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Echocardiographic evaluation of left ventricular systolic function in patients with new onset non-ST elevation myocardial infarction

Article History:

Name of Author:
Dr Bilal Mustafa[1],Maria pirzada[2],Dr Waleed Anwar[3],Dr Hidayatullah[4],Dr. Asad Ali Saleem[5],Dr Sardar Muhammad Zia khan[6]

Affiliation:[1]*Email:bilalmustafa204@gmail.com*
FCPS cardiology trainee at Shifa International hospital Islamabad
[2]*mariapeerzada91@gmail.com*
FCPS cardiology trainee at Pakistan atomic energy commission General hospital Islamabad
[3]*Waleedagq@gmail.com*
FCPS cardiology trainee at Shifa International hospital Islamabad
[4]*hidayatkhanzada@hotmail.com*
FCPS cardiology trainee at Pakistan atomic energy commission General hospital Islamabad
[5]*HEAD OF DEPARTMENT CARDIOLOGY AT SHIFA INTERNATIONAL HOSPITAL ISLAMABAD*
[6]*drsardarzia@gmail.com*
FCPS cardiology trainee at Pakistan atomic energy commission General hospital Islamabad

Corresponding Author:
Dr Bilal Mustafa
Email: bilalmustafa204@gmail.com

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Abstract: Background: **Objectives:** To evaluate the left ventricular systolic function in patients presenting with new onset non–ST elevation myocardial infarction using transthoracic echocardiography.**Study Design:** Descriptive cross-sectional study.**Place and duration of study**: This study was conducted at the department of Cardiology, Shifa International Hospital Islamabad, Pakistan from Feb-2023 to Jul-2023. **Methodology:** A total of 70 patients aged ≥ 18 years and admitted to the cardiology unit with a first episode of non–ST elevation myocardial infarction were enrolled. Diagnosis was based on clinical features, absence of persistent ST-segment elevation (on electrocardiography), and elevated cardiac biomarkers. Transthoracic echocardiography was performed and left ventricular systolic function was assessed by calculating left ventricular ejection fraction (modified Simpson's biplane method) and categorized as normal, mildly reduced, moderately reduced, or severely reduced. Regional wall motion abnormalities were also evaluated using the standard 17-segment model. Descriptive statistics were employed to share the study findings.**Results:** The mean age of study patients was 58.93 ± 6.73 years, with a male predominance (67.14%) in overall study population. Mean left ventricular ejection fraction was recorded as 47.24 ± 9.7%. The results showed reduced systolic function in 64.29% of patients, with mild, moderate, and severe dysfunction present in 27.14%, 22.86%, and 14.29%, respectively. Regional wall motion abnormalities were present in 74.29% of patients, where most commonly reported was hypokinesia (45.71%). **Conclusions:** Impaired left ventricular systolic function and regional wall motion abnormalities are present in a notable proportion of patients reported with new onset non–ST elevation myocardial infarction.

Keywords: Echocardiography, Ejection fraction, Left ventricular function, Myocardial Infarction, Non-ST Elevation.

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INTRODUCTION

Global data rank acute coronary syndrome (ACS) among the leading causes of morbidity and mortality worldwide, with non–ST elevation myocardial infarction (NSTEMI) accounting for nearly 60–70% cases of myocardial infarction (MI).1 NSTEMI is a clinically heterogeneous entity which is characterized by necrosis occurring in the myocardium with absence of persistent ST-segment elevation on electrocardiography (ECG). Although perceived as less acute, NSTEMI is associated with a substantial burden of adverse outcomes and reflects complex underlying pathophysiological mechanisms such as coronary plaque rupture, dynamic coronary obstruction, and distal embolization.2,3

Early risk stratification and prognostic assessment are, however, more challenging in NSTEMI than STEMI as there are fewer overt transmural ischemic changes on ECG and diagnosis relies more on cardiac biomarkers and imaging modalities.4 Left ventricular ejection fraction (LVEF) is the most widely used measure of systolic function (SF) and serves as a well-established predictor of both short- and long-term clinical prognosis, including heart failure, recurrent ischemic events, and mortality. In this context, timely evaluation of left ventricular systolic function (LVSF) gains critical importance in guiding clinical management and improving prognostic assessment. Early identification of impaired LVSF in patients with new-onset NSTEMI is therefore important to improve the clinical outcomes in these patients. However, EF alone may overlook early or regional dysfunction, which makes the assessment of regional wall motion abnormalities (RWMA) a valuable complementary tool to provide insight into the extent and distribution of ischemic injury.5,6

