Bangladesh J Med Microbiol 2014; 08 (01): 07-11
Bangladesh Society of Medical Microbiologists

Original Article

Antimicrobial Resistance Pattern of Bacterial Isolates from Intensive Care Unit of a Tertiary Care Hospital in Bangladesh

Taslima Akter[1] , Mohammad Murshed[1], Taslima Begum[1], Kamrun Nahar[2], Syeda Sharmin Duza[1], Sabeena shahnaz[1]

[1] Department of Microbiology, Holy Family Red Crescent Medical College;
[2]Department of Microbiology & Virology, Ispahani Islamia Eye Institute & hospital

Abstract

Infections with resistant strain are one of the leading causes of morbidity and mortality in hospitalized patients especially the critically ill patients in intensive care unit (ICU). The present study was conducted to know the changing pattern of antibiotic resistance of the common isolates from blood, urine, respiratory secretions and pus/ wound swab of patients admitted in ICU at Holy Family Red Crescent Medical College hospital over a two years period from January 2012 to December 2013. A total of 1282 samples were analyzed. Out of which 301 (23.5%) samples were positive for growth of organisms. The predominant isolates were E.coli (28%), Klebsiella (27%), Acinetobacter (17.3%), Pseudomonas (9.6%), Staphylococcus aureus (5.3%) & candida (6%). Majority isolates were resistant to Cephalosporin and Amoxycillin, (>70-90%). Carbapenem were still highly active against E.coli. However, Klebsiella, Pseudomonas and Acinetobacter were showing alarming resistance (55-60%) towards those drugs. Aminoglycosides resistance has also increased for Pseudomonas and Klebsiella. The percentage of Cloxacillin resistant for staphylococcus was near about 40%. The most active drug against Pseudomonas was piperacillin/Tazobactam. The positive result from this study was that organisms showed decreased resistance towards Tetracycline, Cotrimoxazole and Ciprofloxacin. The sensitivity of Nitrofurantoin for urinary isolates was good. Regular surveillance of antibiotic susceptibility pattern & judicious use of antibiotics is very important for reducing the infection rate and antimicrobial resistance.

Key Words: Intensive care units, antimicrobial resistance pattern.

Introduction:

Infections with resistant strain are one of the leading cause of morbidity and mortality in hospitalized patients especially the critically ill patients in intensive care unit (ICU)[1]. Patients admitted in ICU have an increased susceptibility to infection because of increased morbidity, decreased mobility and increased use of invasive devices[2]. The therapeutic interventions which are associated with infectious complications include indwelling catheters, sophisticated life support, intravenous fluid therapy, prosthetic devices, immunosuppressive therapy and use of broad spectrum antibiotics leading to a spectrum of multi-drug resistant pathogens, which contributed to the evolution of the problem of infections[3].

The patterns of organisms causing infections and their antibiotic resistance pattern vary widely from one country to another, as well as from one hospital to other[4]. In addition, there is also variation in the frequency and types of infections among different subsets of patients within the same ICU[5]. In a study in an Indian ICU, the most common organisms were *Escherichia coli, Proteus sp., Pseudomonas aeruginosa, Candida albicans, Staphylococcus aureus, Klebsiella sp.*, etc[6]. However, 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%) [7].

To formulate an antibiotic policy for the ICU, knowledge of the antibiotic susceptibility of the organisms isolated in the ICU is essential. This also avoids unnecessary use of broad spectrum antibiotics and prevents emergence of drug resistant

✉ ***Correspondence:***
Dr. Taslima Akter
Assistant professor, Holy Family Red Crescent Medical College,
1, Eskaton Garden Road, Dhaka-1000
Email: doctor_taslima11@yahoo.com
Phone: 01712138461

bacterial strains. The data on the changing antibiotic susceptibility trends is important for infection control activities in ICU settings. Therefore, the present study was undertaken to determine the antimicrobial resistance pattern of bacterial isolates from Holy Family Red Crescent Medical College & Hospital over a 2 year period. The results of this study will help clinicians to plan the antibiotic guidelines as well as antibiotic cycling in ICU settings.

