Section: Cardiology

Original Research Article

# CLINICAL AND ANGIOGRAPHIC PROFILE IN PATIENTS WITH CORONARY CHRONIC TOTAL OCCLUSION

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## Abstract

**Background:** The objective is to study, analyse and compare the Clinical, Angiographic Profile in Patients with Coronary Chronic Total Occlusion. **Materials and Methods & Result:** A retrospective, single-center study of the clinical and angiographic profiles of patients with coronary CTO. Out of 50 cases 9 (18%), 11 (22%), and 30 (60%) were located in LAD, LCx and RCA respectively. Patients with CTO in RCA had significantly lower mean left ventricular ejection fraction, significantly more common involvement of ostial segment and bridging collaterals. Patients with CTO in LAD had significantly more frequent presence of blunt stumps and calcification. Patients with CTO in LCx had significantly more common presentation as inferior-wall MI and involvement of distal segment. **Conclusion:** Clinical and angiographic differences in the CTO lesions of 3 main coronary arteries should be subjected to prospective studies to compare the short and long-term clinical cardiovascular outcomes.

## INTRODUCTION

Coronary chronic total occlusions (CTOs) are defined as 100% occlusions with TIMI 0 flow with at least a 3-month duration. Treatment options for patients with coronary CTOs include lifestyle changes and medications and coronary revascularization with either percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG).[1]

Chronic total occlusions are present in 14% to 50% of patients undergoing coronary angiography. The presence of a CTO is associated with angina, decreased quality of life. Despite the high prevalence of CTO, CTO recanalization represents only a small fraction of the overall volume of percutaneous coronary intervention (PCI), because of a combination of low success rates, high incidence of complications, long procedural duration, high costs and lack of clinical benefit.[2]

Retrospective data have suggested several possible benefits of successful CTO recanalization, including angina relief, improvement in quality of life and exercise capacity, decrease in the ischemic burden, improvement in left ventricular function and remodelling, electric stabilization and reduction of the arrhythmic burden and even increased survival.[3]

Assessment of the anatomical complexity of a CTO is important for procedural strategy selection. The first and most commonly used is the J CTO (Multicentre CTO Registry in Japan) score (21). It includes 4 angiographic characteristics (blunt stump, calcification, bending >45_ within the occlusion, and length >20 mm) plus a prior failed CTO PCI attempt. Angiographic characteristics with poor outcomes are the presence of tortuosity, bridging collaterals. Success in managing CTO lesions may be influenced by their location in the three major coronary arteries-left anterior descending artery (LAD), left circumflex artery (LCx), and right coronary artery (RCA). Previous studies have demonstrated a trend towards lower success rate for CTO-PCI of RCA lesion.[4,5]

## MATERIALS AND METHODS

### Study Design and Patient Population

This was a retrospective, single-center study conducted at Government Coimbatore medical college between October2023- October 2024. For All patients who are undergoing diagnostic angiography at our Cath lab, the clinical and angiographic profiles of patients who were diagnosed with CTO coronary lesions were examined. Patients with previous history of PCI or CABG were excluded from the analysis. a CTO was defined as a complete obstruction of the vessel with Thrombolysis In Myocardial Infarction (TIMI) flow grade 0 and an estimated duration of >3 months. Age of the occlusion was determined by the interval from the last episode of acute coronary


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syndrome or myocardial infarction consistent with the location of the occlusion.

The CTO patients were grouped according to the involvement of LAD, LCx, and RCA. Subsequently, the clinical and angiographic characteristics of CTO lesions were compared based on their presence in three major coronary arteries.

**Data Collection and Outcome Measures**

Demographic, clinical, and angiographic data were collected from all patients included in the study. Demographic variables like age and gender along with cardiovascular risk factors including hypertension, diabetes mellitus, dyslipidaemia, smoking and renal failure and previous stroke were recorded. Diagnosis of acute coronary syndrome, including stable angina, unstable angina, NSTE-ACS, was made based on the criteria established by the American Heart Association (AHA) guidelines All patients had underwent diagnostic coronary angiography through femoral/radial route. Based on the angiographic data, presence of CTO lesion and involved vessel were identified. Further, the distribution of CTO lesions in ostial, proximal, mid, and distal segments of the vessels was also noted. The coronary arterial dominance was defined by the vessel which gives rise to the posterior descending artery and PLV.

