

Colonization by *Staphylococcus aureus* among the nursing staff of a teaching hospital in Pernambuco

COLONIZAÇÃO PELO STAPHYLOCOCCUS AUREUS EM PROFISSIONAIS DE ENFERMAGEM DE UM HOSPITAL ESCOLA DE PERNAMBUCO

COLONIZACIÓN POR *STAPHYLOCOCCUS AUREUS* EN PROFESIONALES DE ENFERMERÍA DE UN HOSPITAL ESCUELA DE PERNAMBUCO

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ABSTRACT

This study was performed with the objective to identify the prevalence of colonization by *Staphylococcus aureus* in nursing professionals from a teaching hospital in Pernambuco, and evaluate the resistance profile of these isolates. To do this, we performed a cross-sectional study where biological samples were collected from the hands and nasal cavities of the subjects. *S. aureus* was identified using agar (blood agar and mannitol salt) via catalase and coagulase tests. The sensitivity profile was determined by Kirby Bauer technique and determination of methicillin resistance was performed with oxacillin screening with sodium chloride (NaCl) addition. Of the 151 professionals evaluated, 39 were colonized which showed a prevalence of 25.8%. Among the variables studied, age and use of PPE were associated with colonization by the organism. Of all the isolates, only five were resistant to methicillin.

DESCRIPTORS

Staphylococcus aureus
Nursing
Cross infection
Infection control

RESUMO

O presente estudo foi realizado com o objetivo de identificar a prevalência de colonização pelo *Staphylococcus aureus* em profissionais de enfermagem de um hospital universitário de Pernambuco, bem como avaliar o perfil de resistência deles isoladamente. Para isso, foi realizado um estudo transversal, no qual foram coletadas amostras biológicas das mãos e da cavidade nasal. A identificação do *S. aureus* foi realizada por meio do semeio em agar-sangue, agar manitol-salgado e através dos testes de catalase e coagulase. O perfil de sensibilidade foi determinado pela técnica de Kirby Bauer e para determinação da resistência à meticilina foi realizado o screening em placa com oxacilina com adição de 4% de NaCl. Dos 151 profissionais avaliados, 39 se encontravam colonizados, o que demonstrou uma prevalência de 25,8%. Entre as variáveis estudadas, a faixa etária e a quantidade de EPI apresentaram-se associadas à colonização pelo microrganismo. De todas as linhagens isoladas, apenas cinco apresentaram resistência à meticilina.

DESCRITORES

Staphylococcus aureus
Enfermagem
Infecção hospitalar
Controle de infecções

RESUMEN

Estudio realizado para identificar prevalencia de colonización por *Staphylococcus aureus* en profesionales de enfermería de hospital universitario de Pernambuco, así como evaluar el perfil de resistencia de la bacteria aislada. Se realizó un estudio transversal en el que se recolectaron muestras biológicas de manos y cavidad nasal. La identificación del *S. aureus* se realizó mediante cultivo en agar-sangre, agar manitol salado y mediante pruebas de catalasa y coagulasa. El perfil de sensibilidad se determinó por técnica de Kirby Bauer y para la determinación de resistencia a meticilina se realizó screening en placa con oxalacina, con adición de 4% de NaCl. De 150 profesionales evaluados, 39 estaban colonizados, lo que demostró prevalencia de 25,8%. Entre las variables estudiadas, faja etaria y cantidad de EPI se presentaron asociadas con la colonización por la bacteria. De todas las cepas aisladas, apenas cinco presentaron resistencia a meticilina.

DESCRIPTORES

Staphylococcus aureus
Enfermería
Infección hospitalaria
Control de infecciones

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INTRODUCTION

Staphylococcus aureus is one of the most frequently identified bacteria as a cause of nosocomial infections⁽¹⁾. This purulent microorganism can be found as a colonizer of human beings' normal skin and mucous tissue microbiota, mainly in health professionals⁽²⁻³⁾. A study among health professionals estimated that this bacteria has colonized between 20% and 30% of these professionals and appoints them as important infection sources for susceptible individuals⁽⁴⁾.

Research developed to explain the transmission dynamics of these microorganisms appoint that this can occur person-to-person (cross-infection or colonization), through indirect contact (aerosols, secretions, dust, fomites and food) or direct contact, when the transfer depends on a source (patients or carriers) and on the rate of microorganisms released, which in turn is related to agent's ability to survive and pathogenesis, to the presence of susceptible individuals and the contact frequency between susceptible and infected/colonized individuals^(3,5).

