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Original Research Article

A Tissue Doppler and Echocardiography Study to Evaluate Modifications in Left Ventricular Functions Following Percutaneous Coronary Intervention for Chronic Total Occlusion of the Left Anterior Descending Artery

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Abstract:

Background: In the last two decades, chronic completely occluded lesions (CTO) have emerged as the most challenging anatomy to treat. With reduced success rates and increased complication rates, CTO lesions continue to provide a significant challenge to interventional cardiologists. The global ejection fraction improved in some studies, but not in another; among patients with successfully recanalized occlusions, those with persistent patency and normal flow had better global function and less ventricular dilatation than patients without patent vessels. Data on the subject are sparse. Successful percutaneous coronary intervention (PCI) may improve ventricular relaxation and regional wall motion. The purpose of this study is to assess change in left ventricular functions using conventional echocardiography and tissue Doppler study in patients with chronic total occlusion of Left Anterior Descending (LAD) after Percutineous Coronary Intervention (PCI).

Methods: The study, which conducted from 2019 to 2021, involved 30 patients, with a mean age of 55.92 years and a range of ages from 40 to 67. Of these, 22 (73.3%) were male and 8 (26.7%) were female. They were chosen from among patients admitted to the Cardiology Department of GB Pant Hospital, New Delhi.

Results: Using M mode there was improvement in LVEF in 18 (60%) patients, unchanged in 4 (13.3%) patients, and decreased in 8 (26.6%) patients. With Mean ± SD = 64.5±8.5 pre PCI and 65.7±6.1 post PCI, with P value = 0.09. Using 2D to assess LVEF there was improvement in LVEF in 18 (60%) patients, unchanged in 5 (16.6%) patients, and decreased in 7 (23.3%) patients. With Mean ± SD = 58.48±5.1 pre PCI and 60.6±4.2 post PCI, with P value = 0.005. Using TDI to assess Left ventricular systolic function there was improvement in LV systolic function in 18 (60%) patients, unchanged in 5 (16.6%) patients, and decreased in 7 (23.3%) patients with Mean ± SD = 11.7±2.7pre PCI and 12.05±2.3 post PCI, with P value = 0.07. Regarding LV diastolic function using pulsed Doppler over mitral flow there was improvement in LV diastolic function by measuring E/A ratio which was Pre PCI:- normal or pseudonormal (E/A ratio 1- 2) in 5 (16.7 %) patients, and Impaired relaxation (E/A ratio < 1) in 25 (83.3 %) patients and post PCI become normal or pseudonormal (E/A ratio 1- 2) in 8 (26.7 %) patients, and impaired relaxation (E/A ratio < 1) in 22 (73.3 %) patients. Mean ± SD = 0.64±0.39 pre PCI and 0.90±0.24 post PCI, with P value = 0.001. And using TDI in patients pre and post PCI there was improvement in LV diastolic function as pre PCI:- normal or pseudonormal (E/A ratio 1- 2) in 3 (10 %) patients, and impaied Impaired relaxation (E/A ratio < 1) in in 27 (90 %) patients. Post PCI become normal or pseudonormal (E/A ratio 1- 2) in 7 (23.3 %) patients, and impaied Impaired relaxation (E/A ratio < 1) in 23 (76.7 %) patients. Mean ± SD = 0.64±0.39 pre PCI and 0.90±0.24 post PCI, with P value = 0.009

Conclusion: Tissue Doppler and conventional echocardiography can be used to predict the improvement in global LV functions that results from PCI for a CTO LAD.

Keywords: Coronary totally occluded (CTO), Coronary artery disease (CAD), and echocardiography, tissue Doppler imaging, left ventricular function (LVF).

Introduction

Cardiovascular diseases (CVD) are the leading cause of death and morbidity globally and one of the most prevalent and dangerous diseases.[1] One of the leading causes of death and morbidity worldwide is coronary artery disease (CAD).[2] It was predicted that in developing nations, the death rate from CAD will rise.[3] Following a myocardial infarction (MI), cardiac necrosis results in left ventricular (LV) dilatation. This is followed by LV systolic dysfunction due to cardiac remodeling. The

clinical course of heart failure is determined by cardiac remodeling.[4]

Early coronary recanalization enhances both global left ventricular function and survival as well as the survival of the viable myocardium.[5] Percutaneous coronary intervention (PCI) in patients with preserved LV function and optimal medical therapy doesn't reduce cardiac death and MI, but it does decrease the need for other procedures and the risk of angina; its effect on LV systolic or diastolic function is unclear. Studies in patients with CAD and LV dysfunction show that the disease outcome can be improved with CABG or PCI.[6] Chronic totally occlusion (CTO) is common, and over the past 20 years, CTO lesions have represented the most difficult anatomy for treatment with lower success rates and higher complication rates. CTO continues to represent one of the greatest challenges to interventional cardiologists.

