



ECHOCARDIOGRAPHIC CHARACTERISTICS OF COVID 19 PATIENTS - A STUDY FROM DISTRICT SUPERSPECIALITY HOSPITAL IN EASTERN INDIA

Cardiology

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ABSTRACT

Introduction: Coronavirus disease 2019 (COVID-19) has emerged as a major cause of morbidity and mortality that is placing unprecedented pressure on healthcare services across the world. Echocardiography is well placed to help further this understanding, being inexpensive, portable, and widely accessible. **Aims:** To describe the cardiac abnormalities in patients with COVID-19 and identify the characteristics of patients who would benefit most from echocardiography. **Materials And Method:** **Result:** In our study, out of 1060 patients, most of the 64 patients were 53–73 years of age in Abnormal scan and 60 patients were 51–69 years of age in Normal scan. Age was not significantly associated with echocardiography ($p=0.7194$). In our study, majority number of patients had severe symptom severity in Abnormal scan [340 (52%)] compared to normal scan [285 (55%)] and it was statistically significant ($p<0.0001$). In our study, 118 patients had Mild Left ventricular abnormality, 87 patients had Moderate Left ventricular abnormality, 59 patients had severe Left ventricular abnormality, 67 patients had dilated Left ventricular abnormality, 37 patients had New MI, 36 patients had Myocarditis and 18 patients had Takotsubo which was statistically significant ($p<.00001$). We observed that, most of the patients had Elevated PAP right ventricular abnormality though it was statistically significant ($p<.00001$). It was found that, most of the 137 patients had Mild or Moderate Biventricular Failure and it was statistically significant ($p<.00001$). **Conclusion:** Cardiac abnormalities were observed in half of all COVID-19 patients undergoing echocardiography. Abnormalities were often unheralded or severe, and imaging changed management in one-third of patients.

KEYWORDS

COVID-19, echocardiography and cardiac abnormalities

INTRODUCTION

Coronavirus disease 2019 (COVID-19) has emerged as a major cause of morbidity and mortality that is placing unprecedented pressure on healthcare services across the world.¹ Whilst the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) responsible for COVID-19 predominantly affects the respiratory tract,² patients with cardiovascular risk factors or established disease and those with elevated cardiac biomarkers appear to be more susceptible and to have a worse prognosis³. The mechanisms underlying these initial observations remain unclear.

Early case reports suggest that COVID-19 can cause a wide range of cardiac conditions that include acute myocardial infarction,⁴ myocarditis,⁵ and takotsubo cardiomyopathy.⁶ Acute left and right ventricular failure may be a direct consequence of cardiac pathology, with the latter also arising secondary to elevations in right ventricular afterload due to pulmonary embolism or pneumonia.⁷ Virus particles have been observed in the myocardium and vascular endothelium in patients with COVID-19 and cardiogenic shock.^{8,9} However, the incidence of these cardiac complications and the subsequent implications for treatment and resource allocation are unknown. Consequently, there is an urgent need to better understand the interactions between COVID-19 and the heart.

Echocardiography is well placed to help further this understanding, being inexpensive, portable, and widely accessible. However, a large systematic evaluation of echocardiography in all patients with COVID-19 would be highly challenging due to the logistical considerations of testing, consumption of personal protective equipment (PPE), and the risk of further viral transmission. We therefore conducted a survey to capture the findings of echocardiography performed on clinical grounds in patients with confirmed or a high probability of COVID-19.

AIMS AND OBJECTIVE

Aims:

To describe the cardiac abnormalities in patients with COVID-19 and identify the characteristics of patients who would benefit most from echocardiography

METHODS

Any transthoracic echocardiogram that was performed on a patient with confirmed, or a high probability of, COVID-19 in the hospital setting was eligible for inclusion. Patients were imaged as part of routine care, and non-identifiable patient data were captured. As such,

this audit did not require individual patient consent and this approach was approved by local research ethics committees.

First, several baseline characteristics are recorded: age, sex, comorbidities, symptom severity, COVID-19 status, presence of pneumonia, and the location in hospital where imaging was performed. Secondly, the indication for imaging is recorded: suspected left heart failure, suspected right heart failure, chest pain with ST-segment elevation on the electrocardiogram cardiac biomarker elevation [troponin or brain natriuretic peptide (BNP)], ventricular arrhythmia, suspected tamponade, or cardiogenic shock. Thirdly, echocardiographic findings are captured for left ventricular abnormalities (normal, mild, moderate, or severe systolic dysfunction, dilatation, evidence of new myocardial infarction, myocarditis, or takotsubo cardiomyopathy), right ventricular abnormalities (normal, mild or moderate, or severe systolic dysfunction, dilatation, D-shaped left ventricle, or elevated pulmonary artery pressure), or cardiac tamponade. The survey then captures whether the echocardiogram changed patient management.

