

Community Acquired Pneumonia; Chest X-Ray Findings in Three Different Times

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Abstract

Introduction: community acquired pneumonia is common health problem with concerns regarding chest-X-ray findings in different occasions during the disease course. The aim of this study is to compare chest-X-ray findings at presentation, 3 days and 6 weeks after presentation.

Methods: A prospective, observational study was conducted. The consecutive cases of single center were collected from January 2016 to January 2017. The diagnosis was made whenever there was new infiltrate in the CXR with compatible clinical features. All patients with nosocomial infection were excluded from the study. The included data were demographic characters, history, clinical examination, and CXR findings.

Results: The study included 60 patients, 44(73.3%) were male while 16(26.7%) were female. The age of the patients ranged from 19 to 87 years with a mean age of 57.81 years. Chronic obstructive pulmonary disease (COPD) is the most concomitant respiratory disease (11, 18.3%), followed by asthma (9, 15%), and pulmonary fibrosis (9, 15%), other 6 cases (10%) had history of bronchogenic carcinoma, while pulmonary tuberculosis (TB) was found in 3 cases (5%). Cough was the most common presenting symptom which was found in all the cases (60, 100%). Smoking did not correlated with the CXR findings significantly at presentation, 3 days and 6 weeks post complaint (P-value 0.189,0.185 , 0.265 respectively). The most common side of affection was right upper zone which was found in 20 (33.3%) cases. Severity of the CAP significantly related to the pattern of pulmonary involvement which was evident in the CXR (P-value 0.000).

Conclusion: community acquired pneumonia is usually diagnosed by compatible clinical presentation and radiological characteristics. Timing of CXR influences its role in both diagnosis and follow up.

Keywords: *Community acquired pneumonia, chest-X-ray, timing, cough.*

Introduction

Community acquired pneumonia (CAP) is described as the development of symptoms and signs of pneumonia (such as cough, fever of >38.5 C, and respiratory distress) in a patient with a previous healthful condition due to an infection with a microorganism which has been gained outside the hospitals¹. It is a common health problem and a frequent cause of hospitalization². Globally, its incidence ranges from 150 to 1500 cases in each 100 000 persons per year with an annual mortality rate of 0.02%². As far as its clinical presentation varies, the

diagnosis depends on the radiological findings despite of limitation in sensitivity and specificity. The Chest-X-ray (CXR) reveals new parenchymal infiltrate in different pulmonary locations with or without complications like cavitation, lung abscess, or plural effusion^{2,3}. The most common scoring system used to evaluate the severity of the condition is Confusion, Urea, Respiratory rate, Blood pressure, 65 (65-CURB)⁴. The list of the differential diagnosis is long, being atelectasis, underlying vascular and bronchial diseases³.

Due to the crucial relevance of CXR to the condition as a first line diagnostic image in CAP and its critical role as a predictor of the various complications and mortality, it is worthy to examine and interpret CXR findings in different times during the disease period². The aim of this study is to present and discuss the CXR findings

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of the cases with CAP in three different occasions (at presentation, day 3 and week 6).

Method

Study design and setting:

A prospective, observational study was conducted. The consecutive cases of single center were collected from January 2016 to January 2017.

Participant selection and data collection:

Those cases with clinical and radiological features consistent with CAP were included in the study. The diagnosis was concerned whenever there was new infiltrate in the CXR with compatible clinical features. The compatible clinical features were defined as fever (temperature more than 38 centigrade) or hypothermia (temperature less than 36 centigrade), dyspnea, pleuritic chest pain, cough, with or without sputum. Findings on clinical examination which were compatible the diagnosis were cyanosis, tachypnea (respiratory rate: more than 25 breaths/minute), use of accessory muscles of respiration, and added sound like wheeze and crackles. All patients with nosocomial infection were excluded from the study. The collection of the data were performed in the form of interview and form. The data included demographic characters, history, clinical examination, and CXR findings. The data used to support the findings of this study are included within the supplementary information file.

Data analysis:

The data were transferred from the forms into the Statistical Package for the Social Sciences (SPSS) after coding. Descriptive analysis (mean, range, standard deviation and percentage) were used to describe the sample. Chi square test was calculated to determine the relationship between categorical data, and paired T-test was analyzed to determine the relationship between the numerical data whenever necessary. Two-tailed fashion was used for all tests. The level of significance was set at 0.05.

