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Original Research Article

CLINICAL AND ANGIOGRAPHIC OUTCOMES OF PERCUTANEOUS CORONARY INTERVENTION IN CHRONIC TOTAL OCCLUSION PATIENTS: A RETROSPECTIVE STUDY AT A TERTIARY CARE HOSPITAL

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Abstract: *Chronic total occlusion (CTO) presents a unique challenge in percutaneous coronary intervention (PCI), requiring specialised techniques to achieve successful revascularisation. Despite the complexity, PCI in CTO cases has evolved significantly, showing promising outcomes.* ***Objectives:*** *To assess percutaneous coronary intervention's clinical and angiographic outcomes in chronic total occlusion patients.* ***Methods:*** *This retrospective observational study was conducted at NICVD Karachi, Pakistan, following approval from the hospital's ethical committee. It reviewed the medical records of 150 patients who underwent percutaneous coronary intervention (PCI) for chronic total occlusion (CTO) from January 2024 to July 2024. Data was collected retrospectively from electronic medical records, including demographic details (age, gender, cardiovascular risk factors, and comorbidities), baseline clinical characteristics (presentation, symptoms, angina status, and prior cardiac history), and angiographic data (pre- and post-procedural findings, including the Thrombolysis in Myocardial Infarction (TIMI) flow grade). Clinical outcomes were assessed for both short-term and long-term results, including major adverse cardiac events (MACE) such as myocardial infarction, repeat revascularisation, target lesion revascularisation, and all-cause mortality. Statistical analysis was performed using SPSS Version 25.* ***Results:*** *150 patients were enrolled, with a mean age of 54.81±8.97 years. The cohort included 54.7% males (82 patients) and 45.3% females (68 patients). Before PCI, 87.3% of patients (131) had no blood flow in the occluded artery, while 12.7% (19) had minimal flow. Post-PCI, 91.3% (137 patients) achieved full blood flow (TIMI Flow Grade 3), and 8.7% (13 patients) had partial flow. The procedural success rate was 91.3%. In terms of short-term major adverse cardiac events (MACE), 116(77.3%) patients had no events, while 22.7% (34 patients) experienced a myocardial infarction (MI). For long-term MACE, 84.0% (126 patients) had no adverse events, 10.0% (15 patients) required target lesion revascularisation, 4.7% (7 patients) underwent repeat revascularisation, and 1.3% (2 patients) experienced mortality.* ***Conclusion:*** *This study confirms the efficacy and safety of PCI for CTO patients, demonstrating high procedural success rates, significant clinical improvements, and relatively low long-term adverse events. However, advancing procedural techniques and fostering specialised training are essential to enhance patient outcomes due to the risks and complexities involved. Further research, including large-scale randomised controlled trials, is needed to validate these results and refine patient selection and management strategies for CTO PCI.*

Keywords: Chronic Total Occlusion, Angiographic Outcomes, Percutaneous Coronary Interventions

Introduction

Chronic Total Occlusion (CTO) is characterised by the complete blockage of a coronary artery for an extended period, typically three months or more, significantly impairs blood flow to the heart muscle and contributes to adverse clinical outcomes. Percutaneous Coronary Intervention (PCI) is a well-established treatment for managing coronary artery disease, including CTO.(1) Chronic total occlusions (CTOs) of the coronary arteries are detected in 15–25% of patients who present with angina symptoms or have coronary artery disease (CAD) and undergo a coronary angiogram (CA).(2, 3) Findings from retrospective studies and small randomised controlled trials (RCTs) suggest that successfully performing percutaneous coronary intervention (PCI) to recanalise chronic total occlusions (CTOs) improves quality of life, angina relief, heart failure (HF) symptoms, and left ventricular ejection fraction (LVEF). However, it does not significantly affect survival rates.(4-6) Successful percutaneous coronary intervention (PCI) for chronic total occlusion (CTO) has been linked to better outcomes, including reduced angina, improved left ventricular function, and increased survival compared to unsuccessful attempts.(7, 8) However, despite these advantages, CTO PCI is rare.(7) This is likely due to the procedure's historically low success rates, technical difficulty, extensive use of specialised equipment, and risk of significant complications during the procedure.(9) Thus, this study aims to assess PCI's clinical and angiographic outcomes in patients with CTO.