RESULTS

Age

In Abnormal scan, 64 patients were 53–73 years of age. In Normal scan, 60 patients were 51–69 years of age. Association of Age with echocardiography was not statistically significant ($p=0.7194$).

Sex

In Abnormal scan, 190 patients were Female and 462 patients were male. In Normal scan, 128 patients were Female and 280 patients were male.

Association of Sex with echocardiography was not statistically significant ($p=0.4404$).

Location of scan

In Abnormal scan, 382 patients had Critical care scan and 284 patients had Non-critical care scan.

In Normal scan, 254 patients had Critical care scan and 140 patients had Non-critical care scan.

Association of Location of scan with echocardiography was statistically significant ($p=0.0224$).

COVID-19 status

In Abnormal scan, 409 patients had Confirmed COVID-19 status, 163 patients had High probability status and 135 patients had Evidence of pneumonia.

In Normal scan, 404 patients had Confirmed COVID-19 status, 84 patients had High probability status and 77 patients had Evidence of pneumonia.

Association of COVID-19 status with echocardiography was statistically significant ($p < 0.0001$).

Symptom severity

In Abnormal scan, 46 patients had Mild severity, 210 patients had Moderate severity and 340 patients had severe severity.

In Normal scan, 62 patients had Mild severity, 117 patients had Moderate severity and 285 patients had severe severity.

Association of Symptom severity with echocardiography was statistically significant ($p < 0.0001$).

Co-morbidities

In Abnormal scan, 254 patients had Hypertension, 136 patients had Diabetes mellitus, 137 patients had Ischaemic heart disease, 106 patients had Heart failure and 53 patients had Valvular heart disease.

In Normal scan, 193 patients had Hypertension, 93 patients had Diabetes mellitus, 30 patients had Ischaemic heart disease, 7 patients had Heart failure and 27 patients had Valvular heart disease.

Association of Hypertension ($p = 0.0039$), Diabetes mellitus ($p = 0.0044$), Ischaemic heart disease ($p < 0.0001$), Heart failure ($p < 0.0001$) and Valvular heart disease ($p = 0.0036$) with echocardiography were statistically significant.

Indication

In our study, 194 patients had suspected left heart failure in abnormal scan and 97 patients had suspected left heart failure in Normal scan.

Association of Suspected left heart failure with echocardiography was not statistically significant ($p = 1.2987$).

In our study, 95 patients had suspected right heart failure in abnormal scan and 48 patients had suspected right heart failure in Normal scan.

Association of Suspected right heart failure with echocardiography was statistically significant ($p < 0.0001$).

In our study, 46 patients had Chest pain and ST-elevation in abnormal scan and 11 patients had Chest pain and ST-elevation in Normal scan.

Association of Chest pain and ST-elevation with echocardiography was statistically significant ($p < 0.0001$).

In our study, 166 patients had elevated cardiac biomarkers in abnormal scan and 48 patients had elevated cardiac biomarkers in Normal scan.

Association of elevated cardiac biomarkers with echocardiography was statistically significant ($p < 0.0001$).

In our study, 164 patients had Troponin in abnormal scan and 75 patients had Troponin in Normal scan.

Association of Troponin with echocardiography was not statistically significant ($p = 8.566$).

In our study, 97 patients had BNP in abnormal scan and 22 patients had BNP in Normal scan.

Association of BNP with echocardiography was statistically significant ($p < 0.0001$).

In our study, 23 patients had Ventricular arrhythmia in abnormal scan and 5 patients had Ventricular arrhythmia in Normal scan.

Association of Ventricular arrhythmia with echocardiography was statistically significant ($p = 0.0006$).

In our study, 13 patients had Cardiac tamponade in abnormal scan and 7 patients had Cardiac tamponade in Normal scan.

Association of Cardiac tamponade with echocardiography was not statistically significant ($p = 0.1797$).

In our study, 48 patients had Circulatory shock in abnormal scan and 14 patients had Circulatory shock in Normal scan.

