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# Comparison between Acute Phase Reactant in COVID-19 Pneumonia And Bacterial pneumonia

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**ABSTRACT**

**Background:** Several instances of pneumonia from an unknown cause were recorded in the city of Wuhan, China in December 2019, and were later confirmed as coronavirus illness 2019. (COVID-19). Pneumonia is an inflammatory disease that impacts the parenchyma of the lungs, resulting in the consolidation of the afflicted area and the filling of alveolar air gaps with exudate, inflammatory cells, and fibrin. Acute phase reactants (APRs) are critical in the early detection, management, and recording of illness development.

**Aim of The Work:** To determine the value of measurement of Acute Phase Reactants (APRs) in Differentiation between Covid-19 pneumonia and Bacterial pneumonia, .

**Patients and Methods:** Thirty patients with Bacterial pneumonia and another thirty patients with Covid-19 pneumonia were included in this cross-sectional research at Al-houssein University Hospital.

**Results:** There was highly significant increased CRP in COVID-19 pneumonia group (68.8mg/L) versus bacterial pneumonia group (42.8mg/L), and D-dimer highly significant increase in COVID-19 pneumonia group (1276.7ng/ml) versus bacterial pneumonia group (643.3ng/ml) , also ferritin highly significant increase in COVID-19 pneumonia group (521ng/ml) versus bacterial pneumonia group (254.3ng/ml) and also there was highly significant decreased Lymphocytes in COVID-19 pneumonia group (1.1/mm3) versus bacterial pneumonia group (3.9/mm3) but WBCs highly significant increase in bacterial pneumonia group (22.3/mm3) versus COVID-19 pneumonia group (8.5/mm3) and Neutrophil highly significant increase in bacterial pneumonia group (18.4/mm3) versus COVID-19 pneumonia group (7.4/mm3).

**Conclusion:** Acute phase reactants (APRs) (CRP, D-dimer, S-ferrittin, WBCs & differential) can be used in differentiation between COVID-19 pneumonia & Bacterial pneumonia.

**Keywords:** *Acute phase reactants; Bacterial Pneumonia; Comparison; COVID_19 pneumonia.*

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## INTRODUCTION

In the Chinese city of Wuhan, province of Hubei, multiple instances of pneumonia of unidentified cause were recorded in December 2019.[1]

This pathogen was discovered as severe acute respiratory disorder coronavirus in January 2020. (SARS-CoV-2). [1] Due to its rapid spread, SARS-CoV-2 has infected more than 183 nations and territories in a short period of time, prompting the WHO to declare a pandemic in March 2020.[2]

Streptococcus pneumoniae, Staphylococcus aureus, Group A Streptococcus, Klebsiella pneumoniae, Haemophilus influenzae, Moraxella catarrhalis, anaerobes, and gram-negative organisms are the most common bacteria that induce pneumonia. Unlike atypical organisms, these organisms can be readily cultivated on normal medium and identified using Gram stain.[3]

Acute phase reactants (APRs) are inflammatory bioindicators that show considerable variations in serum levels during inflammation induced by infectious and noninfectious disorders. APRs are utilized for early detection, to differentiate infectious from noninfectious diseases, and to assess treatment response.[3]

The erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), lactate dehydrogenase (LDH), fibrinogen, ferritin, procalcitonin, D-dimer, and Troponin are some of the most relevant APRs.[1]

During inflammation, the concentrations of all of these positive (APRs) rise in the serum.[4, 5]

An acute inflammatory reaction is triggered by bacterial infections of the lower respiratory tract. In bacterial pneumonia, a complicated interplay between immune cells and inflammatory cytokines regulates the inflammatory response.[1]

The study aimed to determine the value of measurement of Acute Phase Reactants (APRs) in Differentiation between Covid-19 pneumonia and Bacterial pneumonia**.**

## PATIENTS AND METHODS

This cross-sectional research took place at Al-Hussein University Hospital from October 2021 to April 2022, and included sixty participants: Thirty patients with pneumonia (diagnosed on clinical , radiological , PCR , culture & sensitivity & laboratory basis), and another thirty patients with Covid-19 (diagnosed on clinical , radiological , PCR , culture & sensitivity & laboratory basis).

Exclusion criteria: The research excluded patients with underlying lung disorders such as TB, lung cancer, or other chronic lung conditions.

Inclusion criteria: Patients presented to the emergency room with symptoms such as fever, dry cough, weakness, chest discomfort, tachypnea, vomiting, disorientation, and headache, and were admitted to the hospital after undergoing a chest CT scan.

