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Original article

Assessment of C-Reactive Protein Concentrations in Patients with COVID-19: A Laboratory-Based Observational Research Study

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Abstract
COVID-19 represents a significant health crisis due to its high transmissibility and elevated mortality rates among critically ill patients. The understanding of the pathological and physiological mechanisms, as well as the diagnostic approaches for COVID-19, remains in the early stages of investigation. Effective clinical monitoring and suitable treatment strategies are crucial for reducing mortality rates. This study aimed to measure the levels of C-reactive protein (CRP) and ferritin in patients diagnosed with COVID-19. A retrospective study was carried out in the Yafran Pathology Center and Analysis Laboratory, Andalusia District, where blood samples from confirmed COVID-19 positive patients were processed following standard laboratory protocols. CRP and ferritin levels were assessed using the Integra 400Plus system. The study involved 117 patients, including both males and females, and they were categorized according to age into groups. 0-17 years, 18-34 years, 35-49 years, 50-64 years, 65 years and older. In conclusion, elevated CRP levels are associated with a more severe disease trajectory, linked to lung damage and poorer prognosis.
Keywords. C-Reactive Protein, Concentrations, COVID-19, Libya.

Introduction

COVID-19 is a recently identified infectious disease for which there is no existing treatment. It is marked by the release of proinflammatory cytokines and chemokines, which seem to play a significant role in the severe and unfavorable outcomes associated with damage to multiple organs and functional failure. Identifying effective laboratory biomarkers to categorize patients according to their risk levels is essential for ensuring timely treatment [1, 2]. C-reactive protein (CRP) is an acute-phase protein produced in the liver in response to IL-6. It serves as a sensitive but non-specific marker for inflammation, infection, and tissue injury. Normally, CRP levels are low but can rise quickly and markedly during acute inflammation. An increase in CRP, either alone or together with other markers, can indicate bacterial or viral infections. Research examining CRP in COVID-19 patients showed that those with CRP levels above 41.8 mg/L had a higher risk of developing severe disease. The inflammatory response is a key factor in COVID-19, with the cytokine storm contributing to greater disease severity. It is a crucial prognostic marker for pneumonia, with higher CRP levels indicating a more severe disease course, which is linked to lung injury and a poorer prognosis. The COVID-19 situation is a public health emergency due to its high transmissibility and significant mortality rates among critically ill patients [3].

The underlying pathological and physiological processes, along with diagnostic techniques for COVID-19, are still in the research phase. Continuing clinical monitoring and the development of effective treatment strategies are critical for improving case fatality rates [4]. The global number of COVID-19 cases is currently on a rapid upward trajectory. The normal blood concentration of CRP is less than 10 mg/L; however, it can rise swiftly within 6 to 8 hours, peaking around 48 hours after the onset of illness [5]. The half-life of CRP is approximately 19 hours [4], and its levels decrease as the inflammatory process resolves and the patient recovers. The concentration of CRP is associated with the level of inflammation and is not influenced by factors such as age, gender, or physical health [6]. Elevated CRP levels can activate the complement system and promote phagocytosis, thereby assisting in the clearance of invading pathogens. CRP levels are valuable for the early diagnosis of pneumonia, with significantly high levels observed in patients with severe pneumonia. It serves as an essential marker for diagnosing and assessing severe pulmonary infections. In the early phases of COVID-19, CRP levels can indicate lung damage and the severity of the disease, making it a critical biomarker for evaluating the prognosis of COVID-19 infections. Patients suffering from severe COVID-19 are typically treated in the intensive care unit, whereas those with mild or non-severe cases are usually managed in standard isolation wards. However, a growing concern is that a small percentage of mild or non-severe patients may progress to a more severe form of the disease. Consequently, it is crucial to identify and treat this specific group early to mitigate disease severity and enhance patient outcomes. Clinical research has shown that variations in certain blood markers may correlate with the severity and mortality rates of COVID-19 patients [7, 8].

