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Clinical Study of Conduction Blocks in the Setting of Acute Myocardial Infarction

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ABSTRACT

Background: Conduction blocks complicating acute myocardial infarction (AMI) are associated with short-term clinical and functional outcomes. However, there is a paucity of data that describes conduction blocks in Indian AMI patients.

Aim: To investigate incidence, patterns, hospital complications, and predictors of conduction blocks in Indian AMI patients.

Method: In this prospective observational study, 100 AMI patients admitted to our tertiary health care centrefrom October, 2021 to March, 2022 were subjected to detailed demographic (patient's age, sex) and clinical evaluation (risk factor, clinical sign, symptom, and site and pattern of conduction blocks). Conduction blocks were observed for seven days after the admission or until the patients' stay in the hospital whichever wasearlier.

Results:A total of 23% of AMI patients developed conduction blocks. Anterior wall (50%) was found to be the most common anatomical location forAMI. First- and second-degree atrioventricular(AV) blocks were more frequent with inferior wall myocardial infarction[15/16=93.8% vs. 1/16=6.3%],whereas the RBBBswere more common with anterior wall myocardial infarction[5/7=71.4% vs. 3/7=42.9%]. Hospital complications wereinsignificantly increased in AMI patients with conduction blockthan in that withnonconduction block.Breathless (OR=4.00 [95% CI:1.04–15.32]; P=0.040), higher involvement of inferior wall (OR=5.24 [95% CI:1.85–14.87]; P=0.001), lower higher involvement of anterior wall (OR=0.26 [95% CI: 0.09–0.74]; P=0.011), and hypotension (OR=5.18 [95% CI: 1.53–17.50]; P=0.008) were found to be important predictors of conduction blocks in AMI.

Conclusion: Conduction blocks complicated AMI in 23% of cases in our study cohort and had a considerable impact on the short-term hospital complications. Authors recommended that clinicians should be paid considerable attention to this clinical subset in order to improve the mortality rate.

Keywords: anterior wall; complications; conduction blocks, incidence, inferior wall; myocardial infarction

I. BACKGROUND

Acute myocardial infarction (AMI), colloquially referred to as "heart attack," is a global public health concern.Indian individuals are at 2–3fold higher risk of developing AMI as compared to others. The clinical definition of AMI denotes the generalized autonomic dysfunction, which causes enhanced automaticity of the myocardium and conduction system. Among a variety of complications developing after AMI, conduction blocksareone of the major complications(1). These blocksconfer a worse prognosis and areassociated with short- and long-term complications and death(2). The most frequent form of conduction blocks is atrioventricular (AV)nodal blocks [first-, second-, and third-degree AV blocks]and intraventricular conduction blocks [right or left bundle branch blocks (RBBBs or LBBBs) and hemiblocks](3).It is established that the prognostic importance and management ofconduction blocks may alter depending on the site of the infarction, type of conduction blocks, related clinical features, and the hemodynamic compromise (4, 5).Acquainting facts about conduction blocks facilitate their early identification, and thus appropriate treatment, including pacing can be instituted promptly.In light ofthis background, the present study was designed to explore the patterns and hospital outcomes of conduction blocks in Indian AMI patients, as there is a scarcity of information about it in this part of the world. Additionally, we also sought to identify the predictors of conduction blocks in the setting of AMI.

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II. METHOD

A cohort of 100 patients with AMI admitted to tertiary health care from October, 2021 to March, 2022 were included in this prospective, observational study. AMI was diagnosed as per World Health Organization (WHO) criteria(6). Diagnosis of conduction blocks was made based on electrocardiogram (ECG) findings. Patients with old established conduction blocksbased on their old medical records or those patients who were taking drugs that may cause conduction blocks (e.g., beta-blockers, calcium channel blockers, and digoxin) were excluded.The study was approved by Institutional Ethical Committee. Informed consent was obtained prior to enrolment in the study.

Demographic and clinical data were abstracted from patients' medical records. Information was collected about patients' age, sex, risk factor, clinical sign, symptom, and site and pattern of blocks. Conduction blocks were observed for seven days after the admission or until the patients' stay in the hospital whichever wasearlier.Based on the ECG appearance of conduction blocks, AMI patients were stratified into two groups, conduction blocks or nonconduction blocks.Besides, clinical outcomes were evaluated during the hospital stay.