At the time of admittance to the emergency department at EL-Hussein university hospital, school of medicine, Al-Azhar university, All of the individuals in the research had just been diagnosed and had not yet been treated. All patients' medical records were obtained and examined; APR levels (CBC, ESR, CRP, D-dimer, S-ferrittin, and Fibrinogen) and chest CT data were acquired on admission to the hospital for each patient before treatment.

Methods: The Ethics Committee of Al-Azhar University's Faculty of Medicine gave its approval to the research. Every patient signed a written or verbal agreement for participation in this research after being informed about the procedure. If the patient was conscious or by relatives if the patient was unconscious. All patients underwent the following: Full history and clinical examination, routine laboratory tests CBC , ESR, CRP, D-dimer, S-ferrittin, LDH, Fibrinogen, sputum culture and examination, chest X-ray, C.T chest & PCR of COVID-19.

Statistical analysis: The Statistical Program for Social Science (SPSS) version 24 was used to examine the data. To represent quantitative data, the mean and standard deviation were utilized. To express qualitative data, frequency and percentage were utilized. The center value of a discrete collection of numbers, namely the sum of values divided by the number of values, is called the mean (average). The standard deviation (SD) is a measure of a collection of values' dispersion. A low SD implies that the values are spread out across a larger range, while a high SD shows that the values are near to the set's mean. When comparing non-parametric data, the Chi-square test was utilized. Kruskal Willis test was used to compare between quantitative data as regard vitamin D status. For data correlation, the Pearson correlation coefficient was applied. P-values < 0.05 were deemed substantial, P-values < 0.001 were regarded very substantial, and P-values > 0.05 were considered insignificant.

## RESULTS

The participants in this research were separated into two groups of sixty people. Thirty patients were assigned to the COVID-19 pneumonia group and another thirty to the Bacterial pneumonia group.

| | | COVID group (N = 30) | | Pneumonia group (N = 30) | |
|---|---|---|---|---|---|
| Age (years) | Mean | 51.2 | | 46.7 | |
| | ±SD | 16.1 | | 16.9 | |
| Sex | Male | 14 | 46.7% | 17 | 56.7% |
| | Female | 16 | 53.3% | 13 | 43.3% |
| Smoking | Non-smoker | 19 | 63.3% | 14 | 46.7% |
| | Smoker | 11 | 36.7% | 16 | 53.3% |

**Table 1:** Demographic data in all studied patients

the mean age of COVID-19 pneumonia group was 51.2 ± 16.1 years while it was 46.7 ± 16.9 in pneumonia group. As regard sex, there were 14 males (46.7%) and 16 females (53.3%) in COVID-19 pneumonia group while there were 17 males (56.7%) and 13 females (43.3%) in Bacterial pneumonia group. As regard smoking, there were 11 smokers (36.7%) in COVID-19 pneumonia group and 16 smokers (53.3%) in Bacterial pneumonia group. and there were 7 DM patients (23.3%) in COVID-19 pneumonia group and 11 DM patients (36.7%) in Bacterial pneumonia group. As regard HTN, there were 17 HTN patients (56.7%) in COVID-19 pneumonia group and 22 HTN patients (73.3%) in Bacterial pneumonia group.

| | | COVID group (N = 30) | | Pneumonia group (N = 30) | | Stat. test | P-value |
|---|---|---|---|---|---|---|---|
| Cough | No | 0 | 0% | 0 | 0% | ------ | ----- |
| | Yes | 30 | 100% | 30 | 100% | | |
| Cough type | Dry | 27 | 90% | 0 | 0% | $X^2 = 49.1$ | < 0.001 HS |
| | Productive | 3 | 10% | 30 | 100% | | |
| Fever | No | 0 | 0% | 0 | 0% | ------ | ----- |
| | Yes | 30 | 100% | 30 | 100% | | |
| Fever duration | Mean | 3.2 | | 5.5 | | MW = 53 | < 0.001 HS |
| | ±SD | 1.01 | | 1.1 | | | |
| Dyspnea | No | 20 | 66.7% | 4 | 13.3% | 17.8 | < 0.001 HS |
| | Yes | 10 | 33.3% | 26 | 86.7% | | |
| Fatigue | No | 0 | 0% | 0 | 0% | ------ | ----- |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Yes | 30 | 100% | 30 | 100% | | |
| DCL | No | 28 | 93.3% | 28 | 93.3% | 0.0 | 1.0 NS |
| | Yes | 2 | 6.7% | 2 | 6.7% | | |

