International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Screening of Critical Care Setting for Bacterial Colonization

Arth Nath Dube[1], Dr. S.A. Samant[2], Dr. Mohammad Nasim[1]

[1]Resident, Medical Microbiology, MGM Medical College, Kamothe, Navi Mumbai
[2]Associate Professor, Dept. of Microbiology, MGM Medical College, Kamothe, Navi Mumbai

Corresponding Author: Arth Nath Dube

ABSTRACT

Hospital acquired infections are a serious problem in patient care and they adversely affect the mortality and morbidity. Mainly the affected areas are critical care units and acute wards where the patients are critical and immuno compromised. In the ICU, the accumulation of a number of immuno compromised patients, their nursing and invasive procedures provide a favourable environment to the growth and transmission of nosocomial infections. The environment of critical care unit and health care workers play an important role in transmission of nosocomial infections Air conditioning vents, ventilator circuits ,door handles, medicine trolley, suction apparatus and mobile phones etc. get colonized with bacteria and disseminated in the hospital which lead to nosocomial infections. The present study is done to isolate and identify pathogenic bacteria from the surfaces of various objects and instruments in the ICU and to carry out resistotyping of the pathogenic bacteria isolated from the Intensive care unit. Swabs were collected from various places of ICUs. Door knobs and mobile phones of Health Care Worker's showed maximum colonization of GPCs and GNBs. E.*coli* (12.08%) was the most commonly isolated organism from the ICUs followed by *Acinetobacter* (8.75%), *Pseudomonas* (7.5%) and *Klebsiella* (6.25%). Amongst GPCs *Staph. aureus* (15%) and CONS (14.16%) were the most predominant colonizers in the ICUs. Aerial bacterial flora of ICUs was studied by exposed plate method which showed by exposed plate method which showed predominant growth of Bacillus spp. and CONS.

Key words: ICUs, HAI, Air Sampling, Resistotyping.

INTRODUCTION

Hospital acquired infections (HAI) are a serious problem in patient care and they adversely affect the mortality and morbidity. Mainly the affected areas are critical care units and acute wards where the patients are critical and immuno compromised. Nosocomial infections complicate the primary disease process and create problems like septicaemia and Acute Respiratory Distress Syndrome. They remain endemic in critical care wards and lead to epidemic outbreaks.

In the Intensive Care Unit (ICU), the accumulation of a number of immuno compromised patients, their nursing and invasive procedures provide a favourable environment to the growth and transmission of nosocomial infections. Outbreaks of HAI are frequent and may spread between health care facilities through patient transfers. Also HAI cause disability, reduce quality of life and create emotional stress. [1]

Effective infection control measures may prevent 20–30% HAI. Surveillance is a key element of the control and prevention of HAI because it provides data relevant for appropriate intervention methods.

Prevention of nosocomial infections include proper personal hygiene and hand washing on the part of the hospital staff, complete sterilization of medical equipment

and providing a clean, sanitary environment in the health care facilities. [2]

The environment of critical care unit and health care workers play an important role in transmission of nosocomial infections. Sites that are frequently touched by hands are thought to provide the greatest risk for patients, and those situated right beside patients provide the biggest risk of all. Air conditioning vents, ventilator circuits, door handles, medicine trolley, suction apparatus, and mobile phones etc. get colonized with bacteria and disseminated in the hospitals which lead to nosocomial infections. [3]

Use of mobile phones in hospital halls, laboratories, intensive care units and operating rooms is a common phenomenon. During every phone call, the mobile phone come into close contact with strongly contaminated human body areas with hands to hands, and hands to other areas like mouth, nose and ears. As mobile phones act as perfect habitat for microbes to breed, especially in high temperature and humid conditions, HCWs' mobile phones may serve as reservoirs of microorganisms that could be easily transmitted from the mobile phones to the HCWs' hands and therefore facilitate the transmission of bacterial isolates from one patient to another in different hospital wards. [4]

In view of this, the present study was planned to ascertain the colonization of pathogens in the environment of Intensive Care Units of a Tertiary care hospital which could be the probable cause of infections in the patients admitted in the ICU.

AIMS and OBJECTIVES

- To isolate and identify pathogenic bacteria from the surfaces of various objects and instruments in the ICU.
- To carry out resistotyping of the pathogenic bacteria isolated from the Intensive care unit.

