Epidemiological surveillance and susceptibility of *Staphylococcus aureus* among healthcare workers at a reference hospital: preliminary assessment

Vigilância epidemiológica e susceptibilidade de *Staphylococcus aureus* em profissionais de saúde de um hospital de referência: Uma avaliação inicial

RIALA6/1266

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Recebido: 14.10.2009 – Aceito para publicação: 10.03.2010

RESUMO
Infecção/colonização por microrganismos patogênicos em profissionais de saúde (PS) representa uma potencial fonte de transmissão para os pacientes, colegas de trabalho, familiares e comunidade. No presente estudo foi avaliada a prevalência da colonização por *Staphylococcus aureus* em PS de um hospital de referência do Recife, no período de março e julho de 2007, e o perfil de susceptibilidade das cepas isoladas às drogas antimicrobianas. Foi realizado um estudo transversal, no qual os PS de salas cirúrgicas, unidades de terapia intensiva (UTIs), hemodiálise e unidades de nefrologia foram avaliados. O isolamento e a identificação de *S. aureus* foram efetuados de acordo com as orientações do CLSI. O perfil de susceptibilidade da bactéria aos antimicrobianos meticilina e vancomicina foi determinado por meio de técnica de difusão em disco associada à técnica de concentração inibitória mínima (E-test). A prevalência de colonização por *S. aureus* entre os PS foi de 25,7%. Entre as cepas isoladas de *S. aureus*, os maiores percentuais de resistência foram observados frente à penicilina (91,4%), eritromicina (43,1%) e cefoxitina (17,2%). Todos os isolados foram sensíveis à vancomicina. Três cepas foram identificadas como resistentes à meticilina, as quais foram isoladas de auxiliares de enfermagem. Sugere-se que avaliações contínuas sejam realizadas para melhor compreensão da dinâmica de colonização/infecção e redução dos riscos de infecção por esse microrganismo.
Palavras-chave. *Staphylococcus aureus*, Profissionais de Saúde, Epidemiologia.

ABSTRACT
Healthcare professionals (HCPs) are liable to pathogenic microorganisms infection/colonization, which plays an important role as a potential source of transmission to patients, coworkers, relatives and communities. The present study evaluates the prevalence of *Staphylococcus aureus* colonization in HCPs who work at a reference hospital in Recife, PE, and the isolates profiles of susceptibility to antimicrobial drugs. A cross-sectional study was undertaken, and HCPs from operating rooms, intensive care units (ICUs), hemodialysis and nephrology units of the Clinical Hospital of Pernambuco were evaluated. *S. aureus* isolates were identified by standard methods recommended by CLSI and the susceptibility to methicillin and vancomycin was determined by the minimum inhibitory concentration technique (E-test). The prevalence of S aureus observed among HCPs was 25.7%. Among *S. aureus* strains isolates, the highest percentage of antibiotic resistance was observed in penicillin (91.4%), erythromycin (43.1%) and cefoxitin (17.2%). All of the strains were sensitive to vancomycin. Three *S. aureus* methicillin-resistant (MRSA) strains were identified, which were isolated from the nursing aides staff. The prevalence of MRSA found in the present study was lower than those reported elsewhere. These findings suggest that a continuous assessment should be performed for better understanding the dynamics of *S. aureus* colonization/infection in order to reduce the risks of infection by this microorganism.
Key words. *Staphylococcus aureus*, Health Care Workers, Epidemiology.

INTRODUCTION

Staphylococcus aureus infections are associated to considerable morbidity and mortality and represent a serious public health problem. Methicillin-resistant *Staphylococcus aureus* (MRSA) is a ubiquitous pathogen that gives rise to community infection and hospital environment[1]. The glycopeptide agent vancomycin is the drug of choice for the treatment of life-threatening infections caused by multidrug-resistant MRSA strains. However, the threat of developing resistance to vancomycin, the only antimicrobial agent effective against MRSA, is alarming[2].

An important factor in the context of nosocomial infections is the chain of transmission within the hospital environment. Studies point out that the transference of microorganisms among individuals who move around hospital environments (patients and professionals) represents a risk factor for the development of these infections by the patients. Health care workers (HCWs) constitute an important reservoir of *S. aureus* and some studies have reported that the rate of nasal carriage of *S. aureus* ranges from 16.8% to 56.1% among them[3].

