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Research Article

Nasal Carriage of Methicillin Resistant Staphylococcus Aureus in Patients Admitted in Health Institutions of Argentina and Madagascar

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Abstract

Introduction: Staphylococcus aureus is a microorganism that cause associate with serious infections, high morbidity-mortality risk and a heavy healthcare economic burden, especially when this germ is resistant to methicillin treatments (MRSA). Since MRSA may colonizes the anterior nares, we developed the present study in order to detect the rate of nasal carriage in patients admitted in two hospitals with similar profiles, one in Argentina (South America) and the other in Madagascar (Eastern Africa).

Methods: A prospective cross-sectional study was performed enrolling patients admitted in R.Rossi (RR) & CHU-P.Zaga (CHU) hospitals. Swabs were immediately seeded in Chapman/Mannitol Salt agar during 24-48 hours period. After the identification of Staphylococcus aureus, the sensitivity to antibiotics was performed by Mueller Hinton agar, following by an antibiogram with oxacillin/cefoxitin.

Results: In RR Hospital-Argentina the nasal Staphylococcus prevalence rate was four times more than in CHU-Madagascar while the MRSA frequency was 52.8% vs 17.5% respectively. In both hospitals, the higher prevalence of MRSA carriage was detected in women and this rate was significantly higher in population >60 yrs (16.0%±3.3-RR-Argentina, 5.1%±1.6-CHU-Madagascar).

Conclusion: RR Hospital in Argentina the nasal Staphylococcus prevalence rate quadruplicate the one found in -P.Zaga and triplicates the frequency of MRSA. It is necessary to search MRSA nasal presence at the time patient admission in every hospital due to the disparities rates detected and the ominous consequences associated to this type of carriage. Knowing the prevalence of MRSA in patients admitted might help in make better decision making in local health management.

Keywords: Staphylococcus Aureus, Methicillin Resistance, Nasal Carriage, MRSA, Argentina, Madagascar

Introduction

Staphylococcus aureus is both a human skin and mucosae commensal but also a frequent cause of serious infections with high morbidity mortality and healthcare associated costs [1,2].

S. aureus colonizes the anterior nares of 25% in the general population which is a mix of persistent and intermittent carriers [3]. Individuals colonized with MRSA serve as a reservoir for its transmission. The most frequent carriage site is the anterior nares, which serves as a place for the spread of the pathogen [4]. A majority of individuals with nasal colonization are also colonized on other areas of intact skin including the hands, axillae, perineum and umbilicus (in infants).

Nasal colonization depends on host factors such as the underlying condition or diseases. Some studies have found that nasal carriage was more frequent in human immunodeficiency virus (HIV)-infected, obese, diabetes, undergoing dialysis, rheumatological conditions and atopic dermatitis compared to healthy individuals [5].

In healthy individuals, MRSA colonization was found to be similar rates among men and women while men had higher bacterial density. Reports of a higher risk of

nasal carriage of S aureus amount hospital workers than the rest of the population have not been confirmed. At the genetic level, no correlation was found between genetic factors and S aureus carriage, neither among twins or family studies. Some polymorphisms in host inflammatory response genes have been associated with S aureus nasal carriage as the presence of the histocompatibility antigen phenotype HLA-DR3 could be a predisposition.

Colonization increases the risk of MRSA infection. In a study of patients for whom nares cultures were obtained on hospital admission, the rate of MRSA infection in the year following admission was substantially higher among those with baseline MRSA colonization than those without colonization (19 versus 2 percent, respectively) [6]. Nasal carriage has been shown to play a key role in the pathogenesis of S. aureus infections, in patients with HIV, undergoing surgery, dialysis and intensive care unit patients with higher infection risks in persistent carriers.

The prevalence of MRSA colonization substantially differs around the world. Among patients admitted to the hospital in the American continent, the MRSA prevalence fluctuates between 6 to 14%, In Africa from 9.8 to 32%. In the Asian continent, China, reported a rate of 28% of nasal MRSA carriage; while in India, the authors reported in 2014 a lower rate of 15% [7].

The present study is designed to establish the prevalence of nasal carriage of Staphylococcus aureus and its resistance to methicillin in patients admitted in two hospitals in the countries of Argentina and Madagascar.

Methodology

Type of study: This is a prospective cross-sectional study of descriptive type, focused on the detection of nasal carriage of methicillin-resistant Staphylococcus aureus at hospital admission, in two hospitals located in two different continents (Argentina and Madagascar). The study was performed from January 1st 2022 to December 1st January 2023.

Patient population: All patients with admission order before transferring to wards in the hospitals R.Rossi (RR) and CHU-P. Zaga (CHU) were selected to be enrolled in this study. Patients who refused the nasal swab or were not able to consent were excluded from the study.

