India Live 2023

HOW EFFECTIVE IS FRACTIONAL FLOW RESERVE AT GUIDING THE TREATMENT OF CORONARY ARTERY DISEASE?

Dr Kirti Punamiya, Mumbai

Unlike coronary angiography alone, fractional flow reserve (FFR) assists interventional cardiologists in accurately determining whether coronary atherosclerotic plaques are responsible for myocardial ischemia and needs to be revascularized. FFR is unparalleled in diagnostic performance compared to nonhyperemic indices and noninvasive techniques. It continues to be the gold standard for the detection of ischemia-inducing coronary stenoses. FFR-guided percutaneous coronary intervention (PCI) is reported to be superior to angiography-guided PCI and over medical therapy alone.

FAME 2 trial investigators demonstrated that in patients with stable coronary artery disease (CAD), FFR-guided PCI, compared with medical therapy alone, improved the outcome. A meta-analysis supported current guidelines advising FFR-guided PCI strategy for CAD. FFR-guided PCI was associated with lower major adverse cardiac events/major adverse cardiac and cerebrovascular events (MACE/MACCE), death myocardial infarction (MI), repeat revascularization, and death or MI than angiography-guided PCI strategy. Revascularization guided by FFR in patients with CAD and stenoses >50% yields better outcomes than revascularization based on a visual analysis of angiographic stenosis severity alone. DEFER and FAME trials have shown that in patients with stable CAD, conservative management of stenoses that could be angiographically severe but are not hemodynamically relevant is safe.

FFR is, therefore, an important tool to guide treatment in CAD.

DECIPHERING THE ROLE OF STENT DESIGN AND POLYMER – FROM ACUTE TO LONG-TERM RESULTS

Dr Aloke Finn, USA

Drug-eluting stents (DES) differs in thromboresistance, which is an important requirement for short-term dual antiplatelet therapy (DAPT). Under aspirin and clopidogrel monotherapy in the porcine arteriovenous (AV) shunt model, XIENCE^{TM} stent showed the lowest amount of platelet aggregation and inflammation in shunt models compared to leading biodegradable polymer stents as well as permanent polymer DES. When considering short-term DAPT, the capability of thromboresistance in individual stents is important. Those differences of thromboresistance in stents may require a different duration of DAPT for each type of stent. The results of XIENCE 28 and 90 lend further support that short-term DAPT with the XIENCE^{TM} stent is feasible and safe. The results of STOPDAPT-2 ACS suggest ACS patients per se should continue on DAPT for at least 6 to 12 months if feasible. Long-term outcomes with XIENCE^{TM} remain good in part because of the stability of the PVDF-HFP polymer and its effects on coronary inflammation.

ARE YOU APPROACHING THE GRAY ZONE?

Dr TS Kler, New Delhi

Fractional flow reserve is considered the gold standard in invasive hemodynamic assessment of epicardial coronary artery stenoses. FFR informs the clinician about how much the blood flow is reduced and can be improved after revascularization. For instance, an FFR of 0.60 means that coronary blood flow is 60% of what should be in the absence of epicardial stenosis, and it could improve by 40% after PCI. FFR is highly reproducible, has an unsurpassed spatial resolution, and is easy to measure during diagnostic coronary angiography. FFR ≤0.75 has a 100% positive predictive value, while FFR >0.80 has more than 95% negative predictive value for reversible myocardial ischemia at noninvasive functional testing. In the era of DES, the threshold of 0.80 was adopted in the FAME 1 and 2 trials to guide clinical decision-making since, in a minority of patients, an FFR value between 0.75 and 0.80 has been found to be associated with typical exercise-induced-angina and reversible flow maldistributions. Revascularization of coronary stenosis with FFR ≤0.80 has been associated with improved clinical outcomes in randomized trials and routine clinical practice. For patients in the 'gray zone', i.e., FFR values of 0.75-0.80, physician decision-making informed by all clinical information (e.g., anginal symptoms and noninvasive evidence of ischemia) is especially important.

A recent study revealed that in comparison with low-FFR lesions (<0.75), those in the gray-zone FFR (0.75-0.80)

are less likely to have improvement or more likely to have impairment in flow after PCI. The findings suggested that the index of microcirculatory resistance measurement may help identify lesions in the FFR gray zone that are most likely to improve. FFR measurements represent a continuum of ischemic values, and a single dichotomous threshold oversimplifies the answer to whether a lesion should be revascularized.

OLD FRIEND DES, NEW BUDDY BRS AND CAMERAMAN OCT

Dr Girish B Navasundi, Bengaluru

Metallic DES remain in arteries permanently. They not only increase the likelihood of adverse outcomes but also increase the risk of comorbidities if additional procedures need to be done in the same artery. However, a more recent kind of stent known as a bioresorbable scaffold (BRS) offers a transient scaffold to the lesion to re-establish blood flow; however, after the vessel blockage is treated and healing is complete, the BRS completely dissolves, leaving the artery in its natural state with no foreign residue. Earlier, there were multiple limitations associated with the first-generation BRS, such as:

- Increased strut thickness
- Lack of radiopacity
- Need for special storage requirements
- Increased risk of late ST
- Limitation of size matrix.