Association of Circulatory shock with echocardiography was statistically significant ($p < 0.0001$).

Change in management

In Abnormal scan, 277 patients had Change in management.

In Normal scan, 68 patients had Change in management.

Association of Change in management with echocardiography was statistically significant ($p < 0.0001$).

Management group

In Abnormal scan, 130 patients had Disease-specific therapy, 18 patients had Level of care, 37 patients had Haemodynamic support and 112 patients were in other Management group.

In Normal scan, 40 patients had Disease-specific therapy, 12 patients had Level of care, 16 patients had Haemodynamic support and 41 patients were in other Management group.

Association of Management group with echocardiography was not statistically significant ($p = 0.2728$).

In our study, 118 patients had Mild abnormality, 87 patients had Moderate abnormality, 59 patients had severe abnormality, 67 patients had dilated abnormality, 37 patients had New MI abnormality, 36 patients had Myocarditis abnormality and 18 patients had Takotsubo abnormality. In our study, 93 patients had Mild or Moderate abnormality, 42 patients had severe abnormality, 161 patients had dilated abnormality, 47 patients had D-shaped LV abnormality and 99 patients had Elevated PAP abnormality.

In our study, 68 patients had Mild Biventricular Failure, 57 patients had Moderate Biventricular Failure, 53 patients had Severe Biventricular Failure, 137 patients had Mild or Moderate Biventricular Failure and 36 patients had Severe Biventricular Failure.

DISCUSSION

We report findings from 1060 definite or suspected COVID 19 patients from our hospital & allied covid hospital & demonstrated left or right ventricular abnormalities in half of all patients with COVID-19 undergoing echocardiography, and that these abnormalities were severe in 1 in 7 patients. The majority had non-specific patterns of ventricular dysfunction, although new myocardial infarction, myocarditis, and takotsubo cardiomyopathy were observed in a minority of patients. Echocardiography was reported to directly change patient management in a third of cases including alterations to disease-specific management, haemodynamic support, and the level of care received by the patients.

Dutta SK et al (2021) found that although coronavirus disease-2019 (COVID-19) is predominantly a respiratory disease, cardiac involvement occurs commonly, especially in those with more severe illness. The remaining 234 (mean age 57 ± 16 years, 71.7% of men) were included in this analysis.

In our study, out of 1060 patients, most of the 64 patients were 53–73 years of age in Abnormal scan and 60 patients were 51–69 years of age in Normal scan. Age was not significantly associated with echocardiography ($p = 0.7194$).

Dweck MR 1 et al (2020) found that to describe the cardiac abnormalities in patients with COVID-19 and identify the characteristics of patients who would benefit most from echocardiography. A total of 1216 patients [62 (52–71) years, 70% male] from 69 countries across six continents were included.

We found that male population [742 (70%)] was higher than the female population [318 (30%)]. Sex was not statistically significant.

($p=0.4404$). It was found that, majority number of patients had Critical care scan 382 in Abnormal scan compared to 254 patients had normal Scan. Which was statistically significant ($p=0.0224$).

Dweck MR 1 et al (2020) found that to describe the cardiac abnormalities in patients with COVID-19 and identify the characteristics of patients who would benefit most from echocardiography. In a prospective international survey, we captured echocardiography findings in patients with presumed or confirmed COVID-19 between 3 and 20 April 2020.

Our study showed that, slightly higher number of patients had Confirmed COVID-19 status in Abnormal Scan [409 (68%)] compared to Normal scan [404 (79%)] but this was statistically significant ($p<0.0001$).

Dweck MR 1 et al (2020) found that to describe the cardiac abnormalities in patients with COVID-19 and identify the characteristics of patients who would benefit most from echocardiography. severity of COVID-19 symptoms (OR 3.19, 95% CI 1.73–6.10) for the latter.

In our study, majority number of patients had severe symptom severity in Abnormal scan [340 (52%)] compared to normal scan [285 (55%)] and it was statistically significant ($p<0.0001$).

We found that, In Abnormal scan, 254 patients had Hypertension, 136 patients had Diabetes mellitus, 137 patients had Ischaemic heart disease, 106 patients had Heart failure and 53 patients had Valvular heart disease. In Normal scan, 193 patients had Hypertension, 93 patients had Diabetes mellitus, 30 patients had Ischaemic heart disease, 7 patients had Heart failure and 27 patients had Valvular heart disease. Association of Hypertension ($p=0.0039$), Diabetes mellitus ($p=0.0044$), Ischaemic heart disease ($p<0.0001$), Heart failure ($p<0.0001$) and Valvular heart disease ($p=0.0036$) with echocardiography were statistically significant.

