Section: Cardiology

Original Research Article

# A STUDY ON TISSUE DOPPLER VELOCITIES IN PATIENTS WITH CHRONIC CORONARY ARTERY DISEASE AND PRESERVED LEFT VENTRICULAR EJECTION FRACTION UNDERGOING ELECTIVE PTCA

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## ABSTRACT

**Background:** Percutaneous coronary intervention (PCI) is a well-established modality for treating chronic coronary artery disease (CAD). However, the impact of PCI on myocardial function in patients with preserved left ventricular ejection fraction (LVEF > 50%) remains incompletely understood. Regional wall motion abnormalities are frequently seen in coronary artery disease, and diastolic function is impaired before systolic function in coronary artery disease patients. The objective is to evaluate the changes in conventional and tissue Doppler imaging (TDI) echocardiographic parameters before and after PCI in patients with chronic CAD and preserved LVEF, and to establish TDI as a sensitive and practical tool for functional assessment in the Indian clinical setting. **Materials and Methods:** A total of 100 patients (54 males, 46 females) with chronic CAD and preserved Left Ventricular Ejection Fraction (LVEF>50%) admitted for Percutaneous Transluminal Coronary Angioplasty were selected. Patients are examined with an echocardiogram including TDI-derived velocities (S', E', A') and conventional parameters (LVEDD, LVESD, LVEF, E, A, E/A ratio)—were recorded at baseline, 1 day, and 6 weeks post-PCI. Statistical analysis was performed using repeated measures ANOVA and Friedman tests. **Result:** Significant improvements were observed in TDI parameters (S', E', A'; $p < 0.001$), LVEF ($p < 0.001$), and LVESD ($p < 0.01$) post-PCI. While LVEDD showed minimal change, the E/A ratio improved modestly. These changes suggest enhanced systolic and diastolic performance following revascularization. **Conclusion:** PCI in patients with chronic CAD and preserved LVEF leads to early and sustained improvements in both systolic and diastolic myocardial function. TDI is a reliable, objective, and accessible tool for detecting functional recovery and may be particularly useful in resource-limited settings.

## INTRODUCTION

Coronary artery disease (CAD) remains the leading cause of morbidity and mortality worldwide, particularly in low- and middle-income countries such as India, where it accounts for a significant burden of cardiovascular events.[1] Percutaneous coronary intervention (PCI) is a cornerstone in the management of CAD, offering effective symptom relief and improved outcomes in patients with chronic stable angina and significant coronary stenosis.[2] However, the impact of PCI on left ventricular (LV) function, especially in patients with preserved left ventricular ejection fraction (LVEF > 50%), remains less clearly defined.While traditional echocardiographic methods such as LVEF and chamber dimensions provide important information about global cardiac function, they may not be sensitive enough to detect subtle, regional myocardial improvements following revascularization.[3] This is particularly relevant in patients who present without overt systolic dysfunction. In such cases, advanced modalities like Tissue Doppler Imaging (TDI) offer a more refined assessment of both systolic and diastolic myocardial velocities, allowing early identification of subclinical functional changes.[4,5] TDI provides quantitative, objective, and reproducible measurements of myocardial motion, particularly useful in assessing longitudinal function, which is often the earliest to be affected in ischemic heart disease.[6] In contrast to conventional Doppler-based mitral inflow assessment, which is load-dependent


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and less reliable in early disease, TDI-derived indices such as S' (systolic velocity), E' (early diastolic velocity), and A' (late diastolic velocity) have shown strong correlations with both functional recovery and prognosis post-PCI.[7] Although several international studies have validated the prognostic utility of TDI in heart failure and acute coronary syndrome, its application in the context of elective PCI in stable CAD patients with preserved LVEF remains underexplored, especially in the Indian population. Moreover, given the widespread availability and cost-effectiveness of echocardiography in India, TDI presents an appealing option for routine follow-up in resource-constrained healthcare settings.[8] This study aims to evaluate the changes in both conventional and TDI-derived echocardiographic parameters before and after PCI in patients with chronic CAD and preserved systolic function. We seek to highlight TDI's clinical relevance as a sensitive and practical tool for monitoring post-PCI myocardial recovery in routine cardiology practice.

## MATERIALS AND METHODS

Study design, population, and duration

This prospective observational study included 100 patients (54 males, 46 females) with chronic CAD and preserved LVEF (>50%) who were admitted for elective PCI under the Department of Cardiology, Government Stanley Medical College, Chennai, India. Patients were enrolled based on predefined inclusion and exclusion criteria.

