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Original Article

Comparison of Regional Wall Motion Abnormalities in STEMI and NSTEMI Patients at Mardan Medical Complex

Faisal Ahmad[1], Abid Ullah Shah[2], Anum Iqbal[1], Muhammad Waqas[1], Syed Arshad Ullah[2], Adeel Ahmed Khalil[2]

[1]Mardan Medical Complex, Mardan, Pakistan, [2]College of Medical Technology, BKMC, Mardan, Pakistan

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Corresponding Author:
Mr. Abid Ullah Shah, Department of Cardiology, College of Medical Technology, Bacha Khan Medical College, Mardan, Pakistan.
Email: abidullahshah22@gmail.com

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Abstract

Objectives: This study aims to determine and compare regional wall motion abnormalities (RWMA) in patients with ST-segment elevation myocardial infarction (STEMI) and non-ST-segment elevation myocardial infarction (NSTEMI), along with associated common complications.

Methodology: A comparative cross-sectional study was conducted in the cardiology department of Mardan Medical Complex from June to November 2023. Patients diagnosed with acute myocardial infarction (both STEMI and NSTEMI) were included. Data were collected using a convenient sampling technique. Ethical approval was obtained prior to data collection, which was performed using a predesigned questionnaire. RWMA assessments were conducted by an expert in accordance with the American Society of Echocardiography guidelines using a Toshiba Xario200 Echocardiography machine. Data were analyzed using SPSS 22.

Results: Out of 274 patients, 156 (56.9%) were male and 118 (43.1%) were female, with 136 (50%) from the STEMI group and 136 (50%) from the NSTEMI group. The mean age of the respondents was 57.4 ± 13.1 years. RWMA was observed in both types of MI, with significant differences ($p < 0.05$) found between STEMI and NSTEMI in several segments: basal anterior (5.83% vs. 1.82%), basal anteroseptal (16.23% vs. 2.55%), basal anterolateral (14.59% vs. 3.23%), basal inferior (18.61% vs. 2.91%), apical anterior (5.09% vs. 1.45%), and apical septal (5.46% vs. 1.82%). Severe left ventricular systolic dysfunction was observed in only 2 (0.73%) STEMI patients, while severe pulmonary hypertension was more common in NSTEMI patients.

Conclusion: RWMA is a common finding in STEMI patients. Echocardiography plays a crucial role in the early detection of RWMA, which can improve prognosis and reduce the risk of complications.

Keywords: Acute Myocardial Infarction, Regional Wall Motion Abnormalities, Echocardiography

INTRODUCTION

Myocardial infarction (MI) is a significant health problem characterized by prolonged ischemia leading to myocardial necrosis. The prevalence of acute myocardial infarction is estimated at 6.65% globally [1]. In Pakistan, the burden of MI risk factors is notably high, with more than 30% of individuals over 45 years of age affected [2]. Acute myocardial infarction manifests as ST-segment elevation myocardial infarction (STEMI) or non-ST-segment elevation myocardial infarction (NSTEMI), with biomarkers indicating that STEMI patients typically experience greater myocardial dysfunction and inflammation, while NSTEMI patients present a more heterogeneous pathophysiological pattern. Cardiac biomarkers are crucial for predicting the prognosis in both STEMI and NSTEMI patients [3].

Compared to STEMI patients, those with NSTEMI or unstable angina are more likely to have hypertension and a history of acute coronary syndrome (ACS) or stable angina [4]. Echocardiography is a vital tool in diagnosing myocardial ischemia in both STEMI and NSTEMI patients by detecting regional wall motion abnormalities (RWMA) [5]. According to American College of Cardiology Foundation (ACCF)/American Heart Association (AHA) guidelines, a 12-lead ECG should be performed promptly to detect STEMI patients [6]. RWMA is often one of the initial indicators of acute MI, identifiable by echocardiography even before infarction changes are visible on ECG or through elevated cardiac biomarkers. Echocardiography is a widely used, noninvasive, and cost-effective diagnostic tool [7].

