Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

The Effect of Successful Percutaneous Coronary Intervention of Chronic Coronary Total Occlusion on Regional Left Ventricular Deformation by Speckle Tracking Echocardiography

Ahmed Gaafar

ahmed.gaafar911@med.helwan.edu.eg

Capital University formerly Helwan https://orcid.org/0000-0003-2437-6638

Muhammad Essam Hussain

Capital University formerly Helwan

Yasser Sadek

Capital University formerly Helwan

Ahmed Alashry

ahmedashry84@hotmail.com

Capital University formerly Helwan

Research Article

Keywords: Percutaneous Coronary Intervention, Chronic Total Occlusion, Left Ventricular, Deformation, Speckle Tracking Echocardiography

Posted Date: February 27th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-8971339/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: The authors declare no competing interests.

Abstract

Background

Percutaneous coronary intervention (PCI) is an invasive percutaneous procedure aiming to relieve coronary obstruction or occlusion, thus improving blood supply to ischemic territory. The study aims to assess the effect of successful PCI of chronic coronary total occlusion on regional left ventricle deformation using two-dimensional speckle tracking echocardiography (STE).

Methods

This prospective observational cohort study was conducted on 50 patients who had been admitted to the Cardiology Department, Helwan University, and underwent successful PCI for coronary chronic total occlusion (CTO). All patients were subjected to complete demographic data collection, complete clinical history and risk factors, complete clinical presentation, general and local examination, and routine laboratory investigations. Echocardiography, including STE, was conducted before and three months after PCI.

Results

After 3-month follow-up compared to pre-procedural data, the RLS, GLS, LVESV, LEDDV, WMSI, and EF were significantly improved (-15.77 ± 3.34 vs -17.63 ± 3.54), (-16.52 ± 1.74 vs -17.84 ± 2.42), (62.36 ± 20.64 vs 56.10 ± 19.54), (142.66 ± 39.74 vs 133.72 ± 37.76), (1.51 ± 0.30 vs 1.36 ± 0.29), and (51.94 ± 9.24 vs 54.86 ± 8.64), respectively, with a p-value of 0.001 for each. The improvement of these parameters was found in LAD, LCX, and RCA interventions; however, it was significantly more prominent in the LAD CTO intervention. The improvement of these parameters was also found in all the patients' subgroups.

Conclusions

We observed that CTO-PCI improved LV global and regional longitudinal strain rates, particularly in LAD intervention, across all patient subgroups.

Introduction

Percutaneous coronary intervention (PCI) aims to relieve coronary occlusion, thus restoring the blood supply to the ischemic territory. Different PCI techniques are available; the most common is ballooning the stenotic segment at the lesion site and/or deploying a stent to keep the artery open [1]. A coronary chronic total occlusion (CTO) is defined as 100% total occlusion for a period of three months or more based on angiographic findings. CTO lesions are found in about one-quarter to one-third of patients

undergoing diagnostic coronary angiography; the true prevalence in the overall population is unknown due to a subset of patients with CTO being asymptomatic[2]. The thrombolysis in myocardial infarction (TIMI) flow grading system is a scoring classification from 0 to 3, referring to the levels of coronary blood flow assessed during coronary angiography [3].

Procedural success of CTO PCI is defined as the achievement of technically successful revascularization with less than 30% residual stenosis within the occluded segment and restoration of antegrade TIMI grade 2 or 3 flow, in addition to the absence of in-hospital major adverse cardiac events (MACE) during the hospital stay before discharge [4]. MACE includes any of the following undesirable events before hospital discharge (death from any cause, Q-wave myocardial infarction, urgent repeated target vessel revascularization with PCI or coronary bypass surgery, tamponade requiring pericardiocentesis, surgery, or stroke) [5]. CTO revascularization didn't show benefit rates of all-cause mortality, myocardial infarction, stroke, or repeat revascularization; however, it has shown to greatly improve patients' quality of life and reduce symptoms of angina [6].

