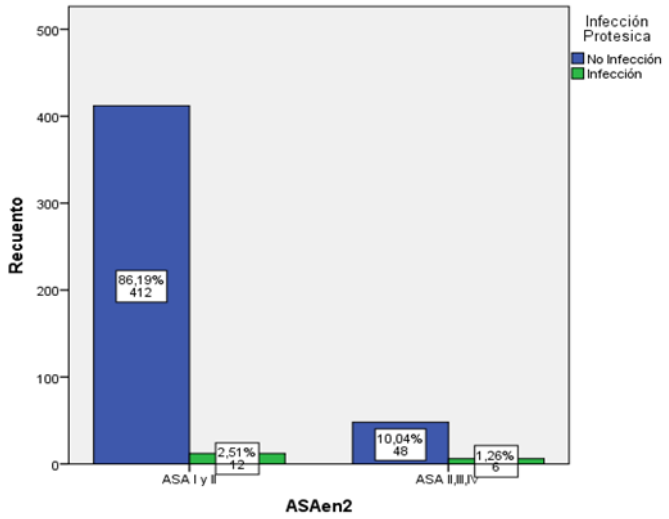

Figure 1. Comparison between two surgical risk groups ASA and presence of periprosthetic infection
Source: Statistical data from the study, 2017

Surgical Time and Periprosthetic Infection: The 75th percentile of surgical time in the Military Hospital was 150 minutes, and 26.78% (n=128) of surgeries had a time greater than or equal to this value. When comparing the presence of infection with surgical time divided into two groups (greater or less than the 75th percentile) no statistically significant difference was found, X^2 (1, 1.39) p=0.23.

Contaminated Surgery and Periprosthetic Infection: 2.7% (n=13) of surgical interventions were considered as Contaminated and Dirty Surgeries. When comparing the presence of infection with the Type of surgery divided into two groups (Clean and Clean contaminated versus Contaminated and Dirty) a statistically significant difference was found, X^2 (1, 9.06) p = 0.003; proportionally Contaminated and Dirty surgery patients have a greater presence of infections, with an OR 5.1 (95% CI 1.04-24.95). see Figure 2.

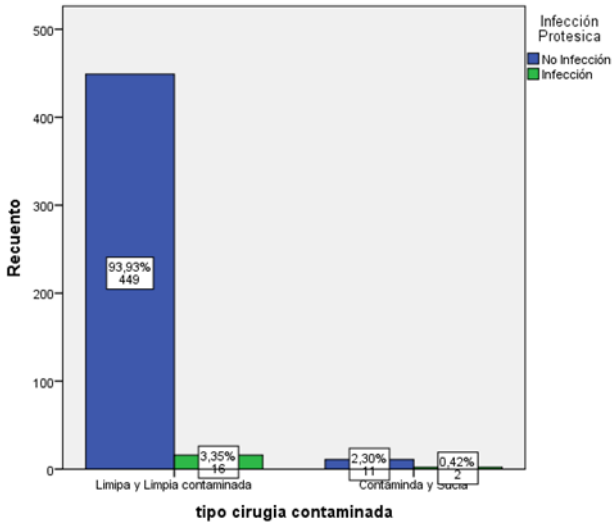

Figure 2. Type of surgical wound divided into 2 comparable groups and its relationship with the development of periprosthetic infection
Source: Statistical data from the study, 2017

National Nosocomial Infections Surveillance Index (NNIS), is a risk index in the prediction of Surgical Site Infection: When calculated, it was found that 62.6% (n=299) of the interventions had a Low risk and only 3.1% (n=15) presented a Medium-High risk, no surgeries with High risk were found. However, when comparing the presence of infection with the value of the NNIS index, a statistically significant difference was found, X^2 (2, 14.80) p=0.001; proportionally, patients with medium-high risk of NNIS, have a higher presence of infections than those of medium and low risk.

The risk of having prosthetic infection with an Intermediate-High NNIS is 7.47 (95% CI 1.91-29.26), see Figure 3.

