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Bacteriological Profile and Antibiotic Resistant Pattern among Patients with Nosocomial Pneumonia

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ABSTRACT

Background & objective: The development of nosocomial pneumonia represents an imbalance between normal host defenses and the ability of microorganisms to colonize and then invade the lower respiratory tract. Although some common bacteria are involved in nosocomial infection, bacteriological profile differs from geographical location and setting of the hospital. The present study was therefore, carried out to identify the common causative organisms of nosocomial pneumonia and determine their antibiotic sensitivity in BIRDEM General Hospital, Dhaka, Bangladesh.

Methods: This cross-sectional study was conducted in Intensive Care Unit (ICU), BIRDEM General Hospital, Dhaka, Bangladesh. A total of 110 subjects with nosocomial pneumonia admitted in the ICU over a period of six months from January 2021 to June 2021 were consecutively included in the study. Samples included (blood, urine, sputum/tracheal aspirate wound swab etc.) were cultured in standard media for isolation of potential pathogens. From 110 subjects 110 samples were collected. Isolates were identified by standard FAN method. For each isolate antibiotic susceptibility was performed by Kirby Bauer disk diffusion technique. Isolates with intermediate susceptibility were considered resistant.

Result: The mean age of the sampled population was 55.6 ±13.6 (range:38-65) years. Among 110 study subjects, 68(61.8%) were male and 42 (38.2%) were female in the study population. Patients with nosocomial pneumonia were presented with raised temperature (100%), *leukocytosis* (86.3%), *tachycardia* (82.7%) and *tachypnoea* (70.9%). Out of 110 samples, microorganisms were isolated from 102 samples (92.9%). Growth revealed Pseudomonas (28.4%), *Acinetobacter* (42.1%), *Staphylococcus aureus* (3.9%), *Enterococcus* (4.9%), E. coli (6.7%), *Klebsiella* (5.9%), *Enterobacter* (3.9%), *Citrobacter* (1.9%) and *Candida sp*. (1.9%). From culture sensitivity test, it was found that majority (90%) of the isolated organisms were resistant to Quinolones and 3rd generation cephalosporin. Majority of the *E coli* and *Klebsiella* were less resistant (9.6% and 14.3%) to Imipenem. Colistin resistance was less than 50%. Piperacillin and Tazobactam combination showed less than 50% resistance in case of *Acinetobacter* and *Klebsiella*.

Conclusion: The study concluded that as patients with nosocomial pneumonia admitted in ICU are already ill, it would be unwise to wait for result of antibiotic sensitivity test and it is recommended that Colistin or Imipenem or Piperacillin and Tazobactam combination should be stared to save the life of the patients and then start suitable antibiotic after obtaining culture –sensitivity result.

Key words: Nosocomial pneumonia, bacteriological profile, antibiotic sensitivity pattern etc.

ORIGINAL ARTICLE

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INTRODUCTION:

According to American Thoracic Society (ATS) guidelines, pneumonia that occurs more than 48 hours after hospital admission but that was not incubating at the time of admission is called nosocomial pneumonia[1]. Although most patients with nosocomial pneumonia develop fever and leukocytosis, these findings are not uniform and are not a requisite for the presumptive diagnosis of nosocomial pneumonia. Respiratory tract symptoms include an increase in respiratory rate, shortness of breath, and a productive cough.[2-5] The ATS subdivides nosocomial pneumonia into early onset (usually within the first 4 days of hospitalization) and late onset (usually occurring after the fourth hospital day). Common bacteria involved in *nosocomial pneumonia* include *P aeruginosa*, *Klebsiella species*, *Escherichia coli*, *Acinetobacter species*, *Staphylococcus aureus* (especially methicillin-resistant S aureus [MRSA]) *Streptococcus pneumoniae*, *Hemophilus influenzae*. *Acinetobacter* species commonly colonize the respiratory tract secretions in patients in the ICU. Early onset nosocomial pneumonia tends to carry a better prognosis than does late-onset nosocomial pneumonia; the latter tends to be associated with multidrug-resistant organisms and so is characterized by higher mortality rates[6].

Intubation and ventilatory support bypass the normal host defense mechanisms, predisposing patients with nosocomial pneumonia to infection. In addition, nosocomial pneumonia that develops in ICU patients is associated with high morbidity and mortality rates, because these patients are already typically critically ill. Compromised cardiac and lung function may further decrease the cardiopulmonary reserve of pneumonia, accounting for the high mortality and morbidity rates associated with nosocomial pneumonia. Barotrauma may decrease an already compromised lung function and alter chest radiographic appearances.[3,7,8]

Although some common bacteria are involved in nosocomial infection, their bacteriological profile differs from geographical location and setting of the hospital. The present study was therefore, carried out to identify the causative organisms of nosocomial pneumonia and determine their antibiotic sensitivity pattern.