Echocardiography provides valuable information regarding left ventricular (LV) remodeling and associated significant changes in systolic and diastolic echocardiographic-derived indices. Doppler tissue imaging of medial and lateral mitral annular velocities reflects the rate of change in LV long-axis dimensions [7]. Although LV ejection fraction (LVEF) is the most commonly used way to assess systolic function, a reduced EF, most commonly measured by echocardiography, is known to be associated with a poor outcome. The Wall Motion Score Index (WMSI) is a subjective assessment based on the operator's experience. Strain is defined as the change in length of an object relative to its original length. Myocardial strain is a sensitive measure of contractility; it can be calculated at both the segmental and global levels, as well as in the three axes of myocardial contractility (circumferential, longitudinal, and radial) [8].

The study aims to assess the effect of successful PCI of chronic coronary total occlusion on regional LV deformation using two-dimensional speckle tracking echocardiography.

Patients and Methods

This prospective observational cohort study was conducted on 50 coronary CTO patients who had been admitted to the Cardiology Department, Helwan University Hospital, for scheduled PCI according to the ESC recommendations for myocardial revascularizations [9] and underwent successful PCI after approval from the Ethical Committee of the Faculty of Medicine, Helwan University, in the duration from November 2022 to November 2023 (Approval code: 1312022). Informed consents were obtained from the patients before they participated in this study.

Patients over the age of eighteen, without regard to gender, and with a viable myocardium within the CTO vessel's territory, met the inclusion criteria. These patients were either symptomatic or asymptomatic

with a significant area of documented ischemia in the occluded vessel territory identified by Dobutamine stress echocardiography, myocardial perfusion imaging, or cardiac magnetic resonance imaging[10].

Patients with non-viable CTO, a failed revascularization trial, suboptimal echocardiographic images, severe renal impairment (creatinine clearance < 30 ml/min), emergency PCI in acute coronary syndrome, the presence of conduction defects in the electrocardiogram, atrial fibrillation, and those who could not be adequately assessed by strain and speckle tracking were excluded from the study.

Complete clinical history, medication history, as well as risk factors, such as dyslipidemia, diabetes mellitus, hypertension, family history, coronary artery disease, chronic obstructive pulmonary disease, prior myocardial infarction (MI), and prior PCI, were collected for each patient. Thorough evaluation of the symptoms, a general and local examination, and standard laboratory tests (including a lipid profile test, a complete blood count, and a kidney function test with creatinine).

Before and three months following PCI, echocardiography was performed by the GE Vivid E9 machine for TTE with machine-integrated ECG recording. Standard acquisitions were acquired in the apical (2-, 3-, and 4-chamber) and parasternal (long- and short-axis) views at a depth of 16 cm. Cine-loop format was used to store standard 2D and colour Doppler data triggered to the QRS complex. M-mode, 2D, and TDI were completed. A 2.5 MHz complete two-dimensional cardiac ultrasound probe was used for the imaging; the parasternal projections were used to quantify the LV dimensions using M-mode online, where LV diameter in end-systole and end-diastole, posterior wall thickness, and intraventricular septal thickness were measured. LVEF was calculated by using the biplane Simpson's method [11]. WMSI was obtained in all patients; the total wall motion score (WMS) was calculated as the sum of the scores of all the segments [12].

Strain, strain rate (SR), and peak systolic strain (peak S) rate were determined as the maximal negative strain and SR value during ejection (between aortic valve opening and closure (AVO and AVC, respectively)). Still, end-systolic strain was measured at AVC [13].

Speckle tracking echocardiography:

Two-dimensional speckle tracking longitudinal strain measurement was calculated in the 16-segment model. In all apical planes, a region of interest was manually drawn, and tracking of motion was done automatically by the software. For each segment, the peak negative systolic strain value representing the maximum segmental systolic contraction was recorded. The LV endocardial surface was traced manually, and the speckle tracking width was modified to cover the whole LV wall thickness to obtain curves for the peak longitudinal strain. LV global longitudinal systolic strain (GLS) was calculated by averaging the peak systolic values of the six LV walls[14].

