Research Paper

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Screening of Health Care Workers For Nasal And Hand Carriage of Multi-Drug Resistant Organisms in a Teaching Hospital in Rural Haryana, India

Medical Science

KEYWORDS : Colonisation, methicillin-resistant *Staphylococcus aureus*, extended spectrum beta lactamase producers, health care workers

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ABSTRACT

Infection with multi-drug-resistant bacteria is a common clinical problem in India. Asymptomatically colonized patients and health care workers (HCWs) are the major sources of these multi-drug-resistant organisms in the hospital environment with HCWs being more commonly associated with transmission of these organisms between patients. A prospective study was done to determine the prevalence of bacterial colonization among HCWs. Anterior nasal and skin swabs were collected from 70 HCWs using pre-moistened sterile cotton wool swabs. Samples were cultured on blood agar and MacConkey agar. The plates were incubated at 37°C for 24-48 hours. Identification and antimicrobial susceptibility testing was done using standard bacteriological methods. Of the 70 healthcare workers, 13 (18.6%) carried Staphylococcus aureus, of which 6 were MRSA and 15 (21.4%) carried ESBL producing Gram negative bacteria. Both MRSA and ESBL were more frequently isolated from nurses and OT technicians than doctors and laboratory technicians.

INTRODUCTION

Health care associated infections are a great challenge to all the health care systems worldwide. It is the biggest risk faced by health care providers as well as users in the hospital. Frequently, most of the nosocomial pathogens are multidrug resistant (MDR) which pose serious therapeutic challenges. Asymptomatically colonized patients and health care workers (HCWs) are the major sources of MDR bacteria like methicillin resistant *Staphylococcus aureus* (MRSA), extended spectrum beta lactamase producing Gram negative bacteria (ESBLs) and vancomycin resistant Enterococci (VRE). The role of HCWs in the transmission of infection has been extensively studied by Albrich. (2008) Since HCWs are at the interface between hospitals and nursing homes at one end and community on the other, they may serve as reservoirs for cross transmission of MDR bacteria, with hands being identified as the most important tools in cross transmission as discussed by Luma et al (2012) Infection with MDR organisms results in longer hospitalization, increased expenses and poorer patient prognosis. A targeted surveillance of the HCWs and isolation and treatment of those colonized with MDR organism can minimize their spread in hospitals. This study was, therefore, carried out to know the prevalence of colonization by MDR organisms among HCWs of a teaching hospital.

MATERIALS AND METHODS

The study was carried out at Faculty of Medicine and Health Sciences, SGT University, Haryana. A total of 70 HCWs from various intensive care units; departments of surgery, medicine, paediatric, gynaecology; operation theatres, and diagnostic laboratory were included in the study. HCWs included were doctors, nurses, operation theatre technicians and laboratory technicians. Inclusion criteria applied were; (i) no respiratory illness, (ii) no hospitalization or antibiotic treatment in the last six months. Information regarding age, sex, designation, duration of working in the hospital was collected from all participants. Swabs were collected from anterior nares and interdigital spaces of hand. For collection of sample from anterior nares, a sterile moistened swab was inserted 1 cm deep into each nostril in turn and rotated 5 times. For collection of skin samples web spaces were sampled from both hands using a sterile moistened swab. The swabs were transported quickly in brain-heart infusion broth to the laboratory. The swabs were plated on Blood agar and MacConkey agar and incubated at 37^{0}C for 24-48 hours. *Staphylococcus aureus* was identified on the basis of colony morphology, microscopic appearance on gram stained smears, catalase test, tube coagulase test and mannitol fermentation on mannitol salt agar (MSA). Antimicrobial sensitivity testing was done on Mueller Hinton Agar (MHA) using an inoculum density of 0.5 McFarland standard by Kirby Baeur disk diffusion method. Interpretation of results was done according to CLSI guidelines. [CLSI 2014] Methicillin resistance in *S. aureus* was determined by cefoxitin disc diffusion method on Mueller Hinton agar. A 30µg disc of cefoxitin was used and isolates showing a zone of inhibition of ≤21 mm were considered as MRSA. [CLSI 2014]

