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Original Article

Internal Medicine Section

Clinical Spectrum and Outcome of Conduction Disturbances in Acute Myocardial Infarction in Thrombolytic Era at a Tertiary Care Centre

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ABSTRACT

Introduction: Significant number of deaths in Acute Myocardial Infarction (AMI) is attributed to conduction disturbances.

Aim: To determine the incidence, pattern of conduction disturbances and their clinical outcome in AMI.

Materials and Methods: This was a hospital-based study conducted at Sher-E-Kashmir Institute of Medical Sciences (SKIMS) Jammu and Kashmir, India, a tertiary care hospital from August 2015 to July 2017, in which a total of 429 patients with diagnosis of AMI were included. There were 89 (20.7%) patients with conduction disturbances, and 340 (79.3%) patients without conduction disturbances. They were examined clinically and Electrocardiography (ECG) and Echocardiography (Echo) and many other relevant routine clinical investigations were done to look for development of conduction disturbances and other complications of MI. Frequency (n) and percentage (%) analysis was done on collected data and Fischer's exact test and Chi-square test was conducted for p-value calculations and checked for significance.

Results: Out of 429 patients 358 (83.40%) males and 71 (16.60%) females, mean age 57.6±12.39 years), 219 (51.04%) received thrombolysis. In those subjects with conduction disturbances, Atrioventricular (AV) blocks were found in 54 (12.58%) constituting the maximum subjects, followed by intraventricular blocks in 35 (8.1%). Among AV blocks, complete AV block in 45 (10.48%) with mostly transient nature and in intraventricular blocks where Right Bundle Branch Block (RBBB) 17 (3.96%) were the most common types. Intraventricular blocks were more common in anterior infarction and AV blocks in inferior infarction (p<0.001). Age >70 years, diabetes and worse Killip class at presentation were independent predictors of conduction disturbances. Temporary pacemaker requirement was more than permanent pacemaker 24 (26.9%) vs 5 (5.6%). Right coronary artery (RCA) was dominant artery among AV blocks, which was statistically significant (p-value 0.003). Mortality was about 12.9% amongst the subjects of Atrioventricular Node block and 25.7% amongst those of Intraventricular Blocks while it was 9.41% amongst the subjects without conduction disturbances (p-value 0.013). Mean duration of stay in the hospital was 7±2 days.

Conclusion: Conduction blocks were more common in age >70 years, diabetics, in worse Killip class and in inferior infarction. However, no statistically significant correlation was found between occurrence of conduction blocks and various risk factors like hypertension and smoking.

Keywords: Atrioventricular blocks, Electrical disturbances, Heart attack, Morbidity, Mortality, Thrombolysis

INTRODUCTION

One of the leading causes of morbidity and mortality in the world is acute myocardial infarction (AMI) [1]. The common electrical disturbances which occur following AMI are atrioventricular (AV) and intraventricular blocks [2]. Among AV blocks and intraventricular blocks, (first, second and third degree) and (right or left BBB) respectively are commonly observed conduction defects. In some cases, fascicular blocks (anterior and posterior hemiblocks) alone or in combination with RBBB (bifascicular blocks) are also observed. Conduction disturbances are associated with increased short-term and long-term mortality rates [3]. AV blocks and bundle branch blocks are more commonly associated with inferior wall and anterior wall MI respectively. Studies have shown that conduction disturbances were associated with increased morbidity and mortality in prethrombolytic era in AMI [4-6].

It has been established that thrombolytic therapy reduce mortality in AMI by restoring blood flow in infarct related artery, thus reducing myocardial damage. However, as far as its role in reducing the incidence of conduction defects is not clearly defined. Incidence of conduction disturbances persist even in thrombolytic era [7]. Majority of the clinical trials on thrombolysis don't refer to the incidence and mortality on conduction disturbance, only few compare these variables between prethrombolytic era and post-thrombolytic era [8,9]. It is believed that the incidence of conduction disturbances may be reduced by reperfusion of the artery incriminated in infarction [10]. Analysis of 681 patients enrolled in GUSTO (e Global Use of Strategies to Open Occluded Coronary Arteries) and TAMI (Thrombolysis in Myocardial Infarction) 9 trial reported lower incidence of persistent bundle branch block, could be possibly because of thrombolysis [11]. However, the GISSI (Gruppo Italiano Per Lo Studio della Streptochinase Nell'Infarto Miocardico)-1 study [12] reported similar incidences of complete AV block in the streptokinase group (5%) and non thrombolytic-treated controls (5.7%) respectively. Early recognition and prompt treatment reduce the mortality in AMI due to conduction blocks.

