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Original Article

# Angiographic predictors of success in antegrade approach of Chronic Total Occlusion interventions in a South Indian population in the contemporary era

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ABSTRACT

Chronic Total Occlusion (CTO) intervention is a challenging area in interventional cardiology. Presently about 70% of CTO interventions are successful.

**Materials and methods:** This was a single center prospective study of a cohort of all patients undergoing percutaneous coronary intervention (PCI) as elective or adhoc procedure for CTO from August 2014 to June 2015. Only antegrade CTO interventions were included. In all patients the following data were recorded.

**Results:** A total of 210 (8.9% of total PCI (2353) during the study period) CTO patients were followed up. The mean age was  $56.54 \pm 8.9$ . In the study sixty nine patients (32.9%) presented with chronic stable angina and rest of the patients had history of acute coronary syndrome of which 22.9% (n = 48) had unstable angina (UA) or non ST elevation myocardial infarction (NSTEMI) and 44.2% (n = 93) had ST Elevation Myocardial Infarction (STEMI). In those with history of ACS, 64.78% (n = 92) had ACS during the previous year and remaining 35.22% (n = 49) had ACS prior to that. Single vessel CTO was seen in 89.5% (n = 188) and two vessel CTO in 10.5% (n = 22). LAD was involved in 36.7% (n = 77), RCA in 48.1% (n = 101), and LCX in 15.2% (n = 32). Procedural success in the first attempt was 68.1% (n = 143), which increased to 71.42% (n = 150) after the second attempt. CTO interventions were more frequently successful when the calcium was absent or minimal (p < 0.05), CTO length was < 10 mm (p < 0.01) and good distal reformation (p < 0.01).

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## 1. Introduction

Coronary chronic total occlusion is defined as an occluded coronary segment with thrombolysis in myocardial Infarction (TIMI) flow 0 for  $\geq$  three months duration.<sup>1,2</sup> In clinical practice, coronary CTOs are commonly encountered, with a prevalence rate of 18–52% among patients undergoing coronary angiography.<sup>3,4</sup> The clinical benefit of CTO revascularization continues to be debated. Several observational studies have shown that successful CTO revascularization improves cardiovascular outcomes.<sup>5,6</sup> A meta-analysis by Hoebbers et al. found that successful revascularization of CTO improved the left ventricular ejection fraction,<sup>7</sup> which is not supported by EXPLORE trial results though improvement in subgroup of patient with viable CTO territory was seen.<sup>19</sup>

The DECISION-CTO trial whose results were presented in ACC 2016 March showed that routine CTO-PCI+OMT is not superior to OMT alone in reducing cardiovascular outcomes among patients with at least one CTO and the management of CTO patients is still a matter of debate.

Chronic Total Occlusion intervention is a demanding area in coronary interventions. CTO interventions are cumbersome requiring more time and hardware and are more costly. CTO interventions have a higher rate of complications when compared to non-CTO interventions. However dedicated equipments and better techniques have kindled the interest in CTO interventions. High rates of success and low rates of complications are now achieved by expert operators, even in complex cases.<sup>8,9</sup> The PROGRESS CTO complications scoring is a new and useful scoring system for predicting complications in patients undergoing CTO PCI.<sup>18</sup>

The last European Society of Cardiology guidelines assigned only a class IIa (level of evidence B) to CTO PCI in 'patients with

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expected ischaemia reduction in a corresponding myocardial territory and/or angina relief,<sup>10</sup> which is reasonable in view of the recent results of DECISION CTO trial and Explore trial.<sup>19</sup>

The J-CTO registry (multicenter CTO registry in Japan) led to the development of J-CTO (Japanese Multicenter CTO registry) score to predict the likelihood of successful guidewire crossing within 30 min.<sup>11</sup> Independent angiographic predictors of failure (each given one point) that made up the J-CTO score included prior failed attempt, angiographic evidence of heavy calcification, bending within the occluded segment, blunt proximal stump, and occlusion length >20 mm. Chronic total occlusions were then graded as easy, intermediate, difficult, and very difficult (J-CTO scores of 0, 1, 2, and ≥3, respectively).

## 2. Materials and methods

The study was a prospective study of a cohort of all patients undergoing PCI as elective or adhoc procedure for CTO in the department of Cardiology Government Medical College, Thiruvananthapuram from August 1st 2014 to June 30th 2015.