By considering the relevance of *S. aureus* as an important pathogen associated with nosocomial infections and related to the colonization of health staff, this paper aims at evaluating the prevalence of colonization by *S. aureus* in HCWs of the Clinical Hospital of the Federal University of Pernambuco (UFPE) and determining the susceptibility to antibiotics, including methicillin and vancomycin.

METHODS

A cross-sectional study evaluating 202 HCWs from operating rooms, intensive care units (ICUs), hemodialysis and nephrology units of the Clinical Hospital of Pernambuco in the period between March and July 2007. This study was approved by the Ethics Committee on Research from the UFPE (CAAE # 0275.0.172.000-06). The data collected were stored and analyzed using version 6.04 of the Epi Info software package (Center for Disease Control and Prevention, Atlanta, GA). Statistical comparisons were made using odds ratios, whenever appropriate. A p value of < 0.05 was considered an indicative of a statistically significant difference.

The biological samples were collected by inserting swabs into both anterior nares and wiped in both hands. They were taken to the laboratory in glass tubes containing Brain Heart Infusion (BHI) and were placed onto agar sheep blood at 5% and incubated at 35°C for 24 hours. After this period, colonies suspected of being *S. aureus* were identified using the Gram stain, catalase, mannitol, DNAase test and coagulase proof in test-tubeand the reading of the latter one occurred after 4 and 24 hours. The antimicrobial susceptibility was performed according to CLSI guidelines by using the diffusion method (Kirby Bauer), with the following antimicrobial impregnated disks[4,5]: penicillin (10μg), oxacillin (1μg), clindamycin (2μg), sulfamethoxazole/trimethoprim (25μg), cloranphenicol (30μg), gentamicin (10μg), mupirocin (5μg), cephoxitin (30μg), linezolid (30μg), vancomycin (30μg), teicoplanin (30μg), rifampicin (5μg) and erythromycin (15μg). The minimum inhibitory concentration to methicillin and vancomycin estimated by the E-test method (Probac Brazil®) was defined as gold standard.

RESULTS

The prevalence of colonization by *S. aureus* was 25.7% (52/202). Among the 52 colonized individuals, 13.6% presented exclusive colonization on the hands, 72.8% presented exclusive colonization in the nasal cavity, and 13.6% of the individuals presented colonization in both anatomic sites evaluated.

In this study, female individuals are more colonized as compared to male. Nevertheless, this difference is not statistically significant. In regards to the age-group, there could be observed that individuals belonging to the age-group 20-28 years old, which is the group with higher prevalence of colonization (33.9%), present approximately, 3.5 times greater probability of being colonized (IC 95% 1.25-10.20) as compared to the age-group that present lower prevalence, which is made of individuals with ages between 33 and 44 (12.7%) (Table 1).

From the health staff studied, 3.5% (3/202) were colonized by Methicillin-resistant *S. aureus* (MRSA), two nursing aides from neonatal ICUs and one from the operating room. All *S. aureus* lineages found were sensitive to vancomycin, and 53 (91.4%) were penicillin-resistant. The rate of resistance to erythromycin was 43.1% and to cephoxitin was 17.2% (Table 2).

Table 1. Colonization by *Staphylococcus aureus* among Health Care Workers of Clinical Hospital of Pernambuco, from March to July of 2007

Variables	Total		Colonized		Non colonized		OR (CI)	*p*
	N	%	n	%	n	%		
Gender								
Male[1]	36	17.8	8	22.2	28	77.8	1	
Female	166	82.2	44	26.5	122	73.5	1.26 (0.50-3.29)	0.75
Age (years)								
20 |- 28	62	30.7	21	33.9	41	66.1	3.51 (1.25-10.20)	0.01*
28 |- 33	41	20.3	12	29.3	29	70.7	2.84 (0.90-9.13)	0.08
33 |- 44[1]	55	27.2	7	12.7	48	87.3	1	
> 44	44	21.8	12	27.3	32	72.7	2.57 (0.82-8.21)	0.11
Professional Activity								
Doctors[1]	39	19.3	7	17.9	32	82.1	1	
Nurses	49	24.3	13	26.5	36	73.5	1.65 (0.53-5.28)	0.48
Nursing aids	102	50.5	26	25.5	76	74.5	1.56 (0.57-4.43)	0.46
Others (Physiotherapist and Lab Technician)	12	5.9	6	50.0	6	50.0	4.57 (0.93-23.49)	0.05*
Sector								
IUCs[1]	86	42.6	21	24.4	65	75.6	1	
Surgical Clinics	84	41.6	22	26.2	62	73.8	1.10 (0.52-2.32)	0.92
Nephrology/ Hemodialysis	32	15.8	9	28.1	23	71	1.21 (0.44-3.30)	0.86

