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Research Article

Antibiotic sensitivity and resistance in nosocomial infection in medical and surgical intensive care units of a tertiary care hospital in north India

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ABSTRACT

Background: Antibiotic resistance threatens the health of many throughout the world. It is a common problem in the ICU patients who acquire nosocomial infections. Critically ill ICU patients are most vulnerable for developing multidrug resistant nosocomial infections.
Methods: Hospital based, cross sectional, descriptive type of observational study involving 311 patients admitted in ICU who were studied for development of nosocomial infections.
Results: In this study, the nosocomial infection rate among ICU patients was 32.79%. The commonest organism isolated from all samples were E. coli., Acinetobacter spp., Pseudomonas sp., CONS and Staph. aureus. In these samples, it was found that E. coli was most commonly resistant to Imipenem (93.8%) and Meropenem (93.8%). Majority of CONS was resistant to Nitrofurantoin (81.0%). Klebsiella sp. was most commonly resistant to Ceftriaxone (94.4%). Pseudomonas was commonly resistant to Imipenem (94.1%) and Meropenem (94.1%). Acinetobacter sp. was resistant commonly to Amikacin (90%) and Gentamicin (90%). Staph. Aureus was mostly resistant to Amikacin (90%), Gentamicin (90%) and Cotrimoxazole (90%).
Conclusions: Nosocomial infections affect about 1/3rd of the patients in ICUs. Development of antibiotic resistance to commonly used drugs becomes a major deterrent to patient outcome, increasing duration of patient stay as well as expense. Strict infection control measures like universal precautions and stringent adherence to hand washing practices; formulation of antibiotic policy; Surveillance activities, appointment of infection control practitioners; might be required for the same for which further research is advocated.

Keywords: Antibiotic resistance, Nosocomial infection, Antibiotic policy

INTRODUCTION

Antimicrobial resistance threatens the health of many throughout the world, since both old and new infectious diseases remain a formidable public health threat.[1] World Health Day 2011 had the theme 'antimicrobial resistance: no action today and no cure tomorrow.[2]

The emergence of antimicrobial resistant organisms is accelerating, and novel drug development has not kept up with its pace.[3] Throughout the world multi-drug resistant nosocomial infections are one of the leading causes of death and morbidity amongst hospitalized patients, accounting a major burden on the patients and public health system of any country.[4] Serious infections caused

by bacteria that have become resistant to commonly used antibiotics have become a major global healthcare problem in the 21st century.[5] Different types of bacteria, fungi and viruses have been implicated in the development of nosocomial infections.

Nosocomial infections are those infections acquired as a result of treatment in a hospital or health care service providing centre.

ICUs are an important area for the emergence of antimicrobial resistance due to the frequent use of broad-spectrum antibiotics; the crowding of patients with high levels of disease acuity within relatively small specialized areas; reductions in nursing staff and other support staff due to economic pressures, which increase the likelihood of person-to-person transmission of microorganisms; and the presence of more chronically and acutely ill patients who require prolonged hospitalizations and often harbor antibiotic-resistant bacteria.[6]

Other factors promoting antimicrobial resistance include prolonged hospitalization; the presence of invasive devices such as endotracheal tubes and intravascular catheters, possibly due to the formation of biofilms on the surfaces of these devices; residence in long-term treatment facilities; and inadequate infection control practices.[6,7]

Compared with an average patient, an ICU patient has five to seven folds higher risk of nosocomial infection and ICU infections contributes to 20% to 25% of all nosocomial infections in a hospital. The identification of pathogenic organisms and their antimicrobial susceptibility will help health care providers and planners in the control and management of nosocomial infections in hospital I.C.Us, as well as it will help in formulating antibiotic policy.

So the present study is designed to evaluate nosocomial bacteriological profile, drug sensitivity and resistance patterns in patients of medical and surgical ICU's.

METHODS

The study was conducted in all medical and surgical ICUs of S.M.S. Hospital, Jaipur. The duration of this study and data collection for this study was started from June 2014 till sample size completed. The design of this study was hospital based, cross sectional, descriptive type of observational study. The population of this study was patients admitted in Medical and Surgical ICUs of S.M.S. Hospital, Jaipur.

Sample size was calculated 300 patients admitted in ICUs of S.M.S. hospital at 95% confidence interval and absolute allowable error 5% assuming the population of nosocomial infection in ICU patient was 25%. So for the study purpose 300 cases were taken.

