Original Article

Clinical and Microbiological Profile of Patients with Pneumonia Admitted to the ICU of a Tertiary Care Hospital in Southern Rajasthan

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Abstract

Background. Lower respiratory tract infection (LRTI) is an acute illness (presenting for 21 days or less), usually with cough as the main symptom, and with at least one other lower respiratory tract symptom, such as fever, sputum production, breathlessness, wheeze, chest discomfort or pain. Out of the LRTIs, pneumonia is the most common. This study was conducted to determine the clinical profile of pneumonia in a medical and respiratory intensive care unit (ICU) of a tertiary care hospital, to identify different micro-organisms in respiratory samples of the patients and pattern of antibiotic susceptibility and to develop anti-biogram charts for starting empirical therapy in the ICU.

Methods. Patients admitted to the Medical and Respiratory ICUs of Geetanjali Medical College and Hospital, Udaipur (Rajasthan), India during January 2016 to October 2017 were included in this study. CURB-65 (Confusion, urea, respiratory rate, blood pressure plus age ≥65 years) score was retrospectively evaluated in the admitted patients.

Results. Out of 84 patients, most (81%) were males, smokers (73%) and above 65 years of age. Most common co-morbidity was chronic obstructive pulmonary disease (COPD) (n=47, 56%) and most common symptom was cough (84%). Chest radiograph revealed multi-lobar involvement as the most common finding. Commonest organism isolated in our study was *Pseudomonas* (n=24, 29%). *Pseudomonas aeruginosa* (n=13, 41%) was the commonest organism found in previously hospitalised patients, whereas *Streptococcus pneumoniae* (n=12, 23%) was the commonest organism found in previously non-hospitalised patients. Most of the Gram-negative isolates were sensitive to colistin (97%). Vancomycin showed highest activity (100%) against Gram-positive isolates.

Conclusions. The most common pathogen in patients with pneumonia admitted to ICU in our area was *Streptococcus pneumonia* in routine patients and *Pseudomonas aeruginosa* in previously hospitalised patients. For the effective management of pneumonia, detailed bacteriological diagnosis and susceptibility testing, and local anti-biogram are required in view of the global problem of antibiotic resistance. **[Indian J Chest Dis Allied Sci 2019;61:123-128]**

Key words: Pneumonia, Intensive care unit, Anti-biogram.

Introduction

Lower respiratory tract infection (LRTI) is an acute illness of 21 days or less in duration, usually with cough as the main symptom and with at least one other lower respiratory tract symptom (such as fever, sputum production, breathlessness, wheeze, chest discomfort or pain) and no other alternative explanation (such as, sinusitis or asthma).[1]

Lower respiratory tract infections are considered the fourth most common cause of death globally.[2] Out of total 39,41,000 deaths in the world, respiratory infection account for 34.6% deaths in the South-East Asia region.[3] Most common LRTIs are the bacterial infections among patients in intensive care units (ICUs), occurring in 10% to 25% of all ICU patients and resulting in a high overall mortality, which may range from 22% to 71%.[4]

Of the LRTIs, pneumonia is the most common,[5] and hence, we included only patients with pneumonia in the final analysis. CURB-65 (Confusion, urea, respiratory rate, blood pressure plus age ≥65 year) score has been found to be helpful in deciding the need for admission and site of treatment in pneumonia patients.[6] The microbiology may be different in patients of community-acquired pneumonia (CAP) who have been previously hospitalised within 90 days of present illness.[7] Thus, it is important to differentiate between CAP and HCAP (health care associated pneumonia).

This study was conducted to understand the microbiology and antimicrobial susceptibility pattern of respiratory pathogens isolated from patients with pneumonia requiring ICU admission.

Material and Methods

Patients aged >18 years admitted to the Medical and Respiratory ICUs of Geetanjali Medical College and

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Hospital, Udaipur during January 2016 to October 2017 were included in this study. The study was the approved by Institutional Ethical Committee.