Among the clinical parameters, serum C-reactive protein (CRP) has emerged as a significant marker that exhibits notable changes in patients with severe COVID-19 [9]. Moreover, it has been noted that individuals with low oxygen saturation (SpO2 < 90%) present with considerably elevated CRP levels (median 76.5 mg/L) compared to those with higher oxygen saturation (SpO2 > 90%) who have a median CRP level of 12.7 mg/L

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[10]. This finding suggests that patients experiencing more severe lung damage tend to have increased CRP levels. Consequently, elevated CRP levels are indicative of a more severe disease progression associated with lung injury and an unfavorable prognosis. There are closely linked relations between CRP levels and the severity of symptoms in individuals with COVID-19, indicating that it may be an appropriate marker for evaluating a patient's condition alongside other clinical findings. COVID-19 represents a new threat to populations [11]. Early monitoring of essential indicators is critical for shaping treatment strategies, and assessing the severity of a patient's condition at an early stage is of great significance. Monitoring essential indicators at an early stage was vital for informing treatment strategies, and the timely assessment of the patient's condition severity is highly valuable [12, 13]. The study was designed to examine the association between C-reactive protein (CRP) concentration levels and COVID-19 infection.

Material and Methods

A retrospective analysis was conducted using blood samples obtained from patients diagnosed with COVID-19 at Yafrin Hospital (Western Mountain) and El-Andalus Laboratory (Tripoli). Data collected from these patients were evaluated to determine C-reactive protein (CRP) and ferritin levels. All samples were processed according to standard laboratory procedures, and CRP concentrations were measured using the Integra 400Plus system. Based on clinical presentation, patients were classified into the following table:

Results

As illustrated in Figure 1, a considerable proportion of individuals in the study exhibited abnormal CRP levels, with 26 classified as moderate, 30 as high, and 6 as very high. Collectively, these categories represent more than half of the population assessed, underscoring a notable burden of systemic inflammation. The relatively small number of individuals with normal CRP (15) compared to those with elevated values suggests that inflammatory or infectious processes may be widespread in this cohort. This distribution highlights the importance of CRP screening as a potential tool for early detection of underlying health risks and emphasizes the need for further investigation into demographic or clinical correlates that may explain the observed elevations (Figure 1).

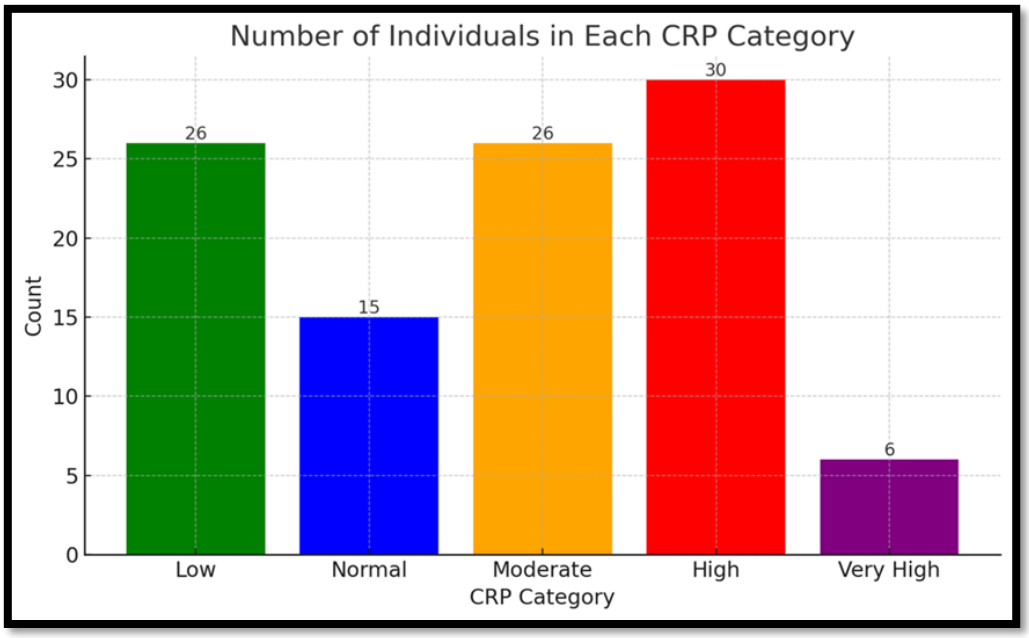

Figure 1. The data suggest that a considerable proportion of individuals have abnormal CRP levels (moderate, high, or very high), which may reflect ongoing inflammatory or infectious processes in the studied population.