STEMI represents a particularly fatal form of acute MI [8]. Confirmation of acute myocardial infarction requires elevated cardiac troponin levels above the ninety-ninth percentile and at least one of the following: ischemic symptoms, new ST-T changes or Q waves on an ECG, or imaging evidence of new loss of viable myocardium . The left ventricle is divided into 17 segments, with each segment scored based on the type of RWMA: 1 for normokinesia, 2 for hypokinesia, 3 for akinesia, and 4 for dyskinesia. Higher scores indicate greater severity of ischemia and infarction [9].

Previous studies have highlighted the significance of RWMA as an early indicator of acute MI. For instance, a study evaluating 57 STEMI patients using the 16-segment model found RWMA to be an early sign of MI [10]. Another 2019 study found RWMA in 89.62% of patients with anterior wall MI as hypokinesia and 10.38% as akinesia, while 89.16% of inferior wall MI patients showed hypokinesia and 12.84% had akinesia. In a 2016 study at LUMHS, Rawalpindi, 70.9% of 148 NSTEMI-ACS patients exhibited RWMA, with an ejection fraction below 40% in 59.5% of cases [11]. Similarly, a 2018 study by German researchers found that 90% of NSTEMI patients had RWMA on echocardiography [12]. A 2020 study in Karachi, Pakistan, involving 70 acute STEMI patients, reported a mean ejection fraction of 42.7% and RWMA in 14.1% of cases [13]. Another 2019 study in Peshawar, KPK, found RWMA as the most frequent echocardiographic finding in 20.4% of 93 patients with acute ischemic heart disease [14].

The aim of this study is to determine and compare regional wall motion abnormalities in STEMI and NSTEMI patients and associated complications. Identifying RWMA early is crucial as it directly impacts patient outcomes, influencing prognosis, complications, and response to therapy. Early detection and intervention can significantly improve survival rates and therapeutic management in patients with acute myocardial infarction.

METHODOLOGY

Study Design: This comparative cross-sectional study was conducted to evaluate the regional wall motion abnormalities (RWMA) in patients with acute myocardial infarction (AMI), specifically focusing on ST-Elevation Myocardial Infarction (STEMI) and Non-ST-Elevation Myocardial Infarction (NSTEMI).

Setting: The study took place in the Cardiology Department of Tertiary Care Hospital, Mardan Medical Complex, Khyber Pakhtunkhwa, Pakistan, over a period of six months, from June 2023 to November 2023.

Participants: A total of 274 patients diagnosed with AMI (both STEMI and NSTEMI) were selected using convenient sampling techniques. The sample size was calculated using OpenEpi software, with an anticipated frequency and a 95% confidence interval. Inclusion criteria encompassed all patients diagnosed with acute myocardial infarction, regardless of gender. Exclusion criteria included patients with a history of old myocardial infarction (MI), coronary artery bypass grafting (CABG), pacemakers, cardiomyopathy, conduction defects, poor echocardiographic images, pericarditis, and

myocarditis, as these conditions could present pre-existing wall motion abnormalities.

Variables: The primary variables in this study included the type of myocardial infarction, categorized as STEMI and NSTEMI, and regional wall motion abnormalities (RWMA), which were assessed using a standardized scoring system (normokinesis, hypokinesis, akinesis, dyskinesis, aneurysm). Additionally, demographic variables such as age and gender were considered to provide a comprehensive analysis of the patient population and the factors influencing RWMA in acute myocardial infarction cases.

Data Sources / Measurement: Data were collected post-approval from the ethical committee of BKMC Mardan. Written informed consent was obtained from all participants. A predesigned questionnaire was used to gather demographic and clinical information. Echocardiographic assessment was performed using a Toshiba Xario200 machine, applying 2D echo, M-mode, and Doppler techniques to visualize all 17 segments of the left ventricle. RWMA was scored from 1 to 5 based on the severity (1: normokinesis, 2: hypokinesis, 3: akinesis, 4: dyskinesis, 5: aneurysm). The assessments were carried out by an experienced Consultant Cardiologist or an expert cardiac sonographer, following the guidelines of the American Society of Echocardiography.

