DOI: https://doi.org/10.53350/pjmhs2023171562

ORIGINAL ARTICLE

Frequency of Ischemic Mitral Regurgitation in ST Elevation Myocardial Infarction and Its Impact on Hospital Course

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ABSTRACT

Background and Aim: Ischemic mitral regurgitation (IMR) is the most prevalent complication following myocardial infarction (MI) and coronary artery disease. Acute or chronic MI can lead to IMR resulting from an abnormality in regional wall motion or dysfunction of papillary muscles in a territory with structurally normal mitral valve leaflets, coronary artery disease and chordae tendineae. The present study aimed to determine the incidence of ischemic mitral regurgitation in ST elevation myocardial infarction and its impact on hospital course.

Material and Methods: This cross-sectional study was conducted on 164 myocardial infarction patients in the Department of Cardiology of Pakistan Institute Medical Sciences Hospital, Islamabad over a time period of 6 months. Institute research and ethical committee approved the study protocol. Patients with prior mitral surgery, heart failure, previous myocardial infarction, and mitral valve disorders were excluded. Demographic detail, echocardiographic parameters, and myocardial complications were recorded. Other parameters such as Killip class, in-hospital mortality, and MI territory with respect to electrocardiographic changes were recorded. Data analysis was carried out in SPSS version 26.

Results: Of the total 164 MI patients, there were 114 (69.5%) male and 50 (30.5%) females. The overall mean age was 58.62±8.62 years. The incidence of IMR was 106 (64.6%), out of which the prevalence of mild, moderate, and severe MR were 86 (81.1%), 12 (11.3%), and 8 (7.6%) respectively. No significant association was found between the presence of IMR and other parameters such as diabetes, smoking, hypertension, gender, and BMI. There was a significant association between triglyceride and serum LDL-cholesterol levels with IMR presence. On comparing the IMR and no MR cases, left ventricular ejection fraction reduced but pulmonary arterial pressure increased in IMR groups.

Conclusion: The present study found that the prevalence of IMR was 64.6% among MI patients and approximately half of the patients who suffer from IMR after having an AMI experience complications as a result of it. A proper treatment decision depends on assessing the severity of the MR in relation to AMI complications.

Keywords: Ischemic mitral regurgitation, Myocardial infarction, ST elevation

INTRODUCTION

Myocardial infarction is frequently associated with ischemic mitral regurgitation (IMR) and mitral valve apparatus is affected by left ventricular alteration [1].

Ischemic mitral regurgitation is the most prevalent complication following an acute myocardial infarction (AMI) and coronary artery disease (CAD). IMR is generally caused by an abnormality in regional wall motion or dysfunction of papillary muscles in a territory with structurally normal mitral valve leaflets, coronary artery disease, and chordae tendineae [2]. During acute myocardial infarction phases, IMR is significantly associated with a poor prognosis [3]. AMI early risk stratification can ascertain the patients at high risk who need advance treatment and early intervention can improve the outcome [4].

Heart failure and chronic MR developing patients following MI could be identified by dominant risk stratification. During the MI early stage, IMR might have emerged as mild, moderate, and severe valve disease. Even transient ischemia can result in reversible IMR if the ischemia is resolved. Papillary muscle rupture might be the most severe forms that are uncommon and had a higher mortality rate as previously reported [5]. Pulmonary oedema, cardiogenic shock, and adverse long-term prognosis were generally reported in these patients after surgical intervention [6]. The prevalence of mechanical complications reduced with time following AMI and ranges from 1% to 5% [7, 8]. Acute MR presence mainly affects the pulmonary venous pressure and significant changes occur before and after load. End diastolic volume increases only slightly in pulmonary venous hypertension due to LV compliance limitations [9]. Acute IMR patients' clinical presentations can range from asymptomatic or milder symptoms, such as coughing and mild dyspnoea, to overt symptoms of haemodynamic compromise and congestive cardiac failure [10, 11]. Acute secondary PM rupture caused by acute MI is generally associated with significant haemodynamic compromise, sudden congestive cardiac failure, and poor clinical outcomes [12].

