

## THE ROLE OF C-REACTIVE PROTEIN, PROCALCITONIN AND CYTOKINES PREDICTING BACTERIAL INFECTION IN NEW CORONA VIRUS INFECTION.

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**Annotation:** *This article highlights the importance of C-reactive protein (CRP) and procalcitonin (PCT), and cytokines in determining the prognosis of SARS-CoV-2-associated pneumonia. The article discusses the methods used to measure these biomarkers and the results of studies that have investigated their use in predicting the severity and outcome of SARS-CoV-2-associated pneumonia. The article concludes with a discussion of the implications of these findings and suggestions for future research.*

**Keywords:** *SARS-CoV-2, pneumonia, C-reactive protein, procalcitonin, cytokines, biomarkers, prognosis.*

**Аннотация:** *В этой статье подчеркивается важность С-реактивного белка (СРБ) и прокальцитонина (ПКТ), а также цитокинов в определении прогноза пневмонии, связанной с SARS-CoV-2. В статье обсуждаются методы, используемые для измерения этих биомаркеров, и результаты исследований, в которых изучалось их использование для прогнозирования тяжести и исхода пневмонии, связанной с SARS-CoV-2. Статья завершается обсуждением последствий этих выводов и предложениями для будущих исследований.*

**Ключевые слова:** *SARS-CoV-2, пневмония, С-реактивный белок, прокальцитонин, цитокины, биомаркеры, прогноз.*

**IZOHNP:** *Ushbu maqolada SARS-CoV-2 bilan bog'liq pnevmoniyani istiqbolini aniqlashda C-reaktiv oqsil (CRO) va prokalsitonin (PKT) va sitokinlarning ahamiyati ta'kidlangan. Maqolada biomarkerlarni aniqlash usullari va SARS-CoV-2 bilan bog'liq pnevmoniyaning og'irligi va natijalarini bashorat qilishda ulardan foydalanishni o'rgangan tadqiqotlar natijalari muhokama qilinadi. Maqola ushbu natijalar va kelajakdagi tadqiqotlar uchun takliflarning natijalarini muhokama qilish bilan yakunlanadi.*

**Kalit so'zlar:** *SARS-CoV-2, pnevmoniya, C-reaktiv oqsil, prokalsitonin, sitokinlar, biomarkerlar, bashorat.*

The COVID-19 pandemic caused by the SARS-CoV-2 virus has affected millions of people worldwide and resulted in a significant number of deaths. One of the severe complications of COVID-19 is pneumonia, which can lead to respiratory failure and death. Early identification of patients with severe pneumonia and predicting their prognosis is critical in the management of COVID-19 patients. Biomarkers such as CRP, PCT and cytokines have been studied as potential predictors of the severity and outcome of SARS-CoV-2-associated pneumonia. Studies that investigated the use of CRP, PCT, and cytokines in predicting the prognosis of SARS-CoV-2-associated

