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POTENTIAL BIOCHEMICAL MARKERS IN COVID-19 PATIENTS.

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ABSTRACT

The COVID-19 pandemic has indeed caused a global health crisis, and India is no exception to its impact. The country has been struggling to control the spread of the virus due to factors such as overpopulation, lack of awareness, and a weak healthcare system. The pandemic has also affected the Indian economy and development. COVID-19 primarily affects the respiratory system, but it can also have an impact on other organs such as the liver, kidneys, heart, and pancreas. Studies have shown that COVID-19 patients may present altered laboratory parameters, which can be used as biomarkers to assess the progression of the disease and categorize patients with severe and/or fatal clinical conditions. In COVID-19 patients, liver injury is a common finding and is associated with a worse prognosis. Elevated liver enzymes such as ALT and AST are frequently seen in COVID-19 patients, indicating liver damage. Similarly, renal impairment is also common, and elevated serum creatinine and blood urea nitrogen levels have been observed in severe cases. Cardiac injury is another significant complication of COVID-19 and can lead to arrhythmias, myocarditis, and heart failure. Elevated levels of cardiac biomarkers such as troponin, NT-proBNP, and CK-MB have been reported in COVID-19 patients with severe disease. Pancreatic injury in COVID-19 patients is also being increasingly recognized. Elevated levels of pancreatic enzymes such as amylase and lipase have been observed, indicating pancreatic inflammation and injury. Markers of inflammation such as CRP, IL-6, and ferritin have been found to be elevated in COVID-19 patients, and their levels correlate with disease severity. These markers can help predict which patients may progress to a severe clinical condition and require more aggressive management. In conclusion, COVID-19 can have significant impacts on various organ systems in the body, and monitoring altered laboratory parameters and biomarkers can aid in the early detection and management of complications associated with the disease.

INTRODUCTION/BACKGROUND

The COVID-19 pandemic has caused widespread disruption and has been responsible for millions of deaths worldwide. India, like many other countries, has been severely affected by the pandemic. The country has experienced two waves of infections so far, with the second wave being particularly devastating. To combat the pandemic, countries have been implementing various measures such as social distancing, lockdowns, and vaccination drives. In India, the government has launched a massive vaccination drive to inoculate its population against the virus. The focus has been on accelerating the pace of vaccination to reduce the severity of the third wave, which is widely expected to hit the country soon. It's crucial for people to continue to follow preventive measures such as wearing masks, maintaining social distancing, and practicing good hygiene to stay safe and prevent the spread of the virus. India reported its first case on 30 January 2020, till date approximately 3.03 Cr cases have been detected with 2.93 Cr recovered and 3.97 L deaths.[4-5] The country has passed through the second wave very short time before, the peak appeared to be on 9 May 2021. The preparation to reduce the impact of the third wave has begun with a large-scale vaccination drive.

Laboratory testing plays a crucial role in the diagnosis and management of COVID-19. Real-Time PCR is the most commonly used diagnostic test for detecting SARS-CoV-2, the virus that causes COVID-19. The RdRp gene is one of the target genes used in this test. Laboratory testing also helps in understanding the disease better by providing information on the epidemiology of the virus, including its spread and transmission patterns. This information is essential for developing effective public health strategies to control the spread of the virus. Moreover, laboratory testing helps in monitoring disease progression, determining the severity of the disease, and identifying patients who are at high risk of developing complications. It also helps in evaluating the efficacy of therapies and vaccines. In summary, laboratory medicine plays a critical role in the COVID-19 pandemic, not only for the diagnosis of the disease but also for understanding the disease, monitoring disease progression, and developing effective public health strategies.[9-10]

COVID-19 can trigger an exaggerated immune response in some patients, resulting in a cytokine storm. This cytokine storm is a systemic inflammatory response that can cause severe damage to vital organs and tissues, and even lead to death. Cytokines are small proteins that play a crucial role in the immune response to infections. However, an overproduction of cytokines can result in a hyperinflammatory state, which can contribute to the development of severe COVID-19. Inflammatory markers such as C-reactive protein (CRP), interleukin-6 (IL-6), and ferritin have been shown to be elevated in patients with severe COVID-19 and have been used as prognostic indicators of disease severity. Other markers, such as procalcitonin (PCT), have been used to differentiate COVID-19 from bacterial infections. Measuring these inflammatory markers can help in identifying patients at high risk of developing severe disease and may guide treatment decisions. For example, the use of anti-inflammatory drugs such as corticosteroids has been shown to be effective in reducing mortality in patients with severe COVID-19 and elevated inflammatory markers. Hence measuring inflammatory markers is an important tool in the management of COVID-19 patients, as it can provide valuable information on disease severity

and guide treatment decisions.