Patients who were on mechanical ventilator, human immunodeficiency virus (HIV) positive, and sputum-smear positive for acid-fast bacilli were excluded. Within 24 hours of ICU admission, all patients underwent clinical and radiographic evaluations. Special emphasis was given for the history of hospitalisation in the last 90 days. General and systemic examinations were done thoroughly.

Diagnosis of pneumonia was made according to NICE guidelines[1] in 84 patients. Samples were collected before starting antibiotics. Investigations included complete blood count, blood urea, electrocardiogram, arterial blood gas analysis and chest radiography. Other blood and urine examinations were done as and when required. After that, CURB-65 score was calculated. Presence of the following co-morbid conditions was noted — diabetes mellitus, hypertension, chronic obstructive pulmonary disease (COPD), previous pulmonary tuberculosis (TB), chronic renal failure, ischaemic heart disease and cerebrovascular accidents.

Respiratory samples of all patients were collected under aseptic precautions and sent for aerobic culture and sensitivity. Patients without sputum production were encouraged for postural drainage of and physiotherapy, if possible. With a high degree of suspicion of pneumonia in patients with dry cough and in strongly suspected TB patients with negative sputum smears, bronchoscopy was done and bronchial aspiration and/or bronchoalveolar lavage (BAL) was done and specimens were sent for microbiological and pathological analysis. Pleural fluid was aspirated wherever required and sent for routine biochemistry and microbiological testing. Gram staining of the samples was done to guide the appropriate treatment option before the arrival of the culture and sensitivity report. Samples were plated onto blood agar, MacConkey agar and chocolate agar plates and incubated at 37 ^{0}C for 18-24 hours. Single or mixed growth (two predominant colonies) isolated from samples inoculated onto media plates were observed for colony characteristics.

Antimicrobial susceptibility testing was done on Muller Hinton agar plates by Kirby-Bauer disc diffusion method according to the Clinical Laboratory Standards Institute (CLSI) guidelines.[8] Susceptibility patterns of bacterial pathogens were determined following the panel of antimicrobial agents as recommended by CLSI 2010 with zone diameters measured in millimetres.[8] Final assessment of the patients was done after collecting sputum culture and sensitivity report.

Results

Of the total 84 patients, 68 (81%) were males and 16 (19%) were females. Maximum number (n=24, 29%) of patients were in the age group of 65-74 years. Most common symptom was cough (n=70, 84%), followed by expectoration (n=66, 79%), shortness of breath (n=52, 62%), fever (n=50, 59%) and chest pain (n=41, 49%). Most common organism isolated on aerobic culture media was *Pseudomonas* spp (n=24, 29%), followed by *Streptococcus pneumonia* (n=16, 19%), *Klebsiella* spp (n=14, 16%), *Acinetobacter* spp (n=10, 11%), *Escherichia coli* (n=8, 10%), *Staphylococcus aureus* (n=5, 6%) and *Citrobacter* spp (n=4, 5%). No organism could be isolated in three (4%) patients.

Pseudomonas aeruginosa (n=13, 41%) was the commonest organism found in previously hospitalised patients, whereas *S. pneumoniae* (n=12, 23%) was the commonest organism found in previously non-hospitalised patients (Table 1). Most common finding on chest radiograph was multilobar involvement (n=24, 29%) of lung infiltrates, followed by right lower lobe (n=16, 19%), left lower lobe (n=14, 16%), right middle lobe (n=16, 15%), left upper lobe (n=9, 11%) and right upper lobe (n=8, 10%). Sixty-two (73.8%) patients were smokers with average pack years of 30.6±9.8 years.

Table 1. Presence of organisms according to hospitalisation history.