Results

The study included 60 patients, 44(73.3%) were male while 16(26.7%) were female (male to female ratios 2.75: 1). The age of the patients ranged from 19 to 87 years with a mean age of 57.81 years and standard deviation of 20.04. Thirty-eight patients (63.3%) were living inside the cities and others (22, 36.7%) came from the rural areas. Regarding smoking history; 23 patients (38.3%) have never smoked, 9 patients (15%) were social smokers, 4 patients (6.7%) were passive smokers, others (24, 40%) were ex-smoker. Among the latter, 14 patients (58.3%) smoked more than 20 pack-years, and 10 patients (41.7%). Forty patients (66.7%) have never drunk alcohol, 12 (20%) were drinker, and 8 patients (13.3) were ex-drinker. Eleven patients (18.3%) had history of recent traveling. Chronic obstructive pulmonary disease (COPD) is the most concomitant respiratory disease (11, 18.3%), followed by asthma (9, 15%), and pulmonary fibrosis (9, 15%), other 6 cases (10%) had history of bronchogenic carcinoma, while pulmonary tuberculosis (TB) was found in 3 cases (5%). Cough was the most common presenting symptom which was found in all the cases (60, 100%), Table 1.

Table 1: Shows the frequency of the symptoms at the time of presentation.

Variables	Numbers (%)
Cough	60 (100%)
Sputum	58 (96.7)
Fever	53 (88.3)
Shortness of breath	29 (48.3)
Chest pain	22 (36.7)
Hemoptysis	13 (21.7)

The most frequent 65-CURB score was score 1, figure1.

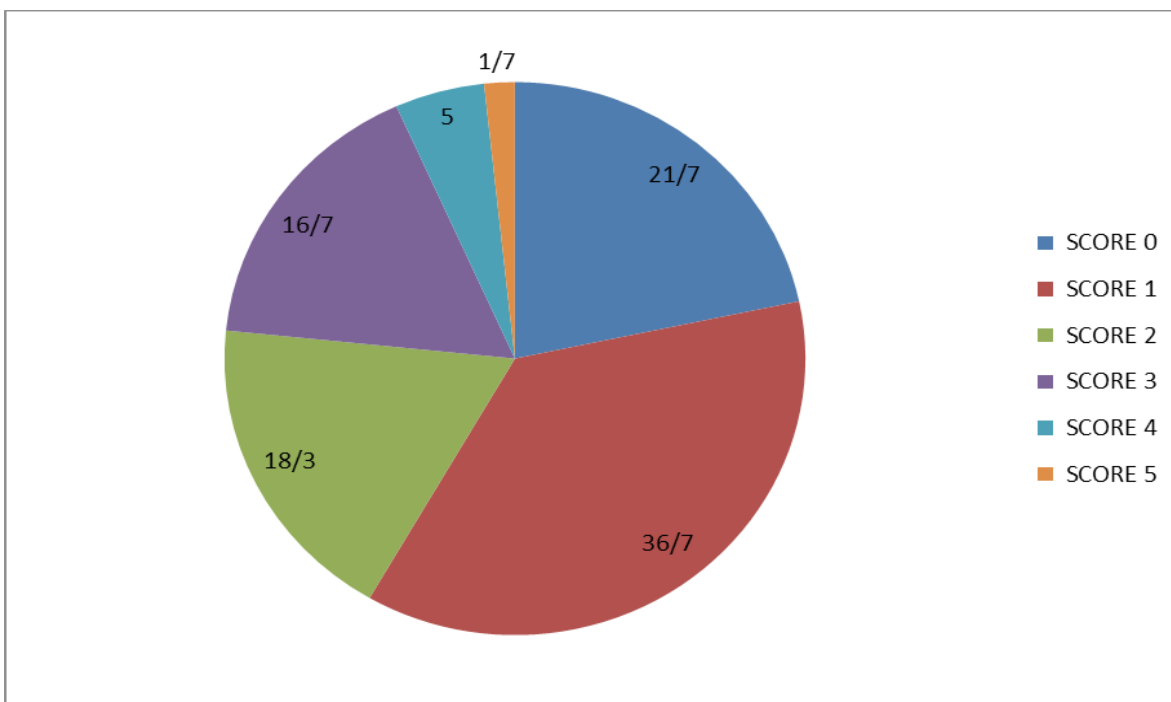


Figure 1: distribution of the patients according to the 65-CURB.

Smoking did not correlated with the CXR findings significantly at presentation, 3 days and 6 weeks post complaint (P-value 0.189,0.185 , 0.265 respectively).

The most common side of affection was right upper zone which was found in 20 (33.3%) cases, table 2.

Table 2: chest x-ray findings on presentation.

