IAMJ

INTERNATIONAL AYURVEDIC MEDICAL JOURNAL

Review Article ISSN: 2320-5091 Impact Factor: 6.719

IMPACT OF COVID-19 ON DIAGNOSTIC ANALYSIS OF MYOCARDITIS

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https://doi.org/10.46607/iamj06p9012024

(Published Online: November 2024)

Open Access

Article Received: 20/10/2024 - **Peer Reviewed:** 17/11/2024 - **Accepted for Publication:** 24/11/2024.

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ABSTRACT

Introduction: Myocarditis is a disease caused by inflammation of the heart muscle, the myocardium. The myocardium is responsible for contracting and relaxing to pump blood in and out of the heart and the rest of the body. When this muscle becomes inflamed, its ability to pump blood becomes less effective. This causes problems such as abnormal heartbeat, chest pain, or breathing disorders. In extreme cases, it can also cause blood clots that lead to heart attack, stroke, and even death.

Purpose: To study the aggravating factors of COVID-19 that caused myocarditis and its prevention. Despite the distinctive clinical signs of patients with COVID-19, there are still elements that remain undiscovered, such as the prognostic factors of COVID-19, which include external factors, such as viral load and internal factors, which include the health conditions of the individual, the incidence rate of myocarditis and distinguishing signs.

Materials and Methods: This is a retrospective study highlighting the clinical and radiographic signs of the above cases diagnosed with COVID-19. Demographic, epidemiologic, radiologic, and laboratory data collected from medical record reviews of adult patients diagnosed with COVID-19 provided the basis for their follow-up. Measurement of the cycle threshold value (Ct), real-time PCR (RT-PCR), electrocardiogram (ECG), and measurement of pulmonary inflammation index (PII) values were among the most frequent examinations performed in these patients.

Results: In the study, 75 adult patients diagnosed with COVID-19 admitted to QSUNT were included, of which 15 cases were severe and 60 were in stable condition. The viral load of severe cases was significantly higher than that of stable patients, regardless of PCR values. Typical Ct abnormalities were more likely to exist in the severe group than in the non-severe group, associated with consolidation and thickening of the interlobular septum and increased PII values. Of the 75 patients, 12 patients were noted to have an abnormal ECG and elevated serum myocardial enzyme levels, and five were clinically diagnosed with SARS-COV-2-induced myocarditis.

Conclusion: During the patient study, three independent risk factors of COVID-19 were identified, which included age, PII, and Ct value. The Ct value is closely related to the severity of COVID-19 and may act as a predictor of the clinical severity of early-stage COVID-19. Oxygen pressure, along with laboratory tests, are elements that should not be neglected as they are also closely related to the severity of COVID-19.

Keywords: COVID-19, Ct, ECG, Myocarditis, PCR

INTRODUCTION

Myocarditis is an inflammatory disease of the heart muscle, usually caused by infections, immune diseases or toxins. In severe cases, myocarditis can lead to permanent heart damage, such as dilated cardiomyopathy and heart pump failure. The symptoms of myocarditis tend to be related to the severity of the inflammation in the heart muscle. They may be associated with mild myocarditis, while severe symptoms usually reflect a significant inflammatory process [1].

The consequences of the 2019 coronavirus disease (COVID-19) have been devastating globally [2]. COVID-19 can affect various physiological systems, leading to chronic health conditions and long-term disabilities that pose significant challenges to healthcare systems Worldwide [3,4]. Nearly 25% of patients hospitalized as a result of COVID-19 have damage to the heart, very often also to the myocardium. In many people, myocarditis is a relatively mild and self-limited disease with so few symptoms that it can often be confused with the symptoms of the virus itself that causes it. If myocarditis worsens to the point of heart failure, dyspnea (difficulty breathing), oedema in the lower limbs (swelling of the legs), narrowing and pain in the chest, palpitations, tachycardia, etc. [5,6,7].

Myocardial injury is a common complication observed in hospitalized patients with COVID-19 and is strongly associated with severe morbidity and in-hospital mortality. However, the long-term consequences of myocardial injury on clinical outcomes remain unclear [8].

