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C3 - Core Curriculum in Cardiology

Guidewire crossing techniques in coronary chronic total occlusion intervention: A to Z

Debabrata Dash [a,b]

[a] *Interventional Cardiologist, S. L Raheja (A Fortis Associate) Hospital, Nanavati Superspeciality Hospital, Mumbai, India*[1]

[b] *Guest Professor of Cardiology, Beijing Tiantan Hospital, Beijing, China*

ARTICLE INFO

Article history:
Received 2 January 2016
Accepted 24 February 2016
Available online 14 March 2016

Keywords:
Percutaneous coronary intervention
Chronic total occlusion
Antegrade approach
Dissection and reentry
Retrograde approach

ABSTRACT

Percutaneous coronary intervention (PCI) of chronic total occlusion (CTO) poses a management dilemma for the interventional cardiologist. Effective wiring technique is the key to success of PCI in CTO, which requires more patience and skill of the operator. The author herein intends to explore in detail the different wiring strategies such as antegrade approach, dissection and reentry, retrograde and hybrid approach. Hopefully, this review would enhance the understanding of this complex procedure and, consequently, promote safe and effective PCI.

1. Introduction

Percutaneous coronary intervention (PCI) of chronic total occlusion (CTO) is a well accepted revascularization procedure representing 10% of PCI procedure.[1–3] Effective wiring technique is the key to success of PCI in CTO.[4] However, success of wire crossing is mainly dependent on operator's experience and skill.[5] In this review the author elaborates the histopathology of CTO, basic and special wire techniques including anatomical consideration, fundamentals of wire handling and manipulation, and review of current CTO-PCI strategies such as antegrade, retrograde, and hybrid approach.

2. CTO structure: pathological and intravascular ultrasound (IVUS) findings

There are some important pathological and IVUS findings, which provide helpful information in crossing a CTO and performing optimal dilation after successful recanalization.[6,7] In the pathological studies, neovascular channels (NCs) with diameter of 100–200 μ are frequently found (85%) especially in CTOs older than 1 year. NCs in pre-existing plaque often connect with vasa vasorum in the adventitia; this is especially true in an old CTO with no well-defined stump, in which a guidewire can easily reach the subintima. Conversely, NCs that develop in old thrombus communicate with distal lumen

E-mail address: dr_dash2003@yahoo.com.

[1] Present address.

http://dx.doi.org/10.1016/j.ihj.2016.02.019

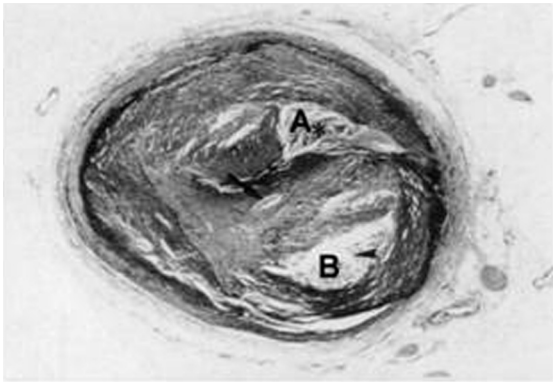

Fig. 1 – In this slice, two sections consisting of relatively scattered fibrous tissue (A, B) are seen. There are bundles between A and B. Though a guidewire tends to pass though relatively soft tissue like A or B, it is difficult for the guidewire to penetrate the fibrous bundle.

(recanalization channels); a tapered CTO on angiogram represents the CTO with these recanalization channels, which may serve as a route for the guidewire to reach the distal vessel.[8,9] Tissue composition in CTO consists of relatively soft tissues (composed by scattered fibrous tissue, lipid core, and NCs) and hard tissues composed by dense fibrous tissue and calcium. The dense fibrous tissue forms fibrous bundles not only cross-sectionally but also longitudinally, which partition soft tissues (Fig. 1). These partitions might restrict wire movement from one soft tissue plane to another and cause the wire to slip into a single soft tissue plane into the subintima to create a dissection plane.