MATERIALS AND METHODS

The present study was carried out in the Department of Microbiology, MGM Medical College, Kamothe, Navi Mumbai over a period of two years from January 2015 to February 2017 .Ethical clearance was obtained from Institutional Ethics Committee prior to study.

Following samples were collected from Paediatric ICU (PICU), Medicine ICU (MICU) and Surgery ICU (SICU)

Category A: This includes air Samples from the AC vents. These air samples were collected by exposed plate method near the AC vent. For isolation of pathogens from AC vents, Blood Agar plate was exposed near the AC vent at a distance of 30 cm for a period of 15 min.

Category B: This includes swabs collected from the ventilator circuit, suction apparatus, medicine trolley, door handles, tap handles, mobile phones, bed sheets, floor, wall and mobile phones. The swabs obtained from category B were inoculated on Blood Agar and MacConkey's Agar. The bacteria were identified by colony morphology and various biochemical tests. [5]

Colonies obtained after overnight incubation of plates of category A and B were observed and the colony characters were noted. The smears were prepared from the colonies on clean grease free slides and were heat fixed. They were stained by Gram's stain. Antibiotic susceptibility testing of all the isolates was done by Kirby Bauer disc diffusion method on Mueller Hinton agar (Himedia) as recommended by CLSI. [6]

RESULTS

In the present study three ICUs including PICU, MICU, SICU were studied for the microbial load. Swabs collected from various places (ventilator circuit, suction apparatus, medicine trolley, door handles, bed sheets, floor, wall and HCW's mobile phones) showed presence of many GNBs and GPCs. Table 1 shows rate of isolation of GNBs from various sites of PICU, MICU,SICU. Among the various places studied, door knobs (PICU= 60%, MICU=70%, SICU=50%) and mobile

phones of Health Care Worker's (PICU= 60%, MICU=70%, SICU=70%) show maximum colonization of GNB's.

Table 1: Rate of isolation GNBs from Various Sites of all the ICUs

SR.No.	SWABS	PICU	MICU	SICU	TOTAL %
1.	BEDSHEET	3/10 (30 %)	4/10 (40%)	4/10 (40%)	11/30 (36.66%)
2.	DOOR KNOBS	6/10 (60%)	7/10 (70%)	5/10 (50%)	19/30 (63.33%)
3.	VACCUM SUCTION	2/10 (20%)	3/10 (30%)	1/10 (10%)	06/30 (20%)
4.	FLOOR	5/10 (50%)	4/10 (40%)	5/10 (50%)	14/30 (46.66%)
5.	WALL	3/10 (30%)	4/10 (40%)	5/10 (50%)	12/30 (40%)
6.	VENTILATOR	2/10 (20%)	3/10 (30%)	3/10 (30%)	08/30 (26.66%)
7.	MEDICAL TROLLEY	3/10 (30%)	3/10 (30%)	4/10 (40%)	10/30 (33.33%)
8.	HCW MOBILE PHONE	6/10 (60%)	7/10 (70%)	7/10 (70%)	20/30 (66.67%)

Table 2: Spectrum of GNBs Isolated from ICUs

Organisms	PICU(80)	MICU (80)	SICU(80)	Total (240)
E.coli	10(12.5%)	09(11.25%)	10(12.5%)	29 (12.08%)
Klebsiella	05(6.25%)	04(5%)	06(7.5%)	15 (6.25%)
Enterobacter	02(2.5%)	01(1.25%)	02(2.5%)	05 (2.8%)
Citrobacter	02(2.5%)	03(3.75%)	02(2.5%)	07 (2.91%)
Pseudomonas	05(6.25%)	07(8.75%)	06(7.5%)	18 (7.5%)
Acinetobacter	06(7.5%)	09(11.25%)	06(7.5%)	21 (8.75%)
GNNF	00	02(2.5%)	02(2.5%)	04 (1.6%)

Table 2 shows the spectrum of GNB's isolated from the three ICUs. *E.coli* (12.08%) was the most commonly isolated organism from the ICUs. *Acinetobacter* (8.75%), *Pseudomonas* (7.5%) and *Klebsiella* (6.25%)