CXR on Presentation	Number (%)
Right upper zone	20(33.3)
Right middle zone	23(38.3)
Right lower zone	16(26.6)
Left upper zone	7(11.6)
Left middle zone	9(15)
Left lower zone	7(11.6)

Severity of the CAP significantly related to the pattern of pulmonary involvement which was evident in the CXR (P-value 0.000) table 3.

Table 3: severity of the CAP and CXR findings.

CXR on Presentation	65-CURB N(%)						P value
	0	1	2	3	4	5	
Right upper zone	3(5)	6(10)	2(3.34)	0(0)	0(0)	0(0)	0.000
Right middle zone	4(6.66)	4(6.66)	1(1.66)	1(1.66)	0(0)	0(0)	
Right lower zone	1(1.66)	4(6.66)	1(1.66)	1(1.66)	0(0)	0(0)	
Left upper zone	2(3.33)	2(3.33)	1(1.66)	1(1.66)	0(0)	0(0)	
Left middle zone	2(3.33)	2(3.33)	1(1.66)	0(0)	0(0)	0(0)	
Left lower zone	0(0)	2(3.33)	0(0)	0(0)	0(0)	0(0)	
Left (middle zone , lower zone)	0(0)	0(0)	0(0)	1(1.66)	0(0)	0(0)	
Left (upper zone , middle zone)	0(0)	0(0)	0(0)	1(1.66)	0(0)	0(0)	
Right (upper zone , middle zone)	0(0)	2(3.34)	2(3.33)	3(5)	1(1.66)	0(0)	
Right (middle zone , lower zone)	0(0)	0(0)	1(1.66)	1(1.66)	0(0)	0(0)	
Right lower zone , Left lower zone	0(0)	0(0)	2(3.33)	0(0)	1(1.66)	0(0)	
Right lower zone left(middle zone , lower zone)	0(0)	0(0)	0(0)	0(0)	1(1.66)	0(0)	
Right (middle zone , lower zone), Left lower zone	0(0)	0(0)	0(0)	1(1.67)	0(0)	0(0)	
Right (middle zone , lower zone), left middle zone	0(0)	0(0)	0(0)	0(0)	0(0)	1(1.66)	
right upper zone , middle zone, lower zone	1(1.66)	0(0)	0(0)	0(0)	0(0)	0(0)	

CXR was positive in all of the cases on presentation, at 3 day follow up, 35% showed complete resolution, 25% improved, 31.7% did not reveal any change, while 8.3% deteriorated. At 6 weeks, 55% showed complete resolution, 35% improved, 6.7% did not reveal any change, while 3.3% deteriorated. Resolution of the CXR was significantly related to the initial pattern of the chest involvement (P-value = 0.002), table 4.

Table 4: Relation of CXR findings at 3 days and 6 weeks with the initial pattern of chest involvement.

CXR on Presentation	Follow Up CRX at 3 days and 6 weeks				P value
	Improvement	Complete resolution	No changes	Deterioration	
	N 3 days/6 weeks				
Right upper zone	6/1	4/9	1/1	0/0	0.002
Right middle zone	1/1	8/9	1/0	0/0	
Right lower zone	2/3	2/3	2/1	1/0	
Left upper zone	2/2	3/4	1/0	0/0	
Left middle zone	1/0	3/4	1/1	0/0	
Left lower zone	0/1	1/1	1/0	0/0	
Left (middle zone , lower zone)	0/1	0/0	1/0	0/0	
Left (upper zone , middle zone)	1/1	0/0	0/0	0/0	
Right (upper zone , middle zone)	1/4	0/3	4/0	3/1	
Right (middle zone , lower zone)	0/2	0/0	1/0	1/0	
Right lower zone , Left lower zone	0/2	0/0	3/1	0/0	
Right lower zone left(middle zone , lower zone)	0/1	0/0	1/0	0/0	
Right (middle zone , lower zone), Left lower zone	1/1	0/0	0/0	0/0	
Right (middle zone , lower zone), left middle zone	0/0	0/0	1/0	0/1	
right upper zone , middle zone, lower zone	0/1	0/0	1/0	0/0	

Discussion

Community acquired pneumonia occurs more commonly in male patients. In the study of Bruns et al, 66% of their patients were male⁵. Monkada and colleagues reported 55.5% male predominance ². Even in pediatric population, the picture remains the same. In their prospective study, Michelow, and associates reported a male to female ratio of about 1.7: 1 in pediatric age group ⁶. In the current study, the ratio of male to female was 2.75:1. The high rate of male affection in CAP is not well understood. Smoking may play a role but this argument is challenged by the high incidence of CAP in pediatric population⁶.