Data collection: The data collected included patient demographics, reason for hospital admission, service ward to be admitted, comorbidities, presence/absence of Staphylococcus in nasal swab sample, resistance to methicillin present in the nasal swab sample, bacterial culture sensitivities results. De-identified data was collected in a spreadsheet from the patient's charts and transferred to a database specifically designed for this study. Presence of staphylococcus aureus and culture results and sensitivities were documented after microbiological studies were performed and validated in each case.

Staphylococcus aureus detection technique:
- Sample collection procedure: After consent was documented and the procedure of sampling was explained, the following steps were followed: a) Open and label the swab kit with the patient's code; b) Insert the swab into the patient's anterior nostril approximately 1-2centimeters; c) Perform 5 complete rotations in the nostril; d) Perform the same gesture in the other nostril with the same swab. Transportation and storage: The swabs were transported a leak proof container as quickly as possible to the laboratory for processing. The time between collection of the sample and its arrival must not exceed 24 hours. Swab characteristics: for the study they were used flocked swab in combination with Amies transport medium.

- Detection of Staphylococcus aureus: Laboratory staff received the swabs following the recommendation guidelines for the proper execution of medical samples. Once the swabs arrived in the microbiology laboratory, they were immediately seeded onto the Chapman or Mannitol Salt agar, which is a specific medium for Staphylococci, and allows thegrows bacteria for 24-48 hours. Then Staphylococcus aureus colonies were identified by Gram stain and enzymatic detection tests. Finally, an antibiogram was carried out on the isolated colony; and the reading is done on the third day.

- Sensitivity test: After the identification of Staphylococcus aureus was performed, the sensitivity of the bacteria to antibiotics was done by Mueller Hinton agar, which is a rich agar, is used for carrying out the antibiogram. On the agar, the colonies are seeded and oxacillin or cefoxitin is placed.

- Validation of results: Performed by the same microbiologist in each hospital.

Data analysis: The data was compiled and entered on a Word and Excel file, purified computer using the Statistical Package for Social Sciences 20.0 for Windows or SPSS version 20.0.

Ethical Aspects: All patient data was it was coded in order to hide its affiliation. All data obtained from primary sources before being analyzed, information was hidden so that they could not be identified by the researchers. Protocol was accepted by the official ethical committee of the State of Buenos Aires (ID0082-24).

Results

The health institutions characteristics enrolled in the project is available in Table 1. Both had a general medicine profile, with a Critical Unit Area that have a similar number of beds destinated to patients that need intensive care, and bacteriology services both equipped with GDP. Although Madagascar`s hospital was bigger than its Argentinian counterpart, both institutions have similar profiles **(Table 1)**
S.aureus isolated had differences since in Argentina the nasal

Hospital	Profile	Number of patients admitted per year	Number of beds (overall)	Critical Unit	Number of beds in Critical Unit or Reanimation service	Bacteriology with GDP
RR-Argentina	General	272.000	184	Yes	24	Yes
CHU-Madagascar	General	543.000	400	Yes	28	Yes

Staphylococcus prevalence quadruplicate the one found in CHU-Madagascar. Among these isolates, the percentage of MRSA detected in RR-Argentina was three time greater that CHU-Madagascar 52.8% vs 17.5% respectively **(Table 2).**

According to patient`s sex, it was detected a higher prevalence of MRSA carriage in women although this difference was not significant. Either in Argentina or in Madagascar`s population

Hospital	Number of patients enrolled	Number of nasal swab performed	Prevalence of Staphylococcus positive samples*	% of MRSA
RR-Argentina	General	106	56	52.8
CHU-Madagascar	General	80	14	17.5

that was attended in the selected institutions, the prevalence of nasal carriage of MRSA was higher in women compared to men (when this variable was corrected according to the number of enrolled patients of each gender), (18.6%±3.5 or 3.9%±1.2 among female vs 15.8%±2.9 or 2.5%±1.0 male in Argentina and Madagascar institution respectively; however, this difference was not statistically significant when compared female-male ratio in each Institution.

