ORIGINAL ARTICLE

MICROBIOLOGICAL SURVEILLANCE IN THE INTENSIVE CARE UNIT: A TERTIARY HOSPITAL EXPERIENCE IN KOSHI AREA (NORTHERN BIHAR) INDIA

Chandan Kumar Poddar[1], Randhir Kumar[2], Ram Nagina Sinha[3], B. D. Choudhary[4]

ABSTRACT: INTRODUCTION: Hospital infections are important because of increased risk of mortality and morbidity and their economic burden countries especially like India, most commonly seen in intensive care units (ICUs). We aimed to document the characteristics of patients at an ICU of Northern India, obtain bacteriologic samples, and determine the distribution of the isolated microorganisms. **MATERIAL/METHODS:** The study was conducted in the ICU of an anesthesiology and Surgery department. The characteristics of 200 patients treated there for a period of over two years were documented. The distribution of bacteriologic samples and isolated microorganisms and susceptibilities were investigated. The emerging hospital infections were determined using surveillance methods that were based on clinical and laboratory data. **RESULTS:** Intoxication was the most common cause of hospitalization, followed by respiratory insufficiency due to severe pneumonia and/or chronic obstructive respiratory disease, then trauma, postoperative conditions, and cerebrovascular problems. Cultures were most commonly obtained from patients with respiratory insufficiency and trauma. According to clinical specimens, the most commonly isolated microorganisms were E. coli (60.86%) in urine, S. aureus (53.84%) in blood, P. aeruginosa (26.22%) in tracheal aspirates, and Acinetobacter spp. (50.00%) in wounds. Considering all specimens, MRSA (24.00%) was the most common microorganism. **CONCLUSIONS:** Hospital infections causes serious problem in an ICU setting. Surveillance studies comprise the basis for treatment of ICU infections. **KEYWORDS:** intensive care unit, hospital infection, bacteriological culture.

INTRODUCTION: Hospital infections are important due to the increased risk of mortality and morbidity as well as their economic burden in countries especially like India.[1] Globally, 5% of all patients acquire hospital infections. In India, 30-35 % of persons admitted to hospitals develop infections. This is a high rate when compared to Western countries; Intensive care units (ICUs) are the areas with the highest rates of nosocomial infections.

ICU patients usually have diseases with high mortality rates. Many invasive procedures are applied to the patients, and related complications may occur.[2] Twenty percent of all hospital infections are encountered in the ICU. Moreover, infectious agents in the ICU are commonly resistant types, and the requirement for treatment with more toxic and expensive medications becomes a problem.[3]

The aim of our study was to document the characteristics of intensive care patients and their bacteriological samples as well as the distribution of isolated microorganisms and their antibiotic susceptibility in our ICU Two-year period.

ORIGINAL ARTICLE

MATERIAL AND METHODS: The admitted patients for treated in the Intensive Care Units (ICUs) of the anesthesiology and Surgery department of the Lord Buddha Koshi Medical College & Associated Hospital, Saharsa (B. N. Mandal University, Madhepura) between June 2012 and June 2014.

Selection of the Patients: The hospitalized patients in the ICU, by the anesthesiology and surgery departments. Patients who were treated for less than 48 hours in the ICU were excluded. Routine microbiological screening from tracheal aspirate, urine, and the surgical field was performed in selected patients.

A blood culture was done if there was clinical suspicion of systemic inflammation. Cerebrospinal fluid (CSF) was obtained when there was fever of unknown origin or clinical suspicion of meningitis. A Medical Officer dealing with infection control followed the patients included in the study by using surveillance methods based on patient and laboratory data. Definitions were used according to the "Centers for Disease Control and Prevention (CDC)" criteria.[4, 5]

DEFINITIONS:
Bacteremia: Positive blood cultures were evaluated for primary or secondary infection following exclusion of contamination. Bacteremia was considered if the infection was not secondary to another focus.
Pneumonia: This was considered when significant growth was observed on transtracheal aspiration and/or blood cultures of patients with clinically or radiologically suspected pneumonia.
Surgical wound Infections: Significant growth with at least one infection sign or symptoms.
Urinary tract Infections: Urinary tract infection was diagnosed when a urine specimen contained ≥102 colonies/ml in the presence of symptoms such as fever, hypothermia, lethargy, or ≥105 colonies/ml without any symptoms.

Microbiological Methods: Bacteriologic samples and microorganisms isolated were investigated at the Clinical Microbiology Laboratory of the Lord Buddha Koshi Medical College & Associated Hospital, Saharsa. Conventional methods (Standard precautions to be taken as per guidelines of Center for Disease control & Prevention) were used to identify bacteria.

