Intravascular Imaging in Acute Coronary Syndrome Patients without Significant Stenosis on Coronary Angiography

Omnia Tajelsir Osman, Mohammed Ahmed Alhijji, Salaheddin Omran Arafa
Department of Cardiology, Heart Hospital, Hamad Medical Corporation, Doha, Qatar

ABSTRACT

Intravascular coronary imaging has facilitated the field of interventional cardiology with multiple studies showing the superiority of intravascular image-guided percutaneous coronary interventions for the reduction of lesion revascularization rates. It also aids in understanding the mechanism of myocardial infarction with nonobstructive coronary artery disease. Despite such results, there is a slow adaptation of intravascular imaging use in the real world. We present two cases where intravascular imaging helped in the rapid understanding of the etiology of acute coronary syndrome and facilitated the management of both patients.

Key words: Acute coronary syndrome, coronary angiography, intravascular imaging

INTRODUCTION

Since its introduction by André Cournand and Dickinson Richards in the 1940s,[1] angiography remains the clinical standard for coronary and peripheral vascular imaging to identify significant arterial narrowing and to guide coronary revascularization. Although angiography provides a highly useful picture of the vessel lumen, it offers only indirect information about the arterial wall. Intravascular imaging in the form of intravascular ultrasound (IVUS) and optical coherence tomography (OCT) provide direct visualization of lesions to understand their morphology, composition, plaque burden, and degree of luminal stenosis.

It also further enhanced our knowledge of the morphological features of stable and unstable plaque.[2] Multiple studies had shown superiority of intravascular imaging in stent results optimization leading to reduced need for recurrent revascularization (Ultimate and IVUS XPL). Given such evidence, American Heart Association and European Society guidelines provided Class II recommendation for the use of IVUS in the left main evaluation and intervention, stent optimization, and evaluation and treatment of in-stent restenosis.[3,4]

Despite these recommendations, intravascular imaging is not readily used in the real world, likely to the concern of additional cost added to the coronary angiography procedure and limited experience of operators.

We present two cases where intravascular imaging led to rapid diagnosis of etiology of myocardial infarction (MI) in patients with the nonobstructive coronary disease by angiography and facilitated management of their disease.

CASE PRESENTATIONS

Case 1
A 46-year-old male smoker without other cardiovascular risk factors developed acute severe substernal chest pain. The pain started 1 h before the first medical contact. His electrocardiogram (ECG) showed ST-segment elevation in the anterolateral leads (V1–V3, I, and AVL) with...
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reciprocal inferior ST-segment depression (II, III, AVF). The patient was loaded with 300 mg oral aspirin and 600 mg oral clopidogrel as well as intravenous fentanyl and sublingual nitroglycerin for pain control. On arrival to the hospital emergency department through ambulance his pain was less in severity and his ECG showed normal sinus rhythm and resolution of ST deviation [Figure 1]. Coronary angiography was done, which revealed only mild narrowing with subtle haziness in the proximal left anterior descending artery with hazy looking lesion and thrombolysis in myocardial infarction III flow [Figure 2a and b]. Further interrogation of the segment was performed using OCT demonstrating plaque erosion with mixed red and white intraluminal thrombi [Figure 3a-c]. The patient was, therefore, treated with direct stenting using second-generation drug-eluting stent appropriate to the vessel size without complications [Figure 3d]. The patient had uncomplicated hospital course and was discharged to home in 72 h.

Case 2
A 63-year-old female known to have Type II diabetes mellitus, hypertension, and dyslipidemia, presented to
the emergency department with epigastric and chest pain radiating to lower jaw and left arm associated with nausea. Physical examination was unremarkable. ECG showed sinus rhythm, left axis deviation, and poor R wave progression in chest leads [Figure 4]. Serial highly sensitive Troponin T was elevated from 6.0 to 107 ng/l, transthoracic echocardiography revealed normal global systolic left ventricular function (ejection fraction 61%). The patient was admitted and treated for non-ST elevation MI. Coronary angiography revealed a moderate 50% middle LAD hazy lesion. Given the patient presentation, the lesion was further interrogated using IVUS with the Eagle Eye Platinum Catheter. IVUS evaluation revealed severe stenosis with severe eccentric atherosclerotic plaque and small residual luminal area [Figure 5a and b]. The

Figure 3: Optical coherence tomography demonstrating atherosclerotic plaque (a) and mixed red and white intraluminal thrombi with plaque erosion (b and c respectively). (d) Coronary angiography in the RAO cranial view demonstrated excellent final result after stent deployment

Figure 4: Twelve-lead electrocardiogram showed normal sinus rhythm, left anterior descending, and poor R wave progression
patient was managed with direct stenting using drug-eluting stent appropriate to the vessel size without complication and TIMI III flow following the procedure [Figure 5c].

DISCUSSION

Intravascular imaging has been valuable in identifying etiology in individuals with MI with nonobstructive coronary arteries associated with ischemic pattern on cardiac magnetic resonance imaging by demonstrating plaque disruption and the presence of thrombus in infarct rather than noninfarct-related arteries. It is also recommended for the facilitation of the diagnosis of MI related to spontaneous coronary artery dissections as OCT frequently can demonstrate intramural hematoma or intimal flap. In both of our cases, IVUS and OCT provided additional crucial direct information for the rapid diagnosis of myocardial infarction etiology and facilitation of treatment.

While both imaging modalities provide direct visualization of coronary vessels, it is important to point out several differences between both technologies. OCT provides ten-fold higher axial resolution compared to IVUS (10–15 µm vs. 150 µm); therefore, it can be superior in identifying subtle morphological details such as malposition, stent fracture, residual thrombus, plaque prolapse, and residual dissections. This information is clinically useful in understanding and predicting stent failure. OCT will require complete elimination of blood from the lumen by contrast administration, which might be difficult in cases where the coronary flow is compromised. IVUS, on the other hand, can provide deeper penetration and therefore better suited to assess larger vessels such as left main and give the clear measurement of plaque burden. In cases were coronary vessels are tortuous and calcified, IVUS compared to OCT catheter might be more difficult as its 5F catheter is bulkier with a more rigid tip.

The majority of the existing clinical trials data relate to the use of IVUS guidance during percutaneous coronary interventions (PCI). Both ULTIMATE and IVUS-XPL demonstrated a significant reduction in the rate of target vessel revascularization.
with IVUS-guided drug-eluting stent implantation compared with angiography guidance, particularly for patients who had an IVUS-defined optimal procedure.\[9,10\]

In addition, there are multiple meta-analyses of randomized trials in bare-metal stents and drug-eluting stents era suggested better outcomes with IVUS guidance compared to angiography only guided PCI in terms of acute procedural results and reduced angiographic restenosis, repeat revascularization, and major adverse cardiac event, with no effect on death. MI.\[11-14\] Perhaps, superiority of intravascular imaging-guided PCI is related to the optimization of stent results by ensuring optimal coverage of coronary plaque, maximum stent expansion, wall apposition, and rapid diagnosis of stent complications such as stent fracture or edge dissections.

**CONCLUSION**

This case highlights the value of integrating intravascular imaging with coronary angiography to provide the proper diagnosis and management for patients presenting with acute MI without significant obstructive coronary artery disease.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.

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