

Intracoronary imaging

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Abstract

Background Intracoronary imaging modalities (IVUS and OCT) are being increasingly used to aid and attain optimal results during percutaneous interventions/angioplasties.

Case presentation We report three cases where intracoronary imaging was used in preprocedural lesion assessment and aided in optimization of angioplasty results.

Conclusion The reported cases underscores the significance and need of intracoronary imaging during complex interventions. Use of IVUS and OCT in the patients would benefit them by improving short term and long term outcomes.

Keywords Percutaneous interventions, Intracoronary imaging, Intravascular ultrasound, Optimal coherence tomography

Background

Interventions for coronary artery stenosis have evolved a long way since the first angioplasty done by Andreas Gruentzig in 1977. From balloon angioplasties, we have moved over to bare metal stents and then to drug eluting stents and even to bioresorbable scaffolds over the past three decades. A variety of interventional tools have been developed to aid in complex angioplasties/percutaneous coronary interventions (PCI) like novel guidewires, cutting and scoring balloons, rotaablation, orbital atherectomy, laser therapy etc. A novel addition to interventional cardiology is the use of intracoronary imaging.

Currently, two modalities of intravascular imaging are available for clinical use.

- (1) Intravascular ultrasound (IVUS)
- (2) Optimal coherence tomography (OCT)

Both IVUS and OCT are superior to angiography for quantification of vessel dimension and thus critically helpful in guiding coronary angioplasty, percutaneous coronary intervention (PCI) and stent implantation.

Intravascular imaging uses special catheters and miniature probes which are mounted and glided over coronary guide wires to visualize coronary arteries from within the lumen. This unique point-of-view picture, generated in real time, yields valuable information.

Intravascular imaging has greatly improved optimization of PCI by [1,3]

1. *Pre procedure assessment:* Identifies and measures vessel size (diameter), lesion length and severity. Helps in choosing correct stent sizes and choosing the optimal PCI strategy.
2. *Plaque characterization:* Identifies plaque characteristics (amount of lipid, fibrotic material, necrotic core, calcium, thrombus). Helps in understanding pathophysiology and choosing optimal PCI strategy.
3. *Post procedure assessment:* Identifies position and placement of stent. Identifies post stenting complications and helps to predict short term and long term outcomes. Improves procedural outcomes by achieving optimal results.

We report case examples where intravascular imaging was used to optimize our PCI results.

Case Presentation

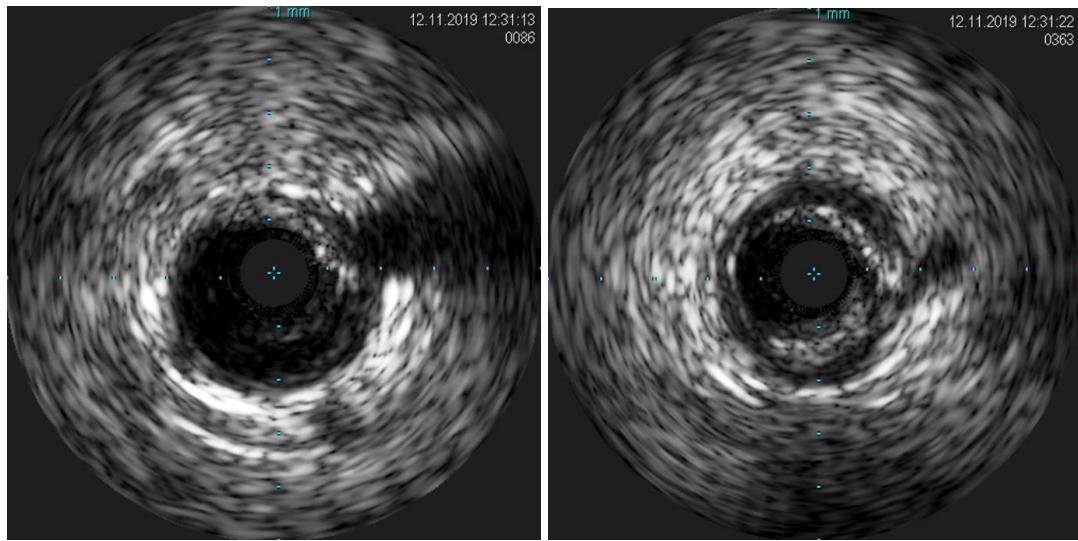
IVUS guided PCI

Intravascular ultrasound (IVUS) uses ultrasound waves to image the coronary vasculature. The received ultrasound signal is modified by the absorbing or reflecting characteristics of the tissue, generating greyscale two-dimensional cross sectional images [1,3]

Case number 1

A 57-year-old male, with past history of PCI to right coronary artery(RCA) presented with acute IWMI. Patient was thrombolysed and underwent coronary angiography which revealed 70–80% stenosis in the stent – instant restenosis (ISR).

