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Study of Several Biochemical Factors in Adult Patients with Community-acquired Pneumonia

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Abstract:
Background: Several biochemical factors will be affected in cases of community-acquired pneumonia. This study will focus on a number of these factors, like WBC and platelet count, blood urea, creatinine, hemoglobin levels, ESR, and CRP.
Methods: A total of 76 patients, older than 18 years, were randomly selected without exclusion criteria. This study was done in a private laboratory. For the period between January 2024 and April 2024. Devices like Mindray BC-5800, Finecare FS-113, Westergreen pipete, and Cobas C-111 have been used.
Results: Most of the patients were 51 years of age and older; more than half of the sample 55.26% were female, and 64.47% of patients were urban residents. Regarding the laboratory findings, an elevated and normal WBC count was found in 52.63% and 43.42%, respectively. 72.37% of patients have been found to have a normal platelet count. Most cases (73.68%) have an elevated level of blood urea. The creatinine level was found to be normal in the majority of cases (89.47%). 52.63% of patients have been found to have a normal hemoglobin level. The mean values of ESR and CRP were found to be 42.61 mm/hr and 61.61 mg/L, respectively.
Conclusion: This study shows that several biochemical factors have been found to be affected in patients with community-acquired pneumonia.

Key words: WBC, platelet count, blood urea, creatinine, hemoglobin, ESR, and CRP.

Introduction. The primary cause of death and morbidity, community-acquired pneumonia (CAP), has a significant impact on both clinical and economic aspects. Data on the spread of pathogens are not consistently represented across nations, considering the fact that multiple species are linked to the disease. The incidence of CAP in adults is affected by a number of factors, including age, study period, and geographic location. Nevertheless, only a small number of nations provide consistent and trustworthy statistics over an extended period of time. Lower respiratory tract infections (LRTIs) are thought to be the cause of around 2.4 million fatalities worldwide across all age groups [1]. South Asia, Southeast Asia, and sub-Saharan Africa have the highest recorded death rates among them. Pneumococcal pneumonia accounted for 197.05 million episodes (112.83-287.64) of reported cases globally in 2016, making it the primary cause of LRTI morbidity and mortality. Between 2005 and 2015, the global mortality rate from LRTI did not change, despite a 19.5% decline

in age-standardized death rates [1]. The rates of hospitalization for CAP, including those in intensive care units (ICUs), have steadily increased in recent years, particularly among the elderly population [2]. When patients are admitted to intensive care units, the case fatality rate varies depending on the healthcare facility, geographic location, patient categories, and age. It can range from 2 to 20% and even approach 50% [3].

Even though a wide variety of microbial infections have been linked to CAP, the list is somewhat short and generally stable in immunocompetent patients [4,5]. The Hantavirus in 1993, the human metapneumovirus in 2001, the coronavirus linked to SARS in 2002, and the middle east respiratory syndrome in 2012 are among the more recent viruses that have been identified. More recently, methicillin-resistant Staphylococcus aureus (MRSA) strains obtained from the community have also been identified as CAP pathogens [6].

The human immune system's white blood cells (WBCs) protect the body from foreign threats and combat infection. They consist of neutrophils, eosinophils, basophils, monocytes, and lymphocytes, each of which makes up a different proportion and has a specialized role to play. Traditionally, a complete blood count (CBC) test—which helps track people's health—includes the clinical laboratory process for measuring the various types of white blood cells [7]

Platelets have pleiotropic effects in addition to their role in hemostasis. They have a role in controlling immunological response, stress, and inflammation [8–10]. As a result, platelets aid in the host's defense against diseases, such as community-acquired pneumonia (CAP) [11] Thrombocytopenia (platelet count $<100 \times 10^9$/L) at the time of admission has been linked to a greater rate of complications in patients who are admitted to the hospital for treatment of CAP [12] and also increased rates of 30-day mortality [13,14]. Patients admitted to an intensive care unit (ICU) for community-acquired pneumonia (CAP) had a greater death rate when their platelet count is less than 150×10^9/L upon admission [15]. Concurrently, in patients admitted with CAP, a platelet count of $\geq 400 \times 10^9$/L has been linked to mortality [14].

