Nepal Journal of Science and Technology Vol. 13, No. 2 (2012) 185-190

Prevalence of Methicillin-Resistant *Staphylococcus aureus* in Hospitals of Kathmandu Valley

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Abstract

Present study was conducted to determine the prevalence of nosocomial pathogen methicillin resistant *Staphylococcus aureus* in hospital environment samples (surface swabs and air, n=188) and health care workers (nose and hand, n=162) of hospitals located in Kathmandu valley. The samples were studied following the standard protocols. Of the 61 *S. aureus*, 20.9% and 14.3% were isolated from health personnel and hospital environment respectively. Of 20.9% *S. aureus* in hospital environment, 6.6% were isolated from OPD and 17.9% from wards. Similarly, in HCWs 28.3% and 13.5% were hand and nasal carrier respectively. In total, 45.9% were MRSA. Among MRSA isolates, 50% were from HCWs whereas, 40.7% from hospital environment. The most effective antibiotic for all isolates was vancomycin with 100% efficacy. The isolates had relatively high rate of resistance to cefixime (44.0%), followed by co-trimoxazole (28.0%), erythromycin (23.0%), gentamicin (18.0%), tetracycline (16.0%) and ofloxacin (8.0%). Since MRSA prevalence was not reduced, so indicates regular surveillance of nosocomial infection, hand hygiene improvement strategies and monitoring of antimicrobial susceptibility pattern.

Key words: healthcare workers, hospital environment, methicillin resistant *S. aureus*, nosocomial infection

Introduction

Staphylococcus aureus, a gram positive cocci, is the major cause of both hospital and community acquired infections worldwide (Kluytmans 1998). *S. aureus* is a common pathogenic commensal bacterium, where approximately 60% of the human populations are by it and as high as 20% humans are persistent carriers (Friendship & Weese 2009).

S. aureus causes a range of infections from superficial abscesses and boils to the more serious infections of osteomyelitis, septicaemia and pneumonia. Approximately, 25% of all nosocomial infections are caused by *S. aureus* and leading to increase hospital stay, antibiotic use, costs and mortality (Minties-de Groot *et al.* 2000, Pittet *et al.* 1995).

The incidence of community-acquired and hospital acquired *S. aureus* infections has been rising with increasing emergence of drug-resistant strains called methicillin resistant *S. aureus* (MRSA) (Shakya *et al.* 2010). MRSA is a major cause of morbidity and mortality around the world (Hiramatsu *et al.* 2001) and has become a challenge to the physicians for its treatment which are often multi drug resistant (Crawcraft & Catchpole 2002). Hospital environment (surfaces, air) and carrier (nasal and hand) of healthcare workers may serve as reservoir and transmission occurs from HCWs to patients or among the patients (Boyce *et al.* 1997).

The percentage of hospitals isolation MRSA in the developed countries has increased from 2% in the 1970s to 30% in the 90's (Gordon 1993). In UK, 44.0% of *S. aureus* isolated from health care system are MRSA (Gould 2005) and in Japan 60.0-70.0% of *S. aureus* are MRSA in inpatients (Kikuchi 2003). In Nepal, prevalence of MRSA shows an increasing trend; 29.1% - 68.0% (Rai *et al.* 1990, Shrestha *et al.* 2009, Rijal *et al.* 2008, Khanal & Jha 2010). Therefore, objective of this study was to determine prevalence of MRSA.

Methodology

Sample collection: Hospital environments comprised surface swabs of bed bar, bed sheet, nursing station, cuffs, etc and air samples (taken by plate exposure technique for 20- 25 minutes). Similarly, HCWs comprised swab of palm and web space between fingers of hand (cotton swab dipped in BHI broth) and nasal swab (sterile cotton swab rotated 4-5 minutes clockwise and anticlockwise within nasal cavity). Study design was cross sectional. After proper sampling, the specimens were transported to laboratory of Nat'l Institute of Tropical Medicine and Public Health Research (NITMPHR) and processed immediately.

Sample processing and bacterial identification: Specimens were inoculated into MacConkey Agar (MA), Blood Agar (BA) and Mannitol Salt Agar (MSA) (only for nasal) and incubated at 37^0 C for 24 hours. Gram positive cocci in clusters, catalase +ve, fermentative, manitol fermentor and coagulase +ve were identified as *S. aureus*.

Antibiotic susceptibility test: All the identified isolates of *S. aureus* were undertaken in-vitro antibiotic susceptibility test by using Kirby Bauer's disc diffusion method. The antibiotics used were Cefixime (5mcg/disc), Methicillin (30mcg/disc), Co-trimoxazole (25mcg/disc), Ofloxacin (5mcg/disc), Tetracycline (30mcg/disc), Gentamycin (10mcg/disc), Erythromycin (15mcg/disc), and Vancomycin (30mcg/disc).

Results and Discussion

Of the 350 samples studied, *S. aureus* was isolated from 61 samples (17.4%). The prevalence rate of *S. aureus* in HCWs were 20.9% and hospital environment (14.3%) were found. Out of 61 *S. aureus* isolates, 28 (45.9%) were methicillin resistant. Among them, 17 (50.0%) and 11 (40.7%) were from HCWs and hospital environment respectively (Table 1). Similarly, in hospital environment the prevalence rate of *S. aureus* in OPDs was found to be 6.6% and 17.9% in wards (Table 2). In HCWs, 13.5% and 28.3% were nasal and hand carrier respectively (Table 3).

