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Chronic Total Occlusion Intervention: Outcomes and clinical course of patients who experienced failure in their first attempt at revascularization of the chronic total occlusion.

Cardiology

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ABSTRACT

Background: Chronic Total Occlusion (CTO) intervention reattempts by percutaneous coronary intervention(PCI) after failed CTO interventions are now an established practice. What is the clinical course, reattempt rate and success in reattempts after a failed first CTO attempt? We documented the present real-world scenario.

Materials and methods: This was a single center, prospective, observational cohort study. It was conducted from August 1st 2014 to June 30th 2015 and followed up for a period of 6 months.

Results: Out of the 67 failed PCI CTO (total 210 PCI CTO patients) 14 (20.9%) patients had a second attempt PCI and 16 patients underwent CABG (25%) and the rest of the patients were on medical management. The success rate during CTO reattempt was 21.4% . In 57% (8 /14 patients), PCI attempt failed due to inability to cross the lesion with a wire. In 14.2 % (2/ 14 patients), a wire was passed across the lesion in the false lumen. Immediate complications of reattempt PCI were one case each of renal failure requiring medical management and heart failure requiring mechanical ventilation and two cases of sustained ventricular tachycardia.

Conclusions: Nearly a quarter of the patients with failed PCI in the first attempt had a repeat PCI attempt, another quarter of the patients underwent CABG. Nearly fifty percent of the patients with failed PCI were put on medical management .Success rate of repeat PCI using antegrade techniques for CTO intervention was low at 21% with low immediate complications. Retrograde and hybrid CTO techniques have to be utilized for better results.

KEYWORDS:

Reattempt PCI CTO, Failed PCI CTO , Chronic total occlusion, Antegrade approach.

INTRODUCTION

Coronary chronic total occlusions (CTOs) are defined as an occluded coronary segment with thrombolysis in myocardial infarction flow (TIMI 0) for ≥3 month's duration[1,2]. Coronary CTOs are commonly encountered in everyday catheterization laboratory practice, with a prevalence rate of 18–52% among patients undergoing coronary angiography[3]. Chronic Total Occlusion (CTO) intervention is a challenging area in coronary interventions. Revascularization of CTOs are among the most complex procedures in the realm of interventional cardiology.

High rates of success and low rates of complications are now achieved by expert operators, even in complex cases[4].Successful revascu larization of CTOs is associated with improved mortality even after adjusting for other factors that are associated with mortality[5] .Despite this, the last European Society of Cardiology guidelines assigned a class IIa (level of evidence B) to CTO PCI in patients with expected ischemia reduction in a corresponding myocardial territory and/or angina relief[6]. World- over presently about 70% of CTO interventions are successful. Incomplete revascularization results in increased morbidity and mortality[7].

Reattempts by percutaneous coronary intervention after failed CTO interventions are now an established practice. There are no guidelines on re-attempting to open a CTO. What is the clinical course, reattempt rate and success in reattempts after a failed first CTO attempt? The CTOI-K group attempts to document the present real-world scenario in a leading teaching hospital in South India. It is a sub-study of our prospective CTO study.

MATERIALS AND METHODS

This was a single center, prospective, observational cohort study. It was conducted from August 1st 2014 to June 30th 2015 and followed up for a period of 6 months. The study was conducted at the Department of Cardiology, Government Medical College, Thiruvananthapuram, India. As it is an Observational study 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

2.1 Inclusion criteria

All patients undergoing PCI for CTO by antegrade approach in the department of Cardiology Government Medical College, Thiruv ananthapuram from August 1st 2014 to June 30th 2015.

2.2 Exclusion criteria

Exclusion criteria included patients with an estimated CTO duration less than 3 months, CTO vessel size < 2.5 mm , in-stent total occlusion, status post CABG, Chronic Kidney Disease (CKD) with a baseline e GFR < 30 ml/min/1.73 m^2, retrograde approach for CTO, inability to take antiplatelets and left ventricular ejection fraction less than 30 %.