The basis of the pathophysiologic benefit of revascularization is improving the function of viable myocardium. Primary PCI is performed during the stage of acute myocardial infarction (MI), late PCI is performed a few days after acute MI, and elective PCI is performed in CAD patients who are candidates for PCI during diagnostic processes.[6] According to studies in patients with CAD and LV dysfunction, early coronary re-canalization helps to preserve the viable myocardium and improves global LV function and survival. PCI or CABG can also improve the course of the illness.[5] PCI has been utilized more frequently for revascularization in patients with ischemic heart disease (IHD).

The majority of studies have examined the main PCI, using parameters such as EF, diastolic function, wall motion, and chamber diameters. The findings of linked past research about elective PCI have revealed divergent opinions. In the outcome of PCI is influenced by the patients' overall health, the time intervals between MI and PCI, and the baseline LVEF before to PCI.10] It has been demonstrated that transthoracic echocardiography (TTE) has potential for CTO identification. [9]

The advent of high-frequency transthoracic transducers and second tissue harmonic imaging technology has made it possible to employ TTE as a common, low-cost, noninvasive technique for diagnosing coronary stenosis in clinical practice.[11] Global ejection fraction improved in some studies but not in another, and patients with successfully recanalized occlusions who had persistent patency and normal flow had better global function and less LV dilatation than patients without patent vessels, despite the paucity of data. Successful PCI may also improve ventricular relaxation and regional wall motion. In a meta-analysis of 13 trials shows that, in comparison to unsuccessful CTO PCI, successful CTO PCI lowers mortality by 44% (odds ratio 0.56; 95% confidence interval 0.43-0.72). [12], [13]

The aim of the current study was to assess, using TDI and conventional echocardiography, the impact of elective PCI to a CTO LAD artery on LV functioning. In this study, 30 patients with a CTO LAD artery were chosen, and before PCI and three months after PCI, global LV systolic and diastolic functions were assessed by echo and TDI.

Material and Methods

The study was conducted through the period from 2019 to 2021 and included 30 patients, 22 (73.3%) males and 8 (26.7%) females, with age from 40 to 67 years old with mean age 55.92. They were selected from patients admitted to Cardiology department of GB Pant Hospital, New Delhi.

Patients with Chronically Occluded Left Anterior Descending Artery were included in this study and patients with rheumatic heart disease, end stage renal disease, end stage liver disease, Heamodynamicaly unstable patients, acute coronary syndrome and decompensated heart failure were excluded in this study. The following was done for all patients. a. Full history taking, b. Complete clinical examination, c. Resting surface 12 leads electrocardiography (ECG), d. Coronary angiography and PCI to the CTO LAD artery, and e. Transthorasic echocardiography with TDI before PCI and within 3 month after PCI.

The clinical and investigating data were collected and transferred to statistical program “SPSS” for windows V6.12 to obtain: - Minimum. -Maximum. -Mean (´X). -Standard deviation ± SD. -Number and percentage (from quantitative data). “T” tests to compare more than two groups. P-value = level of significance -P > 0.05 = not significant -P < 0.05 = significant -P < 0.001= highly significant.

Results

Table 1: Comparison of basic characteristics of the patients

Demographic variables	No. of cases	Percentage
Gender		
Male	22	73.3%
Female	8	26.7%
HIN	25	83.3%
DM	20	66.7%
Smoking	21	70%
DM and HTN	17	56.7%

The study comprised thirty patients. Of the patients, 22 were male (73.3%), 8 were female (26.7%), 25 had hypertension (83.3%), 20 had diabetes (66.7%), and 21 had been smokers (70%). As seen in Table 1, 17 patients (56.7%) had both diabetes and hypertension.

Table 2: Comparison between patients as regard EFpre and post PCI

EF " modified Simpson's		**P value**
LVEF 2D Pre – PCI	58.48±5.1	P value = 0.005
LVEF 2D Post – PCI	60.6±4.2	

Comparison of all patients before and after PCI based on EF using a modified Simpson's method: The patient's pre- and post-PCI EF by modified Simpson's showed a statistically significant difference (mean ± SD: 58.48± 5.1% pre-PCI against 60.6± 4.2% post-PCI; P value = 0.005).

