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Original Research Article

Prevalence of microbial infection and strategic pattern of antimicrobial resistance among intensive care unit patients in a tertiary care teaching hospital from rural Northern India

Anurag Ambroz Singh[1], Manpreet Kaur[2], Abhishek Singh[3*], Shewtank Goel[4], Avinash Surana[5], Anu Bhardwaj[6], Sanjeet Panesar[7], Virender K Chhoker[8], Richa Chaturvedi[9]

[1]Associate Professor, Department of General Medicine, SHKM Govt. Medical College, Haryana, India
[2]Associate Professor, Department of Ophthalmology, SHKM Govt. Medical College, Haryana, India
[3]Assistant Professor, Department of Community Medicine, SHKM Govt. Medical College, Haryana, India
[4]Assistant Professor, Department of Microbiology, Major S D Singh Medical College and Hospital, Fatehgarh, Uttar Pradesh, India
[5]Deputy Assistant Director Health, 19 Inf. Div., India
[6]Associate Professor, Department of Community Medicine, MM Institute of Medical Sciences, Haryana, India
[7]Senior Resident, Department of Community Medicine, Vardhman Mahavir Medical College and Safdarjung Hospital, India
[8] Professor and Head, Department of Forensic Medicine, Santosh Medical College, Ghaziabad, Uttar Pradesh, India
[9]RCH Consultant, SIHFW, Rajasthan, India
*Corresponding author email: abhishekparleg@gmail.com

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Abstract

Background: Better management of patients cannot be ensured and the antibiotic policy cannot be designed till one knows the profile of prevalent strains along with their antimicrobial resistance pattern.

Objective: To assess the strategic patterns of the organisms and its resistance patterns that were isolated from the patients admitted in various ICUs in a tertiary care hospital.

Material and methods: The present study was undertaken based on reports of bacterial isolates of various clinical specimens from different ICUs of a tertiary care teaching hospital, that were submitted to the Microbiology laboratory for culture and sensitivity during the period of October 2012 to September 2014. All the organisms were identified morphologically and biochemically by standard laboratory procedure and antibiotic susceptibility pattern was determined by disc diffusion methods.

Results: Out of the total samples (2920) received; organisms were isolated from 66.57%. One organism was isolated in 71.19% samples whereas 2 or more organisms were obtained in 28.8% samples. The most frequently isolated bacteria were P. aeruginosa (38.17%). Among P. aeruginosa, tobramycin had the highest susceptibility rate (94.2%) followed by meropenem (93.93%), carbenecillin (79.11%), and levofloxacin (73.45%). Most of the frequently isolated organisms like K. pneumoniae, Acinetobacter anitratus, Enterobacter were highly resistant to ampicillin, cephalexin, cefepime, ciprofloxacin.

Conclusion: Appropriate antibiotic utilization in ICU is crucial not only to ensure an optimal outcome, but also to prevent the emergence of multi drug resistance. Antibiotic policies and effective surveillance are needed for better management of ICU infections with resistant organisms. Alteration and rotation in antibiotic prescribing patterns would decline the antibiotic resistance.

Key words

Prevalence, Pattern, Intensive care unit, Microbial infection, Antimicrobial resistance.

Introduction

Infection and antibiotic resistance are definitely important public health issues. The consequences of increased drug resistance are far-reaching beyond any doubt. One of the major problems worldwide is the rise in antibiotic-resistant strains of bacteria, mainly in hospitals, and also in the community which has proved difficult to control without considerable resources and expenditure [1]. The possibility of reducing resistance by controlling the use of antibiotics is a rational approach, but the implementation of effective policies has proved difficult in most situations. However, a combined approach of antibiotic restriction, effective surveillance and good infection control practices is essential to tackle the problem of antibiotic resistance [2].

Intensive Care Unit (ICU) is one of potential sources of nosocomial infections even in countries where extensive infection control measures are routinely implemented. In ICU the accumulation of a number of immuno-compromised patients and their nursing and invasive procedures provide a favorable environment to the growth and transmission of nosocomial infections [3, 4]. Globally, patients in the ICUs have encountered an increasing emergence and spread of antibiotic resistant pathogens. Although ICUs generally comprise 5% of all hospital bed, they account for 20% to

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25% of all nosocomial infections. The increased risk of infections is associated with the severity of the patient contact with healthcare personal and length of stay in the ICU [5].

During the last few years the increase in antibiotic resistance has compromised the selection of empirical complicated treatment. Better management of patients cannot be ensured and the antibiotic policy cannot be designed/ framed till one knows the profile of prevalent strains along with their antimicrobial resistance pattern. Therefore, the present study was planned with an objective to evaluate the bacteriological profile and tracing resistance rate among different infections in the ICU patients in this hospital. This study was a modest attempt to summarize the strategic patterns of the organisms and its resistance pattern that are isolated from the patients admitted in various ICUs in a tertiary care hospital.