Recent IVUS findings indicate that subintimal space made by a guidewire is a strong factor of unsuccessful recanalization of CTOs. A typical case with subintimal space indicated by IVUS is shown in Fig. 2. Once the subintimal space is created by a guidewire, the wire tends to slip into the space repeatedly and extend it along the circumference of media like E and F in Fig. 2. If this happens, it is difficult to reach the distal true lumen. The most difficult part of CTO procedure is to penetrate tissue at the distal end of CTO to reach distal true lumen. Recent IVUS findings also indicate a thick fibrous membrane rarely exists at a distal end of CTO in contrast to a proximal end. The major reason, why it is difficult to penetrate into the distal true lumen in spite of absence of the thick fibrous cap is considered to be the false lumen made around the distal true lumen by a guidewire as shown in Fig. 3.

2.1. *Antegrade loose tissue tracking*

Angiographically occluded lesions might contain loose tissue segments in both short and long duration CTO as suggested by histopathology and animal CTO model research.[8,9]

In the loose tissue tracking technique, the tip of an intermediate-strength wire is bent at 45–60° at the distal 1–2 mm, so that wire tip can be controlled and directed and it does not penetrate hard atherosclerotic plaque. Usually, the loose tissue tracking is performed with 1.0 g tip strength hydrocoated wire. The aspects of wire handling and movement in loose tissue tracking tend to be similar to acute myocardial infarction cases; in that, the wire is advanced easily and smoothly, with minimal rotations of the wire tip.[10,11] In case of failure of the intermediate-strength wires to pierce the space between loose and dense fibrous tissues, an over-the-wire (OTW) balloon or microcatheter can be advanced and the wire is exchanged for stiffer tapered tip end

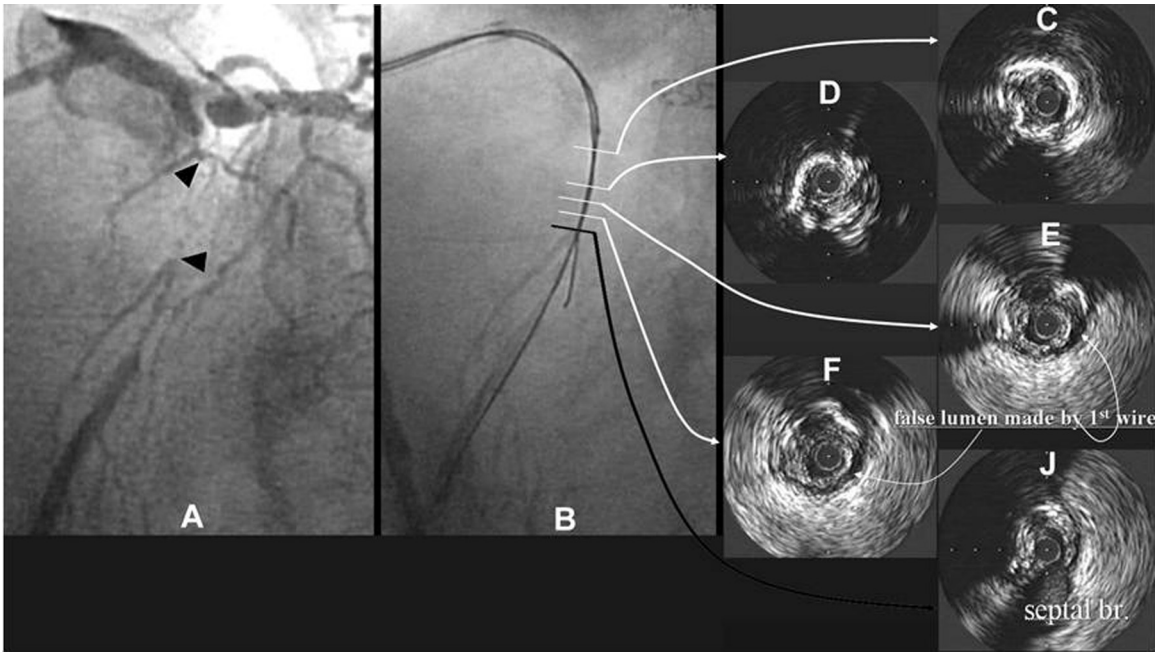

Fig. 2 – A typical case in which subintimal space was made by guidewire handling. After successful wiring (B), subintimal space was observed on IVUS (E and F). The major reason of the failed wire attempt was indicated to be calcification inside the CTO by IVUS.