International Journal of Advances in Medicine
Thakur L et al. Int J Adv Med. 2019 Feb;6(1):18-22
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20190104

Original Research Article

Active surveillance culture in a critical care unit of a tertiary care hospital of West Bengal, India: a prospective study

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Received: 29 October 2018
Accepted: 29 November 2018

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ABSTRACT

Background: Hospital-acquired infections are a common and serious public health problem and their management and control are essential to minimize hospital-related morbidity and mortality. The aim was to acquire the base line data regarding prevalence of Multi Drug Resistant (MDR) organism in a tertiary care institution and to help in ensuring proper practice guidelines like contact isolation, cohorting and sterile barrier precaution. The study design was an observational descriptive hospital based cross sectional study.
Methods: The study was conducted in a critical care unit of a tertiary care hospital for a duration of 6months. Patients with the age more than 18yrs, duration of stay more than 48hrs were included in the study. Categorical data are expressed in percentages.
Results: In the study 111 patients more than 18 yrs of age were enrolled of which 68 were male and 43 females. The sample collected from the axillary site were 110, nasal site 108, urine 96 and respiratory site 95. The culture positivity for pathogenic organisms were maximum for axillary site (95.5%) followed by nasal site (83.33%), respiratory site (36.8%) and urine (26%). Of all the organisms isolated multidrug resistance were as follows: MRSA 63% and MSSA 37% (of all *S. aureus*), MR CoNS 41.32% (of all CoNS), ESBL producer 22.2% and carbapenemase producer 22.2% (of all *Klebsiella* species), ESBL producer 37.5% and carbapenemase producer 31.26% (of all *E. coli*), non albicans Candida 57.14% (of all *Candida* species).
Conclusions: Early identification of the causative pathogen in nosocomial and community-acquired infection is crucial for initiating the correct antibiotics as well as preventing further spread.

Keywords: Active surveillance culture, Hospital acquired infection, ICU, MRSA, Nosocomial infection

INTRODUCTION

Hospital-acquired infections (HAIs) are common and serious public health problems which relate to the high morbidity and mortality. As per WHO HAIs or Nosocomial Infections (NIs) is defined as an infection acquired in the hospital by a patient who was admitted for a reason other than that infection. An infection occurring in a patient in a hospital or other healthcare facility in whom the infection was not present or incubating at the time of admission. This includes infections acquired in the hospital but appearing after discharge, and also occupational infections among the staff of the facility.[1,2]

The incidence of HAIs ranges from 7% to 10% among the developed and developing countries respectively. As per various studies in the USA and Europe shows incidence density ranged from 13.0 to 20.3 episodes per thousand patient-days. The prevalence is more in the patients in Intensive Care Units (ICUs), burn units, undergoing organ transplant and neonates. Among these, as per Extended Prevalence of Infection in Intensive Care

(EPIC II) studies, the rate of infected patients within the ICU are often as high as 51%.[3,4]

Critical care units of the hospital have a prominent role in patient care but HAIs related to these areas not only increases the morbidity, mortality or duration of stay in hospital but also increase in the cost imposed of patients and society.[5] And this is a problem for all the countries despite the economic status. The CDC estimated that the cost of events related to HAIs was an average of $2,100 and varied from $680 for urinary tract infections to $5,683 for respiratory tract infections in the United States of America.[6]

The microorganisms causing HAIs are usually of multidrug resistant. However, these organisms are imported to the critical care areas in her/his admission flora, which does not belong to ICUs. Classifying these are important for the infection surveillance programme. To distinguish between hospital and community acquired infections to microorganisms acquired during patient's hospital stay, a cut off time generally 48hrs has been accepted. The incidence is more in ICUs because of immunosuppression caused by various intensive/invasive treatments for the underlying life-threatening diseases.[7,8]

To check the HAIs in critical care areas surveillance culture is needed. Recommendations and guidelines for the active surveillance culture (ASCs) were strongly supported in 2003, the Society for Healthcare Epidemiology of America (SHEA) guideline "SHEA guideline for preventing nosocomial transmission of multidrug-resistant strains of *Staphylococcus aureus* and *Enterococcus*". These guidelines were the first to recommend the ASCs from a major infection control organization.[9] The study was conducted to check prevalence of Multi Drug Resistant (MDR) organism in our institution. To assess the full reservoir of the organism and helps in ensuring proper practice guidelines like contact isolation, cohorting and sterile barrier precaution.