METHODS:

This cross-sectional study was carried out in the Department of ICU, BIRDEM General Hospital, Shahbagh, Dhaka over a period of six months from January 2021 to June 2021. Ethical clearance was taken from the respective authority of BIRDEM General Hospital, Dhaka and the purpose of the study was discussed in details with the patients or their attendants before taking their consent to enroll in the study. A total of 110 patients, admitted in the ICU, aged between 38-65 years suffering from nosocomial pneumonia were consecutively included. Their demographic profile was recorded and substantiated by means of inspection of medical record. Information included was the subjects' age, gender, medical and clinical history. Inclusion criteria were hospitalization in an acute care hospital for two or more days in the last 90 days or residence in a nursing home or long-term care facility in the last 30 days, receiving outpatient intravenous therapy (like antibiotics or chemotherapy), or home wound care within the past 30 days, attending a hospital clinic or dialysis center in the last 30 days, Having a family member with known multi-drug resistant pathogens. However, community acquired pneumonia, hospital acquired pneumonia and patient or attendant not giving consent were excluded from the study.

Samples included (blood, urine, sputum/tracheal aspirate wound swab etc.) were cultured in standard media for isolation of potential pathogens. From 110 subjects 110 samples were collected. Isolates were identified by standard FAN method. For each isolate antibiotic susceptibility was performed by Kirby Bauer disk diffusion technique. Isolates with intermediate susceptibility were considered resistant. Data were collected in a semi-structured data collection sheet containing

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clinical history and laboratory investigation findings and were processed and analyzed using SPSS (Statistical Package for Social Sciences), version 13.0. The test statistics used analyze the data were descriptive statistics.

RESULTS:

The mean age of the sampled population was 55.6 ±13.6 (range: 38-65) years. Among 110 study subjects, 68(61.8%) were male and 42(38.2%) were female. The subjects invariably presented with raised temperature. Leukocytosis was observed in majority (86.3%) of them. Increased heart and respiratory rate were seen in 82.7 and 70.9% of the subjects respectively. Out of 110 samples, microorganisms were isolated from 102 samples (92.9%). Some samples revealed growth of more than one organism. Growth of pseudomonas was found in 28.4% samples and *Acinetobacter* was seen in 42.1% cases. Growth of Staphylococcus aureus and *Enterococcus* was seen in 3.9% and 4.9% of the samples respectively. Commonest *Enterobacteriaceae* isolated from different samples were E. coli (6.9%), *Klebsiella* (5.9%), *Enterobacter* (3.9%) and *Citrobacter* (1.9%). *Candida sp*. was isolated in 1.9% samples (Table II). Culture sensitivity test showed majority of the isolated organisms to be resistant to Quinolones and 3rd generation cephalosporin. *Acinetobacter* was 100% and *Pseudomonas* was 89.6% resistant to *Piperacillin*. *E* coli and *Klebsiella* were less resistant (28.6% and 33.3% respectively) to *Imipenem*. *Colistin resistance* was less than 50%. Piperacillin and *Tazobactam* combination showed less than 50% resistance in case of *Acinetobacter* and *Klebsiella*. (Table III)

Table I. Clinical presentations of the study subjects

Clinical presentations	Number	Percentage
Raised temperature	110	100.0
Leukocytosis	95	86.3
Increased heart rate	91	82.7
Increased respiratory rate	78	70.9

Table II. Microorganisms isolated from tracheal secretion samples

Microorganisms	Frequency	Percentage
Organisms		
Pseudomonas sp.	29	28.4
Acinetobacter sp.	43	42.1
Gram positive cocci		
Staphylococcus aureus	4	3.9
Enterococcus	5	4.9
Enterobacteriaceae		
E. coli	7	6.9
Klebsiella sp.	6	5.9
Enterobacter sp.	4	3.9
Citrobacter sp.	2	1.9
Fungus		
Candida sp.	2	1.9

Table III. Antibiotic resistant pattern of the microorganisms isolated from samples

