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RESEARCH ARTICLE

ELECTROCARDIOGRAPHIC MANIFESTATIONS OF COVID-19 INFECTION IN INDIA

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Abstract

Background:-Patients admitted for COVID-19 have cardiac problems, require extended hospital stay, and have higher rates of mortality. The current retrospective study aims to understand the burden and pattern of ECG abnormalities at admission among patients with COVID-19 attending a tertiary care centre in Eastern India.

Methodology:-The current retrospective study included adult patients who tested positive for COVID-19 in a tertiary care centre in East India. The demographic parameters included age, gender, andhistory of co-morbidities. The patients were categorized into four groups and compared according to the number of co-morbidities (Cb0 vs Cb1 vs Cb2 vs Cb≥3). $P<0.05$ was considered to be statistically significant.

Results:-A total of 215 patients were enrolled in the study, with a mean age of 58.2 ± 9.3 years, and 56% were between 30-60 years of age. Two-thirds of the population had at least one co-morbidity. One, two and more than two co-morbidities were observed in 40.5%, 20.0%, and 6.5% of the study population, respectively.Almost all (96%) had ECG anomalies. Sinus tachycardia was the most common electrocardiograph ic anomaly (61.9%), followed by sinus bradycardia (16.7%) and atrial fibrillation (14.4%). Compared to those with no co-morbidities, the prevalence of STEMI was significantly higher in those with two or more co-morbidities (1.4% vs 14%; $P<0.0001$).

Conclusion:-Our study shows the prevalence and trends of ECG abnormalities among East Indian patients diagnosed with COVID-19. It underscores the need for broader pan-Indian investigations into the relationship between ECG anomalies, patient prognosis, and outcomes related to COVID-19.

Introduction:-

Coronavirus Disease 2019 (COVID-19), considered a “public health emergency of international concern,” is caused by severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) infection. It utilizes the Angiotensin-Converting Enzyme 2 (ACE2) as a functional receptor for cellular entry.[1]The ACE2 functional receptor in the cardiomyocytes, cardiac fibroblasts and coronary artery endothelial cells of the heart acts as an important endogenous antagonist of the renin-angiotensin system and provides cardiovascular protection.[2]SARS-CoV-2 may exploit this pathway to invade and damage myocardial cells. COVID-19 also indirectly affects the myocardium by increasing cytokine

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activity, further increasing cardiac demand.[3]Previous studies have observed that up to 40% of patients admitted due to COVID-19 have cardiac problems.[4] The presence of cardiac problems in COVID-19 patients was associated with significantly poor prognosis, extended duration of hospital stay and higher rates of mortality.[5]

Given the morbidity and mortality associated with the condition, it is important to assess and monitor for cardiac abnormalities in patients with COVID-19 for early detection and timely intervention.These cardiac abnormalities may potentiate cardiac injuries that might be detected as various patterns in an electrocardiogram.[6]Adding to this, the rapidity, widespread availability, cheap cost, and remote interpretability, the conventional 12-lead electrocardiogram (ECG) may play a significant role in screening and prognosis of cardiac involvement in COVID-19 patients.[7] Several studies have described the involvement of arrhythmia among COVID-19 patients in India.[6,8]The current retrospective study adds to the existing studies on the burden and pattern of ECG abnormalities at admission among patients with COVID-19 attending a tertiary care centre in Eastern India.

Methodology:-

The current retrospective study involved adult patients attending a tertiary care centre who tested positive for COVID-19 (tested via real-time reverse transcription-polymerase chain reaction from nasal or pharyngeal swab specimens). Patients who had incomplete records were excluded from the study. All participating patients provided informed consent.

Echocardiogram assessment:-

All patients had a 12-lead ECG performed[8] at the time of admission. Clinicians blinded to the study design and clinical status of the patients, reviewed and interpreted it.

Data collection and analysis:-

The data was collected and stored in an Excel sheet. The demographic parameters included age, gender, and history of co-morbidities such as heart failure (HF), Diabetes Mellitus, Hypertension, and Coronary Artery Disease (CAD). The recorded types of ECG anomalies encompassed atrial fibrillation, Supraventricular Tachycardia, Ventricular Fibrillation, Non-sustained Ventricular Tachycardia, Atrial Flutter, sinus Tachycardia, Ventricular Tachycardia, sinus Bradycardia, Atrioventricular Block, STElevated Myocardial Infarction, and Non-STElevated Myocardial Infarction. The patients were categorized into four groups according to the number of co-morbidities (Cb0, Cb1, Cb2, Cb≥3) and compared for differences in the prevalence of ECG anomalies.

Statistical analysis:-

Categorical variables were expressed as frequency (%), and continuous variables were expressed as mean ± SD. For categorical variables, test for proportions was used to compare for statistical significance between the groups.$P<0.05$ was considered to be statistically significant.