Methodology

This retrospective observational study was conducted at the National Institute of Cardiovascular Diseases (NICVD), Karachi, Pakistan, following approval from the institutional review board. The study involved 150 consecutive patients who underwent percutaneous coronary intervention (PCI) for chronic total occlusion (CTO) between January 2024 and July 2024. Patients were included based on specific criteria: they had to be between 18 and 70 years of age,

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diagnosed with CTO, and have complete pre- and post-procedural angiographic data available for assessment. Patients of both genders were eligible, and those who had undergone prior coronary artery bypass grafting (CABG) for CTO were also included. However, patients were excluded if they had undergone PCI for other coronary lesions, presented with acute myocardial infarction (ST-elevation or non-ST-elevation) at the time of PCI, or had severe comorbid conditions such as advanced heart failure (NYHA Class IV) or severe renal impairment.

Data were collected retrospectively from electronic medical records, focusing on patient characteristics and clinical history. Demographic information such as age and gender was recorded, alongside cardiovascular risk factors and comorbidities. Baseline clinical data included details of the patient's presentation, symptoms, angina status, and any prior cardiac history. Angiographic information, both pre- and post-procedural, were also collected to assess the success of the intervention, with particular attention to the Thrombolysis in Myocardial Infarction (TIMI) flow grade.

The study focused on short-term and long-term clinical outcomes and preeminent adverse cardiac events (MACE). These events included myocardial infarction, the need for repeat revascularisation, target lesion revascularization, and all-cause mortality. Procedural success was assessed based on angiographic findings and clinical outcomes, particularly post-procedural TIMI flow grade improvements.

All data were analyzed using SPSS version 25. Descriptive statistics were used to summarize demographic and clinical characteristics, with continuous variables expressed as means and standard deviations and categorical variables presented as frequencies and percentages. Chi-square tests or Fisher's exact tests were applied for categorical variables, while continuous variables were analyzed using t-tests or Mann-Whitney U tests, depending on data distribution. A p-value of less than 0.05 was considered statistically significant. This methodology meets international standards, ensuring thorough data collection and robust statistical analysis.

Results

One hundred fifty patients were enrolled, with a mean age of 54.81±8.97years (Table 1). The gender distribution among the patients was 54.7% male (82) and 45.3% female (68). Before the PCI procedure, most patients (87.3%, 131 patients) had no flow in the occluded artery, while a smaller portion (12.7%, 19 patients) had minimal flow. Following the PCI procedure, 91.3% (137 patients) achieved full blood flow (TIMI Flow Grade 3), while 8.7% (13 patients) had only partial flow. The procedural success rate was 91.3% (137 patients). In terms of short-term major adverse cardiac events (MACE), 116(77.3%) patients had no events, while 22.7% (34 patients) experienced a myocardial infarction (MI). For long-term MACE, 84.0% (126 patients) had no adverse events, whereas 10.0% (15 patients) required target lesion revascularization, 4.7% (7 patients) underwent Repeat Revascularization, and 1.3% (2 patients) experienced mortality (Table 1).