Material and Methods

A retrospective record based study was carried out based on data of bacterial isolates from the ICU of Holy Family Red Crescent Medical College & Hospital.

Study period: All the samples obtained for culture and sensitivity tests from patients admitted in the ICU during January, 2012 to December, 2013 were included in the study.

Study samples: Samples included blood, urine, sputum/tracheal aspirate (respiratory secretions) and pus/wound swabs. The samples were cultured in standard media for isolation of potential pathogen. Isolates were identified by standard microbiologic methods and then susceptibility testing was performed by Kirby Bauer disk diffusion method. Isolates with intermediate susceptibility were considered resistant.

Result:

In the 2 year study period, total 1282 samples were analyzed. The cumulative isolates of all samples together were 301 (23.5%). Out of these, 83 isolates (27.6%) were from respiratory tract; 83 (27.6%) isolates from blood; 129 (42.9%) isolates from urine; 6 (2%) isolates from pus/ wound swab as shown in Table-I.

The major organism isolated in a 2 year study period were Escherichia coli 84(28%) followed by *Klebsiella sp*. 81(27%), *Acinetobacter sp*. 52(17.3%), Pseudomonas sp. 29(9.6%), Candida 18(6%) and *Staphylococcus aureus* 16(5.3%). The numbers of percentages of Klebsiella and Staphylococcus aureus have markedly increased from 17.8% & 1.9% in 2012 to 37.1% & 7.2% in 2013 respectively. *Acinetobacter* was the most commonly isolated organism from blood 30 (36.1%), while E. coli was the most frequently isolated organism from urine, 57 (44.1%). The most common organism from respiratory tract was *Klebsiella*, 44 (53%). (Table-II)

Antibiotic resistance pattern of major five bacterial isolates is shown in Table-III. Majority isolates were resistant to Cephalosporin and Amoxycillin, (>70-90%). Carbapenems are still highly active against *E.coli*. However, *Klebsiella, Pseudomonas and Acinetobacter* are showing alarming resistance (55-60%) towards those drugs. The resistance patterns of Gentamycin & Amikacin have increased for *Pseudomonas* (37% to 67% & 25% to 52% respectively) and for *Klebsiella* (52% to 62% & 26% to 58% respectively) during this study period. For *E. coli & Acinetobacter*; Gentamycin resistance was stable; however, Amikacin resistance has slightly increased from 32% to 45% & 48% to 60% respectively over the 2 years time. The percentage of Cloxacillin resistant for staphylococcus was near about 40%. As per sensitivity analysis, the most active drug against *Pseudomonas* was piperacillin/Tazobactam. Organisms were showing decreased resistance towards Tetracycline, Cotrimoxazole and Ciprofloxacin. The sensitivity of Nitrofurantoin for urinary isolates was good in this 2 year period.

Table-I: Distribution of isolates among samples

Sample	2012 N(%)	2013 N(%)	Total N(%)
Blood	27(25.2)	56(28.9)	83(27.6)
Respiratory tract	30(28)	53(27.3)	83(27.6)
Urine	49(45.8)	80(41.2)	129(42.8)
Pus/Wound swab	01(1)	05(2.6)	06(2)
Total	107	194	301

Figure within parentheses indicate percentage

Table-II: Pattern of organisms isolated from different samples between 2012 & 2013.

Organism most Frequently isolated	Samples	2012 N=107	2013 N=194	Total N=301
E. coli	Respiratory tract	5	2	7
	Blood	3	15	18
	Urine	28	29	57
	Pus/Wound	1	1	2
Klebsiella	Respiratory tract	9	35	44
	Blood	3	16	19
	Urine	7	19	26
	Pus/Wound	-	2	2
Acinetobacter	Respiratory tract	12	13	15
	Blood	15	15	30
	Urine	-	7	7
	Pus/Wound	-	-	-
Pseudomonas	Respiratory tract	2	6	8
	Blood	2	7	9
	Urine	4	8	12
	Pus/Wound	-	-	-
Staph aureus	Respiratory tract	-	6	6
	Blood	-	-	-
	Urine	2	6	8
	Pus/Wound	-	-	-
Candida	Respiratory tract	-	-	-
	Blood	-	-	-
	Urine	8	10	18
	Pus/Wound	-	-	-
Others	Respiratory tract	2	1	3
	Blood	4	3	7
	Urine	-	1	1
	Pus/Wound	-	-	-

Table-III: Antibiotic resistance pattern of major organisms isolated from ICU in the year 2012 & 2013 (Numbers are percent resistant).

