

ISSN: 1674-0815

Chinese Journal of Health Management

Chinese Medical Association



Study Of Clinical Cardiac Manifestations, Ecg and Echo Findings in The Post-Acute Phase of Covid-19 In Otherwise Healthy Individuals

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Article Information

Received: 02-06-2026

Revised: 16-06-2026

Accepted: 23-06-2026

Published: 28-07-2026

Keywords

COVID-19, Post-acute COVID syndrome, Cardiovascular manifestations, Electrocardiography, Echocardiography, Cardiac biomarkers, SARS-CoV-2, Cardiac dysfunction, Post-COVID cardiac care, Arrhythmias

ABSTRACT:

Background: The SARS-CoV-2 virus, first identified in 2019, has demonstrated significant cardiovascular implications beyond its primary respiratory manifestations. While acute cardiac complications of COVID-19 have been well-documented, the post-acute cardiac manifestations in otherwise healthy individuals remain an area of ongoing research. **Methods:** This descriptive cross-sectional study investigated the clinical cardiac manifestations, ECG, and echocardiographic findings in 92 post-COVID-19 patients at teaching hospitals affiliated with Kasturba Medical College, Mangalore. The study included previously healthy people who were above 18 years of age and who had confirmed evidence of COVID-19 infection at least one month prior, excluding those with pre-existing cardiovascular conditions or acute-phase cardiac involvement. **Results:** We found that males comprised 69.6% of participants, with the majority (46.7%) aged 31-45 years. Common cardiac symptoms included palpitations (30.4%), dyspnea (29.3%), chest pain (25%), and syncope/light-headedness (25%). ECG abnormalities were frequently observed, with tachycardia being the most common (29.3%), followed by ST-T changes (26.1%) and QRS variations (20.7%). Among rhythm disorders (14.1%), atrial fibrillation was predominant (61.5%). Echocardiographic findings revealed diastolic dysfunction (20.7%), biventricular dysfunction (18.5%), decreased ejection fraction (14.1%), pericardial effusion (12%), and pulmonary arterial hypertension (12%). Elevated cardiac biomarkers were noted in 32.6% of patients. **Conclusion:** The study demonstrates significant cardiac involvement in post-acute COVID-19, even in previously healthy individuals,

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emphasizing the importance of thorough cardiovascular assessment and monitoring in COVID-19 survivors. These findings contribute to the growing understanding of COVID-19's long-term cardiac implications and support the development of targeted post-COVID cardiac care protocols.

INTRODUCTION:

The COVID-19 illness which was first detected in 2019 with symptoms similar to pneumonia is caused by the SARS-CoV-2 virus. [1]. It was announced to be a "Public health emergency of international concern (PHEIC)" [2], with vaccination campaigns being the primary intervention [3].

Common symptoms include sore throat, cold, dry cough, fatigue, fever, dyspnea, and occasionally diarrhea and headache [4]. Severe cases may develop multiple organ complications, including cardiac damage, rhythm abnormalities, acute lung injury, thrombosis, infarct, and secondary infections [5].

Cardiovascular manifestations include myocarditis, arrhythmias, thrombosis, endothelial damage, and cardiac fibrosis, potentially caused by direct viral damage or inflammatory response [6]. The virus enters host cells through ACE2 receptors [7], which are present in cardiac myocytes and influence cardiac physiology, hypertension, and diabetes mellitus [8]. Cytokine storms and hypoxia contribute to cardiac damage [9], leading to various ECG patterns [10].

Initial therapeutic investigations explored medications like remdesivir, hydroxychloroquine, chloroquine, lopinavir, favipiravir, and oseltamivir [11], along with supplements and other treatments [12]. Some medications, particularly azithromycin, hydroxychloroquine, and chloroquine, were associated with ECG abnormalities, especially QTc prolongation [13].

Approximately 90% of severe cases showed ECG abnormalities, with manifestations like atrial fibrillation, prolonged QT intervals, ST-T changes, and ventricular arrhythmias correlating with poor outcomes [14]. These changes may result from inflammatory storms, hypoxic damage, electrolyte imbalances, coronary spasm, plaque rupture, thrombosis, or direct injury [13,14].