METHODOLOGY

This cross-sectional study was conducted on 164 myocardial infarction patients in the Department of Cardiology, Pakistan Institute of Medical Sciences, Hospital Islamabad over a period of 6 months. Institute research and ethical committee approved the study protocol. Patients with prior mitral surgery, heart failure, previous myocardial infarction, and mitral organ valve disorders were excluded. Demographic details, echocardiographic parameters, and myocardial complication were recorded. Other parameters such as Killip class, in-hospital mortality, and MI territory with respect to electrocardiographic changes were recorded. Male patients with diabetes mellitus (plasma concentration > 200 mg/dL), prior hypertension (SBP 140 mmHg or DBP 90 mmHg), smoking history, and hyperlipidemia (TCL> 200 mg/dL or TGL > 150 mg/dL) were different coronary risk factors. Philips Envisor-C (2.5-3.5MHz) probe was used for echocardiograms within the first week of admission. The left atrium and ventricle size were measured in M mode with parasternal view. Severely reduced, moderately reduced, mildly reduced, and normal left ventricular ejection fraction was defined as <30%, 31%-44%, 45%-54%, and ≥ 55% respectively.

Pattern of mitral inflow velocities (E, A) was used for the assessment of diastolic function of left-ventricular functions defined in various diastolic dysfunction stages. To calculate the flling pressure, the ratio of transmitral Doppler early filling velocity to tissue Doppler early diastolic mitral annular velocity (E/é) was used. Echocardiographic parameters were used for the measurement of systolic pulmonary arterial pressure and categorized into four groups as follows a) Normal (SPAP≤ 30 mmHg), b) Mild pulmonary hypertension (SPAP was 31-45 mmHg), c) Moderate (SPAP was 46-65 mmHg), and severe (>65

mmHg). SPSS version 26 was used for data analysis. Quantitative data were expressed as mean and standard deviation. Qualitative variables were described as frequency and percentages. Independent t-test was used for comparing the different demographic and clinical details in both groups. All the descriptive statistics were carried out taking 95% CI and 5% level of significance.

RESULTS

Of the total 164 MI patients, there were 114 (69.5%) male and 50 (30.5%) females. The overall mean age was 58.62±8.62 years. The incidence of IMR was 106 (64.6%), out of which the prevalence of mild, moderate, and severe MR were 86 (81.1%), 12 (11.3%), and 8 (7.6%) respectively. There was insignificant association between MR presence and smoking, gender, hypertension, diabetes, and BMI. There was a significant association between triglyceride and serum LDL-cholesterol levels with IMR presence. As a result of IMR, left ventricular ejection fraction was reduced, left ventricular end-diastolic pressure increased, and pulmonary arterial pressure increased (p-value 0.001). Patients with IMR were more likely to have stage III diastolic dysfunction. Baseline characteristics are shown in Table-I. Figure-1 illustrates the prevalence of IMR and no MR patients. Figure-2 depicts the comparison of different risk factors in IMR and no MR groups. Myocardial infarction location is demonstrated Figure-3. The prevalence of severe, moderate, and mild are shown in Figure-4. Table-II represents the comparison of echocardiographic parameters in IMR and no MR groups.

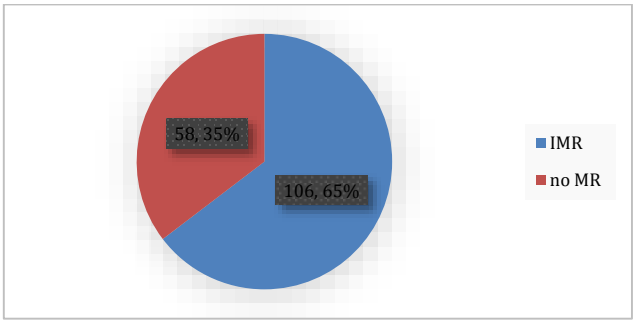

Figure-1: Prevalence of IMR and no MR in MI patients (n=164)

Table-1: Baseline characteristics of IMR and no MR patients

Characteristics	IMR group (N=106)	No MR (N=58)	P-value
Age (years)	58.32±7.82	58.92±9.42	0.410
BMI (kg/m2) <24 25-29 >30	 8 (7.6) 84 (79.2) 14 (13.2)	 10 (17.2) 40 (69.0) 8 (13.8)	0.523
Killip Class I II III IV	 62 (58.5) 18 (17.0) 20 (18.9) 6 (5.7)	 52 (89.7) 6 (10.3) 0 (0) 0 (0)	0.001

