Prevalence of Nasal carriage of coagulase negative staphylococci and its antimicrobial susceptibility among ICU health care workers at a tertiary care hospital of Barabanki, UP

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Abstract

Introduction: Health care workers (HCW) including medical as well as paramedical workers are a potential source of carrier of infection for the patients admitted in different intensive care units (ICU). The anterior nares are the main reservoir of Staphylococcus although other body sites are frequently colonised with it, such as hands, skin, axillae, and intestinal tract. The body parts of health care workers as well as the equipments and accessories used by them are likely to transmit infections.

Materials and Methods: A prospective study was conducted to evaluate the infections in different ICUs. A total of 288 parallel nasal and hands swabs were collected. These samples were cultured as per standard protocols and antibiotic sentivity was also carried out. For antibiotic sensitivity Kirby disc diffusion method on Mueller Hinton agar plate was used. Coagulase negative Staphylococcus was the bacteria isolated and subjected to sensitivity towards different antibiotics.

Results: Of the 288 samples 90 samples (31.3%) were positive while 198 (68.7%) were negative. The distribution of the positive samples from Medical ICUs – 47 cases, Paediatric ICUs – 21 and, Surgical ICUs – 22 cases.

Conclusion: Coagulase negative Staphylococci were predominantly isolated from culture and increasing antibiotic resistance is also observed. The most effective antibiotics were Tobramycin, Teicoplanin and Linezolid while Penicillin, Gentamycin and Erythromycin showed highest resistance. HCW themselves as well as the accessories used by them are an important potential source of infection for the admitted patients. Regular disinfection of these accessories should be strictly followed in each and every ICU.

Keywords: Nosocomial, Cons, Healthcare workers, Nasal carrier, ICU.

Introduction

The term "healthcare-associated infections" is gradually replacing the term "hospital infection" because it includes both health care-associated infections and those related to failure in health care, prevention, diagnosis and treatment.

Group of coagulase-negative *Staphylococci* (CoNS) are of utmost significance because they are believed to be the main agents of HAI in neonatology.[3-7] However, the identification of these agents in cultures from patients can be difficult due to the distinction between colonization and infection, as CoNS are typically found on the skin surface of newborns.

CONS are important and normal commensals of skin and nasal mucosa. They can lead to community acquired infections and nosocomial infections in hospitalised patients. These bacteria are responsible for various haematogenous infections in Intensive care units (ICU) especially in neonates who are preterm as well as adults who are immunosuppressed. It can also cause other opportunistic infections.

Health care associated infections (HAI) are associated with significant morbidity, mortality and cost towards health care throughout the world.[1] In hospitals, paediatric Intensive Care Unit (ICU) and nurseries are the most critical areas that require high standards of hygiene. Moreover, accessories such as stethoscopes, mobile phones, finger rings and pens of health care professionals are seldom disinfected, and hence serve as a potential source of infection.[2] These accessories are often used in close contact with the patient body and are seldom disinfected.

It has been well documented that the rate of antimicrobial resistance is much higher in bacterial isolates of ICUs as compared to isolates from hospital wards and outpatient department.

As there is increasing multidrug resistance in CONS isolated from Health care workers (HCWs) hand and nasal swabs. Only few studies have been conducted on this subject, so we have performed this study to highlight the prevalence and antimicrobial susceptibility pattern of such multidrug resistance of CONS in HCWs in various ICUs. The goal of this study was to attempt to determine the rate of contamination of health-care workers' (HCWs) hands and environmental surfaces in intensive care units (ICU) by the main bacteria.

Materials and Methods

A total of 288 non-duplicate samples were taken from Health Care Workers (HCWs) from Medical ICU(114), Paediatric ICU(84) and Surgical ICU(90) with four swabs (two nasal and two hand swabs) from each including resident doctors, interns, nursing staff, nursing students, ward boys and other housekeeping

staff HCWs. HCWs who were on antibiotics for the last one week were excluded from the study.