Transthoracic echocardiography (TTE) is a non-invasive imaging technique, which is widely used in the initial evaluation of patients with acute coronary syndromes (ACS). TTE offers real-time assessment of global and regional LV systolic function. The technique remains highly cost effective by providing estimation of ejection fraction (EF) and detection of ischemia-related complications such as papillary muscle dysfunction, mitral regurgitation, and ventricular thrombus. The utility of TTE in the context of NSTEMI is particularly valuable because myocardial injury may be subendocardial and heterogeneous, leading to clinically meaningful impairment of systolic performance.7,8

The degree of left ventricular (LV) systolic impairment in patients with new-onset NSTEMI is influenced by various patient characteristics, comorbidities, and the extent of myocardial injury. In resource-limited settings, early assessment using TTE helps in risk stratification, optimization of medical therapy, and identification of patients requiring early invasive management. Conventional parameters including LVEF, along with the assessment of RWMA, are central to evaluate SF and calculate the ischemic burden. Additionally, echocardiographic measures, including global longitudinal strain (GLS), offer greater sensitivity for detecting subtle systolic dysfunction. Assessment of LV systolic function in NSTEMI extends beyond acute care as the reduced LVEF and impaired global longitudinal strain independently predict adverse cardiovascular (CV) outcomes, including heart failure (HF), recurrent myocardial infarction (MI), and mortality. In short, impaired LV systolic function serves as a strong independent predictor of adverse CV outcomes and an early and comprehensive TTE evaluation is essential for optimal patient management.

Despite this established prognostic significance of left ventricular systolic dysfunction (LVSD) in NSTEMI, data regarding the early echocardiographic patterns of systolic impairment in patients with newly diagnosed NSTEMI remain limited, particularly in Pakistan where most of the health care settings are resource-constrained.

This study was therefore designed to evaluate the LVSF using TTE in patients presenting with new-onset NSTEMI, specifically the LVEF and RWMA. This local evidence will assist our cardiologists in early risk stratification, guide therapeutic decision-making, and reinforce the role of routine TTE for optimizing NSTEMI management during acute phase.

Methodology:

This descriptive cross-sectional study was conducted at the Department of Cardiology, Shifa International Hospital, Islamabad, from Feb-2023 to Jul-2023, over a period of six months after getting approval from Ethical Review Committee of the hospital.

The sample size was calculated to estimate the mean LVEF in the given study population. Using the formula for a single mean, with an expected standard deviation of 10.63 (based on prior data), a 95% confidence level, and a margin of error (precision) of 2.5%, the sample size was calculated as 70 patients. 11 A total of 70 patients aged ≥18 years, admitted with a first episode of NSTEMI, were enrolled in this study through consecutive sampling. NSTEMI was diagnosed on the basis of clinical features suggestive

of MI with the absence of persistent ST-segment elevation on ECG, and with elevated cardiac biomarkers (troponin I or T) above the 99th percentile upper reference limit.12

Exclusion criteria consisted of patients with a history of MI, known cardiomyopathy, significant valvular heart disease, congenital heart disease, or those with prior coronary revascularization. Patients with hemodynamic instability or poor echocardiographic windows were also excluded.

A written informed consent was obtained from patients prior to their inclusion.

All the demographics, clinical characteristics and CV risk factors were documented. Moreover, relevant clinical parameters were obtained from patient medical records at the time of enrollment.
Echocardiographic examinations for each patient were performed by experienced cardiologists and standard parasternal long- and short-axis as well as apical four-, two-, and three-chamber views were recorded (in accordance with American Society of Echocardiography recommendations).13 TTE was performed within 24–48 hours of admission to the cardiac unit using a standard echocardiography machine equipped with a phased-array transducer (2.5–3.5 MHz).