Gram negative organisms were identified upto species level on the basis of typical colony morphology and biochemical characteristics. Antimicrobial susceptibility pattern was determined using Kirby-Bauer disc diffusion method. Isolates with cefotaxime, ceftazidime and cefpodoxime zones of inhibition less than 27mm, 22mm and 17mm respectively were suspected to be ESBL producers. A confirmatory test was done using double disk diffusion test according to CLSI guidelines. On a plate of MHA a lawn culture of the isolate was prepared using spread plate technique. A disc of ceftazidime (Ce) was placed and at a distance of 30mm another disc of ceftazidime/clavulanic (Ce-Cl) acid was placed. An increase in zone of inhibition of Ce-Cl disc by 5mm as compared to Ce disc was taken as a confirmatory test for ESBL production.

RESULTS

A total of 140 swabs were collected from 70 HCWs. The age range was between 20 to 65 years; 29 (41.4%) were males and 41 (58.6%) were females; 20 (28.6%) doctors, 20 (28.6%) nurses, 20 (28.6%) operation theatre (OT) technicians and 10 (14.2%) were laboratory technicians.

Overall S. aureus was isolated in 13(18.6%) and coagulase negative staphylococcus in 44 (63%) HCWs. Of the total 13, S. aureus isolates 6 (46.2%) were MRSA. Overall 8.6% HCWs were MRSA carriers. Gram negative bacteria (GNB) were isolated in 22 (31.5%) out of which 15 (68.2%) were ESBL producers. Overall 15 (21.4%) HCWs were carriers of ESBL producing Gram negative

bacilli. Table 1. Maximum rate of isolation of MRSA (30%) and for ESBL (35%) and was seen among the nurses and minimum among the laboratory technicians. Among the 15 ESBL producers, 9 were Klebsiella pneumoniae, 5 were Escherichia coli and 1 was Proteus mirabilis.

Antibiotic sensitivities of *S. aureus* and MRSA are given in Table 2. The sensitivity of *S. aureus* strains ranged from 77% to 92.3% for various antibiotics, and 16.7% to 83.3% for MRSA. All strains of S. aureus including MRSA were sensitive to vancomycin. The sensitivity patterns of all gram negative bacilli and ESBL producing GNB are given in Table 3.

DISCUSSION

Multi drug resistant organisms have evolved as most important causes of hospital acquired infections. Although nasal carriage is harmless in healthy individuals, these carriers pose a risk of transmission of the organisms to the community at large. In case of carriage among the HCWs, transmission to other HCW and the patients can become a serious challenge.

The results of our study indicate the presence of multidrug resistant bacteria among the staff of our hospital. The carriage of MRSA in our study was seen in 8.6% of HCWs. Carriage rate of gram negative bacilli among HCWs was 31.5% and about 68% of these were ESBL producers. The nasal and skin carriage rate of different organisms varied among the different health professionals.

The prevalence of MRSA varies between different institutions and geographic areas. Various studies from India have reported different carriage rates for MRSA ranging from 2% from Chennai as seen by Vinodkumarad ityaa et al (2009), 2.5 % from Mangalore as seen by Radhakrishna M et al (2013), 6.6% from Delhi as seen by Goyal et al (2002), 8.5% from Pondicherry as seen by Mathanraj et al (2009) and 10% MRSA from Bangalore as discussed by Malini et al (2012). Most of these studies are from South India. There is a paucity of data regarding the carriage rate of MRSA among HCWs in north India.

The reported colonization rates for MRSA from studies done in other countries varies from 0%-100%. In a study done in Vienna by Gualdoni et al (2012) a complete absence of MRSA carriage was found among the medical students, whereas in another study which was done in Cameroon by Luma et al (2012), 100% of nursing personnel were found to carry pathogenic organisms. In a study done in Iran by Askarian et al (2009), a MRSA carriage rate of 5.3% was seen among HCWs, whereas Shibabaw et al (2013) from Ethiopia reported a prevalence of MRSA carriage at 12.7%. All MRSA isolates in our study were multidrug resistant. None of the *S. aureus* isolates including MRSA were vancomycin resistant.