**Table 2:** Clinical symptoms in all studied patients

Symptoms in all studied patients were revealed increased percentage of productive cough in bacterial pneumonia group (30 patients, 100%) when compared with COVID-19 pneumonia group (3 patients, 10%), increase duration of fever in bacterial pneumonia group (5.5 ± 1.1) when compared with COVID-19 pneumonia group (3.2 ± 1.01) and also increased percentage of dyspnea in bacterial pneumonia group (26 patients, 86.7%) when compared with COVID-19 pneumonia group (10 patients, 33.3%). No statistical substantial variance (p-value > 0.05) between investigated groups (COVID-19 pneumonia and bacterial pneumonia groups) as regard presence of cough, fever, fatigue and DCL(Disturbed Conscious level).

| | | COVID group (N = 30) | Pneumonia group (N = 30) | MW | P-value |
|---|---|---|---|---|---|
| ESR (mm/h) | Mean | 60.3 | 67.4 | 385 | 0.336 NS |
| | ±SD | 38.0 | 40.6 | | |
| CRP (mg/L) | Mean | 68.8 | 42.8 | 306.5 | 0.034 S |
| | ±SD | 51.7 | 31.0 | | |
| D-Dimer | Mean | 1276.7 | 643.3 | 83.5 | < 0.001 HS |
| | ±SD | 553.8 | 171.1 | | |
| Ferritin (ng/ml) | Mean | 521.0 | 254.3 | 148.5 | < 0.001 HS |
| | ±SD | 361.8 | 60.5 | | |
| LDH (U/L) | Mean | 297.7 | 292.5 | 448 | 0.976 NS |
| | ±SD | 31.8 | 42.0 | | |
| Fibrinogen | Mean | 529.0 | 531.3 | 432.5 | 0.784 NS |
| | ±SD | 74.2 | 75.1 | | |
| WBCs ($x10^3$/ul) | Mean | 8.5 | 22.3 | 41 | < 0.001 HS |
| | ±SD | 5.3 | 5.1 | | |
| Neutrophil ($x10^3$/ul) | Mean | 7.4 | 18.4 | 69 | < 0.001 HS |
| | ±SD | 5.4 | 5.7 | | |
| Lymphocytes ($x10^3$/ul) | Mean | 1.1 | 3.9 | 0.0 | < 0.001 HS |
| | ±SD | 0.3 | 1.6 | | |

**Table 3:** Comparison between laboratory data in all studied patients

This table shows: Statistically substantial (p-value = 0.034) increased CRP in COVID-19 pneuonia group (68.8 ± 51.7mg/L) when compared with bacterial pneumonia group (42.8 ± 31.0mg/L). Highly statistical significant (p-value < 0.001) increased D-Dimer in COVID-19 pneumonia group (1276.7 ± 553.8ng/ml) when compared with bacterial pneumonia group (643.3 ± 171.1ng/ml). Highly statistical significant (p-value < 0.001) increased ferritin in COVID-19 pneumonia group (521 ± 361.8ng/ml) when compared with bacterial pneumonia group (254.3 ± 60.5ng/ml). Highly statistical significant (p-value < 0.001) increased WBCs in bacterial pneumonia group (22.3 ± 5.1/mm3) when compared with COVID-19 pneumonia group (8.5 ± 5.3/mm3). Highly statistical significant (p-value < 0.001) increased Neutrophil in bacterial pneumonia group (18.4 ± 5.7/mm3) when compared with COVID-19 pneumonia group (7.4 ± 5.4/mm3). Highly statistical significant (p-value < 0.001) decreased Lymphocytes in COVID-19 pneumonia group (1.1 ± 0.3/mm3) when compared with bacterial pneumonia group (3.9 ± 1.6/mm3). No statistical substantial variance (p-value > 0.05) between studied groups (COVID-19 pneumonia and bacterial pneumonia groups) as regard ESR, LDH and fibrinogen.