OR: Odds Ratios, IC: Confidence interval, [1]Reference Group, *$p < 0.05$ was considered statistically significant

Table 2. Susceptibility antimicrobial observed to *S. aureus* strains HCWs of Clinical Hospital of Pernambuco, Brazil, period March – July 2007

Antimicrobial	Diffusion Method Technique						MIC	E-test			
	Susceptible		Intermediate		Resistant			Susceptible		Resistant	
	N	%	N	%	N	%		N	%	N	%
Penicillin	5	8.6	-	-	53	91.4	-	-	-	-	-
Oxacillin	49	84.5	4	6.9	5	8.6	≥ 4	2	40.0	3	60.0
Clindamycin	50	86.2	1	1.7	7	12.1	-	-	-	-	-
Sulfamethoxazole/ Trimethoprim	56	96.5	-	-	2	3.5	-	-	-	-	-
Cloranphenicol	54	93.1	-	-	4	6.9	-	-	-	-	-
Gentamicin	56	96.5	-	-	2	3.5	-	-	-	-	-
Mupirocin	55	94.8	-	-	3	5.2	-	-	-	-	-
Cephoxitin	45	77.6	3	5.2	10	17.2	-	-	-	-	-
Linezolid	57	98.3	-	-	1	1.7	-	-	-	-	-
Vancomycin	54	93.1	4	6.9	-	-	≥ 32	4	100.0	-	-
Teicoplanin	51	87.9	5	8.6	2	3.5	-	-	-	-	-
Rifampicin	42	72.4	2	3.5	14	24.1	-	-	-	-	-
Erythromycin	31	53.4	2	3.5	25	43.1	-	-	-	-	-

DISCUSSION

In this study, biological samples from the hands and nasal cavity of HCWs were evaluated. In regards to the anatomic sites, a greater rate of *S. aureus* was observed in the nasal cavity, confirming that this ecological niche of *S. aureus* is important for nosocomial infections[3].

Recent studies have shown that the prevalence of colonization by MRSA, in HCWs, changes according to the location and to the characteristics of each hospital[6]. For instance, in a Slovenian institution, the prevalence was of 2.6%[4]. Eveillard et al[7] found that the percentage was of 6.2% and Wang et al[8] verified a rate of 8.3%. In Brazilian hospitals, a research performed by Busato et al[9] in a Public Hospital of Santa Catarina, described a 31,5% prevalence of colonization, meanwhile, a study conducted in the Federal University Hospital of São Paulo found a lower rate, 12.1%[10]. These results contrast with another study

conducted in an Iranian hospital that, has made evident a higher rate of colonization (31.1%)[11].

The health staff colonized by MRSA was nursing aides. This result corroborates similar studies, which had shown that among health staff colonized by MRSA, the nursing aides are the one most attacked, with a prevalence of 61.5%[12].

The prevalence of MRSA in the present study was lower than the results described in the literature. The two MRSA positive were from the ICUs and the other from the operating room department. Rahbar et al[11] also described a higher prevalence of MRSA carriage in HCWs in operating rooms and ICUs.

Infections occurring in Japan and United States caused by strains of *S. aureus* with reduced susceptibility to vancomycin have been described[13]. In Brazil, intermediately resistant vancomycin has been described in patients but there are scarce studies with HCWs colonization[14]. In the present study resistant vancomycin strains are not found. However, it is important to examine this microorganism as a measure to reduce the risk for employees within the hospital environment.

In this study, we could document the prevalence of *S. aureus* colonization in HCWs in a Hospital in Recife, Brazil (25.7%) and that MRSA was more prevalent in nursing aides.

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