BACTERIAL PROFILE AND THEIR ANTIMICROBIAL RESISTANCE PATTERN IN AN INTENSIVE CARE UNIT OF A TERTIARY CARE HOSPITAL IN DHAKA

Lovely Barai[1], Kaniz Fatema[2], J Ashraful Haq[1], Mohammad Omar Faruq[2], ASM Areef Ahsan[2], Md. Abu Hana Golam Morshed[1], Md. Belayet Hossain[1]

[1]Department of Microbiology and [2]Department of Critical Care Medicine, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorder (BIRDEM)

Abstract

Critically ill patients admitted in intensive care units (ICU) are always at a higher risk of developing infections with various antibiotic resistant organisms. The objective of this study was to know the antibiotic resistance pattern of the common isolates from blood, urine, respiratory secretions and pus/wound swab of patients admitted in ICU at BIRDEM (Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorder) hospital, during a one year period from March 2006 to February 2007. A total of 1660 samples were analyzed. Growth was obtained in 34% of the samples yielding 632 organisms. The major organism isolated were *Pseudomonas sp*. (29.1%), *Acinetobacter sp*. (27.5%), *Candida sp*. (12.8%), *Escherichia coli* (10.3%) and *Klebsiella sp*. (9.7%). *Staphylococcus aureus*, *Enterobacter sp*, *Citrobacter sp*, *Enterococcus sp*, *Providencia sp* and *Serratia sp* accounted for 10.6% of the isolates. All the isolates were highly resistant (>80%) to cephalosporins and fluoroquinolones. The frequency of third generation cephalosporin resistant *E. coli, Klebsiella* and imipenem resistant *Pseudomonas* and *Acinetobacter* were >50%. *Acinetobacter* was remarkably resistant to most antibiotics including imipenem (>70% resistant), but most of the members of the *Enterobacteriacae* group showed maximum sensitivity to imipenem (50%-94%). The findings of this study might help clinicians to formulate their first line empirical antibiotic treatment regimens for the patients admitted in ICUs.

Key words: Intensive care units, antimicrobial resistance pattern, bacterial profile.

Introduction

Critically ill patients admitted in intensive care units (ICU) are always at a higher risk of developing nosocomial infections with resistant strains.[1] Patients admitted in ICUs have an increased susceptibility to infection because of decreased mobility and increased use of invasive devices.[2]

Infection with resistant strains in the ICUs leads to increased mortality and cost.[3] In ICU patients, the patterns of organisms causing infections and their antibiotic resistance differ widely from one hospital to other or one country to another, and even among ICUs within one hospital. In addition, certain types of pathogens are becoming common in each local community and represent an important risk factor for the morbidity and mortality of ICU patients.[4] In a study in an Indian ICU, the most common organisms were *Acinetobacter sp*, *Escherichia coli*, *Klebsiella sp*., *Pseudomonas aeruginosa, Staphylococcus aureus, Streptococcus pyogen,* etc.[5] But in an European ICU, *Staphylococcus aureus* was found as the most frequently isolated organism (30.1%) followed by *Pseudomonas aeruginosa* (28.7%), coagulase negative staphylococcus (19.1%) and yeast (17.1%).[6]

Address for Correspondence:
Dr. Lovely Barai, Assistant Professor, Dept. of Microbiology, BIRDEM, 122 Kazi Nazrul Islam Avenue, Dhaka 1000. e-mail: barai_lovely@yahoo.co

A knowledge of the antibiotic susceptibility of the organisms isolated in the ICU helps to formulate an antibiotic policy for the ICU. This also avoids unnecessary use of broad spectrum antibiotics and prevents emergence of drug resistant bacterial strains.[7] The data on the changing antibiotic susceptibility trends is important for infection control activities in ICU settings. Presently, data on pattern of organisms and their antibiotic susceptibility in ICUs of large hospitals of our country are lacking. Therefore, the present study was undertaken to determine the pattern of organisms causing infection in ICU with their antibiotic sensitivity patterns over a one year period in a 600 bed tertiary care hospital of Dhaka city. This data may be useful to plan antibiotic guidelines as well as antibiotic cycling in ICU settings.

Material and Methods

The study unit was a 10 bed closed combined ICU of BIRDEM hospital. All the samples obtained for culture and sensitivity tests from patients admitted in ICU during March 2006 to February 2007 were included in the study. Samples included blood, urine, sputum/tracheal aspirate (respiratory secretions) and pus/wound swabs. The samples were cultured in standard media for isolation of potential pathogens. Isolates were identified by standard methods.[8] For each isolates antibiotic susceptibility was performed by Kirby Bauer disk diffusion techniques.[9] Isolates with intermediate susceptibility were considered resistant.

