

A Comparative Study of Clinical and Paraclinical Findings of Elderly and Non-Elderly Patients With Acute Pneumonia and Pneumosepsis

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Abstract- Accurate diagnosis and timely treatment of pneumonia, as one of the most common infectious diseases in elderly patients, require careful attention to the clinical and paraclinical findings, which may be different between the elderly and non-elderly patients. The aim of the present study was to compare the clinical, laboratory, and radiological findings of elderly and non-elderly patients with pneumonia and pneumosepsis. This cross-sectional study was performed on 97 elderly and 93 non-elderly patients with pneumonia, admitted to Sina hospital in Hamadan, west of Iran, in 2017. Patients in both groups were also compared in terms of the underlying diseases, sepsis rate, electrolyte disturbances and CURB-65 criteria. All underlying diseases, except for HIV infection, in addition to clinical findings such as tachypnea, lethargy, decreased consciousness, hypotension, and respiratory alkalosis were significantly more common in the elderly, compared to the non-elderly group. In the elderly group, the average length of hospital stay, sepsis rate, and mortality rate were 9.4 days, 74.2%, and 21.7%, respectively versus 6.2 days, 46.3%, and 3.2%, respectively in the non-elderly group. Patients in the two groups were significantly different in terms of CckURB-65 criteria and radiological findings. For the timely diagnosis of pneumonia and pneumosepsis in the elderly, it is necessary to consider any alteration in respiratory rate and consciousness status. Also, for proper treatment, the clinicians should pay attention to the existence of any comorbidities and electrolyte disturbances.

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Introduction

Infectious diseases are the most prominent cause of hospitalization in medical centers. Elderly people, who comprise a large and growing proportion of the population in all countries around the world, are susceptible to infections more than other age groups. The higher susceptibility and incidence of infectious diseases in this population are attributed to factors, such as humoral and cellular immune impairments, changes in physiological functions (e.g., reduced cough reflex, circulatory disorders, and slow wound healing), increased prevalence of underlying chronic diseases, and use of immunosuppressive drugs (1-4).

Mortality and hospitalization due to infectious diseases have significantly increased in this population

(5).

The incidence of community-acquired pneumonia (CAP) as one of the most important causes of hospitalization and mortality is about 20-30% in developing countries and 3-4% among developed countries. CAP is 50 times more common among the elderly over 75 years, compared to people aged 15 to 19 years. In a previous study, 20% of hospitalized elderly patients with CAP died three months after admission; this rate was twice higher than that of the non-elderly group (1).

Furthermore, the risk of hospitalization, subsequent complications (such as nosocomial infections), side effects of drugs, and mortality is known to be higher in elderly patients. In attention to the reduced physiologic response of elderly patients to infections and the

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subsequent delay in diagnosis and treatment, their morbidity and mortality are high (1,6,7). Since the unusual manifestations of infections, including pneumonia and sepsis, are common in the elderly, any acute changes in the functional status can indicate the onset of an infectious disease. In these cases, cognitive changes may occur, even without the involvement of the central nervous system (CNS) and fever is less likely (6-8).

The clinical manifestations of pneumonia can vary from mild to life-threatening diseases. Patients, in general, present with fever and tachycardia. In some cases, pleuritic chest pain, along with tachypnea and shortness of breath, has been reported. Moreover, breath sounds, including crackle, bronchial sounds, and possibly pleural friction rubs, may be documented in auscultation. Furthermore, an altered state of consciousness is one of the most common critical manifestations of pneumonia in the elderly (9).

The typical symptoms of acute pneumonia include productive cough, fever, pleuritic chest pain, shortness of breath, nausea, vomiting, and less frequently, diarrhea. However, these typical symptoms may not be seen in the elderly, especially those over the age of 80 years. A chest X-ray is, therefore, an accurate diagnostic tool for the diagnosis of pneumonia (10,11).