Material and methods

The present retrospective study was undertaken based on reports of bacterial isolates of various clinical specimens from different ICUs of a tertiary care teaching hospital located in rural Northern India, that were submitted to the Microbiology laboratory for culture and sensitivity during the period of October 2012 to September 2014. All the patients who were admitted to various ICUs during the study period and whose reports were retrieved from the laboratory were included in the study. Laboratory reports and data from medical records department served as study tools. A total number of 2920 specimens were received during this period. Various sources of clinical specimens included blood, urine, pus, cerebrospinal fluid (CSF), catheter tips, endotracheal tips, drainage fluids (trauma, pleural, ascitic) bronchial aspirates, central venous catheters (CVC) etc.

Major S.D. Singh (MSDS) Medical College and Hospital, Fatehgarh, Uttar Pradesh is a tertiary care teaching hospital equipped with ultra modern multi super specialty facilities. The hospital receives major chunk of its patients not only from Uttar Pradesh but also from neighboring states especially from Haryana, Rajasthan, and Madhya Pradesh. Thus this tertiary care dental hospital provided us a perfect base to study such an objective.

All the organisms were identified morphologically and biochemically by standard laboratory procedure. Specimens received were plated on the blood agar and Mac-Conkey agar and incubated aerobically overnight at 37 degree centigrade. Single and mixed growth (two or more than two isolates) per specimens isolated from all the sample were identified by observing the colony characteristics on blood agar, Mac-Conkey agar plates and biochemical reactions using standard microbiological methods [6].

Antibiotic susceptibility testing was done by disc diffusion method [7]. The following antibiotics (Hi–media disc) were tested: ampicillin (10 µg), cephalexin (30 µg), cefotaxime (30 µg), amoxycillin/ clavulanic acid (20/10 µg), piperacillin (100 µg), ceftazidime (30 µg), ceftriaxone (30 µg), meropenem (10 µg), gentamicin (10 µg), amikacin (30 µg), ciprofloxcian (5 µg), nitrofurantoin (100 µg), cotrimoxazole (25 µg), levofloxacin (5 µg), cefepime (30 µg). Zone of diameter was measured and interpreted as per the Clinical and Laboratory Standard Institute guidelines. For quality control of disc diffusing tests, ATCC control strains of Staphylococcus ATCC 43300, Escherichia coli ATCC 25922 and Pseudomonas aeruginosa ATCC 27873 strains were used. After compilation of collected data, analysis was done using Statistical Package for Social Sciences (SPSS), version 20 (IBM, Chicago, USA). The

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results were expressed using appropriate statistical methods.

Results

A total of 2920 samples were received during the study period i.e. during October 2012 to September 2014. Out of the total samples received, organisms were isolated from 1944 (66.57%). One organism was isolated in 1384 (71.19%) samples whereas 2 or more organisms were obtained in 560 (28.8%) samples. The most frequently isolated bacteria were Pseudomonas aeruginosa (P. aeruginosa) 742 (38.17%) and Klebsiella pneumoniae (K. pneumonia) 462 (23.76%), followed by Acinetobacter anitratus (A. anitratus) 291 (14.96%). Least number of isolates (0.46%) was found in Citrobacter Species as per **Table - 1**.

Table - 1: Patten of microorganisms isolated from study subjects.

Microorganisms	Frequency of isolates	Percentage
P. aeruginosa	742	38.17
K. pneumoniae	462	23.76
A. anitratus	291	14.96
Enterobacter Species	119	6.12
E.Coli	107	5.50
P. mirabilis	91	4.69
Staphylococcus aureus	39	2.01
CONS	41	2.11
Candida albicans	12	0.62
Klebsiella oxytoca	19	0.98
Enterococcus Species	12	0.62
Citrobacter Species	09	0.46
Total	1944	100

The antibiotic sensitivity pattern of P. aeruginosa showed that almost all the isolates were resistant to Cephalexin (97.29%). Among P. aeruginosa, tobramycin had the highest susceptibility rate (94.2%) followed by meropenem (93.93%), carbenecillin (79.11%), and levofloxacin (73.45%) as per **Table – 2**.

Table - 2: Antibiotic pattern of P. aeruginosa among the study subjects.

Antibiotics	Sensitive		Resistant	
	N	%	N	%
Cephalexin	22	2.96	720	97.29
Tobramycin	699	94.2	43	5.8
Piperacillin	339	45.68	403	54.32
Carbenecillin	587	79.11	155	20.89
Cefotaxime	514	69.27	228	30.73
Amikacin	496	66.84	246	33.16
Ceftriaxone	381	51.34	361	48.66
Ceftazidime	419	56.46	323	43.54
Gentamicin	294	39.62	448	60.38
Ciprofloxacin	113	15.22	629	84.78
Levofloxacin	545	73.45	197	26.55
Meropenem	697	93.93	45	6.07

Most of the frequently isolated organisms like K. pneumoniae, Acinetobacter anitratus, Enterobacter were highly resistant to ampicillin, cephalexin, cefepime, ciprofloxacin etc. as per **Table – 3**.