Results:-

A total of 215 patients were enrolled in the study, and the demographics and clinical characteristics are presented in Table 1. The mean age of the patients was 58.2 ± 9.3 years, with the majority being 30-60 years of age (55.8%) and 75.6% being men.In the current study, two-thirds of the population had at least one co-morbidity (Table 1). One, two and more than two co-morbidities were observed in 40.5%, 20.0%, and 6.5% of the study population, respectively(Table 1).Diabetes (39.5%) and hypertension (37.2%) were the most common co-morbidities. CAD and HF were present in 14.9% and 9.8%, respectively (Table 1). With respect to ECG investigations, 96% of the study had one or more ECG anomalies (Table 1). Over half of the individuals (61.9%) had one anomaly, around a quarter (24%) had two anomalies, and approximately 12% had more than two anomalies. Of all the anomalies, sinus tachycardia was the most common electrocardiographic anomaly (61.9%), followed by sinus bradycardia (16.7%) and atrial fibrillation (14.4%). Comparison of the distribution of anomalies in individuals with no co-morbidity, one, two or more than two co-morbidities revealed a significantly higher prevalence of STEMI among those with more than two co-morbidities (Table 2).

Table 1: Demographics and clinical characteristics

Total Number of population (N)	**n/N (%)**
Age Distribution	215(58.2±9.3)
Young adult (<30)	0/215 (0.0%)
Mid Age adult (30-60)	120/215 (55.8%)
Old (≥60)	95/215 (44.2%)
Gender Distribution	
Male	164/215 (76.3%)
Female	51/215 (23.7%)
Co-morbidities	
Individuals with no co-morbidities	71/215 (33.0%)
Hypertension	80/215 (37.2%)
Diabetes Mellitus	85/215 (39.5%)
Coronary artery disease (CAD)	32/215 (14.9%)
Heart failure (HF)	21/215 (9.8%)
Individuals with only one co-morbidity	87/215 (40.5 %)
Individuals with two co-morbidities	43/215 (20.0%)
Individuals with three or more co-morbidities	14/215 (6.5 %)
ECG investigation	
One anomaly only	133/215 (61.9%)
Two anomalies	54/215 (25.1%)
Three anomalies	17/215 (7.9%)
Four anomalies	9/215 (4.2%)
Five anomalies	2/215 (0.9%)
Atrial fibrillation (AF)	31/215 (14.4%)
Atrial flutter (AFL)	19/215 (8.8%)
Supraventricular tachycardia (SVT)	22/215 (10.2%)
Non-sustained ventricular tachycardia (NSVT)	25/215 (11.6%)
Ventricular tachycardia (VT)	16/215 (7.4%)
Ventricular fibrillation (VF)	16/215 (7.4%)
Sinus tachycardia	133/215 (61.9%)
Sinus bradycardia	36/215 (16.7%)
Atrioventricular block	18/215 (8.4%)
STEMI	14/215 (6.5%)
NSTEMI	8/215 (3.7%)
Mortality	3/215 (1.4%)

Table 2: Comparison of the distribution of anomalies in individuals with different co-morbidity profiles

	Cb0	**Cb1**	**Cb2**	**Cb≥3**	**P-value**
Atrial fibrillation (AF)	10/71(14.1%)	11/87 (12.6%)	5/43 (11.6%)	5/14 (35.7%)	0.4382
Atrial flutter (AFL)	2/71 (2.8%)	10/87 (11.5%)	4/43 (9.3%)	3/14 (21.4%)	0.0813
Supraventricular tachycardia (SVT)	4/71 (5.6%)	11/87 (12.6%)	4/43(9.3%)	3/14 (21.4%)	0.3187
Non-sustained ventricular tachycardia (NSVT)	2/71 (2.8%)	16/87 (18.4%)	7/43 (16.3%)	0/14 (0.0%)	NA
Ventricular tachycardia (VT)	6/71 (8.5%)	5/87 (5.7%)	2/43 (4.7%)	3/14 (21.4%)	0.6802
Ventricular fibrillation (VF)	4/71 (5.6%)	6/87 (6.9%)	4/43 (9.3%)	2/14 (14.3%)	0.6725
Sinus tachycardia	46/71	49/87	30/43	8/14 (57.1%)	0.4469

	(64.8%)	(56.3%)	(69.8%)		
Sinus bradycardia	11/71 (15.5%)	18/87 (20.7%)	5/43 (11.6%)	2/14 (14.3%)	0.5893
Atrioventricular block	8/71 (11.3%)	5/87 (5.7%)	4/43 (9.3%)	1/14 (7.1%)	0.6518
ST Elevation Myocardial Infarction	1/71 (1.4%)	2/87 (2.3%)	6/43 (14.0%)	5/14 (35.7%)	<0.0001
Non – ST Elevation Myocardial Infarction	1/71 (1.4%)	3/87 (3.4%)	2/43 (4.7%)	2/14 (14.3%)	0.1361