The mortality rate of the elderly population with acute pneumonia ranges between 10% and 30%, which is higher than the rate reported in other age groups. Some conditional states such as chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), diabetes mellitus (DM), chronic renal failure (CRF), cerebrovascular accidents (CVAs), malignancies, immune system suppression, and high CURB score are considered as risk factors for mortality (12). Clinical manifestations, along with chest X-ray findings, are often needed to diagnose pneumonia. Sputum smear and blood culture are more commonly used in hospitalized cases of pneumonia (9).

On the other hand, non-specific clinical manifestations of sepsis in elderly patients due to any sources can increase the rate of mortality due to delayed timely diagnosis and proper treatment (8,13,14).

Considering the importance of pneumonia as one of the most common causes of hospitalization in the elderly, besides the increasing aging rate in recent years, it is obvious that timely diagnosis and treatment can play a major role in reducing the rate of morbidity, mortality, length of hospital stay, and medical expenses. An accurate diagnosis requires careful attention to the clinical and paraclinical findings, which may be

different between the elderly and non-elderly patients. Therefore, the aim of this study was to compare the clinical, laboratory, and radiological findings of acute pneumonia in the elderly and non-elderly patients.

Materials and Methods

This cross-sectional and prospective study was conducted among hospitalized elderly (65 years or older) and non-elderly patients (1,6) with acute pneumonia, who was admitted to Sina Teaching Hospital in Hamadan, west of Iran, in 2017. Considering the reported prevalence of pneumonia in an elderly population in a previous study (15), a sample size of 190 was estimated. Acute pneumonia was defined as a combination of radiological pulmonary infiltration with one of the major criteria, including fever, cough, expectoration, or two of the minor criteria (altered mental status, pleuritic pain, dyspnea, leukocytosis, and auscultation abnormality) (16).

Demographic information, clinical manifestations, laboratory results (complete blood cell count, arterial blood gas [ABG], alanine aminotransferase, blood urea, creatinine, and electrolytes), radiological findings, and data related to comorbidities, such as CHF, DM, CRF, CVA, and hypertension (HTN), were recorded in the checklists. The data were compared between the elderly and non-elderly groups. The CURB-65 criteria (12) and severity of sepsis (sepsis, severe sepsis, and septic shock) (13) were also studied and compared between the two groups.

Ethical considerations

This study was approved by the ethics committee of Hamadan University of Medical Sciences (code, IR.UMSHA.REC.1394.452).

Statistical analysis

All statistical analyses were performed in SPSS version 16.0 (SPSS Inc., Chicago, IL, USA). Quantitative data are presented as mean and standard deviation (SD), and qualitative data are presented as percentages and frequency. For quantitative variables with a normal distribution, student t-test was applied, while the Mann-Whitney U test was performed for quantitative variables without normal distribution. A *Chi-square* test was also applied for qualitative variables. *P* less than 0.05 were considered statistically significant.

Results

In this study, 97 elderly patients with acute pneumonia (mean age, 78 ± 7.9 years), as well as 93 non-elderly patients with acute pneumonia (mean age, 42.9 ± 14.2 years), were recruited. In total, 50 (51.5%) elderly and 59 (63.4%) non-elderly patients were male ($P=0.097$). The length of hospital stay in the elderly and non-elderly groups was 9.4 ± 7.5 and 6.2 ± 3.9 days, respectively ($P=0.001$). Based on the findings, 24 out of 190 (12.3%) patients died, including 22% of the elderly and 2.3% of the non-elderly patients ($P=0.001$).

The findings indicated that 24 (32.4%), 47 (63.5%), and 3 (4.1%) elderly patients, as well as 25 (55.6%), 20 (44.4%), and 0 (0%) non-elderly patients, had sepsis, severe sepsis, and septic shock, respectively ($P=0.010$). All three patients with septic shock, 16 patients with severe sepsis, and two patients with sepsis died ($P=0.010$); three of the patients who died had no characteristics of sepsis. Also, 64 (33.7%) patients had only one underlying disease, while 48 (25.26%) patients had two or more underlying diseases (Table 1).

