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ORIGINAL ARTICLE

Frequency of Parapneumonic Effusion in Patients with Community-Acquired Pneumonia

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ABSTRACT

Background: Community-acquired pneumonia (CAP) is a signif,icant cause of morbidity and hospitalization worldwide. Parapneumonic effusion (PPE), the accumulation of pleural fluid secondary to pneumonia, is a common complication that can increase disease severity and negatively affect clinical outcomes if not identified early. Our objective is to determine the frequency of parapneumonic effusion among patients with community-acquired pneumonia and to evaluate its association with selected demographic and clinical characteristics.

Methods: This cross-sectional study was conducted in the Department of Pulmonology at MTI Mardan Medical Complex, Mardan, over a six-month period from September 2025 to February 2026. A total of 107 patients diagnosed with community-acquired pneumonia were included in the study. Demographic characteristics, clinical history, and radiological findings were recorded using a structured data collection form. Data were analyzed using statistical software. Categorical variables were presented as frequencies and percentages. Stratification was performed based on age and gender, and the chi-square test was applied to assess associations. A p-value ≤0.05 was considered statistically significant.

Results: Among the 107 enrolled patients, 54 (50.5%) were males and 53 (49.5%) were females, with a mean age of 49.18 ± 14.88 years. Parapneumonic effusion was identified in 43 (40.2%) patients, including 37 (34.6%) with uncomplicated and 6 (5.6%) with complicated parapneumonic effusion. Increasing age, low body mass index, presence of comorbidities, prolonged duration of symptoms before hospital admission, and greater pneumonia severity were significantly associated with parapneumonic effusion ($p < 0.001$), whereas gender and smoking status showed no statistically significant association.

Conclusion: Parapneumonic effusion is a frequent complication among patients with community-acquired pneumonia. Early detection and appropriate management may help reduce complications and improve patient outcomes.

Key words: Community acquired pneumonia, parapneumonic effusion, Pleural effusion, Pulmonary infection

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Introduction

Community-acquired pneumonia (CAP) is one of the significant morbidity and mortality causes that pose a threat to the global community and is considered among the most prevalent infectious diseases that necessitate hospitalization.

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It is defined as the lung parenchyma infection occurring out of hospitals and is usually caused by bacterial pathogen like Streptococcus pneumoniae, Staphylococcus aureus as well as Gram-negative ones. CAP still represents a significant health care burden in healthcare systems especially in the elderly and people with underlying comorbidities despite the improved treatment in terms of antimicrobial therapy and supportive care. (1)

The parapneumonic effusion (PPE) is one of the most common complications of CAP defined as the collection of fluid in the pleural space as a result of pneumonia. PPE is a continuum of pleural disease involving simple sterile effusion to the complex effusion and empyema. (2) The development of PPE occurs because of inflammation of the pleural space as a result of infection in the surrounding lung parenchyma. (3) The majority of epidemiological studies indicate that about 20–50% of patients hospitalized with CAP develop para pneumonic effusion, but only a sub-set evolves to complicated effusion and empyema. (4)

PPE has significant clinical outcomes, including increased severity of the disease, long-term hospitalization, and higher costs of healthcare, and its early identification could prevent further development of effusion with complicated complications or empyema that might require invasive treatment.(5) Various risk factors have been reported in regard to the occurrence of PPE, including old age, smoking, delay in diagnosis, and the presence of comorbid conditions like diabetes mellitus and chronic lung disease.(6) Early identification of PPE is critical because timely diagnosis and appropriate management can prevent progression to complicated effusion or empyema, which may require invasive interventions.(7)