Bias: To minimize bias, all echocardiographic assessments were conducted by highly experienced professionals. Patients with conditions known to affect wall motion were excluded to ensure the accuracy of the RWMA evaluations specific to acute myocardial infarction.

Study Size: The study involved a total of 274 patients, with an equal distribution of STEMI and NSTEMI cases. The sample size was determined to provide sufficient power to detect statistically significant differences in RWMA between the two groups.

Quantitative Variables: The primary quantitative variables in this study included age and RWMA scores. For age, the mean and standard deviation were calculated to provide a measure of central tendency and variability within the patient population. RWMA scores, ranging from 1 to 5, were assigned to each of the 17 left ventricular segments, with the scoring system reflecting the severity of motion abnormalities (1: normokinesis, 2: hypokinesis, 3: akinesis, 4: dyskinesis, 5: aneurysm). These scores allowed for a detailed assessment of regional wall motion abnormalities in patients with acute myocardial infarction.

Statistical Methods: Data analysis was performed using SPSS (latest version). Descriptive statistics, including mean and standard deviation, were calculated for age. A chi-square test was utilized for bivariate analysis to compare RWMA between STEMI and NSTEMI patients. Statistical significance was determined at a p-value ≤ 0.05.

Ethical Considerations: The study was conducted following ethical standards, with approval from the ethical committee of BKMC Mardan. Informed consent was obtained from all participants, ensuring their voluntary participation and confidentiality of their information.

RESULTS

Participants: Out of the 274 patients included in the study, 156 (56.9%) were male and 118 (43.1%) were female. The distribution of patients with STEMI and NSTEMI was equal, with 136 (50%) in each group.

Descriptive Data: The mean age of the respondents was 57.4 ± 13.1 years, with acute myocardial infarction (AMI) incidents, including both STEMI and NSTEMI, being more frequent in the age group of 51-60 years. Gender distribution varied significantly between the two types of MI. Among STEMI patients, 34.67% were male and 15.32% were female, while in the NSTEMI group, 22.26% were male and 27.73% were female, indicating a statistically significant difference ($p < 0.05$).

Outcome Data: The study observed the types of myocardial infarction and their locations based on ECG findings. Inferior wall MI was most common in STEMI patients, accounting for 37.2% of cases. In the NSTEMI group, 54.01% of patients had non-identifiable changes on ECG but were confirmed by cardiac biomarkers (Troponin-I, Troponin-T, CK-MB). Additionally, most NSTEMI patients exhibited changes in the anterior leads as shown in Figure 1.

Main Results

Regional Wall Motion Abnormalities: Regional wall motion abnormalities (RWMA) were observed in both STEMI and NSTEMI patients, with significant differences noted in various segments. Statistically significant differences ($p < 0.05$) were found between

STEMI and NSTEMI in segments such as basal anterior, basal anteroseptal, basal anterolateral, basal inferior, apical anterior, and apical septal (Table 1).

Figure 1. Types of Acute Myocardial infarction and location on ECG basis

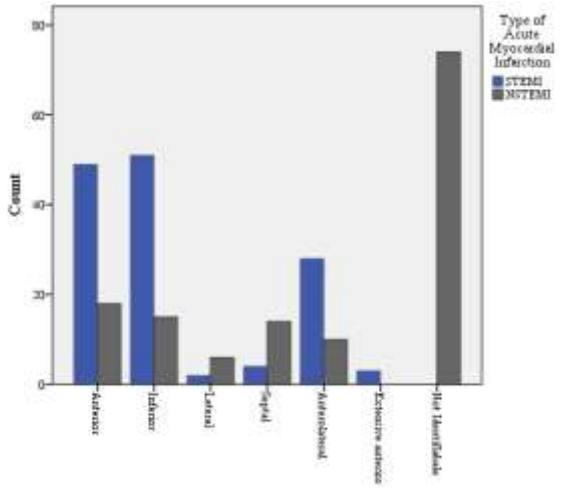
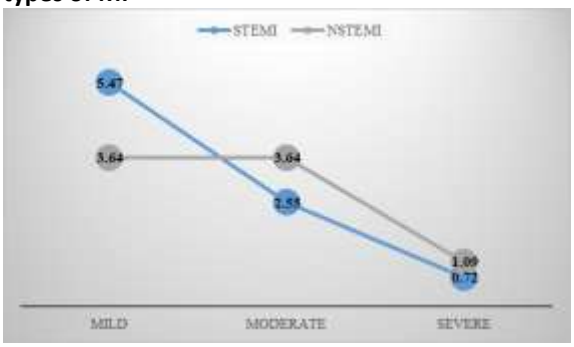


