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CORRELATION OF POSTOPERATIVE INFECTION WITH THE ETIOLOGY OF THE DISEASE IN SPINAL SURGERY WITH INSTRUMENTATION

CORRELAÇÃO DA INFECÇÃO PÓS OPERATÓRIA COM A ETIOLOGIA DA DOENÇA NA CIRURGIA DE COLUNA INSTRUMENTADA

CORRELACIÓN DE LA INFECCIÓN POSTOPERATORIA CON LA ETIOLOGÍA DE LA ENFERMEDAD EN CIRUGÍA ESPINAL INSTRUMENTADA

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ABSTRACT

Objective: To evaluate the epidemiological characteristics of postoperative infection in surgeries of the spine with instrumentation in our service, and whether there is a correlation between the rate of postoperative infection and the etiology of the indication for the primary surgical procedure. Methodology: A retrospective search through medical records of patients who underwent spinal surgery with instrumentation in our hospital between 2015 and 2019 was performed, and the ones that evolved with acute or chronic postoperative infection with need for surgical cleaning to resolve it were selected. Cases of non-instrumented surgery, primary infection of the spine (osteomyelitis and spondylodiscitis) and superficial infection of the surgical wound without the need for surgical cleaning were excluded. Results: The rate of postoperative infection was 11.6%. In this group of patients who evolved with this complication, most were submitted to surgery primarily for trauma (38.9%), followed by degenerative disease (30.8%), neoplasm (19.2%), and deformity (15, 4%). However, when we analyzed these patients comparing them with the total number of cases of spinal surgery with instrumentation performed in the period, we obtained a higher prevalence of infection in patients operated for deformity (17.6%), followed by degenerative disease (13%) , neoplasm (11.4%) and trauma (9.9%). This difference did not prove to be statistically significant (p = 0.79), nor the correlation with sex and age. Conclusion: In our study, proportionally, there was a difference in the prevalence of postoperative infection according to the etiological indication, being higher in cases operated for deformity, mainly due to neuromuscular disease. ***Level of evidence IV; A case series therapeutic study.***

Keywords: Spine; Postoperative Complications; Infection; Risk Factors.

RESUMO

Objetivo: Avaliar as características epidemiológicas da infecção pós-operatória nas cirurgias com instrumentação da coluna vertebral no nosso serviço, assim como se há correlação entre a taxa de infecção pós-operatória e a etiologia da indicação do procedimento cirúrgico primário. Metodologia: Foi realizada uma busca retrospectiva por meio dos prontuários de pacientes submetidos a cirurgia da coluna vertebral com instrumentação em nosso hospital entre 2015 e 2019, e que evoluíram com infecção pós-operatória aguda ou crônica com necessidade de limpeza cirúrgica para sua resolução. Foram excluídos os casos de cirurgias não instrumentadas, casos de infecção primária da coluna (osteomielite e espondilodiscite) e casos de infecção superficial da ferida operatória sem necessidade de limpeza cirúrgica. Resultados: A taxa de infeção pós-operatória foi de 11,6%. Deste grupo de pacientes que evoluíram com essa complicação a maioria foi submetida a cirurgia primariamente por trauma (38,9%), seguido de doença degenerativa (30,8%), indicação oncológica (19,2%), e deformidade (15,4%). Porém quando analisamos esses pacientes comparando-os com o total de casos de cirurgia na coluna vertebral com instrumentação realizadas no período, obtivemos uma prevalência maior de infecção em pacientes operados por deformidade (17,6%), seguido de doença degenerativa (13%), doença oncológica (11,4%) e trauma (9,9%). Essa diferença não mostrou ser estatisticamente significativa (p=0,79), assim como a correlação com sexo e idade. Conclusão: Em nosso estudo, proporcionalmente, houve diferença na prevalência de infecção pós-operatória de acordo com a indicação etiológica, sendo maior nos casos operados por deformidade, principalmente em decorrência de doença neuromuscular. ***Nível de evidência IV; Estudo terapêutico de série de casos.***

Descritores: *Coluna Vertebral; Complicações Pós-Operatórias; Infecção; Fatores de Risco.*