Discussion:-

COVID-19 is associated with cardiovascular and ECG anomalies, which have been associated with poor prognosis, extended duration of hospital stay and higher rates of mortality.The current study observed ECG anomalies in almost all (~96%)of the population. Sinus tachycardia was the most common electrocardiographic anomaly, followed by sinus bradycardia and atrial fibrillation. Mortality was observed in only 1.3% of the population.
Among the study participants, the majority were within the age of 30-60 years of age (55.8%) and about 75% were men (Table 1). Galidevara et al., in their study, aimed to understand the associations between ECG findings at admission and patient prognosis in Indian COVID-19 patients,observed that the majority of patients were men (~70%) and in the age group of 31-50 years (~40%).[8]Another study by Kaliyaperumal et al., also observed the majority of individuals to be between 30 and 60 years of age.[9] This highlights the burden of COVID-19 on the middle-aged population in India and can be attributed to the fact that they are of working age with high mobility and numerous interpersonal interactions.

Specific co-morbidities in COVID-19 patients have been associated with increased risk of infection with worse lung injury and poor patient outcomes. In the current study, two-thirds of the population had at least one co-morbidity. One, two and more than two co-morbidities were observed in 40.5%, 20.0%, and 6.5% of the study population, respectively.Among those with co-morbidities, diabetes mellitus was the most common co-morbidity (39.5%).Previous studies on COVID-19 suggest that 20–37% of Indian COVID-19 patients have diabetes.[7,8] In patients with diabetes, a membrane-bound protease named Furin is elevated. Furin interacts with ACE-2 receptors and pre-activates the viral spike protein, thus facilitating the entry of SARS-CoV-2 into cells.[10] Therefore, patients with diabetes are at an increased risk of acquiring the infection, its progression and worsened outcomes.

Another important co-morbidity of COVID-19 in the current study was hypertension (37.2%), similar to the prevalence observed in previous studies (28-31%).[7,8]Angiotensin receptor blockers and ACE-2 inhibitors are treatments commonly used to manage hypertension. These drugs may also upregulate ACE2 receptor expression and increase susceptibility to SARS-CoV-2 infection. Furthermore, uncontrolled blood pressure is associated with an increased risk of case fatality. Therefore, achieving optimal blood pressure levels may play a key role in reducing the risk of fatality among COVID-19 patients with hypertension.[10]With respect to ECG investigations, 96% of the study had one or more ECG anomalies.Previous studies have observed the prevalence of ECG abnormalities in COVID-19, ranging from 33% to 81% among Indian patients.[7,8]The increased prevalence of ECG abnormalities may be attributed to differences in the population characteristics included in the study.

In the current study, more than half (61.9%) had one anomaly, about one-fourth (24%) had two anomalies, and about 12% had more than two anomalies. Of all the anomalies, sinus tachycardia was the most common electrocardiographic anomaly (61.9%), followed by sinus bradycardia (16.7%) and atrial fibrillation (14.4%).The mortality rate of patients in the group was 1.4%. Kaliyaperumal et al., in their study, also observed sinus tachycardia (23.8%), sinus bradycardia (12.7%), and atrial arrhythmia (3.5%) to be the most common presentations of ECG abnormalities.[7]In their narrative systematic review, Brit Long also mentions sinus tachycardia as the commonest ECG abnormality in COVID patients.[11]COVID-19 symptoms such as fever, hypovolemia, hypoxia, pain, anxiety, and hypoperfusion lead to intrinsic sinus node hyperactivity, autonomic dysfunction and a hyperadrenergic state.[12] This can affect myocardial ion channel function and exacerbate tachycardia, leading to Sinus tachycardia.

Our study observed that the prevalence of STEMI was higher among those with two or more co-morbidities(Table 1). A large-scale registry analysis observed that patients with COVID-19 are at an increased risk for cardiovascular disease, including ischemic and non-ischemic, cerebrovascular, dysrhythmias, heart failure and thromboembolic disease. A precise diagnosis of STEMIis difficult since COVID-19 can cause myocarditis, coronary spasm, and

stress cardiomyopathy, all mimicking STEMI.[13] Therefore, longitudinal studies may be needed to shine more light on the incidence of STEMI among COVID-19 patients.[14]

Limitations:-

Small sample size and missing data on variables such as presenting symptoms are the limitations of the study.

Conclusion:-

This study highlights the burden and patterns of ECG anomalies in East Indian patients with COVID-19. This lends scope for pan-Indian studies on the associations between ECG anomalies, prognosis and outcomes of patients with COVID-19.

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Conflict of interest:
Nil

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