	History of Hospitalisation		
Organism	**Present**	**Absent**	**Total**
Pseudomonas spp	13 (41%)	11 (21%)	24 (29%)
Streptococcus pneumoniae	4 (13%)	12 (23%)	16 (19%)
Klebisiella spp	4 (13%)	10 (20%)	14 (16%)
Acinetobacter spp	5 (15%)	5 (10%)	10 (11%)
Escherichia coli	3 (9%)	5 (10%)	8 (10%)
Streptococcus aureus	1 (3%)	4 (8%)	5 (6%)
Citrobacter spp	2 (6%)	2 (3%)	4 (5%)
Culture negative	0	3 (5%)	3 (4%)
Total	**32 (38%)**	**52 (62%)**	**84 (100%)**

Most common organism found in the smokers was *S. pneumonia*, while *Pseudomonas* was the most common organism in the non-smokers. Bronchoscopy was done in 12 (14%) patients. Most common co-morbidity was COPD (n=47, 56%), followed by hypertension (n=37, 44%), diabetes (n=30, 36%), ischaemic heart disease (n=13, 16%), TB (n=12, 14%), renal disease (n=12, 14%) and cerebrovascular accident (n=9, 11%). Most of the patients (n=68, 81%) had a CURB-65 score of 3 or more. No patient had a CURB-65 score of 0. Among Gram-positive organisms, vancomycin was 100% active against *S. pneumonia* and *S. aureus* followed by linezolid and gentamicin (81%). Overall, highest resistance was found to amoxicillin-clavulanate (33%) (Table 2) whereas among Gram-negative organisms, this was (97%) for stocolistin (Table 3).

Discussion

In this prospective study, 84 patients with pneumonia were analysed with respect to presenting symptoms, history, radiological presentation, organisms in respiratory specimens and antibiotic susceptibility pattern. CURB-65 score was retrospectively evaluated for the admitted

Table 2. Antibiotic susceptibility pattern of Gram-negative isolates.

Isolates	No.		Antibiotic Sensitivity Pattern - Gram Negative Isolates													
			AMK (30 mcg)	AMX + CLV (30 mcg)	AMP + SUL (10/ 10 mcg)	PIP + TAZ (30/ 6 mcg)	CEFU (30 mcg)	CEFT (30 mcg)	CEF + SUL (75/ 10mcg)	CEFP (30 mcg)	CIP (5 mcg)	LEV (5 mcg)	IMI (10 mcg)	MERO (10 mcg)	TIG (15 mcg)	COL (10 mcg)
Pseudomonas	24	S	19 (80%)	14 (60%)	15 (62%)	19 (79%)	17 (71%)	16 (67%)	14 (60%)	18 (75%)	19 (79%)	20 (83%)	22 (92%)	22 (92%)	N/A	23 (96%)
		R	5 (20%)	10 (40%)	9 (38%)	5 (21%)	7 (29%)	8 (33%)	10 (40%)	6 (25%)	5 (21%)	4 (17%)	2 (8%)	2 (8%)		1 (4%)
Klebsiella	14	S	11 (79%)	8 (57%)	9 (64%)	10 (71%)	8 (57%)	7 (50%)	10 (71%)	10 (71%)	10 (71%)	11 (79%)	13 (93%)	13 (93%)	14 (100%)	14 (100%)
		R	3 (21%)	6 (43%)	5 (36%)	4 (29%)	6 (43%)	7 (50%)	4 (29%)	4 (29%)	4 (29%)	3 (21%)	1 (7%)	1 (7%)	0 (0%)	0 (0%)
Acinetobacter	10	S	10 (100%)	6 (60%)	7 (70%)	8 (80%)	5 (50%)	6 (60%)	7 (70%)	7 (70%)	7 (70%)	7 (70%)	9 (90%)	9 (90%)	N/A	9 (90%)
		R	0 (0%)	4 (40%)	3 (30%)	2 (20%)	5 (50%)	4 (40%)	3 (30%)	3 (30%)	3 (30%)	3 (30%)	1 (10%)	1 (10%)		1 (10%)
Escherichia coli	8	S	5 (63%)	5 (63%)	6 (75%)	5 (63%)	5 (63%)	4 (50%)	6 (75%)	6 (75%)	6 (75%)	6 (75%)	7 (87%)	7 (87%)	8 (100%)	8 (100%)
		R	3 (37%)	3 (37%)	2 (25%)	3 (37%)	3 (37%)	4 (50%)	2 (25%)	2 (25%)	2 (25%)	2 (25%)	1 (13%)	1 (13%)	0 (0%)	0 (0%)
Citrobacter	4	S	2 (50%)	2 (50%)	3 (75%)	2 (50%)	2 (50%)	1 (25%)	1 (25%)	2 (50%)	4 (100%)	4 (100%)	2 (50%)	3 (75%)	1 (25%)	4 (100%)
		R	2 (50%)	2 (50%)	1 (25%)	2 (50%)	2 (50%)	3 (75%)	3 (75%)	2 (50%)	0 (0%)	0 (0%)	2 (50%)	1 (25%)	3 (75%)	0 (0%)
Overall		S	47 (78%)	35 (58%)	40 (66%)	44 (73%)	37 (62%)	34 (56%)	38 (63%)	43 (72%)	46 (77%)	48 (80%)	53 (88%)	54 (90%)	26 (93%)	58 (97%)
		R	13 (12%)	25 (42%)	20 (36%)	16 (27%)	23 (38%)	26 (44%)	22 (37%)	17 (28%)	14 (23%)	12 (20%)	7 (12%)	6 (10%)	2 (7%)	2 (3%)