The present study was carried out at a tertiary care hospital to know about the pattern and outcome of conduction disturbances in AMI, as there is little knowledge about it in this part of the world.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Cardiology at Sher-E-Kashmir Institute of Medical Sciences (SKIMS), Srinagar, Jammu and Kashmir, India, from August 2015 to July 2017. Study was approved by Institutional Ethical Committee (letter number 67/2015).

Sample size calculation: According to formula:

Sample Size (N)=$Z^2p(1-p)/e^2$

Assuming 5% significance level, prevalence (p) of Coronary Artery Disease (CAD) in general population as 10% (0.10) [13] and margin of error (e) as 3%, sample was calculated to be 385.

Inclusion Criteria: Patient with diagnosis of AMI were included in the study.

Exclusion Criteria: Those patients with presence of AV or intra-ventricular conduction disturbances existing prior to MI, or with cardiomyopathy, congenital heart disease, rheumatic heart disease, right ventricular hypertrophy, those patients on permanent pace maker (PPM), those on drugs like verapamil or beta blockers and the patients who did not consent for the study were excluded.

Study Procedure

Finally the study incorporated 429 patients. The diagnosis of AMI was done on the basis of Increase in cardiac biomarkers including cardiac troponin I or T or Creatine Phosphokinase myocardial band more than two times upper normal plus one or more of the following: a) typical symptoms of myocardial ischaemia; b) Q wave in the ECG; c) ST segment elevation >1 mm in contiguous leads or ST depression in ECG were included in the study.

A detailed history was taken regarding time of onset of pain, time of reporting to hospital, time of receiving reperfusion therapy, type of reperfusion therapy. History was also taken regarding the predisposing factors like hypertension, diabetes mellitus, smoking, alcoholism, dyslipidaemia, Previous history of ischaemic heart disease, family history of MI, preinfarct angina.

Detailed clinical examination was done to look for features of congestive heart failure, any abnormalities in heart sounds, added sounds and murmurs, features of pericardial involvement, features of papillary muscle dysfunction. Besides, other systems were also examined to rule out any other associated illness. A 12 lead ECG was done at the time of admission and repeated every 24 hours till discharge. Patients were admitted in Cardiac Care Unit (CCU) and continuously monitored to detect any abnormal conduction disturbances, which was recorded by means of electrocardiogram. Routine investigations like random blood sugar, complete blood count, blood urea, serum creatinine along with other investigations like lipid profile and cardiac specific enzymes were done in all the patients. Each patient was subjected to echocardiography to detect the wall motion abnormalities and assess the regional ventricular function. Written informed consent was taken from patients or their guardian.

STATISTICAL ANALYSIS

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel). Statistical Package for Social Sciences (SPSS) Version 20.0 (SPSS Inc., Chicago, Illinois, USA) was used to analyse the data.Variables were divided into two types: continuous and categorical variables. Continuous variables were summarised in the form of means and standard deviation and categorical as frequencies and percentages. Tables were used to graphically represent the data. Chi-square test or Fisher's-exact test, whichever appropriate, was employed for comparing categorical variables. A p-value of less than 0.05 was considered statistically significant. All p-values were two tailed.

RESULTS

Demographic data of the study population is mentioned in [Table/Fig-1]. Out of 429 patients, 358 (83.40%) were males and 71 (16.60%) were females (male to female ratio of 5:1). Dyslipidaemia was present in 28 (6.5%) of patients. H/o alcoholism, preinfarct angina and family h/o MI were not significant risk factors in the present study population.

The mean age of the patients was 57.6±12.39 years. Maximum number of patients {120 (28%)} were in the age group of 60-69 years. Among the various risk factors, smoking constituted the major risk factor {313 (73.0%)}, followed by hypertension 264 (61.5%). History of Ischaemic Heart Disease (IHD) {16 (3.7%)} constituted the least among risk factors. Mean duration of stay in the hospital was 7±2 days.