Table 1. Distribution of conditional diseases in elderly and non-elderly groups

	Elderly	Non-elderly	<i>P</i>
	Number(percent)	Number(percent)	
Diabetes mellitus	19(19.6)	5(5.4)	0.003
HTN	46(47.4)	8(8.6)	0.001
Stroke	19(19.6)	3(3.2)	0.001
Malignancy	4(4.1)	4(4.3)	0.616
COPD/Asthma	20(20.6)	12(12.9)	0.155
HIV	0(0)	6(6.4)	0.013
Cardiovascular	26(26.8)	13(14)	0.029
Without condition	58(74.4)	20(25.6)	0.001

HTN: hypertension; COPD: Chronic obstructive pulmonary disease

There was no significant relationship between the number of underlying diseases and mortality. No significant difference was also observed in diastolic blood pressure (DBP), heart rate (HR), and fever

between the groups. Meanwhile, the average systolic blood pressure of elderly patients was higher than non-elderly ($P=0.030$) (Table 2).

Table 2. Frequency of clinical manifestations in the elderly and non-elderly patients with acute pneumonia

	Elderly	Non-Elderly	<i>P</i>
	Number(percent)	Number(percent)	
Fever	64(65.9)	67(72.1)	0.367
Cough	92(94.8)	88(94.6)	0.945
Sputum	79(81.4)	80(86.1)	0.393
Bloody sputum	5(5.1)	19(20.4)	0.002
Chest pain	14(14.4)	29(31.2)	0.006
Dyspnea	66(68.1)	56(60.2)	0.261
Headache	7(7.2)	17(18.3)	0.022
Myalgia	8(8.2)	24(25.8)	0.001
Diarrhea	2(2.1)	4(4.3)	0.437
Vomiting/nausea	15(15.5)	14(15.1)	0.937
Weakness	25(25.8)	14(15.1)	0.067
Consciousness deficit	41(42.3)	10(10.7)	0.001
Respiratory rate >24	46(47.2)	16(17.2)	0.000

The frequency of bloody sputum, muscle pain, and the headache was higher in the non-elderly group ($P<0.05$). Fever, shortness of breath, and cough were

seen simultaneously in 80 patients, including 38 elderly and 31 non-elderly patients ($P=1.00$). There was no significant difference in the erythrocyte sedimentation

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rate (ESR) and C-reactive protein (CRP) level between the two groups (Table 3). The groups were significantly different in terms of the CURB-65 score (Table 4), radiological findings (Table 5), and ABG level (Table 6).

Table 3. Frequency of paraclinical finding in the elderly and non-elderly patients with acute pneumonia

	Elderly(97) Number(percent)	Non-Elderly(93) Number(percent)	P
leukocytosis	50(51.5)	41(44.1)	0.52
leukopenia	9(9.3)	12(12.9)	
Elevated BUN	50(51.5)	18(19.4)	0.000
Thrombocytopenia	26(26.8)	15(16.1)	0.07
Elevated creatinin	32(33)	11(11.8)	0.000
Hyponatremia	14(14.4)	7(7.5)	0.004
Hypernatremia	15(15.4)	3(3.2)	
Hypokalemia	10(10.3)	7(7.5)	0.19
Hyperkalemia	9(9.3)	3(3.2)	
Hyperbilirubinemia	5(5.2)	6(6.5)	0.7

Table 4. comparison of CURB65 between elderly and non-elderly groups

	Elderly (97)	Non-Elderly (93)	P
Consciousness deficit	41(42.3%)	10(10.7%)	0.001
Urea/BUN \geq 19.1	68(70.1)	21(22.5)	0.001
Respiratory Rate \geq 30	18(18.6)	5(5.4)	0.005
Systolic blood pressure $<$ 90	5(5.2)	2(2.2)	0.27
Diastolic blood pressure $<$ 60	2(2.1)	2(2.2)	0.96

Table 5. Radiologic findings of elderly and non-elderly patients with acute pneumonia

	Elderly(92)	Non Elderly(82)	P
Normal	8(8.7)	11(13.4)	
Multi lobar	10(10.9)	10(12.2)	
Lobber	11(12)	22(26.8)	0.040
Reticulo-noduler	19(20.7)	12(14.6)	
Patchy.inf	41(44.6)	22(26.8)	
Other(nonspecific)	3(3.3)	5(6.1)	