The study was conducted in the Department of Microbiology, Hind Institute of Medical Sciences, Barabanki. Ethical committee approval was taken before conducting the study. A written informed consent was taken from all individuals or their relatives whose samples were collected.

The samples were collected in sterile cotton swab along with transport tube. Nasal swab was inserted into the nares and rolled inside against the nasal mucosa gently to prevent sneezing. The same procedure was performed for other nares with another swab. Hand swabs dipped in sterile normal saline were rolled on the palmar surface of the left hand. The steps were repeated with another swab on the right hand. Similar steps were repeated for all samples. The swabs for each sample were kept into transport tube and labelled properly.

The samples were brought to the Bacteriology lab in the department of Microbiology where the processing was started immediately. Culture was done on sheep blood agar, and kept at 37^{o}C for 16-18 hrs in the incubator. Swab samples were immediately inoculated on Blood agar and MacConkey agar plates and plates were incubated overnight at 37°C. Plates were examined for bacterial growth after 24 hrs. CONS were identified on the basis of morphology of colony gram stain, catalase test, slide and tube coagulase tests and other biochemical tests.

After bacterial identification, antibiotic sensitivity was performed using Kirby Bauer disc diffusion method, using various drugs including Penicillin (10Units), Cefoxitin (30µg), Vancomycin (30µg), Gentamicin (10µg), Amikacin (30µg), Teicoplanin (30µg), Tetracycline (30µg), Ciprofloxacin (5µg), Levofloxacin (5µg), Erythromycin (15µg), Clindamycin (2µg), Linezolid (30µg), Cotrimoxazole (30µg), Rifampicin (5 µg), Tobramycin (30µg).

S. aureus ATCC 29213 was used as the reference strain for the standardization of antibiotic susceptibility testing. Zone diameters of inhibition were measured and determined as resistant, intermediate and sensitive as per recommendations of clinical and laboratory standards institute (CLSI) guidelines of 2016.

Results

The study included a total of 288 health care workers from 3 different ICUs – Medical (114 cases), Paediatric (84 cases) and Surgical (90 cases). The distribution is depicted in Table 1. The subjects included interns and residents, nursing staff, nursing students, ward boys and other housekeeping staff.

Of the total 288 cases included 90 (31.3%) showed positive result on culture, while 198 (68.7%) were negative. (Table 2) Amongst individual ICUs, Medical ICU demonstrated 41.7% positivity, Paediatric 25% while, Surgical 24.4% positivity rates. Medical ICUs were thus observed to carry the maximum positivity.

Table 3 shows the antibiotic sensitivity pattern of CONS in health care workers in different ICUs. The various antibiotics that were used to test for sensitivity or resistance are depicted in Table 3. It clearly depicts the pattern of reactivity towards the drugs in individual ICUs. Among all the 3 ICUs, few antibiotics showed very good sensitivity such as Tobramycin, Teicoplamin, Linezolid, and Amikacin.

Use of equipments and accessories was also taken into consideration. These included mobile phones, ear phones, stethoscopes, pens, patients files, finger rings, wrist watches and even masks and gowns used during patient rounds. It was even observed that use of the same surgical glove was liable to transfer microorganisms from one patient to another.

Table 1: Distribution of isolates among HCWs in different ICUs

Source	MICU	PICU	SICU
Interns & Residents	10	16	18
Nursing staff	48	29	31
Nursing students	28	15	14
Ward boys	17	16	17
Other housekeeping staff	11	8	10
Total	114	84	90

Table 2: Showing distribution of positive and negative samples

ICUs	Total sample	Positive (%)	Negative (%)
MICU	114	47 (41.7)	67 (58.7)
PICU	84	21 (25.0)	63 (75.0)
SICU	90	22 (24.4)	68 (75.5)
Total	288	90 (31.3)	198 (68.7)