The patients were identified as right dominant, left dominant or codominant. Additionally, severity of coronary artery disease was noted by presence of significant coronary occlusion and the patients were classified to have single-vessel disease or multi-vessel disease. Other angiographic features of CTO lesions, including presence of blunt stumps, calcification, tortuosity, and bridging collaterals were also recorded. The choice of management trens for the patient with CTO coronary lesions was at the discretion of interventional cardiologist handling the case. patients were then managed medically or by PCI or CABG.

All patients were evaluated for in-hospital mortality and long term cardiovascular outcomes.

**Statistical Analysis**

Continuous variables were presented as mean +/- standard deviation and compared using student's t test. Categorical variables were presented as frequencies with percentages and compared using the chi square test. A P value<0.05 was considered statistically significant.

## RESULTS

Out of 50 patients who were found to have CTOs during their diagnostic angiography were included into the study.Of these lesions 9(18%) were located in LAD, 11 (22%) were located in LCx and 30 (60%) were located in RCA.

**Table 1**

| Clinical Characteristics | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Variables** | **Total Cases (50)** | **LAD (9)** | **LCX(11)** | **RCA(30)** | **LAD vs. LCx** | **LAD vs. RCA** | **LCx vs. RCA** |
| Age | 55 +/- 10 | 56 +/-9 | 58 +/- 10 | 57 +/-9 | 0.658 | 0.196 | 0.297 |
| Male | 42(84%) | 7(77.7%) | 11(100%) | 25(83.3%) | 0.568 | 0.538 | 0.116 |
| RISK FACTORS | | | | | | | |
| DM | 21(42%) | 4(44.4%) | 5(45.5%) | 12(40%) | 0.862 | 0.949 | 0.769 |
| SYSTEMIC HYPERTENSION | 28(56%) | 5(55.5%) | 79(63.6%) | 16(53.3%) | 0.658 | 0.856 | 0.684 |
| DYSLIPIDEMIA | 20(40%) | 3(33.3%) | 5(45.5%) | 12(40%) | 0.89 | 0.365 | 0.549 |
| SMOKING | 15(30%) | 1(11.1%) | 4(36.3%) | 10(33.3) | 0.059 | <0.01 | 0.168 |
| RENAL FAILURE | 2(4%) | 1(11.1%) | 1(9%) | 0 | 0.568 | <0.01 | 0.05 |
| H/O CVA/TIA | 2(4%) | 0 | 1(9%) | 1(3.3%) | 0.649 | 1 | 0.513 |
| LVEF | 46+/- 12 | 46+/- 12.6 | 47+/- 13.2 | 45+/-15 | 0.598 | 0.394 | <0.05 |
| ACS | | | | | | | |
| STABLE ANGINA | 5(10%) | 0 | 2(18.1%) | 3(10%) | 0.456 | 0.106 | 0.695 |
| UNSTABLE ANGINA | 24(48%) | 5(55.5%) | 6(54.5%) | 13(43.3%) | 0.066 | 0.066 | 0.797 |
| NSTEMI | 6(12%) | 1(11.1%) | 3(27.2%) | 2(6%) | | | |
| MI | | | | | | | |
| AWMI | 15(30%) | 2(22.2%) | 2(18.1%) | 11(36.6%) | 0.286 | 0.269 | <0.001 |
| IWMI | 10(20%) | 2(22.2%) | 5(45.5%) | 3(10%) | | | |
| AW& IWMI | 2(4%) | | 1(9%) | 1(3.3%) | | | |
| Generalised | 1(2%) | | 1(9%) | | | | |

**Clinical Characteristics:** The differences in clinical characteristics of patients with CTO in each of three major arteries are shown in [Table 1]. Age, male gender, angina status, and presence of Cardiovascular risk factors like diabetes, hypertension, dyslipidaemia and history of previous stroke or transient ischaemic attack was compared among patients with CTO lesions in LAD, LCx, and RCA.

The patients with CTO lesions in RCA displayed significantly lower levels of mean ejection fraction as compared to that in patients with CTO lesions in LCx (48.9±12. % vs. 45.5±14%; P<0.05).

