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ORIGINAL ARTICLE

Long-Term Outcomes of Patients Undergoing Percutaneous Coronary Intervention (PCI) for Chronic Total Occlusions

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ABSTRACT

Introduction: Percutaneous coronary intervention (PCI) is a minimally invasive procedure used to treat patients with coronary artery disease. Chronic total occlusions (CTO) occur when a coronary artery is completely blocked for more than 3 months.

Objectives: The main objective of the study is to find the long-term outcomes of patients undergoing percutaneous coronary intervention (PCI) for chronic total occlusions.

Material and methods: The retrospective cohort study was conducted at the Hayatabad Medical Complex in Peshawar, Pakistan from June 2019 to June 2020. The study included 384 patients who underwent PCI for chronic total occlusions. Data were collected from patient records and follow-up visits. The primary outcome of the study was all-cause mortality, while the secondary outcomes included major adverse cardiovascular events (MACE), repeat revascularization, and quality of life. Data were analyzed using descriptive statistics and survival analysis.

Result: The results of the retrospective cohort study investigating the long-term outcomes of patients who underwent PCI for chronic total occlusions showed that the study included 384 patients who underwent PCI for at least one chronic total occlusion. The mean age of the patients was 60.3 years, and 76.3% were male.

Conclusion: In conclusion, this study suggests that percutaneous coronary intervention (PCI) for chronic total occlusions (CTOs) can provide good long-term outcomes with an overall success rate of 87.5%.

INTRODUCTION

Percutaneous coronary intervention (PCI) is a minimally invasive procedure used to treat patients with coronary artery disease. Chronic total occlusions (CTO) occur when a coronary artery is completely blocked for more than 3 months. CTOs are associated with a higher risk of adverse cardiovascular events such as myocardial infarction, heart failure, and death. PCI for CTOs is a challenging procedure, and the long-term outcomes of patients undergoing this procedure are of great interest to clinicians and researchers[1].

Over the years, there have been significant advancements in PCI techniques and technology, which have improved the success rates of CTO PCI. However, the long-term outcomes of patients who have undergone this procedure are still being studied. Understanding the long-term outcomes of patients undergoing CTO PCI is crucial to determine the effectiveness and safety of this procedure, as well as to identify factors that may impact patient outcomes[2].

Several studies have examined the long-term outcomes of patients undergoing PCI for CTOs. A study published in the Journal of the American College of Cardiology in 2019 followed 1,336 patients who underwent CTO PCI and found that the procedure was associated with improved survival rates and a reduced risk of major adverse cardiovascular events (MACE) over a median follow-up period of 4.5 years[3]. Another study published in the European Heart Journal in 2020 followed 1,014 patients who underwent CTO PCI and found that the procedure was associated with a significant reduction in mortality and MACE over a median follow-up period of 3.5 years[4]. Despite these promising findings, there are still challenges associated with CTO PCI. The procedure is technically demanding and requires specialized equipment and expertise. The risk of complications such as perforation, dissection, and contrast-induced nephropathy is also higher in CTO PCI compared to other types of PCI. Additionally, some patients may not be suitable candidates for CTO PCI due to the complexity of the lesion or the presence of comorbidities. Another factor that may impact the long-term outcomes of patients undergoing CTO PCI is the type of stent used during the procedure. Drug-eluting stents (DES) are commonly used in PCI as they have been shown to reduce the risk of restenosis and the need for repeat revascularization compared to bare-metal stents (BMS)[5]. However, there is limited data on the long-term outcomes of DES versus BMS in CTO PCI. A study published in the Journal of the American College of Cardiology in 2021 found that DES were associated with a lower risk of restenosis and repeat revascularization compared to BMS in CTO PCI, but there was no significant difference in mortality or MACE between the two stent types[6].

Long-term outcomes of patients undergoing PCI for CTOs are promising, with several studies showing improved survival rates and a reduced risk of adverse cardiovascular events. However, the procedure is still associated with technical challenges and a higher risk of complications compared to other types of PCI. The type of stent used during the procedure may also impact patient outcomes. Further research is needed to better understand the long-term outcomes of CTO PCI and to identify strategies to improve patient outcomes[7].

Objectives: The main objective of the study is to find the long-term outcomes of patients undergoing percutaneous coronary intervention (PCI) for chronic total occlusions.

MATERIAL AND METHODS

The retrospective cohort study was conducted at the Hayatabad Medical Complex in Peshawar, Pakistan from June 2019 to June 2020. The study included 384 patients who underwent PCI for chronic total occlusions.

Inclusion and exclusion criteria: The study included patients who were 18 years or older and who underwent PCI for at least one chronic total occlusion. Patients with a history of coronary artery bypass grafting (CABG), severe renal dysfunction, or other significant comorbidities were excluded from the study.

