

# PREVALENCE OF METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* IN SPINAL SURGERY PATIENTS

PREVALÊNCIA DE *STAPHYLOCOCCUS AUREUS* METICILINA RESISTENTE EM PACIENTES DE CIRURGIA DE COLUNA

PREVALENCIA DE *STAPHYLOCOCCUS AUREUS* RESISTENTE A METICILINA EN PACIENTES DE CIRUGIA DE COLUMNA

DANIEL CUNHA DE ARAUJO,<sup>1</sup> LUIZ CLÁUDIO DE MOURA FRANÇA,<sup>1</sup> ANDRÉ MOREIRA CASTILHO,<sup>1</sup> TIAGO COSTA FALCI,<sup>1</sup> TIAGO PENIDO,<sup>1</sup> ERIC GUSTAVO REGGIANI<sup>1</sup>

1. Rede Mater Dei, Department of Orthopedics. Belo Horizonte, MG, Brazil.

## ABSTRACT

**Objective:** The objective of this study was to determine the prevalence of patients with colonization of methicillin-resistant *Staphylococcus aureus* (MRSA) in the nasal mucosa, who underwent elective spinal procedures. **Methods:** Retrospective study of the medical records of all patients submitted to elective procedures, totaling 125 individuals in the period of 2015 and 2017, performed by two spinal surgeons of the Orthopedics and Traumatology Service of Hospital Mater Dei, Belo Horizonte, Minas Gerais. The pre-operative investigation of MRSA consisted of the collection of a nasal swab for microbiological culture. **Results:** Of the 125 patients evaluated, three (2.4%) showed positive results for MRSA nasal colonization. This prevalence is consistent with the international literature, that ranges from 1.5 to 5.9%. Of these patients none had infection of the surgical wound, probably due to the preoperative prophylactic measures. **Conclusions:** Despite the limitations of the study, we found that the prevalence of carriers of this nasal MRSA population is similar to that of populations worldwide. **Level of evidence III; Retrospective Study.**

**Keywords:** *Staphylococcus Aureus*; Prevalence; Spine.

## RESUMO

**Objetivo:** O objetivo desse trabalho foi determinar a prevalência dos pacientes submetidos a procedimentos eletivos de coluna com mucosa nasal colonizada por *Staphylococcus aureus* Meticilina Resistente (MRSA). **Métodos:** Foi realizado estudo retrospectivo dos prontuários de todos os pacientes submetidos a procedimentos eletivos, totalizando 125, entre 2015 e 2017, por dois cirurgiões de coluna do serviço de Ortopedia e Traumatologia do Hospital Mater Dei, de Belo Horizonte, Minas Gerais. A investigação pré-operatória para MRSA consistiu em swab nasal submetido à cultura microbiológica. **Resultados:** Dos 125 pacientes avaliados, três (2,4%) apresentaram resultado positivo para colonização nasal por MRSA. Essa prevalência está de acordo com a literatura estrangeira, que varia de 1,5 a 5,9%. Desses pacientes, nenhum apresentou infecção da ferida operatória, provavelmente devido às medidas de profilaxia instituídas. **Conclusão:** Apesar das limitações do estudo, constatamos que a população estudada apresenta prevalência de carriageamento nasal de MRSA similar às populações estrangeiras. **Nível de evidência III; Estudo Retrospectivo.**

**Descritores:** *Staphylococcus Aureus*; Prevalência; Coluna Vertebral.

## RESUMEN

**El objetivo de este estudio fue determinar la prevalencia de pacientes con colonización de *Staphylococcus aureus* resistente a la meticilina (SARM) en la mucosa nasal que se sometieron a procedimientos electivos de columna vertebral. **Métodos:** Estudio retrospectivo de los registros médicos de todos los pacientes sometidos a procedimientos electivos, con un total de 125 individuos en el período de 2015 a 2017, realizado por dos cirujanos de columna vertebral del Servicio de Ortopedia y Traumatología del Hospital Mater Dei, de Belo Horizonte, Minas Gerais. La investigación preoperatoria de SARM consistió en la recolección de un hisopo nasal para cultivo microbiológico. **Resultados:** De los 125 pacientes evaluados, tres (2,4%) tuvieron resultados positivos para la colonización nasal por SARM. Esta prevalencia está de acuerdo con la literatura internacional, que varía de 1,5% a 5,9%. De estos pacientes, ninguno tuvo infección de la herida quirúrgica, probablemente debido a las medidas profilácticas preoperatorias. **Conclusiones:** A pesar de las limitaciones del estudio, encontramos que la prevalencia de portadores de SARM nasal de esta población es similar a la de poblaciones de todo el mundo. **Nivel de Evidencia III; Estudio retrospectivo.****