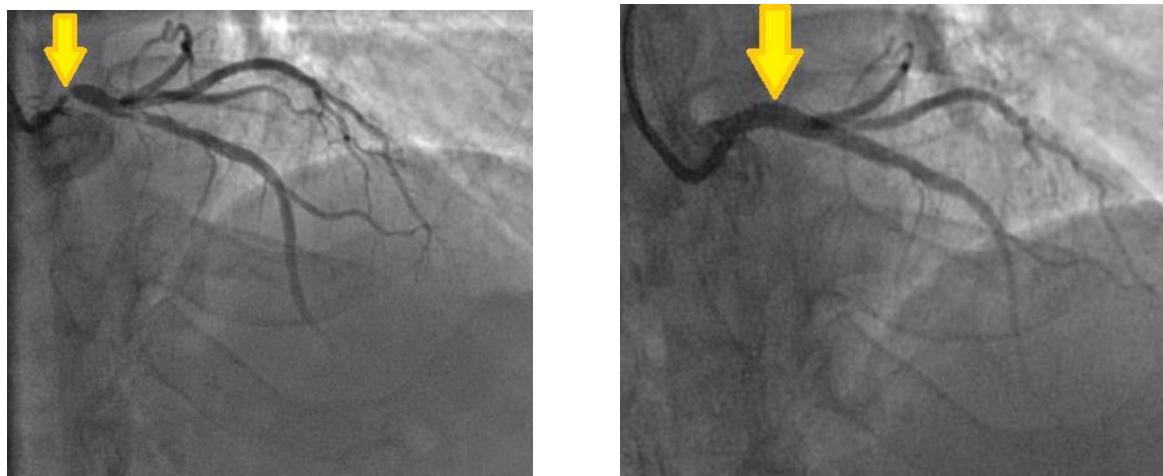
Patient underwent successful IVUS guided PCI to RCA. Pre stenting IVUS was done to demonstrate plaque characteristics, mechanism of ISR and vessel dimensions (**Figs. 1 and 2**).



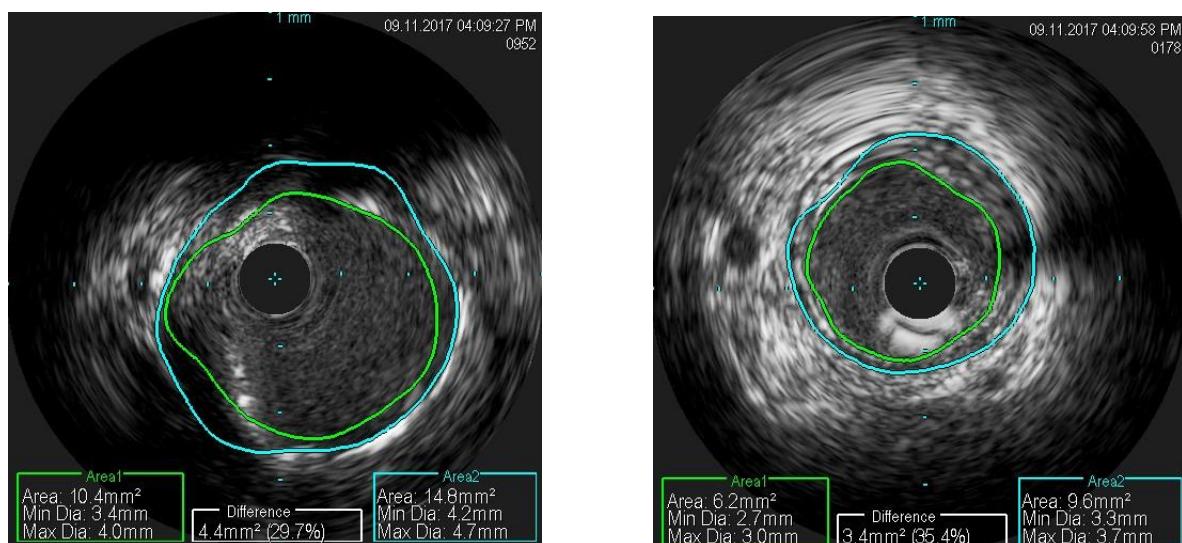
Figs. 1 and 2 IVUS shows cross sectional image of RCA demonstrating calcified plaque (1–3°clock position) and in-stent restenosis at distal edge of the stent with significant lumen narrowing.