Table 6. Acid-base disorders in elderly and non-elderly patients with acute pneumonia

	Elderly(67)	Non elderly(44)	P
Normal	20(30.8)	22(47.8)	
Respiratory alkalosis	25(38.5)	20(43.5)	
Metabolic acidosis	5(7.7)	0(0)	0.006
Compensated respiratory Alkalosis	10(15.4)	0(0)	
Other	5(7.7)	4(8.7)	

The findings showed that 33 (36.3%) elderly and 6 (5.7%) non-elderly patients with pneumonia had parapneumonic effusion ($P=0.01$). Radiographic involvement was greater in the right lung than the left lung in 67 cases versus 33 cases with greater left lung involvement. In 50 patients, there was no significant difference in the involvement of the right and left lungs. Based on the results, 1, 9, 5, and 7 patients died with

normal ABG, respiratory alkalosis, metabolic acidosis, and respiratory alkalosis with metabolic acidosis compensation, respectively ($P=0.001$).

Discussion

One of the main problems of elderly patients with pneumonia is the lack of timely diagnosis and treatment

due to their atypical symptoms (14,17). These atypical symptoms may lead to the selection of unsuitable non-specific therapies for patients. Vague and variable clinical characteristics of pneumonia in elderly people and insufficient cooperation of these patients with laboratory and radiographic studies pose great challenges to the process of diagnosis, causing a delay in treatment and increased mortality.

There are also other factors, which can independently affect the prognosis of patients and increase their mortality (15,17). In the present study, 48 (25.26%) patients had two or more underlying diseases. HTN, cardiovascular diseases, and COPD/asthma were among the most common underlying diseases. Except for HIV, other underlying diseases were more common in the elderly than younger patients. In a study by Wawruch (18), comorbidities were more common in the elderly, which is in line with the findings of the present study. Additionally, in a study by Momen Heravi, 51.6% of the elderly had more than one underlying disease. In their study, the most common underlying diseases were HTN and DM (19).

In another study performed in 2014, it was observed that 30% of elderly patients had at least one underlying disease (20). It seems that a contributing factor, besides high age, which influences the duration of hospitalization, prognosis, and mortality of patients, is the presence of chronic diseases, such as CVA, DM, and COPD (18,21). In the present study, in line with the study by Harison (22), the hospital stay was significantly longer in the elderly. Nearly 22% of elderly patients died in the current study, while this rate was below 4% in non-elderly patients.

According to a study by Stupka, the mortality of CAP was up to 40% in elderly patients. Age, as an important prognostic factor, along with underlying diseases such as DM and heart failure, contributed to the increased mortality rate (13). Another cause of mortality in the elderly is delayed diagnosis due to the non-specificity or uncertainty of clinical presentations (22). Furthermore, in another study from Australia in 2010, the mortality of the elderly with pneumonia was reported to be 21% (6), which is closely similar to the mortality rate reported in our study (22%).

In the current study, in agreement with the study by Momen and Heravi (19), the most common complaints of patients were cough, sputum, dyspnea, and fever. The prevalence of fever in the elderly group was lower than that of the non-elderly group. Conversely, shortness of breath was observed more frequently in the elderly group than the non-elderly group. In another study,

Faverio *et al.*, reported that pneumonia was not accompanied by increased fever in elderly patients (10). Ahkee *et al.*, also showed that lack of fever and leukocytosis in elderly people with CAP was correlated with mortality (23).

In a study by Fernandez *et al.*, it was found that the elderly group complained of fever less frequently than the non-elderly group (24). In the current study, the incidence of fever in the elderly was lower than that of the non-elderly group, although the difference was not significant. The possible reasons for this finding could be the use of antipyretic drugs before hospital admission in both groups and/or higher risk of atypical pneumonia in non-elderly patients.

