

IMPACT OF LEFT VENTRICULAR DYSFUNCTION ON THE OCCURRENCE OF VENTRICULAR ARRHYTHMIAS AFTER ACUTE ST ELEVATION MYOCARDIAL INFARCTION

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Contribution

SK conceived the idea and designed the study. Data collection and manuscript writing was done by SK, SK, SN, NR, and FM. All the authors contributed equally to the submitted manuscript.

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ABSTRACT

Objective: The objective of the study was to compare the incidence of post STEMI ventricular arrhythmias among patients with versus without LV dysfunction.

Methodology: This prospective Cohort study was conducted in the department of cardiology of a tertiary care hospital, Isra University Hospital, Hyderabad over a period of eleven months from 1st September 2019 to 31st July 2020 and recruited a total of 95 patients with STEMI. Baseline data (age, gender, social class, and marital status) and clinical data (basal metabolic rate, systolic and diastolic blood pressure, random blood sugar, and LVSD) were recorded in a pre-structured questionnaire and analyzed using Statistical Package for the Social Sciences (SPSS) version 21 to see the comparative incidence of ventricular arrhythmias by applying chi-square test where applicable.

Results: Out of total 95 STEMI patients, 53 patients had left ventricular systolic dysfunction (55.7%). The overall incidence of ventricular arrhythmias was 23.1% and it was significantly higher in patients with LVSD as compared to those with normal LV function, 36.3% and 72.7% respectively ($p = 0.001$).

Conclusion: Our study shows that overall burden of ventricular tachyarrhythmias is two times higher in patients with left ventricular systolic dysfunction as compared to normal left ventricular systolic function.

Keywords: Acute STEMI, Ventricular tachyarrhythmias, LV systolic dysfunction, Pakistan

INTRODUCTION

Ventricular arrhythmias (VAs) include ventricular tachycardia and ventricular fibrillation and are the most common cause of death in patients suffering from acute myocardial infarction particularly ST-segment elevation myocardial infarction (STEMI).^{1,2} Its prevalence reported in a Harmonizing Outcomes with Revascularization and Stents in Acute Myocardial Infarction (HORIZONS-AMI) trial³ was around 5.2% particularly who were revascularised through primary percutaneous coronary intervention and among them more than 80% of the ventricular arrhythmias occurred within 48 hours after myocardial infarction and those patients who experience ventricular arrhythmias during acute or early phase of myocardial infarction were at high risk of sudden cardiac death up to one year after the index hospitalization.

Left ventricular systolic dysfunction (LVSD) is labeled when ejection fraction (EF) is <50%, is a major complication of acute myocardial infarction and is particularly associated with STEMI with underlying comorbid conditions such as diabetes mellitus, hyperlipidemia, smoker, and / hypertension.⁴

The incidence of LVSD is around 55% in patients with acute STEMI and 17% in patients with NSTEMI, respectively.^{5,6} Previously conducted studies have shown two times higher risk of left ventricular dysfunction in patients with STEMI as compared to NSTEMI because of large myocardium is affected by ischemic injury hence causing LV dysfunction.^{5,7}

Data regarding the incidence of post STEMI ventricular tachyarrhythmias is quite limited especially in Pakistan. Patients who experience ventricular arrhythmias are at high risk of in-hospital poor outcome and even some patients die before reaching to healthcare facility. Identification of such patients and leading risk factors may help in characterization of better management structure in patients presented with STEMI with and without LVSD who experience ventricular arrhythmias in a tertiary care Hospital, Hyderabad.

METHODOLOGY

This prospective Cohort study was conducted in the department of cardiology of a tertiary care hospital, Isra University Hospital, Hyderabad over a period of eleven months from 1st September 2019 to 31st July 2020. The study includes all consecutive adult patients of acute STEMI with or without LVSD, having age between ≥ 25 years to ≤ 60 years, both gender, and consented to participate in the study. Patients with NSTEMI, experienced atrial arrhythmias alone or with ventricular arrhythmias, known case of LV dysfunction, underlying having chronic liver or kidney disease, malignancy, and hyperthyroidism were excluded. Before commencement of the study ethical review committee approved the protocol and consent was taken from all patients/family member after explaining the objective and purpose of the study.