Antibiotics	Acinetobacter	Pseudomonas	E. coli	Klebsiella
ß-lactam				
Piperacillin	100.0	89.6	-	-
Piperacillin+				
Tazobactam	44.1	65.5	71.4	33.3
Ceftriaxone	90.7	93.1	85.7	83.3
Ceftazidime	100.0	82.7	85.7	83.3
Cefotaxime	66.7	96.5	71.4	83.3
Aztreonam	90.7	89.6	-	-
Imipenem	72.1	48.3	28.6	33.3
Aminoglycosides				
Amikacin	48.83	63.2	48.4	33.3
Netilmicin	54.48	89.6	71.4	83.3
Gentamicin	90.7	89.6	71.4	83.3
Quinolones				
Ciprofloxacin	81.4	86.2	85.7	83.3
Others				
Co-trimoxazole	100.0	93.1	71.4	83.3
Colistin	44.2	41.4	28.5	16.7
Tetracycline	100.0	93.1	85.7	83.3

DISCUSSION:

Nosocomial pneumonia causes major morbidity and mortality. Nosocomial pneumonia refers to any pneumonia contracted by a patient in a hospital at least 48 hours after being admitted. It is thus distinguished from community-acquired pneumonia. It is usually caused by bacteria, rather than virus[9]. Nosocomial pneumonia is the second most common nosocomial infection after urinary tract infection and accounts for 15–20% of the total.[10] It is the most common cause of death among nosocomial infections and is the primary cause of death in intensive care unit.

In previous studies[11-15] it was revealed that nosocomial pneumonia had no race or gender predilection. Nosocomial pneumonia is most common in elderly patients; however, patients of any age may be affected. In the present study, mean age of the study subjects was 55.6 (± SD of 13.6) years. Majority (32.7%) of the respondents was found in the age group of 50-59 years. Over one-quarter (27.3%) of the subjects were 60 years and older and over 60% were male with male-to-female ratio roughly being 3:2. Like community acquired pneumonia, nosocomial pneumonia manifested by raised temperature, leukocytosis and features of infection i.e., tachycardia and tachypnoea[3,5,6,9,10]. In the present study, leukocytosis was observed in 86.3% subjects. Increased heart and respiratory rate were seen in 82.7 and 70.9% cases respectively.

Previous studies[1-5,16-18] revealed that common bacteria involved in nosocomial pneumonia included *P. aeruginosa, Klebsiella species, E. coli, Acinetobacter species, Staphylococcus aureus, Streptococcus pneumoniae* and *Hemophilus influenzae*. The less-common pathogens[7,10,12,14] implicated in nosocomial pneumonia were Serratia species, Legionella species Influenza A virus, Respiratory syncytial virus (RSV), Parainfluenza virus and Adenovirus. In our study most common organisms isolated were *Acinetobacter* (42.1%) followed by pseudomonas (28.4%). Growth of *Staphylococcus aureus, Enterococcus, E. coli, Klebsiella, Enterobacter* and *Citrobacter* were less commonly observed. *Candida sp*. was even rare (1.96%). The precise pathogen that causes a given case of nosocomial pneumonia is usually unknown so, empiric antimicrobial therapy is the only practical approach. Delaying therapy until the pathogen is identified may be harmful for the patient and is not recommended. For empiric coverage of antibiotic in nosocomial pneumonia, monotherapy is as effective as combination therapy for early nosocomial pneumonia. American Thoracic Society and the Infectious Diseases Society of America[16] recommended combinations include meropenem or doripenem with either levofloxacin or aztreonam. Alternately, antipseudomonal penicillin (e.g., piperacillin) in combination with levofloxacin, meropenem, aminoglycoside, or aztreonam may provide equal efficacy. In the present study majority of the isolated organisms was found resistant to Quinolones & 3rd generation cephalosporin. So, the mentioned therapy[16] may be a choice of treatment. However, we found that majority of *E coli* and *Klebsiella* were less resistant to Imipenem. Colistin resistance was less than 50%. *Piperacillin* and *Tazobactam* combination showed less than 50% resistance in case of *Acinetobacter* & *Klebsiella*. Some investigators[17,18] suggested that optimal combination regimens for proven P aeruginosa nosocomial pneumonia which included (1) piperacillin/tazobactam plus amikacin or (2) meropenem plus levofloxacin, aztreonam, or amikacin. Use of ciprofloxacin, ceftazidime, gentamicin, or imipenem in combination regimens should be avoided, as combination therapy does not eliminate potential resistance to these antibiotics[17,18].

