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Original Research Article

Clinical, Radiological, and Bacteriological Profile of Community-Acquired Pneumonia among Adults Attending a Tertiary Care Hospital in Northeast India: A Prospective Observational Study

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Abstract

Background: Community-acquired pneumonia (CAP) continues to be one of the most important infectious diseases worldwide and is associated with substantial morbidity, mortality, prolonged hospitalization and healthcare expenditure. Despite advances in antimicrobial therapy and critical care services, CAP remains a major challenge due to the heterogeneity of etiologic agents, increasing antimicrobial resistance, and variability in clinical presentation. There is paucity of data on clinical characteristics, radiological features and bacteriological profile of CAP from Northeast India and region-specific evidence is vital for improving the empirical treatment strategies.

Objectives: To evaluate the clinical profile, radiological findings, bacteriological profile, risk factors and clinical outcomes in adult patients diagnosed with community acquired pneumonia in a tertiary care teaching hospital.

Materials and Methodology: Methods: It was a prospective observational hospital based study done in Department of Pulmonary Medicine, Gauhati Medical College and Hospital, Guwahati, Assam. Consecutive adult patients meeting the diagnostic criteria for community-acquired pneumonia, based on clinical features and chest radiography, were included during the study period. The demographic characteristics, clinical symptoms, physical examination findings, laboratory investigations, sputum Gram stain, bacterial culture, chest radiography and treatment outcomes were recorded on a structured proforma. Descriptive and inferential statistics were used to analyze the data. Continuous variables are presented as mean ± SD; categorical variables are expressed as frequencies and percentages. Statistical analyses were carried out using appropriate statistical tests and $P<0.05$ was considered statistically significant.

Results: The study showed that community acquired pneumonia mainly affected the elderly and patients with underlying comorbid illnesses. Fever, productive cough, dyspnea, pleuritic chest pain and expectoration were the most common presenting complaints. Smoking and chronic obstructive pulmonary disease were the most common associated risk factors. The main radiological finding was lobar consolidation, with lower lobes being more often affected than upper lobes. Streptococcus pneumoniae remained the most common bacterial pathogen isolated but Gram-negative organisms such as Klebsiella pneumoniae and Pseudomonas aeruginosa were also identified, particularly in elderly patients and those with significant comorbidities. Multilobar involvement, severe hypoxemia, bacteremia and multiple comorbid conditions were associated with longer hospital stay and worse clinical outcomes.

Conclusion: Pneumonia acquired in the community remains a major problem for public health in adults, especially in the elderly with pre-existing pulmonary disease and a history of smoking. Early chest radiography and microbiological assessment, along with a thorough clinical assessment, are essential for prompt diagnosis and appropriate empirical antimicrobial therapy. Knowledge of regional pathogen distribution may lead to evidence-based antibiotic choice and improve treatment outcome.

Keywords: Community-Acquired Pneumonia; Clinical Profile; Chest Radiography; Bacteriology; Streptococcus Pneumoniae; Adult Pneumonia; Pulmonary Medicine.

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Introduction

Community-acquired pneumonia (CAP) is an acute pulmonary parenchymal infection acquired outside the healthcare facilities and continues to be a leading cause of morbidity, hospitalization and mortality worldwide, especially in the elderly and patients with chronic medical illnesses [1]. It is characterized by symptoms of lower respiratory tract infection with new infiltrates on chest radiography in patients without recent hospitalization [2,3]. Despite significant advances in antimicrobial therapy, vaccination and supportive care, CAP continues to be a significant clinical and economic burden on healthcare systems in both developed and developing countries [4].

Infections of the lower respiratory tract are the leading cause of death from infectious diseases worldwide. Pneumonia is among the leading causes of death and represents a large proportion of deaths in adults and older people [5], according to the World Health Organization. In India, CAP continues to be a major public health problem due to delayed diagnosis, lack of microbiology facilities, irrational use of antibiotics and rising antimicrobial resistance [6].

The clinical picture of CAP is very variable and depends on the patient's age, immune status, associated co-morbidities and the causative organism. Classically, the manifestations are fever, productive cough, dyspnea, pleuritic chest pain and constitutional symptoms. Elderly patients often present with atypical symptoms, such as confusion, altered mental status or generalized weakness, often delaying diagnosis and treatment [7,8].

CAP has a wide microbiological spectrum, which includes typical bacteria, atypical organisms, respiratory viruses, and occasionally fungal pathogens. Streptococcus pneumoniae is still the most commonly identified pathogen worldwide, but Gram-negative bacilli including Klebsiella pneumoniae, Pseudomonas aeruginosa and Haemophilus influenzae are increasingly being reported, particularly in elderly patients and those with chronic pulmonary disease or other co-morbid conditions [9–11].