Coronary angiography and PCI:

The trans-femoral and trans-radial coronary angiography standard technique was used in all patients. All procedures were performed using a Philips Azurion biplane machine. Drug-eluting stents (DESs) were used in all the angioplasty procedures. Heparin was administered to maintain an activated clotting time > 250 seconds. PCIs of the CTO lesions were performed using bilateral injections, specialized hydrophilic tapered tips, stiff wires, parallel wires, microcatheters, and a retrograde approach when needed. After the PCI, all the patients were prescribed lifelong aspirin. Clopidogrel was prescribed for at least 12 months in all the patients. Procedural success was defined as the successful recanalization and dilation of at least one CTO per patient.

Statistical analysis:

All statistical calculations were done using computer programs Microsoft Excel 2010 (Microsoft Corporation, NY, USA) and SPSS (Statistical Package for the Social Sciences, SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows. Data were statistically described in terms of range, mean, standard deviation (SD), median, frequencies, and percentages when appropriate. Comparison of quantitative variables between the study groups was done using the Mann-Whitney U test for independent samples. For comparing categorical data, the chi-square ($\chi 2$) test was performed. ROC curves were plotted to determine cutoff values. Correlation between various variables was done using the Spearman rank correlation coefficient for non-normal variables. A probability value (p-value) less than 0.05 was considered statistically significant.

Results

Table 1 shows demographic distribution, risk factors, CTO vessel, and baseline echocardiographic data of the studied patients. Regarding the number of affected vessels.

Table 1
Baseline Characteristics of the Study Cohort (N = 50)

Characteristic	Value
Demographics	
Age (years)	55.9 ± 10.0
Sex (% Male)	44 (88.0%)
BMI (kg/m²)	29.8 ± 2.5
Risk Factors	
Smoking (%)	30 (60.0%)
Dyslipidemia (%)	26 (52.0%)
Diabetes Mellitus (%)	25 (50.0%)
Hypertension (%)	29 (58.0%)
Family History (%)	11 (22.0%)
CAD History	
Prior MI (%)	16 (32.0%)
Prior PCI (%)	35 (70.0%)
CTO Vessel	
LAD (%)	16 (32%)
LCX (%)	10 (20%)
RCA (%)	24 (48%)
Baseline Echo Parameters	
LVEF (%)	51.9 ± 9.2
GLS (%)	-16.5 ± 1.7
RLS (%)	-15.8 ± 3.3
WMSI	1.51 ± 0.3

Data is presented as mean ± SD or frequency (%), SD: Standard deviation, BMI: Body mass index, CAD: Coronary artery disease, MI: Myocardial infarction, PCI: Percutaneous coronary intervention, HDL: High density lipoprotein, TG: Triglycerides, CTO: Chronic total occlusion, LAD: Left anterior descending, LCX: Left circumflex, RCA: Right coronary artery.

This study included 50 patients with CTO with a mean age of 55.9 ± 10 years with a mean BMI of 44 kg/m²; 30 patients (60%) were smokers, 26 patients (52%) were dyslipidemics, 25 patients (50%) were diabetics, 29 patients (58%) were hypertensives, and 11 patients (22%) had a family history of CAD. Regarding CAD history, 16 patients (32%) had prior MI, and 35 patients (70%) had prior PCI. LAD was the CTO vessel in 16 patients (32%), LCX was the CTO vessel in 10 patients (20%), while the RCA was the CTO vessel in 24 patients (48%). Regarding the echocardiographic parameters of the studied population, the mean LVEF was 51.9 ± 9.2%, the mean GLS was − 16.5 ± 1.7%, while the mean RLS was − 15.8 ± 3.3%, and the mean WMSI was 1.5 ± 0.3.