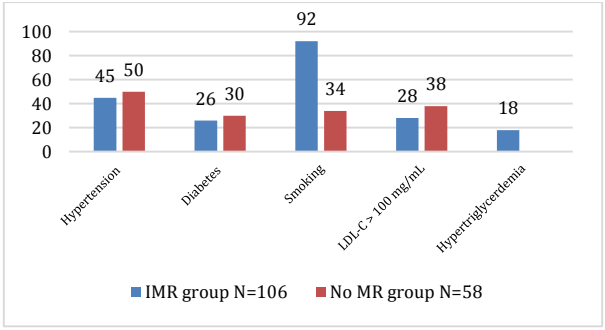

Figure-2: Comparison of various risk factors in IMR and no MR groups

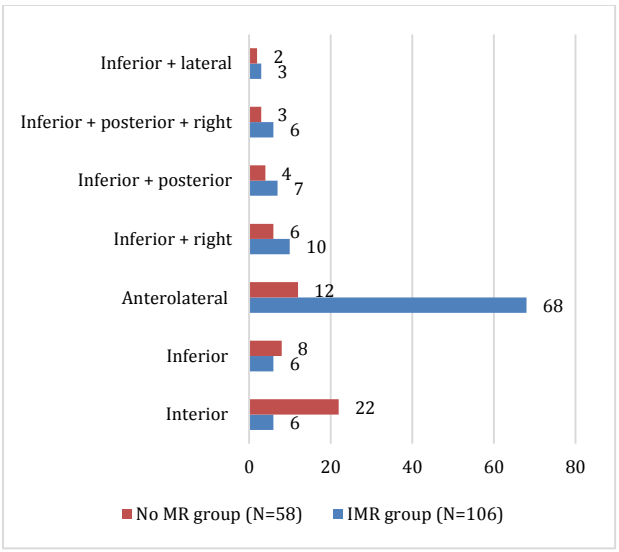

Figure-3: location of Myocardial infarction

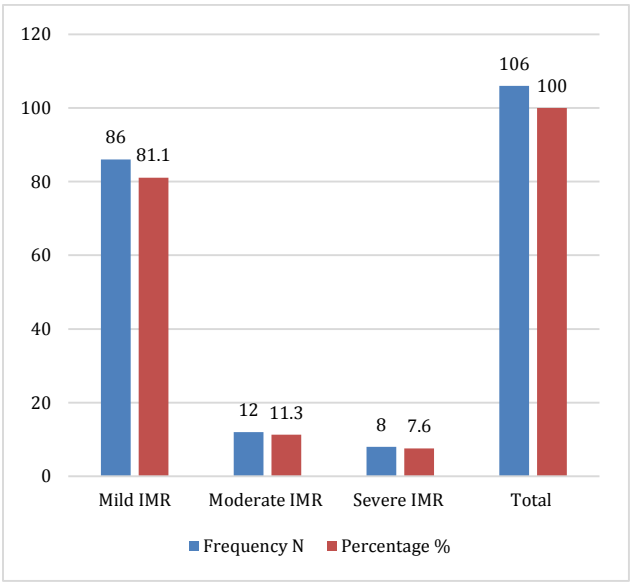

Figure-4: Incidence of mild, moderate, and severe IMR

Table-2: Comparison of IMR and no MR groups based on echocardiographic parameters

Parameters	IMR group N=106 N (%)	No MR group N=58 N (%)	P-value
Left ventricular ejection fraction (%) <30 31-44 45-54 ≥ 55	 14 (13.2) 26 (24.5) 28 (26.4) 38 (35.8)	 26 (44.8) 18 (31) 12 (20.7) 2 (3.5)	0.001
Pulmonary arterial pressure (mmHg) Normal ≤ 30 Mild 31-45 Moderate 46-65 Severe>65	 42 (39.6) 40 (37.7) 22 (20.8) 2 (1.9)	 46 (79.3) 12 (20.7) 0 (0) 0 (0)	0.001