Antibiotic susceptibility tests were determined by the Kirby-Bauer disc diffusion method while maintaining the required standardization conditions given by CLSI.[6] Plates were incubated at 37°C in an aerobic environment for 24 hours. The results of antibiotic sensitivity were interpreted on the basis of diameters of growth inhibition zones according to CLSI suggestions.

Statistical Analysis: Data analysis was performed using Chi-square and Kruskal-Wallis tests were used for comparisons. A p value $p<0.05$ was considered as Statistically Significant.

RESULTS: The study was conducted in the ICU of an anesthesiology and Surgery department of the Lord Buddha Koshi Medical College & Associated Hospital, Saharsa. During the Two-years period, 200 patients were included in the study. The mean age was 44.3±21.5 (range: 5–65) years. Etiologies were as follows: 57 (28.5%) intoxication, 47(23.5%) respiratory insufficiency due to chronic obstructive pulmonary disease (COPD) or severe pneumonia, 42 (20.5%) trauma, 27(13.5%) postoperative, 16 (8%) cerebrovascular accident (CVA), and 11 (5.5%) other causes.

The mean hospitalization period of the patients was 3.7±3.1 days for intoxication patients, 11.3±2.3 for patients with COPD or severe pneumonia, 19.2±17.8 for trauma patients, 14.5±12.5 for

ORIGINAL ARTICLE

postoperative patients, 7.8±3.3 for CVA patients, and 9.8±10.2 days for other etiologies. The mean hospitalization periods showed significant differences between groups (Kruskal-Wallis p=0.0001).

Three hundred and thirty urine, 340 blood stream, 260 tracheal aspirate, 12 catheter, 10 pleural fluid, 38 wound, and 10 CSF specimens, making a total of 1000 bacteriologic samples, were sent to our clinical Microbiology laboratory of the Lord Buddha Koshi Medical College & Associated Hospital, Saharsa. The number of samples obtained from respiratory insufficiency and trauma patients was greater than from the other groups. The distribution of the samples according to patient groups is shown in Table 1.

Patient groups														
Sample	Intoxication		COPD		Trauma		Postoperative		CVA		Other		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Urine	21	6.4	80	24.3	85	25.7	60	18.2	77	23.2	7	21	330	100
Blood	6	1.7	127	37.5	119	35	20	5.8	65	19.2	3	0.8	340	100
Tracheal aspirate	5	1.9	99	38.1	64	24.6	40	15.3	52	20.1	-	-	260	100
Catheter	-	-	3	18.2	3	27.3	6	45.5	1	9.1	-	-	12	100
Pleural fluid	-	-	10	100	-	-	-	-	-	-	-	-	10	100
Surgical field	-	-	-	-	25	66.7	10	25	3	8.3	-	-	38	100
CSF	7	66.7	-	-	-	-	-	-	3	33.3	-	-	10	100
Table 1: The distribution of the samples obtained from reanimation unit according to patient groups														

The isolated microorganisms were mostly from wound samples (54%). No microorganism grew on CSF samples. The most frequently isolated microorganisms according to clinical samples were as follows: Escherichia coli (E. coli) (60.86%) from urine samples, Staphylococcus aureus (S. aureus) (53.84%) from the blood stream, Pseudomonas aeruginosa (P. aeruginosa) (26.22%) from tracheal aspirate samples, and Acinetobacter spp. (50.00%) from surgical wound samples.

Among all the samples, the most frequently isolated microorganism was methicillin-resistant Staphylococcus aureus (MRSA) (24.00%) followed by P. aeruginosa (17.0%) and Acinetobacter spp. (17%). The distribution of the growing microorganisms according to the samples showed significant difference (p=0.0001). The encountered isolates are listed in Table 2.

ORIGINAL ARTICLE

| Microorganism | Samples | | | | | | Total | |
	Urine	Blood	Tracheal aspirate	Catheter	Pleural fluid	Surgical field	No	%
Candida spp.	1						1	0.5
P. aeuruginosa	3	13	16	1		1	34	17.0
E. coli	14	2	8				25	12.0
Acinetobacter spp.	2	23	5	1		3	34	17.0
Group-D streptococci	1						1	0.5
Proteus spp.	1						1	0.5
S.epidermidis	1	2	5			1	9	4.5
MRSA		42	4	1	1		48	24.0
MSSA		14	8			1	23	11.5
Enterobacter spp.		3	4	1			8	4.0
S.typhi		1					1	0.5
Budding yeast cells		1	2				3	1.5
K. pneumonia		1	2				3	1.5
Streptococcus spp.		1	3				4	2.0
Citrobacter		1					1	0.5
Steptococci Gr A-2			3				3	1.5
Steptococci Gr F-1			1				1	0.5
S.pneumoniae				1			1	0.5
Total (%)	23(11.5)	104(52)	61(30.5)	5(2.5)	1(0.5)	6(3)	200(100)	100

Table 2: The distribution of growing microorganisms in the samples

The antibiotic sensitivities of predominant bacteria are shown in Table 3. Among the 200 patients included in the study, (30 bacteremia, 24 pneumonia, 12 urinary tract infections, and 2 surgical field infections). The infection rate in the ICU was 34%.

