

Aetiological agents of Adult Bacterial Pneumonia patients admitted at a Tertiary Care Hospital in Dhaka city

Jahan R¹, Tarafder S², Haque A³

Abstract

Background: Bacterial pneumonia is one of the most common causes of mortality and morbidity worldwide especially in adults. Objective: The purpose of this present study was to identify the aetiological agents and antimicrobial sensitivity pattern of bacterial pneumonia in patients admitted at intensive care unit (ICU). **Methodology:** This cross sectional study was carried out in the Department of Microbiology & Immunology at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh from August 2012 to July 2013. Blood and tracheal aspirates (TA) culture were done in clinically diagnosed pneumonia patients admitted in the ICU of BSMMU. PCR of TA was performed to identify Legionella species. Urine ICT of patients was done to detect Streptococcus pneumoniae and Legionella pneumophila serogroup 1 antigens. Antimicrobial susceptibility of isolated bacteria was done by disc diffusion method. **Result:** A total of 36 pneumonia patients admitted at ICU were recruited. The most common identified bacteria were Acinetobacter species (33.3%) followed by Pseudomonas species (30.5%), Klebsiella pneumoniae (11.1%), Escherichia coli (5.5%), Enterobacter aerogenes (5.5%), Legionella (8.3%), Citrobacter freundii (2.8%) and Proteus mirabilis (2.8%). Majority of the bacteria were resistant to first line antibiotics and highly sensitive to carbapenems. **Conclusion:** Most common isolated bacteria are the Acinetobacter species, Pseudomonas species and Klebsiella pneumoniae among the pneumonic patients with the resistant to first line antibiotics and sensitive to carbapenems. (J Shaheed Suhrawardy Med Coll, 2015;7(1):22-25)

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Introduction

Pneumonia is an inflammation of the pulmonary parenchyma associated with recently developed radiological pulmonary shadowing. It is one of the most common causes of morbidity and hospitalization worldwide particularly in the adults¹. The incidence of pneumonia ranges from 4 million to 5 million cases per year of which 25% require hospitalization². In 2009 in United States, 1.1 million people were hospitalized with pneumonia and more than 50,000 people died³. 1.2% to 10% adult hospitalized patients with pneumonia require management in an intensive care unit (ICU)⁴. The case fatality rate of pneumonia was 30% to 40% during the pre-antibiotic period⁵. However, the rate varies from different clinical settings. The mortality among adult hospitalized patients is 4 to 14% compared to more than 50% in patients

admitted to intensive care⁴. Patients admitted in intensive care unit (ICU) with severe pneumonia represent a major concern for physicians because of the high mortality and morbidity rate attributable to these episodes.

In Bangladesh, annual rate of new pneumonia cases is 6 million and this is the 4th highest annual pneumonia rate in whole world⁶. Increasing age is associated with an increasing incidence of admission to hospital with pneumonia⁴. There are structural and functional alterations in increasing age which impair the host's defense against pulmonary infection. The rate of pneumonia amongst adults in Bangladesh may be underestimated owing to practical difficulties such as lack of a productive cough and frequent use of antibiotics before diagnosis¹. Adult patients may present with atypical

1. Dr. Rownak Jahan, Lecturer, Department of Microbiology, Shaheed Suhrawardy Medical College, Dhaka

2. Dr. Shirin Tarafder, Associate Professor, Department of Microbiology and Immunology, Bangabandhu Sheikh Mujib Medical University, Dhaka.

3. Dr. Anwarul Haque, Department of Microbiology and Infectious Disease, Toho University School of Medicine, Japan.

Correspondence

Dr. Rownak Jahan, Lecturer, Department of Microbiology, Shaheed Suhrawardy Medical College, Sher-E-Bangla Nagar, Dhaka-1207, Bangladesh; Cell no.: +8801711045346; Email: jahan_rownak@yahoo.com

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symptoms other than the typical respiratory symptoms of pneumonia that lead to delay in diagnosis and initiation of treatment and may be responsible for higher observed mortality⁷. Moreover, the direct healthcare cost is high in pneumonia patients, which is mostly associated with inpatient care costs. Though hospitalization of adult patients with pneumonia is increasing in Bangladesh, information regarding their bacterial aetiology and antimicrobial susceptibility pattern for choosing empiric antibiotic treatment are lacking. Therefore, this study conducted a wide range of microbiological investigations to identify the bacterial aetiology and of clinically diagnosed pneumonia patients of adult age group admitted in ICU in a tertiary care hospital.