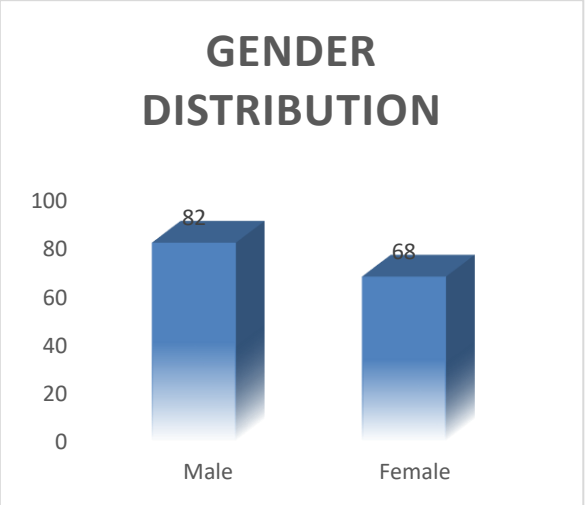

Figure 1: Gender distribution of the study population

Table 1: Clinical and Angiographic Outcomes of enrolled patients (n=150)

Variables	Frequency (%)
Gender	
Male	82(54.7%)
Female	68(45.3%)
Pre-PCI TIMI Flow Grade	
No flow	131(87.3%)
Minimal flow	19(12.7%)
Post-PCI TIMI Flow Grade	
Partial flow	13(8.7%)
Full flow	137(91.3%)
Procedural success	137 (91.3)
Short-Term MACE	
None	116(77.3%)
Myocardial Infarction (MI)	34(22.7%)
Long-Term MACE	
None	126(84.0%)
Target Lesion Revascularization	15(10.0%)
Repeat Revascularization	7(4.7%)
Mortality	2(1.3%)

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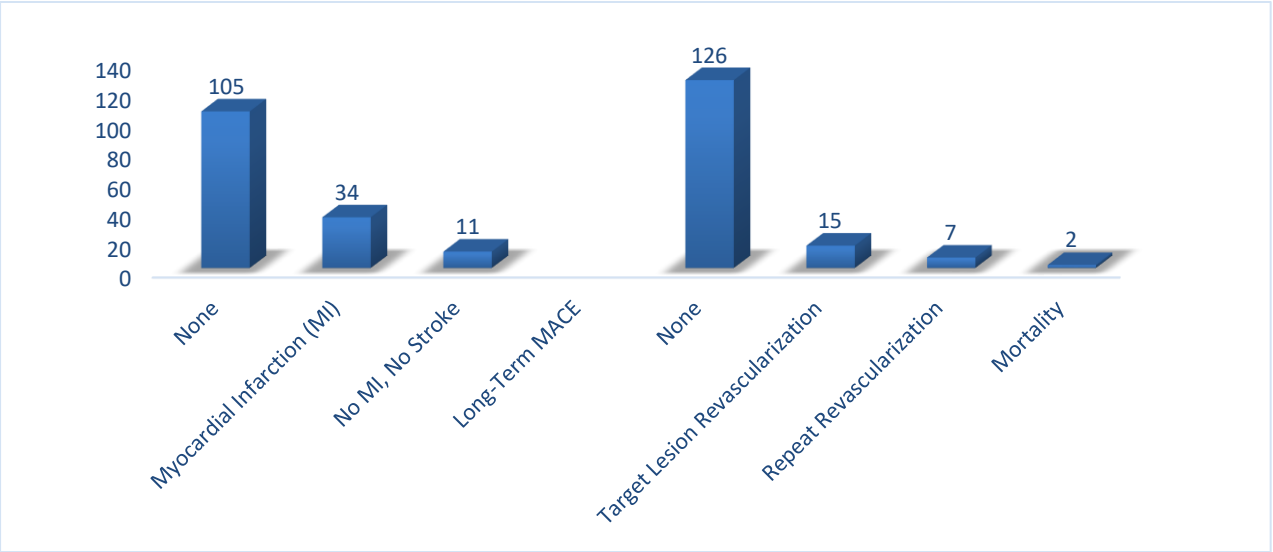

Fig 2: Frequency of outcomes.

Discussion

This retrospective study aimed to evaluate the clinical and angiographic outcomes of percutaneous coronary intervention (PCI) in patients with chronic total occlusion (CTO) at a tertiary care hospital. The findings provide valuable insights into the success rates, complications, and long-term prognosis of PCI in this high-risk patient population.