Table 2
Procedural details and acute complications

Procedure details	
Procedure time (min)	75.6 ± 19.24
TIMI III flow after procedure	50 (100%)
Radiation dose (Gy)	3.4 ± 0.8
Contrast volume (mL)	283 ± 19
Fluoroscopy Time (min)	50 ± 15
Acute Complications	
CIN	2
Coronary perforation	1
Acute/subacute stent thrombosis	0
In-hospital mortality	0
ACS	0
Acute heart failure	0

The mean procedural time was 75.6 ± 19.2 minutes; all patients had TIMI III flow at the end of the procedure, the average radiation dose was 3.4 ± 0.8(GY), while the mean amount of contrast was 283 ± 19 ml. The total fluoroscopy time was 50 ± 15 minutes.

As regards the acute complications of the procedure, 2 patients only had CIN and a single patient had coronary perforation, while no patients had stent thrombosis, no in-hospital mortality, no patients had post-procedural ACS, nor Acute heart failure

Table 3
Change of GLS data between pre-procedural and 3-month follow-up in patients with different angiographic data

		GLS Preprocedural (n = 50)	GLS 3-month follow-up (n = 50)	P value
Risk Factors	**1 risk factor**	-14.4 ± 1	-15.5 ± 0.9	**< 0.001***
	2 risk factors	-14.7 ± 0.8	-15.7 ± 0.5	**0.034***
	3 or more risk factors	-13.1 ± 0.6	-15.7 ± 0.6	**0.019***
CTO vessel	**LAD**	-12.37 ± 0.89	-18.37 ± 0.81	**0.001***
	LCX	-13.5 ± 0.97	-15.3 ± 0.67	**0.039***
	RCA	-14.4 ± 1.02	-15.75 ± 0.89	**< 0.001***

Data presented as mean ± SD or frequency (%), CTO: Chronic total occlusion, LAD: Left anterior descending, LCX: Left circumflex, RCA: Right coronary artery, ACS: Acute coronary syndrome.

There was a significant improvement in GLS in CTO patients with single or multiple risk factors. There was also a significant improvement in GLS after successful PCI to the CTO of LAD (P-value 0.001), RCA (P-value 0.001), and LCX (P-value 0.039).

Table 4
; 3-month follow-up in the studied patients

	Study participants (n = 50)
Readmission for ACS	**7 (14%)**
Heart failure	2 (4%)
Readmission for Arrhythmias (AF)	1 (2%)

Data presented as mean ± SD or frequency (%), CTO: Chronic total occlusion, LAD: Left anterior descending, LCX: Left circumflex, RCA: Right coronary artery, ACS: Acute coronary syndrome.

Regarding the clinical outcome in the 3-month clinical follow-up, readmission for ACS occurred in 7 (14%) participants, 2 patients in the same CTO territory, and 5 patients due to other vessels. Arrhythmic hospital readmission occurred in 1 patient due to AF and rapid ventricular response, and due to heart failure in 2 participants who had baseline reduced EF.

Table 5
Comparison of echocardiographic parameters before and after successful CTO-PCI

Parameter	Pre-Procedure (Mean ± SD)	Post-Procedure (Mean ± SD)	Mean Difference	95% Confidence Interval	P-Value
GLS (%)	-16.52 ± 1.74	-17.84 ± 2.42	-1.32	[-1.77, -0.86]	< 0.001
RLS (%)	-15.77 ± 3.34	-17.63 ± 3.54	-1.86	[-2.46, -1.26]	< 0.001
LVEF (%)	51.94 ± 9.24	54.86 ± 8.64	+ 2.92	[+ 1.83, + 4.01]	< 0.001
LVEDV (ml)	142.66 ± 39.74	133.72 ± 37.76	-8.94	[-12.75, -5.13]	< 0.001
LVESV (ml)	62.36 ± 20.64	56.10 ± 19.54	-6.26	[-8.47, -4.05]	< 0.001
WMSI	1.51 ± 0.30	1.36 ± 0.29	-0.15	[-0.19, -0.11]	< 0.001

There was a significant improvement in GLS from (-16.52 ± 1.74) to (-17.84 ± 2.42) and a significant improvement in RLS from (-15.77 ± 3.34) to (-17.63 ± 3.54). LVEF also showed a significant improvement from (51.94 ± 9.24%) to (54.86 ± 8.64%), LVEDV improved from (142.66 ± 39.74) to (133.72 ± 37.76 ml), and LVESV improved from (62.36 ± 20.64 ml) to (56.10 ± 19.54 ml); also, WMSI improved from (1.51 ± 0.3) to (1.36 ± 0.29).