*Percentages are in paranthesis

Table 3: Showing antibiotic sensitive and resistant pattern of coagulase negative staphylococcus in health care workers in different ICUs

Antibiotics	MICU (n= 47)		PICU (n = 21)		SICU (n = 22)	
	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Resistant
Erythromycin	8	39	3	18	6	16
Clindamycin	20	27	15	6	12	10
Cefoxitin	35	12	9	12	12	10
Amikacin	45	2	20	1	10	12
Ciprofloxacin	23	24	15	6	8	14
Tobramycin	47	NIL	20	1	20	2
Teicoplanin	47	NIL	20	1	20	2
Linezolid	47	NIL	20	1	21	1
Rifampicin	42	5	20	1	14	8
Cotrimazole	19	28	9	12	6	16
Gentamicin	8	39	11	10	17	5
Penicillin	5	42	NIL	21		
Vancomycin	26	21	14	7	16	6
Tetracycline	19	28	9	12	8	14
Levofloxacin	29	18	19	2	6	16
Total	**420**	**285**	**204**	**111**	**176**	**132**

Discussion

Health care workers (HCWs) with patients admitted in the wards and ICUs and can have nasal and hand colonization of these multidrug come in contact resistant CONS. These workers act as carriers and are liable to transmit infections of these hospital acquired strains from one patient to another while treating or nursing them during their visit to the patients.

Risk factors for the occurrence of infection are long term hospital stay, invasive procedures, prolonged indwelling catheters and immunocompromised patients like extremes of ages, neonates and elderly. In ICUs, these drug resistant CONS infection offer lead to infections of high severity. Various virulence factors are responsible for the infections caused by CONS. Biofilm formation in catheterised patients due to slime production, a complex glycoprotein helps these CONS to colonize foreign bodies like intravascular catheters, (haemodialysis shunts, peritoneal dialysis catheters, cerebrospinal fluid shunts) and indwelling prostheses making it an important cause of hospital acquired infections. A higher rate of Methicillin resistance has added to the virulence factor of CONS.

Health education and proper hygiene practice of HCWs can help reduce the load of transmission of infection thus, decreasing the morbidity and mortality in ICU patients.

Health care associated infections, such as bacteremia, pneumonia, urinary tract and skin or soft tissue infections, are among the most frequent complications that occur in hospitalized patients. Patients in ICUs are at the highest risk for HAIs because of invasive medical procedures during their hospitalizations. The ICU staff and physicians can serve as vehicles for the spread of infecting agents from different hospital wards to ICUs.[2] Accordingly, the hands of HCWs and ICU personnel require the greatest hygiene standards. Contamination of the ICU environment also plays an important role in the acquisition of nosocomial pathogens by both patients and HCWs.

It has been demonstrated that the bacterial strains isolated from the hands and accessories of HCWs, and the ICU environment are associated with hospital-acquired outbreaks. Although most enteric Gram-negative bacilli cannot remain viable on the dry surfaces of medical equipment or in the ICU environment and are known to be sensitive to commonly used disinfectants, biofilm-forming bacteria, suchas *Pseudomonas aeruginosa* and *Acinetobacter bau-mannii*, are highly resistant to such harsh conditions and are strongly associated with HAIs through contaminated medical devices and other environmental equipment in hospitals.[4] HCWs and ICU staff can serve as major reservoirs of common bacterial pathogens, such as vancomycin resistant *Enterococci.*

Shedding of the normal skin, is a routine process. Patient gowns, linens, bedsides and other objects in the ICU environment become contaminated. These when come in contact with other patients makes them infected. Diverse groups of bacteria, including both Gram-positive (60.7%) and Gram-negative (39.3%) types are potential contaminants. Colonization and transmission of these hyper resistant bacterial pathogens are generally considered to be a major problem in infection control programs in ICUs.

Previous studies have reported that Gram-negative bacteria comprise the majority of bacterial growth compared with Gram-positive cocci among the bacteria isolated from devices used for breathing aids.

