Advanced Journal of Microbiology Research Volume 2013
Available online at http://advancedresearchjournals.org/AJMR

Full Length Research Paper

Prevalence and transmission of methicillin-resistant *Staphylococcus aureus* (MRSA) at the intensive care unit of Domat Al-Jandal Hospital, Al-Jouf, Saudi Arabia

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Accepted 28 October 2012

Methicillin-resistant *Staphylococcus aureus* (MRSA) often colonize the anterior nares. Nasal carriage thus remains the main source of bacterial dissemination. The prevalence and rate of acquisition of methicillin-resistant *S. aureus* in patients admitted to the intensive care unit (ICU) of Domat Al-Jandal Hospital were studied over one year in order to estimate the possible risk for those, who are initially free of the organism, of acquiring MRSA infection while maintained in the ICU. Of the 160 patients, 15 (9.4%) were colonized with MRSA in their anterior nares on admission to the ICU. Six of 140 (4.3%) patients were positive for MRSA in their blood cultures, while nine of 60 (15%) had MRSA in their wound cultures (Table 1). Eleven patients (7.1%) were initially negative, but acquired MRSA while they were at the ICU. Antibiotic sensitivity testing identified 30 (18.8%) *S. aureus* strains to be resistant to oxacillin, while all the strains were susceptible to vancomycin. In conclusion, screening of ICU patients for *S. aureus* colonization and infection, accompanied by antibiotic sensitivity testing of cultured isolates, is important to understand its epidemiology, and to develop preventive measures and treatment strategies.

Key words: Methicillin-resistant, *Staphylococcus aureus* (MRSA), Intensive care unit (ICU), carriage.

INTRODUCTION

Methicillin-resistant *Staphylococcus aureus* (MRSA) was first described in the 1960s (Jevons, 1961), and it is presently endemic in many hospitals (Vincent et al., 1995). The existence of MRSA strains have largely been confined to hospitals and long-term care facilities, but are also emerging in the community (Vandenesch, 2003). The worldwide emergence of community-acquired methicillin-resistant *S. aureus* (CA-MRSA) can have severe public health implications. As a human pathogen, it can cause a variety of nosocomial and community-acquired infections, ranging from minor skin abscesses to serious, potentially life-threatening disease (Wannet et al., 2003). The differentiation between community-acquired MRSA and hospital- acquired MRSA (HA-MRSA) has been difficult, since CA-MRSA can also spread into hospitals (Calfee et al., 2003). Infection and colonization with MRSA may be more frequent in the intensive care units (ICUs) than in general wards (Hardy et al., 2004). The possible risk of acquiring MRSA infection in ICUs is dependent upon the severity of illness (Ibelings and Bruining, 1998), length of stay (Law and Gill, 1988), use of intravascular devices (Pujol et al., 1994), and the intensity of exposure to infected patients (Merrer et al., 2000). Hence, complete and accurate characterization of cultured isolates to the species-level, along with antibiotic sensitivity testing, is crucial in patients at risk to being infected with these bacteria, e.g. those admitted to ICUs.

The aim of this study was to determine the prevalence of MRSA in patients admitted to our ICU and to estimate the risk, for those initially free of the organism, of acquiring MRSA while in the unit.

MATERIALS AND METHODS

Clinical cases

The study was conducted at the ICU of Al-Jouf province, Domat Al-Jandal Hospital, Saudi Arabia, over a period from February 2007 to March 2008. A total of 160 ICU patients were screened for MRSA carriage and infection. Blood samples, as well as wound and nasal swabs were taken from all patients on admission and at weekly

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Table 1. Distribution of positive MRSA in ICU cases by time and site.

Time	(+ve) MRS	Nasal swab	Blood culture	Wound swap	Total
	On admission	14n = 160	2n = 140	3n = 60	19
	2nd week	0	1	1	2
	3rd week	1	3	5	9
	Total	15(9.4%)	6(4.3%)	9(15%)	Total No = 30

MRSA = Methicillin-resistant *Staphylococcus aureus.*
ICU = Intensive care unit.

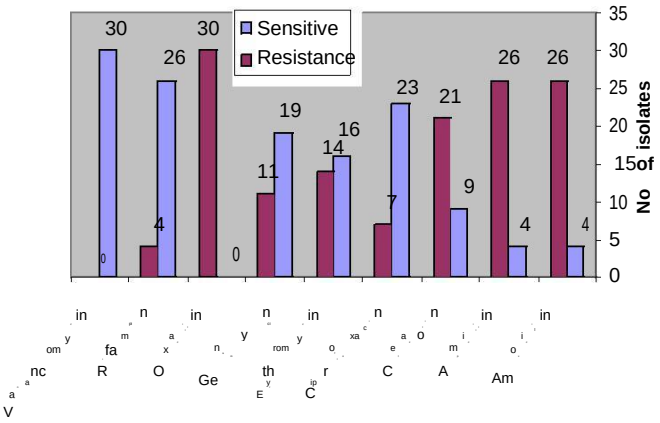

Figure 1. Susceptibility of MRSA isolates (*n* = 30) to different antibiotics.

intervals thereafter.