Sex	Number (percentage)
Males	358 (83.40 %)
Females	71 (16.60 %)
Age distribution (years) Number (Percentage)	
<30	5 (1.2%
30-39	17 (4%)
40-49	86 (20%)
50-59	110 (25.60%)
60-69	120 (28%)
≥70	91 (21.20%)
Mean Age	57.16±12.39
Risk factors Number (Percentage)	
Smoking	313 (73%)
Hypertension	264 (61.50%)
Diabetes	98 (22.80%)
Dyslipidemia	28 (6.5%)
Ischemic Heart Disease (IHD)	16 (3.70%)

[Table/Fig-1]: Demographic features.

Out of 429 patients, 89 (20.74%) had conduction disturbances. AV blocks constituted the most {54 (12.58%)} common type of conduction disturbance. Among AV blocks, complete AV block {45 (10.48%)} was the most common type. Intraventricular blocks were the 2nd most common type of conduction disturbance {35 (8.1%)} and among this, RBBB was the most common type {17 (48.57%)} [Table/Fig-2].

Type of conduction disturbances	Number (n)	Total Percentage (%) (n=429)	Group Percentage (%)
Atrioventricular blocks	54	12.58	60.67
First degree AV block	4	0.9	7.4
Second degree AV blocks	5	1.1	9.25
Complete AV block	45	10.48	83.33
Intraventricular blocks	35	8.1	39.3
Left bundle branch block	13	3.03	37.14
Right bundle branch block	17	3.96	48.57
Bifascicular block	5	1.16	14.28

[Table/Fig-2]: Conduction disturbances in the study population.

Intraventricular blocks were more common in Anterior Wall Myocardial Infarction (AWMI) while as A-V blocks were more common in Inferior Wall Myocardial Infarction (IWMI) which was statistically significant (p<0.001). Intraventricular blocks constituted of 23 (82.12%) of all conduction disturbances in AWMI. A-V blocks constituted of 42 (85.7%) of all conduction disturbances in IWMI [Table/Fig-3].

Conduction disturbances	NSTEMI (n=12)	AWMI (n=28)	IWMI (n=49)
Intraventricular blocks			
RBBB *	1 (8.38)	13 (46.42)	3 (6.12)
LBBB #	4 (33.3)	5 (17.85)	4 (8.16)
Bifascicular blocks	0	5 (17.85)	0
Atrioventricular blocks			
Complete AV block	7 (58.33)	5 (17.85)	33 (67.34)
First degree heart block	0	0	4 (8.16)
Second degree heart block	0	0	5 (10.20)

[Table/Fig-3]: Types of MI and conduction disturbances (n=89).
*Right bundle branch block; # left bundle branch block; NSTEMI: Non-ST segment elevation myocardial infarction; AWMI: Acute Wall Myocardial Infarction; IWMI: Inferior Wall Myocardial Infarction

Conduction disturbances [Table/Fig-4] were more common in the age group >70-year-old, diabetics and worse Killip class at presentation, which was statistically significant. However, no statistically significant correlation was found between occurrence of conduction blocks and various risk factors like hypertension and smoking. Mortality was higher in patients having conduction blocks which was statistically significant (p=0.013).

Variable		Normal (n=340)	AV Node Block (n=54)	IVB## (n=35)	p-value (Chi-square test)
Age (years)	≤70	308 (90.5)	41 (10.8)	30 (7.9)	**0.007***
	>70	32 (10.4)	13 (26.0)	5 (10.0)	
Gender	Male	284 (83.5)	44 (12.3)	30 (8.4)	0.868
	Female	56 (16.4)	10 (14.1)	5 (7.0)	
Smoking	Present	248 (72.9)	39 (12.5)	26 (8.3)	0.977
	Absent	92 (27.1)	15 (12.9)	9 (7.8)	
Hypertension	Present	202 (59.41)	38 (14.4)	24 (9.1)	0.206
	Absent	138 (40.6)	16 (9.7)	11 (6.7)	
Diabetes Mellitus	Present	67 (19.7)	20 (20.4)	11 (11.2)	**0.009***
	Absent	273 (80.3)	34 (10.3)	24 (7.2)	
Type of MI	NSTEMI§	73 (21.5)	7 (8.1)	6 (7)	**<0.001***
	AWMI	140 (41.2)	5 (3.0)	22 (13.2)	
	IWMI	127 (37.4)	42 (23.8)	7 (4.0)	
Killip Class	Class I	285 (82.10)	36 (10.3)	26 (7.5)	**0.009**
	Class II	32 (69.6)	10 (21.7)	4 (8.7)	
	Class III	4 (66.7)	0 (0.0)	2 (33.3)	
	Class IV	19 (63.3)	8 (26.7)	3 (10.0)	
Outcome	Death	32 (9.41)	7 (12.9)	9 (25.7)	**0.013***
	Alive	308 (90.6)	47 (87.03)	26 (74.3)	