Table 3: Comparison between patient's as regard EF"M mode" pre And post PCI

LVEF by M-Mode		**P value**
LVEF by M-Mode pre	64.5±8.5	P value = 0.09
LVEF by M-Mode post	65.7±6.1	

Comparison of all patients' EFs using the M-mode approach before and after PCI: Regarding EF by M mode, the patient's pre- and post-PCI mean ± SD was 64.5±8.5% pre-PCI and 65.7±6.1% post-PCI (P value = 0.09), with no statistically significant difference found.

Table 4: Comparison between patient's as regard (S)wave pre and post PCI

Aver SW		**P value**
Aver SW pre	11.7±2.7	P value = 0.07
Aver SW post	12.05±2.3	

Comparing all patients before and after PCI based on EF using the "(S) wave" TDI method: There was no statistically significant difference in the patient's EF by TDI "(S) wave" before and after PCI (mean ± SD: 11.7± 2.7% pre-PCI, 12.1± 2.3% post-PCI; P value = 0.07).

Table 5: Comparison between patients as regard E/Aratio pre and post PCI

E/A		**P value**
E/A pre	0.64±0.39	P value = 0.001
E/A post	0.90±0.24	

Comparing all patients before and after PCI based on PWD's LV diastolic function over mitral inflow "E/A": A statistically significant change was seen in the LV diastolic function by PWD over mitral inflow between the pre- and post-PCI patient groups (mean ± SD: 0.64± 0.39 % pre-PCI group, 0.90±0.24% post-PCI; P value = 0.001).

Table 6: Comparison between patients as regard by TDI pre and post PCI

E/A by TDI		**P value**
E/Am pre	7.8±2.7	P value = 0.009
E/Am post	8.4±2.9	

Comparison of all patients' LV diastolic function before and after PCI using TDI: There was a statistically significant difference in the patient's LV diastolic function by TDI over mitral inflow between the pre- and post-PCI groups (mean ± SD: 7.8±2.7% in the pre-PCI group and 8.4±2.9% in the post-PCI group; P value = 0.009). The percentage of patients with reduced left ventricular diastolic function decreased from 27 (90%) to 23 (76.7%) following PCI, with 4 (13.3%) showing improvement.

Table 7: Comparison between patient's as regard (RWS) pre and post PCI

RWS		**P value**
Pre – PCI	1.28±0.25	P value=0.05
Post – PCI	1.16±0.25	

Comparing every patient's regional ventricular function (RWS) before and after PCI There was a statistically significant difference between the patient's pre- and post-PCI regional ventricular function by (RWS).

Table 8: Conventional Echo results of the studied group

	Mean ± SD	**P value**
FS		
Pre – PCI	33.57±5.5	0.3
Post – PCI	34.17±7.2	
LVEF M- Mode		
Pre – PCI	64.5±8.5	0.09
Post– PCI	65.7±6.1	

LVEF 2D average		
Pre – PCI	58.48±5.1	0.005
Post – PCI	60.6±4.2	
E/A		
Pre – PCI	0.64±0.39	0.001
P – PCI	0.90±0.24	

Table 9: Tissue Doppler results of the studied group

	Mean ± SD	**P- Value**
Aver E wave		
Pre- PCI	7.8±2.7	0.009
Post PCI	8.4±2.9	
Aver Awave		
Pre- PCI	10.4±	0.6
Post- PCI	10.5±	
Aver S wave		
Pre- PCI	11.7±2.7	0.07
Post- PCI	12.05±2.3	
RWS		
Pre- PCI	1.28±0.25	0.05
Post- PCI	1.16±0.25	Post – PCI

Discussion

One of the most prevalent, dangerous diseases and the leading cause of death worldwide is cardiovascular disease (CVD).(Source:) Following MI, myocardial necrosis results in LV dilatation, which is then followed by LV systolic dysfunction due to cardiac remodeling. The clinical course of HF is determined by cardiac remodeling.[7] Medical treatment, PCI and CABG are the treatment options for CAD.[14]

CTO is a common condition in patients with CAD, CTO represents one of the most challenging targets of lesion re-canalization, because of its complexity, PCI in cases with CTO is associated with lower rates of procedural success, higher complication rates, greater radiation exposure, and longer procedure times compared with interventions in non-CTO lesions, despite these obstacles, reported benefits of successful CTO - PCI include a reduction in symptoms and improvement in both ventricular function and survival.[15]

The basis of pathophysiologic benefit of revascularization is improving the function of viable myocardium.[6] Early coronary re-canalization helps to survive the viable myocardium and improve global LV function, according to the studies in patients with CAD and LV dysfunction the outcome can be improved with PCI or surgical revascularization (CABG).[5]