Chest radiography is the cornerstone for confirming the diagnosis of CAP showing new pulmonary infiltrates and helping to determine the severity of the disease, the anatomical distribution, complications and differential diagnoses such as pulmonary tuberculosis, malignancy or pulmonary edema [12,13]. Radiographic findings alone are not reliable to identify the organism causing the infection; however, characteristic imaging patterns may provide important clues that facilitate early empirical antimicrobial therapy [13].The regional epidemiology of clinical characteristics, radiological manifestations and bacteriological profile of CAP in North-East India is still limited. Local data are especially critical as the distribution of pathogens and antimicrobial susceptibility differs between geographic regions, directly influencing empiric antibiotic selection [14,15].

Better understanding of these regional differences may help improve diagnostic accuracy, optimize antimicrobial stewardship, reduce treatment failure and ultimately improve patient outcome.

Therefore, the present study was undertaken to evaluate the clinical presentation, radiological findings, bacteriological profile, associated risk factors and outcome of treatment of adult patients with community acquired pneumonia attending a tertiary care teaching hospital in North East India.

Materials and Methods

Study Design and Setting: This prospective observational hospital-based study was conducted in the Department of Pulmonary Medicine in collaboration with the Department of Internal Medicine and allied specialties at Gauhati Medical College and Hospital, Guwahati, Assam, India. The study was carried out over a period of one year from August 2018 to July 2019 after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all eligible participants before enrolment. Patient information was recorded in a predesigned and pretested case record proforma.

Study Population: A total of 130 consecutive adult patients diagnosed with community-acquired pneumonia (CAP) were enrolled prospectively after applying the predefined inclusion and exclusion criteria. Patients were recruited from both outpatient and inpatient services of the Department of Pulmonary Medicine and allied departments. The diagnosis of CAP was established on the basis of clinical presentation together with chest radiographic evidence of pneumonia.

Inclusion Criteria: Patients fulfilling all of the following criteria were included:

1. Clinical features suggestive of acute lower respiratory tract infection, including cough with or without expectoration, dyspnea, or pleuritic chest pain of less than one week's duration.
2. Presence of at least one systemic feature such as body temperature >37.7°C, chills, rigors, or severe malaise.
3. New focal chest signs including bronchial breath sounds and/or crackles on physical examination.

4. Age greater than 14 years.
5. Provision of written informed consent for participation in the study.

Exclusion Criteria

Patients were excluded if they had:

- Hospital-acquired pneumonia.
- Ventilator-associated pneumonia.
- Pulmonary tuberculosis.
- Pulmonary infarction.
- Immunocompromised status.
- Refusal to participate in the study.

Clinical Evaluation: All enrolled patients underwent a comprehensive clinical evaluation that included detailed demographic information, presenting symptoms, smoking history, alcohol consumption, occupational exposure, previous respiratory illnesses, associated comorbidities, and prior medication history. A complete general physical examination and detailed systemic examination were performed for every patient.

Vital parameters including temperature, pulse rate, respiratory rate, blood pressure, and oxygen saturation were documented at admission. Tachycardia was defined as heart rate >100 beats/minute, tachypnea as respiratory rate >24 breaths/minute, hypotension as systolic blood pressure <90 mmHg and/or diastolic blood pressure <60 mmHg, and hyperthermia as body temperature >37.7°C.

Laboratory Investigations

The following investigations were performed according to clinical indications:

- Complete blood count with erythrocyte sedimentation rate (ESR)
- Random blood glucose estimation; fasting blood glucose, postprandial blood glucose, and glycated hemoglobin (HbA1c) when indicated
- Serum electrolytes in elderly patients and those receiving diuretic therapy
- Liver function tests
- Kidney function tests
- Arterial blood gas analysis in hospitalized patients
- Electrocardiography for elderly patients and those with suspected cardiac disease

Microbiological Evaluation: Sputum specimens were collected before initiation of antimicrobial therapy whenever feasible.

Acid-Fast Bacilli Examination: Two sputum specimens (one spot and one early morning sample) were collected according to the Revised National Tuberculosis Control Programme (RNTCP) guidelines. Ziehl–Neelsen staining was performed to exclude pulmonary tuberculosis.

Gram Staining and Bacterial Culture: Representative sputum samples were subjected to Gram staining followed by bacterial culture using Blood agar and MacConkey agar media.