Community-acquired pneumonia (CAP) remains one of the leading infectious causes of hospitalization and mortality worldwide, accounting for substantial healthcare utilization. Approximately 20–40% of hospitalized patients with CAP develop parapneumonic effusion (PPE), while 5–10% progress to complicated parapneumonic effusion or empyema requiring invasive intervention. (8,9) Previous studies have identified increasing age, delayed presentation, smoking, diabetes mellitus, chronic lung disease, malnutrition, and severe pneumonia as important predictors of PPE development. These factors are associated with prolonged hospitalization, increased healthcare costs, and poorer clinical outcomes. In Pakistan, published data regarding the burden of parapneumonic effusion remain limited. Farooq et al. reported pleural effusion in approximately 16.7% of hospitalized CAP patients, whereas another local study reported parapneumonic effusion frequencies ranging between 25% and 35%, reflecting considerable regional variation. (10) Despite these observations, there is a paucity of data from Khyber Pakhtunkhwa regarding the frequency of PPE and its associated clinical factors. Therefore, the present study was undertaken to determine the frequency of parapneumonic effusion among hospitalized patients with community-acquired pneumonia and to evaluate its association with selected demographic and clinical characteristics in our local population.

Methods

This study was carried out in the Department of Pulmonology, MTI Mardan Medical Complex, Mardan, to estimate the incidence of the parapneumonic effusion among patients admitted with community-acquired pneumonia. The research was conducted in

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six months between 1st September 2025 and 28th February 2026. The estimated sample size was 107 patients, which was calculated by the open Epi sample size calculator with an assumed incidence of parapneumonic effusion of 7.5% among patients with community-acquired pneumonia, a 95% confidence level, and a 5% margin of error.(11)1 Patients were sampled by a non-probability consecutive method. The study included adult patients aged 18 to 70 years who had clinical features of community-acquired pneumonia, such as cough, fever, and dyspnea, and radiological evidence of new pulmonary infiltrates on the chest imaging. Hospital-acquired pneumonia, ventilator-associated pneumonia, aspiration pneumonia, underlying lung disease (e.g. TB), active immunosuppressive disorders (e.g. HIV infection or chemotherapy), pregnant females, and those with severe comorbidities (e.g. heart failure) were excluded.

Data were collected upon receiving an ethical approval by the institutional review board of the hospital. All participants were enrolled with informed written consent. Patients were selected sequentially and were eligible to join the study in case of presenting within the study period. A structured data collection proforma was used to collect sociodemographic and clinical data, such as age, gender, smoking status, duration of symptoms, presenting symptoms, comorbidities, and radiological data. All patients were subjected to a chest X-ray for diagnosis of community-acquired pneumonia and to detect the existence of pleural effusion. The clinical and radiological data were used to classify parapneumonic effusion into no effusion, uncomplicated parapneumonic effusion or complicated parapneumonic effusion. The CURB-65 scoring system was used to determine the severity of pneumonia.

IBM SPSS statistics 25 was used to enter and analyze data. The quantitative variables (age and duration of symptoms) were expressed in terms of mean ± standard deviation following an evaluation of the normality, and the categorical variables (gender, smoking, comorbidities, and the presence of parapneumonic effusion) were expressed in terms of frequencies and percentages. Stratification was done based on age group and gender to determine their influence to the outcome variable. To test the relations between categorical variables, the Chi-square test was used and a p-value of 0.05 was set as statistically significant.

Results

A total of 107 patients with community-acquired pneumonia were included in the study comprising of 54(50.5%) males and 53(49.5%) females, showing an almost equal gender distribution. The mean age of the participants was 49.18 ± 14.88 years where as the mean BMI was 21.22 ± 3.09 kg/m². the overall baseline demographics of the enrolled patients are summarized in table 1.