RESUMEN

Objetivo: evaluar las características epidemiológicas de la infección postoperatoria en cirugías de columna con instrumentación en nuestro servicio, así como si existe una correlación entre la tasa de infección postoperatoria y la etiología de la indicación para el procedimiento quirúrgico primario. Metodología: se realizó una búsqueda retrospectiva a través de los registros médicos de pacientes que se sometieron a cirugía de columna con instrumentación en nuestro hospital entre 2015 y 2019, y que evolucionaron con infección postoperatoria aguda o

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crónica con necesidad de una limpieza quirúrgica para resolverlo. Se excluyeron los casos de cirugía no instrumentada, infección primaria de la columna (osteomielitis y espondilodiscitis) y infección superficial de la herida quirúrgica sin necesidad de limpieza. Resultados: la tasa de infección postoperatoria fue del 11,6%. De este grupo de pacientes que evolucionaron con esta complicación, la mayoría fueron sometidos a cirugía principalmente por trauma (38.9%), seguidos de enfermedad degenerativa (30.8%), neoplasia (19.2%) y deformidad (15, 4%). Sin embargo, cuando analizamos a estos pacientes comparándolos con el número total de casos de cirugía de columna con instrumentación realizada en el período, obtuvimos una mayor prevalencia de infección en pacientes operados por deformidad (17,6%), seguido de enfermedad degenerativa (13%) , neoplasia (11.4%) y trauma (9.9%). Esta diferencia no resultó ser estadísticamente significativa (p = 0,79), así como la correlación con el sexo y la edad. Conclusión: En nuestro estudio, proporcionalmente, hubo una diferencia en la prevalencia de infección postoperatoria según la indicación etiológica, siendo mayor en los casos operados por deformidad, principalmente debido a enfermedad neuromuscular. ***Nivel de evidencia IV; Estudio terapéutico de serie de casos.***

Descriptores*: Columna Vertebral; Complicaciones Postoperatorias; Infección; Factores de Riesgo.*

INTRODUCTION

Spinal fixation with arthrodesis is currently the main surgical procedure for the treatment of unstable vertebral fractures, severe congenital and developmental spinal deformities, degenerative diseases, and tumors with spinal instability associated or not with neurological deficit. The use of implants and bone grafts have substantially improved the fusion rates for these procedures, and they are used in almost all procedures of this type.[1,2]

Postoperative infection is one of the complications with the highest comorbidity in spinal implant surgery. Its incidence varies widely in the literature, reaching as high as 20% in some studies.[1,3,4] The rate of this unwanted complication appears to vary according to the complexity of the surgical procedure, with an incidence of less than 3% in minimally invasive surgeries without the use of implants and approximately 12% in patients with instrumented arthrodeses.[5-7] This higher incidence is related to increased tissue exposure, prolonged surgical time, as well as to greater blood loss and the resulting increase in dead space. This combination of factors, associated with any patient history of previous unfavorable clinical conditions, enable the development of innocuous, potentially infectious bacteria.[1,4]

In this way, the related risk factors can be grouped as intrinsic to the patient, to the procedure, or to postoperative care.[2,4,5] Comorbidities such as diabetes, chronic renal failure, malnutrition, corticosteroid use, smoking, and cancer are among the most relevant risk factors.[2,5] Longer procedures involving many people in the surgical field and large blood losses also increase the risk of infection due to violation of the sterile technique.[5] The etiology of the disease that leads to an indication of instrumented surgery also seems to influence the risk of postoperative surgical site infection (SSI).[1,8] However, with the small number of studies conducted on this topic, there is still no well-established consensus in the literature on this correlation.

The objective of this study is to determine whether any correlation exists between the incidence of postoperative infection and the etiology of the spinal disease that led to a primary surgical indication, as well as to evaluate the demographic characteristics of the selected patients.