### 2.1. Inclusion criteria

All patients undergoing PCI as elective or adhoc procedure for CTO in the department of Cardiology Government Medical College, Thiruvananthapuram from August 1st 2014 to June 30th 2015 were included in the study.

CTO was defined as a high-grade coronary occlusion with reduced antegrade flow (Thrombolysis in Myocardial Infarction [TIMI] grade 0 flow) with estimated duration of at least 3 months.

### 2.2. Exclusion criteria

Exclusion criteria included patients with an estimated CTO duration less than 3 months, CTO vessel size <2.5 mm, retrograde approach for CTO intervention, second or third attempt failed CTO interventions and second or third vessel CTO interventions of multi vessel CTO, in-stent total occlusion, status post Coronary Artery Bypass Graft surgery (CABG), Chronic Kidney Disease (CKD) with a baseline e GFR <30 ml/min/1.73 m<sup>2</sup>, retrograde approach for CTO, inability to take antiplatelets and left ventricular ejection fraction less than 30%.

### 2.3. Definitions

CTO was defined as a lesion showing a complete occlusion of the coronary vessel with antegrade TIMI 0 flow with an estimated 3 months or more duration.

Procedural success was defined as successful CTO recanalization with achievement of <30% residual diameter stenosis within the treated segment and restoration of TIMI grade-3 antegrade flow.

### 2.4. Procedure

All patients were pre-treated with aspirin and clopidogrel (a loading dose of 300 mg at least 6 h before the procedure). After the procedure, all patients were on dual antiplatelet therapy with aspirin and one of clopidogrel or prasugrel or ticagrelor. Baseline characteristics procedural and angiographic characteristics were recorded.

Peri-procedural complications were recorded and included coronary perforation with or without tamponade, heart failure (requiring NTG and diuretic), cardiogenic shock, sustained ventricular tachycardia (VT) and atrial fibrillation.

Immediate outcomes before the discharge of the patient which included death, ACS – STEMI, NSTEMI, unstable angina, stroke (ischemic/hemorrhagic), renal failure, need for urgent revascularization (PCI/CABG) and stent thrombosis and six month outcomes in terms of NYHA functional class of angina and dyspnea, death, ACS – STEMI, NSTEMI/UA, stroke-(ischemic/hemorrhagic), renal function, need for urgent revascularization (PCI/CABG), stent thrombosis, target vessel revascularization, heart failure requiring hospitalization, AF and sustained VT were recorded.

### 2.5. Data analysis

Continuous variables were analyzed by the student *T*-test, the discrete variables by chi-square test and paired ANOVA test wherever applicable. Statistical significance was assumed as  $P < 0.05$ .

## 3. Results

### 3.1. Baseline demographics

A total of 210 (8.9% of total PCI (2353) during the study period) CTO patients were followed up. The mean age was  $56.54 \pm 8.9$ . In the study sixty nine patients (32.9%) presented with chronic stable angina and rest o had history of acute coronary syndrome of which 22.9% (n=48) had unstable angina (UA) or non ST elevation myocardial infarction (NSTEMI) and 44.2% (n=93) had ST Elevation Myocardial Infarction (STEMI). In those with history of ACS, 64.78% (n=92) had ACS during the previous year and remaining 35.22% (n=49) had ACS prior to that. The base line patient characteristics are shown in Table 1.

Single vessel CTO was seen in 89.5% (n=188) and two vessel CTO in 10.5% (n=22). LAD was involved in 36.7% (n=77), RCA in 48.1% (n=101), and LCX in 15.2% (n=32).

### 3.2. Lesion characteristics

J-CTO score in the cohort was J- CTO < 1–13.3% (n=28) J- CTO = 2–50.5% (n=106), J- CTO > 3–36.2% (n=76). The lesion characteristics are shown in Table 2.

### 3.3. Procedural outcomes

Procedural success in the first attempt was 68.1% (n=143), which increased to 71.42% (n=150) after the second attempt.

The CTO interventions were more successful in younger patients and females. There were no difference in outcomes

**Table 1**  
Patient demographics.

		Frequency	Percentage
Age	≤60	133	63.3
	>60	77	36.7
Gender	Male	170	81.0
	Female	40	19.0
Diabetes mellitus	No	139	66.2
	Yes	71	33.8
Systemic Hypertension	No	100	47.6
	Yes	110	52.4
Smoking habit	No	111	52.9
	Yes	99	47.1

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