Table 6
Subgroup Analysis.

Subgroup	Category	N	Δ GLS (Mean ± SD)	P-Value (GLS)	Δ RLS (Mean ± SD)	P-Value(RLS)
All Patients		50	-1.32 ± 1.84	< 0.001	-1.86 ± 2.42	< 0.001
Diabetes	**DM**	25	-1.22 ± 1.86	0.003	-1.68 ± 2.41	0.002
	Non-DM	25	-1.42 ± 1.84	0.001	-2.04 ± 2.47	< 0.001
Hypertension	**HTN**	29	-1.41 ± 1.83	< 0.001	-1.85 ± 2.42	< 0.001
	Non-HTN	21	-1.20 ± 1.88	0.008	-1.87 ± 2.49	0.002
Dyslipidemia	**Present**	26	-1.38 ± 1.79	< 0.001	-1.96 ± 2.44	< 0.001
	Absent	24	-1.26 ± 1.92	0.004	-1.75 ± 2.44	0.001
Prior PCI	**Yes**	35	-1.29 ± 1.83	< 0.001	-1.83 ± 2.41	< 0.001
	No	15	-1.40 ± 1.91	0.013	-1.93 ± 2.53	0.007
Prior MI	**Yes**	16	-1.29 ± 1.82	0.012	-1.79 ± 2.43	0.009
	No	34	-1.33 ± 1.87	< 0.001	-1.89 ± 2.44	< 0.001

Across the overall cohort, both GLS and RLS demonstrated significant improvement, with mean changes of − 1.32 ± 1.84 and − 1.86 ± 2.42, respectively (both $p < 0.001$). This improvement remained statistically significant within all examined subgroups, including diabetes status, hypertension, dyslipidemia, prior PCI, and prior myocardial infarction. Notably, significant reductions in both ΔGLS and ΔRLS were observed consistently in each subgroup regardless of baseline comorbidity or prior coronary history, indicating a uniform treatment or temporal effect across different patient profiles.

Table 7
Between-Subgroup Comparisons of Improvement

Comparison	Variable	Subgroup 1 (Mean Δ ± SD)	Subgroup 2 (Mean Δ ± SD)	Mean Difference	P-Value
Diabetes	GLS	DM: -1.22 ± 1.86	Non-DM: -1.42 ± 1.84	0.20	0.697
	RLS	DM: -1.68 ± 2.41	Non-DM: -2.04 ± 2.47	0.36	0.602
Hypertension	GLS	HTN: -1.41 ± 1.83	Non-HTN: -1.20 ± 1.88	-0.21	0.697
	RLS	HTN: -1.85 ± 2.42	Non-HTN: -1.87 ± 2.49	0.02	0.979
Dyslipidemia	GLS	Present: -1.38 ± 1.79	Absent: -1.26 ± 1.92	-0.12	0.819
	RLS	Present: -1.96 ± 2.44	Absent: -1.75 ± 2.44	-0.21	0.765
Male Sex	GLS	Male: -1.34 ± 1.86	Female: -1.18 ± 1.75	-0.16	0.843
	RLS	Male: -1.91 ± 2.42	Female: -1.46 ± 2.69	-0.45	0.686
Prior PCI	GLS	Yes: -1.29 ± 1.83	No: -1.40 ± 1.91	0.11	0.847
	RLS	Yes: -1.83 ± 2.41	No: -1.93 ± 2.53	0.10	0.896
Prior MI	GLS	Yes: -1.29 ± 1.82	No: -1.33 ± 1.87	0.04	0.943
	RLS	Yes: -1.79 ± 2.43	No: -1.89 ± 2.44	0.10	0.895

