

# Severe Mitral Regurgitation after Inferior Wall Myocardial Infarction and Coronary Artery Dominance

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## ABSTRACT

**Objective:** To analyze the frequency of development of severe mitral regurgitation in patients with right or left coronary artery dominance after inferior wall myocardial infarction.

**Methodology:** This cross-sectional study was conducted at the Emergency Department, Punjab Institute of Cardiology, Lahore for a period of six months. Two hundred and thirty patients presenting with inferior wall myocardial infarction (IWMI) were enrolled in the study by non-probability consecutive sampling. After informed consent and emergency treatment, echocardiography, and angiography of the patients were performed. Coronary artery dominance and the presence of severe mitral regurgitation (MR) were noted. The data was entered and analyzed in Statistical Package for the Social Sciences (SPSS) version 23.0.

**Results:** The mean age of the patients was  $52 \pm 13.73$  years. There were 120 (52.2%) males and 110 (47.8%) females. The right coronary artery (RCA) was involved in 136 (59.13%) while the left circumflex artery (LCX) was involved in 94 (40.87%) of the IWMI patients. In patients having RCA as a dominant artery, severe MR was observed in 30 (22.1%) while in patients having LCX as a dominant artery, severe MR was observed in 5 (5.3%) cases. Out of 230 patients, heart failure was found in 107 (46.5%) patients, hypertension in 114 (49.6%), uncontrolled diabetes in 101 (43.9%), and current smoking was found in 61 (26.5%) patients.

**Conclusion:** Right coronary artery was the more common artery involved in IWMI. Patients with dominant RCA were more severely affected by MR as compared to the patients with LCX as dominant artery.

**Keywords:** *Mitral regurgitation. Coronary artery. Inferior wall myocardial infarction.*

## INTRODUCTION

Cardiovascular diseases are among the leading causes of morbidity and mortality throughout the world. These diseases account for thirty percent of deaths occurring annually.<sup>1</sup> The number may vary among different ethnic groups and countries. This difference can be described according to the healthcare system i.e. rapid and quality treatment protocols that lead to decreased mortality. In settings lacking enough resources, short as well as long term prognostic features and characteristics are essential for the effective triage of the patients.<sup>2,3</sup>

Myocardial infarction is one of the major cardiovascular diseases.<sup>4</sup> The most common location of the myocardial infarction is the left ventricular inferior wall which is mostly supplied by the right coronary artery (RCA).<sup>5</sup> In about 20% of the individuals, the inferior wall of the left ventricle is also supplied by the left circumflex artery (LCX). The artery supplying blood to the ventricular walls is labeled as the dominant artery. The severity of complications varies with the

dominance of either artery, secondary to the physiological mechanisms.<sup>6</sup>

Most of the patients with myocardial infarction report early during the course of their disease but the patients who report later might be at risk of development of mechanical complications because of weakened cardiac structured integrity leading to rupture of the interventricular septum or the rupture of the ventricular free wall or severe mitral regurgitation. The development of mitral regurgitation (MR) after myocardial infarction occurs from ruptured papillary muscle or chordae. This may lead to life-threatening emergencies.<sup>7,8</sup>

The current study was carried out to analyze the difference in frequency of development of severe mitral regurgitation in patients with RCA or LCX dominance after inferior wall myocardial infarction. A difference in frequency of mitral regurgitation in patients with RCA versus LCX dominance may form the basis of future research and may also help to triage the patients for more intensive care.

## METHODOLOGY

This cross-sectional study was conducted at the Emergency Department, Punjab Institute of Cardiology, Lahore for a period of six months i.e. December 2017 to May 2018 after approval from the ethical review committee of the Institution (Letter No: RTPGME-Research/062, 20-10-2017). Two hundred

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and thirty patients were enrolled in the study through non-probability consecutive sampling technique after taking the informed consent. Patients of either gender, ages between 30 to 75 years, and those presenting with inferior wall myocardial infarction within 72 hours of the start of symptoms were included in the present study. Patients with a history of previous mitral regurgitation, history of previous myocardial infarction or concomitant involvement of other coronary artery areas like anterior wall or septal wall, history of renal failure (serum creatinine on admission  $>1.1$  mg/dl), and patients with a history of rheumatic heart disease were excluded from this study. Patients were treated according to the standard departmental protocols. Severe mitral regurgitation was determined using echocardiography followed by subsequent angiography and coronary artery dominance was noted. Patient's history regarding heart failure, smoking, uncontrolled diabetes & hypertension were also noted. Patient was considered diabetic if glycosylated hemoglobin (HbA1C) was more than 6.5%. Patients with blood pressure  $>130/90$  mmHg were taken as hypertensive. A proforma was filled for each patient, designed to mention the patients' demographics i.e. name, age, gender, and admission number.

