

Laboratory Parameters for Diagnosing and Managing COVID-19 Infection: A Comprehensive Review

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Abstract: *Coronavirus is a novel virus that was originated in China and caused pandemic. The symptoms vary from mild to severe respiratory illness and various systemic disorders. The clinical features and severity of disease may be reflected by pathological laboratory findings. It is important to find out the severity of the disease in concordance to its diagnosis for rapid management of the condition of the patient. This article provides a comprehensive review of the laboratory parameters associated with COVID-19 infection. It discusses the hematological, serological, immunological, and biochemistry parameters that may indicate the severity and prognosis of the disease. The article aims to aid in the rapid management of patient conditions.*

Keywords: Coronavirus, laboratory, hematology, biochemistry, coagulopathy.

1. Introduction

Coronavirus disease (COVID-19) is a newly discovered infection caused by coronavirus 2 (SARS CoV-2). It has infected 765 million people worldwide so far¹. India has reported 44.9 million cases till 10th May 2023.¹ Most people infected with COVID-19 virus experience respiratory illness that may be mild, moderate or severe. Older people or those with underlying medical problems like CVS, diabetes, chronic respiratory disease or cancer are more likely to develop severe illness. The most confirmatory approach to diagnose COVID-19 infection is reverse transcriptase-polymerase chain reaction (RT-PCR) of the patient's sample taken from throat or nose. Other popular tests are Truenat and rapid antigen tests. These tests require the desired laboratory formalities to be done. There are certain routine laboratory parameters that may be used in concordance with clinico – radiological findings to make early suspicion of COVID-19 infection. Serial monitoring of them may also be used as prognostic markers.

2. Diagnostic Parameters

2.1. Hematological Parameters

2.1.1. The complete blood count (CBC): CBC is usually the first approach to any infection. The evaluation of routine hematological parameters may be used as screening as well as evaluating the severity of COVID-19 illness. The patient infected with covid-19 infection shows high total leucocyte count (TLC), high absolute neutrophil count (neutrophils comprise >80% of TLC), low absolute lymphocyte count and mild to moderate thrombocytopenia.² Important is to evaluate the neutrophil to lymphocyte ratio (NLR). A study in Beijing shows the cut off value of NLR as 3.13 to assess the severity of covid illness with reported sensitivity 87% and specificity 71.7%. Patients with age >50 years and NLR > 3.13 may show severe illness and may be transferred to ICU. If NLR is less than 3.13 and age <50 yrs, patients can be isolated at home or community hospital.³ The peripheral blood picture of COVID-19 infected patient shows presence of few reactively lymphocytes and a subset appears to be plasmacytoid. Severe cases may

show leucoerythroblastosis. Erythrocyte sedimentation rate (ESR) is elevated in COVID-19 patients in presence of severe disease or pneumonia.⁴

2.1.2. Coagulopathy parameters: The coagulopathy parameters prothrombin time (PT), activated partial prothrombin time (aPTT) may be mildly increased, however, D-dimer and fibrinogen levels are markedly increased in COVID-19 infection.⁵ Serial monitoring of D-dimer bears a prognostic value.

2.1.3. Immunoassay: Immunoassay studies have demonstrated lower CD3+, CD4+ and CD8+ among COVID-19 patients suggesting a disturbance of cell mediated immunity. A study on flow cytometry of COVID-19 patients show monocytes with high forward scatter (FSC-high) means larger than normal monocytes are observed.⁶ However, it needs to be evaluated further with increased sample size.

2.2. Biochemistry Parameters

2.2.1. Liver enzymes: Liver enzymes that include serum glutamic pyruvic transaminase (SGPT), serum glutamic-oxaloacetic transaminase (SGOT), lactate dehydrogenase (LDH) and alkaline phosphatase (ALP) are raised in covid-19 patients due to liver injury. More severe cases show more increase in enzymatic levels. Quingxian Cai⁷ et al in their study of 417 COVID-19 patients showed 76.3% had abnormal liver function tests and more severe cases showed these enzymatic levels raised to three times than normal.

2.2.2. Serum creatinine (Scr) and BUN (blood urea nitrogen) levels: There is mild to moderate increase in Scr and BUN levels in covid-19 patients as this virus may affect kidneys due to presence of ACE receptors. Studies showed that approximately 10-14% of COVID-19 positive patients presented with increase in Scr and BUN levels and associated with unfavorable clinical outcome.^{8,9}

2.3. Serological Parameters

2.3.1. C-Reactive Protein (CRP): CRP is an important marker that changes significantly in COVID-19 patients.

Volume 12 Issue 7, July 2023

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CRP is produced by liver and categorized as an early marker of infection and inflammation. In blood, the normal concentration of CRP is <10mg/L. It rises rapidly within 6-8 hours of disease onset and falls down when tissue damaged is resolved. The available studies show a significant increase in CRP levels on an average of 20-25mg/L in 86% of covid-19 patients depending on the severity of illness. Also, the risk of developing severe events is increased by 5% for every one unit increase in CRP level.¹⁰

2.3.1. Ferritin: Ferritin is a key mediator of immune dysregulation. Hyperferritinemia in COVID-19 patients is seen due to cytokine storm and indicates severity of the disease. It is observed that the concentration of ferritin is generally within the normal range (30–400 µg/L) in patients with non-severe disease (according to the National health commission of China guidelines for COVID-19 severity classification). However, hyperferritinemia (ferritin level 400-1400 µg/L), was observed in patients with severe disease.¹¹

2.3.2. Interleukin (IL-6): IL-6 is proinflammatory cytokine produced by lymphocytes, monocytes, and fibroblasts. Studies show IL-6 concentration to be raised to 2-3 times higher in patients with complicated Covid-19 compared with non-complicated disease and associated with adverse clinical outcomes.¹²

2.3.3. Procalcitonin (PCT): Procalcitonin is an inflammatory marker. The increased levels of procalcitonin indicates the severity of disease in COVID-19 patients. It is seen that the mean serum procalcitonin level was over four times higher in severe patients than in moderate patients and was over eight times higher in critical patients than in moderate patients.¹³

2.3.3. Troponins: The increase in troponins levels is observed in acute respiratory illness, sepsis and myocardial injury. The covid-19 virus causes myocardial damage as a result of viral myocarditis or direct virus mediated lysis of cardiomyocytes. Abnormally high level of high sensitivity cardiac troponin I (above 99th percentile of upper reference value) could be observed in 19.7% of COVID- 19 patients.¹⁴

3. Conclusion

The COVID- 19 pandemic is characterized by respiratory illness and diverse systemic clinical presentation due to host inflammatory response to virus that may lead to cytokine storm causing multi-organ damage. This in turn is reflected by routine and specialized laboratory tests abnormalities, based on severity of disease. The routine laboratory parameters comprise an array of deranged CBC, coagulation profile, increased inflammatory biomarkers, tissue-specific tissue injury indicators (liver, kidney, cardiac). The WBC count, neutrophil count, lymphocyte count and platelet count may be used for screening of COVID-19 patients in correlation with clinico-radiological findings. NLR depending on age may be used to identify the need for hospitalization or ICU. In hospitalized patients, there should be close monitoring of CRP, PCT, D-dimer, ferritin, SGOT, SGPT, LDH, ALP, BUN and creatinine as markers for

potential progression to critical stage of the illness and fatality.

Source of funding: None.

Conflicts of interest: None.

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