The CURB-65 scoring system includes blood urea and is used to divide pneumonia patients into those who need to be admitted to the hospital and those who do not. A score of 0 indicates that the patient is most likely appropriate for at-home care, while a score of 2 indicates that hospital-supervised treatment should be considered. A hospital-supervised outpatient program and a short-stay inpatient program are possible options. Consider patients in hospitals to have serious pneumonia if their score is three or higher. Assess the patient for ICU admission, particularly if their CURB-65 score is 4 or 5 [16]. Figure 1 summarizes the benefits of the CURB-65 scoring system [16].

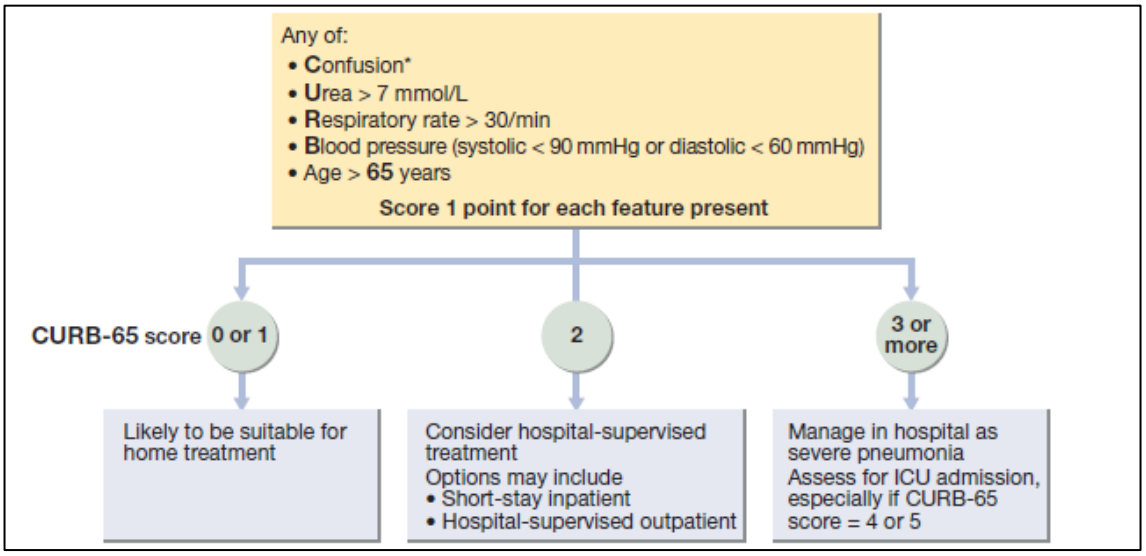

Figure 1. Hospital CURB-65.

Regarding creatinine levels, it has been reported that patients with acute kidney injury (AKI) have an increased rate of 30-day mortality in patients with CAP. When the creatinine level increased above the baseline by more than 20%, it was strongly associated with an increased 30-day mortality rate. If the creatinine level increases as low as 20% above the baseline, this will also increase the 30-day mortality rates in patients with CAP in comparison with patients without an increased level of creatinine [17].

In patients with community-acquired pneumonia who are admitted to the hospital, anemia was detected in both those with moderate disease and no risk factors, as well as in those with severe disease or anemia risk factors. The increased rate of 90-day mortality was found to be independently correlated with the development of anemia when it was moderate to severe (hemoglobin ≤ 10 g/dL) [18].

A vertical column of anticoagulated blood's fall distance in an hour is measured by the ESR. The ESR is affected by any illness that affects fibrinogen levels or red blood cells. Because it appears to be a more accurate indicator of an acute-phase reaction and is more responsive than ESR to small changes in the acute-phase response, C-reactive protein has an advantage over ESR. The liver produces it predominantly in reaction to cytokines, notably IL-6. The synthesis rate is the primary factor that determines the amount of CRP in the bloodstream. It rises in direct proportion to the degree of inflammation that stimulates the production of CRP, and vice versa [19].

Clinical picture

Th

e different clinical findings in CAP are mostly caused by the inflammatory response to infection. The disease can appear in a variety of manifestations, ranging from mild to lethal in intensity and from fairly benign to fulminant, depending on the host and, to some extent, the pathogen. In addition to affecting the lung, the

numerous signs and symptoms may also be constitutional in nature. In addition to myalgias and arthralgias, the average patient may also experience chills, a raised body temperature, and an increased heart rate. Both coughing and dyspnea are possible, with the former fluctuating between non-productive and productive episodes with purulent, maybe blood-tinged sputum. Chest pain can develop as a result of pleuritic involvement or coughing. It's interesting to note that gastrointestinal symptoms like nausea, vomiting, or frequent bowel motion might affect up to 20% of CAP patients.