LVSF was assessed and LVEF was calculated using the modified Simpson's biplane method from apical views. LVSF was then categorized as normal (≥55%), mildly reduced (45–54%), moderately reduced (35–44%), or severely reduced (<35%) on the basis of EF values. RWMA were evaluated as per standard 17-segment LV model and were classified as hypokinetic, akinetic, or dyskinetic. Associated echocardiographic findings such as functional mitral regurgitation (FMR) or left ventricular thrombus (LVT) were also noted.

Data were analyzed using SPSS 25. Descriptive statistics were employed where continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Appropriate tables were used to describe the distribution of LVSF and RWMA among patients with new-onset NSTEMI.

Results:

The mean age of patients in this study was 58.93±6.73 years which ranged from 45 to 72 years. Male gender was in majority with 67.14% of total study population. The details of demographics and CV risk factors present in patients are shown in Table-I.

Table-I: Demographics and CV risk factors in study population
n = 70

Demographics and cardiovascular risk* factors		
Age (Mean± SD) years		**58.93±6.73**
Gender	Male n (%)	47 (67.14)
	Female n (%)	23 (32.86)
BMI (Mean± SD) Kg/m²		28.86±3.56
Smoking history n (%)		28 (40)
Presence of comorbidities	Hypertension n (%)	40 (57.14)
	Diabetes n (%)	32 (45.71)
	Dyslipidemia n (%)	25 (35.71)

Cardiovascular*

The findings of TTE showed a mean LVSF of 47.24± 9.7%, where a considerable proportion of patients exhibited reduced LVSF, with varying degrees of systolic impairments among patients with new-onset NSTEMI as shown in Table-II.

Table-II: LVSF and its categories (based on LVEF)
n = 70

LVSF* and its categories (based on ejection fraction)		
LVSF* % (Mean± SD)		**47.24± 9.7**
Categories of LVSF	Normal (LVSF* ≥55%) n (%)	25 (35.71)
	Mildly reduced (LVSF* 45–54%) n (%)	19 (27.14)
	Moderately reduced (LVSF* 35–44%) n (%)	16 (22.86)
	Severely reduced (LVSF* <35%) n (%)	10 (14.29)

Left ventricular systolic function*

RWMA were observed in 74.29% of patients, where hypokinesia was the most frequently reported abnormality (45.7%), followed by akinesia in (21.43%) and dyskinesia (7.1%), as shown in Table-III.

Table-III: Distribution of RWMA
n = 70

Distribution of RWMA*	
RWMA	**n (%)**
Hypokinesia	32 (45.71)
Akinesia	15 (21.43)
Dyskinesia	5 (7.14)
Total patients with RWMA	52 (74.29)

Additional TTE findings were made in patients of impaired LVSF reported with new-onset NSTEMI, which showed the presence of FMR in 21.43% while LVT was reported in 5.71% of patients as shown in Table-IV.

Table-IV: Additional TTE in patients with new-onset NSTEMI
n=70

TTE findings	**n (%)**
Functional mitral regurgitation	15 (21.43)
Left ventricular thrombus	4 (5.71)
No additional findings observed	51 (72.86)

DISCUSSION

Giant congenital melanocytic nevi (GCMN) represent The results of our study demonstrated a substantial burden of LVSD at presentation as nearly two-thirds of patients (64.29%) exhibited reduced LVEF, with varying degrees of systolic impairment. Among these 22.86% had moderately reduced while 14.29% had severely reduced LVSFs. This high prevalence in our study is particularly concerning as this was diagnosed early in the disease course within 24-48 hours of admission to the hospital. The findings suggest that despite the absence of ST-segment elevation, a significant proportion of these patients may already have established myocardial injury.