METHODS

After the Institutional Review Board approved the study (CAAE:92596818.9.00000.5479) and the participants signed the Informed Consent Form, a retrospective search of the medical records, made available by the Medical Archive Service (SAME) of our hospital, of patients who underwent spinal surgery with instrumentation between October 2015 and December 2019, and who evolved with acute or chronic postoperative infection and underwent surgical cleaning for resolution, was conducted. All the patients were operated on by the same group of surgeons from the Spine Group of the Orthopedics and Traumatology Department of our service. Patients with incomplete medical records, those who had undergone noninstrumented spine surgery, and those with previous active or sequellary infectious systemic disease were excluded. Patients who evolved with superficial infection of the operative wound without requiring surgical cleaning were also excluded. The selected cases were divided according to the etiology behind the surgical indication, being grouped into trauma, deformity, degeneration, and tumor. The overall incidence of infection was calculated as the ratio between the number of cases included in the sample and the total number of instrumented spine surgeries performed during the period. The individual incidences of the etiological groups (trauma, deformity, degeneration, and tumor) were calculated as well. Epidemiological patient data such as age, sex, comorbidities, clinical and laboratory data at the time of diagnosis, the need for removal of synthesis material, number of cleanings, and the isolated etiological agent were also collected.

Fisher´s exact test was used for the statistical analysis of the qualitative variables sex and etiological indication with postoperative infection, with values of $p<0.05$ considered statistically significant. For the analysis of the relationship between age and infection we used the Wilcoxon test, which consists of a non-parametric test with statistically relevant values when $p<0.05$. Other epidemiological data were described by calculating their respective means and medians.

RESULTS

A total of 161 procedures with spinal instrumentation were performed during the period between October 2015 and December 2019. After exclusion of the 6 cases of previous infection (4 vertebral tuberculoses and 2 spondylodiscities), a total of 155 surgeries was considered, 71 (45.8%) of which were indicated for trauma, 44 (28.4%) for tumors, 23 (14.9%) for degenerative disease, and 17 (10.9%) for deformity. Regarding sex, 92 (59.4%) of the patients were men and 63 (40.6%) were women. Patient age ranged from 4 to 81 years, with a mean age of 42.5 years. Twenty-six of these patients evolved with postoperative infection, 8 of whom manifested late as they had undergone primary surgery before the period being analyzed. Thus, they were excluded from the overall incidence calculations by etiological group and included only in the epidemiological analysis. Therefore, considering the 18 positive cases, an overall postoperative infection rate of 11.6% was obtained for patients submitted to surgical instrumentation.

Eleven (42.3%) of the patients who developed this complication were men and 15 (57.7%) were women. As for the etiology of the surgical indications, 9 (38.9%) were submitted primarily for trauma, 8 (30.8%) for degenerative disease, 5 (19.2%) for neoplastic disease, and 4 (15.4%) for deformity.

However, when we analyzed only the 18 patients who were both operated on and developed infection during the study period and compared them against all the cases of instrumented spine surgery performed during this time interval, we obtained a higher prevalence in patients operated for deformity (3 patients, 17.6%), followed by degenerative disease (3 patients, 13%), oncological disease (5 patients, 11.4%), and trauma (7 patients, 9.9%). However, this difference was not statistically significant ($p=0.79$) (Table 1).

Of these 18 patients, 10 (15.9%) were men and 8 (8.7%) were women, and considering the control group, there was no statistical significance ($p=0.21$) (Figure 1).

Of the 17 patients who underwent surgery during the period to

correct deformity, 10 (58.8%) had idiopathic scoliosis, 5 (29.4%) had neuromuscular scoliosis, and 2 (11.8%) had congenital scoliosis. In this etiological group, 3 patients evolved with SSI, 2 of whom with neuromuscular scoliosis and the other with idiopathic scoliosis. Therefore, 40% of the cases operated for deformity caused by neuromuscular disease and 10% of the cases operated for idiopathic scoliosis developed SSIs (Table 2).

The age groups of both included and control patients are illustrated in Figure 2, and there was no statistical significance (p=0.66).

The prevalence of comorbidities in the group with infection was divided into smoking (26.9%), alcohol consumption (26.9%), drug use (11.5%), diabetes mellitus (15.4%), high blood pressure (38.5%), and neoplastic disease (19.2%) (Table 3).

Clinical and laboratory data recorded at the time of the infection diagnosis were collected. The patients had back pain in 84.6% of cases, as measured by the visual analog scale (VAS) for pain scores, which ranged from 3 to 9, with a mean of 5.5, a median of 5, and a standard deviation of 1.4. The neurological status at the time of diagnosis was also analyzed using the Frankel classification (A: 7.7%, B: 3.8%, C: 15.4%, D: 19.2%, and E: 53.8%).