2.3 Definitions

CTO is 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

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

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. Sixty nine (32.9%) patients had chronic stable angina, 48(22.9 %) patients had UA/NSTEMI and 93 (44.2%) patients had previous STEMI

3.2 Success and failure in first attempt

Procedural success in the first attempt was 68.1 % (n=143). Procedural success was 77.9% (n=60) for LAD, 64% (n= 65) for RCA and 56.3% (n=18) for LCX (p = 0 .04).

The CTO interventions were more successful in younger patients and females. There is no difference among diabetics, hypertensives or smokers as given in Table -1

Table -1 Baseline demographics in successful and failed CTO interventions in first attempt

		First attempt					
		Success (N=143)		Failure (N=67)			
		N	%	N	%	N	P
Age	≤60	97	72.9	36	27.1	133	0.048
	>60	46	59.7	31	40.3	77	
Gender	Male	106	62.4	64	37.6	170	<0.001
	Female	37	92.5	3	7.5	40	
DM	No	89	64	50	36	139	0.077
	Yes	54	76.1	17	23.9	71	
HTN	No	65	65	35	35	100	0.359
	Yes	78	70.9	32	29.1	110	
PAD	No	143	68.8	65	31.3	208	0.038
	Yes	0	0	2	100	2	
F/H	No	123	66.8	61	33.2	184	0.302
	Yes	20	76.9	6	23.1	26	
Smoker	No	71	64	40	36	111	0.174
	Yes	72	72.7	27	27.3	99	

3.3 Symptom status after first attempt

Six month outcomes -Angina class improved in 18.8 % in failed PCI compared to 71.3% in those with procedural success (p <0.001) and dyspnea class improved in 25.5% (p <0.01) of those with failed PCI compared to 79.7% (p <0.001) those with procedural success. See table 2

Table 2: 6 month symptom improvement following first CTO attempt

	Successful CTO intervention n= 143	Unsuccessful CTO intervention n=48(19 of failed CTOs were revascularised before 6 months)	P value
Angina improvement	102 (71.3 %)	9 (18.8%)	<0.001
Dyspnea improvement	114 (79.7%)	12 (25.0%)	<0.001

3.4 Repeat intervention

Out of the 67 failed PCI CTO patients, 14 (20.9%) patients had a second attempt PCI and 16 patients underwent CABG (25%) and the rest of the patients were on medical management. See table 3

Table 3: Management strategy following failure of first CTO intervention

Strategy	
Repeat PCI	14 (20.9%)
CABG	16 (25%)
Medical Management	37(55.2%)

3.5 Baseline characteristics of patients who underwent repeat CTO intervention

14 patients underwent repeat CTO intervention. The mean age was 56.28 +/- 56.

All the patients were males. About 2/3rd had history of ACS 64.28% (n= 9) while rest had stable CAD. Baseline characteristics of patients who underwent repeat CTO and procedural succe and failure are given in Table 4

Table 4: Baseline characteristics of patients who underwent repeat CTO intervention

	Success N= 3	Failure N= 11
Age<60	2 (66.66%)	3(27.27%)
Age>60	1(33.33%)	8(72.72%)
DM	0(00.00%)	3(27.27%)
SHT	0(00.00%)	2(18.18%)
F/H	0(00.00%)	1(09.09%)
Smoker	2(66.66%)	9(81.81%)
Past ACS	0(00.00%)	9(81.81%)
CSA	3(100.0%)	2(18.18%)

3.6 Angiographic characteristics of patients who underwent repeat CTO intervention

The baseline angiographic characteristics were more complex with all the patients having a J- CTO score ≥ 3 in second attempt PCI as compared to the first attempt CTO see Table 5

Table 5: Angiographic characteristics of patients who underwent repeat CTO intervention