In relation to patient`s age, we observed that elder patients demonstrated more prevalence of positive test than others, in both countries. Hence, after adjustment of the variable, we found that subjects over the age of 60 were the most affected by MRSA compared to other age groups 16.0%±3.3 in RR-Argentina and 5.1%±1.6 in CHU-Madagascar **(Table 3).**

Discussion

Patients	RR-Argentina CHU-Madagascar			RR-Argentina CHU-Madagascar		
	General			General		
Age	MRSA (+) (%)	MRSA (-) (%)	Non-Carriers	MRSA (+) (%)	MRSA (-) (%)	Non-Carriers
<20	0	0	0	0	3.7	7.5
21-30	0.9	0	4.7	1.3	3.7	22.5
31-40	1.9	0	5.7	0	0	21.3
41-50	6.6	5.7	9.4	0	1.3	6.3
51-60	7.6	1.9	8.5	0	2.5	6.3
61-70	13.2	9.4	15.1	1.3	0	11.3
>70	2.8	2.8	3.8	3.8	0	7.5

Nasal carriage of Staphylococcus aureus has been identified as an important risk factor for infection. Currently, the number of studies on colonization or infection by Staphylococcus is increasing specially those resistant to methicillin [8].

In our study, nasal carriage of Staphylococcus aureus (MRSA) was found in 52.8% and 17.5% in Hospitals from Argentina & Madagascar respectively.

These results about the nasal carriage of MRSA in patients attending hospitals in Argentina and Madagascar, should be compared with data reported by other health institutions from American or African countries in order in order to determine if the data obtained are comparable to the data published so far [9].

In Africa and the middle east, the average MRSA colonization rate was 15.5% (13.4-17.6%). However, the MRSA colonization rate was 24.1% (21.6-26.5%) in individuals with chronic medical conditions, 2.3% (1.5-3.2%) in healthy subjects and 5.8% (3.4-8.2%) in healthcare workers. Furthermore, MRSA colonization rates were highest in South Africa (21.2%; 9.8-32.5%) followed by Middle East (15.8%; 14.0-17.6%), sub-Saharan and central Africa (14.1%; 9.8-18.4%) and the Arabian Peninsula (6.0%; 2.8-9.1%) [3, 4]. A study in inpatients in Madagascar reports a MRSA prevalence of 4 -13% [10]. On the other hand, Madagascar revealed a much lower prevalence of MRSA nasal carriage than the one reported by other countries on the African continent (30% in Morocco, 39.2% in Algeria; or 23.7% in Angola [9,11-13].

Furthermore, In South America, data from reports by Argentina neighboring countries like Brazil, or Colombia showed a prevalence of MRSA carriage of 13.4% and 8.4% respectively, similar to the one reported in our study [14-16]. In Central America in Nicaragua, the prevalence varies from 7-11% [17]. Approximately 7 percent of patients in United States hospitals are colonized with MRSA increasing this percentace in certain regions [18,19]. Canada reported 62% of MRSA nasal carriage in its First Nations population on hospital admission, while in Atlanta US this rate was about 48% in CLC hospitalized patients [20].

The prevalence of MRSA worldwide is very heterogeneous and variable. It varies by country and region, depending on the period of study, the services and the living conditions of the populations concerned [21,22]. Also, important differences are seen when prevalence is separated by age, sex and race/ethnicity. To make the prevalence more confusing, studies may be confounded by the quality of sampling, culture techniques and the population studied [23-25].

The prevalence of nasal carriage of MRSA differs among patients based on different risk factors including demographics like age and weight, comorbidities and geographical location [24,25]. This study reinforces the importance of individual and universal MRSA colonization testing on patients admitted to hospitals to help healthcare workers to take preventive measures and facilitate antimicrobial empiric prescription when patients colonized present with infections.

Conclusion

This study shows that the prevalence of MRSA nares colonization in two similar profile hospitals in two different continents, differs demographically, although it exists similarities in terms of age and gender. Prevalence rates were higher in females and adults >60 years old. These results indicate the importance of detection of MRSA colonization at the individual level to take preventive measures and antimicrobial decisions in case of infections in hospitalized patients no matters where the institution is located.

References

1. Lowy FD (1998) Staphylococcus aureus infections NEngl J Med 339: 520-29.

2. Lyon B, Skurray R (1987) Antimicrobial resistance of Staphylococcus aureus: genetic basis. Microbiol Rev mars 51: 88-134.

3. Makongwana B (2014) Common causes of bacterial meningitis at Mthatha Hospital Complex, Eastern Cape South Africa16th ICID abstracts/ International Journal of Infectious Disease 21S: 1-460.

4. Coello R, Jimenez J, Garcia M, Arroyo P, Minguez D, et al. (1994) Prospective study of infection, colonization and carriage of methicillin-resistant Staphylococcus aureus in an outbreak affecting 990 patients. Eur J Clin Microbiol Infect Dis 13 :74

5. Sakr A, Bregeon F, Mege J, Rolain J, Blin O (2018) Staphylococcus aureus Nasal Colonization: An update on Mechanisms, Epidemiology, Risk Factors and Subsequent Infections. Front Microbiol 9: 2419. PMID 30349525.