Acute STEMI was diagnosed based on the universal definition of acute MI⁸ consisting of on-going central chest pain with evidence of ST-Segment elevation in two or more than two contiguous leads along with reciprocal changes in opposite leads in electrocardiography supporting of cardiac ischemia along with positive cardiac troponin I or troponin T. Patients with acute STEMI were managed as per the ESC/AHA guidelines for the management of acute STEMI. Ventricular arrhythmias were diagnosed on twelve lead ECG or monitor's rhythm lead shows ventricular arrhythmias. Assessment of left ventricular systolic function was made using Echocardiogram. Ejection fraction of less than 50% was labeled as left ventricular systolic dysfunction.

A structured questionnaire was designed for the collected of data and a senior doctor was responsible for collection of data who had at least 5 years of experience of managing such patients. We have used statistical package for the social sciences version 21 (SPSS) for the entry of data and final analysis. Continuous variable such as age was recorded as mean and standard deviation and assessed using parametric test such as student t-test. Categorical data presented in the form of numbers and percentages and chi-square test was used for difference of significance assessment. A p-

value of ≤ 0.5 was considered as statistically significant.

RESULTS

Among patients of STEMI, 53 (55.7%) had LVSD while 42 patients had normal left ventricular systolic function (44.2%). The mean age of patients admitted with STEMI had LVSD was comparatively higher than in patients with normal LV function, 46.12 ± 9.77 and 52.03 ± 8.62 years ($p = 0.03$), respectively. Smoking as a cardiovascular risk factor was significantly associated with LVSD ($n = 30$, 56.6%, $p = 0.02$). Rest of the descriptive analysis is presented in Table 1.

Table 1: Association of baselines characteristics with left ventricular function in patients with STEMI

Characteristics	Normal LVSF	LVSD	p value
	(N = 42)	(N = 53)	
Age (years)	46.12 ± 9.77	52.03 ± 8.62	0.03*
Gender			
Male	28 (66.6%)	32 (60.3%)	0.17
Female	14 (33.3%)	21 (39.6%)	
Marital Status			
Married	35 (83.3%)	43 (81.1%)	0.08
Single	7 (16.6%)	10 (18.8%)	
Area of residence			
Urban	26 (61.9%)	40 (75.4%)	0.34
Rural	16 (38.0%)	13 (24.5%)	
Socioeconomic Status			
Low Class	6 (14.2%)	6 (11.3%)	0.12
Middle Class	27 (64.2%)	36 (67.9%)	
Upper class	9 (19.0%)	11 (32.2%)	
Addiction			
Smoker	19 (42.2%)	30 (56.6%)	0.02*
Chewable Tobacco	8 (19.0%)	18 (33.9%)	0.11
Alcohol consumption	3 (7.1%)	5 (9.4%)	0.78

The overall incidence of ventricular arrhythmias was 23.1% and it was significantly higher in patients with LVSD as compared to normal LV function, 36.3% and 72.7% ($p = 0.001$), respectively.

In our study mean increasing age (53.60 ± 4.33), smoking ($n = 7$, 43.7%), and hypertension ($n = 9$, 56.2%) were significantly ($p < 0.05$) associated with ventricular arrhythmias in patients with LVSD. Rest of the descriptive analysis is presented in Table 2.

Table 2: Common risk factors associated with ventricular tachyarrhythmias in patients with STEMI with and without LV systolic dysfunction

Characteristics	Normal LVSF	LVSD	p value
	(N = 8)	(N = 16)	
Mean age \pm SD - years	45.22 ± 7.41	53.60 ± 4.33	0.001*
Gender			
Male	6 (75.0%)	9 (56.2%)	0.06
Female	2 (25.0%)	7 (43.7%)	
Addiction			
Smoking	4 (50.0%)	7 (43.7%)	0.01*
Chewable Tobacco	3 (37.5%)	6 (37.5%)	0.46
Alcohol consumption	2 (25.0%)	2 (12.5%)	0.19
Comorbidities			
Hypertension	5 (62.5%)	9 (56.2%)	0.93
Type 2 DM	5 (62.5%)	6 (37.5%)	0.04*
Hyperlipidemia	4 (50.0%)	6 (37.5%)	0.14