Antiobiotics	E. coli		Klebsiella		Acinetobacter		Pseudomonas		Staph Aureus
	2012 N=37	2013 N=47	2012 N=19	2013 N=72	2012 N=27	2013 N=25	2012 N=8	2013 N=21	2013 N=14
Ceftriaxone	89.2	83	89.5	82	81.5	80	-	-	64.3
Ceftazidime	-	-	-	-	77.8		75	85.7	-
Cefuroxime	94.6	82.97	78.9	84.72	-	-	-	-	
Cephalexin	94.6	93.6	94.7	91.7	-	-	-	-	71.4
Ciprofloxacin	78.4	55.3	52.6	73.6	44.4	44	50	47.6	50
Cotrimoxazole	64.9	66	78.9	70.8	59.1	28	-	-	50
Amikacin	32.4	44.7	31.6	47.2	48.1	60	25	52.4	35.7
Gentamycin	59.5	57.4	52.6	62.5	66.4	68	37.5	66.7	42.8
Imipenem	13.6	21.3	26.3	58.3	40.7	56	12.5	62	43
Meropenem	13.6	19.1	21.1	56.9	37	40	12.5	60	-
Tetracycline	73	61.7	78.9	50	77.8	76	-	-	71.4
Amoxicillin	91.9	100	-	-	100	100	-	-	-
Amoxiclave	83.8	70.2	89.5	75	-	-	-	-	64.3
Cloxacillin	-	-	-	-	-	-	-	-	42.2
Nitrofurantoin (in urine)	21.4	34	14.3	26.4	-	-	-	-	28.6
Piper-Tazobac	-	-	-	-	-	-	-	24	-
Azithromycin	56.8	48.9	68.4	72.2	51.9	44	-	-	57.14

Discussion

During the study period, organisms were mostly isolated from Urinary tract 129 (42.9%) followed by respiratory tract and blood 83 (27.6%). These finding corroborated the results reported in a study from India[6]. Gram negative bacteria were isolated at a significant higher rate (98%) than Gram positive bacteria and candida. This observation is agreed with findings of *Barai et al* (2010)[8].

In total, predominant organisms isolated from our ICU were E.coli 84 (28%), *Klebsiella sp*. 81 (27%), Acinetobacter sp 52. (17.3%), *Pseudomonas sp*. 29 (9.6%), Candida 18 (6%) and Staphylococcus aureus 16(5.3%). These finding were comparable to the finding of *Pattanayak et al(2013), Barai et al (2010) & Shalinis et al(2010)*[6,8,9]. The spectrum of pathogens in ICU may change from country to country with time and by hospital, type of ICU, and specific patient population[10,11]. *Klebsiella pneumoniae* is one of the common causative organisms for respiratory and urinary tract infection[12]. The microorganism can rapidly spread from the gastrointestinal tract of patient and via the hands of the hospital personal to other patients, leading to nosocomial outbreak[13]. In our study, the percentage of *Klebsiella* isolates markedly increased from 17.8% to 37.11%. Moreover it was the most common isolates in respiratory tract. Similar finding was observed by *Jain & Khety* (2012)[12].

Acinetobacter sp. has recently advanced to one of the most common pathogens isolated from ICUs. In our study it was the most common isolates in blood and 2nd most common isolates from respiratory tract. A study conducted in ICU of Dhaka city by *Haque et al* (2013) [14]reported that the most common pathogen from tracheal aspirates was *Acinetobacter*. Another study from *Barai et al(2010)*[8] also found, *Acinetobacter* as the 2nd most common organism from all samples. In our study, the most common isolates from urinary samples were *E. coli* which corresponds to the finding of *Pattanayak C et al* (2013)[6].