Collection of sample was baseline sample at the time of admission, samples of patients with clinical suspicion of having acquired bacterial infections after 48 hours and within 7 days of admission during the study period. The specimens were cultured onto suitable culture media like MacConkey agar, sheep blood agar, chocolate agar and Sabouraud's agar. Plates were incubated aerobically for 24-48 hours. The isolates were identified by colonial morphology, gram-staining, biochemical tests like catalase, coagulase, oxidase, bile solubility and API-10S (Biomeroux, France). Antimicrobial susceptibility testing was performed on Mueller Hinton agar using disc diffusion method in accordance with Clinical and Laboratory Standard Institute Guidelines. Zone sizes of each antimicrobial agent were recorded and interpreted as resistant, intermediate or susceptible. Intermediately susceptible isolates were considered resistant. Microsoft Excel spread sheet was used to analyse the data in the form of percentages.

RESULTS

Sample type wise distribution

Maximum clinical samples were of blood 201 (64.63%) followed by 40 swab (12.86%), fluid 30 (09.65%), urine (5.79%), pus (4.5%) and sputum (2.57%).

Table 1: Sample type wise distribution.

Samples	No. of samples (n = 311)	
	No.	**%**
Blood	201	64.63
Urine	18	5.79
Swab	40	12.86
Sputum	8	2.57
Fluid	30	9.65
Pus	14	4.50
Total	**311**	**100.00**

Distribution of isolates among patients of different ICU according to positive culture

Chi-square = 0.005 with 1 degree of freedom; P = 0.946 NS.

Table 2: Distribution of isolates among patients of different ICU.

	No of isolates		Positive	
	No	**%**	**No**	**%**
Medical ICU	205	65.92	67	32.68
Surgical ICU	106	34.08	35	33.02
Total	**311**	**100.00**	**102**	**32.80**

According to positive culture

Numbers of isolate were 65.9% in medical ICU and rests were in surgical ICU. But no significant association was

observed in distribution of isolates among patients of different ICU according to positive culture.

Pattern of organism isolated from different samples

Most common isolates were observed E Coli (31.37%) followed by CONS (coagulase negative staphylococci) (20.59%), Acinetobacter sp. (19.61%), Klebsiella (17.65), Pseudomonas sp. (16.67), Staph. aureus (9.80), Enterococcus (4.90) and least were Citrobacter (3.92%), Enterobacter (2.94%) Proteus sp. (1.96%).

Sample profile and rate of positive culture from different samples

Samples; No. of samples (n = 311), Samples yielding growth organism (n = 102). Chi-square = 82.419 with 5 degrees of freedom; P <0.001S.

Table 3: Pattern of organism isolated from different samples.

Organism	No	%
E. coli	32	31.37
CONS	21	20.59
Acinetobacter sp.	20	19.61
Pseudomonas sp.	17	16.67
Klebsiella	18	17.65
Staph.aureus	10	9.80
Enterococcus	5	4.90
Citrobacter	4	3.92
Enterobacter	3	2.94
Proteus sp.	2	1.96
Total	**102**	**100.00**

Table 4: Sample profile and rate of positive culture from different samples.

Samples	No. of samples (n = 311)		Samples yielding growth organism (n = 102)	
	no.	%	Positive culture	%
Blood	201	64.63	36	17.91
Urine	18	5.79	9	50
Swab	40	12.86	34	85
Sputum	8	2.57	6	75
Fluid	30	9.65	9	30
Pus	14	4.50	8	57.14
Total	**311**	**100.00**	**102**	**32.80**

Significant difference was observed in sample profile and rate of positive culture from different samples. Proportion of the samples yielding growth organism was higher (85%) in swab Sample and 75% in sputum sample as compared to blood and fluid samples (17.91% and 39% respectively).

DISCUSSION

Hospital based studies showed higher and varied spectrum of resistance in different regions, while there are limited number of community based studies at country level. In the Holy Family Hospital, Rawalpindi, Pakistan study done by Akhtar N et al during the period of May 2007 to April 2008 which revealed that Bacteria or Candida spp. were isolated from most 269/440 (60.1%) samples.[8] The most frequent site of infection was respiratory tract (47.95%) followed by urinary tract (25.3%). Pseudomonas (P.) aeruginosa, Klebsiella (K.) pneumoniae, Escherichia (E.) coli and Candida spp. were the commonest organisms. The isolation rate of Gram-positive bacteria was relatively low.