DISCUSSION

The present study mainly focused on determining the frequency of ischemic mitral regurgitation in ST elevated myocardial infarction patients and its impact on hospital courses. The prevalence of IMR

was 64.6% among myocardial infarctions. Approximately half of the patients who suffer from IMR after having an AMI experience complications as a result of it. These complications were electrical and mechanical complications. Ventricular tachycardia, Atrial fibrillation or SVT, Ventricular fibrillation, Bundle branch block, and Atrioventricular block are different electrical complications whereas mechanical complications included Left ventricular aneurysm, Ventricular septal rupture, Free wall rupture, and Left ventricular clot. Though the exact prevalence of MR following MI is still uncertain. But numerous angiographic studies reported that incidence of MR in myocardial infarction ranges from 1.6% to 19% [13. 14]. In Color Doppler echocardiographic sequences, a higher prevalence of IMR was reported 8% to 74% [15, 16].

From the past few years, significant improvements have been reported in coronary artery syndrome outcomes and revascularization on time worldwide [17, 18]. Additionally, there has been a significant reduction in mechanical complications caused by myocardial infarction in assessing the temporal trends reported in various studies. However, mortality rates are continuously increasing [19, 20]. During the myocardial infarction acute phase, the rate of adverse events of Mitral regurgitation increased that developed the risk of congestive heart disease and mortality [21].

In the present study, the prevalence of mild, moderate, and severe IMR was 81.1%, 11.3%, and 7.6% respectively. The flail mitral valve was present in 8 (4.9%) patients. According to a previous study done by Ashikhmina et al [22] investigating 1190 patients using echocardiography for AMI reported that incidence of mild and severe ischemic MR was 39.7% and 6.3% respectively. Gerosa et al. [23] found that occurrence of no detected and mild color Doppler echocardiography was 34% and 45% patients. Additionally, about 16% had moderate MR detected on color Doppler echocardiography. The variations in severity of IMR are associated with different risk factors for coronary artery, baseline characteristics, and echocardiography time differences.

The present study found that anterior and anterolateral walls were most prevalent MI territories in IMR and no MR patients. Quinn et al [24] found that 9% cases of moderate to severe MR were reported in 234 patients and 17% in 242 patients of inferoapical extension. In our study, left ventricular ejection fraction >55% were mostly found in no MR patients whereas left ventricular ejection fraction <35% observed in IMR. Gammie et al [25] adjusted the clinical variables and ejection fraction in both IMR and no MR groups. Clinical variables were age, Killip class, hypertension, anterior infarction, gender, diabetes mellitus, and coronary revascularization. Heart failure ratio in both IMR and no MR patients were 3.5 (95% CI, 1.9-6.3), p-value=0.001) and 2.8% (95% CI, 1.6-4.1, P-value= 0.001) respectively. George et al [26] reported that left ventricular pressures were similar in both IMR and no MR patients.

CONCLUSION

The present study found that the prevalence of IMR was 64.6% among MI patients and approximately half of the patients who suffer from IMR after having an AMI experience complications as a result of it. A proper treatment decision depends on assessing the severity of the MR in relation to AMI complications.