[Table/Fig-4]: Relation of conduction disturbances with various variables.
##Intraventricular blocks *Statistically Significant §Non STEMI

Just over half of the patients were thrombolysed 219 (51.04%) and among them, thrombolysis was successful in 180 (82.19%) and failed in 39 (17.81%). Out of the total subjects, 210 (48.95%) patients were not thrombolysed, because of late presentation. Overall, 29 (32.5%) of present patients required Temporary Pacemaker (TPM) and Permanent (PPM) Pacemaker. Twenty nine patients with conduction blocks required support of pacing with 24 requiring TPM and rest PPM. Temporary pacemaker requirement was commoner than permanent pacemaker 24 vs 5 (26.9% vs 5.6%). Mean duration of TPM was 3±1 days.

As far as conduction blocks and type of vessel is concerned, RCA was dominant artery in AV blocks which was statistically significant. Although, Left Anterior Descending (LAD) was dominant artery in intraventricular blocks but was not statistically significant (p=0.112) [Table/Fig-5].

Variable	Normal (n=340) n (%)	AV Node Block (n=54) n (%)	Intra-ventricular blocks (n=35) n (%)	p-value (Chi-square test)
Left Main Artery	19 (86.4)	2 (9.1)	1 (4.5)	0.841
Left Anterior Descending Artery	194 (84.0)	18 (7.8)	19 (8.2)	0.112
Left Circumflex Artery	108 (82.4)	11 (8.4)	12 (9.2)	0.375
Right Coronary Artery	136 (78.2)	30 (17.2)	8 (4.6)	**0.003***

[Table/Fig-5]: Relationship between conduction disturbances and type of vessel.
##Intraventricular blocks; *Statistically Significant §Non STEMI

As shown in [Table/Fig-6], out of 29 patients who required pacing, 24 (82.7%) patients underwent angiography, Single Vessel Disease (SVD) (40%) was commonly involved, followed by Double Vessel Disease (DVD) (35%) in patients, who required support of TPM; while Triple Vessel Disease (TVD) was involved in half of patients in whom PPM was implanted.

Patients requiring pacing	Single Vessel Disease (SVD)	Double Vessel Disease (DVD)	Triple Vessel Disease (TVD)	Left main artery	Normal
TPM*	8	7	4	nil	1
PPM**	1	-	2	1	-

[Table/Fig-6]: Angiographic profile of patients requiring pacing.
*Temporary pace maker; **permanent pacemaker

DISCUSSION

This study was conducted to find out overall incidence, pattern of conduction disturbances in AMI in this present era of revascularisation. Overall, 89 (20.7%) developed conduction disturbances and mortality was higher in the patients with conduction disturbances as compared to those who were normal with significant p-value of 0.013. Diabetes, worse Killip class at presentation, age > 70 years and inferior infarction were independent predictors of conduction blocks in AMI.

In this study, mean age of presentation was 57.6±12.39 years, which is comparable with other studies in developing world like Gulf Registry of Acute Coronary Events (RACE) registry (56.4±13 years), Study Design of the Program for the Evaluation and Management of the Cardiac Events (SPACE) registry (58 years), and with many studies from India such as CREATE (Treatment and outcomes of acute coronary syndromes in India) registry (56±13years), Jose VJ and Gupta SN study (57±13 years), Sharma R et al., (54.70±19.90 years) [14-18]. In this study, predominance of males (83.4%) versus females (16.6%) can be attributed to the gender bias and atypical presentation which is also feature in INTERHEART (nine risk factors predict nine out of ten myocardial infarctions) [19] study (overall male, 76% and South Asian cohort, 85%). Smoking was the major risk factor which is consistent with the findings of Chavda AB et al., [20]. Diabetes constituted 98 (22.8%) which is almost equal with CREATE registry [15] (30.4%). Hypertension was also major risk factor in this study like the EUROASPIRE (European Action on Secondary Prevention through Intervention to Reduce Events) study [21]. Hyperlipidaemia was less prevalent as compared to western population possibly because of life style differences (dietary habits and sedentary life style) [22].