Organisms isolated on culture were identified by standard microbiological techniques, and antimicrobial susceptibility testing was performed using routine laboratory protocols. Fungal culture was undertaken selectively whenever clinically indicated.

Radiological Assessment: Posteroanterior chest radiographs were obtained for all enrolled patients to confirm the diagnosis, determine the anatomical distribution of pulmonary infiltrates, identify lobar involvement, and detect associated complications including pleural effusion or cavitary lesions.

Computed tomography (CT) of the thorax was performed only in selected patients presenting with severe disease, recurrent pneumonia, non-resolving pneumonia, uncertain chest radiographic findings, or suspicion of underlying pulmonary malignancy or other structural lung diseases.

Pleural Fluid Analysis: Patients with pleural effusion underwent ultrasound-guided diagnostic thoracentesis under aseptic precautions. Pleural fluid was analyzed for gross appearance, glucose, protein, lactate dehydrogenase (LDH), adenosine deaminase (ADA), total and differential leukocyte counts, Gram stain, bacterial culture and sensitivity, and malignant cytology wherever indicated.

Bronchoscopic Evaluation: Flexible fibreoptic bronchoscopy was performed in selected patients with persistent or non-resolving pneumonia or when an alternative diagnosis such as pulmonary tuberculosis or bronchogenic carcinoma was suspected. Bronchoalveolar lavage specimens were collected from radiologically abnormal segments for microbiological evaluation.

Assessment of Disease Severity: Severity of community-acquired pneumonia was evaluated using the CURB-65 scoring system, which assigns one point each for:

- Confusion
- Blood urea nitrogen >19 mg/dL
- Respiratory rate >30/minute
- Systolic blood pressure <90 mmHg or diastolic blood pressure <60 mmHg
- Age >65 years

Patients were categorized into low-, intermediate-, and high-risk groups according to the total CURB-65 score, which guided clinical risk stratification and site-of-care decisions.

Outcome Measures: The primary outcomes evaluated were:

- Clinical presentation
- Radiological characteristics
- Bacteriological profile
- Distribution of associated comorbidities
- Disease severity according to CURB-65
- Complications during hospitalization
- Final treatment outcome (recovery or mortality)

Secondary outcomes included identification of factors associated with disease severity and adverse clinical outcomes.

Statistical Analysis: Data were entered into Microsoft Excel 2007 and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM/SPSS Inc., Chicago, IL, USA). Continuous variables were summarized using mean ± standard deviation, whereas categorical variables were expressed as frequencies and percentages.

Associations between categorical variables were assessed using the Chi-square test or Fisher's exact test wherever appropriate. A p-value <0.05 was considered statistically significant, while $p<0.01$ was considered highly significant. Graphical presentation of data included bar diagrams, histograms, and pie charts to facilitate interpretation of the study findings.

Ethical Considerations: The study protocol received approval from the Institutional Ethics Committee of Gauhati Medical College and Hospital before commencement of patient enrolment. Written informed consent was obtained from every participant before inclusion. Confidentiality of patient information was maintained throughout the study in accordance with institutional ethical guidelines and the principles of the Declaration of Helsinki.

Results

A total of 130 adult patients diagnosed with community-acquired pneumonia (CAP) were included in the study. The mean age of the study population was 52.93 ± 12.35 years (range: 14–80 years). Most patients belonged to the 51–60 years age group (37.69%), while 65.38% were older than 50 years.

Table 1: Baseline demographic characteristics of the study population

Variable	Number (n=130)	Percentage (%)
Age >50 years	85	65.38
Age ≤50 years	45	34.62
Male	91	70.00
Female	39	30.00

CAP occurred predominantly among middle-aged and elderly adults, with a male-to-female ratio of 2.3:1.

Table 2: Presenting clinical symptoms

Symptom	Number	Percentage (%)
Fever	110	84.62
Cough	105	80.77
Expectoration	90	69.23
Dyspnea	30	23.08
Chest pain	18	13.85

Fever and cough were the predominant presenting symptoms. Dyspnea was significantly more frequent among patients older than 50 years, whereas pleuritic chest pain was more common in younger patients.

Table 3: Major comorbidities

Comorbidity	Number	Percentage (%)
COPD	50	38.46
Diabetes mellitus	28	21.54
Hypertension	18	13.85
Liver disease	11	8.46
Malignancy	10	7.69
Renal disease	9	6.92
Congestive heart failure	7	5.38
Cerebrovascular accident	3	2.31

Overall, 102 patients (78.46%) had at least one pre-existing comorbidity. COPD showed a significant association with patients older than 50 years ($p=0.0004$).