Case number 2

A 58-year-old male, hypertensive presented with chest pain. He was diagnosed and treated for acute coronary syndrome – anterior wall infarction. Patient was thrombolysed elsewhere with streptokinase and referred to us for further treatment in view of ongoing chest pain, persistent ECG changes and cardiogenic shock. Patient was taken up for coronary angiogram which showed significant stenosis of left main coronary artery along with significant lesions in ostium of left anterior descending (LAD) and mid right coronary artery (RCA). Patient underwent a rescue PCI with second generation drug eluting stent placed from (left main coronary artery) LMCA to (left anterior descending) LAD. Post stenting IVUS (intravascular ultrasound) was done to confirm good stent apposition (**Figs. 3–6**).



Figs. 3 and 4 Pre stenting CAG showing critical ostial left main lesion and ostioproximal LAD lesion. Lesion is successfully treated by PCI.



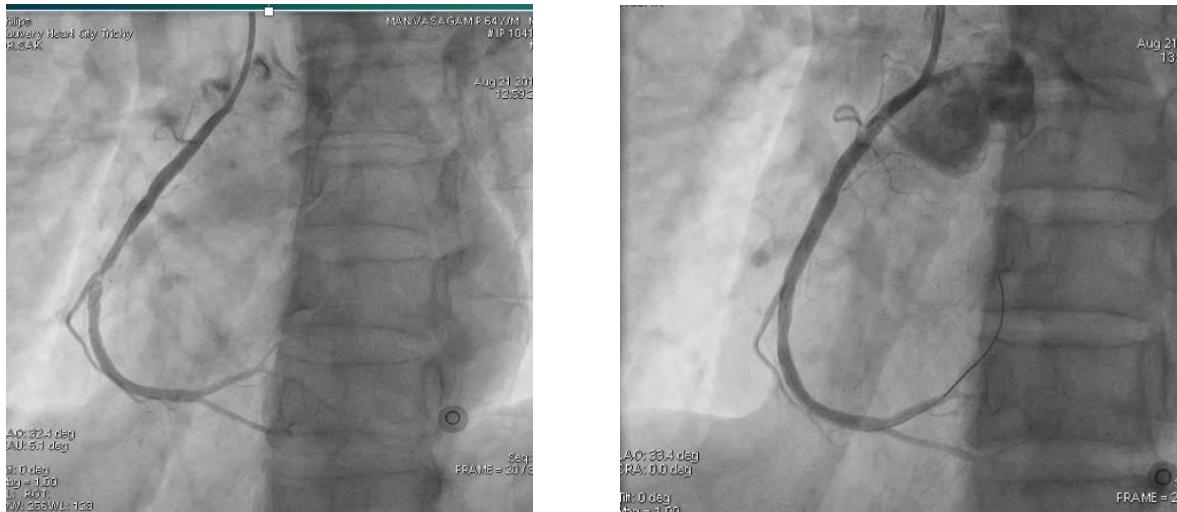
Figs. 5 and 6 Post stenting IVUS images showing good stent expansion in left main (**Fig. 4**) and ostioproximal LAD (**Fig. 5**). Measurements of stent expansion and vessel diameter (MSA and MLD) are made, which predict good short term and long term outcomes

