ORIGINAL ARTICLE

Screening of nasal carriage of methicillin-resistant *Staphylococcus aureus* during admission of patients to Frantz Fanon Hospital, Blida, Algeria

Mohamed Amine Ouidri
University of Blida, Blida, Algeria

Abstract

A study was performed of *Staphylococcus aureus* and methicillin-resistant *S. aureus* (MRSA) strains isolated from nasal preoperative samples. Of 663 samples assessed, staphylococcus was detected in 143 (21.57%). The disc diffusion method (cefoxitin 30 µg), a screening test (oxacillin 6 µg/mL) and a search for Protein Binding Additional Penicillin 2 (PLP2a) allowed the detection and confirmation of resistance to methicillin for 36 strains, a rate of 5.43% of the total population studied. Eight MRSA carriers received care in the trauma service, 14 in cardiology, five in ear, nose and throat, four in neurosurgery and paediatrics, and one in SCI. Thirty-six methicillin-resistant of the nasal portage strains are in their great majority, 27 of 36, rather limited multi-R character (two to three families namely resistance: tetracyclines, fluoroquinolones, aminoglycosides, macrolides). One of the MRSA strains was found to have intermediate sensitivity to vancomycin.

Keywords: Antibiotic resistance, Healthy volunteers, MRSA, Prevalence, *Staphylococcus aureus*
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M. A. Ouidri, University of Blida, Ouled Yaïch, Blida, Algeria.
E-mail: moam606@yahoo.com

Introduction

Staphylococcus aureus is classified as one of the most common pathogens causing nosocomial infections [1]. Because of its virulence and its resistance to the usual antibiotics, this bacterium occupies great importance in human pathology. This saprophytic, ubiquitous species is present in humans in the commensal state. Twenty-five to 50% of individuals are healthy yet carry *S. aureus* in their nasal cavities, skin flora or mucosa. Along with *Escherichia coli* and *Pseudomonas aeruginosa, S. aureus* is the most frequently isolated bacterium in in-hospital sampling [2]. In the general population, the prevalence of permanent nasal carriage is between 20% and 25%, whereas transient colonization by this bacterium affects at least 60% of the remaining population [3]. *S. aureus* rapidly adapted to the selective pressure of antibiotics, leading to the diffusion of methicillin-resistant *Staphylococcus aureus* (MRSA) strains, which are responsible for approximately 30% of nosocomial infections [4].

In Algeria, MRSA accounts for 45.6% of strains isolated in hospitals, compared to 27.9% for those of external origin [5]. In Blida, a study published in 2007 on the prevalence of MRSA nasal carriage among 1005 patients indicated that 45 (4.478%) had a MRSA strain [6]. The recommended sampling for MRSA is nasal sampling [7] because the anterior nasal cavity is one of the preferred carrier sites of this bacterium, and the frequency of skin portage depends on nasal carriage [8]. Laboratory screening is based on evidence of *Staphylococcus aureus* resistance to methicillin. Several different techniques for rapid *in vitro* detection of the resistance to methicillin of staphylococci have been developed. They included phenotypic techniques using sensitized latex to detect PLP2a [9]; screening tests for oxacillin and cefoxitin; and genotypic techniques searching for the *mecA* gene by classical PCR [10,11] as well as by real-time PCR [12,13].

The objectives of this study were the isolation, identification and prevalence of strains of *S. aureus* collected from the nasal cavity by swab in different services in Frantz Fanon Hospital, Blida, Algeria; and the determination of the prevalence of MRSA and resistance associated with MRSA. Screening of patients at

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TABLE 1. Relationship between variable risk factors and carriage of *Staphylococcus aureus* by age, sex and history of patients and hospitalization service

Variable	Chi-square test	p	Statistically significant
Sex	0.16	0.6891	No
Age	11.48	0.0093	Yes
Previous hospitalization	3.02	0.0822	No
Catheter or other material insertion	10.94	0.0042	Yes
Previous antibiotic therapy	5.30	0.0213	Yes
Service	7.19	0.2068	No

admission and during hospitalization identified subjects with asymptomatic MRSA. This screening strategy is a major component of any control programme [14]. This study proposes a strategy to prevent infection.