The subgroup analysis demonstrated no statistically significant differences in the change of myocardial strain parameters (GLS and RLS) across the evaluated clinical characteristics. Specifically, the magnitude of ΔGLS and ΔRLS was comparable between patients with and without diabetes, hypertension, and dyslipidemia, as well as between sexes and according to prior cardiovascular history (prior PCI and prior MI), with all p-values > 0.05. Successful CTO-PCI resulted in statistically significant improvements in both Global Longitudinal Strain (GLS) and Regional Longitudinal Strain (RLS), with p-values < 0.001 for both parameters.

Discussion

In the current study, successful recanalization of chronic total occlusion by percutaneous coronary intervention resulted in significant improvement in myocardial deformation parameters assessed by speckle tracking echocardiography, with consistent enhancement of both global and regional left ventricular function at 3-month follow-up. The main findings are summarized as follows: (1) significant improvement in GLS and RLS, (2) parallel favorable changes in conventional echocardiographic indices

such as LVEF, LV volumes, and WMSI, (3) strain recovery across all CTO territories, and (4) a uniform response independent of baseline comorbidities.

GLS (− 1.32) and RLS (− 1.86) showed significant improvement after CTO revascularization, indicating that myocardial distortion is sensitive to functional recovery, in a study by **Abd ElFattah Kholeif et al.**,[15], who similarly found improvement in RLS, but they noticed no improvement in GLS. Importantly, the size and direction of strain change in this cohort are consistent with previous research, which indicates that longitudinal fibers, the most vulnerable to ischemia, recover quickly after coronary flow is restored **(Gerhard et al.,)**[16]. The contemporaneous decrease in LVESV, LVEDV, and WMSI provides evidence of reverse remodeling rather than measurement variability. Importantly, GLS improvement was observed despite relatively preserved baseline LVEF, highlighting the superiority of strain imaging over conventional echocardiographic parameters in detecting subtle changes in myocardial function [17, 18].

One important mechanistic implication is that CTO-PCI likely restores perfusion to persistently hibernating myocardium, resulting in early contractile improvement detectable by strain before significant ejection fraction changes occur. Although LVEF increased significantly in this study, the relative magnitude of strain change validates the concept that strain imaging gives incremental sensitivity for detecting subtle functional recovery, but **Abd ElFattah Kholeif et al.** [15] didn't find improvement in LVEF.

This study's ability to assess regional deformation is a significant strength. Significant GLS improvement across the LAD, RCA, and LCX CTOs suggests that functional recovery is not limited to a single coronary area. The significant improvement in LAD CTO is physiologically plausible given the vessel's higher myocardial mass[18, 22]. However, the existence of considerable strain improvement across all areas lends credence to the broader hypothesis that effective CTO revascularization results in global mechanical benefit via enhanced synchronization and reduced ischemia burden. Another explanation for the significant improvement in GLS following intervention for RCA and LCX CTO could be attributed to the selection rationale of our study, as it included only the dominant vessels.

One of the most therapeutically significant findings is the constancy of strain alleviation across diabetes, hypertension, dyslipidemia, previous MI, and prior PCI. While comorbidities have traditionally been linked to poor cardiac recovery, the lack of substantial between-group differences shows that effective CTO-PCI can overcome baseline risk-related functional impairment, and myocardial viability and successful revascularization are the primary determinants of functional recovery rather than baseline clinical characteristics [23, 24].

This finding could be augmented by "the role of documented significance" which we used for recruitment of cases with significant ischemia and viability on the territory of the CTO vessels, which should be documented by non-invasive tests, such as dobutamine stress test or stress MPI. This regional recovery supports the presence of dysfunctional but viable myocardium before intervention and underscores the importance of appropriate patient selection based on myocardial viability [19, 28].

This uniform response increases the data's generalizability and suggests that myocardial deformation recovery during CTO revascularization is predominantly influenced by flow restoration rather than patient risk profile. At the same time, numerical tendencies toward slightly better improvement in non-diabetic patients are consistent with pathophysiological expectations and require further investigation in larger cohorts.