However, the new generation BRS is more advanced than the first-generation BRS and offers special features, such as:

- Hybrid cell design
- 100 μm strut thickness
- High vessel conformability
- Optimal side branch access
- Estimated degradation in 2 to 3 years
- 1.2 mm low-profile delivery system
- Low balloon overhang
- Short, abrupt balloon overhangs.

"*Stents are used in the procedure to provide a scaffold for the lesion, not to provide lumen gain*".

IVUS – IMAGE ARTEFACTS

Dr Arun Mohanty, New Delhi

Artefacts in intravascular ultrasound (IVUS) imaging are an infrequently inevitable phenomenon due to the inherent limitations of the ultrasound modality itself. In most cases, it is brought on by external electrical interference, which can be caused by the number of equipment placed in the lab.

On the other hand, near-field artefacts can be classified into:

- Air bubble artefacts
  - Air trapping in the sheath of the IVUS catheter
  - Primarily responsible for poor imaging quality.
- Ring down artefacts
  - Bright halo of variable thickness caused by the interference of rotating piezoelectric crystals in the catheter
  - Produced by acoustic oscillations in transducers
  - Creates a zone of uncertainty adjacent to the transducer surface
  - Common in the solid-state system.
- Blood speckle artefacts/stagnant flow
  - Intensity of blood speckle artefacts increases with the frequency of the catheter
  - Stasis produced by the interference is most visible when a catheter is across a tight stenosis.

But it has to be pointed out that reverberations caused by air bubbles are easily avoidable by saline flushing the IVUS catheter before use, whereas contrast flush can help in dealing with the stagnant flow.

There are several other types of artefacts, such as:

- Shadowing artefacts can be caused by calcium, stent or guidewire. As a result of the shadow effect, analysis of the vessel behind the artefact becomes difficult.
- Guide catheter artefact.
- Catheter motion artefact can be divided into the catheter to-and-fro motion artefact and nonuniform rotational distortion (NURD).
- Side lobe artefact
  - Intense reflections of the side beam from the edge of strong reflectors, such as calcium and stent, which forms the image along with the original image
  - Follow the circumferential sweep
  - Mistaken for malapposition or dissection.
- Transducer position artefact
  - Mostly seen in large and tortuous vessels
  - Can cause vessel folding and catheter eccentricity.

Hence, it is essential to recognize the artefact to get a true image of the situation and proceed with the correct treatment. Other key points to remember are:

- Air in the catheter is one of the most common avoidable artefacts.
- NURD can be avoided by a larger size guide, proper care of the hemostatic valve and catheter alignment.
- Measurement error due to the catheter to-and-fro motion or angulation must be considered for device sizing.

LEFT MAIN INTERVENTIONS – PCI OR CABG?

Dr Samin Sharma, USA

Patients with obstructive left main coronary artery (LMCA) disease have often been treated with coronary artery bypass grafting (CABG). The EXCEL trial has, however, shown that PCI with an everolimus-eluting stent is a suitable and less invasive option in patients with a SYNTAX score <32. There was a significant difference between PCI and CABG in terms of the 30-day incidence of procedural MI. Large MIs, including ST-segment elevation MIs, were more common with bypass surgery than with PCI.

A systematic review and meta-analysis suggested that PCI and CABG may be reasonable approaches to revascularization in patients with significant LMCA stenosis and predominantly low to intermediate CAD complexity. Patient preference should be considered regarding the risks of periprocedural complications of surgery and long-term repeat revascularization after PCI. Patients with low surgical risk may benefit from CABG; however, if a patient is not a good candidate for surgery or wishes to avoid the morbidity associated with CABG, PCI is a reasonable option.

RENAL ARTERY STENOSIS

Dr Atul Mathur, New Delhi

Renal artery stenosis (RAS) is a frequently encountered problem in clinical practice. A wide range of diagnostic modalities and treatment approaches for RAS is available to clinicians. With the advent of endovascular interventions, selecting the best course for a given patient has only become more challenging.

This disease encompasses a broad range of pathophysiologies, the most common being fibromuscular dysplasia and atherosclerotic renal artery disease. Depending on the degree of narrowing, patients can develop renal vascular hypertension. The results of several trials, including ASTRAL, EMMA, SNRASCG and DRASTIC, are debatable. Renal angioplasty can reduce systolic and diastolic pressure.

If the patient has indications for renal angiography, it must be done. The ongoing CORAL trial gives hope and shows a positive expectation for renal stenting. Available evidence has supported stenting in RAS in reducing blood pressure, improving the management of refractory hypertension, and preserving or improving renal function.

OPTIMIZING THE FUTURE OF YOUR ACS PATIENTS: MORE STENTS OR MORE PILLS?