OCT guided PCI

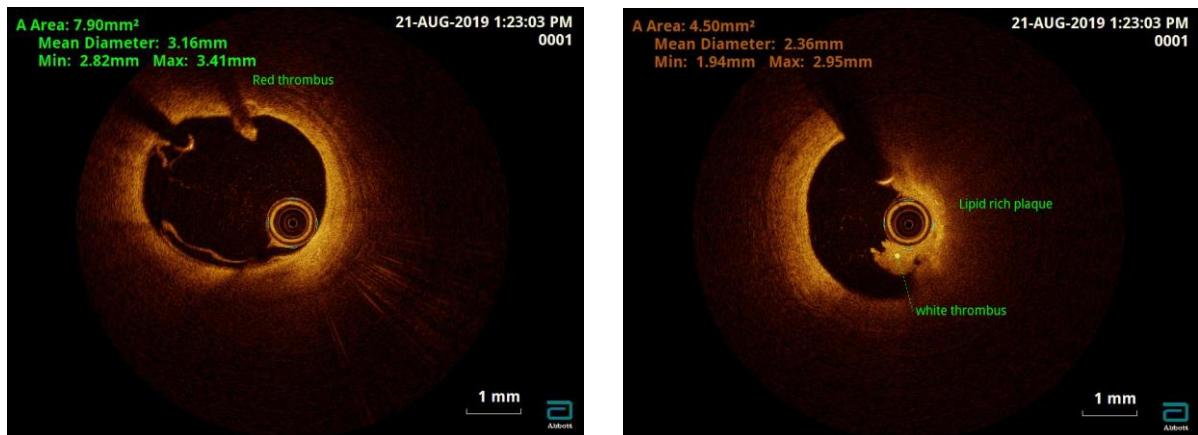
OCT uses infrared waves (in contrast to ultrasound waves in IVUS) to image the coronary vessel. Cross sectional images are displayed in orange red scale [1,3]. OCT has better spatial resolution but lesser penetration than IVUS. OCT helps to achieve stenting results with precision as the lumen is visualised in a magnified view.

Case number 3

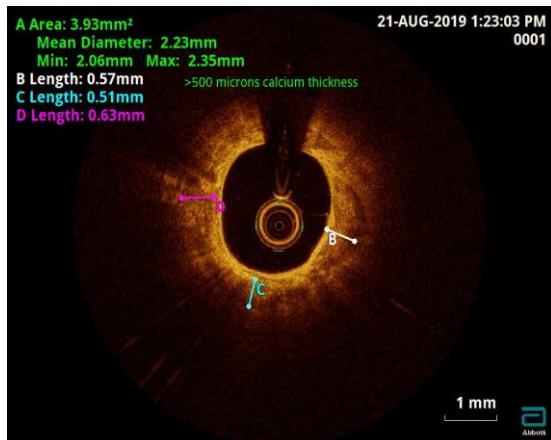
A 50-year-old male presented with IWMI. Patient underwent coronary angiogram which showed critical 90% stenosis of mid RCA. Patient underwent successful primary PCI to RCA under OCT guidance (**Figs 7–12**).



Figs. 7 and 8 Pre stenting angiogram showing significant stenosis in mid RCA. Post PCI showing good result.



Figs. 9 and 10 Pre stenting OCT images demonstrating plaque characteristics – ruptured lipid rich plaque with thrombus as the cause of IWMI.



Figs. 11 and 12 Pre and post stenting OCT showing increase in lumen area after stenting and good stent apposition.

Discussion

IVUS imaging in the first case demonstrated the possible aetiology of instent restenosis. IVUS demonstrated calcified plaque in the proximal portion and underexpanded stent in the distal edge which aided in further decision making to treat the lesion. These findings cannot be demonstrated by angiography.

IVUS in the second case, aided in optimizing the angiographic result by providing critical information on the degree of stent expansion, stent apposition and final lumen area achieved. These parameters studied by IVUS provide precise data about post stenting results and reflect good short and long term outcomes for the patient.

The third patient who underwent OCT guided PCI, where OCT demonstrated the plaque characteristics and mechanism of acute coronary syndrome. The post stenting images of OCT are predictive of excellent outcomes for the patient.

Intracoronary imaging is a useful adjunctive tool in improving PCI outcomes. The pitfalls and fallacies of angiographic assessment can be overcome by using intracoronary imaging. Several trials and data support the use of IVUS and OCT in selected scenarios to optimize PCI results [2] Current guidelines recommend the use of imaging during left main PCI interventions and elucidating mechanism of stent failure [1].

Conclusion

Intracoronary imaging has shown good promise in improving outcomes of PCI. Intracoronary imaging in selected patients, in adjunct to angiographic assessment will result in better outcomes. Our cases demonstrate the usefulness of these modalities.

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Author contributions

We, S. Aravindakumar, P. Vijay Shekar and Suraj Narasimhan were involved in performing the procedures and data collection. P. Vijay Shekar drafted and edited the manuscript.

Competing interests

The authors have no competing interest to declare.

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