	P. aeruginosa (Tn: 34)	Acinetobacter (Tn: 34)	E. coli (Tn: 24)	S. aureus (Tn: 71)
Antibiotics	Rn/ %	Rn /%	Rn /%	Rn /%
Amox/Clav		32/94.7	11/48.1	48/67.5
Pip/Tazo	1/ 2.94	30/89.5	0/0	-/-
Ceftazidime	20/57.9	28/84.2	4/18.5	-/-
Cefepime	14/42.1	27/81.6	5/22.2	-/-
Ciprofloxacin	8/23.7	21/63.2	6/25.9	-/-
Amikacin	15/44.7	13/39.5	2/7.4	-/-
Netilmicin	20/60.5	21/63.2	3/11.1	-/-
Imipenem	16/47.4	11/34.2	0/0	-/-
Vancomycin	-/-			

Table 3: Susceptibilities of the predominant pathogens

Tn – total number; Rn – resistant number.

ORIGINAL ARTICLE

DISCUSSION: Microbiological surveillance in the ICU facilitates the monitoring of changes of dominant microorganisms and antibiotic susceptibilities in the unit, detecting epidemics, deciding empirical treatment regimes and, as a result, selecting the right antibiotics.[7]

Starting empirical treatment without microbiological investigations and surveillance studies is recognized as a mistake. In our Lord Buddha Koshi Medical College, & Associated Hospital, Saharsa, the Anesthesiology & Surgery unit Medical Officer works in cooperation with the infection control committee in performing the necessary microbiological investigations. A total of 1000 bacteriologic samples from the patients included in our study were sent to our Clinical Microbiology laboratory.

The most of the samples were sent from the respiratory insufficiency and trauma patients (Table 1). A long hospitalization time in the ICU is found to be the most important risk factor for the development of ICU infections.[8] In our study, trauma cases were hospitalized in the ICU for longer periods (mean: 19.2±17.8 days). The increased number of bacteriological culture samples is related to the longer ICU stay period of patients with trauma and respiratory problems.

Staphylococci are the most frequently isolated bacteria in hospital infections. Intensive care units are suitable places for methicillin-resistant bacteria. Hospitalization in an ICU is an important risk factor for MRSA colonization and infection.[9] Some studies showed that MRSA is most commonly isolated from surgical fields.[10] In our study; MRSA was most frequently isolated from the blood stream, as reported by Berghmans T et al.[11]

In our study the most commonly isolated bacteria in ICU patients was MRSA (24.00%). According to the results of the same study, Pseudomonas and Acinetobacter species are commonly isolated from the lower respiratory tract, and S. aureus was the leading cause of bacteremia as in our study. Usually in the non-fermenter group, P. aeruginosa is the most common hospital infection agent.

The second most frequently isolated non-fermenter bacteria are Acinetobacter spp. Both bacteria are related with a high mortality rate.[12] In our study; both bacteria are the second most frequently isolated bacteria if all samples are taken into account. P. aeruginosa is the most frequently isolated bacterium from tracheal aspirate cultures. Acinetobacter spp. is the most commonly isolated bacteria from wound cultures.

Resistance rates were high in the frequently isolated Gram-negative bacilli such as P. aeruginosa and Acinetobacter strains, and in S. aureus, a Gram-positive microorganism. The increase in resistance was related with the severity of underlying disease, long duration of hospitalization, and prior inappropriate antibiotic use in patients hospitalized in the ICU.

These microorganisms pose difficulties not only in the treatment of ICU infections, but also other hospital- or community-acquired infections because of their antibiotic resistance. Piperacillin-tazobactam was reported to be the most effective agent against P. aeruginosa and Enterobacteriaceae by Dzierzanowska-Fangrat K et al.[13]

We also found piperacillin-tazobactam to be the most active agent against P. aeruginosa and E. coli, inhibiting 97% and 100% of isolates, respectively. As with other opportunistic Gram-negative organisms (e.g. P. aeruginosa), increasing antibiotic resistance has hindered therapeutic management in Acinetobacter. Acinetobacter infections have been treated with ampicillin, second-generation cephalosporins, carbenicillin, and gentamicin in recent years.

Combined measures with a reasonable antibiotic policy and observation of the principles of hygiene and monitoring for possible infections may help to prevent the spread of multiple-resistant strains in hospital environment.

ORIGINAL ARTICLE

Intensive care units are also appropriate environments for the colonization of resistant microorganisms. The microbiologic results must be interpreted by differentiating infection from colonization. Colonization is the presence and reproduction of microorganisms without any immune response and clinical findings in the host.[14] Among the samples taken, surgical field infections are the least commonly detected although growth occurs most commonly in wound samples.