There has been growing concern with the dissemination of *S. aureus* in the hospital environment and in the community, and has been the focus of different authors since the 1960's⁽⁶⁻⁸⁾. Infection episodes by this bacterial are frequently reported in critical hospital units (burns sector, nursing wards, intensive care units and surgical clinical) and are associated with the inadequate use of antimicrobials, incorrect hand washing, insufficient number of nursing professionals and presence of asymptomatic carriers among health professionals⁽⁹⁾. Despite its relevance, little study has been done on this event in the Brazilian Northeast, demanding research to support the establishment and monitoring of control actions, minimizing these microorganisms dissemination potential and, consequently, reducing hospital infections.

This study aimed to identify the prevalence of colonization by *Staphylococcus aureus* among nursing professionals from a teaching hospital in Pernambuco, as well as to assess the resistance profile of these isolated strains.

METHOD

Study population

This study was conducted at the *Hospital das Clínicas* in Pernambuco, Brazil, between March and July 2007. During this period, all nursing professionals working at the surgical center, intensive care units and nephrology/hemodialysis sector were assessed, including 49 nurses, 52 nursing technicians and 50 nursing auxiliaries, totaling 151 professionals. Approval for this study was obtained from the Institutional Review Board at *Universidade Federal de Pernambuco* – CAAE No 0275.0.172.000-06. All participants were informed about the research aims. After they had signed the Informed Consent Term, biological

samples were collected and a specific questionnaire was applied. Through the questionnaire, the following variables were assessed: age, gender, professional category, work sector, time on the job, use of individual protection equipment (IPE) and number of IPE used.

Collection, isolation and microbiological procedures

The biological samples from the professionals' palmar/interdigital region of both hands and nasal cavity were collected during work, using sterile swabs. After the collection, the material was immediately transported to the microbiology lab at *Universidade Federal de Pernambuco*, in tubes with Brain Heart Infusion (BHI). Next, the samples were cultured with 5% sheep blood and incubated at 35°C for 24 hours. After this period, suspected *S. aureus* colonies were identified through Gram coloring and biochemical tests with the following phenotypes: catalase test (+); tube coagulase test (+); DNase (+) and cultivation in 7.5% mannitol-salt agar (+).

The sensitivity profiles of the isolated *S. aureus* were determined through the Kirby Bauer technique, according to the Clinical and Laboratory Standards Institute (CLSI) criteria⁽¹⁰⁾. The following antimicrobials were used:

penicillin (10µg), oxacillin (1µg), clindamycin (2µg), sulphamethoxazole/trimetoprim (25µg), chloramphenicol (30µg), gentamycin (10µg), mupirocin (5µg), ceftiofur (30µg), linezolid (30µg), vancomycin (30µg), teicoplanin (30µg), rifampicin (5µg) and erythromycin (15µg). The diameters of the incubation halos were interpreted after 24 hours of incubation at 35°C. Isolated with oxacillin-resistant phenotypes through the disk diffusion technique, they were submitted to confirmation through the screening test in a plate with Mueller-Hinton agar, 4% NaCl and 6µg of oxacillin per mL.

Statistical analysis

Epiinfo® 6.04 software was used for data entry and analysis. Statistical analysis involved frequency determinations of the study variables, as well as the identification of possible risk factors for nursing professionals' colonization by *S. aureus*, using odds ratio analysis. Associations with p-value < 0.05 were considered statistically significant.

RESULTS

In this study, 302 biological samples were obtained from the hands (151) and nasal cavity (151), collected from 151 nursing professionals, in three distinct categories. Among the professionals assessed, the general prevalence of *S. aureus* colonization corresponded to 25.8%. Out of 39 colonized individuals, 25.6% presented colonization of the hands only, 48.8% of the nasal cavity only and 25.6% in both research sites. Descriptive analysis demonstrated that, out of 151 examined individuals, 14.6% were

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male and 85.4% female, with a mean age of 32.2 ± 8.5 years. These professionals were distributed across the ICU (42.4%), surgical clinics (41.7%) and nephrology/hemodialysis service (15.9%). Regarding IPE use, 56.3% of the professionals confirm that they always use the equipment

during procedures (Table 1). Among the research variables, age range and number of IPE used were associated with the outcome (colonization). Regarding IPE use, professionals who indicated using one IPE only referred to gloves.