## DISCUSSION

Pneumonia is one of the most causes of mortality in children and adults alike. Much of its impact is avoidable, allowing the global health community to focus efforts on reducing it. In response, the World Health Organization's comprehensive Global Action Plan for the Prevention and Control of Pneumonia has established objectives and a framework for addressing the problem. Measuring progress is a key component.[6] Causes of pneumonia may be viral, bacterial, or fungal.[7]

Several instances of pneumonia of unknown cause were recorded in December 2019 in Wuhan, Hubei Province, China1. Chinese scientists discovered this pathogen as a more infectious coronavirus in January 2020, similar to the ones seen in the (SARS-CoV)Severe Acute Respiratory Syndrome coronavirus and (MERS-CoV) Middle East Respiratory Syndrome coronavirus. The International Committee on Taxonomy of Viruses (ICTV) named this novel coronavirus severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in February 2020, and the disease was named coronavirus disease 2019 (COVID-19) by the World Health Organization (WHO). SARS-CoV-2 has influenced more than 183 countries and territories in a short time due to its high transmission rate. [8]

Inflammatory indicators known as acute phase reactants show considerable variations in serum levels during inflammation. Fever, chronic illness anemia, anorexia, somnolence, lethargy, and cachexia are some of the side effects of acute phase reactants. Depending on their blood concentrations during inflammation, acute phase reactants may be classed as positive or negative. Positive acute phase reactants such as c-reactive protein (CRP), ferritin, erythrocyte sedimentation rate (ESR), and D-dimer are upregulated and their concentrations rise during

inflammation. During inflammation, negative acute phase reactants are downregulated and reduce as albumin levels rise.[9]

So, the goal of our research is to analyze between laboratory findings of acute phase reactants in pneumonic patients due to covid _19 vs bacterial pneumonia, this cross sectional study included 60 patients (30bacterial pneumonia) & (30 covid pneumonia) that were identified with COVID-19 by RT-PCR. The study was conducted at Al-houssein university hospital, in the period from October 2021 to April 2022.

Different presentations were observed in the patients included in this study. Frequently, more than one symptom was noted. productive cough was observed in bacterial pneumonia group (100%) when compared with COVID-19 pneumonia group (10%). This is comparable to the results of Tao et al., who found an occurrence of (92.2%).

Fever was detected in bacterial pneumonia group (5.5 ± 1.1 days) when compared with COVID-19 pneumonia group (3.2 ± 1.01 days), Sayit et al., reported similar high incidences of fever In Bacterial pneumonia (20.8%)

The current study was showed that significant increased CRP in COVID-19 group (68.8 ± 51.7mg/L) more than Bacterial pneumonia group like apart from study done by Zhang JJ et al.[10] reported that COVID-19 was substantially linked to a higher CRP level rather than bacterial pneumonia.

This study was revealed highly significant increased D-Dimer in COVID-19 group (1276.7 ± 553.8ng/ml) more than Bacterial pneumonia group that matched with study done by Long H et al.[11] reported that COVID-19 patients had considerably higher D-dimer values.

Furthermore, this study was reported highly significant increased ferritin in COVID-19 group (521 ± 361.8ng/ml) that more linked with Lin Z et al.[12] was reported that high serum ferritin in patients with COVID-19.

Our research was reported that highly significant elevated WBCs in bacterial pneumonia group (22.3 ± 5.1/mm3) like the study done by Cataudella et al.[13] recorded a mean TLC of (12.6/ mm3), highly significance increasing in Neutrophil in bacterial pneumonia group (18.4 ± 5.7/mm3) when compared with COVID-19 group (7.4 ± 5.4/mm3) like the study done by Zhu F et al. [14] But showed Highly significant decreased Lymphocytes in COVID-19 group (1.1 ± 0.3/mm3) like the study done by Zhao Q et al.[15] was documented the importance of decreased lymphocyte count among COVID-19 pneumonia patients, and spotlighted its helpful role in identifying patients who are unlikely to have the disease.[15, 16]

## CONCLUSION

Acute phase reactants, which were included in our study, TLC, CRP, D-dimmer, Ferritin, and ESR were elevated in the studied patients than the normal values. All markers except CRP , D-dimer , S-ferrittin and WBCs & Differential Leukocytic counts had insignificant difference in between both groups. CRP level was more significant increased in COVID-19 pneumonia group when compared with bacterial pneumonia group , D-dimer level was more significant increased in COVID-19 pneumonia group when compared with bacterial pneumonia group .S-ferrittin level was more significant increased in COVID-19 pneumonia group when compared with bacterial pneumonia group . Also WBCs and Neutrophils were more significant increased in bacterial pneumonia group when compared with COVID-19 pneumonia group, while Lymphocytes were more significant decreased in COVID-19 pneumonia when compared with bacterial pneumonia group.

Conflict of interest : none

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