Definition of abbreviations: S=Susceptibile; R=Resistant; AMK=Amiakcin; AMX=Amoxicillin; CLV=Clavulante acid; AMP= Ampicillin; SUL=Sulbactam; PIP=Piperacillin; TAZ=Tazobactam; CEFU=Cefuroxime; CEFT=Ceftriaxone; CEF= Cefoperazone; CEFP=Cefipime; CIP=Ciprofloxacin; LEV=Levofloxacin; IMI=Imipenam; MERO=Meropenam; TIG=Tigecyclin; COL=Colistin; NA=Not Applicable

Table 3. Antibiotic susceptibility pattern of Gram-positive isolates.

Isolates	No.		Antibiotic Sensitivity Pattern - Gram Positive Isolates														
			AMK (30 mcg)	GEN (10 mcg)	AMX + CLV (30 mcg)	AMP + SUL (10/10 mcg)	CEFU (30 mcg)	CEFT (30 mcg)	CEFP (30 mcg)	AZI (15 mcg)	ERY (15 mcg)	LIZ (30 mcg)	VAN (30 mcg)	CIP (5 mcg)	LEV (5 mcg)	TIG (15 mcg)	COL (10 mcg)
Streptococcus pneumoniae	16	S	13 (81%)	14 (88%)	11 (69%)	12 (75%)	13 (81%)	13 (81%)	13 (81%)	13 (81%)	14 (88%)	15 (93%)	16 (100%)	13 (81%)	14 (88%)	15 (93%)	16 (100%)
		R	3 (19%)	2 (12%)	5 (31%)	4 (25%)	3 (19%)	3 (19%)	3 (19%)	3 (19%)	2 (12%)	1 (7%)	0 (0%)	3 (19%)	2 (12%)	1 (7%)	0 (0%)
Staphylococcus aureus	5	S	4 (80%)	3 (60%)	3 (60%)	3 (60%)	3 (60%)	3 (60%)	3 (60%)	3 (60%)	4 (80%)	4 (80%)	5 (100%)	3 (60%)	4 (80%)	4 (80%)	5 (100%)
		R	1 (20%)	2 (40%)	2 (40%)	2 (40%)	2 (40%)	2 (40%)	2 (40%)	2 (40%)	1 (20%)	1 (20%)	0 (0%)	2 (40%)	1 (20%)	1 (20%)	0 (0%)
Overall		S	17 (81%)	17 (81%)	14 (67%)	15 (71%)	16 (76%)	16 (76%)	16 (76%)	16 (76%)	18 (86%)	19 (90%)	21 (100%)	16 (76%)	18 (86%)	19 (90%)	21 (100%)
		R	4 (19%)	4 (19%)	7 (33%)	6 (29%)	5 (24%)	5 (24%)	5 (24%)	5 (24%)	3 (14%)	2 (10%)	0 (0%)	5 (24%)	3 (14%)	2 (10%)	0 (0%)