Further, the type of myocardial infarction was significantly different between the LCx and the RCA groups, with anterior-wall MI present in 2 (4%) patients with CTO lesions in the LCX as compared to 11 (22%) of patients with CTO lesions in the RCA


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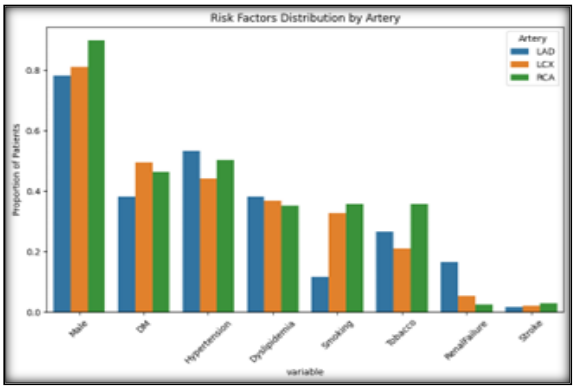
(P<0.001). Smoking habits were more common among patients with CTO lesions in the RCA (12)as compared to that in patients with CTO lesions in the LAD(1) (24% vs. 2%; p<0.01). Conversely, presentation with renal failure was noted among patients with CTO lesions in the LAD (1) as compared to that in patients with CTO lesions in the RCA(0).



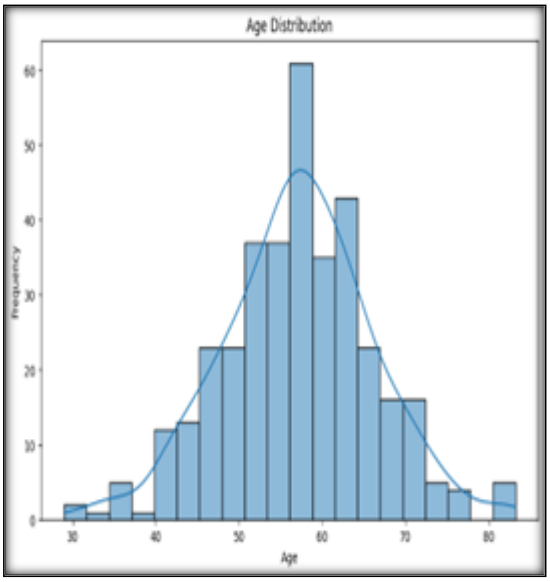




**Table 2**

| Angiographic findings | Total(50) | LAD(9) | LCX(11) | RCA(30) | P value | P value | P value |
|---|---|---|---|---|---|---|---|
| DOMINANCE | | | | | | | |
| Right | 43 (86%) | 9(100%) | 10(90.9%) | 24(80%) | 1.023 | 0.652 | 0.523 |
| left | 3(1.6%) | 0 | 1(9%) | 2(6.6%) | 0.544 | 1 | 0.101 |
| Co dominant | 4(8%) | 0 | | 4(13.3%) | 0.422 | 0.101 | 1 |
| SEVERITY OF DISEASE | | | | | | | |
| SVD | 3(6%) | 1(11.1%) | 1(9%) | 1(3.3%) | 0.354 | 1.266 | 0.122 |
| multivessel disease | 47(94%) | 8(88.8%) | 10(90%) | 29(96.6%) | 1 | 0.101 | 1 |
| CTO LESION | | | | | | | |
| ostial segment | 3(6%) | 1(11.1%) | | 2(6.6%) | <0.001 | 0.562 | <0.001 |
| proximal | 28(56%) | 4(44.4%) | 8(72.7%) | 16(53.3%) | 0.0732 | 0.398 | 0.142 |
| mid | 10(20%) | 4(44.4%) | 2(18%) | 4(13.3%) | <0.01 | 0.758 | <0.001 |
| distal | 9(18%) | | 1(9%) | 8(26.6%) | <0.05 | <0.05 | 0.786 |
| CTO-characteristics | | | | | | | |
| Blunt | 5(10%) | 2(22.2%) | 1(9%) | 2(6.6%) | <0.001 | <0.05 | <0.05 |
| calcification | 6(12%) | 4(44.4%) | 1(9%) | 1(3.3%) | <0.001 | <0.001 | 0.865 |
| tortuosity | 1(2%) | | | 1(3.3%) | 1.23 | 1 | 1 |
| bridge collaterals | 2(4%) | | | 296.6%) | 0.265 | 0.196 | <0.01 |