**Inclusion Criteria**

- Adults aged above 18 years with chronic coronary artery disease and preserved left ventricular ejection fraction (LVEF > 50%) admitted for percutaneous transluminal coronary angioplasty (PTCA)

**Exclusion Criteria**

- Patients with Acute NSTEMI, Acute STEMI
- Patients with valvular heart disease, cardiomyopathy, atrial fibrillation, prior coronary revascularization, and congenital heart disease

**Study Procedure**

**Data Collection**

All patients underwent echocardiographic evaluation at three time points: 24 hours before PTCA, 24 hours post-PTCA, and six weeks post-PTCA.

Conventional Echocardiographic Parameters were recorded: Left Ventricular End-Diastolic Diameter (LVEDD), Left Ventricular End-Systolic Diameter (LVESD), Left Ventricular Ejection Fraction (LVEF) using the Teichholz method, and Mitral inflow velocities: E-wave, A-wave, and E/A ratio.

Tissue Doppler Imaging (TDI) Parameters like Systolic (S'), Early diastolic (E'), and late diastolic (A ') measurements were taken at the basal septal and basal lateral walls of the left ventricle, and at the lateral annulus of the tricuspid valve.

Recordings were obtained with a Doppler angle of insonation less than 20 degrees, and at a sweep speed of 50–100 mm/sec, during end-expiration to ensure optimal accuracy.

**Statistical Analysis:** Data were processed and analysed using SPSS (Statistical Package for the Social Sciences), version 24 (SPSS Inc., Chicago, IL, USA). Continuous variables were presented as means ± standard deviations (SDs), while categorical variables were summarized using frequencies and percentages. To assess differences in continuous variables across time points (pre- and post-PCI), the Repeated Measures ANOVA test was used. For comparisons within the same group, the Friedman test was applied for non-parametric analysis of repeated measures. A p-value < 0.05 was considered statistically significant.

**Ethical Considerations:** The study was conducted by the Declaration of Helsinki. Ethical approval was obtained from the institutional ethics committee of Stanley Medical College. Written informed consent was obtained from all participants before enrolment.

## RESULTS

The study population included 54 males and 46 females. Among them, 42 were diabetic,63 were hypertensive, 22 were dyslipidemic, and 13 were smokers. The stent was LAD alone in 50 patients, RCA in 37 patients, LCX in 6 patients, both LAD /LCX in 2 patients, and LAD/RCA in 5 patients. The association of parameters was depicted in [Table 1]. Statistically significant improvements were found in TDI parameters: S' increased from 7.45 ± 1.45 to 8.53 ± 1.54 ($p < 0.001$), E' from 9.06 ± 2.3 to 11.36 ± 2.2 ($p < 0.001$), and A' from 10.2 ± 1.62 to 12.18 ± 1.47 ($p < 0.001$).LVEF improved from 58.15 ± 2.92 to 62.19 ± 2.72 ($p < 0.001$).LVESD decreased significantly from 32.14 ± 2.99 to 30.79 ± 3.00 ($p < 0.01$).LVEDD showed a modest decline from 50.11 ± 3.86 to 48.43 ± 4.41 ($p = 0.01$ by ANOVA, not significant by the Friedman test). The E/A ratio showed slight improvement but remained less sensitive compared to TDI indices.

**Table 1: TDI Parameters and conventional echocardiographic parameters before and after PCI**

| Parameter | Mean ± SD (Before PCI) | Day 1 Post PCI | 6 Weeks Post PCI | p-value (ANOVA) |
|---|---|---|---|---|
| S' | 7.45 ± 1.45 | 7.91 ± 1.47 | 8.53 ± 1.54 | <0.001 |
| E' | 9.06 ± 2.30 | 10.36 ± 2.10 | 11.36 ± 2.20 | <0.001 |
| A' | 10.20 ± 1.62 | 12.00 ± 1.39 | 12.18 ± 1.47 | <0.001 |
| LVEF | 58.12 ± 3.18 | 60.06 ± 3.02 | 62.18 ± 2.95 | <0.001 |
| LVESD | 32.14 ± 2.99 | 30.90 ± 2.91 | 30.79 ± 3.00 | 0.002 |
| LVEDD | 50.11 ± 3.86 | 49.64 ± 3.78 | 48.43 ± 4.41 | 0.011 |
| E/A Ratio | 1.19 ± 0.32 | 1.29 ± 0.33 | 1.38 ± 0.30 | 0.043 |


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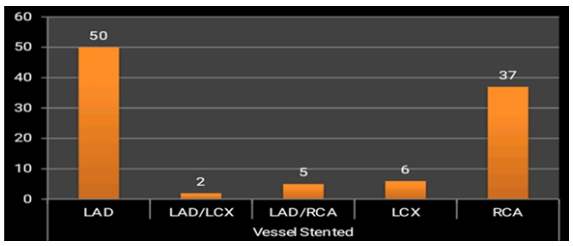