In a study done by Edem et al (2013), the carriage rate of ESBL producers was quite low (2.1%) as compared to MRSA (20%). In the present study 68.2% of the total gram negative isolates were ESBL producers whereas in a study done by Metri et al (2011), 91.7% of gram negative isolates were ESBL producers. Very few studies have been done on colonization of HCW by ESBL producing organisms. In the present study the carriage rate of ESBL (21.4%) was higher than MRSA (8.6%). According to a report by Sandle (2013), in about one-third of European countries there is a rise in infections due to antibiotic resistant gram negative bacteria, whereas infections due to MRSA are decreasing or have reached a pleateau. This may be true for colonization by MRSA and ESBL producers among the health care workers also.

The carriage rate of different bacteria varies not only in different geographic regions but also among different health professionals. In our study the highest rate of colonization by MDR bacteria was seen in nurses and OT technicians. According to a review done by Dulon et al (2014), the risk of nursing staff of being colonized with MRSA was almost two-fold higher than for medical staff and three-fold higher than for other healthcare staff. This can be explained by the more frequent and close contact of nurses with the patients as compared to other healthcare staff. Even in the same geographical regions it varies from hospital to hospital. So based on regional data one cannot predict the prevalence of carriage rate of different MDR organisms among HCWs in a particular hospital. HCWs have been implicated as the

source in a number of published outbreak reports. German guidelines recommend the decolonisation of a colonised healthcare worker and removal of the affected employee from patient care until proven eradication as discussed by Dulon et al. (2013).

In order to curb the spread of MDR organisms to the community and in the hospital, screening of HCW should be done routinely as a protocol for control of hospital acquired infections. Effectively functioning Hospital Infection Control policies, surveillance for nosocomial infections, hand washing, barrier precautions and regular screening and treatment of HCWs infected with MDR organisms are some of the measures which can help to prevent the spread of nosocomial infections.

Table 1. Distribution of various MDR bacteria among health care workers

Profession	No. sampled	S. aureus N (%)	MRSA N (%)	Coagulase negative staphylococcus N (%)	Gram negative bacilli N (%)	ESBL producers N (%)
Doctors	20	3 (15)	1 (5)	13 (65)	4 (20)	2(10)
OT technicians	20	3 (15)	2 (10)	12 (60)	9 (45)	5 (25)
Nurses	20	6 (30)	3 (15)	14 (70)	8 (40)	7 (35)
Laboratory technicians	10	1 (10)	0 (0)	5 (50)	1 (10)	1 (10)
Total	70	13 (18.6)	6 (8.6)	44 (63)	22 (31.5)	15 (21.4)

Table 2: Antimicrobial susceptibility of S. aureus and MRSA [sensitive=%]

Organism	E	Cd	Ctx	Cipro	Ac	Azm	G	Ak	Net	Van
S. aureus (13)	84.6	92.3	77	92.3	92.3	100	84.6	77	92.3	100
MRSA (6)	33.3	83.3	16.7	66.7	50	50	16.7	16.7	16.7	100

E- erythromycin, Cd- clindamycin, Ctx- ceftriaxone, Cipro- ciprofloxacin, Ac- amoxicillin-clavulanic acid, Azm- azithromycin, G-gentamicin, Ak- amikacin, Net- netilmicin, Van- vancomycin.

Table 3: Antimicrobial susceptibility of total Gram negative bacteria and ESBL producers [sensitive=%]

Organism	G	Ak	Cipro	Ctx	Ce	Cf	Cx	Ac	PT	Azt	I
GNR (22)	40.9	63.6	59.1	63.6	31.8	31.8	31.8	100	100	100	100
ESBL producers (15)	33.3	46.7	40	66.7	0	0	0	100	100	100	100

G-gentamicin, Ak- amikacin, Cipro- ciprofloxacin, Ctx- ceftriaxone, Ce- ceftazidime, Cf- ceftazidime, Cx- cefpodoxime, Ac- amoxicillin-clavulanic acid, PT- pipercillin-tazobactam, Azt- aztreonam, I- imipenem.

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