There was no significant difference between the elderly and non-elderly groups in terms of cough and sputum. However, the elderly group had weaker cough and less expectorated sputum. These symptoms were overlooked by family members due to the lack of fever symptoms, resulting in late referrals to physicians. The findings of the present study showed that nearly 50% of the elderly and less than 20% of the non-elderly patients had tachypnea, which is similar to the findings of previous studies (24,25).

Among vital signs, tachypnea seems to be a sensitive marker for the diagnosis of lower respiratory tract infections (6) and is a contributing factor for mortality in the elderly (12). Our findings showed that chest pain was twice more prevalent in the non-elderly group. Similarly, in a study by Fernandez and Sabe, elderly people had fewer complaints of pleuritic chest pain, compared to the non-elderly group (24). Extrapulmonary manifestations, including headache, myalgia, and diarrhea, were more common in the non-elderly group, which might be attributed to the higher incidence of atypical pneumonia in this group of patients.

According to the present study, the prevalence of consciousness deficit was four times higher among the elderly. Any changes in the elderly's consciousness status can be an important clinical finding for the diagnosis of infections (10). Acute pneumonia may not be associated with cough, sputum, or fever, but it may have manifestations, such as delirium, poor general condition, and decreased consciousness (25). In a previous study, 45% of elderly patients with pneumonia had different levels of consciousness deficit (6). In another study, elderly people had a lower level of consciousness (24). Moreover, Pieralli *et al.*, found delirium to be an independent factor for the mortality of elderly people (20).

In our study, paraclinical findings indicated that the

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level of white blood cells did not increase in most elderly and non-elderly patients with acute pneumonia. In the elderly group, the absence of leukocytosis resulted in delayed diagnosis and treatment in some cases and increased the rate of mortality (26). CRP is one of the most important markers, which can be valuable in the diagnosis of infections in the elderly (27). The results of this study revealed that the level of this marker was higher in elderly people; however, the difference with the non-elderly group was insignificant. According to Stupka *et al.*, a CRP level above 100 was associated with increased mortality (12).

According to the present study, nearly 75% of the elderly and 45% of the non-elderly patients were admitted with pneumosepsis. Based on the hospital records, the occurrence of sepsis in the elderly group was roughly 10 times higher than that of the non-elderly group (28). Sepsis was also more common among the elderly. Moreover, the presence of underlying diseases and atypical manifestations has been associated with an increased risk of sepsis (8). Advancing age, morbidities, malnutrition, and use of aggressive equipment are among factors influencing the increase in the prevalence of sepsis among the elderly (29). It seems that sepsis is diagnosed with more difficulty in elderly patients due to unclear clinical manifestations, such as fatigue, loss of appetite, changes in consciousness, fever, and absence of leukocytosis (8,13).

In a study by Green *et al.*, there was no significant difference in the incidence of fever between the elderly and non-elderly patients with sepsis (30). Generally, for the timely diagnosis of infectious diseases, it is necessary to perform diagnostic procedures more accurately. If an infectious disease is suspected, it is essential to initiate treatment immediately in order to reduce the risk of mortality. Attention to primary care and preventive procedures, improvement of nutritional status, vaccination (mainly against influenza or pneumococcus), and abstinence from unnecessary intubation can reduce the risk of infection in these patients (31).

Measurement of CURB-65 factors showed that the main contributors to the difference between the two groups were differences in the patients' level of consciousness, serum urea, and respiratory rate, besides age. In a previous study (6), people with a CURB-65 score equal to or greater than three had a mortality rate of 22%, which is consistent with the finding of our study. Lobber's involvement in chest X-ray was significantly lower in elderly patients with pneumonia, compared to non-elderly patients. One reason could be

the higher possibility of non-specific findings in the chest radiography of elderly patients due to other comorbidities, chronic pulmonary diseases, or heart failure (32).

For timely diagnosis and treatment of pneumonia and sepsis in the elderly, any consciousness deficit or tachypnea should be taken into consideration. Owing to the higher incidence of comorbidities and electrolyte disturbances in elderly patients, other contributing factors, in addition to antibiotic therapy, should be considered.

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