METHODS

This is an observational descriptive hospital based cross sectional study. This study was conducted in a critical care unit of a tertiary care hospital for the duration of 6 months (July to December 2017). Patients with the age more than 18yrs, who were expected to stay in ICU for more than 48hrs and the referral cases that had already spent 48hrs in other institutional ICU were included in the study. The research proposal was approved by the institutional human ethics committee.

The demographic data was collected. The urine samples along with the swabs from external nares and axillary sites and respiratory samples e.g., throat swab or ET secretions were collected. Then these were sent immediately to the central laboratory of the same institute for microbiological investigations. Samples were cultured on MacConkey's agar, chocolate agar, and blood agar and incubated aerobically at 37ºC for 24hrs. Isolated organisms were identified using biochemical tests and drug susceptibility tests were done by using modified Kirby-Bauer's method. All the laboratory tests were performed according to CLSI standard operating procedures. The standard strains *Staphylococcus aureus* (ATCC 25923), *Escherichia coli* (ATCC 25922) and *Pseudomonas* aeruginosa (ATCC 27853) were used as the control. The categorical data are expressed in proportions; continuous data based upon their distribution are tested either by parametric or non-parametric tests.

RESULTS

In the study 111 patients, more than 18yrs of age were enrolled of which 68 (61.26%) were males and 43(38.74%) were females. The samples collected from the axillary site were 110, nasal site 108, urine 96 and respiratory site 95 in number which is described in Table 1.

Table 1: The % of culture positives as per site selected.

	Axillary site	Nasal site	Urine	Respiratory samples
No. of samples	110	108	96	95
No. of culture positives	105 (95.45%)	90 (83.33%)	34 (35.42%)	87 (91.58%)

As per Table 2 and Figure 1 the organisms isolated from different sites were coagulase negative *Staphylococcus* (CoNS), *Staphylococcus aureus*, *Enterococcus* species, *Escherichia coli*, *Klebsiella* species, *Candida* species, *Pseudomonas* species, *Acinetobacter* species and Diphtheroids. Out of all isolated organisms many were multidrug resistant. In the Table 2 and also in Table 3 shows infection among axillary site samples, organisms isolated were maximally CoNS 93 (88.57%) out of these 42 (45.15%) were methicillin resistant CoNS (MRCoNS) and 51(54.84%) were Methicillin Sensitive CoNS (MSCoNS). This is followed by *Staphylococcus aureus* 08 (7.27%), *Klebsiella* species 02 (1.9%), *Escherichia coli* 01 (0.91%) and *Citrobacter* species (0.91%). Among all the organism isolated 06 (5.45%) were methicillin resistant *S. aureus*, 01 (0.9%) was carbapenemase producing *Klebsiella* species and all (0.9%) *E. coli* were carbapenemase producing.

Table 2: The organisms isolated from different sites

Organisms Isolated	Culture Positive Samples			
	Axillary Site (N=105)	Nasal Site (N=90)	Urine (N=34)	Respiratory Samples (N=87)
CoNS	93	71	-	03
S. aureus	08	05	-	03
Klebsiella species	02	05	05	15
E. coli	01	03	12	-
Candida species	00	03	05	06
Enterococcus species	-	-	03	-
Pseudomonas species	-	01	-	03
Acinetobacter species	-	-	-	05
Citrobacter species	01	-	-	-
Diphtheroids	-	02	-	-
Mixed Growth/Normal Flora	-	-	09	52

*CoNS=Coagulase Negative Staphylococcus

Table 3: Number of Multidrug Resistant (MDR) organisms.