Table 1: Comparison of LV segmental wall motion abnormalities in STEMI and NSTEMI patients (Hypokinetic and Akinetic)

LV segments	Group I STEMI	Group II NSTEMI	P-value
Basal anterior	5.83%	1.82%	0.021
Basal anteroseptal	16.23%	2.55%	0.001
Basal anterolateral	14.59%	3.23%	<0.001
Basal inferior	18.61%	2.91%	<0.001
Basal inferoseptal	1.45%	0.00%	0.122
Basal inferolateral	2.91%	0.72%	0.053
Mid anterior	1.08%	0.36%	0.622
Mid anteroseptal	1.08%	0.36%	0.622
Mid anterolateral	0.72%	0.36%	>0.999
Mid inferior	0.72%	0.36%	>0.999
Mid inferoseptal	0.00%	0.00%	>0.05
Mid inferolateral	0.36%	0.00%	>0.999
Apical anterior	5.09%	1.45%	0.030
Apical septal	5.46%	1.82%	0.034
Apical inferior	0.36%	0.00%	>0.999
Apical lateral	0.00%	0.00%	>0.05
Apical cap	1.81%	0.00%	0.060

Pulmonary Hypertension: In the STEMI group, 5.47% of patients had mild pulmonary hypertension, 2.55% had moderate, and 0.72% had severe pulmonary hypertension. For NSTEMI patients, 3.64% had mild, 3.64% had moderate, and 1.09% had severe pulmonary hypertension. The chi-square test showed no statistically significant difference between the pulmonary hypertension severity in STEMI and NSTEMI groups (p-value = 0.62) as shown in Figure 2.

Figure 2. Severity of pulmonary hypertension in both types of MI



LV Systolic Dysfunction: Left ventricular (LV) systolic dysfunction was a common complication in both types of myocardial infarction, with varying severity. In the STEMI group, 14.23% of patients had mild, 14.96% had moderate, and 0.72% had severe LV systolic dysfunction. In the NSTEMI group, 5.10% had mild and 2.55% had moderate LV systolic dysfunction, with no patients experiencing severe dysfunction. The chi-square test revealed a statistically significant difference in LV systolic dysfunction between the two groups ($p < 0.001$) (Table 2).

Table 2: Severity of LV systolic dysfunction after acute myocardial infarction

LV Systolic Dysfunction	Group I STEMI	Group II NSTEMI	P-value
Mild	39 (14.2%)	14 (5.1%)	
Moderate	41 (15.0%)	07 (2.6%)	0.001
Severe	2 (0.7%)	0 (0.0%)	

Mild: Patients having ejection fraction of 40 - 55%.
Moderate: Patients having ejection fraction of 30-40%.
Severe: Patients having ejection fraction of <30 %.

DISCUSSION

This study highlights the prevalence and characteristics of acute myocardial infarction (AMI) in a cohort of patients aged between 51 and 60 years. Our findings align with a 2019 study which reported that 51.27% of STEMI cases occurred in the 40-60 age group, reinforcing the observation that myocardial infarction is common within this age range [10]. Notably, inferior wall MI was the most frequent type of STEMI in our study, which differs from previous research that identified anteroseptal MI as more prevalent in STEMI patients. This discrepancy could be due to our inclusion of both STEMI and NSTEMI

patients, whereas the previous study focused solely on STEMI.

In NSTEMI patients, we found that 6.56% showed ST-segment depression and T-wave alterations in anterior leads. This is higher than the 35.8% and 17.0% reported in a previous study, which could be attributed to our larger sample size and different study design [15]. Additionally, our study found significant differences in regional wall motion abnormalities (RWMA) between STEMI and NSTEMI patients. Basal anterior, basal anteroseptal, basal anterolateral, basal inferior, apical anterior, and apical septal segments were more frequently hypokinetic and akinetic in STEMI patients, with p-values < 0.05.