This study aims to investigate ECG and echocardiographic changes in post-COVID-19 patients, particularly in the Indian population, where limited research exists. The focus is on understanding cardiac manifestations in the post-acute phase, which is crucial for developing healthcare policies and post-discharge monitoring programs.

METHODOLOGY:

This descriptive cross-sectional study was carried out in teaching hospitals connected to Kasturba Medical College in Mangalore, Manipal Academy of Higher Education. The study period extended from the ethics committee approval date until December 2023.

The study population included consenting adults who were 18 years old and older who had confirmed COVID-19 infection at least one month prior to study commencement. Participants with pre-existing cardiovascular disease, hypertension, diabetes mellitus, hypothyroidism, or those who developed cardiovascular changes at the time of acute phase of COVID-19 were excluded. Using convenience-based non-probability sampling, a sample size of 92 was calculated as derived from a previous research showing 60% cardiac sequelae in post-COVID patients.

Data collection commenced after approval was given by the Institutional Ethics Committee and required permissions from hospital authorities. Patients were interviewed during their follow-up visits by residents who could communicate in local languages. A pre-validated, semi-structured case record form was used to collect information about demographics, symptomatology, comorbidities, hospitalization requirements, disease severity, and treatment course.

All participants underwent a thorough clinical systemic examination along with investigations including a 12-lead electrocardiogram and 2D-echocardiography. Cardiac biomarkers were performed when indicated. These tools helped assess cardiac involvement, including various dysrhythmias and other cardiac manifestations.

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The data was analyzed using SPSS Version 25.0. Qualitative variables were analyzed using percentages and proportions, while quantitative variables were analyzed using mean $\pm$ standard deviation or median $\pm$ interquartile range. Independent t-test/Mann Whitney U test was employed for comparing data with baseline investigations where applicable. Statistical significance was set at $p < 0.05$.

The study maintained strict ethical considerations, including informed consent and participant confidentiality. No additional financial burden was placed on the participants, and the study was not funded by any pharmaceutical company or institution.

RESULTS:

The demographic analysis (Table 1) showed a male predominance (69.6%) in the study population. The age distribution revealed that most participants were middle-aged adults, with 46.7% falling in the 31-45 years age group, followed by 31.5% in the 18-30 years category. Regarding COVID-19 severity, the majority (78.3%) experienced mild disease (Category A), while 15.2% had severe disease (Category C). Nearly half of the participants (46.7%) were assessed more than 12 months after their COVID-19 infection.

Table 1: Demographic and COVID-19 Characteristics (n=92)

Characteristic	Category	n (%)
Gender	Male	64 (69.6%)
	Female	28 (30.4%)
Age Groups (in years)	18-30	29 (31.5%)
	31-45	43 (46.7%)
	46-60	16 (17.5%)
	>60	4 (4.3%)
COVID-19 Severity Category	A (Mild)	72 (78.3%)
	B (Moderate)	6 (6.5%)
	C (Severe)	14 (15.2%)
Time Since COVID-19 (in months)	<6	10 (10.9%)
	6-12	39 (42.4%)
	>12	43 (46.7%)

Cardiovascular symptomatology (Table 2) demonstrated that palpitations were the most frequent complaint (30.4%), closely followed by dyspnea (29.3%). Chest pain and syncope/light-headedness were equally prevalent, each affecting 25% of participants. Notably, elevated cardiac biomarkers were observed in 32.6% of cases, indicating ongoing cardiac involvement.

Table 2: Cardiovascular Symptoms Post-COVID (n=92)

Symptom	Present n (%)
Palpitations	28 (30.4%)
Dyspnea	27 (29.3%)
Chest Pain	23 (25%)
Syncope/Light headedness	23 (25%)
Elevated Cardiac Biomarkers	30 (32.6%)

ECG findings (Table 3) revealed tachycardia as the most common abnormality (29.3%), with 40.7% of these cases attributed to Postural Orthostatic Tachycardia Syndrome (POTS). ST-T changes were observed in 26.1% of participants, while QRS variations were present in 20.7%. Among rhythm disorders (14.1%), atrial fibrillation was the predominant finding, accounting for 61.5% of rhythm abnormalities.