Definition of abbreviations: S=Susceptibile; R=Resistant; AMK=Amiakcin; GEN=Gentamicin ; AMX=Amoxicillin; CLV=Clavulanteacid; AMP=Ampicillin; SUL=Sulbactam; CEFU=Cefuroxime; CEFT=Ceftriaxone; CEFP=Cefipime; AZI= Azithromycin; ERY= Erythromycin; LIZ= Linezolid; VAN= Vancomycin; CIP=Ciprofloxacin; LEV=Levofloxacin; TIG=Tigecyclin; COL=Colistin

patients. Age more than 65 years is one of the known risk factors for the development of severe pneumonia.[9] Pneumonia is increasingly common in older patients with associated co-morbidities, like COPD, diabetes, renal failure, congestive heart failure, chronic liver disease, etc.[1] Most common co-morbidity in the present study was COPD. Common symptoms found in patients include cough (84%), followed by expectoration (79%), shortness of breath (62%), fever (59%) and chest pain (49%). These findings are consistent with the other studies.[10,11]

In the present study, multilobar involvement was the commonest finding followed by the right lower lobe and left lower lobe on chest radiographs. However, Jain *et al*[11] and Bansal *et al*[12] have reported involvement of the right lower lobe in most of the cases. This difference may be because Gram-negative pathogens were more common in our study, while Gram-positive pathogens were common in the previous studies. Most patients included in our study had a CURB-65 score of 3 or more which justifies their admission in ICU.[6]

A microbiological diagnosis was achieved in 96% of the patients in the study. The total yield of isolation of microbes in the sputum may vary from 34% to 86% as reported in National Pneumonia Guidelines.[13] The higher yield of isolation of microbes in our study may be due to encouraged sputum production by physiotherapy measures and induced sputum measures in patients who either had absent or scanty sputum. Bronchoscopy was also performed to get good samples for microbiological assessment. The most common organism isolated in our study was *Pseudomonas* followed by *S. pneumonia, Klebsiella, Acinetobacter, E. coli, S. aureus* and *Citrobacter*. Higher incidence of Gram-negative pathogens in pneumonia has also been reported in various other studies with severe CAP and HAP.[14,15]

Patients who did not have prior history of hospitalisation showed *S. pneumonia* as the most common pathogen isolated, which is in contrast with other studies.[16-18] *Pseudomonas aeruginosa* is a common pathogen in patients with severe COPD admitted to ICU.[14]

Most of the Gram-negative isolates were susceptible to colistin (97%), tigecycline (93%) and meropenem (90%) while the least effective antibiotic was ceftriaxone (56%). The pattern of antibiotic resistance recorded in the present study among *P. aeruginosa, Acinetobacter spp., K. pneumonia* and *E. coli* isolates is consistent with the results from other developing countries.[19-21] Vancomycin showed highest activity (100%) against Gram-positive isolates followed by linezolid (90%) and gentamicin (81%) in the present study, which is in contrast with the results of earlier studies.[22,23]

The limitation of this study was that we were unable to isolate atypical and anaerobic bacteria on culture media because of unavailability of such tests in the hospital laboratory.

Conclusions

The increasing resistance to antibiotics in respiratory pathogens has complicated the use of empirical treatment with traditional agents and a definitive bacteriological diagnosis and susceptibility testing would, therefore, be required for the effective management of the pneumonia. It is well known that critically ill and elderly patients are at greater risk of contracting Gram-negative pneumonia. Antimicrobial resistance monitoring helps in optimisation of antimicrobial therapy and is more important in the ICUs where infection and antimicrobial consumption are significantly higher. Thus, for the effective management of pneumonia, bacteriological diagnosis and susceptibility testing and proper locally developed anti-biogram are required to overcome the global problem of antibiotic resistance.

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