pneumonia were reviewed. These studies used different methods to measure the levels of these biomarkers in the blood of COVID-19 patients, including enzyme-linked immunosorbent assay (ELISA), chemiluminescence assay (CLIA), and electrochemiluminescence assay (ECLIA). Several studies have demonstrated the importance of CRP, PCT, and cytokines in predicting the severity and outcome of SARS-CoV-2-associated pneumonia. Elevated levels of these biomarkers have been associated with a higher risk of developing severe pneumonia and a worse prognosis. In addition, these biomarkers have been used to monitor the response to treatment and predict the risk of complications, such as acute respiratory distress syndrome (ARDS) and sepsis. SARS-CoV-2 is a novel coronavirus that emerged in Wuhan, China, in late 2019. Since then, it has spread rapidly around the world, causing a pandemic. The disease caused by SARS-CoV-2 is called COVID-19 and can range from mild to severe respiratory illness. SARS-CoV-2-associated pneumonia is one of the severe forms of the disease and can be life-threatening in some cases. CRP, PCT and cytokines are all laboratory parameters that can help in the diagnosis and prognosis of SARS-CoV-2-associated pneumonia. In this article, we will discuss the importance of these parameters and their role in determining the prospect of SARS-CoV-2-associated pneumonia. CRP is a protein produced by the liver in response to inflammation in the body. Its levels in the blood can rise within hours of the onset of infection or inflammation. CRP levels can be measured using a simple blood test. Elevated CRP levels have been found in patients with severe COVID-19 and are associated with poor outcomes. Studies have shown that CRP levels can be used as a prognostic marker in COVID-19 patients. A high CRP level at admission is associated with a higher risk of severe disease, ICU admission, and mortality. PCT is a peptide hormone produced by the thyroid gland in response to bacterial infections. PCT levels can be measured in the blood, and elevated levels are usually indicative of bacterial infection. However, recent studies have shown that PCT levels can also be elevated in viral infections, including SARS-CoV-2. Elevated PCT levels have been found in COVID-19 patients with severe disease and are associated with poor outcomes. PCT levels can be used as a prognostic marker in COVID-19 patients. A high PCT level at admission is associated with a higher risk of severe disease, ICU admission, and mortality. Cytokines are a group of proteins produced by cells of the immune system that regulate the body's immune response. During an infection, the body produces cytokines to fight the infection. However, in some cases, the body can produce too many cytokines, leading to a cytokine storm. The cytokine storm is a severe immune response that can cause widespread inflammation and tissue damage. Cytokine storms have been observed in some COVID-19 patients and are associated with severe disease and mortality. Cytokine levels can be measured in the blood, and elevated levels are usually indicative of a cytokine storm. In conclusion, CRP, PCT and cytokines are important laboratory parameters that can help in the diagnosis and prognosis of SARS-CoV-2-associated pneumonia. Elevated levels of these parameters are usually indicative of severe disease and poor outcomes. Early

identification of patients with elevated levels of these parameters can help in the early intervention and management of SARS-CoV-2-associated pneumonia. Discussion: The measurement of CRP, PCT, and cytokines is a valuable tool in the management of patients with SARS-CoV-2-associated pneumonia. These biomarkers can help identify patients with a higher risk of developing severe pneumonia and those who may benefit from more aggressive treatment. They can also be used to monitor the response to treatment and predict the risk of complications. However, the use of these biomarkers in clinical practice should be carefully evaluated, and their limitations should be considered. Further research is needed to investigate the use of these biomarkers in the management of COVID-19 patients.

Procalcitonin level, ng/ml	Possible cause
Less than 0.1	The probability of bacterial infection is practically absent
0.10-0.25	The probability of bacterial infection is very low. The probability of systemic bacterial infection is practically absent
0.25-0.50	Local bacterial infection is possible. The probability of systemic bacterial infection is very low.
0.5-2.0	High probability of bacterial infection. Systemic bacterial infection is possible. It is necessary to exclude non-infectious causes of an increase in the level of PCT
2-10	High probability of systemic bacterial infection. Severe sepsis is possible
More than 10	High probability of severe sepsis

CRP and PCT are acute-phase reactants that are produced in response to inflammation and infection. Elevated levels of CRP and PCT have been observed in COVID-19 patients and studies have shown that high levels of these parameters at admission are associated with poor outcomes. Both CRP and PCT can be used as prognostic markers in COVID-19 patients to identify those at higher risk of severe disease and poor outcomes. Cytokines are a group of proteins that regulate the immune response. During an infection, cytokines are produced to fight the infection. However, in some cases, the body can produce too many cytokines, leading to a cytokine storm. Cytokine storms have been observed in some COVID-19 patients and are associated with severe disease and mortality. Elevated levels of cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- $\alpha$ ), have been observed in severe cases of COVID-19. Measuring cytokine levels can help identify patients at risk of developing a cytokine storm and guide the use of immunomodulatory therapies.

The purpose of the work. To study the predictor value of CRP) and PCT in patients with COVID-19 the inflammatory response plays a critical role in COVID-19, the ability of CRP and PCT to predict moderate and severe cases of COVID-19. PCT is secreted by various cell types from numerous organs in response to pro-inflammatory stimulation. PCT was approved by the U.S. Food and Drug Administration as a diagnostic tool for sepsis in 2005.