METHODS

One-hundred-and- sixty (160) nasal and 60 wound swabs were streaked primarily on blood and mannitol salt agar, and incubated at 37°C for 24 and 48 h, respectively. The continuous-monitoring blood culture system (BD Bactec R 120, Becton-Dickinson Co., Shannon, Ireland) was used according to the manufacturer's instructions to isolate the organism from 140 blood samples. Preliminary identification of *S. aureus* strains was performed on the basis of colonial morphology, cultural characteristics on agar media, Gram staining reaction, catalase, coagulase and -lactamase production, using standard methods (Kloos and Bannerman, 1999). Methicillin resistance was detected at the time of initial culture using the disk diffusion method. Antibiotic sensitivity of the isolates initially demonstrating resistance to methicillin was confirmed by using BD Phoenix™ System (Becton-Dickinson Co., Shannon, Ireland) according to recommendations given by the National Reference Centre in Saudi Arabia. The BD Phoenix™ System was used to test the *S. aureus* strains for sensitivity to the following antibiotics: Rifampin, oxacillin, ciprofloxacin, gentamicin, amoxacillin-clavulanic acid, erythromycin, cetazolin, ampicillin and vancomycin.

RESULTS

Results of the present study revealed that 15 of the 160 (9.4%) patients in the ICU were colonized with MRSA in their anterior nares. Six of 140 (4.3%) patients were positive for MRSA in their blood cultures, while nine of 60 (15%) patients had MRSA in their wound cultures. Eleven patients (7.1%) that were initially negative acquired MRSA while they were at the ICU. Patients showing positive nasal carriage on admission was not included in the subsequent weekly-interval examination for nasal culture, but they were tested for wound and blood cultures. Antibiotic sensitivity testing identified 30 (18.8%) *S. aureus* strains to be resistant to oxacillin, while all the strains were susceptible to vancomycin. Among the MRSA isolates, the resistance rates are shown in Figure 1.

DISCUSSION

The present study highlights the scope of the problem posed by MRSA in ICUs, and estimates the risk degree for those, initially free of the organism, to acquire MRSA while they are maintained at the ICU. The prevalence (11.9%) of MRSA in the present clinical cases at the time of admission is comparable to that reported in other studies that were based on routine screening (Girou et al., 1998). The 7.1% of previously negative patients with positive cultures in ICU, underestimates the true incidence. The weekly screening cycle was used to estimate the acquisition rate as a function of time. The acquisition rate is the proportion of those MRSA- negative cases at the start of a given week to those who are positive at the end of that week. Consequently, the risk of acquiring MRSA was 1.3% at the second week and 6.0% at the third week. Therefore, it is concluded that the risk of acquiring MRSA while in ICU is largely dependent upon the length of stay.

In this study some patients acquired MRSA in spite of absence of known positive patients at the unit. Possibly there were some MRSA-positive patients who were not identified by weekly nasal swabs (Lucet et al., 2003). Nearly 12% of our admissions were MRSA-positive; this constituted a reservoir of infection that was constantly refreshed. Eradication of a resistant organism requires exclusion of infected patients from the ICUs (Sebille et al., 1997). Additionally, segregation and treatment of infected patients can reduce the spread of infection (Girou et al., 1998). Only a minority of positive patients was known before admission to ICUs and it takes time to identify the remainder. Besides, nasal swabs did not de-detect all the colonized patients (Lucet et al., 2003). Side-rooms and a separate cohort of nurses are not always

available. Good basic hygiene and hygienic hand disinfection, in particular, plays an important role in reducing cross-infection rates (Rampling et al., 2001; Pittet et al., 2000).

The currently applied measures to prevent the spread of MRSA and consequently, progression to bacteraemia enjoyed limited success, and their vigorous application might be neither practicable nor beneficial (Van Saene et al., 2004). It was found that a length of stay greater than one week poses a high and continuing risk of both acquiring MRSA and progressing from just carriers to seriously infected cases. There is no evidence that in those high-risk patients treatment of MRSA carriage with vancomycin, in addition to the standard control-of-infection practice, is effective and safe (Rello et al., 1994). Clinicians responsible for patients in ICUs need expert advice on the wider application of this promising treatment.

There is recent evidence indicating that the epidemiology of MRSA may undergo a change through the appearance of community- acquired MRSA (CA-MRSA). This represents a group of staphylococci of progressive clinical significance due to their significant pathogenic potential and their ability to cause life-threatening infections in otherwise healthy people (Ala Aldeen, 2002; Vandenesch, 2003; Faria, 2005).

There is accumulating literature data indicating that most *S. aureus* isolates responsible for infections are of endogenous origin (Toshkova, 2001; Peacock, 2002). Nevertheless, the recent data emphasize that particular attention should be paid not only to colonization with MRSA isolates, but also to methicillin-sensitive*. S. aureus* colonization, since both groups of microorganisms may precede the development of invasive infections such as bacteremia (Archer and Climo, 2001). The results of our study indicate that the MRSA carriage rate among the examined patients was 15 (9.4%) . MRSA isolates were identified during the investigation by their resistance to oxacillin, as evidenced by the disc diffusion method, and confirmed by the automated BD Phoenix ^{TM} System. There was a lack of multi-drug resistance, which has been considered a characteristic feature of nosocomial MRSA. Okuma (2002) and Diep (2004) suggested that currently isolated strains might be members of CA-MRSA, since this group of staphylococci is commonly susceptible to the majority of other non- -lactam antibiotics (Fey, 2003).

Conclusion

In conclusion, patients included in our study were screened for *Staphylococcus* colonization of the nasal mucosa, as well as invasive infections. The colonization and invasive frequency determined in the study indicates the usefulness of the investigation to develop preventive measures and treatment strategies in cases of established infections among predisposed patients.

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