Smoking has been recognized as a risk factor of CAP. A person with smoking history has at least two folds increased risk of CAP compared to the healthy population ⁷. Generally, there are three theories behind the increased risk of CAP in the smokers. First, structural and physiological changes induced by the tobacco.

Second, increasing bacterial virulence by the tobacco. Lastly, disturbance of the immune system by the tobacco ⁸. In this study, 35 cases (55%) were either current or ex-smoker. Although there is no comparison group, this may comply with the international standard.

Excessive use of alcohol is another well-known risk factor for development of CAP, it has a crucial impact on the complication and outcome, and it prolongs the hospital stay ¹⁰. In the present study, 20 patients (33.3%) were either current or ex-drinker. Patients with COPD have an increased risk for developing CAP by fourfold. This is independent of smoking history. The increased risk of CAP in cases of COPD is confirmed but the mechanism is not well understood ⁷. In the current study, the most common comorbid disease accompanying CAP was COPD being recognized in 11 patients (18.3%).

The symptoms of CAP include but not limited to cough, hypo or hyperthermia, sputum, lethargy, chest pain, shortness of breath, palpitation and in the severe

form, it may present with disturbed level of consciousness⁵. In the study of Monkada and associates, the most common presenting symptoms were cough (97.8%), shortness of breath (87.5%) and chest pain (63.5%)². In the present study, cough was the most common symptoms found in all the patients (100%). The second most common symptom was sputum (96.7%), followed by fever (88.3%) and shortness of breath (48.3%).

Chest-x-ray is a simple and handy diagnostic image. It is not only used to diagnose CAP but also to exclude other conditions which may present with similar signs and symptoms¹⁰. Timing of CXR is another crucial consideration by some authors^{5,11}. Claessene and associates revealed the low sensitivity and specificity of CXR in the early course of the disease development. They examined the diagnostic accuracy of early CXR in CAP against chest computed tomography scan (CT-scan). In their experiment, CXR illustrated a parenchymal infiltration in 188 patients (61%). The diagnosis initially was categorized as definite in 44.8% of the cases, possible or probable in 53.8%, and it was excluded in 4 patients (1.2%). CT-scan showed a parenchymal infiltration in 40 cases (33%) who were initially labeled as infiltration-free on CXR and it excluded CAP in 29.8% of the 188 patients with parenchymal infiltration revealed by CXR. CT-scan modified the categorization in 187 (58.6%), leading to exclusion of 28.8% and 50.8% definite cases of CAP¹¹.

In the study of Bruns and colleagues, clearance of CXR infiltrate in patients with CAP occurred in the 7th day in 25% of the cases, this ratio increased to the 50% in the fourth weeks of follow up. Findings like high respiratory rate, dullness to percussion, high C-reactive protein (CRP) level, and multilobar disease were shown to be independent predictors for CXR findings in the 7th day of follow up, while only a high CRP level at the presentation was found to be a predictor for delayed clearance of CXR abnormalities in the 28th day¹¹. In the current study, CXR was positive in all of the cases on presentation, at 3 day follow up, 35% showed complete resolution, 25% improved, 31.7% did not reveal any change, while 8.3% deteriorated. At 6 weeks, 55% showed complete resolution, 35% improved, 6.7% did not reveal any change, while 3.3% deteriorated. In both timelines, early pattern of chest involvement on CXR was the predictor of deterioration (the more severe early involvement, the higher chance to deteriorate).

Monkada and his colleagues denied that the CXR findings would expect the severity of the disease and predict and outcome². The result of this study revealed the reverse of this conclusion. Chest-X-ray findings on presentation significantly related to the severity of the score (65-CURB) and consequently, the outcome of the disease.

There are few limitations for CXR in the diagnosis of CAP. First of all, it is almost normal in the early stage of the disease. From this perspective, some authors recommend early chest CT-scan to diagnose and predict the outcome¹¹. Secondly, it necessitates a radiation exposure¹⁰. Thirdly, sensitivity and specificity depend on the quality of the images and experience of the inspectors (interobserver and intraobserver disagreement). Fourthly, there is no correlation between the CXR findings and the etiology of the infection. It does not differentiate viral from bacterial infection³.

In conclusion, CAP is usually diagnosed by compatible clinical presentation and radiological characteristics. Timing of CXR influences its role in both diagnosis and follow up.

Conflict of Interest: Not

Ethical Clearance: The study was approved by the Ethics Committee of the College of Medicine, University of Sulaimani, Kurdistan Region, Iraq.

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