REFERENCES

1. Fazlinezhad A, Dorri M, Azari A, Bigdelu L. Frequency of Ischemic Mitral Regurgitation after FirstTime Acute Myocardial Infarction and its Relation to Infarct Location and In-Hospital Mortality. J Teh Univ Heart Ctr 2014;9(4):160-165.
2. Vahanian, A.; Beyersdorf, F.; Praz, F.; Milojevic, M.; Baldus, S.; Bauersachs, J.; Capodanno, D.; Conradi, L.; De Bonis, M.; De Paulis, R.; et al. 2021 ESC/EACTS Guidelines for the Management of Valvular Heart Disease: Developed by the Task Force for the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). Eur. Heart J. 2022, 43, 561–632.
3. McInerney, A.; Marroquin-Donday, L.; Tirado-Conte, G.; Hennessey, B.; Espejo, C.; Pozo, E.; de Agustín, A.; Gonzalo, N.; Salinas, P.; Núñez-Gil, I.; et al. Transcatheter Treatment of Mitral Regurgitation. J. Clin. Med. 2022, 11, 2921.
4. Nishino, S.; Watanabe, N.; Kimura, T.; Enriquez-Sarano, M.; Nakama, T.; Furugen, M.; Koiwaya, H.; Ashikaga, K.; Kuriyama, N.; Shibata, Y. The Course of Ischemic Mitral Regurgitation in Acute Myocardial Infarction After Primary Percutaneous Coronary Intervention: From Emergency Room to Long-Term Follow-Up. Circ. Cardiovasc. Imaging 2016, 9, e004841.
5. Elbadawi, A.; Elgendy, I.Y.; Mahmoud, K.; Barakat, A.F.; Mentias, A.; Mohamed, A.H.; Ogunbayo, G.O.; Megaly, M.; Saad, M.; Omer, M.A.; et al. Temporal Trends and Outcomes of Mechanical Complications in Patients With Acute Myocardial Infarction. JACC Cardiovasc. Interv. 2019, 12, 1825–1836.
6. Kimura, T.; Roger, V.L.; Watanabe, N.; Barros-Gomes, S.; Topilsky, Y.; Nishino, S.; Shibata, Y.; Enriquez-Sarano, M. The Unique Mechanism of Functional Mitral Regurgitation in Acute Myocardial Infarction: A Prospective Dynamic 4D Quantitative Echocardiographic Study. Eur. Heart J. Cardiovasc. Imaging 2018, 20, 396–406.
7. Guvenç, R.Ç. Clinical Presentation, Diagnosis and Management of Acute Mitral Regurgitation Following Acute Myocardial Infarction. J. Acute Dis. 2016, 5, 96–101.
8. Ibanez, B.; James, S.; Agewall, S.; Antunes, M.J.; Bucciarelli-Ducci, C.; Bueno, H.; Caforio, A.L.P.; Crea, F.; Goudevenos, J.A.; Halvorsen, S.; et al. 2017 ESC Guidelines for the Management of Acute Myocardial Infarction in Patients Presenting with STSegment Elevation: The Task Force for the Management of Acute Myocardial Infarction in Patients Presenting with ST-Segment Elevation of the European Society of Cardiology (ESC). Eur. Heart J. 2018, 39, 119–177.
9. Briosa e Gala, A.; Hinton, J.; Sirohi, R. Cardiogenic Shock Due to Acute Severe Ischemic Mitral Regurgitation. Am. J. Emerg. Med. 2021, 43, 292.e1–292.e3.
10. Bhardwaj, A.; Kumar, S.; Salas de Armas, I.A.; Nascimbene, A.; Nathan, S.; Kar, B.; Gregoric, I.D. Pre- and Post-Operative Mechanical Circulatory Support in Surgical Repair of Post-Acute Myocardial Infarction Mechanical Complications. Ann. Cardiothorac. Surg. 2022, 11, 304–309.
11. Freixa, X.; Hernandez, M.; Farrero, M.; Sitges, M.; Jimenez, G.; Regueiro, A.; Fita, G.; Tatjer, I.; Andrea, R.; Martin-Yuste, V.; et al. Levosimendan as an Adjunctive Therapy to MitraClip Implantation in Patients with Severe Mitral Regurgitation and Left Ventricular Dysfunction. Int J. Cardiol. 2016, 202, 517–518.
12. Bhardwaj, B.; Sidhu, G.; Balla, S.; Kumar, V.; Kumar, A.; Aggarwal, K.; Dohrmann, M.L.; Alpert, M.A. Outcomes and Hospital Utilization in Patients With Papillary Muscle Rupture Associated With Acute Myocardial Infarction. Am. J. Cardiol. 2020, 125, 1020–1025.