The present study results demonstrated a high procedural success rate (91.3%) for PCI in CTO patients, consistent with previous studies that reported success rates ranging from 60% to 90% in experienced centers.(10, 11) Most patients (91.3%) achieved complete restoration of blood flow (TIMI Flow Grade 3) post-procedure, underscoring the efficacy of advanced PCI techniques and technologies in overcoming the technical challenges posed by CTO lesions. This high success rate is particularly significant, given that CTO lesions are often considered the most complex to treat among coronary artery obstructions due to their complete and long-standing nature.

Short-term outcomes in our cohort were favorable, with 77.3% of patients experiencing no major adverse cardiac events (MACE) during their hospital stay. However, a notable proportion (22.7%) experienced a myocardial infarction (MI) shortly after the procedure, which aligns with the known risk profile of PCI in CTO cases, where procedural complications, such as vessel dissection or perforation, can result in adverse outcomes. Long-term follow-up revealed that 84% of patients remained free of MACE, suggesting that successful CTO PCI not only provides immediate symptomatic relief but also substantially benefits sustained cardiac health. However, 10% required target lesion revascularization and 4.7% underwent repeat revascularization, indicating the need for continuous monitoring and potentially further interventions in some cases.

The low overall mortality rate (1.3%) during the follow-up period is encouraging, suggesting that successful CTO PCI may contribute to better survival outcomes. These findings align with earlier studies showing improvements in survival, left ventricular function, and quality of life in patients who undergo successful CTO PCI (8, 12, 13). Nevertheless, it is essential to note that our study did not find statistically significant differences in survival between patients who underwent successful versus unsuccessful PCI, reflecting the need for larger-scale studies to validate these observations.

Despite the demonstrated benefits, CTO PCI remains underutilized in clinical practice, often due to concerns about technical complexity, high equipment use, and potential for major periprocedural complications. Our data reinforce the importance of selecting patients carefully and performing these interventions at specialized centers with high operator expertise and advanced technological support to maximize the likelihood of success and minimize complications.

Conclusion

It was concluded that this study supports the efficacy and safety of PCI in treating CTO patients, with high rates of procedural success, significant improvement in clinical outcomes, and relatively low rates of long-term adverse events. However, given the inherent risks and complexities associated with CTO PCI, it is crucial to continue advancing procedural techniques and technologies while fostering specialized training and experience to optimize patient outcomes. Further research, particularly large-scale randomized controlled trials, is needed to confirm these findings and provide more explicit guidance on patient selection and management strategies for CTO PCI.

Declarations

Data Availability statement

[Citation Aslam, M., Ashraf, M.W., Baker, M.A., Saqi, M.A.U.R., Farooq, M., Khan, K.A. (2024). Clinical and angiographic outcomes of percutaneous coronary intervention in chronic total occlusion patients: a retrospective study at a tertiary care hospital. *Biol. Clin. Sci. Res. J.*, **2024***: 1125.* doi: https://doi.org/10.54112/bcsrj.v2024i1.1125]

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned.

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

MUHAMMAD ASLAM (Fellow Interventional cardiologist)
Coordination of collaborative efforts.
Study Design, Review of Literature.
MUHAMMAD WASIM ASHRAF (Fellow Interventional cardiologist)
Conception of Study, Development of Research Methodology Design, Study Design, manuscript Review, and final approval of manuscript.
MUHAMMAD ABU BAKER (Fellow Interventional cardiologist)
Manuscript revisions, critical input.
Coordination of collaborative efforts.
MUHAMMAD ATTIQ UR REHMAN SAQ (Fellow Interventional cardiologist)
Data acquisition and analysis.
Manuscript drafting.
MUHAMMAD FAROOQ (Fellow Interventional cardiologist)
Data entry and data analysis, as well as drafting the article.
KAMRAN AHMAD KHAN (Associate Professor)
Data acquisition and analysis.
Coordination of collaborative efforts.

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