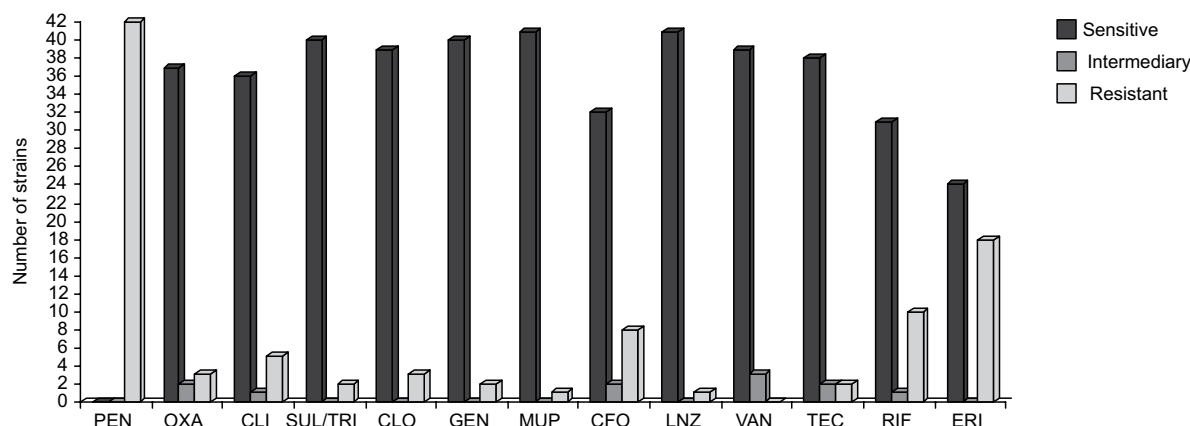
Table 1 – Epidemiological profile and risk factors for *Staphylococcus aureus* colonization in nursing professionals at a teaching hospital in Pernambuco, Brazil

Variables	Colonized		Not colonized		OR (95%CI)	p
	N	%	N	%		
Gender						
Male	22	14.6	6	27.3	1.09 (0.35-3.30)	0.92
Female	129	85.4	33	25.6	1	
Age						
20 - 28	46	30.5	16	34.8	3.84 (1.14-13.71)	0.00*
28 - 33	31	20.5	9	29.0	2.95 (0.76-11.82)	0.14
33 - 44	41	27.2	5	12.2	1	
> 44	33	21.8	9	27.3	2.70 (0.71-10.74)	0.17
Professional category						
Nurse	49	32.4	13	26.5	1.14 (0.42-3.12)	0.95
Nursing technician	52	34.4	14	26.9	1.17 (0.44-3.13)	0.91
Nursing auxiliary	50	33.2	12	24.0	1	
Sector						
ICU	64	42.4	16	25.0	1	
Surgical clinics	63	41.7	16	25.4	1.02 (0.43-2.45)	0.87
Nephrology/hemodialysis	24	15.9	7	29.2	1.17 (0.38 3.93)	0.90
IPE use						
Always	85	56.3	17	20.0	1	
Sometimes	66	43.7	22	33.3	1.29 (0.60 2.82)	0.60
Number of IPE						
1 IPE	12	7.90	6	50.0	4.14 (0.99-17.68)	0.05*
2 IPE	67	44.4	19	28.4	1.64 (0.70-3.89)	0.30
3 IPE	72	47.7	14	19.4	1	

OR: Odds Rates, CI: Confidence Interval, *Reference Group, *p<0.05: Statistically significant.

The sensitivity profile analysis demonstrated that 100% of the isolated *S. aureus* strains were penicillin-resistant and that greater sensitivity was observed with regard to mupirocin (97.6%) and linezolid (97.6%). As for vancomycin, three samples (7.14%) showed intermediary resistance. Also, three samples with a resistant phenotype and two with intermediary oxacillin resistance were observed (Picture 1). All samples resistant or with intermediary resistance

to oxacillin displayed resistance in the plate screening technique for oxacillin. Concerning the other antimicrobial agents, 11.9% of resistance was observed against clindamycin, 4.8% against sulphamethoxazole/trimetoprim, 7.1% against chloramphenicol, 4.8% against gentamycin, 2.4% against cefoxitin, 2.4% against teicoplanin, 23.8% against rifampicin and 42.8% against erythromycin.



Antimicrobials: PEN, penicillin; OXA, oxacillin; CLI, clindamycin; SUL/TRI, sulfphamethoxazole/trimetoprim; CLO, chloramphenicol; GEN, gentamycin; MUP, mupirocin; CFO, cefoxitin; LNZ, linezolid; VAN, vancomycin; TEC, teicoplanin; RIF, rifampicin; ERI, erythromycin.

Picture 1 – Antimicrobial susceptibility profile of *Staphylococcus aureus* strains isolated from nursing professionals at a teaching hospital in Pernambuco, Brazil

All five oxacillin-resistant samples were collected from the nasal cavity. One was collected from a pediatric ICU nurse, two from nursing technicians, one from a surgical center nurse and another from the general ICU, while two others had been collected from nephrology/hemodialysis service auxiliaries.