Our results also differ from a 2019 study that reported high rates of hypokinesia and akinesia in STEMI patients, possibly due to the exclusion of patients with conduction defects in our study, which can mimic RWMA on 2D echo. In contrast, an earlier study on non-ST-elevation myocardial infarction-ACS patients found higher RWMA prevalence, likely because they included patients with significant coronary artery stenosis (>50%), whereas our study did not differentiate based on stenosis severity [16].

Another study on NSTEMI patients in 2018 reported that 90% had RWMA and a mean ejection fraction of 38.0 ± 11.7%, with 68% showing evidence of acute heart failure [17]. Differences in sample size, the inclusion of new LBBB, and other comorbidities may explain the variance with our findings, where LV dysfunction was observed in 19.3% of patients (mild), 17.5% (moderate), and 0.7% (severe).

Our study found that in STEMI patients, 5.47% had mild, 2.55% had moderate, and 0.72% had severe pulmonary hypertension. In NSTEMI patients, these figures were 3.64% for both mild and moderate, and 1.09% for severe pulmonary hypertension. A previous study reported 47.84% of patients with pulmonary hypertension (RVSP ≥ 35mmHg), which may differ due to their prospective cohort design and possible lung pathologies affecting results, whereas our cross-sectional study had a different focus.

Strengths of the Study

Balanced Sample Size: We ensured an equal sample size for both STEMI and NSTEMI patients, providing a robust comparative analysis.

Expert Assessment: Regional wall motion abnormalities were assessed by a senior consultant cardiologist or an expert cardiac sonographer, following the guidelines of the American Society of Echocardiography.

Advanced Equipment: The study utilized the latest model of echocardiography machine (Xario200), ensuring high-quality imaging and accurate assessments.

Limitations of the Study

Single Diagnostic Modality: The study assessed regional wall motion abnormalities using echocardiography alone and did not compare the findings with other diagnostic tests, such as MIBI scans or coronary angiography, to locate the culprit lesions and affected segments.

CONCLUSION

This study found that STEMI cases predominantly exhibited inferior wall MI changes on ECG, while NSTEMI cases primarily showed anterior wall MI changes. Regional wall motion abnormalities (RWMA) were significantly more frequent in STEMI patients compared to NSTEMI patients across various segments (p-value < 0.05). Most STEMI patients experienced severe left ventricular systolic dysfunction, whereas severe pulmonary hypertension was more common among NSTEMI patients. Our findings suggest that studying RWMA via echocardiography and comparing the results with MIBI scans and coronary angiography can help identify culprit lesions and affected segments, aiding in the therapeutic management of acute myocardial infarction.

RECOMMENDATIONS

Given the differences in regional wall motion abnormalities between STEMI and NSTEMI, we recommend conducting a cohort study to investigate the recovery of affected segments. This study should use multiple investigative modalities, including echocardiography, to provide a more comprehensive assessment of the recovery process and therapeutic outcomes in STEMI and NSTEMI patients.

AUTHORS' CONTRIBUTION

FA, AUS, AI, MW, SAU, and AAK: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work.

FA, AUS, AI, MW, SAU, and AAK: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