The simultaneous improvement in strain, LVEF, LV volumes, and WMSI implies that CTO-PCI resulted in early reverse remodeling. These findings support the notion that deformation imaging represents substantial structural recovery rather than isolated functional fluctuations. The relatively low complication rate and satisfactory short-term clinical results emphasize the safety and functional value of successful CTO-PCI in adequately selected patients, and it is consistent with previous observational studies [25, 26].

Overall, the current findings are consistent with growing evidence suggesting that strain improves following CTO revascularization and frequently predates detectable changes in conventional indicators. The paper builds on previous research by assessing both global and regional deformation, proving vessel-specific recovery, and giving thorough subgroup analysis that demonstrates independence from baseline comorbidities. This combination strategy supports the mechanistic understanding while also providing clinically relevant evidence on the constancy of myocardial healing.

Limitation:

This study has limitations, including a relatively small sample size, short follow-up duration, and an observational design without a control group.

Conclusions

In conclusion, successful CTO-PCI is associated with significant improvement in global and regional LV longitudinal strain, LVEF, LV volumes, and wall motion score index. Two-dimensional speckle tracking echocardiography provides sensitive and early detection of myocardial functional recovery following CTO revascularization.

Abbreviations

2D-STE
Two-Dimensional Speckle Tracking Echocardiography
AF
Atrial Fibrillation
BMI
Body Mass Index
CNS

Central Nervous System
COPD
Chronic Obstructive Pulmonary Disease
CTO
Chronic Total Occlusion
CTO-PCI
Chronic Total Occlusion Percutaneous Coronary Intervention
ECG
Electrocardiogram
GIT
Gastrointestinal Tract
GLS
Global Longitudinal Strain
LVEF
Left Ventricular Ejection Fraction
MACE
Major Adverse Cardiac Events
MI
myocardial infarction
MPI
myocardial perfusion imaging
PCI
Percutaneous Coronary Intervention
STE
Speckle Tracking Echocardiography
TIMI
Thrombolysis in Myocardial Infarction
TOSCA
Total Occlusion Study of Canada
TTE
Transthoracic Echocardiography
WMSI
Wall Motion Score Index

Declarations

Conflict of Interest:

Nil

Financial support and sponsorship

Nil

References

1. Khan SQ, Ludman PF (2022) Percutaneous coronary intervention. Medicine 50:437–444
2. Adhikari BK, Wang S, Li C, Wang Y, Liu Q (2019) Percutaneous intervention of CTO lesion and non-CTO lesion in patients with coronary chronic total occlusion. World J Cardiovasc Dis 9:600
3. Morino Y, Abe M, Morimoto T, Kimura T, Hayashi Y, Muramatsu T et al (2011) Predicting successful guidewire crossing through chronic total occlusion of native coronary lesions within 30 minutes: the J-CTO score. JACC Cardiovasc Interv 4:213–221
4. Rolf A, Werner GS, Schuhbäck A, Rixe J, Möllmann H, Nef HM et al (2013) Preprocedural coronary CT angiography improves success rates of PCI for chronic total occlusion. Int J Cardiovasc Imaging 29:1819–1827
5. Mehran R, Claessen BE, Godino C, Dangas GD, Obunai K, Kanwal S et al (2011) Long-term outcome of percutaneous coronary intervention for chronic total occlusions. JACC Cardiovasc Interv 4:952–961
6. Sapontis J, Salisbury AC, Yeh RW, Cohen DJ, Hirai T, Lombardi W et al (2017) Early procedural and health status outcomes after chronic total occlusion angioplasty: OPEN-CTO Registry. JACC Cardiovasc Interv 10:1523–1534
7. Shacham Y, Khoury S, Flint N, Steinvil A, Sadeh B, Arbel Y et al (2016) Serial echocardiographic assessment of LV filling pressure after STEMI treated by PCI. J Am Soc Echocardiogr 29:745–749
8. Shetye A, Nazir SA, Squire IB, McCann GP (2015) Global myocardial strain assessment to predict outcomes after STEMI: a systematic review. World J Cardiol 7:948–960
9. Neumann FJ, Sousa-Uva M, Ahlsson A, Alfonso F, Banning AP, Benedetto U et al (2019) 2018 ESC/EACTS guidelines on myocardial revascularization. Eur Heart J 40:87–165
10. Fefer P, Knudtson ML, Cheema AN, Galbraith PD, Osherov AB, Yalonetsky S et al (2012) Current perspectives on coronary chronic total occlusions. J Am Coll Cardiol 59:991–997
11. Lang RM, Badano LP, Mor-Avi V, Afilalo J, Armstrong A, Ernande L et al (2015) Recommendations for cardiac chamber quantification by echocardiography in adults. J Am Soc Echocardiogr 28:1–39
12. Møller JE, Hillis GS, Oh JK, Reeder GS, Gersh BJ, Pellikka PA (2006) Wall motion score index and ejection fraction after acute myocardial infarction. Am Heart J 151:419–425
13. Kholeif AE, El Sharkawy E, Loutfi M, ElGowelly M (2019) Impact of CTO PCI on regional myocardial function using strain echocardiography. Egypt Heart J 71:8
14. Wang P, Liu Y, Ren L (2019) Evaluation of LV function after PCI of chronic coronary occlusions using STE. Herz 44:170–174

