ORIGINAL ARTICLE

Frequency of cardiac arrhythmias, the associated risk factors, and in-hospital mortality in patients admitted with community-acquired pneumonia

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ABSTRACT

Background: Community-acquired pneumonia is a common infection that causes significant illness and death globally. Cardiac arrhythmias, particularly atrial fibrillation, are known to be associated with greater disease severity, resulting from cardiovascular effects of an acute episode of pneumonia.

Material and Methods: This prospective observational study, included 220 patients aged >18 years with pneumonia, admitted from April 2023 to March 2024, to Aga Khan University Hospital in Karachi, Pakistan. CURB-65 and PSI scores were used to assess disease severity. Patients who were immunocompromised or had a hospital stay of >48 hours prior to development of pneumonia, were excluded. Primary outcomes included frequency of cardiac arrhythmia, whereas secondary outcomes comprised in-hospital mortality, length of hospital stay and occurrence of complications.

Results: The study involved 220 patients with a mean age of 66.3 ± 12.7 years. Cardiac arrhythmias were observed in 37 (16.7%) patients, with atrial fibrillation being the most common type, affecting 20 (9%) individuals. Mortality was observed in 37 patients (16.3%). Majority of the patients (37.1%) needed 3-4 days of hospital stay, followed by 34.4% requiring 4-6 days of hospitalization. Patients with severe pneumonia (CURB-65 ≥ 3 and PSI class IV-V) were at greater risk of developing cardiac arrhythmia, which in turn was associated with increased mortality and longer hospital stay.

Conclusion: Patients with pneumonia exhibited a greater risk of developing cardiac arrhythmia and associated complications, including longer hospital stay and greater in-hospital mortality. Atrial fibrillation was the most common arrhythmia encountered.

Keywords: Arrhythmia, Atrial fibrillation, Community acquired pneumonia, Mortality, Pneumonia

BACKGROUND

Community-acquired pneumonia (CAP) continues to be a common infectious disease, causing substantial morbidity and mortality worldwide.[1-4] Limited information exists regarding the frequency of CAP in Pakistan. However, research from the USA indicates that CAP results in roughly 1.7 million hospital admissions and nearly 50,000 deaths annually. Similar adjusted incidence rates are observed in Europe.[5]

Multiple studies have indicated an increased occurrence of cardiac complications in hospitalized patients with CAP, including acute myocardial infarction (AMI), new or worsened arrhythmias, and new or exacerbated heart failure.[4,5,6] It is speculated that respiratory infections, including pneumonia, can trigger systemic inflammation and oxidative stress, which in turn can lead to endothelial dysfunction and activation of the coagulation cascade.[7] These processes increase the risk of acute cardiac events such as myocardial infarction, heart failure exacerbation, arrhythmias, and even cardiac arrest .[6, 7]

Over the past few decades, the link between CAP and cardiovascular complications has been extensively researched, and previous systematic reviews have attempted to compile the available evidence.[5,6] According to a recent meta-analysis including 39 studies, patients who were admitted with CAP had an overall rate of cardiac complications of 13.9%, with arrhythmias accounting for 7.2% of these complications among all inpatients and up to 12.7% among high risk inpatient population.[8] Atrial fibrillation remains the most frequently encountered sustained arrhythmia in clinical settings.[9]

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This article can be cited as: Ameen U, Irfan M, Zubairi ABS. Frequency of cardiac arrhythmias, the associated risk factors, and in-hospital mortality in patients admitted with community-acquired pneumonia. Infect Dis J Pak. 2025; 34(2): 104-110.

DOI: https://doi.org/10.61529/idjp.v34i2.354

Receiving date: **05 Nov 2024** Acceptance Date: **27 Mar 2025**
Revision date: **17 Feb 2025** Publication Date: **30 Jun 2025**

Low socioeconomic countries like Pakistan face a high burden of respiratory infections, including pneumonia, which remain a leading cause of morbidity and mortality, particularly among vulnerable populations such as children, the elderly, and the individuals with underlying co-morbid conditions. Few studies have been done from Pakistan regarding the overall prevalence of different kinds of arrhythmias encountered in CAP, the precipitating risk factors including severity of the disease, and the associated outcomes. This study, therefore, aims to evaluate frequency of arrhythmia in CAP, the relevant risk factors, and its impact on length of hospital stay and in-hospital mortality.

MATERIAL AND METHODS

It was an observational prospective study carried out on patients diagnosed with CAP between April 2023 and March 2024 at Aga Khan University Hospital, a tertiary care facility situated in Karachi, Pakistan. Approval for the research protocol was granted by the hospital's ethics review committee (ERC # 2023-8581-24706). The calculated sample size was 220 subjects assuming 17.3% prevalence of cardiac arrhythmias in patients admitted with CAP mentioned in the reference paper from Pakistan (10), keeping confidence level at 95% and accepting 5% margin of error.