		Second attempt procedure				Total
		Success		Failure		
			%	N	%	N
TARGET VESSEL INVOVLED IN CTO	LAD	0	0.0	3	100.0	3
	RCA	2	22.2	7	77.8	9
	LCX	1	50.0	1	50.0	2
SIZE OF CTO VESSEL	2.5-2.9	1	16.7	5	83.3	6
	3.0-3.9	2	25.0	6	75.0	8
ENDING OF CTO	Blunt	3	23.1	10	76.9	13
	Tapering	0	0.0	1	100.0	1
SITE OF CTO	Ostial	3	75.0	1	25.0	4
	Proximal	0	0.0	5	100.0	5
	Mid	0	0.0	4	100.0	4
	Distal	0	0.0	1	100.0	1
CALCIUM	No	2	66.7	1	33.3	3
	Mild	0	0.0	3	100.0	3
	Moderate	0	0.0	4	100.0	4
	Severe	1	25.0	3	75.0	4
LENGTH OF CTO	<10	0	0.0	1	100.0	1
	10-20	2	50.0	2	50.0	4
	>20	1	11.1	8	88.9	9
COLLATERAL	Bridging	1	10.0	9	90.0	10
	Homo	2	50.0	2	50.0	4
DISTAL REFORMATION	Poor	3	30.0	7	70.0	10
	Good	0	0.0	4	100.0	4
SIDE BRANCH LESION	No	3	21.4	11	78.6	14

3.7 Procedural characteristics of re-attempt of CTO

The success rate during CTO reattempt was 21.4% (3/ 14 patients). In 57% (8 /14 patients), PCI attempt failed due to inability to cross the lesion with a wire. In 14.2 % (2/ 14 patients), a wire was passed across the lesion but it was in the false lumen. In one patient, the procedure had to be abandoned due to pulmonary edema

3.8 Complications of second attempt

Immediate outcomes of second attempt PCI were one case each of renal failure requiring medical management and heart failure requiring mechanical ventilation and two cases of sustained ventricular tachycardia. There was no death, myocardial infarction or stroke. In contrast, complications during first attempt PCI were peri- procedural myocardial infarction 4.8% (n=10), coronary perforation 8.1% (n=17), renal failure 5.7% (12) and heart failure 1.5% (n=3), There was no In hospital death, stroke, stent thrombosis and need for urgent revascularization see Table 6.

Table 6: Complications during second attempt compared to complications during second CTO intvervention attempt

Complications	First CTO intervention attempt	Second CTO intervention attempt
Peri procedural myocardial infarction	10 (4.8%)	0
Coronary perforation	17 (8.1%)	0
Heart failure	3 (1.5%)	1 (7.1%)
Ventricular tachycardia	0	2 (14.2%)
Renal failure	12 (5.8%)	1 (7.1%)

3.9 Symptom status after second attempt

Six month outcomes -Angina and dyspnea class both improved in 1

patient in successful PCI (n= 3,33%) while both improved in 4 patients in failed PCI group (n= 11, 36.36%).There was no significant difference between improvement in symptom status between these two groups

4. DISCUSSION

In a recent repeat CTO intervention publication of data from Japan, the success of re-intervention in CTO s was 82%[10]. It may be due to the higher utilization of retrograde techniques (63.8 % vs 28 % in the first attempt[10]) as well as hybrid techniques.

In this study only antegrade approach was considered, retrograde and hybrid approaches were not considered for this study and hence the procedural success rate was 21.1% which was considerably lower compared to other studies. [8,10]

All patients in this cohort had a J-CTO score ≥3 and hence the procedural success was low even by multiple expert operators in this high volume center

Reattempts were done by same operators and this might also be one reason for low success rates in this study as compared to Japanese registry data which also showed low success rate in those reattempts by the same operator (67.7% vs 87.9%). [10]

Anginal class improved in 18 .8 % and dyspnea class improved in 25% patients in failed PCI to CTO on medical management while there was no significant difference in MACE outcomes in those with successful and failed CTIO similar to other studies.[2,5,8]

Cardiac complications especially coronary perforations and periprocedural myocardial infarction were less in reattempts, probably because the operators had a lower threshold for advising CABG because they had already tried once unsuccessfully.

5. CONCLUSIONS

In a real world scenario in India, 32 % of antegrade CTO interventions ended in failure. Nearly a quarter of these patients with failed PCI in the first attempt had a repeat PCI attempt. Nearly another quarter of the patients with failed PCI in the first attempt underwent CABG. Nearly fifty percent of the patients with failed PCI were put on medical management. The success rate of repeat PCI using antegrade techniques for CTO intervention was low at 21%. Retrograde and hybrid CTO techniques have to be utilized for better results. The main complications were periprocedural renal failure and heart failure and the rates of complications were low.

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