Methodology

This was a descriptive cross sectional study conducted from August 2012 to July 2013 in ICU of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka. Clinically diagnosed adult pneumonia patients with an age of 16 years in both sex admitted in ICU of BSMMU were included in this study. Blood, urine and tracheal aspirates (TA) were collected from clinically diagnosed pneumonia patients. Blood culture was done by automated culture method (BACTEC 9240). Subculture of positive samples was done in blood agar and MacConkey's agar media. TA were cultured in blood agar, chocolate agar and MacConkey's agar media and incubated for overnight at 37° C. If growth was present then identification of the organism were done by Gram staining, colony morphology and conventional biochemical test. After organism identification, antimicrobial susceptibility tests were performed according to the Clinical and Laboratory Standards Institute (CLSI) guidelines by disc diffusion method using Kirby-Bauer technique⁸. Both centrifuged and uncentrifuged urine samples were used for detection of *Streptococcus pneumoniae* and *Legionella pneumophila* serogroup 1 antigens by Immunochromatographic test (ICT) kit (BinaxNOW S. pneumoniae and BinaxNOW Legionella) following the manufacturer's instructions. PCR of TA was carried out to identify *Legionella* by amplification of 386-bp fragment of the 16S rRNA gene with the use of primers pair JFP and JRP. The sequences of the used primers were⁹: forward primer JFP: 5'-AGGGTTGATAGGTTAAGAGC-3'; reverse primer JRP: 5'-CCAACAGCTAGTTGACATCG-3'. All data were recorded in preformed data collection questionnaire, coded and entered in a data base using SPSS software (Version-19). Data were expressed as frequency distribution and percentage.

Results

A total of 36 adult (± 16 years) clinically diagnosed pneumonia patients admitted in ICU of BSMMU were included in this study. Out of 36 blood and tracheal aspirates, *Acinetobacter baumani* 10 (27.77%) was the most common isolated bacteria followed by *Pseudomonas aeroginosa* 9 (25%), *Klebsiella pneumoniae* 4 (11.11%), *E. coli* 2 (5.56%), *Enterobacter aerogenes* 2(5.56%), *Citrobacter freundii* 1(2.78%) and *Proteus mirabilis* 1 (2.78%). Among the 3 (8.33%) *Legionella* positive cases, 1(2.78%) case were urine ICT positive and PCR was found to be positive in all 3(8.33%) cases (Table 1).

Majority of the bacteria were resistant to first line antibiotics

Table 1: Bacterial aetiology of pneumonia studied (n=36)

Bacteria	Frequency	Percentage
<i>Acinetobacter baumani</i>	10	27.77
Other <i>Acinatobacter</i> spp	2	5.56
<i>Pseudomonas aerogenosa</i>	9	25.00
Other <i>Pseudomonas</i> spp.	2	5.55
<i>Klebsiella pneumoniae</i>	4	11.11
<i>E.coli</i>	2	5.56
<i>Enterobacter aerogenes</i>	2	5.56
<i>Legionella</i>	3	8.33
<i>Citrobacter freundii</i>	1	2.78
<i>Proteus mirabilis</i>	1	2.78
Total	36	100.0

like Amoxicillin, Cephadrine, Co-trimoxazole and Ciprofloxacin. *Klebsiella pneumoniae*, *E. coli*, *Enterobacter aerogenes* and *Citrobacter freundii* are moderately sensitive to Ceftriaxone and *Proteus mirabilis* were 100% sensitive to it. *Acinetobacter* spp (100%) and *Pseudomonas* spp (93.75%) were highly sensitive to Colistin. Tazobactam-Piperacillin had good activity against *Pseudomonas* (87.50%) and *Acinetobacter* (77.78%). Most of *Klebsiella pneumonia*

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Table 2: Antimicrobial sensitivity pattern of isolated bacteria in pneumonia patients other than *Legionella*

Antimicrobial Agents	Acinetobacter	Pseudomonas	Klebsiella	E. coli	Enterobacter	Citrobacter	Proteus
Amoxicillin	0.0	0.0	28.6	45.4	17.0	0.0	0.0
Cephadrine	0.0	0.0	35.7	45.4	17.0	0.0	0.0
Co-trimoxazole	0.0	0.0	35.7	27.3	17.0	33.3	0.0
Ciprofloxacin	0.0	56.2	57.1	63.6	33.0	33.3	50.0
Gentamicin	0.0	68.7	42.9	63.6	50.0	33.3	100
Ceftriaxone	0.0	0.0	71.4	72.7	67.0	66.7	100
Cefuroxime	0.0	0.0	35.7	72.7	50.0	33.3	0.0
Amikacin	44.4	31.2	85.7	90.9	83.0	66.7	100
Aztreonam	61.1	31.2	57.1	63.6	83.0	66.7	100
Imepenem	44.4	62.5	92.9	90.9	100	100	100
Netilmicin	61.1	37.5	92.9	81.8	83.0	100	100
TZP	75.0	87.5					
Colistin	100	93.75					

TZP- Tazobactam-Piperacillin

(92.86%) was sensitive to imepenem and netilmicin and 85.71% were sensitive to amikacin. All *Enterobacter aerogenes*, *Proteus mirabilis* and *Citrobacter freundii* were 100% sensitive to imipenem but *E. coli* were 90.91% sensitive. 81.82% *E. coli* and 83% Enterobacter were sensitive to Netilmicin, but *Citrobacter freundii* and *Proteus mirabilis* were 100% sensitive to it (Table 2).