Among 61 *S. aureus* isolates, 45.9% showed resistant towards methicillin followed by cefixime (44.0%), co-trimoxazole (28.0%), erythromycin (23.0%), gentamicin (18.0%), tetracycline (16.0%) and ofloxacin (8.0%), while none (0.0%) were resistant to vancomycin (Fig. 1).

Table 1. Frequency of *S. aureus* and MRSA from different sample sources

Sample sources	Total samples	*S. aureus* (%)	MRSA (%)
Health-personnel	162	34 (20.9%)	17 (50%)
Hospital environment	188	27 (14.3%)	11 (40.7%)
Total	350	61 (17.4%)	28 (45.9%)

Table 2. Frequency of S. *aureus* from environment samples

Sampling site	Total sample	+ve	%
OPDs	60	4	6.6
Wards	128	23	17.9
Total	188	27	14.3

Table 3. Frequency of *S. aureus* from nose and hand of HCWs

Sample site	Total sample	+ve	%
Hand	81	23	28.3
Nose	81	11	13.5
Total	162	34	20.9

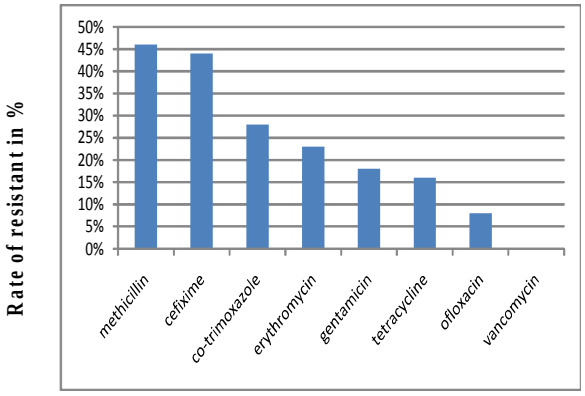

Fig. 1. Resistant pattern shown by total *S. aureus* isolated

MRSA is a global phenomenon with a prevalence rate ranging from 2% in Netherlands and Switzerland, to 70% in Japan and Hong Kong (Fluit *et al.* 2001, Diekema *et al.* 2001). In this study, the prevalence of MRSA was found to be 45.9% which was in accordance with the reports by Rijal *et al.* 2008, Shrestha *et al*. 2009 and Shakya *et al*. 2010. On the contrary, some of the reports show an alarmingly high incidence of MRSA (Khanal & Jha 2010, Ajamal *et al.* 2009). Higher isolation rates reported in these studies can be attributed to several factors. These include indiscriminate use of antibiotics, lack of awareness and failure to observe simple yet effective infection control precautions like strict patient isolation and frequent hand washing by health care personnel, population and area studied, etc.

Present study revealed that the prevalence of MRSA in hospital environment was 40.7% which was higher than reports from Panta *et al.* 2006 and Boyce *et al.* 1997. This was, however, significantly less as compared to the results on clinical samples (Khanal & Jha 2010, Shrestha *et al.* 2009, Verma *et al.* 2000, Ahmad *et al.* 2007. The difference might be due to the reason that clinical isolates showed higher degree of resistance to antibiotics than environmental isolates (Shaffer & Goldin 1969). Similarly present study showed the prevalence of *S. aureus* was high in wards than in OPD. It might be due to large sample size from wards. This report was contrary from Chitwan (Sanjana *et al.* 2010).

The 28.3% hand samples showing *S. aureus* was lower than that has been reported by Zahoor *et al, and* Pant *et al*. among hospital staffs. The lower hand carrier rate among the study subjects observed in this study was indicative of adequate hygienic practice.

The nasal carriage rate of *S. aureus* (13.5%) in the present study was lower than the rate reported (Tejero 1991, Akhtar 2010). Likewise, relatively higher prevalence has been reported in community (Onanuga & Temedie 2011). It might be due the distribution of *S. aureus* which varies according to factors such as population, area of study, the use of different culture technique and different interpretation guidelines, etc.

Report of this research showed *S. aureus* was highly resistant towards â-lactam antibiotics like methicillin and cefixime among the others which were in accordance with the findings of Shakya *et al.* Resistance to quinolones was not high as compared with the reports from Khanal & Jha (2010) and Kumari *et al.* (2008). The low resistance rate in our study was probably due to the samples of hospital environment as well as indiscriminate and empirical use of the drugs in other study.

There was low resistance towards gentamicin which was similar with the reports of Onanuga *et al.* (2005). This may be due to the absence of resistance conferring genes in these MRSA strains as reported by (Polyzou *et al*. 2001).Vancomycin seems to be the only antimicrobial agent which showed 100% sensitivity and so may be used as the drug of choice for treating MRSA infections. Vancomycin is not a commonly prescribed drug, which is almost certainly due to its higher price and its unavailability in many parts of the country.

Small number of MRSA was found from the hospital environment and staff in comparison with other study (Khanal & Jha 2010, McCarthy *et al.* 2010, Vidhani *et al.* 2001). Even though, this findings focuses for cleaning, disinfection and sterilization of hospital environment, and regular surveillance of microbial flora among hospital staff and environment to prevent MRSA transmission among them.

Acknowledgements

We would like to acknowledge Mr. Sudhakar Pant, Mrs Chandra kala Rai and entire staffs of Nepal Police Hospital, Shi-Gan Health Foundation and St. Xavier's College.

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