The results of the examination will depend on the degree of the pulmonary parenchyma's local involvement, the existence or absence of an effusion, and the degree of the systemic reaction to the cytokine release. Upon examination, the patient can appear flushed, cyanotic, or use the accessory muscle of respiration. Tactile fremitus may be noted on palpation, and a dull or flat percussion sound may suggest consolidations or pleural effusion, respectively. Abnormal breathing sounds such as rales, rhonchi, bronchial breath sounds, and may be pleural friction rub can all be heard when listening to the chest using a stethoscope. The physical examination is not very sensitive or specific for pneumonia and might be deceptive [20]. Particularly in the elderly, a patient's clinical presentation and examination results may be deceptive, and some old individuals may just appear confused [21].

Investigation

Numerous investigations have been conducted in relation to this case, which can be summed up as follows:

- Blood
    - Full blood count
    - Urea and electrolyte
    - Liver function test
    - ESR/CRP
    - Blood culture
    - Cold agglutinins
    - Arterial blood gasses
- Sputum
    - Gram stain
    - Culture
    - Antimicrobial sensitivity testing
- Oropharynx swab

- PCR

- Chest X-ray
- Urine
- Pleural fluid

Such investigations can be used to determine the onset of complications, evaluate the severity, and confirm the diagnosis. While many mild to moderate cases of CAP can be effectively treated without identifying the organism, individuals with severe CAP should undergo a variety of microbiological investigations [16]. Figure 2 shows a chest X-ray of a patient with pneumonia [16].

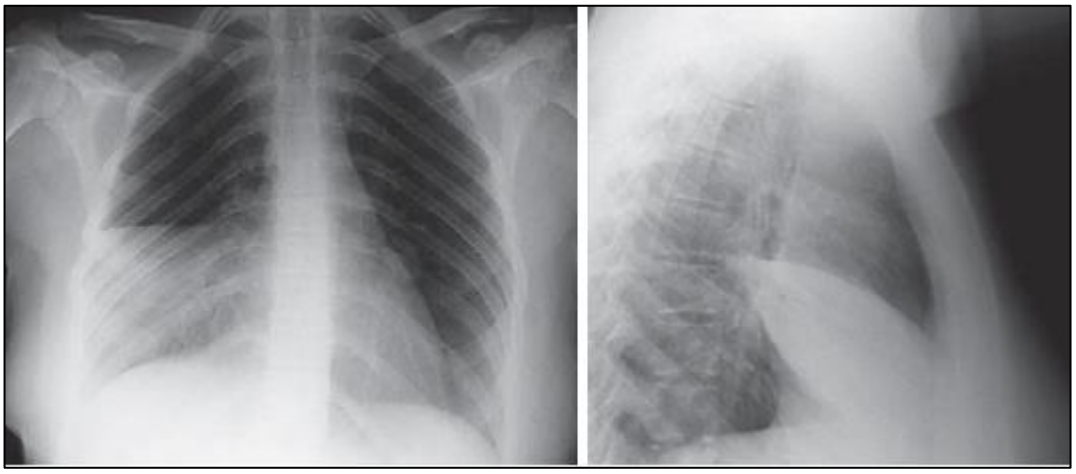

Figure 2. Chest X-Ray demonstrates pneumonia of the right middle lobe.

Management

The most important elements of treatment include providing oxygenation, fluid balance, and antibiotic treatment. In severe or chronic diseases, nutritional support might be necessary. Relieving the patient's pleural pain is important for allowing patients to cough effectively and breathe normally. It is sufficient to use simple analgesia with paracetamol, co-codamol, or NSAIDs for most patients. Opioids may be necessary for certain patients; however, they must be administered extremely carefully to those with compromised lung function. Physiotherapy is not usually suggested for individuals with CAP, while it might aid people who suppress their cough due to pleural pain by facilitating expectoration [16].