13. Massimi, G.; Matteucci, M.; Kowalewski, M.; Ronco, D.; Jiritano, F.; Beghi, C.; Severgnini, P.; Lorusso, R. Surgical Treatment of Post-Infarction Papillary Muscle Rupture: Systematic Review and Meta-Analysis. Ann. Cardiothorac. Surg. 2022, 11, 25260.
14. Vandenbriele, C.; Balthazar, T.; Wilson, J.; Adriaenssens, T.; Davies, S.; Droogne, W.; Dubois, C.; Caetano, A.F.; Goetschalckx, K.; Jacobs, S.; et al. Left Impella®-Device as Bridge from Cardiogenic Shock with Acute, Severe Mitral Regurgitation to MitraClip®-Procedure: A New Option for Critically Ill Patients. Eur. Heart J. Acute Cardiovasc. Care 2021, 10, 415–421.
15. DiVita, M.; Visveswaran, G.K.; Makam, K.; Naji, P.; Cohen, M.; Kapoor, S.; Saunders, C.R.; Zucker, M.J. Emergent TandemHeartECMO for Acute Severe Mitral Regurgitation with Cardiogenic Shock and Hypoxaemia: A Case Series. Eur. Heart J. Case Rep. 2020, 4, 1–6.
16. Sultan, I.; Aranda-Michel, E.; Gleason, T.G.; Navid, F.; Kilic, A. Mitral Valve Surgery for Acute Papillary Muscle Rupture. J. Card Surg 2018, 33, 484–488. [CrossRef]
17. de Cannière, D.; Vandenbossche, J.L.; Nouar, E.; Faict, S.; Falchetti, A.; Unger, P. Clinical Implications of Preserving Subvalvular Apparatus During Mitral Valve Replacement for Acute Ischemic Papillary Muscle Rupture. Ann. Thorac. Surg. 2016, 102, 305–308.
18. Ternus, B.W.; Mankad, S.; Edwards, W.D.; Mankad, R. Clinical Presentation and Echocardiographic Diagnosis of Postinfarction Papillary Muscle Rupture: A Review of 22 Cases. Echocardiography 2017, 34, 973–977.
19. Yun-Dan, D.; Wen-Jing, D.; Xi-Jun, X. Comparison of Outcomes Following Mitral Valve Repair versus Replacement for Chronic Ischemic Mitral Regurgitation: A Meta-Analysis. Thorac Cardiovasc Surg 2017, 65, 432–441.
20. Goldstein, D.; Moskowitz, A.J.; Gelijns, A.C.; Ailawadi, G.; Parides, M.K.; Perrault, L.P.; Hung, J.W.; Voisine, P.; Dagenais, F.; Gillinov, A.M.; et al. Two-Year Outcomes of Surgical Treatment of Severe Ischemic Mitral Regurgitation. N. Engl. J. Med. 2016, 374, 344–353.
21. Chikwe, J.; Toyoda, N.; Anyanwu, A.C.; Itagaki, S.; Egorova, N.N.; Boateng, P.; El-Eshmawi, A.; Adams, D.H. Relation of Mitral Valve Surgery Volume to Repair Rate, Durability, and Survival. J. Am. Coll Cardiol 2017.
22. Ashikhmina, E.; Schaff, H.V.; Daly, R.C.; Stulak, J.M.; Greason, K.L.; Michelena, H.I.; Fatima, B.; Lahr, B.D.; Dearani, J.A. Risk Factors and Progression of Systolic Anterior Motion after Mitral Valve Repair. J. Thorac. Cardiovasc. Surg. 2021, 162, 567–577.
23. Gerosa, G.; Nadali, M.; Longinotti, L.; Ponzoni, M.; Caraffa, R.; Fiocco, A.; Pradegan, N.; Besola, L.; D'Onofrio, A.; Bizzotto, E.; et al. Transapical Off-Pump Echo-Guided Mitral Valve Repair with Neochordae Implantation Mid-Term Outcomes. Ann. Cardiothorac Surg 2021, 10, 131–140.
24. Quinn, R.W.; Pasrija, C.; Gammie, J.S. Secondary Mitral Regurgitation Repair Techniques and Outcomes: Initial Clinical Experience with Mitral Valve Translocation. JTCVS Tech. 2022, 13, 53–57.
25. Gammie, J.S.; Bartus, K.; Gackowski, A.; Szymanski, P.; Bilewska, A.; Kusmierczyk, M.; Kapelak, B.; Rzucidlo-Resil, J.; Duncan, A.; Yadav, R.; et al. Safety and Performance of a Novel Transventricular Beating Heart Mitral Valve Repair System: 1-Year Outcomes. Eur. J. Cardio-Thorac. Surg. 2021, 59, 199–206.