6. National Nosocomial Infections Surveillance System (2004). National Nosocomial Infections Surveillans (NNIS) System Report, data summary from January 1992 through June 2004. Am J Infect Control 32: 470.

7. Tacconelli E, Carrara E, Savoldi A, Harbarth S, Mendelson M, et al. (2018) Discovery, research, and development of new antibiotics: the WHO priority list of antibiotic-resistant bacteria and tuberculosis. Lancet Infect Dis 18: 318-27.

8. Jialing L, Jianping L, Ting Z, Bai C, Jianping Y, et al. (2018) Dose-response associations of methicillin-resistant Staphylococcus aureus between school environmental contamination and nasal carriage by elementary students. Infect Drug Resist 11: 773-82.

9. Munn Z, Moola S, Riitano D, Lisy K (2014) The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence. Int J Health Policy Manag 3:123-8.

10. Rasamiravaka T, Rasoanandrasana S, Zafindraibe NJ, Rakoto Alson AO, Rasamindrakotroka A (2013) Evaluation of methicillin-resistant Staphylococcus aureus nasal carriage in Malagasy patients. J Infect Dev Ctries 7: 318-322.

11. Benouda A, El Hamzaui S (2009) Staphylococcus aureus : épidémiologie et prévalence des souches résistantes à la méticilline (SARM) au Maroc. Ver Tun Infectiol 3: 15-20.

12. Zriouil SB, Bekkali M, Zerouali K (2012) Epidemiology of Staphylococcus aureus infections and nasal carriage at the Ibn Rochd University Hospital Center, Casablanca, Morocco. J Infect Dis 3: 279-83.

13. Bentrar K, Bensnouci H (2016) Prévalence du portage nasal de Staphylococcus aureus en communautaire dans la region de Tlemcen. [Thèse:Med].Algérie; Université d' ABOU BEKR BELKAÎD.

14. Barberato-Filho S, Bergamaschi CC, Del Fiol FS, Antoniazzi FB, Stievano JM, Justo AC, et al. (2020) Methicillin-resistant Staphylococcus aureus in the Americas: systematic review and metanalysis of prevalence in food-producing animals. Rev Panam Salud Publica 44:e48.

15. Veloso JO, Lamaro-Cardoso J, Neves LS, Borges LFA, Pires CH, et al. (2019) Methicillin-resistant and vancomycin-intermediate Staphylococcus aureus colonizing patients and intensive care unit environment: virulence profile and genetic variability. APMIS 127:717-26.

16. Cáceres M (2011) Frequency of nasal carriers of methicillin-resistant Staphylococcus aureus among health workers in Nicaraguan hospitals. Rev Panam Salud Publica 30: 610-14.

17. Jarvis WR, Jarvis AA, Chinn RY (2012) National prevalence of methicillin-resistant Staphylococcus aureus in inpatients at the United States health care facilities. Am J Infect Control 40: 194-200.

18. Klevens RM, Morrison MA, Nadle J, et al. (2007) Invasive Methicillin-Resistant Staphylococcus aureus Infections in the United States. JAMA 298(15): 1763-71.

19. Embil J, Ramotar K, Romance L, et al. (1994) Methicillin-resistant Staphylococcus aureus in tertiary care institutions on the Canadian prairies 1990–1992. Infect Control Hosp Epidemiol 15:646-51.

20. Stone N, Lewis D, Lowery H, Darrow LA, Kroll C, et al. (2008) Importance of Bacterial Burden Among Methicillin-Resistant Staphylococcus aureus Carriers in a Long-Term Care Facility. Infect Control Hosp Epidemiol 29: 143-148.

21. Munn Z, Moola S, Lisy K, Riitano D, Tufanaru C (2015) Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and cumulative incidence data. Int J Evid Based Healthc 13: 147-53.

22. Hasanpour AH, Sepidarkish M, Mollalo A, et al. (2023) The global prevalence of methicillin-resistant Staphylococcus aureus colonization in residents of elderly care centers: a systematic review and meta-analysis. Antimicrob Resist Infect Control.

23. Phillips C, Wells N, Martinello M, Smith S, Woodman R, et al. (2016) Optimizing the detection of methicillin-resistant Staphylococcus aureus with elevated vancomycin minimum inhibitory concentrations within the susceptible range. Infect Drug Resist 9: 87-92.

24. Houkes KMG, Stohr JJJM, Gast KB, et al (2023) A pseudo-outbreak of MRSA due to laboratory contamination related to MRSA carriage of a laboratory staff member. Antimicrob Resist Infect Control 1: 1-10.

25. Gould IM, Reilly J, Bunyan D, Walker A (2010) Costs of healthcare-associated methicillin-resistant Staphylococcus aureus and its control. Clinical Microbiology and Infection 12: 1721-28.