DISCUSSION

Ventricular tachycardia and ventricular fibrillation are point of concern in patients with STEMI and some studies suggest double or even triple the burden of these fatal arrhythmias when STEMI is associated with LVSD.⁹⁻¹¹ In our study the incidence of ventricular arrhythmias was two times higher in patients who developed left ventricular systolic dysfunction (36.36%) as compared to normal left ventricular systolic function (72.72%), ($p = 0.001$), respectively. Previously conducted studies can validate the findings of our study.¹²⁻¹⁴ A randomized

clinical trial Harmonizing Outcomes with Revascularization and Stents in Acute Myocardial Infarction (HORIZONS-AMI) has shown overall incidence of ventricular tachyarrhythmias was 5.2% which is quite less than we have observed in our study also their study did not compare the incidence of ventricular arrhythmias with left ventricular systolic function, as we did in our study.³ Another Danish international study conducted by Sattler SM and colleagues¹⁵ has shown 11.6% of the patients experienced ventricular tachyarrhythmias and also their study did not compare the occurrence in relation to left ventricular function. Saudi Project for Assessment of Acute Coronary Syndrome also shown relatively low burden of ventricular arrhythmias (3.3%) in patients admitted with NSTEMI or STEMI. While among them more than 74% of the patients were diagnosed as STEMI who experienced arrhythmias.¹⁶ Multiple reasons can define the underlying pathophysiology of causing a ventricular tachyarrhythmias such as change in the intramyocardial ionic concentration when leads to potential development of ventricular arrhythmias. Besides its mechanism, there are certain identifiable risk factors which provoke excitation in myocytes leading to atrial and ventricular arrhythmias such as increased age, hyperlipidemia, alcohol consumption, high caffeine, smoking, male gender, diabetes mellitus, and hypertension. In our study, smoking and increasing age, and hypertension were the most common associated risk factors played a significant role in the development of left ventricular tachyarrhythmias in patients with left ventricular systolic dysfunction. A very limited data is available on smoking as a risk factor of cardiac arrhythmias. A study conducted in Europe by D'Alessandro, A et al has shown cigarette smoking as a single modifiable risk factor leading to cardiac arrhythmias irrespective of left ventricular function. The pathophysiology underlying this mechanism is still not well understood but hypothesis is that cigarette smoking induced cardiac arrhythmias is very likely a complex one where the pro-fibrotic effect of nicotine on myocardial tissue with consequent increased susceptibility to catecholamine might play a role.¹⁷

Common cardiovascular risk factors may play a significant role in the incident rate of ventricular arrhythmias. In our study hypertension and type 2 diabetes mellitus were significantly associated with ventricular arrhythmias in patients with LVSD while smoking was independently associated with ventricular arrhythmias irrespective of left ventricular systolic function. In a previously conducted Danish case control multicentre clinical hospital based trial named Genetic causes of Ventricular Arrhythmias in

patients with first ST-elevation Myocardial Infarction (GEVAMI) has evaluated the risk factors causing ventricular tachyarrhythmias and some of the risk factors such as age less than 60 years are in concordance with our study.¹¹ Our study has drawn the data from the patients admitted at our hospital and shown very remarkable findings and also opened the door for future studies to explore these associations and include other risk factors which may associated with significant or insignificant associations.

Limitations

Besides unique objective of our study and findings which were not previously carried out in Pakistan. Our study has certain limitations such as smaller sample size, lack of previous medical record & drug history of patients, other comorbid conditions such as thyroid disease/inflammatory disease should be evaluated that may promote the occurrence of ventricular arrhythmias in such patients. However, our study's findings will surely be helpful in conducting and planning of larger scaled studies and better management of patients.

CONCLUSION

Patients with left ventricular systolic dysfunction are two times more prevalent for the development of ventricular tachyarrhythmias as compared with normal left ventricular systolic function. Among them, increased age, smoking, and diabetes mellitus were the significant risk factors associated with ventricular tachyarrhythmias.

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