Table 1: Baseline Characteristics of Patients with Community-Acquired Pneumonia (n= 107)

Variable	Category	Frequency (n)	Percentage (%)
Age	18–30 years	17	15.9
	31–45 years	24	22.4
	46–60 years	29	27.1
	>60 years	37	34.6
Gender	Male	54	50.5
	Female	53	49.5
BMI	Underweight (<18.5 kg/m²)	27	25.2
	Normal (18.5–24.9 kg/m²)	67	62.6
	Overweight (25–29.9 kg/m²)	13	12.1

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Variable	Category	Frequency (n)	Percentage (%)
Smoking Status	Active smoker	24	22.4
	Ex-smoker	19	17.8
	Non-smoker	64	59.8
Comorbidities	Diabetes	11	10.3
	Hypertension	17	15.9
	DM + HTN	27	25.2
	HTN + COPD	13	12.1
	No comorbidities	39	36.4

The duration of symptoms before hospital admission varied among patients. Most patients came to the hospital after experiencing symptoms for more than two weeks, while a smaller proportion presented within the first week. The most common presenting complaint was cough with fever, followed by cough accompanied by fever and chest pain. Chest X-ray commonly showed pulmonary infiltrates and pleural effusion, with consolidation also noted in some patients. Based on the CURB-65 score, most patients had low to moderate disease severity, while fewer had severe illness. The detailed clinical profile is presented in Table 2.

Table 2: Clinical Characteristics of enrolled Patients

Variable	Category	Frequency (n)	Percentage (%)
Duration of Symptoms Before Admission	<1 week	27	25.2
	1–2 weeks	36	33.6
	>2 weeks	44	41.1
Presenting Symptoms	Cough	27	25.2
	Cough + Fever	46	43.0
	Cough + Fever + Chest Pain	34	31.8
Chest X-ray Findings	Pulmonary Infiltrates	38	35.5%
	Consolidation	26	24.3%
	Unilateral effusion	34	31.8%
	Bilateral effusion	09	8.4%
Severity of Pneumonia (CURB-65)	Low (score 0–1)	42	39.3
	Moderate (score 2)	26	24.3
	Severe (score 3)	27	25.2
	Very severe (score 4–5)	12	11.2

The frequency of parapneumonic effusion among patients with community-acquired pneumonia was 40.2% (43/107). Among these, 37 (34.6%) patients had uncomplicated parapneumonic effusion, while 6 (5.6%) had complicated parapneumonic effusion, Summarized as Table 3.

Table 3: Frequency of Parapneumonic Effusion in CAP Patients

	Frequency (n)	Percentage (%)
No PPE	64	59.8
Uncomplicated PPE	37	34.6
Complicated PPE	6	5.6
Total	**107**	**100**

Stratification analysis demonstrated that the incidence of parapneumonic effusion was significantly associated with increasing age, body mass index (BMI), presence of comorbidities, duration of symptoms before hospital admission, and severity of pneumonia (all $p < 0.001$). Patients aged >60 years, those who were underweight, those with combined diabetes and hypertension or hypertension with COPD, those presenting after more than 5 days of symptom onset, and those with severe or very severe pneumonia had a significantly higher frequency of

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parapneumonic effusion, particularly complicated parapneumonic effusion. In contrast, gender (p = 0.134) and smoking status (p = 0.075) were not significantly associated with the incidence of parapneumonic effusion. Stratification analysis are summarized in Table 4.

Table 4: Association of Baseline Variables with the Incidence of Parapneumonic Effusion

Variable	No PPE n (%)	PPE* n (%)	P value
Age	78 (72.9)	29 (27.1)	**<0.001**
Gender	78 (72.9)	29 (27.1)	0.134
BMI	78 (72.9)	29 (27.1)	**<0.001**
Smoking status	78 (72.9)	29 (27.1)	0.075
Comorbidities	78 (72.9)	29 (27.1)	**<0.001**
Duration of symptoms before hospital admission	78 (72.9)	29 (27.1)	**<0.001**
Severity of pneumonia	78 (72.9)	29 (27.1)	**<0.001**

