Short Communication

Interventional Cardiology

Clinical effects of percutaneous coronary intervention of chronic total occlusion in noninfarct-related artery after acute myocardial infarction

Abstract

TThe success rate of Percutaneous Coronary Intervention (PCI) in coronary Chronic Total Occlusion (CTO) has improved with technical and technological progress, however, the clinical benefit of CTO PCI is still controversial. In this article, we summarize the clinical studies with long term follow up data investigating the effect of CTO PCI in noninfarct-related artery after acute myocardial infarction.

Keywords: Percutaneous coronary intervention • Chronic total occlusion • Acute myocardial infarction

Description

In the current era, the technical success rate of Percutaneous Coronary Intervention (PCI) of coronary Chronic Total Occlusions (CTOs) has achieved nearly 90%, along with the improvements in techniques, devices and operator's experiences, as well as the standardization of the procedure [1,2]. However, CTO PCI remains a controversial procedure as its clinical benefit remains to be determined. The Randomized Clinical Trials (RCTs) demonstrated improvement in Quality Of Life (QOL) [3,4] and relieved myocardial ischemic burden [5] in patients underwent CTO PCI compared with Optimal Medical Therapy (OMT), but failed to show recovery of regional wall motion or benefit on Major Adverse Cardiovascular Events (MACEs) in these patients [3-6]. Consequently, the recommendation level of CTO PCI in 2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization is IIB [7]. The results of the ongoing ISCHEMIA-CTO (Revascularization or Optimal Medical Therapy of CTO; NCT03563417) may add evidence to the benefit of CTO-PCI in patients with myocardial ischemia.

Recently, clinical studies focused on the effect of CTO PCI in non-culprit arteries of patients with Acute Myocardial Infarction (AMI), as patients with AMI and concurrent CTO had worse clinical outcomes compared with patients with AMI but without CTO [8]. Moreover, Fujimoto Y, et al. demonstrated patients with AMI with CTO in non-culprit arteries had worse clinical outcomes than those with 90% to 99% stenosis in non-culprit arteries during a median follow-up duration of 1.2 years [9], suggesting patients with CTO had more myocardial damage and early revascularization may be considered. However, the long term follow up results of EXPLORE trial failed to confirm the beneficial effect of early CTO PCI on MACE after ST-Segment Elevation Myocardial Infarction (STEMI) [10]. Instead, a significantly higher rate of cardiac death was demonstrated in patients randomized to CTO PCI [10]. The long term follow up data from the randomized EXPLORE trial seems to be contrary to the data from retrospective studies, which demonstrated lower rate of cardiac death in patients in CTO PCI group after AMI (Table 1) [11-14].

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Table 1: Clinical studies with long term follow up data investigating the effect of percutaneous coronary intervention of chronic total occlusion in noninfarct-related artery after acute myocardial infarction.

Authors	Year published	Study design	Area	Sites	Target	Number of patients	Group	Time interval after IRA PCI	MACE/MACCE definition	J-CTO score	Procedural success	Follow-up duration	Cardiac death	MACE/MACCE
Elias, et al. [10]	2018	Randomized clinical trial	Europe and Canada	14 centers	STEMI and concurrent CTO	302	CTO PCI vs. MT (n=148) (n=154)	5.0 ± 1.9 days	cardiac death, MI, and CABG	2 ± 1 vs. 2 ± 1	73%	Median 3.9 years	6% vs. 1% p=0.02	13.5% vs. 12.3% p=0.93
Valenti, et al. [11]	2014	Retrospective	Italy	Single center	STEMI and concurrent CTO	169	s-CTO vs. o-CTO (n=58) (n=111)	within 1 month	-	-	78.40%	Median 3.9 years	3.7% vs. 14.9% p=0.03	-
Choi, et al [12]	2016	Retrospective	Korea	9 centers	AMI and concurrent CTO	324	s-CTO vs. o-CTO (n=170) (n=154)	-	all-cause death, stroke, nonfatal MI, and any revascularization	-	-	Median 3.5 years	7.6% vs. 20.1% p=0.001	15.9% vs. 37.7% p<0.001
Yoshida, et al. [13]	2020	Retrospective	Japan	Single center	AMI and concurrent CTO	172	s-CTO vs. o-CTO (n=65) (n=107)	within 3 months	cardiac death, MI, and CABG	1(1-2) vs. 1(1-2)	73.90%	Median 4.1 years	19.0% vs. 51.9% p=0.004	22.7% vs. 57.1% p=0.0002
Cui, et al. [14]	2020	Retrospective	China	Single center	STEMI and concurrent CTO	287	CTO PCI vs. MT (n=91) (n=196)	8 (5-40) days	all-cause death, stroke, nonfatal MI, and unplanned revascularization	-	80.20%	Mean 6.1 years	4.4% vs. 16.8% -	22% vs. 46.9% p=0.002
Qin, et al. [15]	2022	Retrospective	China	Single center	AMI and concurrent CTO	330	CTO PCI vs. MT (n=198) (n=132)	within 1 year	all-cause death, stroke, nonfatal MI, and any revascularization	-	83.80%	Median 2.6 years	3.0% vs. 12.1% p=0.004	22.2% vs. 37.1% p=0.055

Abbreviations: IRA: Infarct Related Artery; PCI: Percutaneous Coronary Intervention; MACE: Major Adverse Cardiacvascular Event; MACCE: Major Adverse Cardiovascular and Cerebrovascular Event; STEMI: ST-Segment Elevation Myocardial Infarction; CTO: Chronic Total Occlusion; MT: Medical Therapy; MI: Myocardial Infarction; CABG: Coronary Artery Bypass Grafting; s-CTO: successful CTO; o-CTO: occluded CTO(MT and failed CTO PCI); AMI: Acute Myocardial Infarction

It should be noted that the procedural success (73%) in EXPLORE trial was relatively lower than that in retrospective studies published recently (>80%), which may cause underestimation of the value of CTO recanalization [14,15]. Furthermore, the early CTO-PCI (5.0 ± 1.9 days) after primary PCI in EXPLORE may aggravate inflammation and cause adverse left ventricular remodeling.

Conclusion

Therefore, a well-designed randomized clinical trial with reasonable time interval after Infarct Related Artery (IRA) PCI is required to show whether patients may benefit from CTO-PCI after AMI under contemporary techniques and experiences. As patients with AMI and concurrent CTO have high risk of clinical events, the sample size to demonstrate the effect of CTO PCI on hard end points will not be too big.

Nowadays, the technical issue in CTO recanalization is no longer a challenge. We need to identify the group of high-risk patients who will benefit from CTO-PCI in terms of hard cardiovascular outcomes.

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