Biochemical markers of significant value in Covid-19 subjects are:

a) Inflammatory markers which include C-reactive protein and Interleukin-6.
b) Coagulation markers including D-dimer
c) Routine biochemical markers such as LDH, HbA1C, Liver and Renal function Tests, and Serum electrolytes.
d) Cardiac biomarkers such as Troponin I, CK-MB, Myoglobin and BNP

COVID-19 is a disease caused by the SARS-CoV-2 virus, and one of the common findings in severe cases is an inflammatory storm or cytokine storm. When the virus infects alveolar epithelial cells in the lungs, it triggers an immune response that leads to the production of cytokines such as IL-6, which activate the JAK-STAT3 signalling pathway and release other biochemical markers like CRP and ferritin. CRP is an acute phase reactant, which means that it is released in response to inflammation or injury, and its levels can be used as a marker of inflammation in COVID-19 patients. Ferritin, on the other hand, is a protein that stores iron and releases it when needed. Inflammation can alter iron homeostasis and lead to hyperferritinemia, which is a common finding in severe COVID-19 cases. Activated macrophages in COVID-19 patients can also lead to elevated production of cytokines and ferritin, which can contribute to the inflammatory response. Ferroptosis is a type of programmed cell death that is induced by iron-dependent lipid peroxidation, and it has been suggested as a possible mechanism of cell death in COVID-19 patients with high levels of ferritin.[15-16]

D-dimer is one of the protein fragments produced when any blood clot get dissolved in the body. Binding of spike protein to ACE-2 receptors of endothelial cells leads to apoptosis and thrombosis, final results is elevated D-dimer.[17]

Routine biochemical parameters like liver function tests (LFT), renal function tests, serum electrolytes, lactate dehydrogenase (LDH), and glycosylated haemoglobin have been found to be altered in COVID-19 patients. LFT abnormalities, including low serum albumin and deranged liver enzymes, have been reported in some COVID-19 patients, which may be due to virus-induced hepatocellular damage or drugs given for COVID-19 treatment. Renal function impairment and deranged serum urea and creatinine have also been indicated in COVID-19 infection. SARS-CoV-2 virus invades human cells through ACE-2 receptors, and ACE-2 has been considered a principal counter-regulatory mechanism of the renin-angiotensin system, which plays an essential role in controlling blood pressure and electrolyte balance. Hence, hyponatremia and hypokalemia have been documented in some COVID-19 cases. Hypoxia, which is a common clinical feature in COVID-19 patients, can lead to upregulation of the glycolytic pathway and elevated LDH in such patients. Cellular damage caused by the virus can also result in an increase in serum LDH concentration in COVID-19 patients. Glycosylated haemoglobin levels have also been found to be elevated in COVID-19 patients, which may indicate impaired glucose metabolism or insulin resistance. Overall, routine biochemical parameters can provide important diagnostic and prognostic information in COVID-19 patients.[14]

Viral infections, including COVID-19, can cause damage to the heart, and this can lead to an increase in cardiac biomarkers in the blood. Troponin I, myoglobin, CK-MB, and BNP are all biomarkers that can indicate cardiac damage or stress. Troponin I is a protein that is released when the heart muscle is damaged, and it is a specific and sensitive marker of cardiac injury. Myoglobin is another protein that is released when the heart muscle is damaged, but it is not as specific as troponin I. CK-MB is an enzyme that is released when the heart muscle is damaged, and it can be used to differentiate cardiac damage from skeletal muscle damage. BNP is a hormone that is released by the heart in response to stress, and it can indicate the severity of heart failure.

In COVID-19 patients, elevated cardiac biomarkers have been associated with more severe disease and worse outcomes. It is believed that COVID-19 can cause direct damage to the heart muscle through various mechanisms, including inflammation, oxidative stress, and endothelial dysfunction. Additionally, the virus can bind to ACE2 receptors, which are found on the surface of heart cells, and this can lead to myocarditis. It is important to monitor cardiac biomarkers in COVID-19 patients, especially those with pre-existing heart conditions or those who develop cardiac symptoms during their illness. This can help healthcare providers identify patients who may need more aggressive treatment and monitoring.[19-21]

These cardiac biomarkers, including troponin I, myoglobin, CK-MB, and BNP, can be measured using commonly available and cost-effective biochemistry analyzers, including chemi-immunofluorescence and immunofluorescence quantitative analyzers. In developing countries like India, where resources may be limited, the availability of these types of analysers can be particularly beneficial. These analysers are relatively easy to use and require minimal training, making them suitable for use in smaller healthcare facilities that may not have access to more specialized equipment. Measuring these cardiac biomarkers can be especially important in the context of COVID-19, where cardiac involvement can be a significant complication. By monitoring these biomarkers, healthcare providers can identify patients who may be at higher risk of developing cardiac complications and adjust their treatment accordingly. It is worth noting, however, that the accuracy and precision of these analysers may vary depending on the specific brand and model used. It is important to ensure that the analyser used is validated for the specific biomarker being measured and to follow appropriate quality control measures to ensure accurate and reliable results.[9]

CONCLUSION

COVID-19 is a systemic illness that can affect multiple organs and systems in the body. As such, a range of laboratory changes can be observed in patients with COVID-19, reflecting the underlying disease severity and organ involvement. Inflammatory biomarkers such as IL-6 and CRP are commonly elevated in patients with severe COVID-19, indicating the presence of an intense immune response and potential cytokine storm. D-dimer, a marker of coagulation activation, is also frequently elevated in severe COVID-19, reflecting the increased risk of thrombotic complications. Tissue-specific indicators such as liver enzymes (AST, ALT), kidney function markers (creatinine, BUN), and cardiac biomarkers (troponin, BNP) may also be elevated in COVID-19 patients, reflecting potential organ damage or dysfunction. Lactate dehydrogenase (LDH), a marker of tissue injury, is also commonly elevated in COVID-19 patients, particularly those with severe disease. Routine and special blood tests in clinical biochemistry can be a valuable tool for understanding COVID-19 and monitoring patients with the disease. These tests can provide important information about disease severity, organ involvement, and potential complications. This information can help healthcare providers make informed decisions about patient management and treatment.

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