**Figure 1: Angiographic data of Study population**

## DISCUSSION

This prospective study demonstrates that percutaneous coronary intervention (PCI) in patients with chronic coronary artery disease (CAD) and preserved left ventricular ejection fraction (LVEF > 50%) results in statistically and clinically significant improvement in both systolic and diastolic myocardial function, as assessed by tissue Doppler imaging (TDI) and conventional echocardiography. Among the TDI parameters, S' velocity, a marker of longitudinal systolic function, increased significantly from a mean of 7.45 ± 1.45 cm/s before PCI to 7.91 ± 1.47 cm/s at 1 day and 8.53 ± 1.54 cm/s at 6 weeks post-PCI ($p < 0.001$). This indicates early restoration of myocardial contractile performance, which may not be reflected by conventional LVEF alone. Comparable findings were reported by Wang et al,[5] where improved S' velocities post-PCI were associated with better long-term cardiac outcomes. Similarly, E' velocity, indicative of early diastolic relaxation, increased from 9.06 ± 2.3 cm/s at baseline to 10.36± 2.1 cm/s on Day 1 and 11.36 ± 2.2 cm/s at 6 weeks ($p < 0.001$), reflecting improved diastolic compliance and myocardial perfusion. In studies by Hillis et al,[4] and Lee et al,[9] enhanced E' velocities post-revascularization were predictive of improved LV filling dynamics and symptomatic relief. A velocity, corresponding to atrial contraction, also rose significantly from 10.2 ± 1.62 cm/s to 12.0 ± 1.39 cm/s and 12.18 ± 1.47 cm/s at 6 weeks ($p < 0.001$). Although A' is more dependent on atrial function, the improvement indicates a more synchronized and responsive myocardium after successful PCI. These observations align with the physiology of longitudinal myocardial fibres, which are more vulnerable to ischemia and are the first to show dysfunction. Their early recovery, as revealed by TDI, supports TDI's role in capturing subtle myocardial changes that are otherwise masked in patients with preserved LVEF. LVEF showed a significant increase from 58.12 ± 3.18% to 60.06 ± 3.02% on Day 1 and 62.18 ± 2.95% at 6 weeks post-PCI ($p < 0.001$). This reinforces the notion that even patients with "normal" LVEF can show functional improvement after restoring coronary perfusion, consistent with Møller et al,[3] who documented LVEF gains in post-MI patients. LVESD significantly decreased from 32.14 ± 2.99 mm to 30.90 ± 2.91 mm at Day 1 and 30.79 ± 3.00 mm at 6 weeks ($p = 0.002$), highlighting the reverse remodelling of the ventricle and improved contractile efficiency. In contrast, LVEDD decreased only modestly from 50.11 ± 3.86 mm to 49.64 ± 3.78 mm, and further to 48.43 ± 4.41 mm, with a borderline significant p-value of 0.011. These subtle changes suggest that chamber dimensions are less sensitive in detecting early functional shifts, especially in patients without prior ventricular dilation. E/A ratio, a traditional marker of diastolic function, improved from 1.19 ± 0.32 at baseline to 1.29 ± 0.33 on Day 1 and 1.38 ± 0.30 at 6 weeks ($p = 0.043$). Although statistically significant, these changes are less robust than those observed in TDI parameters, reaffirming prior findings that mitral inflow patterns can be influenced by preload and are less reliable in early diastolic assessment.[6,7] Several studies echo our findings. In a Korean cohort, Lee et al,[9] observed significant improvements in S' and E' velocities at 1- and 3-month post-PCI in patients with stable angina and preserved LVEF. Voigt et al,[10] also reported that tissue Doppler markers can detect early changes in myocardial function before visible changes in LVEF or wall motion occur. Unlike these studies, our work adds real-world data from an Indian population, where echocardiographic tools like TDI are more accessible than cardiac MRI or speckle-tracking echocardiography. Our use of TDI in both septal and lateral basal walls, as well as the tricuspid annulus, adds dimension to the evaluation, potentially extending the findings to right ventricular function and interventricular synchrony, though not the focus of this report.

## CONCLUSION

PCI in chronic CAD patients with preserved LVEF leads to significant early improvements in myocardial function, detectable through TDI and conventional echocardiographic parameters. TDI emerges as a cost-effective and sensitive tool for evaluating both systolic and diastolic recovery post-revascularization and should be incorporated into routine echocardiographic assessment protocols.

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