15. Kholeif AE, El sharkawy E, Loutfi M et al (2019) Evaluation of the impact of percutaneous coronary intervention of chronic total occlusion on regional myocardial function using strain echocardiography. Egypt Heart J 71:8. https://doi.org/10.1186/s43044-019-0007-1
16. Diller G-P, Wasan BS, Simon A, McG Thom RA, Foale, Alun D, Hughes DP, Francis Jamil Mayet,Evidence of Improved Regional Myocardial Function in Patients With Chronic Stable Angina and Apparent Normal Ventricular Function—A Tissue Doppler Study Before and After Percutaneous Coronary Intervention, Journal of the American Society of Echocardiography, Volume 22, Issue 2,2009,Pages 177–182,ISSN 0894–7317,https://doi.org/10.1016/j.echo.2008.10.018
17. Shetye A, Nazir SA, Squire IB, McCann GP (2015) Global myocardial strain assessment by different imaging modalities. World J Cardiol 7:948–960
18. Emara A, Zahran S, Samy NI (2019) Evaluation of LV function after CTO PCI using speckle tracking echocardiography. World J Cardiovasc Dis 9:899–914
19. Kholeif AE, El Sharkawy E, Loutfi M, ElGowelly M (2019) Impact of CTO PCI on regional myocardial function. Egypt Heart J 71:1–5
20. Magdy G, Azab SH, Esmail YA, Elfaky MK (2023) Speckle tracking echocardiography in prediction of LV reverse remodeling after CTO PCI. J Cardiol Cardiovasc Med 8:34–55
21. El Khashab K, Sadek S, Gharib H, Abdo M (2020) Echocardiographic evaluation after CTO PCI. Fayoum Univ Med J 7:147–160
22. Chimura M, Yamada S, Yasaka Y, Kawai H (2019) Global longitudinal strain improvement after CTO PCI. PLoS ONE 14:e0215934
23. Fefer P, Knudtson ML, Cheema AN et al (2012) Coronary chronic total occlusion perspectives. J Am Coll Cardiol 59:991–997
24. Hoebers LP, Claessen BE, Elias J et al (2015) Meta-analysis of CTO PCI and LV function. Int J Cardiol 187:90–96
25. Olivari Z, Rubartelli P, Piscione F et al (2003) PCI outcomes in chronic total occlusions. J Am Coll Cardiol 41:1672–1678
26. Sapontis J, Salisbury AC, Yeh RW et al (2017) Outcomes after chronic total occlusion angioplasty. JACC Cardiovasc Interv 10:1523–1534