Data analysis was performed using Statistical Package for Social Sciences (SPSS) Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were summarised in the form of means and standard deviation and categorical as frequencies and percentages.The means of the two groups were compared using an independent T-test. Odds ratios with 95% confidence interval were used to compare categorical data. P<0.05 was reported as significant.

III. RESULTS

The study cohort comprised 100 AMI patients, whose demographic are depicted in **Table 1**. The mean age of the patients was 55.57 ± 12.62 years, the majority of patients were males (79%). Among the various risk factors, smoking constituted the main risk factor (52%), followed by hypertension (31%) and diabetes mellitus (27%). Obesity (8%), sedentary lifestyle (10%), and family history (3%) constituted the least prevalent risk factors. The major proportionof the study population had elevated jugular venous pressure. Chest pain was the most frequent complaint in our study cohort. In nearly half of the population, the anterior wall was the most frequent anatomical location for AMI.

Table 1: Demographic features

Variables	**Percentage**
Age groups, years	
>60	69%
≤60	31%
Age, years (mean ± SD)	55.57 ± 12.62
Gender	
Male	79%
Female	21%
Risk factors	
Smoking	52%
Hypertension	31%
Diabetes mellitus	27%
Obesity	8%
Sedentary lifestyle	10%
Family history	3%
Clinical signs	
Tachycardia	19%
Bradycardia	12%
Hypertension	23%
Hypotension	13%

Raised jugular venous pressure	26%
Symptoms	
Chest pain	96%
Sweating	12%
Breathlessness	10%
Palpitation	17%
Vomiting	68%
Giddiness	21%
Sites of block	
Anterior wall	50%
Inferior wall	44%
Global	6%

† SD, Standard deviation

Twenty-three percent of AMI patients had conduction blocks and the remaining 77% of AMI patients were designated to the nonconduction group.Of 23 AMI patients with conduction blocks, the AV blocks and the bundle branch blocks were observed in 16 and 17 cases, respectively.With respect to patterns of conduction block, 7 (30.4%) AMI patients had first- degree AV block, 9 (39.1%) had third- degree AV block, 2 (8.7%) had LBBBs, and 5 (21.7%) had RBBBs.

As depicted in **Table 2**, overall incidence of conduction blocks in AWMI and IWMI was found to be 8% (4/50) and 38.6% (17/44), respectively. Moreover, first- and third-degree AV blocks were more common with inferior wall myocardial infarction (IWMI) [15/16=93.8% vs. 1/16=6.3%], whereas the RBBBswere more frequent with anterior wall myocardial infarction (AWMI) [5/7=71.4% vs. 3/7=42.9%].

Table 2: Patterns of conduction blocks according to type of acute myocardial infarction

Conduction blocks	**AWMI (n=50)**	**IWMI (n=44)**	**Global (n=6)**
First- degree AV block	1 (2%)	6 (13.6%)	0 (0.0%)
Third- degree AV block	0 (0.0%)	9 (20.5%)	0 (0.0%)
LBBB	2 (4%)	0 (0.0%)	0 (0.0%)
RBBB	3 (6%)	2 (4.5%)	0 (0.0%)
Total	4 (8%)	17 (38.6%)	0 (0.0%)

†AV, atrioventricular; MI, myocardial infarction; AWMI, anterior wall MI; IWMI, inferior wall MI; LBBB, left bundle branch block; RBBB, right bundle branch block.

As elaborated in **Table 3**, AMI patients with conduction blocks were more likely to develop significant clinical complications during the index hospitalization including congestive cardiac failure, left ventricular failure, ventricular/supraventricular tachycardia, and death as compared to their counterparts. However, this association was not statistically significant. There were 4 deaths noted in AMI patients with conduction blocks; one death (1/7=14.3%) occurred in an AMI patient with first- degree AV block, one in an AMI patient with third- degree AV block (1/9=11.1%), and two in an AMI patient with RBBBs (2/5=40.0%).

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Table 3: Hospital complications of acute myocardial infarction patients with conduction blocks † *Indicate statistically significant value.CI, confidence interval.