Table 4: Clinical examination findings

Finding	Percentage (%)
Hyperthermia	81.50
Tachypnea	78.46
Tachycardia	74.62
Crepitations	61.54
Increased vocal fremitus	42.31
Increased vocal resonance	42.31
Bronchial breath sounds	36.92

Hyperthermia and tachypnea were the most frequent abnormal vital signs, while crepitations represented the commonest respiratory examination finding.

Table 5: Radiological and microbiological profile

Variable	Number	Percentage (%)
Lobar consolidation	102	78.46
Interstitial infiltrates	21	16.15
Pleural effusion	7	5.38
Gram-positive smear	65	50.00
Gram-negative smear	26	20.00
No organism on smear	37	28.46

The predominant chest radiographic finding was lobar consolidation (78.46%). Gram-positive organisms were the commonest organisms identified on sputum Gram stain.

Table 6: Sputum culture findings

Organism	Number	Percentage (%)
Streptococcus pneumoniae	45	34.62
Staphylococcus aureus	19	14.62
Klebsiella pneumoniae	15	11.54
Pseudomonas aeruginosa	11	8.46
No growth	40	30.76

Streptococcus pneumoniae was the predominant bacterial isolate, followed by Staphylococcus aureus. No bacterial growth was observed in approximately one-third of sputum cultures.

Table 7: Disease severity, complications and outcome

Parameter	Number	Percentage (%)
Low-risk CURB-65	66	50.77
Intermediate-risk CURB-65	50	38.46
High-risk CURB-65	14	10.77
Pleural effusion	7	5.38
Septic shock	4	3.08
Overall recovery	118	90.77
Mortality	12	9.23

Patients with high CURB-65 scores had markedly higher mortality (57.14%) than those in the intermediate-risk (8%) and low-risk (0%) groups. Complications occurred in 13.85% of patients and were significantly associated with mortality (p=0.0033).

Discussion

Community-acquired pneumonia (CAP) continues to be a leading cause of morbidity and mortality worldwide despite major advances in antimicrobial therapy, vaccination strategies and supportive care. Because of impaired host defenses and several risk factors for severe infection, elderly people and patients with underlying comorbidities still remain at high risk [1–3].In the present study, the mean age of patients was 52.93 ± 12.35 years. 65.38% of patients were above 50 years. Shah et al. [4], Bansal et al. [5] and Jain et al. [6] have similarly observed that with increasing age the incidence and severity of CAP increases. Elderly individuals are more vulnerable owing to age-related decline in immune function, diminished mucociliary clearance, and a higher prevalence of chronic diseases.

The present study showed a marked male predominance (70%) with a male to female ratio of 2.3: 1. Similar results have been reported in studies from India and other developing countries [4–6]. This preponderance can be explained by the greater

exposure of men to smoking, alcohol consumption, occupational pollutants and chronic respiratory diseases, all of which increase the risk of lower respiratory tract infections.

The most common presenting symptoms were fever (84.62%), cough (80.77%) and expectoration (69.23%). Patients older than 50 years of age reported significantly more dyspnea, while young patients reported more chest pain. Similar findings were reported by Bansal et al. [5], Shah et al. [4] and Dey et al. [7] where fever and productive cough were the major clinical presentation of CAP. The higher prevalence of dyspnoea in elderly patients probably reflects higher disease severity and decreased cardiopulmonary reserve.

78.46% of patients had comorbid illnesses with the commonest being chronic obstructive pulmonary disease (COPD) (38.46%). Diabetes mellitus, hypertension, liver disease, renal disease and congestive heart failure were also common conditions. COPD was significantly associated with patients older than 50 years. Similar findings have been reported by Donowitz and Cox [8], Marrie and Huang [9], and Shah et al. [4]. Repeated infections of the lower respiratory tract occur in patients with COPD due to chronic airway inflammation, impaired mucociliary clearance and recurrent bacterial colonisation.

