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The impact of dissection and re-entry versus wire escalation techniques on one-year clinical outcomes in patients with chronic total occlusion

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Abstract
Three distinct degrees of assurance about occlusion length are defined in the Euro CTO club consensus statement. Without a doubt: The flow was verified to be TIMI grade 0 in an earlier angiography performed more than three months ago.Most likely: More than three months ago, a clinical diagnosis of acute myocardial infarction was made in the area of the blocked artery.Unknown: chronic total occlusion (CTO) with TIMI grade 0 flow and angiographic evidence of chronic occlusion; three months of stable angina symptoms have not improved. An epicardial coronary artery blockage with no antegrade flow, mature collaterals, no thrombus, no proximal cap staining, and a duration of three months or more is defined as a chronic complete occlusion (CTO) by the CTO Academic Research Consortium (CTO-ARC). The terms "intraplaque" (wire tracking inside plaque) and "extraplaque" (outside plaque but within adventitia) have been substituted for "true lumen" and "subintimal"(1) in the CTO-ARC paper. By doing away with the word "escalation" to represent both the escalation and de-escalation of wire tip-load, it creates two new categories for crossing techniques: antegrade wiring (AW) and retrograde wiring (RW).

Key words: Dissection **;** Re-Entry Versus Wire; chronic total occlusion

Introduction

Related definitions

Renalization with less than 30% stenosis and TIMI 3 flow is considered a technical success. Death and MI that occur while a patient is in the hospital are not considered procedure success criteria (1).

Epidemiology

The prevalence of chronic complete occlusions (CTOs) increases from 16-20% of CAD patients (2) to 54-89% after coronary artery bypass grafting (3). In 30% of patients with MI who had thrombolytic treatment prior to PCI, CTOs developed. Although these rates have dropped, 5-10% of individuals who have had a myocardial infarction still encounter CTOs after unsuccessful treatments (4).

Chronic total occlusions (CTO)

Table (1): CTO Criteria: Definite Versus Probable **(7)**

CTO criteria	Definition
Definite CTO	CTO with typical appearance and definitive corroborating evidence of occlusion duration ≥3 months.
Probable CTO	CTO with typical appearance

Anatomy of Chronic Total Occlusion

The adventitia, plaque, and vessel wall—all of which might be affected by occlusions—are the focal points of modern CTO-PCI.(٥) "intraplaque" refers to wire tracking within the occlusive plaque, whereas "extraplaque" refers to wire tracking outside of it, as per CTO-ARC's recommendations. The less accurate words "subintimal" and "true lumen" are replaced by this. There are still several techniques that allow the use of "true" and "false lumen" close to CTO caps.(٦)

Proximal Cap

An older occlusion will have a calcific, harder cap, and vice versa for the proximal cap. The cap is often softer on more recent occlusions (8). Blunt, tapering, or ambiguous proximal caps are the most common, and sophisticated imaging is necessary to clarify ambiguous caps (9), (10).

The Chronic Total Occlusion Body

Lesion length, calcification, and tortuosity increase DART procedure likelihood and complexity **(11), (12).**

The Distal Cap and Landing Zone

For re-entry during ADR, the distal landing zone (LZ) is used; it is situated beyond the distal cap and before a significant side-branch (13). There is an increased danger of dissection when bifurcations are close by. One should use a major retrograde method if the LZ is severely infected (14).

Collateral Supply

When doing antegrade operations or a retrograde approach, collateral vessels that feed the distal vessel aid in target visualization. Considerations for appropriateness include the collateral's diameter, tortuosity, angle, and its origin and trajectory. For difficult instances, a microcatheter-based selective imaging technique may be useful (15). Particularly when dealing with epicardial collateral channels,

the risk of complications during retrograde operations is increased (16), (17).