Material and Method

This is a cross-sectional study; 76 patients, older than 18 years, were randomly selected. This study was done in a private laboratory between January 2024 and April 2024. Permission was obtained from all patients, and the questioner represented in Figure 3 was used to collect the information. Table 1. summarizes the device that has been used for each test. SPSS has been used for the statistical analysis of data.

Table 1. Laboratory devices that used for each test.

Test	Device name
WBC count, Platelet count, and hemoglobin level.	Mindray BC-5800
CRP	Finecare FS-113
ESR	Westergreen pipete
Urea, and creatinine levels	Cobas C-111

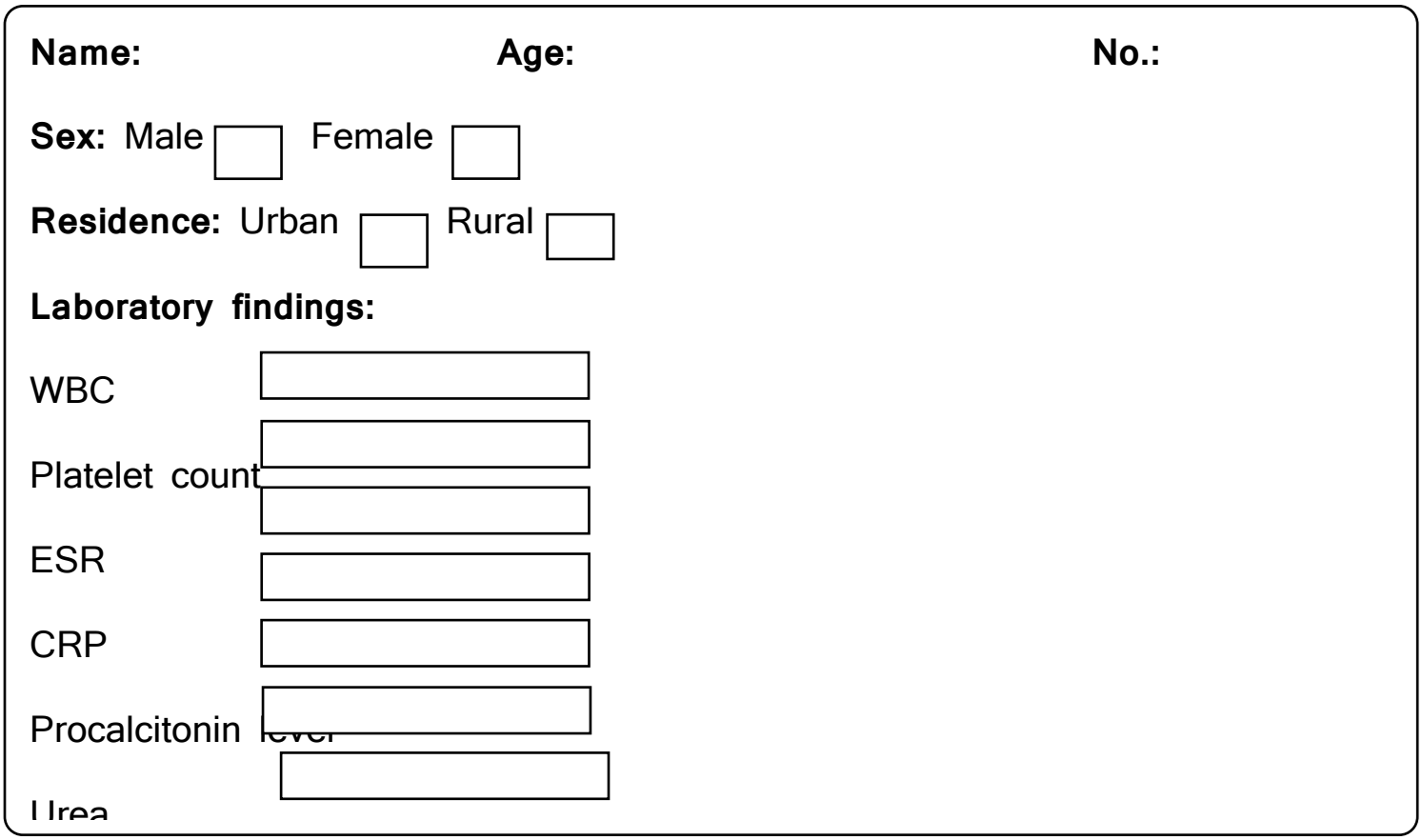

Figure 3. Questioner.