Table 1 demonstrates a relatively balanced distribution of males and females across most age groups, with a slight predominance of females in the younger and middle age categories (18–34 and 50–64 years). Notably, the 18–34 age group is the largest segment overall, with 38 participants, indicating that young adults formed the bulk of the study population. In contrast, the 65 and older group is heavily skewed toward males (12 vs. 2 females), suggesting lower female representation in the elderly cohort. This distribution highlights both the demographic concentration of the study in younger adults and the gender disparities in older age groups, which may influence the interpretation of health outcomes or risk factor prevalence.

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Table 1. The age and gender-based distribution of the study population

Age group	Female	Male
0-17 years	10	8
18-34 years	27	11
35-49 years	13	9
50-64 years	16	9
65 and older years.	2	12

Discussion

C-reactive protein (CRP) is a plasma protein produced by the liver and is part of the pentraxin family, playing a significant role in inflammatory responses. As an acute-phase protein, its levels can rise swiftly in the presence of infection. CRP is a crucial element of the innate immune response, with concentrations potentially increasing over 1,000 times above baseline due to tissue damage or infection. Coronavirus disease 2019 (COVID-19), recognized as a serious illness, is characterized by inflammation induced by the virus, which can lead to dysfunction in multiple organs.

Research indicates that severe cases of COVID-19 exhibit elevated levels of inflammatory markers compared to milder cases, and monitoring these markers can facilitate the early detection or prediction of disease progression (Figure 1). Although it acts as a classical mediator of innate immunity, its function is facilitated by the interaction of components from both humoral and cellular effector systems related to inflammation. It has attained a unique position as a disease marker in cardiovascular diseases and is recognized for its clinical and pathological relevance. Current research across numerous diseases and associated conditions has significantly highlighted the role of CRP as a therapeutic and research agent. In this study, an examination of CRP in relation to COVID-19 was carried out. CRP is related to the epidemic virus COVID-19 and is an independent predictor of mortality from COVID-19 infection [14-17]**.**

This study indicates that females experience more severe cases of COVID-19 compared to males. (Figure 2). This observation aligns with findings from two other studies conducted in China and Iraq [18, 19]. Furthermore, these disparities have been effectively highlighted in a separate literature review [20]. It has been noted that acute inflammation associated with coronavirus disease in males may exacerbate the progression from mild to severe infection. This phenomenon could be attributed to the differing levels of sex hormones, such as estrogen and androgens, in females and males, respectively, which may significantly influence the immune response to COVID-19. In summary, our study reveals that the laboratory biomarker CRP can be significantly elevated in patients with COVID-19. It was observed that older individuals are at a greater risk for severe and critical cases (Figure 3) compared to younger individuals, and that male patients are more prone to severe cases than their female counterparts. These findings can be leveraged as a biomarker for early management, which may enhance disease prognosis, reduce mortality rates, and contribute to the creation of effective prevention strategies.

Conclusion

This study underscores the critical role of C-reactive protein (CRP) as a biomarker in the context of COVID-19. Elevated CRP levels were consistently associated with severe and critical cases, particularly among older individuals and male patients, reflecting its value in predicting disease progression and mortality. The findings also highlight gender-related differences, with females showing more severe cases in some cohorts, while acute inflammation in males may accelerate progression from mild to severe infection. These disparities may be influenced by sex hormones and their impact on immune responses.

Conflict of interest. Nil

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