We observed that, higher number of 194 patients had suspected left heart failure in abnormal scan compared to 97 patients in Normal scan but this was not statistically significant ($p=1.2987$).

In our study, majority number of 95 patients had suspected right heart failure in abnormal scan compared to 48 patients in Normal scan and it was statistically significant ($p<0.0001$).

From our study, lower number of 11 patients had Chest pain and ST-elevation in normal scan compared to 46 patients in abnormal scan though it was statistically significant ($p<0.0001$).

In our study, higher number of 166 patients had elevated cardiac biomarkers in abnormal scan compared to 48 patients in Normal scan which was statistically significant ($p<0.0001$).

We found that, majority number of 164 patients had Troponin in abnormal scan compared to 75 patients in Normal scan but this was not statistically significant ($p=8.566$).

In our study, more number of 97 patients had BNP in abnormal scan compared to 22 patients had in Normal scan which was statistically significant ($p<0.0001$).

Dweck MR 1 et al (2020) found that to describe the cardiac abnormalities in patients with COVID-19 and identify the characteristics of patients who would benefit most from echocardiography. Severe cardiac disease (severe ventricular dysfunction or tamponade) was observed in 182 (15%) patients.

We observed that, lower number of 5 patients had Ventricular arrhythmia in abnormal scan compared to 23 patients in Normal scan it was statistically significant ($p=0.0006$).

We found that, higher of 13 patients had Cardiac tamponade in abnormal scan compared to 7 patients in Normal scan which was not statistically significant ($p=0.1797$).

In our study, majority number of 48 patients had Circulatory shock in abnormal scan compared to 14 patients in Normal scan but this was statistically significant ($p<0.0001$).

Our study showed that, majority number of 277 patients had Change in management in In Abnormal scan compared to 68 patients in normal scan which was statistically significant ($p<0.0001$).

We observed that, higher number of 130 patients had Disease-specific therapy in abnormal scan compared to 40 patients in normal scan but this was not statistically significant ($p=0.2728$).

Dutta SK et al² (2021) found that although coronavirus disease-2019 (COVID-19) is predominantly a respiratory disease, cardiac involvement occurs commonly, especially in those with more severe illness. Right ventricular (RV) dilatation and/or dysfunction (37%) was the most common finding, followed by left ventricular (LV) systolic and diastolic dysfunction (27.7% and 23.1%, respectively).

Vieira ML et al (2021) showed that information is lacking concerning in-hospital echocardiography analysis of COVID-19 infection in Brazil. We evaluated echocardiographic parameters to predict a composite endpoint of mortality, pulmonary thromboembolism or acute renal failure. 19 (17.1%) presented with right ventricle dilated/dysfunction, 31 (28%) had pericardial effusion.

In our study, 118 patients had Mild Left ventricular abnormality, 87 patients had Moderate Left ventricular abnormality, 59 patients had severe Left ventricular abnormality, 67 patients had dilated Left ventricular abnormality, 37 patients had New MI, 36 patients had Myocarditis and 18 patients had Takotsubo Left ventricular abnormality which was statistically significant ($p<0.0001$).

We observed that, most of the patients had Elevated PAP right ventricular abnormality though it was statistically significant ($p<0.0001$).

It was found that, most of the 137 patients had Mild or Moderate Biventricular Failure and it was statistically significant ($p<0.0001$).

CONCLUSION

In this study, cardiac abnormalities were observed in half of all COVID-19 patients undergoing echocardiography. Abnormalities were often unheralded or severe, and imaging changed management in one-third of patients.