Complications	**Conduction blocks (n=23)**	**Nonconduction blocks (n=77)**	**Odd ratio (OR)**	**95% CI**	**P-value**
Congestive cardiac failure	7 (30.4%)	11 (14.3%)	2.63	0.88–7.84	0.083
Left ventricular failure	1 (4.3%)	6 (7.8%)	0.54	0.06–4.71	0.575
Ventricular/Supra ventricular tachycardia	3 (13.0%)	3 (3.9%)	3.70	0.69–19.75	0.126
Death	4 (17.4%)	8 (10.4%)	1.82	0.49–6.68	0.370

With respect to the predictors of conduction blocks in setting of AMI,breathless(OR=4.00 [95% CI:1.04–15.32];P=0.040), higher involvement of inferior wall (OR=5.24 [95% CI:1.85–14.87]; P=0.001), lower involvement of anterior wall (OR=0.26 [95% CI: 0.09–0.74]; P=0.011), and hypotension (OR=5.18 [95% CI: 1.53–17.50]; P=0.008)were found to be significant predictors of conduction blocks in AMI. However, no statistically significant correlation was found between the occurrence of conduction blocks and the risk factors **(Table 4)**.

Table 4: Analysis of predictor of acute myocardial infarction developing conduction block

Variables	**Conduction blocks (n=23)**	**Nonconduction blocks (n=77)**	**Odd ratio (OR)**	**95% CI**	**P-value**
Risk factor					
Smoking	12 (52.2%)	40 (51.9%)	1.01	0.40–2.56	0.985
Hypertension	9 (39.1%)	22 (28.6%)	1.61	0.61–4.25	0.190
Diabetes mellitus	4 (17.4%)	23 (29.9%)	0.49	0.15–1.61	0.243
Obesity	-	8 (10.4%)	8.18	0.15–439.41	0.295
Sedentary lifestyle	2 (8.7%)	8 (10.4%)	0.82	0.16–4.17	0.812
Family history	1 (4.3%)	2 (2.6%)	1.70	0.15–19.70	0.669
Clinical sign					
Tachycardia	3 (13.0%)	16 (20.8%)	0.57	0.15–2.17	0.411
Bradycardia	7 (30.4%)	5 (6.5%)	6.30	1.77–22.41	6.300
Hypertension	3 (13.0%)	20 (26.0%)	0.43	0.11–1.59	0.206
Hypotension	7 (30.4 %)	6 (7.8%)	5.18	1.53–17.50	0.008*
Raised jugular venous pressure	8 (34.8%)	18 (23.4%)	1.75	0.64–4.79	0.277
Symptom					
Chest pain	20 (87.0%)	76 (98.7%)	0.09	0.009–0.889	0.087
Sweating	2 (8.7%)	10 (13.0%)	0.64	0.13–3.15	0.581
Breathlessness	5 (21.7%)	5 (6.5%)	4.00	1.04–15.32	0.040*
Palpitation	6 (26.1%)	11 (14.3%)	2.12	0.69–6.55	0.193
Vomiting	17 (73.9%)	51 (66.2%)	1.44	0.51–4.10	0.490
Giddiness	7 (30.4%)	14 (18.2%)	1.97	0.68–5.68	0.211
Sites of block					
Anterior wall	6 (26.1%)	44 (57.1%)	0.26	0.09–0.74	0.011*

Inferior wall	17 (73.9%)	27 (35.1%)	5.24	1.85–14.87	0.001*
Global	-	6 (7.8%)	0.23	0.01–4.31	0.329

† *Indicate statistically significant value.CI, confidence Interval.

IV. DISCUSSION

This present study aimed to investigate the overall incidence, the patterns of conduction blocks, hospital outcomes, and predictors of conduction blocks in settings of AMI. The main findings obtained from the study were: a) twenty-three percent of AMI cases developed conduction blocks, b) conduction blocks were more prevalent in IWMI; first- and second-degree AV blocks were more frequent in IWMI whilst RBBBs were more common in AWMI, c) AMI patients with conduction blocks were more likely to develop significant clinical complications and death as compared to those with nonconduction blocks, but figures were not statistically significant, and d) breathless, higher involvement of inferior wall, lower involvement of anterior wall,and hypotension were proved to be important predictors of conduction blocks in AMI.

Our findings were in accordance with the findings reported by many previous studies, which claimed that AMI was more common in individuals aged 60 years or more(7-9).Similar to what had been found previously, we discovered that the males outnumbered females in developing AMI (10-12). In this study, smoking (72.0%) was the most common risk factor, which was also apparent in the famous work of Chavda et al. (13).Most studieshad demonstrated the inferior wall as the most frequent site of conduction blocks followed by the anterior wall, which was consistent with our results(7, 14).