CONCLUSION: As a result, there are major differences in patient characteristics between other hospital departments and the ICU. The growing knowledge and technology in intensive care services and the development of invasive procedures bring complicated problems. Effective infection-control programs need to be considered for the prevention of infection with resistant bacteria in the ICU. Surveillance results and antibiotic resistance tests should be routinely evaluated.

REFERENCES:

1. 1 Edmond MB, Wenzel RP: Infection control. In: Mandell GL, Bennett JE, Dolin R, eds. Principles and Practice of Infectious Diseases. 4th edition. New York: Churchill Livingstone, 1995: 2572-2575.
2. Bongard F S, Sue D Y. Current Critical Care Diagnosis & Treatment. Lange Medical Books/McGraw-Hill, 2002 - 945 pagina's.
3. Flaherty JP, Weinstein RA. Nosocomial infections caused by antibiotic-resistant organisms in the intensive care unit. Infect Control Hosp Epidemiol, 1996; 17: 236–48.
4. Garner JS, Jarvis WR, Emori TG et al. CDC definitions for nosocomial infections. Am J Infect Control, 1988; 16 (3): 128–40.
5. Horan TC, Gaynes RP, Martone WJ et al. CDC definitions of nosocomial surgical site infections, 1992: A modification of CDC definitions of surgical wound infections. Infect Control Hosp Epidemiol, 1992; 13 (10): 606–8.
6. NCCLS: Performance Standards for Antimicrobial Susceptibility Testing; Fifteenth Informational Supplement. CLSI document M100-S15. Clinical and Laboratory Standards Institute, 940 West Valley Road, Suite 1400, Wayne, Pennsylvania 19087-1898 USA, 2005.
7. Alvarez-Lerma F. ICU acquired pneumonia study group. Modification of empiric antibiotic treatment in patients with pneumonia acquired in intensive care unit. Intensive Care Med, 1996; 22: 387–94.
8. Kollef MH, Sharpless L, Vlansik J et al. The impact of nosocomial infections on patient outcomes following cardiac surgery. Chest, 1997; 112: 666–75.
9. Coello R, Glyn JR, Gaspar C et al. Risk factors for developing clinical infection with methicillin-resistant Staphylococcus aureus (MRSA) amongst hospital patients initially only colonized with MRSA. J Hosp Infec, 1997; 37: 39–46.
10. Simor AE, Ofner-Agostini M, Bryce E et al. The evolution of MRSA in Canadian hospitals: 5 years of national surveillance. CMAJ, 2001; 165: 21–26.
11. Berghmans T, Crokaert F, Markiewicz E, Sculier JP. Epidemiology of infections in the adult medical intensive care unit of a cancer hospital. Support Care Cancer, 1997; 5: 234–40.
12. Fagon JY, Chastre J, Hance AJ et al. Nosocomial pneumoniae in ventilated patients: A cohort study evaluating attributable mortality and hospital stay. Am J Med, 1993; 94: 281–88.

ORIGINAL ARTICLE

13. Dzierzanowska-Fangrat K, Semczuk K, Lopaciuk U et al. Antimicrobial susceptibility of aerobic microorganisms isolated from intraabdominal infections in pediatric patients in Poland. Med Sci Monit, 2005; 11(5): CR241–CR245.

14. Rodriguez-Bano J, Cisneros JM, Fernandez-Cuenca F et al. Grupo de Estudio de Infeccion Hospitalaria. Clinical features and epidemiology of Acinetobacter baumannii colonization and infection in Spanish hospitals. Infect Control Hosp Epidemiol, 2004; 25: 819–24.

AUTHORS:
1. Chandan Kumar Poddar
2. Randhir Kumar
3. Ram Nagina Sinha
4. B. D. Choudhary

PARTICULARS OF CONTRIBUTORS:
1. Tutor, Department of Medical Microbiology, Lord Buddha Koshi Medical College, Saharsa, Bihar.
2. Assistant Professor, Department of Medical Microbiology, Lord Buddha Koshi Medical College, Saharsa, Bihar.
3. Associate Professor (Medical Superintendent), Department of Surgery, Lord Buddha Koshi Medical College, Saharsa, Bihar.
4. Assistant Professor, Department of Surgery, Lord Buddha Koshi Medical College, Saharsa, Bihar.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:
Mr. Chandan Kumar Poddar,
Tutor, M.sc, Medical Microbiology,
Department of Medical Microbiology,
Lord Buddha Koshi Medical College,
Saharsa-852201, Bihar, India.
Email: chandan_microbiology@yahoo.co.in

Date of Submission: 07/07/2014.
Date of Peer Review: 09/07/2014.
Date of Acceptance: 05/08/2014.
Date of Publishing: 09/08/2014.