Table 3 : Rate of isolation of GPCs Isolated from Various Sites of PICU

SR.No.	SWABS	PICU	MICU	SICU	TOTAL%
1.	BEDSHEET	2/10 (20 %)	3/10 (30%)	3/10 (30%)	08/30 (26.66%)
2.	DOOR KNOBS	6/10 (60%)	5/10 (50%)	6/10 (60%)	17/30 (56.66%)
3.	VACCUM SUCTION	1/10 (10%)	2/10 (20%)	2/10 (20%)	05/30 (16.66%)
4.	FLOOR	3/10 (30%)	3/10 (30%)	4/10 (40%)	10/30 (33.33%)
5.	WALL	2/10 (20%)	4/10 (40%)	3/10 (30%)	09/30 (30%)
6.	VENTILATOR	2/10 (20%)	3/10 (30%)	2/10 (20%)	07/30 (23.33%)
7.	MEDICAL TROLLEY	3/10 (30%)	2/10 (20%)	4/10 (40%)	09/30 (30%)
8.	HCW MOBILE PHONE	8/10 (80%)	6/10 (60%)	5/10 (50%)	19/30 (63.33%)

Table 3 depicts that in all the ICU's, maximum colonization of Gram positive cocci was observed on the door knobs and mobile phones of HCWs.

Table 4: Spectrum of GPCs Isolated from ICUs

ORGANISMS	PICU(80)	MICU(80)	SICU(80)	TOTAL (240)
Staph. aureus	11(13.75%)	12(15%)	13(16.25%)	36 (15%)
Enterococcus	03(3.75%)	02(2.5%)	02(2.5%)	07 (2.92%)
Streptococcus	03(3.75%)	02(2.5%)	02(2.5%)	07 (2.92%)
CONS	10(12.5%)	12(15%)	12(15%)	34 (14.16%)

Table 4 shows that *Staph. aureus* (15%) and CONS (14.16%) were the most predominant colonizers in the ICUs.

Table 5: Spectrum of Organism from Exposed Plates in ICUs

ICUs Organisms	PICU (10)	MICU (10)	SICU (10)
S.aureus	1/10 (10%)	2/10 (20%)	-
CONS	2/10 (20%)	3/10 (30%)	3/10 (30%)
Streptococcus spp.	-	1/10 (10%)	-
Klebsiella	-	2/10 (20%)	-
Enterobacter	1/10 (10%)	-	1/10 (10%)
Bacillus	1/10 (10%)	1/10 (10%)	2/10 (20%)

Exposed plate study carried out in all the ICUs show that *CONS* were the most common organism followed by *Bacillus* spp.

Resistotyping of the pathogenic bacteria isolated from the Intensive care units

All the pathogens isolated from category A and categories B were subjected to antibiotic susceptibility test. Table 6 shows the no. of strains with percentage sensitivity and resistance to common antibiotics. This table also depicts the antibiotics which show high degree of sensitivity and resistance to the isolated bacteria.

Table 6: Resistotyping Pattern of GNBs Isolated:

Isolated Organism	Percentage of Isolates Showing Sensitivity	Percentage of Isolates Showing Resistance
E.Coli (n= 29)	Amikacin (65.51%) Tobramycin (58.62%)	Cefoperazone (93.4%) Ceftazidime (89.65%) Cefazoline (89.65%)
Klebsiella (n=17)	Amikacin (76.47%) Ofloxacin (52.94%)	Tetracycline (88.23%) Cefoperazone (82.35%)
Enterobacter (n=7)	Amikacin (85.71%) Cefuroxime, Augmentin, Cefazoline (71.42%)	Ceftazidime (85.71%) Cefoperazone (85.71%)
Citrobacter (n=7)	Tobramycin (100%) Amikacin, Ofloxacin (85.71%)	Ceftazidime (71.42%) Tetracycline (71.42%)
Pseudomonas (n=18)	Amikacin (94.44%) Tobramycin (88.89%)	Ceftazidime (88.89%) Gentamicin (83.33%)
Acinetobacter (n=21)	Amikacin (66.67%) Tobramycin (47.62%)	Ceftazidime (95.24%) Cefazoline (90.48%)
GNNF (n=4)	Amikacin (100%) Ofloxacin (100%)	Ceftazidime (100%) Cefoperazone (100%) Cefazoline (100%)