In one study done by Maksum R et al in the ICU of Fatmawati hospital, Indonesia during January 2009 to March 2010, the most predominant isolates were Pseudomonas aeruginosa (26.5) followed by Klebsiella pneumoniae (15.3) and Staphylococcus epidermidis (14.9).[9]

A retrospective record based study was conducted in the ICU of Hi-Tech Medical College and Hospital, Odisha, Eastern India from November, 2011 to October, 2012 by Pattanayaka C et al on patients who were clinically suspected of having acquired any infection after 48 hours of admission to the ICUs were included in the study. The rate of nosocomial infection was 28.2%. Urinary tract infection was the most common infection (54.9%). The predominant isolate was E. coli (52.7%) followed by P. mirabilis (15.4%) and Ps aeruginosa (13.2%). E. coli was highly sensitive to Polymyxin B, Gatifloxacin and Ceftriaxone and showed high degree of resistance to Cephalexin, Cefadroxil, Tobramycin and Prulifloxacin. They concluded that most of the bacterial isolates were resistant to third generation Cephalosporins and aminoglycosides.[6]

This current study was conducted in medical and surgical ICUs of S.M.S. hospital, Jaipur, Rajasthan to determine the sensitivity and resistance pattern of the isolates to some commonly used antibiotics, and to identify the predominant bacterial species causing nosocomial infections. In present study, the nosocomial infection rate among ICU patients was 32.79% in the surgical and medical ICUs of Hospital. Pseudomonas, Acinetobacter, E. coli, Klebsiella and CONS and Staph Aureus were the most prevalent pathogens recovered from our ICU patients. Sensitivity pattern of major isolates were: E.coli was most commonly sensitive to Amikacin (78.13%), CONS was most sensitive to Imipenem (76.2%) and Meropenem (76.2%), Klebsiella sp. was most commonly sensitive to Amikacin (66.66%). Pseudomonas was commonly sensitive to Piperacillin+ tazobactam (70.6%), Acinetobacter sp. was sensitive commonly to Cefoperazone + sulbactum (60%) and Staph. Aureus was mostly sensitive to Meropenem (80%).

While antibiotic resistance pattern of major isolates were: E. coli was most commonly resistant to Imipenem (93.8%), Meropenem (93.8%). Majority of CONS was resistant to nitrofurantoin (81.0%). Klebsiella sp. was most commonly resistant to ceftriaxone (94.4%). Pseudomonas was commonly resistant to Imipenem (94.1%), Meropenem (94.1%). Acinetobacter sp. was resistant commonly to Amikacin (90%) and Gentamicin (90%). Staph. Aureus was mostly resistant to Amikacin (90%), Gentamicin (90%) and cotrimoxazole (90%).

CONCLUSION

In this study, the nosocomial infection rate among ICU patients was 32.79% in the surgical and medical ICUs of Hospital. The commonest organism isolated from all samples were E.coli., Acinetobacter spp., Pseudomonas sp., CONS and Staph. aureus.

E.coli was most commonly sensitive to Amikacin, CONS was most sensitive to Imipenem and Meropenem, Klebsiella sp. was most commonly sensitive to Amikacin, Pseudomonas was commonly sensitive to Piperacillin+ tazobactam, Acinetobacter sp. was sensitive commonly to Cefoperazone+ sulbactam, and Staph. Aureus was mostly sensitive to Meropenem. E.coli was most commonly resistant to Imipenem; Meropenem. Majority of CONS was resistant to nitrofurantoin. Klebsiella sp. is most commonly resistant to ceftriaxone.

Pseudomonas was commonly resistant to Imipenem; Meropenem. Acinetobacter sp. was resistant commonly to Amikacin and Gentamicin Staph. Aureus was mostly resistant to Amikacin, Gentamicin and cotrimoxazole.

Nosocomial infections and antimicrobial resistance in the ICUs is a major deterrent to patient outcome, increasing duration of patient stay as well as expense. Reduction of the same is both challenge and goal of all intensive care units around world. Strict infection control measures like universal precautions and stringent adherence to hand washing practices; formulation and antibiotic policy; Surveillance activities, appointment of infection control practitioners; might be required for the same for which further research is advocated.

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