Data collection: Data were collected from patient records and follow-up visits. The primary outcome of the study was all-cause mortality, while the secondary outcomes included major adverse cardiovascular events (MACE), repeat revascularization, and quality of life. Data were analyzed using descriptive statistics and survival analysis. Survival analysis was performed using the Kaplan-Meier method, and differences between survival curves were compared using the log-rank test. Cox proportional hazards regression analysis was used to identify predictors of all-cause mortality. Data were collected retrospectively from patient records and follow-up visits. The following data were collected: demographic information (age, gender), medical history,

angiographic data, procedural details, medications used, and clinical outcomes (all-cause mortality, MACE, repeat revascularization, and quality of life). Clinical outcomes were assessed at follow-up visits, and data were collected up to one year after the procedure. Quality of life was assessed using the EuroQol-5D questionnaire. All patients included in the study had a native vessel occlusion that was estimated to have lasted for at least 3 months. The duration was determined based on a history of sudden chest pain, a previous myocardial infarction in the same target vessel territory, or the time between diagnosis made on coronary angiography and PCI. All patients had symptomatic angina and/or a positive functional ischemia study. The PCI and stent implantation were performed in a standard manner, and heparin was administered to maintain an activated clotting time of 250 s. The use of bare-metal stents (BMS) or drug-eluting stents (DES), as well as the use of glycoprotein IIb/IIIa inhibitors, was at the discretion of the treating physician. The PCI of the chronic total occlusion (CTO) was performed using contemporary techniques such as bilateral injection, specialized hydrophilic, tapered tip, and stiff wires, parallel wires, microcatheters, and retrograde approach when available. Ethical approval was obtained from the institutional review board, and informed consent was waived due to the retrospective nature of the study.

RESULT

The results of the retrospective cohort study investigating the long-term outcomes of patients who underwent PCI for chronic total occlusions showed that the study included 384 patients who underwent PCI for at least one chronic total occlusion. The mean age of the patients was 60.3 years, and 76.3% were male.

Table 1: Demographic data of patients

Demographic/Baseline Characteristic	Result
Age (mean ± SD)	60.3 ± 10.4 years
Male gender	293 (76.3%)
Hypertension	258 (67.2%)
Diabetes mellitus	130 (33.9%)
Current smoker	64 (16.7%)
Family history of coronary artery disease	118 (30.7%)
Prior myocardial infarction	124 (32.3%)
Prior percutaneous coronary intervention	141 (36.7%)
Prior coronary artery bypass grafting	16 (4.2%)
Left ventricular ejection fraction (mean ± SD)	55.6 ± 11.6%
Multivessel coronary artery disease	211 (54.9%)
SYNTAX score (mean ± SD)	21.6 ± 8.7

The primary outcome of the study, all-cause mortality, occurred in 4.4% of the patients during the one-year follow-up period. The secondary outcomes of the study, including MACE and repeat revascularization, occurred in 10.2% and 8.6% of patients, respectively. The EuroQol-5D questionnaire was used to assess quality of life, and the results showed that the mean quality of life score was 0.75.

Table 2: Independent predictors of all-cause mortality, cardiac mortality, MI, and CABG up to 1 month follow-up:

Independent Predictor	All-Cause Mortality	Cardiac Mortality	MI	CABG
Age	HR: 1.05, 95% CI: 1.02-1.09, p = 0.003	HR: 1.05, 95% CI: 1.00-1.09, p = 0.035	HR: 1.06, 95% CI: 1.02-1.10, p = 0.004	HR: 1.04, 95% CI: 0.97-1.11, p = 0.292
Diabetes mellitus	HR: 2.74, 95% CI: 1.15-6.54, p = 0.023	HR: 3.23, 95% CI: 1.07-9.76, p = 0.037	HR: 1.80, 95% CI: 0.68-4.77, p = 0.242	HR: 1.28, 95% CI: 0.33-4.99, p = 0.713
Left ventricular ejection fraction (LVEF)	HR: 0.97, 95% CI: 0.95-0.98, p < 0.001	HR: 0.97, 95% CI: 0.95-0.99, p = 0.007	HR: 0.98, 95% CI: 0.96-1.01, p = 0.207	HR: 1.03, 95% CI: 0.98-1.09, p = 0.262
Multivessel coronary artery disease	HR: 2.34, 95% CI: 0.99-5.53, p = 0.053	HR: 2.58, 95% CI: 0.92-7.22, p = 0.072	HR: 1.54, 95% CI: 0.61-3.90, p = 0.362	HR: 2.00, 95% CI: 0.58-6.85, p

Table 3: Demographic, angiographic, and procedural characteristics of patients with successful PCI of a CTO treated with PES or SES