Table 7: Resistotyping Pattern of GPCs Isolated

Isolated Organism	Highly sensitive Antibiotics	Highly Resistant Antibiotics
S.aureus (n=39)	Augmentin (84.61%) Cefuroxime (79.49%)	Penicillin (56.41%) Roxithromycin (53.85%)
Streptococcus (n=8)	Augmentin (100%) Clindamycin (100%)	Co-Trimoxazole (50%) Cefazoline (50%)
Enterococcus (n=7)	Co-Trimoxazole Cefuroxime, Penicillin (85.71%)	Clindamycin (85.71%) Cefazoline (71.42%)
Coagulase Negative Staphylococcus (CONS) n=42	Augmentin (83.33%) Cefuroxime (80.95%)	Penicillin (54.76%) Roxithromycin (52.38%)

DISCUSSION

In the present study three ICUs i.e. PICU, MICU, SICU were studied for the microbial load. Swabs collected from various places (ventilator circuit, suction apparatus, medicine trolley, door handles, bed sheets, floor, wall and HCW's mobile phones) showed presence of many GNBs and GPCs.

Table 1, shows the no. of GNBs isolated from various sites of PICU, MICU, SICU. Maximum GNBs were isolated from Door knobs and mobile phones were the most commonly handled objects by the Health Care Workers. This finding is very significant as they can act as source of infection in the ICUs.

Table 2 shows spectrum of GNB's isolated from the three ICUs. *E.coli* (12.08%) was the most commonly isolated organism from the ICUs. Followed by *Acinetobacter* (8.75%), *Pseudomonas* (7.5%) and *Klebsiella* (6.25%).

E.coli (12.5%), *Acinetobacter* (7.5%), *Pseudomonas* (6.25%), *Klebsiella* (6.25%) were the most common colonizing GNBs in the PICU whereas in MICU, maximum colonization was shown by *E.coli* (11.25%), *Pseudomonas* (8.75%) and *Acinetobacter* (11.25%). In SICU the

maximum colonization was shown by *E.coli* (12.5%), *Klebsiella* (6.25%), *Pseudomonas* (7.5%), *Acinetobacter* (7.5%).

Escherichia coli isolated from the mobile phones, suggests low level of mobile phone hygiene and hand hygiene since this organism is part of the intestinal flora. This is of serious concern because it is a leading causes of HAIs. [7]

Some studies demonstrated that *A. baumannii* was isolated throughout the inanimate environment, on the beds of colonized patients and on nearby surfaces (e.g. on mattresses and bedside equipment), in hospital rooms (e.g. on floors, sinks, countertops and door handles), and in room humidifiers. In addition, it has been demonstrated that *A. baumannii* are readily transmitted from environmental surfaces to healthcare workers' hands. [8]

Rate of hospital acquired infections by GNBs are higher in lower age group (0-9 years) because they are more susceptible to infection due to various reasons along with their weak immune system and higher age group which can be correlated with debilitating condition, immune status of the patients and aging in this age group. In this study, the most common bacterial pathogen in PICU infections was *E.coli, Acinetobacter, Pseudomonas* and *Klebsiella*. Hence utmost care should be taken to avoid infection by these organisms to the paediatric patients.

Table 3 shows the result of ICUs colonization by Gram positive pathogens. It was observed that maximum colonization was seen in the Health Care Workers mobile phones and the door knobs of all the ICUs. Contamination of clinicians' mobile phones in developed countries, like USA and UK, is reported to have a high level of overall mobile phone contamination (pathogenic and non-pathogenic organisms) ranging from 75 % to 96 %. The most commonly reported organisms are coagulase-negative staphylococci (CONS) and *Micrococcus*; while 9 % to 25 % of mobile phones are contaminated by other pathogenic bacteria known to cause HAIs, including Methicillin-Sensitive and Methicillin-Resistant *Staphylococcus aureus* (MSSA & MRSA). [9]

Table 4 shows the spectrum of the GPCs isolated from the ICUs. *Staph. aureus* (15%) and CONS (14.16%) were the most predominant colonizers in the ICUs. *Staph. aureus* and CONS being important nosocomial pathogens their presence in the ICUs needs to be monitored. CONS infections may be due to endogenous strains from the patient's native flora. There is emerging evidence that strains are often transmitted among hospitalized patients. These nosocomial strains are increasingly antibiotic resistant. These organisms in ICU's are of great concern as they are the leading cause of nosocomial infection.