Ventilators, oxygen masks of patients and linens were among the most frequently contaminated

environmental samples in our study. This contamination was especially by *S. aureus* and *A. baumannii*, that hare reported to be more resistant to desiccation and disinfectants. Cross contamination of the patients' files was also observed in our study.

The hands of workers are major sources of transmission of nosocomial bacteria. This bacterial contamination is often acquired due to direct contact with patients body fluid secretions, or touching of contaminated environmental surfaces in the ICUs. Majority of the isolated bacteria from the hands of HCWs are commensals of skin.

It has been further reported that contamination of the medical equipments was more common in nurses, while contamination of the non- medical devices was more common in the housekeeping staff. These observations further emphasise on the need of regular cleaning and disinfection of the intensive units as well as education of the staff. Safety of these areas should be of prime importance for the hospital management.

So far as the treatment modalities are concerned the regimens used in the ICUs is different. Vancomycin is the first choice drug. Following high resistance to other drugs such as Oxacillin and Aminoglycosides less potent antibiotics may play a role in the treatment. The results of the study showed an increasing incidence of antibiotic resistance especially in the nosocomial infections. The positive culture rate for microbial agents causing HAI varies between hospital services. HAI represent an important cause of morbidity and mortality in newborns admitted to NICUs, with variable rates ranging from 18.9 to 57.7%, depending on the unit studied. HCAI are a potential health hazard for service provider also

The results showed that 44.92% of various accessories were contaminated with various Gram positive and Gram-negative bacteria. Amongst accessories, the mobile phones were the most contaminated. The second important source of contamination was stethoscope. In the present study, *Staphylococcus* spp. was the most common microorganism isolated. This increased incidence could be attributed to the survival nature of *Staphylococcus* spp. even on dry surfaces, whereas can survive even *Acinetobacter* on wet surfaces. Human skin contains *Staphylococcus* as normal flora, so this could be a probable reason of observation of a high number of *Staphylococcus* in this study. Another problem associated with CoNS infections is the determination of antimicrobial susceptibility. This knowledge is critical to establish the best treatment possible and to avoid the indiscriminate use of broad-spectrum antibiotics.

Amongst the Important factors that contribute to this pattern of antibiotic resistance is that in most infections with CoNS, those children had already received antibiotics in the past.

The result of the present study correlate well with those reported earlier. It indicates that such close contact contaminated objects could serve as reservoirs for bacterial pathogens, and hence can transmit pathogens readily from mobile phones to the hands, and then finally to their body parts resulting in spreading of infections.

Children are more commonly affected by contamination than adults. Especially, immature often-abraded skin with a variety of skin wounds of premature and very low birth weight infants, due to intravenous access or recent surgeries pose great risk of transmission of these infections.

CoNS and *S. aureus* were the major pathogens isolated.

Although HCWs were aware about the pathogenic potential of accessories, but at times following increasing patient load, it becomes practically impossible to disinfect accessories on a regular basis during patient care in a day. Moreover, in many institutions, strict guidelines are not been followed to restrict medical staff from carrying accessories into the sterile environment of the OT, ICU or other critical care areas. Further, cleaning guidelines for the accessories of HCWs needs to be maintained.

Conclusion

The results of the present study clearly indicate that ICU staff as well as environmental surfaces as probable sources of infections.

Compliance with proper precautions during contacts and more aggressive environmental cleaning is likely to decrease such transmission in these ICUs.

Furthermore it should be stressed that only hand washing is not sufficient and disinfection of accessories also needs to be routinely followed. Cross transmission of pathogens from accessories to clean hands to patients or vice versa, will continue making it a vicious cycle. Furthermore training and education programme for HCWs to manage their accessories with good hygiene practices may also need to be implemented.

The role of the ICU staff and environment in HAIs should be considered when devising strategies to prevent or reduce the occurrence of these infections among the highly sensitive patients.

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