Clinical phenotypes and clinical manifestations

Clinical scenarios where chronic complete occlusions (CTOs) might be discovered include acute coronary syndromes (ACS), examinations for chest discomfort, and, more rarely, incidentally, coronary angiography performed prior to operations (18). A clear diagnostic pathway is established by exertional symptoms like angina, while asymptomatic individuals need a thorough assessment, often including modern imaging. Decisions on optimum medical therapy (OMT) or revascularization, with PCI or surgical alternatives, are impacted by factors such as age, fragility, comorbidities (such as valvular heart disease, aortic aneurysms, cancer treatment, cognitive impairments), and technical considerations. Older people with diabetes and a decreased left ventricular ejection fraction (LVEF) are the most common characteristics of CTO patients. The interruption of collateral flow worsens the prognosis in STEMI instances when a CTO impacts an artery that is not the cause. Consequences of CTO on the acute event in non-STEMI ACS are unclear. Prior to considering CTO revascularization, individuals with type 2 myocardial infarction should receive treatment for the acute trigger (19).

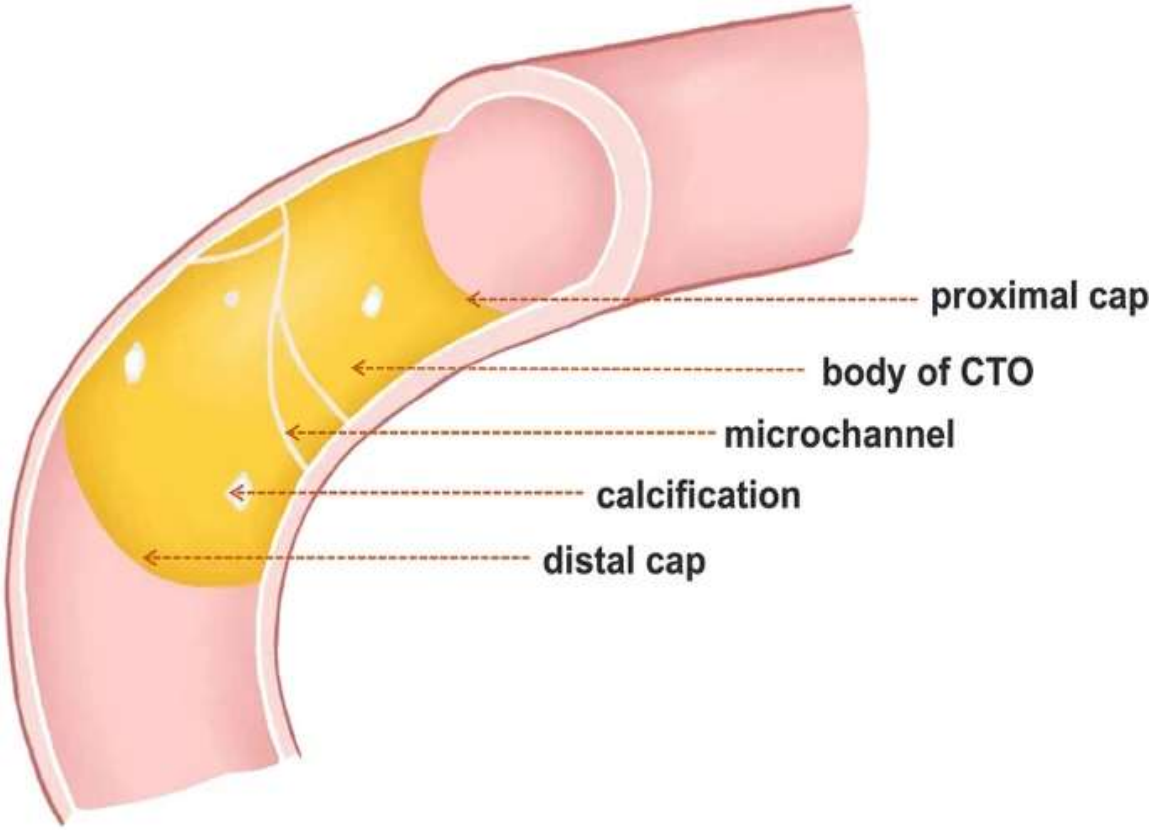

Fig. (1): The components of chronic total occlusion (CTO) lesions ***(10)***

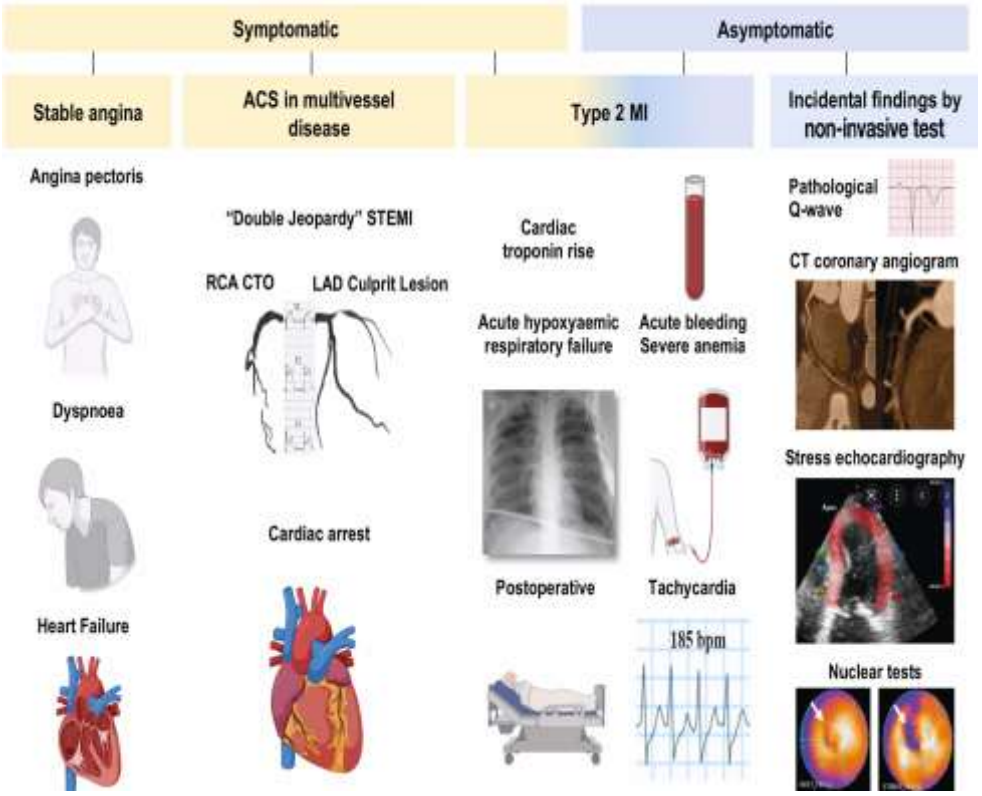

Fig. (2): Different clinical presentation modalities of patients with coronary CTO ***(II)***.

Imaging