Discussion

This study employed a wide range of diagnostic tools to identify the aetiological agents in adult pneumonia patients including *Legionella*. Among the 36 clinically diagnosed pneumonia patients, bacteria were identified in 100% cases. Among the isolated bacteria, *Acinetobacter baumani* (27.77%) were most frequently detected. Previous study at India isolated 24% *Acinetobacter* species from tracheal aspirates¹⁰. Similar percentage of *Acinetobacter* species was reported from BIRDEM hospital in Dhaka¹¹. In this study other gram negative bacilli were *Pseudomonas* spp, *Klebsiella pneumoniae*, *E. coli*, *Enterobacter aerogenes*, *Legionella*, *Citrobacter freundii* and *Proteus mirabilis*. Generally, these organisms are more reported in hospital acquired infection and less commonly in community acquired pneumonia¹²⁻¹³. However, over the last three decades, many studies have reported higher incidence of gram-negative organisms among culture positive pneumonia cases¹⁴⁻¹⁶. Study conducted by Arancibia et al¹⁷ showed Gram negative bacilli were most common bacteria causing pneumonia. Gram-negative enteric bacilli causing pneumonia carry a high mortality ranging from 29% to 45%¹⁷. Inadequate initial empirical antimicrobial treatment in pneumonia patients with gram-negative bacteria was associated with higher mortality¹⁷. Therefore, selection of initial antimicrobial treatment needs to be more judicious¹⁷. This study did not find *S. pneumoniae* as a causative agent as it is known to be very fragile. Moreover, the patient might receive antibiotics before admission as many antimicrobial drugs are available over the counter in our country which reduces the sensitivity of *S. pneumoniae*¹⁸.

Atypical bacteria like *Mycoplasma*, *Chlamydia* and *Legionella* are important aetiological agents of pneumonia. However, culture techniques for the *Mycoplasma pneumoniae* are insensitive and also time consuming¹⁹. *Chlamydia pneumoniae* is very difficult to grow in laboratory. Serological assays of these atypical bacteria are not only less sensitive but also depend on timing of sample collection and availability of paired serum sample²⁰. Molecular diagnostic methods like PCR are not widely available and validated. As a result there are no well validated rapid tests for *Mycoplasma* and *Chlamydia*²⁰. If the mortality of severe pneumonia patients by atypical bacteria is considered, only *Legionella* species are significantly associated²⁰. Moreover, ICS and NCCP recommend investigations for *Mycoplasma* and *Chlamydia* need not to be routinely done. They suggest *Legionella pneumophila* serogroup 1 urinary antigen test in patients with severe pneumonia as it is a very rapid and specific test²⁰. Therefore, in this study urinary antigen ICT and PCR was done to detect *Legionella*. In this study *Legionella* were identified in 2.77% patient by urine ICT and in 8.33% patients by PCR. A large study in Germany among 2503 pneumonia patients showed 3.8% *Legionella* infection by urine Ag detection and PCR²¹. Identification of *Legionella* in pneumonia patients is very important as many first-line antibiotics commonly used to treat typical bacterial pneumonias are ineffective against *Legionella* species²².

In the present study, majority of the bacteria were resistant to first line antibiotics like amoxicillin, cephradine, cotrimoxazole and ciprofloxacin. *Acinetobacter* species were

100% resistant to amoxicillin, cefuroxime, ceftriaxone and gentamicin. Similar result was observed in another study conducted by Nahar et al²³ in BSMMU, Dhaka. Other Gram negative bacteria showed moderate sensitivity to ceftriaxone and lower sensitivity to ciprofloxacin and gentamicin. Similar type of resistance pattern was reported in a study at Dhaka Medical College Hospital²⁴. In this study the antibiotic which showed maximum activity against most of the isolates was imipenem which is related to another study in Bangladesh²⁴. As carbapenems remain the last options for treating severe pneumonia infections, there is a possibility that the increasing, irrational use of carbapenems may lead to a rapid emergence of carbapenems resistance.

The microbial spectrum causing pneumonia found in this study has similarity with other studies in Bangladesh and South East Asia. In this study, Gram negative bacteria predominate in the bacteriological profile of pneumonia including one important atypical bacteria. Though this study was a single center study and might not be generalized to the whole population, it provides useful insights of bacteriological testing that contribute directly to patients' care and treatment. Prospective multicenter studies are needed to develop local pneumonia guidelines focusing on its aetiology, indicators of severity, time of admission to ICU and selection of appropriate antimicrobial treatment to reduce the requirement for hospital admission and to shorten the length of hospital stay of pneumonia patients.

Conclusion

Most common isolated bacteria are the *Acinetobacter* species, *Pseudomonas* species and *Klebsiella pneumoniae* among the pneumonic patients. Majority bacterial isolates were to resistant to first line antibiotics and sensitive to carbapenems. Increasing, irrational use of carbapenems may lead to a rapid emergence of carbapenems resistance.

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