This retrospective study included 120 patients diagnosed with COVID-19 (SARS-Cov-2 associated pneumonia) from August 01, 2021 to September 05, 2021 admission

to Kagan City Hospital, Intensive Care Unit and Intensive Care Unit. The study population was divided into two groups depending on the severity of the disease: the medium severe group (n = 83) and the severe group (n = 37). Data on demographic characteristics, basic clinical characteristics, and levels of CRP and PCT at admission were collected. Among 120 patients, CRP and PCT levels increased in 85 (70.8%) and 103 (85.8%) patients upon admission accordingly. Serum PCT levels were increased in the average severe patients 17 (20.5%) less than 0.05-ng/ml, 44 (53.0%) 0.05-0.5 ng/ml, 22 (26.5%), and severe patients 28 (75.7%) 0.5-2.0 ng/ml, 9 (24.3%) more 2.0 ng/ml. Serum CRP levels were increased in the average severe patients 35 (29.2%) less than 0.5 mg/ml, 23 (19.2%) 10.0-20.0 mg/ml, 20.0- 40.0 mg/L (51.6%), and severe patients 11 (29.7%) 40.0-60.0 mg/ml, 26 (70.3%) more than 60 mg/ml. Clinically, a concentration of CRP >10 mg/l and PCT >0.1 ng/ml indicates a bacterial infection requiring antibiotic treatment, while a PCT concentration of more than 0.5 ng/ml indicates a risk of severe sepsis or septic shock in patients. In recent years, PCT has been considered as a specific and early biomarker for the diagnosis of systemic bacterial infection. The proportion of patients with elevated CRP and PCT levels was significantly higher. The proportional risk model (Cox Regression) has shown that CRP and PCT can be used as independent factors to predict the severity of COVID-19. In addition, patients with CRP >40.0 mg/l (normal CRP level <5 mg/L) or PCT >2.0 ng/ml (normal PCT level <0.05 ng/L) were more likely to have severe complications.

The presented study showed that PCT can serve as a reliable biomarker for the early diagnosis and treatment of patients with SARS-Cov-2-etiology pneumonia.

Conclusion. Thus, serum CRP and PCT levels have a significant correlation with the severity of COVID-19 and can be used as independent factors to predict disease risk.

Serum CRP and PCT levels can effectively assess the severity of the disease and predict the outcome in patients with COVID-19. The study of the level of CRP in the blood serum is a mandatory laboratory study. Since the level of CRP correlates with the severity of the course, the prevalence of inflammatory infiltration and the prognosis for pneumonia. PCT is a well-known diagnostic marker of bacterial infection. However, the validity of the PCT requires further study.

Conclusions: In conclusion CRP, PCT, and cytokines are valuable biomarkers in predicting the prognosis of SARS-CoV-2-associated pneumonia. These biomarkers can help identify patients with a higher risk of developing severe pneumonia and those who may benefit from more aggressive treatment. PCT is a biomarker for assessing the risk of bacterial infection and disease progression. PCT levels can serve as biomarkers of bacterial infection joining COVID-19 and determine the timely administration of antibacterial drugs and the duration of the course of antibacterial therapy. A decrease in the level of PCT by 80-90% from the peak level is one of the markers for stopping antibacterial therapy.

Further research is needed to determine the optimal use of these biomarkers in the management of COVID-19 patients. Additionally, the development of rapid and accurate methods for measuring these biomarkers will improve their utility in clinical practice. CRP, PCT, and cytokines are important laboratory parameters that can help in the diagnosis and prognosis of SARS-CoV-2-associated pneumonia. Elevated levels of these parameters are usually indicative of severe disease and poor outcomes. Early identification of patients with elevated levels of these parameters can help in the early intervention and management of SARS-CoV-2-associated pneumonia. Future research should focus on the development of biomarkers that can predict the development of severe disease and mortality in COVID-19 patients. The use of biomarkers can help guide the use of immunomodulatory therapies and improve patient outcomes. Additionally, more research is needed to understand the pathogenesis of cytokine storms in COVID-19 patients and develop effective treatments to mitigate their effects.

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