COVID-19 is a respiratory, systemic syndrome which mainly presents clinical symptoms of dry cough, wheezing, sore throat, dyspnea and fever, which, in some cases (8-15%) depending on the geographical environment and individual characteristics), lead to pneumonia and even more critical conditions that require specialized management in in intensive care units (ICU) [9,10].

Timely identification of virus carriers is vital not only to prevent their spread but also to more efficiently control the progression of the disease. Few studies refer to the values of diagnostic and prognostic laboratory tests of COVID-19 since most of the published articles deal more with the clinical features, the structure of the virus, or its imaging findings [11, 12, 13.]

Based on several studies conducted mainly in China, where the outbreak occurred, patients affected by COVID-19 were classified based on age and whether patients required intensive care or not. Patients aged less than 10 years and 10–19 years were found to have a smaller percentage of being affected by COVID-19, about 1%, compared to those aged over 60. Classification into groups treated by intensive care units (ICU 26.1%) and groups that did not require intensive care (without ICU 73.9%) highlighted that patients treated in ICU were mostly elderly, with co-morbidities, who complained of dyspnea and anorexia, compared to non-ICU patients. This division of

patients also depended on several other factors, which were: 1) Difficulty breathing, 2) O2 saturation, 3) Arterial partial pressure of oxygen, 4) Pulmonary imaging, 5) Respiratory failure and 5) Combined shock with the failure of other organs [14].

Laboratory indicators in intensive care patients included higher white blood cell and neutrophil counts, higher levels of D-dimer, creatine kinase, ferritin, and creatine, and, in particular, the highest level of lactate dehydrogenase (LDH) [18-22].

Another important diagnostic characteristic of COVID-19 is detecting SARS-CoV-2 nucleic acid by real-time PCR (RT-PCR). For RT-PCR diagnosis, the cycle threshold value (Ct) mainly reflects the viral copies, i.e. the viral load. A low Ct value represents a higher viral load as an external factor for individuals [15].

Methods

A retrospective study highlighted the clinical and radiographic signs of the above cases that were diagnosed with COVID-19. Demographic, epidemiologic, radiologic imaging and laboratory data were collected from intensive reviews of the medical records of the included cases and with duplicate controls. Diagnosis and treatment were carried out in full compliance with the COVID-19 program. The study subjects had nasopharyngeal samples taken every 24 hours, which were subjected to duplicate tests to detect SARS-CoV-2 nucleic acid. Thus, viral nucleic acid from samples was performed using viral isolation kits, while real-time fluorescence PCR was performed with diagnostic reagent kits [15,16,17]

Laboratory tests

The main routine tests required in patients with COVID-19 include the hemogram, tests related to coagulation and fibrinolysis such as (PT, aPTT, and D-dimer), and tests related to inflammation (ESR-erythrocyte sedimentation rate, PCR, ferritin, and procalcitonin). Due to the ability of the virus to seriously damage some vital organs, such as the heart, liver and kidneys, the analysis of biochemical factors is a suitable way for clinicians to evaluate the functional activities of these organs. During the examination of this analysis, it was noticed that the increased levels they had were lactate dehydrogenase (LDH), alanine aminotransferase (ALT), aspartate aminotransferase (AST), total bilirubin (Bili Tot), creatinine kinase (CK) and creatinine (Cr), and decreased levels of albumin. The increased CK, CKMB or LDH levels indicated significant damage to the cardiovascular system at [18-21].

Based on the analysis of some patients with COVID-19, of various forms, severe and non-severe, it has been noticed that the values of the elements of the leukocyte formula, especially of leukocytes, lymphocytes and neutrophils, have changed. The most common abnormal findings that attracted attention during a hemogram in patients with COVID-19 were decreased lymphocytes associated with neutrophils and mild thrombocytopenia. Eosinophils and basophils were also essential elements in the identification of COVID-19. The absence of the number of eosinophils and basophils in a hemogram is an important clue that can help in the early diagnosis of COVID-19 and whether to start therapy in these patients. Continuous eosinopenia or basopenia in a patient with COVID-19 is also related to the high aggressiveness of the disease [20,21].

Regarding coagulation factors, some patients with COVID-19 have increased prothrombin time (PT), prolonged activated partial thromboplastin time (aPTT), and D-dimer, which is one of the most important indicators of disease progression [21, 22.]