**Management and In-hospital Outcomes:** Majority of patients with CTO coronary lesions were managed with CABG (54%). PCI was chosen as method of reperfusion in 10% patients, while medical management was opted in 36% patients with CTO coronary lesions. The distribution of patients with respect to management modality showed no significant difference among patients with CTO lesions in LAD, LCx, and RCA. Procedure was successful in all cases. There were no instances of procedural complications. All patients remained event free at the time of discharge and no in-hospital mortality was reported in any patient.

| Management | Total | LAD | LCX | RCA |
|---|---|---|---|---|
| PCI | 5(10%) | 2 | | 3 |
| CABG | 27(54%) | 5 | 14 | 9 |
| OMT | 18(36%) | 2 | 3 | 13 |

## DISCUSSION

In this study CTO lesions mostly involved RCA vessels. Further, the mean age at presentation with CTO lesions in our study was 55 years, which is in lines with studies involving Indian population, but is comparatively younger than the mean age of 62–68 years reported in studies involving western population. Further, there was a male predominance (84%) among patients with CTO lesions. This is in lines with the global trend. We also observed that 94% of patients included in our study had multi-vessel disease. This finding is similar to previous published reports, confirming that CTO lesions are associated with an extensive atherosclerosis burden. In addition, our study also observed that patients with CTO lesions were more likely to have the presence of cardiovascular risk factors. In our study population,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hypertension, diabetes, dyslipidaemia, and smoking were present in 42%, 56%, 40% and 30% patients respectively.[6-8]

Analysis of clinical and angiographic characteristics of CTO lesions based on involved vessels revealed that patients with CTO lesions in RCA had significantly lower mean left ventricular ejection fraction as compared to those with LAD. Further, anterior-wall MI was the most common presentation among patients with CTO lesions in RCA. Distribution-wise, involvement of ostial segment was more common among patients with CTO lesions in RCA as compared to that in patients with CTO lesions in LCx. Presence of bridging collaterals was also significantly more common among patients with CTO lesions in RCA as compared to that in patients with CTO lesions in Lcx.[9,10]

On the other hand, patients with CTO lesions in LAD had significantly lesser number of smokers as compared to that in patients with CTO lesions in RCA. However, renal insufficiency was significantly more common among patients with CTO lesions in LAD as compared to that in patients with CTO lesions in RCA. Involvement of ostial, mid, and distal segments was also more common among patients with CTO lesions in LAD as compared to that in patients with CTO lesions in LCx. Lastly, the presence of blunt stumps as well as calcification was significantly higher among patients with CTO lesions in LAD as compared to that in patients with CTO lesions in LCx and in RCA. Patients with CTO lesions in LCx had inferior-wall MI as the most common presentation. CTO lesion in the distal segment of the vessel was also significantly more common among patients with CTO lesions in LCx as compared to that in patients with CTO lesions in LAD. Presence of blunt stumps, calcification, tortuosity, or bridging collaterals were least common among patients with CTO lesions in LCx.[11,12]

In our study, all patients with CTO received appropriate treatment according to the operating cardiologists. We observed that 54% patients were referred for CABG, while 1% patients were opted for PCI and 36% patients on medical therapy. This defines the severity of CTO lesions and its interventional challenge.[13]

Although the current indications and benefit of CTO-PCI remain a topic of controversy and debate, there is a growing body of evidences from various studies reporting favourable short-term and long-term outcomes of CTOPCI.

Successful CTO-PCI offers better tolerance in case of future acute coronary syndromes and can significantly improve angina and left ventricular function.

The distribution of patients with respect to management modality showed no significant difference among patients with CTO lesions in LAD, LCx, and RCA. Procedure was successful in all cases. There were no instances of procedural complications. All patients remained event free at the time of discharge and no in-hospital mortality was reported in any patient.

Retrospective study design can be considered as one of the major limitation of this study. A long-term clinical follow-up of clinical outcomes would have provided insights regarding the influence of CTO vessel and location on individual management modalities.

## CONCLUSION

The findings of this study have showed light on the complexity of various PCI procedures that will inform the physician and patients on the expected outcomes. Hence all the decision in medicine should be based on the risk/benefitratio. The documented benefit of CTO PCI is symptomatic betterment (ie, improvement in angina or angina equivalents). Consequently, for asymptomatic patients, CTO PCI should be considered for other indications, such as ischemia reduction or improvement in Left ventricular ejection fraction.

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