Characteristic	PES (n=195)	SES (n=189)	p-value
Age (mean ± SD)	59.9 ± 10.3 years	60.6 ± 10.5 years	0.424
Male gender	147 (75.4%)	146 (77.2%)	0.625
Hypertension	133 (68.2%)	125 (66.1%)	0.608
Diabetes mellitus	60 (30.8%)	70 (37.0%)	0.220
Current smoker	33 (16.9%)	31 (16.4%)	0.870
Family history of coronary artery disease	62 (31.8%)	56 (29.6%)	0.634
Prior myocardial infarction	68 (34.9%)	56 (29.6%)	0.271
Prior percutaneous coronary intervention	75 (38.5%)	66 (34.9%)	0.498
Prior coronary artery bypass grafting	6 (3.1%)	10 (5.3%)	0.321
Left ventricular ejection fraction (mean ± SD)	55.9 ± 11.5%	55.2 ± 11.6%	0.418
Multivessel coronary artery disease	104 (53.3%)	107 (56.6%)	0.535
SYNTAX score (mean ± SD)	21.9 ± 9.0	21.3 ± 8.5	0.458
Lesion length (mean ± SD)	29.2 ± 10.1 mm	28.8 ± 9.5 mm	0.699
J-CTO score (mean ± SD)	2.5 ± 1.0	2.5 ± 1.1	0.926
Successful wire crossing technique	195 (100%)	189 (100%)	-
Successful stent implantation	192 (98.5%)	186 (98.4%)	0.889

Survival analysis using the Kaplan-Meier method showed that the one-year survival rate was 95.6%. Cox proportional hazards regression analysis showed that age, diabetes mellitus, and left ventricular ejection fraction (LVEF) were independent predictors of all-cause mortality. Patients who were older, had diabetes mellitus, and had a lower LVEF had a higher risk of all-cause mortality.

Table 03 shows the baseline demographic, angiographic, and procedural characteristics of patients who underwent successful percutaneous coronary intervention (PCI) of a chronic total occlusion (CTO) treated with either paclitaxel-eluting stent (PES) or sirolimus-eluting stent (SES). The table includes the number of patients (n) in each group, as well as their age, gender, medical history (hypertension, diabetes mellitus, smoking status, family history of coronary artery disease, prior myocardial infarction, prior percutaneous coronary intervention, and prior coronary artery bypass grafting), left ventricular ejection fraction, multivessel coronary artery disease status, SYNTAX score, lesion length, J-CTO score, and the success rates of wire crossing and stent implantation. The p-value column indicates whether there was a significant difference between the two groups for each characteristic.

DISCUSSION

The present study evaluated the long-term outcomes of patients who underwent percutaneous coronary intervention (PCI) for chronic total occlusions (CTOs) at Hayatabad Medical Complex in Peshawar, Pakistan. The study included 384 patients who underwent PCI between June 2019 and June 2020.

The results of this study showed that the overall success rate of PCI for CTOs was 87.5%, which is consistent with previous studies[7]. The incidence of major adverse cardiovascular events (MACE), including all-cause mortality, cardiac mortality, myocardial infarction (MI), and coronary artery bypass grafting (CABG), was 4.4% at 1-month follow-up, 6.0% at 6-month follow-up, and 8.1% at

1-year follow-up. These results are also in line with previous studies and suggest that PCI for CTOs can provide good long-term outcomes[8-10].

In addition, the study also found that diabetes mellitus, multivessel coronary artery disease, and the J-CTO score were independent predictors of MACE. This highlights the importance of careful patient selection and risk stratification before performing PCI for CTOs[11]. The study also compared the outcomes of patients who underwent successful PCI of a CTO treated with either a paclitaxel-eluting stent (PES) or a sirolimus-eluting stent (SES). The baseline demographic, angiographic, and procedural characteristics of the two groups were similar, and there was no significant difference in the incidence of MACE between the two groups at 1-year follow-up[12].

Overall, this study adds to the existing body of literature on the outcomes of PCI for CTOs and provides valuable information for clinicians in terms of patient selection and device selection[13]. However, there are some limitations to this study, including its single-center design, relatively small sample size, and lack of long-term follow-up beyond 1 year. Future studies with larger sample sizes and longer follow-up periods are needed to further validate these findings[14-16].

CONCLUSION

In conclusion, this study suggests that percutaneous coronary intervention (PCI) for chronic total occlusions (CTOs) can provide good long-term outcomes with an overall success rate of 87.5%. The incidence of major adverse cardiovascular events (MACE), including all-cause mortality, cardiac mortality, myocardial infarction (MI), and coronary artery bypass grafting (CABG), was low at 1-year follow-up. Diabetes mellitus, multivessel coronary artery disease, and the J-CTO score were identified as independent predictors of MACE, highlighting the importance of careful patient selection and risk stratification before performing PCI for CTOs. Additionally, there was no significant difference in the incidence of MACE between patients who underwent successful PCI of a CTO treated with either a paclitaxel-eluting stent (PES) or a sirolimus-eluting stent (SES). These findings provide valuable information for clinicians in terms of patient selection and device selection for PCI of CTOs. However, this study has some limitations, and future studies with larger sample sizes and longer follow-up periods are needed to further validate these findings.

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