Myocardial viability, coronary architecture, inducible ischemia, and the effects of revascularization on left ventricular remodelling may all be predicted with a thorough imaging workup in patients with coronary thromboembolism (22).

CCTA for diagnosing CTO lesions

The lack of contrast opacification on CCTA is a hallmark of CTO. However, because of its similarity to subtotal occlusion (STO), CTO might be difficult to distinguish owing to factors such as extensive calcification, low CT resolution, or linear enhancement. Diagnosis may be complicated by microchannels inside CTO, which can induce partial linear amplification and range in size from 100 to 500 μm. The prognostic and PCI planning processes rely on the identification of CTO.

Length

The most telling characteristic that differentiates CTO from STO is its length, which is usually more than 9 mm.

Although collaterals are less common on CCTA and get better with higher resolution, they are more common on STO lesions.(٤)

Attenuation-related signs

With TAG reflecting increases in attenuation on CCTA, distal vascular attenuation is larger than proximal attenuation in CTO (14).

Comprehensive assessment

Achieving a 92% accuracy rate in differentiating CTO from STO (5), combining CCTA signals increases diagnostic accuracy.

Management of CTO

Indications

For refractory angina or extensive ischemic regions, CTO PCI is recommended according to the 2018 ESC recommendations (19). Although percutaneous coronary intervention (PCI) is advised for certain patient populations, the ACC/AHA/SCAI recommendations for 2021 indicate unproven benefits in alleviating symptoms (6).