**Descriptores:** *Staphylococcus Aureus*; Prevalencia; Columna Vertebral.

## INTRODUCTION

*Staphylococcus aureus* is a facultative anaerobic bacterium described for the first time in 1880 by Alexander Ogston.<sup>1</sup> It is an immobile, Gram positive, non-sporulated, coagulase positive coccus without a capsule or with a limited capsule. It is found in the external environment and is part of the normal human microbiota. Thus, under normal conditions it is not pathogenic, but when there is a

break in the cutaneous barrier or a reduction in immunity it can cause infections and complications that range from cellulitis to sepsis.<sup>2</sup>

Among these conditions, we highlight early infection of the surgical wound as an important cause of complications in orthopedic surgeries. Such interurrences are typically caused by Gram-positive germs,<sup>3</sup> and among them *Staphylococcus aureus* is the most common pathogen.<sup>3,4</sup>

This study was conducted at the Hospital Mater Dei, Belo Horizonte, MG, Brazil.

Correspondence: Daniel Cunha de Araujo. Rua Abre Campo 193, ap 802 Santo Antônio. BH, MG, Brazil – 30350-190 danielcunhamed@gmail.com



The prevalence of individuals colonized by these pathogens varies in the literature and depends on the population studied, the anatomical site where the collection is taken, and the number of locations collected.<sup>5</sup> American studies cite prevalence of nasal colonization by *Staphylococcus aureus* as varying between 20 and 30%.<sup>6-8</sup> In a World Health Organization study, the rate of nasal colonization by Methicillin-Resistant *Staphylococcus aureus* (MRSA) in patients awaiting surgery was 1.8%.<sup>9</sup> Sporer et al.<sup>10</sup> screened 9825 patients for *Staphylococcus* colonization prior to knee and hip prosthesis surgery and found 2.9% of the patients positive for MRSA and 25.1% positive for Methicillin-Sensitive *Staphylococcus aureus* (MSSA).

However, there are a few studies on the prevalence of colonization by these bacteria in the healthy Brazilian population. Most of the studies found in Portuguese deal with patients in intensive care units with nosocomial infections or immunocompromised,<sup>11-13</sup> since these individuals are more susceptible to this infection.

The patients colonized with these bacteria have a significantly higher rate of surgical wound infections following orthopedic surgery,<sup>14</sup> among which spinal surgery and hip and knee replacement surgeries stand out.<sup>10</sup> Studies show that this risk is also valid for cardiac and vascular surgeries.<sup>15</sup> In addition, infections by both Methicillin-Resistant and Methicillin-Sensitive *Staphylococcus aureus* are associated with higher potential morbidity and mortality when compared to infections by other bacteria of the human flora.<sup>16</sup>

## OBJECTIVE

The objective of this study was to determine the prevalence of mucous membranes colonized by MRSA among patients who underwent elective spinal procedures.

## METHODS

In this retrospective study, we reviewed the medical records of all patients who underwent elective procedures, a total of 125 from 2015 to 2017, performed by two spine surgeons of the Orthopedics and Traumatology Service of the Hospital Mater Dei, in Belo Horizonte, Minas Gerais.

The preoperative investigation for colonization by MRSA in our service consists of a swab of both nostrils that is submitted to the standard microbiological culture methods. The test was performed no more than 30 days prior to the surgical procedure and the patients returned to the surgeon responsible for the surgery for a preoperative visit and evaluation of the results.

Patients who had undergone a surgical procedure or who had been hospitalized for any reason less than 30 days prior to the examination were excluded.