Discussion

Infection among ICU patients might be community acquired or iatrogenic. Modern intensive care is a multi–disciplinary effort of a team lead by the intensivist, clinical microbiologist and supported as and when required by associated medical/surgical specialities. A sustained partnership between the intensivist and the clinical microbiologist is essential not only for improving clinical outcome but also for optimising resource utilization [8].

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Out of total 2920 samples received, organisms were isolated from 66.57% samples. One organism was isolated in 71.19% samples whereas 2 or more organisms were obtained in 560 (28.8%) samples. The present study showed that the most frequently (38.17%) isolated bacteria were Pseudomonas aeruginosa. These results are cohort with others [9, 10]. This is in contrast to the study by Kumari HB and Erb A [11, 12]. Kumari HB reported non fermenting gram negative bacilli other than P. aeruginosa as the most common pathogen in her study [11].

In the current study, high level of resistance was observed to cephalexin (97.29%), ciprofloxacin (84.78%), gentamicin (60.38%) and pipercillin (54.32%) against the most common isolate P. aeruginosa. Tobramycin, meropenem, carbenecillin and amikacin were found to be relatively effective against P.aerugiosa. High resistance to cephalexin and quinolons among P. aeruginosa was in concord with another study from Indonesia [13].

In this study it was observed that, Pseudomonas, K. pneumoniae, Acinetobacter spps were multi drug resistant bacteria to ampicillin, cephalosporins including cefepime and quinolone antibiotics. These isolates were also resistant to gentamicin. Results of studies carried out elsewhere were also in agreement with the findings of the present study [14, 15]. This may be attributed to extensive usage of cephalosporins and quinolones in this hospital.

It has also been observed in this study that amikacin, tobramycin and meropenem showed good sensitivity against all bacteria isolated from ICU admitted patients. Another study from Pakistan also reported good sensitivity to aminoglycosides against gram negative bacilli from the lower respiratory tract specimen of the ICU admitted patients [16]. High sensitivity rate of meropenem which was similar with our observation is also reported by another study from Jordan [17].

Several reports are available across the globe where P. aeruginosa, Acinetobacter spps., K. pneumoniae and E. coli are the most frequent pathogens isolated. High resistance rate to cephalosporins and quinolone antibiotics to these frequently isolated pathogens were also noted. All these studies reconfirm that indiscriminate antibiotic use without following to antibiotic policy contributes to the emergence of antimicrobial resistance in gram positive as well as gram negative bacteria [18, 19, 20, 21].

Conclusion

Appropriate antibiotic utilization in ICU is crucial not only to ensure an optimal outcome, but also to prevent the emergence of multi drug resistance. Antibiotic policies, effective surveillance, and scrutiny of epidemiological trends of these infections are need of the hour for better management of ICU infections with resistant organisms. There is an evident necessity to study not only the trends in epidemiology of nosocomial infections but also the local situations for which multicentre studies need to be carried out in our country to coordinate and arrive at protocols based on certain patterns of antibiotic resistance. Alteration and rotation in antibiotic prescribing patterns would decline the antibiotic resistance.

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Table - 3: Pattern of Antibiotic resistance among predominant microorganisms isolated from the study subjects (in %).

Antibiotics	K. pneumoniae N= 462	A. anitratus N= 291	Enterobacter spp. N=119	E. coli N=107	P. mirabilis N= 91	S. aureus N=39	CONS N=41
Ampicillin	97.23	98.1	81.7	83	92.1	90.30	89.5
Amoxycillin/Clavulinic acid	87.6	74.4	66.7	76.2	72.4	72.6	88.6
Ciprofloxacin	70.9	37.2	25.7	66.4	37.2	30.21	54.2
Amikacin	29.4	76.1	54.8	47.8	59.4	57.3	48.9
Gentamicin	89.2	72.34	32	41.9	72.2	69.23	57.4
Cotrimoxozole	39.5	45.17	59	26.27	58.5	59.5	61.29
Cefepime	54.5	86.3	98.7	51.09	67.2	68.71	35.54
Ceftrixone	67.2	50,18	96.4	52.78	70.21	67.4	98.7
Cephalixin	93.5	95.6	29.7	76.36	20.2	14.5	37.21
Meropenem	24.2	37.2	35.56	11.97	50.10	50.2	39.41
Levofloxacin	37.47	39.4	44.67	21.92	65.76	38.98	24.87
Vancomycin	-	-	-	-	-	0	0
Penicillin	-	-	-	-	-	100	98.7
Cefotaxime	67.3	71.8	55.14	32.9	67.84	68-14	58.6