Results

Table 2 shows that the majority of participants were 51 years and older (57.89%), those between 19 and 30 years old accounted for 6.58%, and those between 41 and 50 made up 22.37%. The age group of 51–60 years was accounting for 34.21%, while those who were older than 61 years were accounting for 23.68%.

Table 2. Age groups of participants.

Patients' groups	No. (Percentage)	Mean ± S.D.
19 - 30 years	5 (6.58 %)	26.40 ± 3.362
31 - 40 years	10 (13.16%)	37.40 ± 2.757
41 - 50 years	17 (22.37%)	46.88 ± 4.029
51 - 60 years	26 (34.21%)	55.23 ± 3.195
≥ 61 years	18 (23.68%)	68.83 ± 5.272

Regarding sex distribution, the majority of cases were female, accounting for 55.26%, while males accounted for 44.74%. Table 3 summarizes these results.

Table 3. Sex distribution.

Sex	Number (Percentage)
Male	34 (44.74%)
Female	42 (55.26%)

As shown in Table 4, the majority of participants (64.47%) were living in urban areas, while those who were living in rural areas accounted for 35.53%.

Table 4. Residence distribution.

Residence	Number (Percentage)
Urban	49 (64.47%)
Rural	27 (35.53%)

The following table 5, shows the laboratory findings for each test that has been used in this study. Regarding white blood cell count, nearly half of patients (52.63%) have an elevated count, 43.42% have a normal count, and only a small percentage (3.95%) have a low count of white blood cells. It has been found that the majority of patients have a normal count of platelets, while 27.63% have a low count of platelets (thrombocytopenia). 73.68% of patients have been found to have an elevated level of blood urea, while only 26.32% have a blood urea within the normal range. Regarding creatinine level, the majority of patients (89.47%) have a normal level, while 10.53% have an elevated level of creatinine. Hemoglobin levels have been found to be normal in nearly

all of the samples (52.63%), while 47.37% have a low level of hemoglobin. Regarding the average values of ESR and CRP, they have been found to be 42.61 and 61.61, respectively.

Table 5. Laboratory findings.

Test	Number	Percentage
White blood cell count		
- **Normal**	33	43.42%
- **Elevated**	40	52.63%
- **Low**	3	3.95%
Platelet Count		
- **Normal**	55	72.37%
- **Low**	21	27.63%
Urea		
- **Normal**	20	26.32%
- **Elevated**	56	73.68%
Creatinine		
- **Normal**	68	89.47%
- **Elevated**	8	10.53%
Hemoglobin		
- **Normal**	40	52.63%
- **Low**	36	47.37%
	Mean	**S.D.**
ESR	42.61 mm/hr	9.371
CRP	61.61 mg/L	7.844

Discussion

Regarding age groups, it has been found that the majority of patients are 51 years and older; this is consistent with findings from another study [22] that found the majority of patients to be 65.5±16.69 years of age. It has been found that most patients are female (55.26%); this percentage shows agreement with another study [23], which stated that 57% of their total sample was female. Urban residents account for 64.47% of the sample, which shows agreement with another study [24]. Regarding the white blood cell (WBC) count, it has been found that about half of patients (52.63%) have an elevated count; this shows agreement with another study [25], as they found that 49.4% of the sample had an elevated WBC count. Regarding the results of normal and low WBC counts, this also shows agreement with the same study.

Platelet count: it has been found that 72.37% of patients have a normal count, which is consistent with the results of another study [24]. Blood urea and creatinine levels have been found to be increased in 73.68% and 10.53% of cases, respectively, which is consistent with the findings of the same study.

Regarding hemoglobin level, it has been found to be normal in 52.63% of patients, which shows agreement with another study [25]. The average values of ESR and CRP were 42.61 mm/hr and 61.61 mg/L, respectively. These results differ slightly from the results of another study [26], and this could be due to the difference in the sample size and the underlying comorbid conditions.

Conclusion

Community-acquired pneumonia can lead to changes in several biochemical factors; some of them are affected in the majority of patients, like ESR and CRP, while other factors are affected in different percentages of the sample.

Recommendations

It is recommended to study these factors separately, describing how underlying comorbid conditions can affect them and their beneficial value in predicting the clinical course of the disease.

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