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REFERENCES

1. Salari N, Morddarvanjoghi F, Abdolmaleki A, Rasoulpoor S, Khaleghi AA, Hezarkhani LA, et al. The global prevalence of myocardial infarction?: a systematic review and meta-analysis. BMC Cardiovasc Disord. 2023;1-12.
2. Khalid SH, Liaqat I, Mallhi TH, Khan AH, Ahmad J, Khan YH. Impact of diabetes mellitus on clinical-laboratory characteristics and in-hospital clinical outcomes among patients with myocardial infarction. JPMA. 2020;70(12):2376-82.
3. Hjort M, Eggers KM, Lindhagen L, Baron T, Erlinge D, Jernberg T, et al. Differences in biomarker concentrations and predictions of long-term outcome in patients with ST-elevation and non-ST-elevation myocardial infarction. Clin Biochem. 2021;98(September):17-23.
4. Ralapanawa U, Kumarasiri PVR, Jayawickreme KP, Kumarihamy P, Wijeratne Y, Ekanayake M, et al. Epidemiology and risk factors of patients with types of acute coronary syndrome presenting to a tertiary care hospital in Sri Lanka. BMC Cardiovasc Disord. 2019;19(1):1-9.
5. Ha ET, Cohen M, Fields PJ, Daele J Van, Gaeta TJ. The Utility of Echocardiography for Non-ST-Segment Elevation Myocardial Infarction?: A Retrospective Study. J Diagnostic Med Sonogr. 2020;36:121-9.
6. Yildiz M, Wade SR, Henry TD. STEMI care 2021: Addressing the knowledge gaps. Am Hear J Plus Cardiol Res Pract. 2021;11:100044.
7. Khan TA, Chowdhury AW, Khan HI, Amin MG, Sabah KM, Hossain M. Echocardiographic comparison of regional wall motion abnormality between patients with acute anteroseptal and acute extensive anteior ST segment elevation myocardial infarction. Bang Med Res Council Bulletin. 2015;41(1):35-40.
8. Chenevier-Gobeaux C, Deweerdt L, Cantero AV, Renaud B, Desmaizières B, Charpentier S, et al. Multi-center evaluation of recent troponin assays for the diagnosis of NSTEMI. Pract Lab Med. 2018;11(February):23-32.
9. Armstrong WF, Ryan T. Stress Echocardiography. In: Feigenbaum's Echocardiography. 8th ed. Philadelphia: Wolters Kluwer; 1986. p. 1580-691.
10. Gopalakrishnan S, Govindharaju A. Clinical, E.C.G. and Echocardiographic Profile of Patients Presenting With Acute ST Elevation Myocardial Infarction (STEMI) in a Tertiary Care Institute At Tamilnadu, South India. J Evid Based Med Healthc. 2018;5(45):3131-6.
11. Memon AA, Shah GF, Memon SH, Brohi GH, Shaikh AA, Haidar A. Echocardiographic Wall Motion Score in the Naive Patients of Non-ST Segment Elevation Acute Coronary Syndrome Regarding their Early Mortality. Pak J Med Health Sci. 2022;16(09):675-.
12. Bergmann I, Büttner B, Teut E, Jacobshagen C, Hinz J, Quintel M, et al. Pre-hospital transthoracic echocardiography for early identification of non-ST-elevation myocardial infarction in patients with acute coronary syndrome. Crit Care. 2018;22:1-6.
13. Sultana R, Makwana D, Rehman FUR, Balouch IJ, Azim W. Prediction of Patient Death due to Sudden Cardiac Arrest with Left Ventricular Dysfunction by Analyzing the Value of BNP?: a Prospective Longitudinal Study. Pak J Med Health Sci. 2021;15(12):3868-70.
14. Pukhtunkhwa K, Khan MF, Qayyum W, Iqbal MS, Khan S. A Cross-Sectional Study of Subtypes of Ischemic Stroke and its Associated Factors at a Tertiary Care Hospital. Khyber J Med Sci. 2022;15(4):167-73.
15. Rácz I, Fülöp L, Kolozsvári R, Szabó GT, Bódi A, Péter A, et al. Wall motion changes in myocardial infarction in relation to the time elapsed from symptoms until revascularization. Anatol J Cardiol. 2015;15(5):363.
16. Manfredonia L, Lanza GA, Crudo F, Lamendola P, Graziani F, Villano A, et al. Diagnostic role of echocardiography in patients admitted to the emergency room with suspect no-ST-segment elevation acute myocardial infarction. Eur Review Med Pharmacol Sci. 2019;23(2):826-32.
17. Oh S, Kim JH, Cho KH, Kim MC, Sim DS, Hong YJ, et al. Clinical impact of pulmonary hypertension on the outcomes of acute myocardial infarction patients with or without chronic obstructive pulmonary disease. Med. 2022;101(3):e28627.