The Epidemiological Study of Colonization by *Staphylococcus aureus* and the Correlation with Surgical Site Infection project was received for ethics analysis by the Hospital Mater Dei IRB as protocol number CAAE: 87466518.5.0000.5128

All the patients signed the Informed Consent Form.

## RESULTS

Of the 125 patients who met the study inclusion criteria, of whom 52% (65 patients) were female and 48% (60) were male, 2.4% (three patients) had positive results for nasal colonization by Methicillin-Resistant *Staphylococcus aureus*.

## DISCUSSION

Surgical wound infections are important complications of surgical procedures, which increase morbidity and mortality and burden the system. The rate of this serious condition following spinal surgery reported in the literature ranges from 0.7% to 12%.<sup>17,18</sup> Risk factors that predispose patients to developing postoperative infection are classified as non-modifiable, such as age and primary or revision surgery, or modifiable, such as obesity, tobacco use, and *Staphylococcus* colonization. The identification of these modifiable factors is important because from it strategies can be designed to optimize progress following surgery.

Thus, this study focused on the prevalence of nasal colonization

by Methicillin-Resistant *Staphylococcus aureus* among the healthy patients who underwent spinal surgical procedures between 2015 and 2017 in two large hospitals. The most common reservoir site for *S. aureus* is the nostrils, followed by the groin, armpits, and perianal region.<sup>5</sup> We used a swab of the nostrils as the screening method, since it is the most widely used in the literature,<sup>19-21</sup> has greater sensitivity, and does not embarrass the patients.

This swab can be submitted to two types of analysis to identify MRSA: the polymerase chain reaction (PCR) and seeding microbiological culture medium. The sensitivity and specificity of PCR are 100% and 98%, respectively, while for culture are 90% and 100%, respectively.<sup>22</sup> The advantage of PCR is that the results are available in 24 hours as opposed to the culture, which may take from 3 to 7 days depending on the laboratory. Thus, the first form of analysis is more useful for the hospitalized patient because it permits real-time identification of nasal MRSA colonization, provides an opportunity for early eradication of the pathogen, and prevents transmission to other patients.<sup>3</sup> However, the PCR kits cost more than twice what is spent on growing the cultures.<sup>23</sup> So, since there was no need for such rapid turnaround of the swab results and so as to not burden the system more than necessary, we opted for culturing the samples collected from the patients.

Once the carriers of these bacteria have been identified, measures should be introduced in the pre- and intraoperative periods directed at minimizing the chances of complications. In our service, we advised all the patients, regardless of the microbiological results, to wash with 2% chlorhexidine the night before and on the day of surgery. We also performed antibiotic prophylaxis with cefazolin 2 g one hour before the skin incision. However, for the patients who screened positive for MRSA, daily washing with 2% chlorhexidine was initiated 5 days prior to surgery. In addition, nasal decolonization was performed with 2% mupirocin, twice daily, for five days and vancomycin 1g was added to the antibiotic prophylaxis.

Mupirocin is a naturally occurring antibiotic, also called pseudomonic acid, as it is derived from the fermentation of *Pseudomonas fluorescens*.<sup>24</sup> Its action mechanism is the inhibition of protein synthesis, preventing the incorporation of isoleucine into the protein.<sup>25</sup> Thus, it is very effective against aerobic Gram-negative cocci (*S. aureus*, *S. epidermidis*, and B-hemolytic *Streptococcus*) and some Gram-negative cocci, but spares most of the normal flora.<sup>26</sup> When used intranasally for 5 days, mupirocin eradicates 78% of the strains of *Staphylococcus aureus* and reduces the carrying of the bacteria in the nose and on the hands for up to a year.<sup>27</sup> Adverse effects are rare, occurring in less than 1.5% of patients, and include a burning sensation, itching, redness, and contact dermatitis.<sup>26</sup> None of the patients who used this antibiotic in our service had adverse reactions.

Of the 125 patients who were screened for MRSA, 2.4% had positive swab results and were given pre- and transoperative prophylaxis. This prevalence in our study agreed with the foreign literature, where it ranges from 1.5 to 5.9%.<sup>9,20,21,28</sup> None of our patients had infections of the surgical wound.