Table 3: ECG Findings (n=92)

Finding	Present n (%)	Type Distribution
Tachycardia	27 (29.3%)	POTS: 11 (40.7%)
		Non-autonomic: 16 (59.3%)
ST-T Changes	24 (26.1%)	-
QRS Variations	19 (20.7%)	-
Rhythm Disorders	13 (14.1%)	Atrial fibrillation: 8 (61.5%)
		SVT: 3 (23.1%)
		First-degree heart block: 2 (15.4%)

Echocardiographic assessment (Table 4) identified diastolic dysfunction as the most prevalent finding (20.7%), followed by biventricular dysfunction (18.5%). Decreased ejection fraction was noted in 14.1% of participants,

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while both pericardial effusion and pulmonary arterial hypertension were observed in 12% of cases. These findings suggest significant cardiac structural and functional alterations in post-COVID patients, even in those without pre-existing cardiac conditions.

Table 4: Echocardiography Findings (n=92)

Finding	Present n (%)
Diastolic dysfunction	19 (20.7%)
Biventricular dysfunction	17 (18.5%)
Decreased Ejection Fraction	13 (14.1%)
Pericardial Effusion	11 (12%)
Pulmonary arterial hypertension	11 (12%)

DISCUSSION:

COVID-19 has been linked to various cardiac complications, with injury to the myocardium being a significant concern. Multiple mechanisms contribute to heart injury in COVID-19, including viral myocarditis through ACE receptor interaction, cytokine release syndrome, acute coronary syndrome, hypercoagulable states, and direct myocardial injury. Additionally, treatments like steroids, electrolyte imbalances, and antiviral medications can cause cardiac damage [15]. Early studies from China showed that 1-7% of patients contracted the illness, with 26% requiring critical care, and research by Shi et al. established a correlation between cardiac involvement and increased mortality [16].

Clinical cardiac manifestations in post-COVID patients include chest pain, palpitations, arrhythmias, dyspnea, and exercise intolerance. ECG findings commonly reveal sinus tachycardia, ST-T segment changes, various arrhythmias, and QT interval prolongation. Echocardiographic examinations show myocardial dysfunction, pericardial effusion, right ventricular strain, and valvular abnormalities. Studies by multiple researchers, including Angeli F et al. [17], Wang Y et al. [18], and Kaliyaperumal D et al. [19], have documented these findings across diverse patient populations, with male predominance (69-72%) and varying age distributions.

The impact of vaccination and disease severity has been noted, with studies like Zhao X et al. [20] reporting vaccination rates of 18-21% among patients with and without cardiovascular comorbidities. Clinical presentations varied, with studies by Menezes Junior AD et al. [21] showing 52.5% moderate disease cases, and Keihanian F et al. [22] reporting high rates of dyspnea (90.8%), cough (54.9%), and fever (49.3%). Significant ECG and echocardiographic abnormalities were documented across multiple studies, including Ryabykina et al. [23], Aghajani et al. [24], and Ingul CB et al. [25], highlighting the diverse cardiac manifestations in post-COVID patients and emphasizing the need for comprehensive cardiovascular evaluation and management.

CONCLUSION:

The comprehensive analysis of clinical cardiac manifestations, ECG findings, and echocardiographic abnormalities in post-acute COVID-19 patients reveals the significant cardiovascular impact of this viral illness, even in previously healthy individuals. The diverse spectrum of presentations—ranging from palpitations and chest discomfort to complex arrhythmias and structural heart changes—underscores COVID-19's role as a systemic disease with substantial cardiac implications. ECG findings frequently show sinus tachycardia, ST-T changes, and various arrhythmias, while echocardiographic assessments reveal structural and functional abnormalities including myocardial inflammation, myocarditis, and fibrosis. These findings emphasize the critical need for thorough cardiac evaluation and monitoring in COVID-19 survivors, highlighting the importance of a multidisciplinary approach to patient care. As our awareness of the prolonged cardiovascular consequences of COVID-19 continues to evolve, ongoing research remains essential to optimize patient outcomes and develop targeted management strategies, ultimately contributing to better healthcare delivery in the context of this unprecedented global health crisis.

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