Dr Robert Jan Van Geuns, Rotterdam, Netherlands

It is challenging to select between stents or a pill. But regarding the MACE rate after ACS, a study published in 2015 showed that the risk of a recurrent event after 3 years was around 20%. However, another study titled RENOVATE-COMPLEX-PCI showed that intravascular imaging-guided PCI would reduce target vessel failure compared to angiography-guided PCI in treating patients with complex coronary artery lesions.

Meanwhile, another study published in the *New England Journal of Medicine* showed that increased pills improved the MACE rate after ACS. According to the study, 1 mmol/L reduction in low-density lipoprotein (LDL) reduced the event by more than 20%. But the researchers of the study observed a very low adherence rate to statins. They found that over 50% of people do not stick to or use statins.

Hence, based on the inferences taken from the following studies, it was concluded that:

- Optimize your PCI results with selected imaging (IVUS/optical coherence tomography [OCT])
- Selective stenting of bystander lesions (FFR)
- Optimize your secondary preventions with intensive medications.

ANGIOGRAPHY VS. OCT TO GUIDE PCI

Dr Sarita Rao, Indore

Angiography-guided PCI has considerable limitations. On the other hand, the superior spatial resolution of OCT can provide meaningful clinical benefits.

A recent study determined the effect on long-term survival of using OCT during PCI. The cohort study was based on the Pan-London (United Kingdom) PCI registry. OCT was used in 1.3% of patients, IVUS was used in 12.6% of patients, and angiography alone in

the remaining patients. OCT-guided procedures were associated with greater procedural success rates and reduced in-hospital MACE rates.

A significant difference in mortality was observed between patients undergoing OCT-guided PCI (7.7%) compared to patients who underwent either IVUS-guided (12.2%) or angiography-guided (15.7%) PCI, with differences noted for both elective and ACS subgroups.

This large observational study suggested that OCT-guided PCI was associated with improved procedural outcomes, in-hospital events and long-term survival in comparison with standard angiography-guided PCI.

OCT-BASED CALCIUM SCORING ALGORITHM

Dr Takashi Akasaka, Japan

Coronary artery calcification is becoming more prevalent and severe with up to 25% of individuals, or 1 in 4, having moderate to severe calcium. Coronary artery calcifications severely affect PCI outcomes if identified and mistreated. Several studies have shown that calcified lesions limit stent expansion, which is a major predictor of stent failure, such as stent thrombosis and restenosis.

Hence, OCT imaging makes it possible to visualize and quantify the characteristics of coronary calcification, which helps determine the best method for lesion preparation. In addition, OCT enables assessment and optimization of stent deployment including treatment of underexpansion and edge dissections. The advantage of OCT in coronary calcification quantification has led to a scoring system to predict stent under expansion and consequently stent failure.

OCT calcium score: An OCT-based calcium scoring algorithm that measures calcium depth can be used to find calcific lesions that would benefit from plaque reduction prior to stent insertion. This method examines the calcium length, calcium angle and thickness, which are some of the most crucial metrics used to forecast the success and necessity of calcium modification devices.

- Thickness >0.5 mm
- Angle >50% vessel arc
- Length >5 mm.

Evaluation of calcium thickness is key in predicting stent expansion. In OCT, the light can penetrate calcium thus evaluate its thickness. In cases with heavily calcifies lesion:

- OCT allows to demonstrate the position, distribution and thickness of the calcium.
- OCT-based calcium scoring system from 0 to 4 maximum calcium angle, maximum calcium thickness and calcium length should be useful to decide the procedure for getting enough stent expansion by making calcium plate fracture.
- Calcium plate fracture can be made by high pressure ballooning with noncompatible scoring or cutting balloon if the thickness of the layer is <500 μm.

RENOVATE TRIAL

Dr Rony Mathew, Ernakulam

Imaging-guided PCI is the future of interventional cardiology. Newer data related to clinical outcomes after intravascular imaging-guided PCI for complex coronary artery lesions, compared with outcomes after angiography-guided PCI, is needed to establish the integration of imaging in PCIs.

"RENOVATE-COMPLEX-PCI" is a new study recently presented in ACC 2023 that investigated whether **Imaging-guided PCI** using IVUS or OCT would improve clinical outcomes compared with **Angiographic-guided PCI** alone in patients with complex coronary artery lesions. One thousand six hundred thirty-nine patients were randomized in a 2:1 ratio of imaging and angiography-only PCI guidance and were followed to a median of 2.1 years.

Highlights of the clinical study results

- Across the study, the primary endpoint of target vessel failure was met (OCT/IVUS 7.7% vs. Angio alone 12.3%, p = 0.008 at 3 years).
- Intravascular imaging-guided PCI was linked to a 37% lower incidence of target-vessel-related MI or death from cardiac causes than angiography-guided PCI.
- In a non-randomized comparison between the two imaging types, OCT showed a numerically lower rate of events (5.8% vs. 8.0%) than IVUS.
- An exploratory sub-analysis of the study, reported in the *NEJM* supplement, showed that stent optimization led to better results, and OCT had a numerically better stent optimization rate.

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