#### STATISTICAL ANALYSIS

All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 23.0. Continuous variables were expressed as mean $\pm$ SD. Categorical data, i.e., gender, severe mitral

regurgitation, and coronary artery dominance were expressed as frequencies and percentages. Data was stratified for age, gender, history of uncontrolled diabetes, hypertension, and smoking. Chi-square test was applied and a p-value of  $\leq 0.05$  was used as significant.

#### RESULTS

The mean age of patients was  $52\pm 13.73$  years with an age range of 30 to 75 years. There were 120(52.2%) male and 110(47.8%) female patients. The frequency of co-morbid conditions of study subjects is shown in Table 1. Right coronary artery was involved in 136(59.13%) while left circumflex artery was involved in 94(40.87%) of the patients. Severe MR was observed in 30(22.1%) post-IWMI patients with RCA as a dominant artery, while 5(5.3%) cases of LCX as a dominant artery suffered from severe MR. The difference was statistically significant ( $p=0.001$ , Chi-square value=12.072) (Figure 1). Comparison of severe MR with a dominant artery in association with age, gender, heart failure, current smoking, uncontrolled diabetes, and hypertension was done (Table 2).

#### DISCUSSION

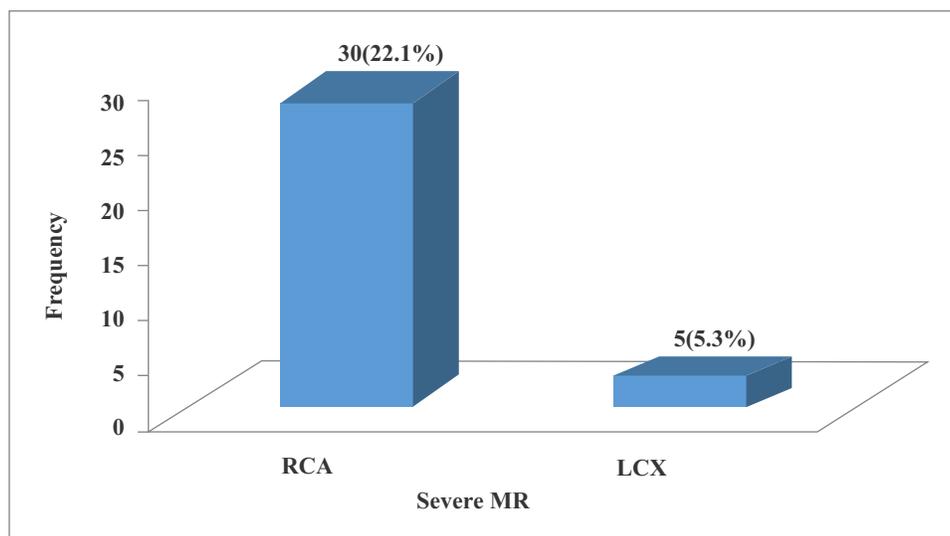
Acute inferior wall myocardial infarction (IWMI) occurs due to the rupture of plaque in different coronary arteries leading to the blockage of sufficient blood supply to the cardiac walls that ultimately leads to infarction. Usually, these plaques are present in the dominant artery supplying the ventricular wall i.e.,

**Table 1: Demographic and Associated Co-morbid Characteristics of Study Participants**

Variables		Total
Age (Years)	Mean $\pm$ SD	52 $\pm$ 13.73
Gender	Male	120(52.2%)
	Female	110(47.8%)
Heart Failure	Yes	107(46.5%)
	No	123(53.5%)
Current Smoking	Yes	61(26.5%)
	No	169(73.5%)
Uncontrolled Diabetes	Yes	101(43.9%)
	No	129(56.1%)
Hypertension	Yes	114(49.6%)
	No	116(50.4%)

**Table 2: Association of Severe MR with Dominant Artery and Age, Gender, Heart Failure, Current Smoking, Uncontrolled Diabetes, and Hypertension**

Variables		Severe MR	Dominant Artery		p-value
			RCA	LCX	
Age (Years)	30-50	Present	14(46.7%)	1(20%)	0.024
	51-75	Present	16(53.3%)	4(80%)	0.005
Gender	Male	Present	30(100%)	1(20%)	0.000
	Female	Present	0(0%)	4(80%)	0.011
Heart Failure	Yes	Present	16(53.3%)	1(20%)	0.007
	No	Present	14(46.7%)	4(80%)	0.026
Current Smoking	Yes	Present	17(56.7%)	1(20%)	0.001
	No	Present	13(43.3%)	4(80%)	0.104
Uncontrolled Diabetes	Yes	Present	13(43.3%)	2(40%)	0.020
	No	Present	17(56.7%)	3(60%)	0.010
Hypertension	Yes	Present	16(53.3%)	1(20%)	0.005
	No	Present	14(46.7%)	4(80%)	0.030