Results

A total of 1660 samples were analyzed which included blood (811), urine (372), respiratory secretions (448) and pus or wound swab (29). Out of 1660 samples, organisms were isolated from 564 samples (Table 1).

Table 1: *Sample profile and rate of positive culture from different samples*

Samples	Total No. sample	Samples yielding growth of organisms	
		N	%
Blood	811	87	10.7
Urine	372	150	40.3
Resp. secretions	448	305	68.1
Pus/wound swab	29	22	75.8
Total	1660	564	34.0

Table 2: *Pattern of organisms isolated from different samples*

Organisms	Blood	Urine	Resp sec.	Pus/ WS	Total (%)
Non fermenter organism					
Pseudomonas sp.	45	17	116	06	184(29.1)
Acinetobacter sp.	16	08	144	06	174(27.5)
Enterobacteriaceae					
E coli	14	33	16	02	65(10.3)
Klebsiella sp.	05	14	38	04	61(9.7)
Enterobacter sp.	00	05	12	02	19(3.0)
Serratia sp.	02	00	00	00	02(0.3)
Providencia sp.	01	07	12	02	22(3.5)
Citrobacter sp.	02	00	00	00	02(0.3)
Gram positive cocci					
Staph aureus	00	01	08	00	09(1.4)
Coag NS	00	02	00	00	02(0.3)
Enterococcus sp.	00	10	01	00	11(1.7)
Fungus					
Candida sp.	02	74	05	00	81(12.8)
Total	87 (13.7)	171 (27.1)	352 (55.7)	22 (3.5)	632

Note: Many samples yielded more than one organism. Resp sec: respiratory secretions, WS: wound swab, Coag NS: coagulase negative staphylococcus

The commonest organism isolated from all samples was *Pseudomonas sp.* 184 (29.11%) followed by *Acinetobacter sp.* 175 (27.5%), *Candida sp.* 81 (12.8%), *Escherichia coli* 65 (10.3%) and *Klebsiella sp.* 61 (9.6%). Table 2 shows the detail pattern of organisms isolated from various types of samples.

Table 3: *The antibiotic resistance pattern of major organisms isolated from the patients in intensive care units.*

Antibiotics	Percent isolates showing antibiotic resistance			
	Pseudomonas sp	*Acinetobacter sp*	*E coli*	*Klebsiella sp*
Â-lactam				
Piperacillin	73.8	100	-	-
Ceftriaxone	95.6	98.2	92.2	93.0
Ceftazidime	81.5	95.3	87.9	94.9
Cefotaxime	96.6	100	73.1	97.2
Aztreonam	82.4	91.6	-	-
Imipenem	57.6	72.4	4.6	21.3
Aminoglycosides				
Amikacin	62.5	81.4	48.3	53.7
Netilmicin	76.4	77.9	71.7	55.9
Gentamicin	90.3	93.2	74.6	73.7
Quinolones				
Ciprofloxacin	80.2	94.6	98.1	88.5
Others				
Cosptrimoxazole	91.9	96.4	81.3	95.1
Tetracycline	97.4	91.6	80.8	83.3

Major organisms isolated from blood were *Pseudomonas sp.* (51.7%) and *Acinetobacter sp.* (18.4%) while from urine it was *Candida* sp (43.3%) and *E. coli* (19.3%). The most frequently isolated organisms from both respiratory secretions and pus were *Acinetobacter sp.* (40.9% and 27% respectively) and *Pseudomonas sp.* (32.9% and 27% respectively).

The antibiograms of common isolates are shown in Table 3. Majority of the isolates were resistant to 3rd generation cephalosporins and ciprofloxacin (>80%). The frequency of third generation cephalosporin resistant *E. coli* and *Klebsiella* and imipenem resistant *Pseudomonas* was more than 50%. *Enterobacteriacae* group showed maximum sensitivity to imepenem but > 70% *Acinetobacter* was resistant. *Acinetobacter* was remarkably resistant to most antibiotics. Resistance pattern of organism to aminoglycosides was variable ranging from 48.3 to 93.2%.

About 77 % of isolated *S. aureus* were methicillin resistant (MRSA).

Discussion

Our study included types and antibiotic susceptibility pattern of organisms isolated from different samples from critically ill patients, but it did not attempt to investigate the underlying disease condition of patients or their sources of infection.

In this study, about 55.7% of the organisms were isolated from respiratory secretions (sputum and tracheal aspirate) which probably were due to the fact that most patients either had prior respiratory problems or were in ventilators.