The patient sample in our study was small and thus may not be representative of the real prevalence in the healthy Brazilian population.

## CONCLUSION

In spite of the study limitations, we found that the population studied had a prevalence of nasal MRSA similar to that of foreign populations. None of the patients carrying the bacteria in the nasal cavity presented infection of the surgical wound, which corroborates the benefits and cost effectiveness of continued screening and the introduction of prophylactic measures when these individuals are identified.

New studies are required to determine whether this prevalence would persist in a larger population and whether there are factors that predispose these patients to be carriers of Methicillin-Resistant *Staphylococcus aureus*.

---

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

---

**CONTRIBUTION OF THE AUTHORS:** Each author made significant individual contributions to this manuscript. AMC (0000-0002-6790-2370)\* and LCMF (0000-0002-6555-6785)\* gathered the data, participated in discussion about the results and the review and approval of the final version of the article. DCA (0000-0002-0727-523X)\*, TCF (0000-0003-3788-3284)\*, TPMF (0000-0003-4835-7618)\*, and EGR (0000-0003-2004-3641)\* participated in discussion about the results. AMC, LCMF, DCA, TCF, TPMF, and EGR participated in the review and approval of the final version of the article. \*ORCID (Open Researcher and Contributor ID).

## REFERENCES

- Orenstein A. The discovery and naming of *Staphylococcus aureus*. Periodical [serial online]. 2011.
- Gelatti LC, Bonamigo RR, Becker AP, d'Azevedo PA. *Staphylococcus aureus* resistentes à meticilina: disseminação emergente na comunidade. *An Bras Dermatol*. 2009;84(5):501-6.
- Thakkar V, Ghobrial GM, Maulucci CM, Singhal S, Prasad SK, Harrop JS, et al. Nasal MRSA colonization: impact on surgical site infection following spine surgery. *Clin Neurol Neurosurg*. 2014;125:94-7.
- Bozic KJ, Lau E, Kurtz S, Ong K, Rubash H, Vail TP, et al. Patient-related risk factors for periprosthetic joint infection and postoperative mortality following total hip arthroplasty in Medicare patients. *J Bone Joint Surg Am*. 2012;94(9):794-800.
- Lauderdale TL, Wang JT, Lee WS, Huang JH, McDonald LC, Huang IW, et al. Carriage rates of methicillin-resistant *Staphylococcus aureus* (MRSA) depend on anatomic location, the number of sites cultured, culture methods, and the distribution of clonotypes. *Eur J Clin Microbiol Infect Dis*. 2010;29(12):1553-9.
- Kim DH, Spencer M, Davidson SM, Li L, Shaw JD, Gulczynski D, et al. Institutional prescreening for detection and eradication of methicillin-resistant *Staphylococcus aureus* in patients undergoing elective orthopaedic surgery. *J Bone Joint Surg*. 2010;92(9):1820-6.
- Van Belkum A. Novel technology to study co-evolution of humans and *Staphylococcus aureus*: consequences for interpreting the biology of colonisation and infection. In: Finn A, Curtis N, Pollard AJ, editors. *Hot Topics in Infection and Immunity in Children VII*. New York: Springer; 2011. p.273-88.
- Wertheim HF, Vos MC, Ott A, van Belkum A, Voss A, Kluytmans JA, et al. Risk and outcome of nosocomial *Staphylococcus aureus* bacteraemia in nasal carriers versus non-carriers. *Lancet*. 2004;364(9435):703-5.
- Kalra L, Camacho F, Whitener CJ, Du P, Miller M, Zalonis C, et al. Risk of methicillin-resistant *Staphylococcus aureus* surgical site infection in patients with nasal MRSA colonization. *Am J Infect Control*. 2013;41(12):1253-7.