Studies in Prethrombolytic era: In this present study, 35 (8.1%) and 45 (10.48%) developed intraventricular and complete AV bocks respectively, is consistent with the study by Jones ME et al., where he found complete AV block in 9.15% cases, bundle branch block in 5.5% cases [23]. Woo KS found complete AV block in 11.3% cases while RBBB was found in 12.7% cases and LBBB in 3.3% [24]. Present study underscores the fact that conduction blocks are still common in thrombolytic era.

Studies in Thrombolytic era: Archbold RA et al., found frequency of AV nodal blocks as 5.3%, bundle branch block 8.9% and complete heart block (at bundle branch level) 1.6% [9]. In a meta-analysis by Meine TJ et al., of 75993 patients, incidence of AV block was 6.9% and was associated with significant mortality [25]. These studies reinforced the fact that conduction blocks are associated with significant mortality in thrombolytic era.

The present study is consistent with the studies shown in [Table/Fig-7], which were conducted in thrombolytic era [26-29]. Further, in a study by Bilal HB et al., 54 cases of MI were studied [30], complete AV block was present in 11.8%, LBBB in 14.7%, RBBB 8.8%. All patients with complete block died and mortality was significantly higher in patients with heart blocks.

In this study, bundle branches blocks were more common in anterior infarction, but blocks at the AV node level occurred mostly in inferior infarction. This association was statistically significant

Authors	Year Published	Patients (n)	Second Degree Block	Third Degree Block (%)	Second and/or Third Degree Block (%)
Clemmensen P et al., [26]	1991	377	NA	13	NA
Berger PB et al., [27]	1992	1786	NA	NA	12
Birnbaun Y et al., [28]	1997	1336	NA	NA	9
Newby KH et al., [29]	1996	3287	NA	NA	8.3

[Table/Fig-7]: Comparative studies showing frequency of Advanced AV block complicating Acute Inferior Myocardial Infarction treated with Thrombolytic therapy [26-29].
NA: Not Applicable

(p<0.001). This finding is secondary to the fact that majority of this study patients had right dominant circulation and consequently AV node was supplied by RCA.

Overall conduction defects (49 out of 89) were more common (55.05%) with inferior myocardial infarction. This finding in the present study is consistent with the studies done by Majumder AA et al [31] and Escosteguy CC et al [32]. They have found strong association of AV blocks with inferior MI and that of bundle branch blocks with anterior MI. They also concluded that the conduction blocks were associated with increased complication and mortality. Similar association was also reported by a previously mentioned study by Archbold RA et al., [9].

Diabetes, old age and worse Killip class at presentation were independent predictors of conduction disturbances in AMI. Patients with conduction defects had a higher mortality as compared to those with normal conduction. This risk was increased for all types of conduction defects being more in bundle branch blocks [Table/Fig-4]. It was probably due to extensive myocardial tissue damage in such cases. Most of the deaths were due to ventricular arrhythmias and cardiogenic shock. In this respect, present study is consistent with other studies which have shown increased mortality in bundle branch blocks and complete heart block [6,9,31,33].

Thrombolysis was given to 219 (51.04%) patients of study population, almost consistent with the CREATE registry [15] in which thrombolysis was given to 58.3% of cases. Majority of patients 164 (74.9%), received streptokinase because of poor socio-economic status although, in another registry like CREATE registry [15] it was used only in few. Various reasons could be attributed to low reperfusion rate in this population like delayed presentation, poor access to healthcare, lack of patient awareness, delayed transport and referral to tertiary care hospital. So, urgent steps to improve reperfusion rates in STEMI are required.

Limitation(s)

Patient surveillance was done only during hospital stay. There was no follow-up on evolution of co-morbidity, mortality after discharge.

CONCLUSION(S)

Conduction blocks were more common in elderly, diabetics, in worse Killip class at presentation and in inferior infarction. However, no statistically significant correlation was found between the occurrence of conduction disturbances in AMI and various risk factors like hypertension and smoking. Hence, the present study showed a small decline in incidence of conduction disturbances as compared to the studies of prethrombolytic era, showing beneficial effect of thrombolytic therapy. The present study population showed that conduction disturbances complicating Acute Myocardial Infarction are common in this thrombolytic era, requiring close observation and monitoring, as they have got higher rate of complications and mortality during hospital course.

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- iThenticate Software: Oct 12, 2021 (17%)

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