Results

Presentation of data

The present study involved a sample of 663 specimens taken from hospitalized patients and from patients before 48 hours of their admission to the hospital, divided as follows. Of the 663, a total of 389 subjects were male and 274 female. Patients were grouped into four major age groups: 12.52% were aged 0 to 15 years; 24.89% were aged 15 to 40 years; 34.99% were aged 40 to 60 years; and 27.60% were aged 60 years and over. A total of 319 people had already been hospitalized, and 197 people had a history of catheter or other material insertion, or a history of disease. Forty-two people had already received an antibiotic. A total of 222 patients were hospitalized in the trauma service, 278 in cardiology, 41 in neurosurgery, 72 in ear, nose and throat (ENT), 33 in paediatrics and 17 in infant surgery. Of the 663 patients studied, 143 (21.57%) were carriers of *S. aureus*. Of the 143 strains of *S. aureus,* 86 strains were found in male subjects and 57 strains in female subjects (sex ratio of 1.51). During the experimental period, the positive cases occurred in patients in different age groups. Subjects aged between 40 and 60 years occurred most often, with 48 cases in this age group of a positive culture for *S. aureus,* followed by 44 cases in subjects aged 60 years and older.

The percentage of nasal carriage according to hospitalization was 24.45%. The percentage of nasal carriage as a function of antecedents was 47.51%. The prevalence of *S. aureus* nasal carriage as a function of previous antibiotic therapy was 35.71%. The percentage of nasal carriage according to service was 17.78% in trauma service, 21.94% in cardiology, 19.51% in neurosurgery, 25.00% in ENT, 27.27% in paediatrics and 41.18% in infant surgery.

TABLE 2. Investigation of resistance of *Staphylococcus* spp. to oxacillin and interpretation of tests (dissemination method).

Organism	Antibiotic		Interpretation
	Oxacillin (1 µg)	Cefoxitin (30 µg)	
S. aureus	≥13 mm	≥22 mm	OXA S strain
	≤12 mm	≤21 mm	OXA R strain

Data from République Algérienne Démocratique et Populaire et al. [5].
OXA, oxacillin; R, resistant; S, susceptible.

Statistical analysis by chi-square test revealed the absence of a statistically significant relationship among sex, service and nasal carriage of *S. aureus.* However, a significant relationship was demonstrated for age, previous antibiotic intake and hospitalization history ($p \leq 0.05$) (Table 1).

Prevalence of MRSA

Research identified 36 MRSA strains. Different techniques can be used to investigate resistance to oxacillin and are summarized in Table 2.

Antibiogram by diffusion of cefoxitin and oxacillin discs. For *S. aureus,* the cefoxitin disc test is comparable to that of oxacillin to detect resistance to oxacillin by production of PLP2a (*mecA* gene); however, the cefoxitin disc is easier to read, and this is therefore the preferred method. In practice, oxacillin (1 µg) and cefoxitin (30 µg) must be tested simultaneously at the level of the *S. aureus* standard antibiogram for better resistance detection. The principle is as follows: It is an examination which makes it possible to evaluate the sensitivity of the bacterium studied with regard to the antibiotics to which it is brought into contact. It consists of placing the bacterial culture (the subject of the test) in the presence of the antibiotics under study, and observing the development and survival. The effect exerted by the antibiotic on the culture results in an area of inhibition, the diameter measurement of which makes it possible to decide on the strain's sensitivity and resistance to that antibiotic. The antibiogram is performed on Muller-Hinton medium, which allows the homogeneous diffusion of antibiotics.

Search for PLP2a. The search for PLP2a (induced protein) by Slidex MRSA (bioMérieux, Marcy l'Etoile, France) was carried out on colonies taken from the border of the inhibition zone of a cefoxitin disc after 24 hours' incubation. As with any antigen–antibody reaction, the kit reagents should be brought to room temperature before use. After extraction of the protein (according to the manufacturer's recommendations), a rapid slide agglutination test is performed using latex particles sensitized by a monoclonal antibody against PLP2a. These particles will react with the extracted PLP2a, which are optionally present.