**Figure 1: Frequency of Severe MR in RCA and LCX**

right coronary artery (RCA) or left circumflex artery (LCX).<sup>9</sup> Certain complications occur in the patients who report later during their course of disease i.e. myocardial infarction. One of the complications includes mitral regurgitation developed due to ruptured chordae or papillary muscles.<sup>10</sup>

The current study enrolled 230 patients. The average age of the patients was 52±13.73 years with an age range of 30 to 75 years. There were 120(52.2%) male

and 110(47.8%) female patients. A study conducted by Pendse et al., in 2016 enrolled 52 patients of acute inferior wall myocardial infarction, out of which, 41 were males and 11 were females. In their study, 42 patients were found to have RCA as the dominant vessel and 9 patients had LCX. They also concluded that the incidence of acute inferior wall myocardial infarction is highest in the age group of 50 to 59 years.<sup>6</sup> In a study by Gaude et al., it was observed that 98% of

the patients presented with severe IWMI had RCA dominance.<sup>10</sup> Sohrabi et al. documented that in patients presented with acute IWMI, 64.5% of the patients had right coronary artery whereas, 35.5% had left circumflex artery involvement.<sup>11</sup> Another study by Li et al., in 2017 demonstrated RCA to be a more commonly infarct related artery in acute inferior wall myocardial infarction as compared to the LCX.<sup>12</sup> The results of all these studies are comparable with the current study.

A study in 2020 observed the involvement of lesions in RCA and LCX arteries in 419 inferior myocardial infarction patients. The study showed that 14.2% of the patients had both RCA and LCX artery lesions on coronary angiography which is a contrasting finding to the present study.<sup>13</sup>

In our study, the dominant artery was the right coronary artery (n=136, 59.13%). These results can be compared to the study by Pendse et al., in which they noted that 80% of the patients presenting with inferior wall myocardial infarction had involvement of RCA.<sup>6</sup>

Our study revealed that severe MR was present in 30(22.1%) post-IWMI patients with RCA as a dominant artery, while 5(5.3%) cases of LCX as dominant artery suffered from severe MR. These results are in accordance with the study by Sohrabi et al., in which they observed 16.5% of the patients having severe MR in patients having RCA as dominant artery as compared to the 2.4% of the patients having LCX as a dominant artery.<sup>11</sup> Vives-Borrás et al., studied ECG algorithms to differentiate RCA and left circumflex coronary artery (LCCA) occlusion in patients with acute IWMI. They reported that patients with LCCA occlusion were more likely to develop mitral regurgitation at hospital discharge.<sup>14</sup> This finding is in contrast to the present study. Another study in 2018 showed that left circumflex infarcts in ST-elevation myocardial infarction had a higher rate of mortality and complications as compared to RCA infarcts. The study also reported that in male patients both LCX and RCA were dominant, however, a relatively higher proportion of females were observed in the RCA group.<sup>15</sup> Our study results indicated that the patients having severe MR and RCA as dominant artery were only males and that no female had RCA as a dominant artery. The results are opposing to the current study.

In our study, comparison of severe MR with a dominant artery in association with age, gender, heart failure, current smoking, uncontrolled diabetes, and hypertension was done. We found that the presence of heart failure, current smoking, uncontrolled diabetes, and hypertension were strongly correlated with the presence of RCA as the dominant artery in the presence of severe MR.

The reason of right coronary occlusion leading to severe MR more frequently as compared to left circumflex artery was elaborated in the study of Labrada et al. They reported that the basic pathogenesis of MR is weakening of tensile strength of papillary muscle due to infarction, thus contributing to its early rupture.<sup>16</sup>

## CONCLUSION

The right coronary artery is the more common artery involved in inferior wall myocardial infarction. Complications like severe mitral regurgitation are more frequent among the IWMI patients having right coronary artery dominance as compared to left circumflex artery dominance. Also, males with RCA as dominant artery are more commonly affected by mitral regurgitation post-IWMI.

## LIMITATIONS & RECOMMENDATIONS

The study included patients presenting within 72 hours of the development of symptoms. Also, other prognostic factors i.e. level of CPK-MB, cardiac troponins, heart blocks, and ejection fraction were not evaluated. Moreover, we did not study the differential impact of mitral regurgitation caused by either artery dominance on LV remodeling and ejection fraction. The correction of mitral regurgitation by culprit coronary revascularization was also not observed. A more extensive study considering these limitations should be conducted.

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