CONCLUSION:

The most common organisms causing nosocomial pneumonia in the ICU of BIRDEM Hospital are *Pseudomonas, Acinetobacter, Staphylococcus aureus, Enterococcus, E. coli, Klebsiella, Enterobacter, Citrobacter* and *Candida sp*. From culture sensitivity test, it appears that majority of the isolated organisms is resistant to Quinolones and 3rd generation cephalosporin. Majority of the *E coli* and *Klebsiella* are less resistant to Imipenem. Colistin resistance is even less. *Piperacillin* and *Tazobactam* combination are less resistant to *Acinetobacter* and

Klebsiella. As patients with nosocomial pneumonia admitted in ICU are already ill, it would be unwise to wait for result of antibiotic sensitivity test. Colistin or Imipenem or Piperacillin and Tazobactam combination should be stared to save the life of the patient and then start suitable antibiotic after obtaining culture-sensitivity test result.

REFERENCES:

1. Cunha BA. Pneumonia Essentials. 2nd ed. Royal Oak, Michigan: Physicians Press; 2008.
2. Mesaros N, Nordmann P, Plesiat P, et al. Pseudomonas aeruginosa: resistance and therapeutic options at the turn of the new millennium. *Clin Microbiol Infect* 2007; 13(6):560-578.
3. Wang S, Kwok M, McNamara JK, Cunha BA. Colistin for Multi-Drug Resistant (MDR) Gram-Negative Bacillary Infections. *Antibiotics for Clinicians* 2007;11:389-396.
4. Herzig SJ, Howell MD, Ngo LH, Marcantonio ER. Acid-suppressive medication use and the risk for hospital-acquired pneumonia. *JAMA* 2009; 301(20): 2120-2128.
5. Agodi A, Barchitta M, Cipresso R, et al. Pseudomonas aeruginosa carriage, colonization, and infection in ICU patients. *Intensive Care Med* 2007;33(7):1155-1161.
6. Cunha BA. S. aureus Nosocomial Pneumonia: Clinical Aspects. *Infectious Disease Practice* 2007;31:557-560.
7. Gerald L. Mandell MD, MACP, John E. Bennett MD, Raphael Dolin MD, Mandell's Principles and Practices of Infection Diseases 6th Edition 2004 Churchill Livingstone. pp. 4016.
8. Tamma PD, Turnbull AE, Milstone AM, et al. Ventilator-associated tracheitis in children: does antibiotic duration matter?. *Clin Infect Dis* 2011;52 (11):1324-1331.
9. Furman CD, Rayner AV, Tobin EP. Pneumonia in older residents of long-term care facilities. *Am Fam Physician* 2004;70(8):1495–500.
10. Mylotte JM. Nursing home-acquired pneumonia: update on treatment options. *Drugs Aging* 2006;23(5):377–90.
11. Cunha BA. Multi-drug Resistant (MDR) Klebsiella, Acinetobacter, & Pseudomonas aeruginosa. *Antibiotics for Clinicians* 2006;10:354-355.
12. Ferrara AM. Potentially multidrug-resistant non-fermentative Gram-negative pathogens causing nosocomial pneumonia. *Int J Antimicrob Agents* 2006; 27(3):183-95.
13. Furtado GH, d'Azevedo PA, Santos AF. Intravenous polymyxin B for the treatment of nosocomial pneumonia caused by multidrug-resistant Pseudomonas aeruginosa. *Int J Antimicrob Agent* 2007; 30(4):315-9.
14. Herzig SJ, Howell MD, Ngo LH, Marcantonio ER. Acid-suppressive medication use and the risk for hospital-acquired pneumonia. *JAMA* 2009;301(20): 2120-8.
15. Wang S, Kwok M, McNamara JK, Cunha BA. Colistin for Multi-Drug Resistant (MDR) Gram-Negative Bacillary Infections. *Antibiotics for Clinicians* 2007;11:389-396.
16. American Thoracic Society and the Infectious Diseases Society of America. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. *Am J Respir Crit Care Med* 2005;171(4):388-416.
17. Siempos II, Vardakas KZ, Manta KG, Falagas ME. Carbapenems for the treatment of immunocompetent adult patients with nosocomial pneumonia. *Eur Respir J* 2007;29(3):548-60.
18. Joshi M, Metzler M, McCarthy M, et al. Comparison of piperacillin/tazobactam and imipenem/cilastatin, both in combination with tobramycin, administered every 6h for treatment of nosocomial pneumonia. *Respir Med* 2006;1(5):312-318.