Discussion

CAP is an infectious disease that is common and often causes pleural complications, especially parapneumonic effusion (PPE), which may have a significant impact on the severity of the disease and its clinical outcome. In the current research, 40.2% of patients with CAP had parapneumonic effusion. The observation is in line with other studies that have indicated the development of pleural effusion about 20-44 % of hospitalized patients with CAP. (11,12) The evidence points to the fact that pleural involvement is a common complication of pneumonia, especially in hospitalized patients. The rate of PPE in the current study is more than those of some of the regional studies. To illustrate, Farooq et al. have found a prevalence of 16.7 percent in the hospitalized CAP patients in Pakistan. (13) The variation may be due to differences in the study design, population of patients and access to health care. Equally, a clinical trial assessing CAP patients has found pleural effusion in about 30% of patients, which is comparably similar with ours. (14) It could as well be so because of difference in the severity of the disease and when the patients present themselves in the hospital. In the study under consideration, the majority of patients with the effusion had simple parapneumonic effusion, but only a few patients developed complicated effusion. This observation is in line with what the previous literature denotes that most parapneumonic effusions are benign and they respond to antibiotic treatment, with only a very small percentage of cases developing to complicated effusion or empyema that may necessitate invasive treatment. (15,16) The previous literature states that the percent of complicated effusions is in the range of 5-10 percent cases with pneumonia, which is in line with the results of the current study. The current research demonstrated significant associations between parapneumonic effusion and increasing age, comorbidities, prolonged duration of symptoms before hospital admission, and greater severity of pneumonia. Although smoking has been identified as a risk factor in previous studies, no statistically significant association was observed in the present study. Body mass index was also significantly associated with parapneumonic effusion in the present study. Underweight patients demonstrated a higher frequency of parapneumonic effusion compared with those having normal or overweight BMI. Malnutrition has been associated with impaired immune responses and increased susceptibility to severe respiratory infections, which may predispose patients to pleural complications. Previous researches have also indicated that older age and co-morbid conditions including diabetes

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mellitus, hypertension, chronic lung disease among others have a contributing role to pleural complications in patients with CAP.(16,17) Smoking has also been cited as a risk factor owing to its adverse impact on the mucociliary clearance and host immune defense mechanisms.(18) The other significant discovery of the current study was the association between extended duration of symptoms and high frequency of PPE, which indicated that delayed medical care could also play a role in pleural involvements. Other past researches have also pointed out that when proper therapy is not taken in time, there is a possibility of the infection spreading to the pleural space, which can lead to the formation of effusion and the development of the disease. (19)

The present study provides region-specific data from Mardan, Khyber Pakhtunkhwa, regarding the incidence and determinants of parapneumonic effusion among hospitalized patients with community-acquired pneumonia. The findings highlight that older age, lower BMI, comorbidities, delayed presentation, and greater pneumonia severity are independently associated with parapneumonic effusion, thereby facilitating early identification of high-risk patients and timely intervention.

Limitations of the Study

This study has several limitations. First, it was conducted at a single tertiary care center with a relatively modest sample size, which may limit the generalizability of the findings to other healthcare settings. Second, the cross-sectional design precludes establishing temporal or causal relationships between the identified risk factors and parapneumonic effusion. Third, microbiological characteristics, pleural fluid biochemical parameters, and treatment outcomes were not evaluated. Finally, multivariable regression analysis was not performed to determine independent predictors of parapneumonic effusion.

Future multicenter prospective studies with larger sample sizes and comprehensive clinical evaluation are recommended to validate these findings.

Conclusion

Parapneumonic effusion is a common complication in patients with community-acquired pneumonia and, to a significant degree, it is closely related to multiple demographic and clinical factors. Our findings suggest that biological and radiological evaluation of CAP patients should be done with care in order to be able to diagnose and treat pleural complications early enough.

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Study Approval Statement

This study was approved by the IERB of MTI Bacha Khan Medical college Mardan. (Reference No. 751/BKMC).

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All the authors agree to take responsibility for every facet of the work, making sure that any concerns about its integrity or veracity are thoroughly examined and addressed.	