RWMA were also observed in the majority of patients (74.29%), predominantly in the form of hypokinesia (45.71%), followed by akinesia (21.43%) and dyskinesia (7.14%). The dominance of hypokinesia over akinesia may suggest that most patients in our study population had reversible ischemic injury and early revascularization therapeutic strategies may lead to improved outcomes. Additionally, a notable proportion of patients showed FMR (21.43%) and LVT (5.71%), highlighting the importance and clinical relevance of early comprehensive TTE in NSTEMI. These echocardiographic patterns are consistent with previously reported findings and suggest the prognostic value of TTE in these cases. Shah P et al. assessed the LVSF in cases of acute MI while comparing STEMI and NSTEMI. Mean age of patients in cases of NSTEMI was 56.12±7.20 with mean LVEF as 50.12 ± 10.63%. Although, comparatively preserved versus STEMI, a notable proportion of patients with NSTEMI had compromised SFs with no significant difference found in most LV dimensions between the groups. Nonetheless, significant RWMA were present in NSTEMI, underscoring the prognostic value of early echocardiographic evaluation.[11] The mean LVEF reported in our study was 47.24±9.7% which is lower than that reported by Shah et al. This may be attributed to differences in patient demographics and higher prevalence of comorbidities in our study population (our cohort was older with mean age 58.93 years and hypertension was present in 57.14% and diabetes in 45.71%.

Clinical use of echocardiography in the early hours in NSTEMI patients is also supported by international guidelines and expert consensus. Jordan MR et al. discussed the utility of echocardiography in providing crucial bedside assessment of cardiac function in NSTEMI patients. The technique was mentioned to enable real-time evaluation of LVSF, quantification of EF, and detection of RWMA. This non-invasive option successfully identifies ischemia-related complications including FMR, LVT and papillary muscle dysfunction, guiding for early risk stratification and therapeutic decision-making in NSTEMI.[14] Our study findings also validated that TTE can identify mechanical complications such as FMR (21.43%) and LVT (5.71%) at early stages that can significantly alter management strategies.

Notable similarities exist in our findings with other

studies conducted in South Asian studies with some differences that can be explained by differences in patients cohorts related to age, co-morbidities and the time of TTE assessment. Tariq O et al. evaluated LVSF through echocardiography in 100 NSTEMI patients with mean age 44.06±5.63 years and a male predominance (77%). The results showed that 37% of these patients had compromised LV functions following NSTEMI. Age, gender, BMI, hypertension, diabetes mellitus, smoking, and dyslipidemia were found to be associated with the development of LV failure.[15] In another study, Sajjad A et al. made echocardiographic assessment of LVSF in 150 NSTEMI patients (mean age 44.28±7.70 years; 77.33% male). The incidence of HF was detected in 13.33% of patients emphasizing the importance of comprehensive cardiac evaluation for risk stratification and management optimization.[16]

In comparison to our findings, Paswan D et al. reported preserved EF in over 80% of NSTEMI patients. The researchers also suggested that "early systolic lengthening' may be useful to identify early MI and therefore may help to plan treatment strategies in these cases.[17] The prevalence of preserved LVEF was markedly different in this study which may reflect factors like differences in study populations, timing of echocardiography after onset of symptoms, or possibly regional variations. Our population included patients with established risk factors like diabetes, hypertension and dyslipidemia with significant proportion having smoking history (40%).

The use of echocardiography in NSTEMI patients for the initial assessment of SF was also strongly suggested by Al Ahmad Y and Ali MT as this provides critical prognostic information and aids in differential diagnosis for evaluating LVSF.[18]
In short our findings, especially the reduced LVEF and presence of RWMA have some important clinical implications particularly in older patients with co-morbidities. Identification of mechanical complications guides the clinicians for anticoagulation and surgical decisions. Earlier use of TTE hence provides accessible, cost-effective and comprehensive assessment and has a critical role in facilitating risk stratification and therapeutic planning which is essential for optimal NSTEMI management.

Limitations of this study include its cross-sectional design, single-center settings and a small sample size. Future studies with larger patient data and long-term follow-up for clinical outcomes may offer robust evidence in patients with NSTEMI.

CONCLUSION

A substantial burden of LVSD is present in patients with new-onset NSTEMI at an early stage of the disease, underscoring the importance of early identification of systolic impairment. TTE provides valuable prognostic information beyond clinical and ECG findings by enabling comprehensive assessment of LVSF as well as RWMA. The technique facilitates timely optimization of evidence-based medical therapy and supports informed decision-making for invasive strategies, contributing to improved overall management of NSTEMI patients in routine cardiology practice.

Disclaimer:
No.

Conflict of interest:
No

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