Electrocardiographic examination (ECG)

During admission, each patient undergoes routine ECG examinations. A senior technician evaluates and reports each electrocardiogram. Abnormal ECGs are collected and analyzed in combination with clinical manifestations and serum myocardial enzyme tests. Repeated ECGs are mainly performed on patients with suspected myocardial damage.

The results

In total, 75 adult patients admitted to QSUT and diagnosed with COVID-19 were included in the study. The average age was 50, with 40 men. Among these patients, 15 cases were classified as severe, while 60 cases were not severe.

The average duration from the onset of the disease to the establishment of the diagnosis was 2 days. The initial symptoms for patients were fever, fever, cough, fatigue, headache and body ache, dizziness, sore throat, shortness of breath, diarrhea, dyspnea, nausea, etc. In addition to these patients, there were also asymptomatic patients, all of whom were included in the non-severe group. The average temperature of these patients was 37.7°C, compared to a higher temperature for the group of patients in the severe group. 30 cases mainly had one or more comorbidities, with the most common diseases being hypertension, liver damage, diabetes, cardiomyopathy, respiratory disease, and brain disease. Less common comorbidities were tumors and renal impairment.

Laboratory parameters

The latter also had significant differences between patients in the severe and non-severe groups. Specific intergroup laboratory findings included elevated values of CRP, ESR, PCT, IL-6, CK, LDH, IMA, AST, ALT, NEUT, PT, D-DIMER, etc.

In addition to these parameters, it was observed that, in the detection of lymphocyte subsets, the total number of T lymphocytes, the number of B lymphocytes, and the number of inhibitory/cytotoxic T lymphocytes were significantly reduced in the severe patients compared to the non-severe group.

Clinically diagnosed with myocarditis

Among 75 patients, we found 12 patients with abnormal indicators of myocardial damage combined with abnormal ECG, including seven severe patients and five non-severe patients. Four of the 12 patients were associated with cardiovascular disease, while the other eight patients did not have cardiovascular disease. Of these, 3 cases were accompanied by a history of hypertension and one patient with atrial fibrillation and coronary heart disease. Most patients had abnormal changes to myocardial enzymes or cTnI.

Typical abnormal ECG findings were observed in 10 patients and were associated with significant ECG abnormalities, including sinus tachycardia or bradycardia, t-wave changes, atrioventricular block, and Q-wave abnormality. Based on the most up-to-date diagnostic criteria of viral myocarditis, 5 cases were clinically diagnosed as SARS-CoV-2 myocarditis in combination with their manifestations, i.e. confirmed SARS-CoV-2 infection, typical ECG abnormalities and increased laboratory indicators of myocardial damage.

DISCUSSION

This study analyses extrinsic factors (viral load) and intrinsic risk factors of patients with COVID-19. Myocarditis caused by SARS-CoV-2 was clinically diagnosed with a high incidence rate. Previous studies have focused mainly on the clinical characteristics, imaging findings and treatment measures of COVID-19 and less on its risk factors and complications.

The study showed that there were significant differences between severe and non-severe COVID-19 cases in age, and not only that. Clinical manifestations, imaging findings, levels of inflammatory cytokines and myocardial enzymes, and the distribution of lymphocytes and their subsets also had highly significant differences that were also related to the severity of COVID-19.

Ct values from RT-PCR can be an essential indicator of viral load. Viral load is closely related to disease severity in respiratory infectious diseases. The study found that patients' viral load was associated with the severity of COVID-19 as an independent risk factor.

Moreover, all complications (except gastrointestinal disorders) occurring in patients with COVID-19 during hospitalization were more pronounced in severe than non-severe patients. Of the 75 patients in the study, 33 had a high level of cardiac enzymes (cTnI). After the exclusion of cardiac disease history and a combination of ECG and clinical manifestations, five patients were clinically diagnosed with SARS-CoV-2 myocarditis.

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Source of Support: Nil
Conflict of Interest: None Declared

How to cite this URL: Klara Hysenaj et al: Impact of covid-19 on diagnostic analysis of myocarditis. International Ayurvedic Medical Journal {online} 2024 {cited November 2024} Available from: http://www.iamj.in/posts/images/upload/41_45.pdf