Conduction blocks arewell-recognizedcomplications of AMI. It reflects extensive damage to the myocardium, which acts as substrate for re-entrant circuits on account of changes in tissue refractoriness. Enhanced efferent sympathetic activity, increased concentrations of circulating catecholamines, and local release of catecholamines from nerve endings in the cardiac muscles culminate in the development of a variety of conduction blocks as well as arrhythmias (15, 16).

In this study, the conduction blocks developed in 23% of cases of AMI, which further supported evidence from previous observations by Ram et al.(17) (17%), Archbold et al.(18) (16.0%), Bhalli et al. (3)(17.6%), Sandeep et al.(19) (31%), Qadir et al.(20) (20.74%), and Shirafkan et al.(21) (15.8%), and Nguyen et al.(22) (4.1%).On looking at **Table 5** data, we realized that patterns of conduction blocks indeed present diverse and unpredictable changes.

Our study divulged that the maximum incidence of conduction blocks was noted with IWMI than AWMI (38.6% vs. 8%). These results were barely distinguishable from findings reported by Qadir et al.(20), Majumder et al.(23), and Escosteguyet al.(24). On further exploration of the pattern of conduction blocks, we observed that first- and third-degree AV blocks commonly occurred in IWMIand RBBBs in AWMI (6%). In the same vein, other schools of thought have established a strong association between AV blocks with IWMI andbundle branch blocks with AWMI (18, 23, 24).

Table 5: Comparisons of incidence and patterns of conduction blocks in AMI patients in the present study and earlier reported studies

Conduction blocks	**Current study**	**Ram et al.(17)**	**Archbold et al.(18)**	**Bhalli et al.(25)**	**Qadir et al.(20)**	**Sandeep et al.(19)**	**Shirafkan et al.(21)**
First- degree AV block	7%	7%	-	-	0.9%	6%	28.6%
Second- degree AV block	-	4%	-	-	1.1%	3%	
Third-degree AV block	39.1%	3%	5.3%	8.1%	10.48%	3%	4.8%
LBBB	8.7%	1%	2.4%	2.3%	3.03%	-	19%
RBBB	21.7%	1%	3.6%	3.7%	3.96%	10%	9.5%
LAHB	-	1%	-	-	-	8%	30.2%
LPHB	-	-	-	-	-	-	6.3%

Bifascicular block#	-	-	2.9%	-	2.16	-	-
CHB (at bundle branch level)	-	-	1.6%	0.2%	-	8%	-

† AV, atrioventricular; CHB, complete heart block; LAHB, left anterior hemiblock; LPHB, left posterior hemiblock; RBBB, right bundle branch block; LBBB, left bundle branch block.#Combination of RBBB with either left anterior fascicular block orleft posterior fascicularblock

The mortality rate among AMI patients withconduction blocksin our study population was found to be 17.4% (4/23), these values were non significantly higher than those with nonconduction blocks (8/77=10.4%). Consistent with our findings, a growing body of evidence claimed that AMI patients with conduction blockshad a higher chance of mortality as compared to those with nonconduction blocks. This finding wascoherent with our study, but we did not find a statistically significant association(3, 13, 21, 26, 27). This happened because of extensive myocardial damage in such cases. Moreover, our study also displayed higher mortality (40%) with the RBBBs. These figures were numerically higher than those reportedby Goet al.(28)(13.1%) andMoreno et al.(29)(9.9%).

This study showed that breathless, higher involvement of inferior wall, lower higher involvement of anteriorwall,and hypotension wereused aspredictors for conduction blocks in AMI. As observed in this study andstudy by Escosteguy et al. (24), males had statistically insignificantly more conduction blocksas compared to females (18.0% vs. 14.7%). Although the prevalence of cigarette smoking, hypertension, and diabetes mellitus in AMI patients with conduction blocks was greater in comparison tothose with nonconduction blocks. However, the differences were not statistically significant in our study and the recent study of Ram et al.(17).

Some limitations should be considered while interpreting the study results. The study was predominantly limited due to the small sample size and single-centre hospital-based study design. Additionally, all the patients might have not come to the hospitalduring the study window period. Further work with large sample size and multicentre design is recommended to throw more light on this context.

V. CONCLUSION

The present study highlighted that conduction blocks complicating AMI are relatively frequent phenomena that require close observation and monitoring because they are usually associated with a higher rate of complications and death during the hospital course. Deep understanding of the pattern of conduction blocks is a crucial aspect of early diagnosis and prompt intervention.

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