Patients who met the admission criteria for CAP according to the guidelines of the British Thoracic Society (11) were enrolled in the study. Severity was evaluated upon admission using the PSI (Pneumonia Severity Index) (12) and CURB-65 (Confusion, Uremia, Respiratory rate, Blood pressure, Age ≥ 65 years) scores (13).

Inclusion criteria were (1) age ≥18 years; (2) meeting CAP diagnostic criteria based on (a) new infiltrates observed on chest X-ray and/or CT scan chest, (b) either one major criterion (axillary temperature >37.8°C, cough, or expectoration) or at least two minor criteria (pleuritic chest pain, dyspnea, leukocytosis, altered mental status, or lung consolidation upon clinical examination).

Patients with history of hospitalization in the last 4 weeks due to any reason and patients who developed pneumonia after 48 hours of hospital admission were excluded. In addition, immunocompromised patients having conditions such as inherited or acquired immune deficiencies, those on active cancer chemotherapy, HIV patients with low CD4 counts, bone marrow or solid organ transplants recipients and patients with “do not resuscitate” or comfort care status were excluded.

Demographic and clinical information, encompassing gender, age, comorbidities, past lung ailments, and smoking habits, were recorded. Both CURB-65 and PSI) scores were computed for each patient. Primary outcomes consisted of frequency of different kinds of arrhythmia in patients with CAP, whereas secondary outcomes comprised in-hospital mortality, length of stay (LOS) and occurrence of complications such as septic shock, acute kidney injury, acute respiratory distress syndrome, lung abscess, empyema, and multi-organ failure.

Data entry and analysis were performed by using the IBM Statistical Package of Social Sciences (SPSS) version 19. Data normality was examined. Quantitative variables are presented as mean ± standard deviation (SD) or median with interquartile range (IQR) and qualitative variables are presented as frequency and percentages. For comparison of the non-numerical data, the Fishers’ exact test is used. p value <0.05 is taken as statistically significant.

RESULTS

A total of 220 CAP patients with a mean age of 66.3 ± 12.7 years were included, of which 142 (64.3%) were male. Diabetes mellitus and hypertension were found to be the most common comorbidities, reported in 96 (43.4%) and 125 (56.6%) patients respectively. COPD was the most common underlying lung disease in 23.5% of the patients, followed by asthma, observed in 15.4% of participants. Demographic characteristics of patients are presented in Table-1.

The CURB-65 and PSI scores were computed to assess severity of pneumonia. We found that 65 (30.5%) patients exhibited a low severity (scores 0-1) according to CURB-65, while 55 (25.0%) scored 2, indicating moderate severity. A significant proportion, 98 (43.6%) cases, fell into higher severity categories with scores ranging from 3 to 5.

The PSI scoring system showed a diverse distribution: 7 (3.2%) patients were categorized as PSI class I, 11 patients (5.0%) as PSI class II, and 48 patients (21.7%) fell within the PSI class III range. Notably, 76 (34.4%) individuals were admitted with PSI class IV scores, while 78 (35.3%) scored over 130 points (PSI class V), representing the highest severity level (Table-1).

Cardiac arrhythmias were observed in 37 (16.7%) of the participants. Atrial fibrillation was found to be the most common type of arrhythmia, affecting 20 (9%) individuals, followed by multifocal atrial tachycardia and supraventricular tachycardia, which were present in 6 (2.7%) and 4 (1.8%) subjects, respectively. Notably, instances of ventricular fibrillation, atrioventricular nodal reentrant tachycardia (AVNRT) and atrioventricular reentrant tachycardia (AVRT) were not documented within our patient population (Table-2).

The study's echocardiographic findings reveal normal left ventricular systolic and normal ejection fraction (EF) in 198 (89%) patients. Similarly, right ventricular assessment showed normal function in majority (n=160; 72%), with mild dysfunction reported in 52 (23%) subjects (Table- II).

The outcome variables assessed in the study included in-hospital mortality, length of hospitalization and occurrence of complications, and are presented in Table III. Mortality was observed in 36 (16.3%) of the cases. Majority of the patients (n=82; 37.1%) needed 3-4 days hospital stay, followed by 34.4% (n=76) requiring 4-6 days of hospitalization.