DISCUSSION

Staphylococcus aureus is acknowledged as one of the main virulent agents. It is considered a persistent member of the human endogenous microbiota and related to important infectious processes. This microorganism stands out among both hospital and community infection causes. Despite the relevance of this bacteria as an etiological agent of nosocomial infections and the importance of health professionals as important disseminators of this microorganism, little research has been developed in Brazil in this regard⁽¹¹⁾.

In this study, the observed colonization prevalence rate (25.8%) among nursing professionals figures between the limits established in literature⁽¹²⁾, which appoints between 20% and 40% of *S. aureus* carriers. In the study population, no statistically significant differences were observed regarding colonization according to professional categories. A study in the United States that involved nurses and nursing residents demonstrated a *S. aureus* colonization rate of 62%, which is considered high⁽¹³⁾. In Brazil, a research on nursing students showed a prevalence level similar to that in our research (26.7%)⁽³⁾. In 2008, a study about *S. aureus* colonization among health professionals from critical units of a teaching hospital in Pernambuco state evidenced 50% of colonization among laboratory technicians and physical therapists ($p < 0.05$)⁽⁸⁾.

Colonization by methicillin-resistant *S. aureus* (MRSA) was observed in five professionals (3.3%). This prevalence is in line with another research, which identified a MRSA prevalence rate of 2.6% among health professionals. These research results contrast with most literature data, which appoint high MRSA colonization rates, ranging between 17% and 40%⁽¹⁵⁻¹⁶⁾. A study at a Brazilian teaching hospital in São Paulo evidenced a MRSA colonization rate of 4.1% among health professionals⁽¹⁷⁾.

The results of this sensitivity test revealed that 100% of isolated *S. aureus* strains were resistant to penicillin G. The bacteria's resistance to this antimicrobial corresponds to almost 100% in most sites where it was analyzed⁽¹⁸⁾. This fact makes it unfeasible to use these drugs for staphylococcus infection treatment, even if caught outside the hospital environment. Based on the present research results, the impact of indiscriminate antimicrobial use is perceived; i.e., greater resistance to more routinely available drugs was observed, which is the case of erythromycin.

For vancomycin, the preferred drug to treat severe staphylococcus infections, where the microorganism re-

vealed to be MRSA, no resistant strains were identified. Three samples, however, demonstrated intermediary resistance. Thus, it is important to monitor these strains at the study location. A research that involved to medical and nursing teams at the ICU, medical clinic, surgical clinic, gynecology/obstetrics and surgical center of a health institution in Goiás evidenced a sensitivity rate of only 53.3% among isolated *S. aureus* strains⁽¹¹⁾. Studies appoint that resistance against the glycopeptide vancomycin should preferably be determined through more sensitive techniques, such as the plate screening technique, the minimum inhibitory concentration determination test (E-test) or genotypic detection⁽¹⁹⁾.

The research variables (gender, professional category, work sector and IPE use) showed no relation with *S. aureus* colonization ($p > 0.05$). Ages between 20 and 28 years and using only one IPE during care procedures appeared as risk factor. Previous studies have demonstrated that, in nursing students, previous involvement in hospital activities does not represent a predisposing factor for *S. aureus* colonization⁽³⁾. According to the present study, in the age range at risk (20 to 28 years), individuals present approximately 3.8 times more chance of colonization. This fact is probably due to the need to consolidate concepts that actually happen in professional practice, such as adequate hand washing before and after each procedure for example. A research at a pediatric unit of a public hospital appoints the inappropriate decontamination process of aerosols as a risk factor for catching pathogenic microorganisms, including *S. aureus*⁽²⁰⁾. A study in the Brazilian Southeast appoints MRSA dissemination control and prevention as essential for nursing practice and patient safety. The same study discusses that understanding and awareness about being a potential disseminator of this microorganism are fundamental to adopt the measures needed to interrupt these agents' transmission chain in the health care context⁽²¹⁾.

Today, molecular epidemiology tools have permitted great advances in research on infectious processes, mainly to clarify epidemic infection episodes, as these permit the safe identification and characterization of etiological agents, as well as the determination of the isolated strains' clonal origins. This information is essential to clarify this microorganism's dissemination dynamics, as well as to determine effective prophylactic measures. One study that used pulsed-field gel electrophoresis revealed the existence of a same clone circulating among patients and health⁽²²⁾.

CONCLUSION

The present study results appoint that the prevalence of *S. aureus* colonization among the nursing professionals under analysis is considered within acceptable limits. These professionals, however, represent a vulnerable group for colonization by microorganisms with a hospital resistance profile. In their professional practice, they are

directly in contact with potentially colonized patients and medical-hospital materials over extensive periods, which are extremely important in the dissemination process of the bacteria in the hospital context. Therefore, surveil-

lance measures should be adopted with a view to minimizing the transference of this microorganism and, consequently, reducing the risks of nosocomial infections at the study institution.

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