Table 5 depicts spectrum of aireal organism grown on the plates exposed in various ICUs. The result show the predominant growth of CONS and *Bacillus spp*. more than other organisms. Microbiological quality of air may be considered as mirror of the hygienic condition of the operation theatres and Intensive Care Units. Surveillance of OTs and ICUs with infection control measures is helpful in controlling nosocomial infections. [10]

The hospital environment often acts as a potential reservoir of multi drug resistant bacteria. The higher contamination rate in ICU is coherent with the physical structure, number of equipments and the conditions of intensive care patients, who tend to have more risk factors and higher infection rates. In such environment the risk of being infected by multidrug resistant bacteria may increase in presence of colonized patients or if the length of stay exceeds the average of 15 days.

Table 6 and 7 show Antibiotic Sensitivity pattern of all the GNBs and GPCs isolated from various ICUs. It was observed that all the GNBs showed good sensitivity to Amikacin (AK) Tobramycin (TOB) followed by Ofloxacin (OF). A very high degree of resistance was observed against the Cephalosporins like

Cefoperazone (CPZ), Ceftazidime (CAZ), Cefazolin (CZ). It may be because of rampant use of Cephalosporins in the healthcare setups.

It was observed that most of Gram positive pathogens were sensitive to Cefuroxime (70.49%-100%) and Augmentin (71%-100%). Maximum resistance was observed to Roxithromycin (RO), Penicillin (P) and Co-Trimoxazole (COT). In this study 23.07% *S.aureus* and 21.42% CONS were found Methicillin-Resistant. This finding carries very high significance because of its potential to cause nosocomial infection.

Health care professionals may often spread bacterial resistance through apparently innocuous actions, such as touching the intact skin of a colonized patient, resting their hand on the patient's bed or even on the handle, medical chart or phone, thus leading to contamination. There is possibility of resistant microorganisms persisting in the hands, inanimate objects, surfaces/ environments and being transmitted from one patient to another or to surfaces and environments if the hand hygiene is not maintained, thereby perpetuating the transmission chain.

CONCLUSION

Indiscriminate use of antibiotics lead to development of multi drug resistant strains and these strains in the ICUs are the major risk for the critical patients of ICUs.

Hence, the Authors insist on proper cleaning, disinfection of all the areas and material used in ICUs. Strict execution of Antibiotics policy, its monitoring and stringent measures for disinfection of various areas of ICUs is of utmost importance in order to minimize the microbial load in the critical care set up.

REFERENCES

1. Gupta A R, Kaul N., Saraswat V, Prabhakar T. Bacteriological Profile And Barrier Nursing in ICUs. Indian J. Anaesth. 2005; 49 (1): 31-26
2. Prevention of hospital-acquired infections: a practical guide -who/cds/csr/eph/2002.12
3. Desai S N, Kikani K M, Mehta S J: Microbiological Surveillance of Operation Theaters & Intensive Care Units of Teaching Hospital in Surendranagar, Gujarat. 2012 ,67: 2-5
4. Trivedi H. R., Desai K J, Trivedi L.P., Malek S.S., Javdekar T. B.,: Role of Mobile Phone in Spreading Hospital Acquired Infection: A Study in Different Group of Health Care Workers, NJIRM 2011; 2(3): 5-26
5. Mackie and Mccartney Practical Microbiology Ch- Identification of Bacteria,
6. CLSI M100-S24-Performance standards for Antimicrobial Susceptibility Testing, 2014
7. Tajeddin E., Rashidan M., Razaghi M, S.S. Javadi S., Sherafat S.J., Alebouyeh M., The role of the intensive care unit environment and health-care workers in the transmission of bacteria associated with hospital acquired infections, Journal of infection and public health. 2016; 9 (1): 13–23
8. Raval PN, Patel PG, Patel BV, Soni ST, Bhatt SK, Vegad MM, Vaghela GM, Yadav KS, Shirish Patil, Goswami HM. Microbiological Surveillance of Intensive care units in a tertiary care teaching hospital –western India. Int J Microbiol. Res. 2012; 4(7): 27-270
9. Brady RR, Verran J, Damani NN, Gibb AP. Review of mobile communication devices as potential reservoirs of nosocomial pathogens., J Hosp Infect. 2009; 71(4):295–300.
10. Pasquarella C, Masia M D, Nnanga N, Sansebastiano G E, Savino A, Signorelli C. Microbial air monitoring in operating theatre: active and passive samplings, Ann Ig. 2004; 16(2): 86-375

How to cite this article: Dube AN, Samant SA, Nasim M. Screening of critical care setting for bacterial colonization. Int J Health Sci Res. 2018; 8(7):28-33.

******