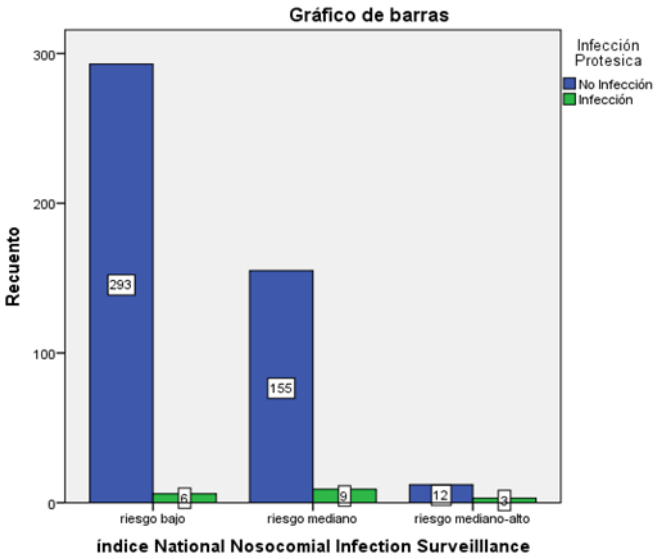

Figure 3. Risk of joint prosthetic infection according to the NNIS index.
Source: Statistical data from the Study

Prepared by: Authors, 2017.

In recent decades, prosthetic joint replacement has been an important improvement in the functional capacity of patients with arthropathies. More than one million arthroplasties are performed each year in the world; However, it is not an intervention without complications, of which one of the most feared is infection. Its presence implies a significant decrease in the quality of life of patients and a high economic cost, therefore, its prevention must be a priority; Knowing in advance the risk factors that can cause infection can help prevent it.

Taking into account the widely fluctuating nature of the epidemiology of these infections around the world, and considering the Armed Forces Specialty Hospital No. 1 as a reference institution at the national level, the study was carried out with the purpose of identifying the factors associated with the development of prosthetic joint infection at the local level.

Joint prosthetic infection occurred in 3.8% of all arthroplasties, somewhat more frequent than that described in the literature (Sanchez et al., 2020; Bassetti et al., 2019; Ortiz et al., 2021**),** in international studies (Sanches et al., 2013) and in a local study (Tande & Patel, 2014), but similar to other publications (Jasenko et al., 2016), which could be explained by involving revision arthroplasties within the analysis, which even present twice the PI compared to a primary prosthesis. In addition, patients with PI have an average age of 71.22 years, they occur somewhat more frequently in women.

When comparing the demographic variables between patients with and without joint prosthetic infection, it was found that age is not associated with periprosthetic infection as described (INFECTION, 2010) although some authors indicate advanced age (>75 years) as a protective factor (Iannotti et al., 2020; Del et al., 2021) likewise, no association was found with the male gender.

which is a factor reported by some studies (Baek, 2014) but not verified by others (Ortiz, et al., 2021), the biological cause of this association is not known with certainty (Ayala et al., 2021 and can be equated in both genders at ten years of follow-up (Kunutsor et al., 2016).

Several investigators indicate the association of obesity (Eka & Chen, 2015; Baek, 2014; Parviszi, 2013) and malnutrition (INFECTION et al., 2010; Del et al., 2021) with the development of IPA, which was not determined in this analysis. This could be because malnutrition is not only defined by body mass index (BMI<18.5), as it consists of several nutritional parameters (Baek, 2014) not taken into account in the study.

Within the clinical history, the history of smoking and UTI (days before surgery and during hospitalization) were significantly related to the development of IPA. The first is a known factor associated with increased postoperative morbidity and mortality (Eka & Chen, 2015; Baek, 2014) and delaying wound healing through nicotine-mediated vasoconstriction contributes to the development of this infection (INFECTION et al., 2010; Del et al., 2021; Kunutsor et al., 2016; Parvizi, 2013). Urinary tract infections, such as cystitis with pyuria, are extra-articular sources of infection associated with the development of infection at the surgical site and resulting in IPA (Ayala et al., 2021; Iannotti et al., 2020), but no clinical studies have been conducted that directly compare this association with periprosthetic infection.