Patients with Symptoms and Myocardial Ischemia

When collateral circulation fails to provide sufficient myocardial perfusion, patients with CTO often experience unusual symptoms such as shortness of breath or extreme tiredness (7).

Patients with Reduced Left Ventricular Ejection Fraction (LVEF)

The presence of myocardial viability and an improvement in LVEF determines whether CTO recanalization is suitable (8).

Patients with Acute Coronary Event

CTOs in STEMI that are located in non-culprit arteries increase death rates and make treatment more difficult. Conflicting data on revascularization after STEMI has been found, with

some studies finding no substantial improvement on LVEF from PCI (8).

Procedural Planning

The success of a CTO PCI procedure depends on careful procedural preparation. To do this, it is necessary to acquire high-quality diagnostic angiograms, choose suitable crossing procedures, and carefully examine the results (3). It is vital to design the access location, particularly for complicated instances. In order to get the best possible results, it is crucial to think about mechanical circulatory support, the role of anesthesiology, and the reduction of contrast and radiation exposure (9).

Complexity Scores

Before deciding on a course of action for CTO PCI, it is essential to evaluate the intricacy of the anatomy. To forecast technical success and crossing difficulties, the J-CTO score (35). takes angiographic features such calcification and bluntness of the stump into account. In addition to guiding experienced operators' procedural planning, it is often utilized to compare results across various cohorts.(١٠)

Taking into account lesion features and approach type in CTO treatments, the PROGRESS-CTO registry (12) established ratings to forecast technical success and consequences.

Crossing Algorithms

Angiography often finds CTOs, but revascularization is seldom performed because of the high perceived failure rates. The Hybrid algorithm (2012) and other crossing algorithms have improved procedural success and decision-making (13), drawing on the work of groups such as the Asia Pacific CTO Club (2017), EURO-CTO (2019), and Japanese CTO-PCI specialists (2019).

Revascularization Strategies

Retrograde (from the furthest point to the nearest) and antegrade (from the nearest point to the nearest) methods are two CTO tactics. Wiring and dissection-reentry are two categories under which techniques fall. In order to determine where the wire is within the plaque, CTO-ARC suggests reporting the anticipated wiring approach and use intravascular imaging (14).

Anterograde Recanalization

First, antegrade dissection and re-entry; second, parallel wiring; and third, wire escalation and de-escalation are all components of antegrade wiring (AW), which is performed with the use of a microcatheter to ensure the best possible guidewire advancement and the avoidance of problems.(١٥)

In cases when direct antegrade wiring (AW) does not work, a second guidewire is inserted into the distal cap to serve as a reference, and a third guidewire is inserted into the subintimal region .(١٦)

The knuckle method and the Stingray balloon are devices used in antegrade dissection and re-entry (ADR) to re-enter the actual lumen and negotiate convoluted or calcified channels.(١٧)

Retrograde Recanalization

Retrograde methods, such as retrograde wiring or dissection and re-entry to traverse the CTO, should be attempted when anterograde methods fail owing to proximal cap ambiguity or poor distal vascular quality.

Complications

Complication rates from CTO-PCI are greater than those from normal PCI. These complications include mortality, stroke, myocardial infarction, and hemorrhage. Risk factors for CTO-PCI include age and chronic kidney disease (18).

Coronary perforation

The most terrifying consequence of CTO PCI is coronary perforation, which needs immediate attention with covered stents, embolization, or, in extreme cases, surgery (19).

Definitions of Efficacy End Points

Four forms of CTO-PCI success may be defined: crossing success (guidewire in true lumen), technical success (TIMI grade 2 or better flow), device success (particular device performance), and procedural success (technical success plus no in-hospital major adverse cardiovascular event). This classification helps to clarify the many aspects of CTO-PCI procedures. On occasion, multivessel disease may need repeat revascularization, most often transvenous angioplasty (20).

Conclusion

Delayed therapy may be necessary for full revascularization of distant arteries after CTO-PCI; this is often the result of remodeling or widespread illness. Adverse events do not occur during planned operations; nevertheless, if symptoms or problems cause unanticipated repeat revascularization, it is designated as TLR or TVR.

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