Table 1. Infection frequency in the sample by indication (p=0.79).

Etiology	% (absolute n)
Deformity	17.6%(3)
Degenerative	13%(3)
Neoplasia	11.4% (5)
Trauma	9.9% (7)

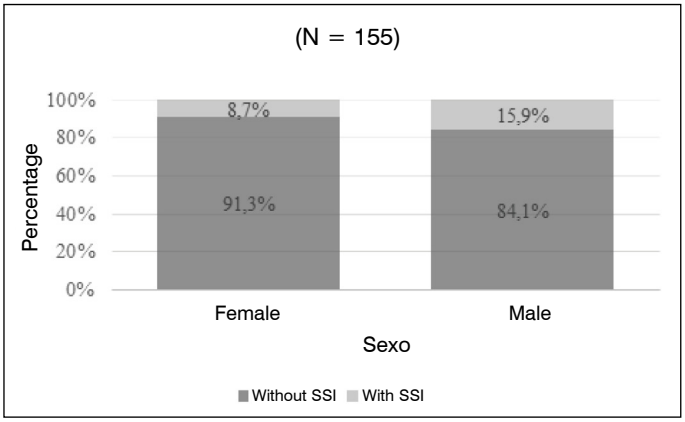

Figure 1. Frequency of infection in the sample by sex (p=0.21).

Table 2. Infection rates in the group operated for deformity.

	no. operated	no. of SSIs	SSI rate (%)
Idiopathic scoliosis	10	1	10%
Neuromuscular scoliosis	5	2	40%
Congenital scoliosis	2	0	0%
Total	17	3	17.6%

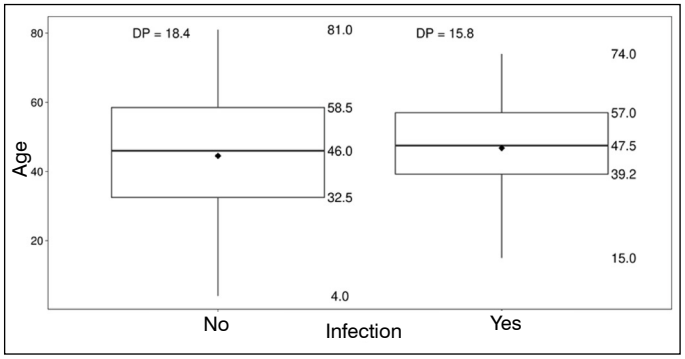

Figure 2. Box plot of the age of patients with and without SSIs (n=26).

Fourteen patients had fevers (53.8%). Laboratory data, such as hemoglobin, leukocytes, creatinine, CRP, and ESR, were also collected with their respective range, standard deviation, mean, and median values (Table 4).

Data related to surgical cleaning were also analyzed. In this study, 18 (69.2%) patients required a single cleaning procedure for resolution of the infection, 4 (15.4%) required two, and 4 (15.4%) had to return to the surgical center three times. Additionally, in 6 (23.1%) patients, synthesis material had to be removed to treat the complication.

In the etiological agent analysis, *S. aureus* was the most prevalent bacteria at 11 cases (67.4%), followed by coagulase-negative *Staphylococci,* which corresponded to 11.8% of the cases of infection. We also concluded that 12 (70.6%) cases of infection were monomicrobial and 29.4% were polymicrobial.

Table 3. Comorbidities and symptoms of the cases with infection (n=26).

	Yes	No
	Absolute n (%)	
Smoking	7 (26.9%)	19 (73.1%)
Alcohol consumption	7 (26.9%)	19 (73.1%)
Drug use	3 (11.5%)	23 (88.5%)
Diabetes mellitus	4 (15.4%)	22 (84.6%)
Chronic renal failure	1 (3.8%)	25 (96.2%)
High blood pressure	10 (38.5%)	16 (61.5%)
Corticotherapy	1 (3.8%)	25 (96.2%)
Pain	22 (84.6%)	4 (15.4%)
Fever (temperature >37.8°C)	14 (53.8%)	12 (46.2%)

Table 4. Descriptive laboratory data serum measurements at the time of diagnosis of infection (n=26).