The Table-IV presents the association between cardiac arrhythmia and various outcome variables, including mortality, length of stay, CURB-65 score, and PSI score. 19 patients (51.3%), out of 37 patients with arrhythmia, died during hospital stay, which indicates a significant association between cardiac arrhythmia and mortality (p-value < 0.001). Regarding length of stay (LOS), 16 patients (43.2%) with arrhythmia needed hospitalization for 3-4 days, while 15 patients (40.5%) remained admitted for 4-5 days. This shows statistically significant association, indicating that patients with cardiac arrhythmia required a longer length of stay (p-value = 0.002). Additionally, CURB-65 score and PSI score indicated that patients admitted with higher severity scores of pneumonia were more prone to developing cardiac arrhythmia (p-value < 0.001 for CURB 65 and 0.012 for PSI score) (Table-IV).

Table-I: Demographic characteristics, co-morbid conditions and severity scores of patients admitted with community acquired pneumonia (n=220).

Demographics Characteristics	n (%)
Age, Years (Mean ± SD)	66.3±12.7
Gender	
Male	142 (64.3%)
Female	78 (35.3%)
Co-morbid conditions	
Diabetes	96 (43.4%)
Hypertension	125 (56.6%)
Ischemic Heart Disease	36 (16.3%)
Chronic Kidney Disease	46 (20.8%)
Stroke	26 (11.8%)
Smoking	
Current	46 (20.8%)
Former	34 (15.4%)
Never	140 (63.3%)
Obstructive Airway Disease	
Asthma	34 (15.4%)
COPD	52 (23.5%)
Bronchiectasis	13 (5.9%)
Interstitial Lung Disease	20 (9.0%)
Prior History of Pulmonary Tuberculosis	16 (7.2%)
Pneumonia severity scores	
CURB-65	
Low severity (0-1)	67 (30.5%)
Moderate severity (2)	55 (25.0%)
High severity (3-5)	98 (43.6%)
PSI	
Class I (<51 points)	7 (3.2%)
Class II (51-70)	11 (5.0%)
Class III (71-90)	48 (21.7%)
Class IV (90-130)	76 (34.4%)
Class V (>130)	78 (35.3%)

Table 2- Frequency of arrhythmias and echocardiographic characteristics of patients admitted with Community-acquired Pneumonia (n=220).

Cardiac Arrhythmias	n (%)
Yes	37 (16.7%)
No	183 (82.8%)
Type of Arrhythmias	
Atrial Fibrillation	20 (9.0%)
Atrial Flutter	04 (1.8%)
Multifocal Atrial Tachycardia	06 (2.7%)
Supraventricular Tachycardia	03 (1.4%)
AVRT/AVNRT	00 (0%)
Ventricular Tachycardia	02 (0.9%)
Ventricular Fibrillation	00 (0%)
Pulseless Electrical Activity	02 (0.9%)
Echocardiographic parameters	
Left Ventricular Systolic Dysfunction	
Normal	198 (89%)
Mild (EF 41-49%)	06 (2.7%)
Moderate (31-40%)	13 (5.9%)
Severe (EF <30%)	03 (1.4%)
Left Ventricular Diastolic Dysfunction	
Normal	125 (56.8%)
Grade I	63 (28.6%)
Grade II	30 (13.6%)
Grade III	02 (0.9%)
Right Ventricular Dysfunction	
Normal	161 (72%)
Mild	52 (23%)
Moderate	07 (3.2%)
Severe	00 (0.0%)
Pulmonary Artery Hypertension	
None	160 (72.7%)
Mild (mean PAP 25-35mm Hg)	40 (18.1%)
Moderate (mean PAP 35-45mm Hg)	12 (5.4%)
Severe (mean PAP >45mm Hg)	08 (3.6%)

Table-III: Characteristics of clinical outcomes of patients including mortality, length of stay and occurrence of complications in study population (n=220).

Outcome Variables	n (%)
Mortality	36 (16.3%)
Length of stay	
1-2 Days	32 (14.5%)
3-4 Days	82 (37.1%)
4-6 Days	76 (34.4%)
>6 Days	30 (13.6%)
Complications	
Sepsis/shock	36 (16.3%)
Pleural Effusion	65 (29.4%)
Empyema	5 (2.3%)
Pneumothorax	6 (2.7%)
ARDS	10 (4.5%)
Lung Abscess	8 (3.6%)
Acute Kidney Injury	75 (34%)
Multi-organ Failure	5 (2.3%)

Table-IV: Association between cardiac arrhythmias and multiple variables

Outcome variable	Patients with cardiac arrhythmia *n*=37	Patients without cardiac arrhythmia n=183	P-value
Mortality	19 (51.3%)	17 (9.29%)	<0.01
Length of Stay			
1-2 Days	02 (5.4%)	30 (16.4%)	
3-4 Days	16 (43.2%)	66 (36%)	<0.01
4-5 Days	15 (40.5%)	61 (33.3%)	
>6 Days	04 (10.8%	26 (14.2%)	
CURB-65			
Low severity (0-1 points)	02 (5.4%)	65 (35.5%)	
Moderate severity (2points)	00 (0%)	55 (30.1%)	<0.01
High severity (3-5 points)	35 (94.6%)	63 (35.4%)	
PSI score			
Class I (<51 points)	00 (0%)	07 (3.8%)	
Class II (51-70 points)	00 (0%)	11 (6.0%)	0.012
Class III (71-90 points)	04 (10.8%)	44 (24%)	
Class IV (90-130 points)	19 (51.4%)	57 (31.1%)	
Class V (>130 points)	14 (37.8%)	64 (35.0%)	