Intervals between MI and PCI, basic LVEF before PCI and global condition of the patients affect the result of PCI; many studies have been done to study the effect of PCI on cardiac function.[14] CTOs are a common, and over the past 20 years, CTO lesions have represented the most difficult anatomy for treatment with lower success rates and higher complication rates, CTO continue to represent one of the greatest challenges to interventional cardiologists, successful revascularization has been strongly associated with improved LV functions, freedom from angina and future revascularization and in several studies increased survival.[16]

Conclusion

According to our research, a successful CTO PCI of the LAD may improve survival. Only patients with LAD CTO showed an improvement in survival when the procedure was successful. According to the current study, individuals with CTO lesions in the LAD artery benefit functionally and clinically from PCI. After revascularization, PCI for a CTO LAD improves regional and global LV functions, myocardial contractility, and LV functions, all of which can be predicted by TDI and conventional echo.

References

1. Gaziano JM, Manson JE, Ridker PM. Primary and secondary prevention of coronary heart disease. In: Libby P, Bonow RO, Mann DL, Zipes DP, editors. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. 8th ed.St. Louis, Mo: WB Saunders, 2007; 1119-45.
2. Shewan LG, Coats AJ. Ethics in the authorship and publishing of scientific articles. Int J Cardiol, 2010; 144: 1-2.
3. Okrainec K, Banerjee DK, Eisenberg MJ.Coronary artery disease in the developing world. Am Heart J, 2004; 148(1): 7-15.
4. Banerjee P, Card D.Preserving left ventricular function during percutaneous coronary

intervention. J Invasive Cardiol, 2007; 19(10): 440-3.
5. Silva JC, Rochitte CE, Júnior JS, Tsutsui J, Andrade J, Kalil-Filho R, Ramires JF, Nicolau JC.Late coronary artery recanalization effects on left ventricular remodelling and contractility by magnetic resonance imaging. Eur Heart J, 2008; 26(1): 36- 43.
6. Phillips HR, O'Connor CM, Rogers J.Revascularization for heart failure.Am Heart J;153(4 Suppl):65-73, 2010.
7. Banerjee P, Card D.Preserving left ventricular function during percutaneous coronary intervention. J Invasive Cardiol, 2009; 19(10): 440-3.
8. Lane GE, Holmes DR Jr. Primary percutaneous coronary intervention in the management of acute myocardial infarction. In: Libby P, Bonow RO, Mann DL, Zipes DP, editors.Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine.8th ed. St. Louis, Mo: WB Saunders, 2007; 1301-11.
9. Remmelink M, Sjauw KD, Henriques JP, Vis MM, van der Schaaf RJ, Koch KT, Tijssen JG, de Winter RJ, Piek JJ, Baan J Jr.Acute left ventricular dynamic effects of primary percutaneous coronary intervention from occlusion to reperfusion. J Am Coll Cardiol, 2009; 53(17): 1498-502.
10. Ioannidis JP, Katritsis DG: Percutaneous coronary intervention for late reperfusion after myocardial infarction in stable patients. Am Heart J, 2010; 154(6): 1065-71.
11. Vrublevsky AV, Boshchenko AA, Karpov RS. Diagnostics of main coronary artery stenoses and occlusions: multiplane transoesophageal Doppler echocardiographic assessment. Eur J Echocardiogr, 2001; 2: 170–7.
12. Serruys P. SYNTAX: Chronic Total Occlusion Subsets Paper presented at: Cardiovascular Research Technologies (CRT) Washington, DC, March-6, 9, 2009.
13. Joyal D, Afilalo J, Rinfret S. Effectiveness of recanalization of chronic total occlusions: A systematic review and meta-analysis. Am Heart J, 2010; 160(1): 179–87.
14. Rihal CS, Raco DL, Gersh BJ, Yusuf S.Indications for coronary artery bypass surgery and percutaneous coronary intervention in chronic stable angina: review of the evidence and methodological considerations. Circulation; 2003; 108(20): 2439-45.
15. Safley DM, Koshy S, Grantham JA , et al. Changes in myocardial ischemic burden following percutaneous coronary intervention of chronic total occlusions. Catheter Cardiovasc Interv, 2011; 78(3): 337–43.
16. Cheng ASH, Selvanayagam JB, Jerosch-Herold M, et al. Percutaneous treatment of CTO improves regional hyperemic myocardial blood flow and contractility: J Am CollCardiolIntv, 2008; 1: 44-53.