In the present study, no association of diabetes mellitus with the development of IPA, as described in the literature (Lübbeke et al., 2016; Parvizi, 2013), was found, but not all studies indicate a clear risk relationship. The International Consensus on Periprosthetic Infection at the 2014 meeting (Baek, 2014) establishes poorly controlled diabetes (glucose> 200 mg/L or HbA1C>7%) as a risk factor for the presence of surgical site infection and IPA; which would justify the result because most of the patients in this study had adequate metabolic control.

The consumption of alcohol, intravenous drugs, history of rheumatoid arthritis, CRF, liver disease, cancer, immunosuppression and previous surgery did not present a significant association with IPA, which is comparable with previous reports that its relationship with the development of infection is controversial (Kunutsor et al., 2016; Baek, 2014).

The NNIS score is a risk scoring system that attempts to aggregate a series of factors or variables on a single scale, which includes the preoperative assessment offered by the American Society of Anesthesiology (ASA), the type of surgical wound and the surgical time. Regarding ASA, it was divided into two groups (ASA I and II versus ASA III, IV, V), where a statistically significant difference was found, providing patients with ASA III or more with an OR 4.29 (95% CI 1.54-11.95); also demonstrated by a systematic review and meta-analysis (Ianotti et al., 2020).

Regarding the classification of the surgical wound, in the same way, two groups were compared (clean wound and clean contaminated versus contaminated and dirty) giving patients with Contaminated and Dirty surgery, greater risk of presenting IPA with an OR of 5.1 (95% CI 1.04-24.95); with a significant association (p<0.001).

And finally, when comparing the presence of infection with the value of NNIS, a statistically significant difference was found (p = 0.001); that is, patients with NNIS 2 or medium-high risk, have 7.47 (95% CI 1.91-29.26) times more risk of presenting joint periprosthetic infection than patients with medium and low risk; similarly in a large case-control study, the higher NNIS score (Eka & Chen, 2015) correlated with 5 times the likelihood of infection, a finding that persists after multivariate analysis (Ayala et al., 2021).

4. Conclusion

The research details a relevant series of patients who have undergone synthetic joint prostheses at the prestigious Armed Forces Specialty Hospital No. 1 over a period of 5 years. The main objective was to analyze demographic, clinical and surgical procedure-related factors, with special attention to the incidence of periprosthetic infection. It was found that periprosthetic infection affected 3.8% of arthroplasties, a rate that coincides with that reported in the medical literature. Those patients who developed infection had a high average age, with a mean of 71.22 years. In addition, a higher percentage of infection was observed in the female gender and a slight increase in body mass index,

indicating a slight tendency towards overweight in this group. Despite these findings, no statistically significant difference was identified when compared to uninfected patients.

Among the clinical factors analyzed, a significant association was found between smoking and urinary tract infection with the development of joint periprosthetic infection. Although other clinical conditions such as diabetes mellitus, neoplasms, rheumatoid arthritis, immunosuppression and history of surgery in the same joint were reported more frequently in patients with periprosthetic infection, it was not possible to establish a direct relationship with the development of the infection. On the other hand, it was determined that the factors related to surgery were not determinants in the appearance of prosthetic infections. Thus, the type of surgery, the type of arthroplasty, the surgical time and the operated joint showed no significant association with the development of infection.

In the search for a risk assessment system, the National Nosocomial Infection Surveillance System (NNIS) score was implemented, which showed that patients with a moderate-high risk were 7.47 times more likely to develop infections compared to patients with medium and low risk. It was concluded that the study has identified demographic and clinical factors that are associated with joint periprosthetic infection. Despite not finding a direct relationship between some factors and infection, the knowledge obtained is relevant for the prevention and adequate management of infections in patients undergoing prosthetic joint replacement. The implementation of the NNIS score represents a useful tool to assess the risk of infection in this population, which will contribute to improving the quality of care and clinical outcomes in this medical area.

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