Prolonged use of Carbapenem in the treatment of nosocomial infection can favor the development of resistance to those antimicrobial agents. In our study, Carbapenem resistant rate has alarmingly increased for *Klebsiella, Acinetobacter and Pseudomonas*. However, they are still highly active against *E.coli*. A study from Birdem hospital in 2010 also reported imipenem resistant *Acinetobacter* (>70%) and Klebsiella (>20%)8. *Jain & Khety* (2012)[12] also reported carbapenem

resistant pseudomonas. Emergence of Imipenem resistant strains in many parts of the world is alarming and a threat to the effective management of those organisms. Majority isolates were resistant to cephalosporin and amoxycillin (>705-90%). This might be due to the selective influence of extensive usage of cephalosporins and amoxicillin/ clavulanic acid. *Ganneja et al* (2011)[15] also reported the similar findings.

According to *Sheth et al* (2012)[16] pipercillin/ Tazobactam and Ceftazidime are ineffective for *Pseudomonas*. They discourage these drugs for use. However, in our study, as per sensitivity analysis the most active drugs against Pseudomonas were pipercillin/ Tazobactam. We can not compare it with previous year because it was not available. The positive result from this study showed that the resistance of Tetracycline, Cotrimoxazole and Ciprofloxacin was decreased. These drugs were not much used in the ICU settings that may be the reason of this decreased resistance. In our study the resistance patterns of Gentamycin & Amikacin have increased for *Pseudomonas* (37% to 67% & 25% to52% respectively) and for *Klebsiella* (52% to 62% & 26% to 58% respectively) over the 2 years study period. *For E. coli & Acinetobacter*; Gentamycin resistance was stable; however Amikacin resistance has slightly increased from 32% to 45% & 48% to 60% respectively. A study from Ibrahim Medical College and Birdem; ICU resistance pattern of these organism to Aminoglycosides showed marked variability ranging from 48.3% to 83.3% [8].

Nitrofurantoin is an urinary antiseptic. The sensitivity of Nitrofurantoin for urinary isolates was good and stable over this 2 year study period. Therefore, this may be the drug of choice for treatment of urinary isolates from ICU. Hooper explained this consistent and high level susceptibility of urinary isolates to nitrofurantoin may be due to nitrofurantoin's narrow spectrum of activity, limited indication (urinary tract infection), narrow tissue distribution (low or undetectable serum concentration) and limited contact with bacteria outside the urinary tract [17].

The rate of isolation of *Staphylococcus aureus* markedly increased from 1.9% in 2012 to 7.2% in 2013. However, number of *Staphylococcus aureus* was decreased from 25% to12% reported by Jain & Khety (2012)[12]. The reason behind this was the good infection control practices. We can not compare the antibiotic resistance of *Staphylococcus aureus* between 2012 and 2013 as the number of Staphylococcus aureus isolates in 2012 was very few. Amikacin showed good susceptibility for *Staphylococcus aureus*. The percentage of Cloxacillin resistant for staphylococcus in our study was near about 40%. Similar finding was observed by a tertiary care hospital in Bangladesh[18].

Candida was isolated from 14% of urine culture, which may be due to the presence of underlying conditions like poor nutritional status, diabetes mellitus, use of steroid and broad spectrum antibiotics & presence of catheters. This may, however, also indicate an overuse of antibiotics and need for strict control measures.

Conclusion:

Antibiotic resistance continues to rise and complicates empirical selection of antibiotics in the ICU. Our data indicate an alarming pattern of antibiotic resistance in the majority of ICU isolates. Thus, strategies to prevent the emergence of multidrug resistant bacteria in ICU must be implemented. These include: knowledge of the infection rates and common pathogens and judicious use of older and newer antimicrobial agent according to antibiogram. This will assist clinicians in choosing appropriate empiric antibiotics to maximize the patient's chances of receiving early and effective therapy. It is important to use direct discussion and communication between clinicians and microbiologists for appropriate antibiotics based on antibiogram in every 6 month interval in the ICU. Strict infection control measures like good aseptic precautions, isolation of patients infected with resistant isolates and hand washing practices need to be reinforced for the same to prevent the occurrence of infection.