Table: Patient characteristics and indications for echo cardiography

	Overall (n = 1060)	Abnormal scan (n = 607)	Normal scan (n = 453)	p-value*
Age	62 (52–71)	64 (53–73)	60 (51–69)	0.7194
Sex				
Female	318 (30%)	190	128	
Male	742 (70%)	462	280	0.4404
Location of scan				
Critical care	636 (60%)	382	254	
Non-critical care	424 (40%)	284	140	0.0224
COVID-19 status				
Confirmed	813 (73%)	409 (68%)	404 (79%)	
High probability	247	163	84	
Evidence of pneumonia	212	135	77	<0.0001
Symptom severity				
Mild	108	46	62	
Moderate	327 (28%)	210 (32%)	117 (23%)	
Severe	625 (54%)	340 (52%)	285 (55%)	<0.0001
Co-morbidities				
Hypertension	447	254	193	0.0039
Diabetes mellitus	229	136	93	0.0044
Ischaemic heart disease	167	137	30	<0.0001
Heart failure	113	106	7	<0.0001
Valvular heart disease	80	53	27	0.0036
Indication				

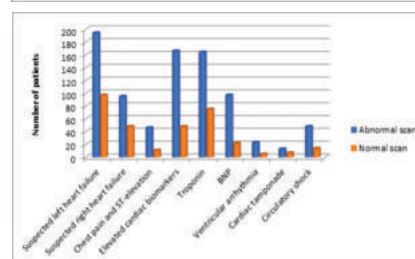
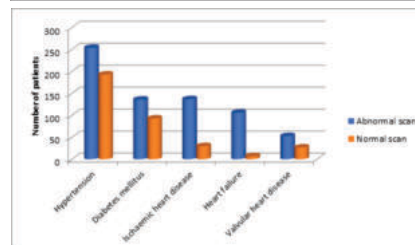
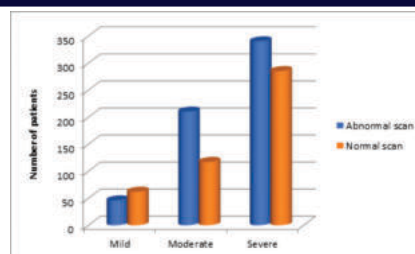
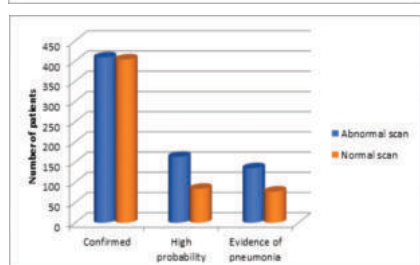
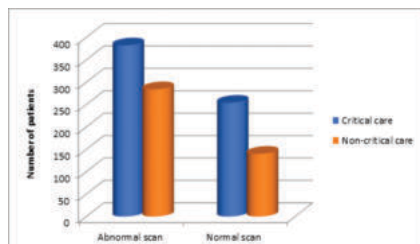
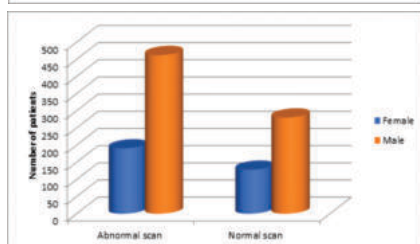
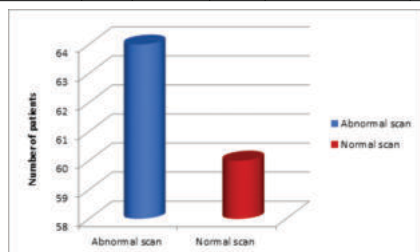
Suspected left heart failure	291	194	97	1.2987
Suspected right heart failure	143	95	48	<0.0001
Chest pain and ST-elevation	57	46	11	<0.0001
Elevated cardiac biomarkers	214	166	48	<0.0001
Troponin	139	164	75	8.566
BNP	119	97	22	<0.0001
Ventricular arrhythmia	28	23	5	0.0006
Cardiac tamponade	20	13	7	0.1797
Circulatory shock	62	48	14	<0.0001
Change in management				
Yes	365	277	68	
No	575	279	296	
Not known	116	59	57	<0.0001
Management group				
Disease-specific therapy	170 (14%)	130 (19%)	40 (8%)	
Level of care	30 (3%)	18 (3%)	12 (2%)	
Haemodynamic support	53 (4%)	37 (5%)	16 (3%)	
Other	153 (12%)	112 (17%)	41 (7%)	0.2728

Table: Distribution of Left ventricular abnormality

Left ventricular abnormality					
Mild	118	Dilated	67	New MI	37
Moderate	87			Myocarditis	36
Severe	59			Takotsubo	18

Table: Distribution of Right ventricular abnormality

Right ventricular abnormality					
Mild or Moderate	93	Dilated	161	D-shaped LV	47
Severe	42			Elevated PAP	99

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