DISCUSSION

This study demonstrated that patients admitted with community-acquired pneumonia (CAP) face a significant risk of developing cardiac arrhythmias. Among all rhythm abnormalities, atrial fibrillation was the most common, followed by multifocal atrial tachycardia and atrial flutter. These findings align with previous studies, which consistently show that atrial fibrillation is the most frequent arrhythmia in CAP patients worldwide and significantly impacts their morbidity and mortality. [5,6,8] In a prior multicenter study in Italy, atrial fibrillation was identified as the second most common cardiac complication of pneumonia, affecting 9.2% of patients, just after heart failure, which was observed in 23.8% of patients.[14]

Similar results have been reported in research from East Asia. A large cohort study of nearly 35,000 patients in Taiwan revealed that individuals with pneumonia had a 4.08-fold higher risk of developing atrial fibrillation compared to those without pneumonia.[15] Moreover, a recent study at Rawalpindi Medical University in Pakistan found that 17.3% of CAP patients developed cardiac arrhythmias during their hospitalization[10]. Another study in India reported a 21.9% incidence of arrhythmias in CAP patients.[16] These results are consistent with the findings of our study.

The evaluation of disease severity using the CURB-65 and PSI scoring systems[17] revealed that a significant proportion of patients had moderate to high severity scores, indicating a higher risk of adverse outcomes such as complications, prolonged hospitalization, and mortality. These results underscore the importance of accurate patient triage at the time of admission, with careful assessment of pneumonia severity, followed by optimized management to prevent complications and reduce mortality.

We monitored patients for underlying cardiac abnormalities to examine any association between new-onset cardiac arrhythmia and pre-existing cardiac dysfunction. Our findings indicated that community-acquired pneumonia (CAP) is an independent risk factor for the development of new-onset cardiac arrhythmia in patients with severe pneumonia. A meta-analysis by Corrales-Medina *et al*. revealed that 18% of all patients admitted with pneumonia developed cardiovascular complications, regardless of their underlying cardiac function.[18]

Consistent with the findings of our study, previous research has also shown that cardiac arrhythmias are linked to increased mortality in patients hospitalized with community-acquired pneumonia. Musher DM *et al*. reported that short-term mortality was significantly higher in CAP patients who experienced cardiovascular events compared to those who did not (17.6% vs 4.5%, $P < 0.001$).[19] Additionally, Shaver CM *et al*. found that atrial fibrillation was an independent risk factor for increased hospital mortality in patients with CAP.[20]

Given the burden of disease in our low socioeconomic country, this study highlights the critical need for clinicians to recognize the significance of pneumonia-related complications, particularly cardiac arrhythmias. Timely identification during the initial hours is crucial in preventing overall mortality. In order to minimize the risk of pneumonia and its associated complications,

pneumococcus as well as yearly influenza vaccinations should be administered to the high-risk groups.

Our study has limitations. First, we did not follow the patients after discharge which could mean missing late-onset arrhythmias, long term cardiopulmonary sequelae and post-discharge mortality. Secondly, we also did not have a control group, which makes it challenging to determine whether observed arrhythmias were directly related to pneumonia rather than other factors. Third, our study was a single-centre study having a small sample size. Therefore, further research is warranted to gauge applicability of the findings to other regions with different healthcare practices or population characteristics.

CONCLUSION

This study exhibited that 36 patients admitted with community acquired pneumonia, developed cardiac arrhythmia, of which atrial fibrillation was found to be the most common. Development of cardiac arrhythmia was associated with high disease severity, greater length of hospitalization and poor outcomes in terms of complications and in-hospital mortality.

CONFLICT OF INTEREST

None

GRANT SUPPORT & FINANCIAL DISCLOSURE

Declared none

AUTHOR CONTRIBUTION

Umama Ameen: Idealized and conceptualized the study, manuscript writing, final approval, agreement to be accountable for all aspects of the work

Muhammad Irfan: Data interpretation, Data analysis, manuscript writing, final approval, agreement to be accountable for all aspects of the work

Ali Bin Sarwar Zubairi: Reviewing it critical for important intellectual content, final approval, agreement to be accountable for all aspects of the work

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