- Sporer SM, Rogers T, Abella L. Methicillin-resistant and methicillin-sensitive *Staphylococcus aureus* screening and decolonization to reduce surgical site infection in elective total joint arthroplasty. *J Arthroplasty*. 2016;31(9):144-7.
- Sousa DM, Sousa AFL, Ibiapina ARS, Queiroz AAFLN, Moura MEB, Araújo TME. Infecção por *staphylococcus aureus* resistente em unidades de terapia intensiva: revisão integrativa. *Rev enferm UFPE on line*. 2016;10(4):1315-23.
- Dombroski V, Da Silva MMG, Silveira ME. Monitoramento terapêutico de vancomicina em uma unidade de terapia intensiva. *Rev Méd UFPR*. 2015;2(2):67-73.
- Carvalho ML, Araújo TRN, Santos CFB, Sousa AFL, Moura MEB. Infecções hospitalares em unidade de terapia intensiva neonatal. *Rev Interdisciplinar*. 2015;7(4):189-98.
- Kluytmans J, Van Belkum A, Verbrugh H. Nasal carriage of *Staphylococcus aureus*: epidemiology, underlying mechanisms, and associated risks. *Clin Microbiol Rev*. 1997;10(3):505-20.
- Tacconelli E, Carmeli Y, Aizer A, Ferreira G, Foreman MG, D'Agata EM. Mupirocin prophylaxis to prevent *Staphylococcus aureus* infection in patients undergoing dialysis: a meta-analysis. *Clin Infect Dis*. 2003;37(12):1629-38.
- Laudermilch DJ, Fedorka DJ, Heyl A, Rao N, McGough RL. Outcomes of revision total knee arthroplasty after methicillin-resistant *Staphylococcus aureus* infection. *Clin Orthop Relat Res*. 2010;468(8):2067-73.
- Pull Ter Gunne AF, Cohen DB. Incidence, Prevalence, and Analysis of Risk Factors for Surgical Site Infection Following Adult Spinal Surgery. *Spine (Phila Pa 1976)*. 2009;34(13):1422-8.
- Roberts FJ, Walsh A, Wing P, Dvorak M, Schweigel J. The influence of surveillance methods on surgical wound infection rates in a tertiary care spinal surgery service. *Spine (Phila Pa 1976)*. 1998;23(3):366-70.
- Sporer SM, Rogers T, Abella L. Methicillin-Resistant and Methicillin-Sensitive *Staphylococcus aureus* Screening and Decolonization to Reduce Surgical Site Infection in Elective Total Joint Arthroplasty. *J Arthroplasty*. 2016;31(9):144-7.
- Chen AF, Heyl AE, Xu PZ, Rao N, Klatt BA. Preoperative decolonization effective at reducing staphylococcal colonization in total joint arthroplasty patients. *J Arthroplasty*. 2013;28(8 Suppl):18-20.
- Liu Z, Norman G, Iheozor-Ejiofor Z, Wong JK, Crosbie EJ, Wilson P. Nasal decontamination for the prevention of surgical site infection in *Staphylococcus aureus* carriers. *Cochrane Database Syst Rev*. 2017;5:CD012462.
- Paule SM, Pasquariello AC, Hacek DM, Fisher AG, Thomson RB, Kaul KL, et al. Direct detection of *Staphylococcus aureus* from adult and neonate nasal swab specimens using real-time polymerase chain reaction. *J Mol Diagn*. 2004;6(3):191-6.
- Wassenberg M, Kluytmans JA, Box AT, Bosboom RW, Buiting AG, van Elzakkler EP, et al. Rapid screening of methicillin-resistant *Staphylococcus aureus* using PCR and chromogenic agar: a prospective study to evaluate costs and effects. *Clin Microbiol Infect*. 2010;16(12):1754-61.
- Rhody C. Bacterial infections of the skin. *Prim Care*. 2000;27(2): 459-73.
- Kaye ET. Topical antibacterial agents. *Infect Dis Clin North Am*. 2000;14(2):321-39.
- Spann CT, Taylor SC, Weinberg JM. Topical antimicrobial agents in dermatology. *Dis Mon*. 2004;50(7):407-21.
- Scully BE, Briones M. Staphylococcal Colonization. *Arch Intern Med*. 1992;152:353-6.
- Luhmann SJ, Smith JC. Preoperative MRSA Screening in Pediatric Spine Surgery: A Helpful Tool or a Waste of Time and Money? *Spine Deform*. 2016;4(4):272-6.