Our study clinical examination findings were consistent with classical bacterial pneumonia. The most common abnormal vital signs were hyperthermia, tachypnea and tachycardia. The predominant finding on respiratory examination was creptations. Similar observations were reported by Jain et al. [6] and Roshni et al. [10] and highlight that a complete bedside examination still remains essential in the diagnosis of CAP especially in resource-limited settings.The most common radiological pattern was lobar consolidation seen in 78.46% of patients on chest radiography. Interstitial infiltrates were found in 16.15% and pleural effusion in 5.38% of patients. These results are in agreement with those of Müller et al. [11] and Hayden and Wrenn [12] who stated that chest radiography is the mainstay for the diagnosis of CAP and that lobar consolidation is predominant in bacterial pneumonia.The microbiological evaluation identified Streptococcus pneumoniae as the most common pathogen (34.62%), followed by Staphylococcus aureus, Klebsiella pneumoniae and Pseudomonas aeruginosa. Similar bacteriological profiles have been reported by Shah et al. [4], Bansal et al. [5] and Para et al. [13], which confirm that S. pneumoniae is still the predominant etiologic agent of CAP. However, Gram-negative pathogens remain an important cause of severe disease in elderly patients and patients with chronic comorbidities. About one third of sputum cultures were negative for bacterial growth, possibly due to prior exposure to antibiotics or infection with atypical pathogens not identified by conventional culture techniques [14].

The severity assessment of CURB-65 score showed that approximately 50% of the patients were in the low-risk group and 10.77% of patients were high-risk. Mortality progressively increased with increasing CURB-65 score and was 57.14% in high risk patients. These results are in line with previous studies by Lim et al. [15] and Shah et al. [16] where the CURB-65 was an accurate predictor of mortality and an excellent tool for decision-making in the setting of hospitalization and ICU management.

Pleural effusion was the most common complication followed by septic shock, lung abscess, congestive cardiac failure, acute respiratory distress syndrome, empyema and acute renal failure. Patients who developed complications had significantly higher mortality, underscoring the importance of early identification and aggressive management of these conditions. Similar observation has been reported by Dey et al. [7] and Macfarlane et al. [17].

The overall clinical outcome was good, with 90.77% of patients recovering after appropriate treatment and in-hospital mortality of 9.23%. This mortality rate is comparable to those seen in previous Indian studies which have ranged from about 8% to 11% [4,5,7]. Mortality was not significantly different between male and female, suggesting that age, disease severity and associated comorbidities have a greater impact on prognosis than gender alone.

Strengths of the present study include its prospective design, comprehensive clinical assessment, microbiological evaluation and standardized severity scoring. However, certain limitations should be acknowledged. The study was done in a single tertiary care centre and had a relatively small sample size. Moreover, the microbiological diagnosis was mainly based on conventional culture techniques without molecular diagnostic methods or routine viral testing, which might underestimate the true spectrum of pathogens for CAP.

Overall, the current study reconfirms that community acquired pneumonia is still a major public health problem among adults in Northeast India. Greatest risk population. Elderly males with COPD and other chronic comorbidities. Early diagnosis, early empirical antimicrobial therapy, microbiological confirmation whenever possible and risk stratification using CURB-65 still remain the basic strategies to improve clinical outcomes.

Conclusion

The present prospective observational study points out that community-acquired pneumonia (CAP) still represents an important cause of hospitalization in adults, especially in patients >50 years old and with comorbidities.

The most common presenting symptoms were fever, cough and expectoration with COPD being the most common associated comorbidity. Lobar consolidation was the main radiological finding, and Streptococcus pneumoniae was the most frequently isolated bacterial pathogen in sputum cultures.

The CURB-65 score was effective in categorizing disease severity and had a robust association with mortality. Most patients recovered with appropriate treatment, but mortality was significantly high in patients with severe disease and patients who developed complications. Early diagnosis, early antimicrobial therapy and timely severity assessment remain important for improving the outcome of the patient.

Study Limitations

- The study was conducted at a single tertiary care teaching hospital, limiting the generalizability of the findings.
- The sample size was relatively small.
- Etiological diagnosis relied primarily on conventional microbiological methods, and atypical bacterial or viral pathogens were not routinely investigated.
- Long-term follow-up after hospital discharge was not performed.

Clinical Implications

- Elderly patients and those with COPD or other chronic illnesses should be considered high-risk for severe CAP.
- Routine application of the CURB-65 scoring system can facilitate early risk stratification and guide hospitalization decisions.
- Sputum Gram staining and culture remain valuable investigations for identifying bacterial pathogens and selecting appropriate antimicrobial therapy.
- Early diagnosis and prompt treatment may reduce complications, hospital stay, and mortality.

Future Recommendations

- Multicenter studies with larger sample sizes should be conducted to validate these findings.
- Molecular diagnostic techniques should be incorporated to improve pathogen detection.
- Studies evaluating antimicrobial resistance patterns and long-term clinical outcomes are warranted.
- Continuous surveillance of the microbiological profile of CAP is necessary to guide empirical antibiotic policies.

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Ethical Approval: The study was conducted after obtaining approval from the Institutional Ethics Committee of Gauhati Medical College and Hospital. Written informed consent was obtained from all participants prior to enrollment.

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