	Mean (min.-max.)	Standard Deviation
Hemoglobin (g/dl)	10.83 (7.3-14.7)	1.85
Leukocytes (x1000/ml)	10.52 (5.7-17.1)	3.29
CRP (mg/dl)	12.47 (0.2-39.9)	11.81
ESR (mg/dl)	62.04 (6-120)	31.69
Creatinine (mg/dl)	0.67 (0.2-12)	0.28

DISCUSSION

The ability to identify and treat the risk factors associated with postoperative surgical site infection (SSI) has become important and challenging, since it is directly related to prolonged hospitalization, worse functional outcomes, and increased morbidity and health care costs.[1,4,5]

This study was mainly focused on relating SSI to the etiology of the primary surgical indication. It is acceptable to deduce that this variable can impact the rate of postoperative SSI, as it influences the choice of the type of surgical procedure, the number of vertebral levels involved, and the access routes used.[8] In addition, the condition of the patient being treated varies considerably according to the surgical indication. There is, for example, a high prevalence of patients in the pediatric age range treated for deformity, while oncological indications more often affect older patients with associated clinical morbidities.[8,9]

In a study that analyzed 108,419 patients, Smith et al. concluded that surgeries to treat spinal deformity in pediatric patients had a statistically significant higher risk of postoperative infection, with 5.4% evolving with this complication (*n*=1,555), compared to surgeries indicated for degenerative pathologies.[9]

In a meta-analysis conducted by Zhou J. et al., which included 27 studies and 603 cases of SSI in 22,745 patients, the highest incidence of SSI (13.0%) among the different indications was found in patients with neuromuscular scoliosis.[10] In our study, we also observed the highest incidence of SSI (40%) in the surgeries performed to correct deformity in patients with this etiological profile.

Watanabe et al. observed a higher incidence of postoperative

infection in emergency surgeries indicated for traumatic events.[11,12] In their retrospective review, the team found that traumatic indications were associated with a risk of SSI almost 10 times higher than indications for other etiologies (OR = 9.42; CI 95% 1.59-55.73; p=0.013).[11]

Olsen et al., in turn, in a study conducted with 219 patients, found surgical indication for oncological disease to be a risk factor, with an incidence of postoperative infection of 18.7%.[13] Our study found a lower incidence (11.4%) without statistical significance for this etiology, perhaps because patients with this condition are admitted to our referral service in the terminal stage of the underlying disease, thus presenting high perioperative mortality and modest survival rates.

Therefore, we can see that there is still no well-established consensus on the real influence of the surgical indication on SSI. Our study found a higher prevalence of this complication in surgeries performed to treat deformities (17.6%), although without the statistical significance observed in the retrospective study by Smith et al. As for the overall incidence of infection, our study found a rate of 11.6%, which is compatible with the range of values encountered in the literature to date.[1,4,5]

As in the systematic review conducted by Nasser et al., the study found *S. aureus* to be responsible for 64.7% of SSI cases, with a smaller percentage of cases caused by polymicrobial infection (29.4%).[5] Another fact worth mentioning was the prevalence of pain (84.6%) at the time of diagnosis of the infected population, reinforcing the concept of the greater sensitivity of this symptom established in the literature for this complication.[5,8]

Regarding the epidemiological results obtained, the study by Farchad et al., which analyzed 1,009 patients, identified the male sex as an independent risk factor for SSI.[14] Although it was not statistically significant (p=0.21), our study was compatible with this result, since 15.9% of the men in our sample developed this complication, a higher percentage than in the female population (8.7%).

As for the limitations of this study, it is worth highlighting the heterogeneity of the cases operated on in the different etiological groups, with a considerably higher prevalence of patients treated for trauma (38.9%), as well as the reduced number of patients evaluated after applying the exclusion criteria.

CONCLUSION

In our study, there were differences in the prevalence of postoperative infection among the etiological groups, with a higher incidence of infection in surgeries performed to correct deformity mainly resulting from neuromuscular disease.

All authors declare no potential conflict of interest related to this article.

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