Name of the organism	Total No of organism isolated	No of MDR organism
CoNS	167	69 (41.32%) MR CoNS
Klebsiella species	27	06 (22.2%) ESBL producer
		06 (22.2%) Carbapenemase producer
E. coli	16	06 (37.5%) ESBL producer
		05 (31.26%) Carbapenemase producer
Candida species	14	08 (57.14%) *Non albicans Candida*
Pseudomonas species	06	
Enterococcus species	03	
Acinetobacter species	04	Only sensitive to colistin and polimyxin B
Citrobacter species	01	

*CoNS-Coagulase Negative Staphylococcus, MRCoNS Methicillin Resistant CoNS, ESBL-Extended Spectrum Beta Lactamase

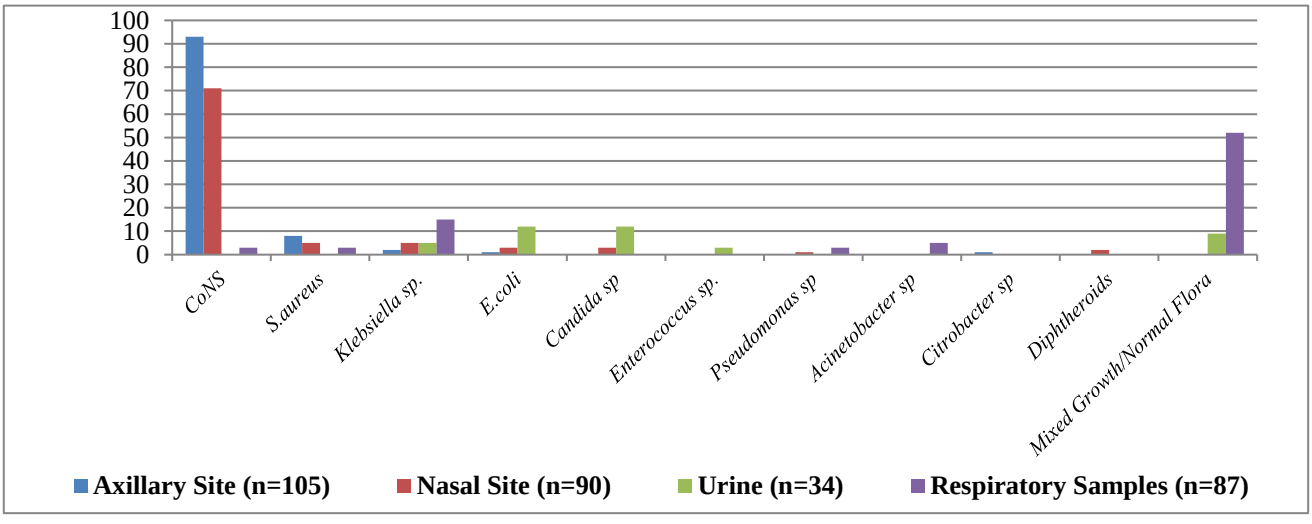

Figure 1: The pattern of organisms isolated from the different site samples.

The results in Table 2 and 3 shows that in the nasal samples, 71 (78.89%) isolated organisms were CoNS, of which 26 (35.2%) were MRCoNS. Which is followed by *S. aureus* 05(5.56%), *Klebsiella* species 05(5.56%), *E. coli* 03 (3.33%), *Candida* species 03 (3.33%) and *Pseudomonas aeruginosa* 02 (2.22%). In the nasal samples 02 (2.22%) MRSA, 02 (2.22%) carbapenemase

producing *Klebsiella* species, 03 (3.33%) *E. coli* were multidrug resistant (02 were ESBL producer and 01 carbapenemase producer). The *Pseudomonas aeruginosa* isolated found to be resistant to ceftazidime, cefepime, cefaperazone-sulbactam, piperacilin-tazobactam, amikacin and carbapenems but sensitive to colistin.