Gram negative bacteria were isolated at a significantly higher rate (84%; p < 0.05) than gram positive bacteria and *Candida*. *Pseudomonas*, *Acinetobacter, E. coli, Klebsiella* and *Candida* were the most prevalent pathogens recovered from our ICU patients (Table-2). The predominant bacterial isolates reported in the Jordanian, Indian and European studies were almost similar to our results.[3,5,10]

Reduction in antimicrobial resistance in the ICUs has been a goal for all intensive care units as it improves the outcome and reduces total expenses as well as duration of ICU stay. The extreme antibiotic use results in the emergence of multi-resistant microorganisms in the ICU environment. The present study revealed high prevalence of antibiotic resistant organisms in our ICU. More than 75% *Pseudomonas sp.* showed resistance to third generation cephalosporins and fluoroquinolons. In 2005, a study conducted in the same ICU reported 82% of *Pseudomonas* as resistant to third generation cephalosporins.[11] But it has been observed that the frequency of fluoroquinolon and imipenem resistant *Pseudomonas* (79.1% and 58.9%) has increased in the present study compared to that of 2005 (48% and 36% respectively).

Acinetobacter sp was the second commonest (27.7% of all isolates) organism isolated from all samples. Though this is commonly isolated from skin and throat of healthy people, it is also known to colonize respirators, respiratory tubing and intravenous catheters in ICU causing serious and often fatal opportunistic infections. They are generally resistant to most classes of antimicrobials and emergence of imipenem resistant strains in many parts of the world is alarming and a threat to the effective management of these infections.[12] In our study, *Acinetobacter* was remarkably resistant to most antibiotics including imipenem (64.2%). *E. coli, Klebsiella* and *Enterobacter* isolates were maximally susceptible to imipenem (>75% sensitive). The susceptibility of these bacteria to cephalosporins was uniformly poor in our study (>80% resistant). This was probably due to over use of cephalosporins in the indoor and ICU patients. Resistance pattern of these organisms to aminoglycosides showed marked variability ranging from 48.3% to 83.3%.

Candida species was the third frequently isolated organism in our ICU. Both *C. albican* and non- albican *Candida* species were found. Most were isolated from urine. High number isolation of *Candida* might be due to the presence of underlying conditions like poor nutritional status, diabetes mellitus and the use of steroids and broad spectrum antibiotics.

References

1. Singh AK, Sen MR, Anupurba S, Bhattacharya P. Antibiotic sensitivity pattern of the bacteria isolated from nosocomial infections in ICU. *Journal of Communicable Diseases* 2002; **34**: 257-263.

2. Rice LB. Controlling antibiotic resistance in the ICU: Different bacteria, different strategies. *Cleveland Clinic Journal of Medicine* 2003; **70**: 793-800.

3. Kaul S, Bahmadathan KN, Jagannati M, Sudarsanam TD, Pitchamuthe K, Abraham OC et al. One year trends in the gram negative bacterial antibiotic susceptibility patterns in a medical intensive care unit in South India. *Indian J Med Microbiology* 2007; **25**: 230-5.

4. Shehabi AA, Baadran I. Microbial infection and antbiotic resistance patterns among Jordanian intensive care patients. *Eastern Mediterranean Health Journal* 1996; **2**: 515-520.

5. Patwardhan RB, Dhakephalkar PK, Niphadkar KB, Chopade BA. A study on nosocomial pathogens in ICU with special reference to multiresistant *Acinetobacter baumannii* harbouring multiple plasmids. *Indian J Med Res* 2008; **128**: 178-187.

6. Spencer RC. Predominant pathogens found in the European prevalence of infection in intensive care study. *Eur J Clin Microbial Infect Dis* 1996; **15**: 281-5.

7. Tullu MS, Deshmukh CT, Baveja SM. Bacterial profile and antimicrobial susceptibility pattern in catheter related nosocomial infections. *J Postgraduate Med* 1998; **44**: 7-13.

8. Colle JG, Miles RS, Watt B. Tests for the identification of bacteria. In: Mackie & McCartney Practical Medical Microbiology, 14th edn. New York. Churchill Livingstone Inc, 1996; 131-149.

9. Bauer AW, Kirby WMM, Sherris JC, Tierch M. Antibiotic susceptibility testing by a standardized sigle disc method. *Am J Clin Pathol* 1966; **45**: 493-9.

10. Verbist L. Epidemiology and sensitivity of 8625 ICU hematology/ oncology bacterial isolates in Europe. *Scand J Infectious Disease* 1993; Supplementum **91**:14-24.

11. Basunia MRA, Rahman MR, Faruq MO, Huq F, Ahsan A, Hasan R, Ahmed B. Microbial pathogens and antibiotic sensitivity at intensive care unit of BIRDEM: A retrospective study. *Bangladesh J Medicine* 2005; **16**: 14-20.

12. Mulvey MR, Simor AE. Antimicrobial resistance in hospitals: How concerned should we be? *Canadian Med Assoc J* 2009;**180**: 408-415.