REFERENCES:

1. Singh AK, Sen MR, Anupurba S, Bhattacharya P. Antibiotic sensitivity pattern of the bacteria isolated from nosocomial infection in ICU. Journal of communicable Diseases 2002; 34: 257-263.
2. Rice LB. Controlling antibiotic resistance in the IC: Different bacteria, different strategies. Clevel and clinic journal of Medicine 2003; 70: 793-800.
3. Tullu MS, Deshmukh CT, Baveja SM. Bacterial profile, antimicrobial susceptibility pattern in cathter related nosocomial infections. J. postgrad Med 1998; 44: 7-13.
4. Wattal C, Goel N, Oberoi JK, Raveendran R, Datta S, Prasad KJ. Surveillance of multidrug resitant organisms in tertiary care hospital in Delhi, India. J. Assoc Physicians India 2010; 58 suppl: 32-36.
5. Fridkin SK. Increasing prevalence of antimicrobial resistance in intensive care units. Crit Care Med 2001; 29 (suppl 4): N64-68.
6. Pattanayak C, Patanaik K, Datta PP, Panda P. A study on antibiotic sensitivity pattern of bacterial isolates in the

intensive care unit of a tertiary care hospital in Eastern India. International J of Basic and clin Pharmacology 2013; 2: 153-159.

7. Spencer RC. Predominant pathogens found in the European prevalence of infection in intensive care study. Eur J Clin Microbial Infect Dis 1996; 15: 281-285.
8. Barail L, Fatema K, Haq JA, Faruq MO, Ahsan ASMA, Morshed MAHG et al. Bacterial profile and their antimicrobial resistance pattern in an intensive care unit of a tertiary care hospital in Dhaka. Ibrahim Med. Coll. J 2010;4 :66-69.
9. Shalimi S, Kranthi K, Gopalkrishna BK. The microbiological profile of nosocomial infections in the intensive care unit. J Clin Diag Res 2010; 4: 3109-12.
10. Sardan YC. Surveillance report of hospital infections from Turkey; 2006-2007. Turkish J of hospital Infection 2009; 13: 215- 269.
11. Gopal KS, Naing L, Jaalam K, Imran Musa K, Nik Mohammad NA, Aiyars et al. Ventrilator- associated nosocomial pneumonia in intensive care units in Malaysia. J Infect Dcv Ctries 2009; 3: 704-710.
12. Jain S, Khety Z. Changing antimicrobial resistance pattern of isolates from an ICU over a 2 year period. JAPI 2012; 60:27-33.
13. Podschun R & Ullmann U. Klebsiella spp. as nosocomial pathogens: Epidemiology, Toxonomy, Typing methods and pathogenicity factors. Clin Microbiol Rev. 1998; 11 (4): 589-603.
14. Haque L, Kamal SMM, Ahmed Z. Isolation, idendification and antimicrobial sensitivity pattern of bacterial isolates from tracheal aspirates of ICU patients of central Dhaka, Bangladesh. International J of Research in Applied 2013; 1: 11-16.
15. Gagneza D, Goel N, Aggarwal R & Chaudhary U. Changing trend of antimicrobial resistance among Gram negative bacilli isolated from lower respiratory tract of ICU patients: A 5 year study. Indian J Crit Care Medicine 2011; 15 (3): 164-167.
16. Sheth KV, Patel TK, Malek SS, Tripathi CB. Antibiotic sensitivity patter of bacterial isolates from the intensive care unit of tertiary care hospital in India. Trop J Pharm Res 2012; 11: 991-999.
17. Hooper DC. Urinary tract agents: nitrofurantoin and mechanism. In: Mandell GL, Bennett JE & Dolin R eds. Principles and practice of infectious diseases, 5th ed, vol-1. Philadelphia: Churchill Livingstone; 2000: pp 423-428.
18. Bacteria and Antibiogram report. Department of Microbiology, Birdem Hospital 2013.4(1):1-6.