Among urine samples organisms isolated maximally *E. coli* 12 (35.3%) of which 03 (8.82) ESBL and 04 (11.76%) were carbapenamase producer. Which is followed by 05 (14.7%) *Klebsiella species*, 05 (14.7%) *Candida* species and 03 (8.82%) *Enterococcus* species were isolated. Among the *Klebsiella* species, 02 (5.9%) were carbapenemase producer. The organisms isolated in the respiratory samples include 15 (17.24%) *Klebsiella* species (04 ESBL producer and 02 carbapenemase producer) maximally which is followed by *Candida* species 06 (6.9%), *S. aureus* 03 (3.45%), *Pseudomonas* species 03 (3.45%), 04 (4.6%) *Acinetobacter* species and 03 (3.45%) CoNS. Among these 02 (2.3%) MRSA and 06 (6.9%) *Klebsiella* species were MDR (4.6% ESBL and 2.3% carbapenemase producer).

Except one, all *Acinetobacter* species found to be resistant to ceftazidime, amikacin, carbapenems and piperacillin/tazobactam but all are sensitive to colistin. This is also described in Table 2 and 3. The results of the same table also shows that of all *Candida* species (Total=14) isolated from different site predominant were non albicans 08 (57.14%).

DISCUSSION

There is a growing concern to reduce the healthcare associated infections in critical care units around the world. To strengthen the contact precautions, prevent further transmission and to direct antimicrobial treatment healthcare institutions started performing active surveillance cultures for the detection of multidrug resistant pathogens among the newly admitted patients. Worldwide various studies were done to assess the significance of active surveillance culture for routine use.

In the study by Latif M et al, rate of isolation of CoNS and methicillin resistance among the hospitalised from intensive care units were on the rise in specimens came from blood (53.5%) followed by pus or swabs (35.1%).[10] In the study by Varsha G et al, 51.7% (75 of total 145 patients) were culture positive for the nasal site sample, while 45.5% (66 of total 145 patients) were positive on culture of the rectal site. Organisms isolated from positive nasal samples were maximally for MRSA followed by MSSA, *Klebsiella* species, Acinetobactor, *E. coli*, *Pseudomonas* species, *Citrobactor* species and *Proteus mirabilis*. The same for rectal site sample were MRSA followed by MSSA, *Acinetobactor* species, *Klebsiella* species, *E. coli*, *Pseudomonas* species and *Citrobactor* species. They also found isolated *Acinetobactor* species were resistant to amikacin, cefazidime, cefoperazone in 100% samples while resistance to ciprofloxacin and pipercillin-tazobactom were 87.5% and 77% respectively. The sensitivity pattern to colistin was observed in 100% samples.[11]

Papadimitriou-Olivgeris M et al, observed that predominant species isolated were *Candida albicans* but the administration of fluconazole and other *Klebsiella pneumonia* infection shows significant association with *Candida* isolation, especially non albicans species.[12]

Ebbing L et al, studied for detection of MRSA in active surveillance culture of multiple sites. The nares were found the most colonized site. They also found sensitivity ≥90% for MRSA when multiple were sites sampled.[13] In our study, we found there were few blood cultures positive in the study patients but most of them were positive for CoNS. Study by Arie S et al, observed for development of bacteremia in ASC positive cases (31% ASC positive). They didn't find any significant association between development of bacteremia and ASC positivity.[14] In our study we had collected around 111 patients in a duration of 6months and the samples were generally collected within 7days of admission. Authors are not able to demonstrate the correlation or significance association between results of ASCs and the subsequent HAIs. As most of the study population were referred, from primary healthcare centres or other health care centres and the pathogenic organisms isolated from them are mostly multidrug resistant, so they may act as a point source of HAI in the critical care units.

According to Van Vught LA, the mortality associated with the ICU-acquired infection does not seem to be higher in patients with a sepsis at the time of admission than in patients admitted with a noninfectious condition.[15]

CONCLUSION

In most infectious events the causative agent at the start is unknown or at best only suspected, thus mandating empiric antibiotics. Early identification of the causative pathogen in nosocomial and community-acquired infection and differentiation from colonizer is crucial for managing the correct antibiotic treatment and reduction in hospital mortality. Consequently, isolation and cohorting the reservoir of MDR organisms can help in containing the disease and further prevention of spread.

DECLARATIONS

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Thakur L, Dash C, Sinha S. Active surveillance culture in a critical care unit of a tertiary care hospital of West Bengal, India: a prospective study. Int J Adv Med 2019;6:18-22.