Healthy Heart

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Honorary Editor :
Dr. Tejas V. Patel

From the Desk of Hon. Editor:

Dear Friends,

Over the past decade, Fractional flow reserve (FFR) measurement has been increasingly used in cardiac catheterization laboratories. FFR is considered nowadays as the gold standard for physiological assessment of any coronary lesion and that's why it is an indispensable tool for decision making in coronary revascularization. In borderline or intermediate coronary lesions, use of FFR accurately identifies which lesions should be stented. Deferral of PCI or CABG in patients with FFR >0.80 appears safe. I hope this article will update you regarding the basic concept of FFR and its application from a practical point of view.

Warm regards,

- Dr. Tejas V. Patel

FFR: When & Why? – Paradigm Shift to Functional Angioplasty

RATIONALE FOR THE USE OF FFR

Revascularization of ischemia-producing coronary lesions with percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) surgery is recommended in the management of coronary artery disease (CAD). A severe coronary artery stenosis can limit myocardial blood flow, resulting in myocardial infarction. In most cases, the severity of a coronary artery stenosis is judged by visual inspection by the cardiologist during coronary angiography. A lesion is generally considered severe and flow-limiting if the narrowing of the luminal diameter is estimated to be 70% or greater. But for borderline or intermediate coronary lesions (usually when 40-70%), stress tests like TMT, stress ECHO or SPECT nuclear scan help to decide for revascularization.

FFR is another such tool used in cath lab to know functional significance of any coronary lesion. If the coronary stenosis is borderline or intermediate, FFR measurement is helpful to decide for revascularization. The use of FFR measurement provides the cardiologist with a straightforward, readily available, quantitative technique for evaluating the physiologic significance of coronary lesions.

WHAT IS FFR?

Fractional flow reserve (FFR) is a special technique used by cardiologist in cath lab to measure pressure difference across a coronary artery stenosis. FFR determines whether the stenosis is functionally significant to produce myocardial ischemia and requires revascularization (PCI or CABG).

Basically, FFR measurement is the ratio between the mean pressure distal to a lesion in coronary artery [Pd] and the mean aortic pressure (mean pressure proximal to the lesion in coronary artery) [Pa]. The distal and proximal pressure

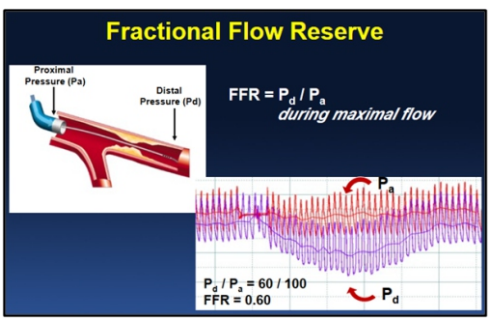
measurements are taken during the period of maximum hyperaemia.

FFR = Pd/ Pa during maximum hyperaemia

Pd- mean pressure in coronary artery distal to the lesion

Pa- mean aortic pressure (mean pressure proximal to the lesion)

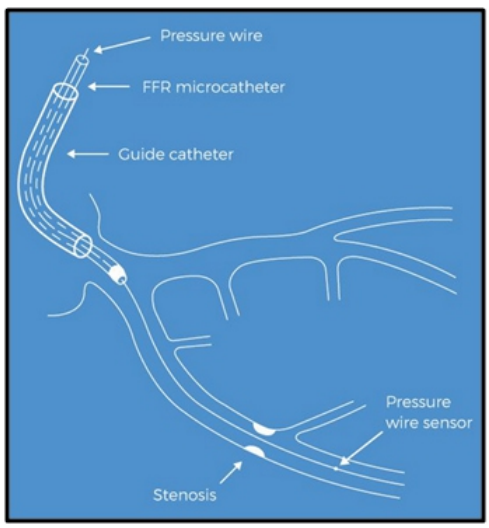
The normal ratio is expected to be 1. Any value <1 is abnormal; for example, an FFR value of 0.80 means that a given stenosis causes a 20% drop in the pressure in the coronary artery. In other words, the maximum blood flow in the coronary artery is 80% of what it would be if the artery were completely normal.



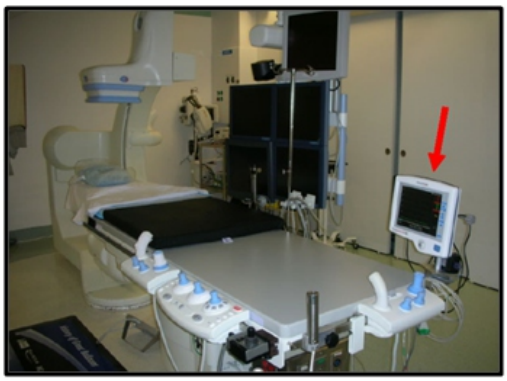
HOW FFR IS MEASURED IN CATH LAB?

FFR is a special guide wire based technology; that wire contains pressure sensor near the tip (3cm proximal from the tip). FFR wire can directly measure pressure of the artery and it can be used through routine angioplasty catheter. It is inserted through routine transradial or transfemoral approach. The guide wire is connected to the FFR system and its monitor; and calibrated before measurements. In coronary artery, the wire is advanced distal to the coronary stenosis and it measures pressure inside the artery distal to the stenosis. Pressure measurement is done after creating maximum hyperaemia in the coronary artery.

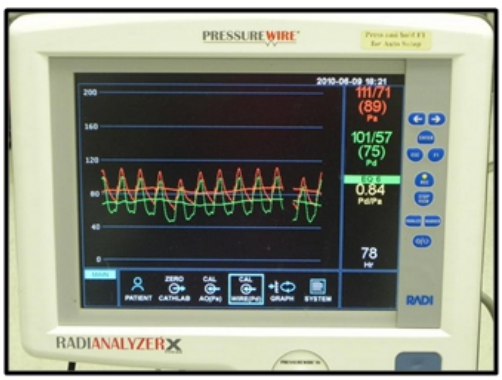
Maximal hyperaemia is achieved by dilation of both the epicardial and microvascular arteries. Epicardial vasodilation is achieved by intracoronary administration of Nitroglycerine. Various pharmacological agents have been used to induce microvasculature vasodilation; most commonly used agent is Adenosine. Adenosine is used either intracoronary or as intravenous infusion at a rate of 140 micg/kg/min.



Graphical demonstration of how FFR is measured in cath lab



FFR unit (arrow) in cath lab



Monitor showing Pd and Pa tracing. FFR is 0.84.

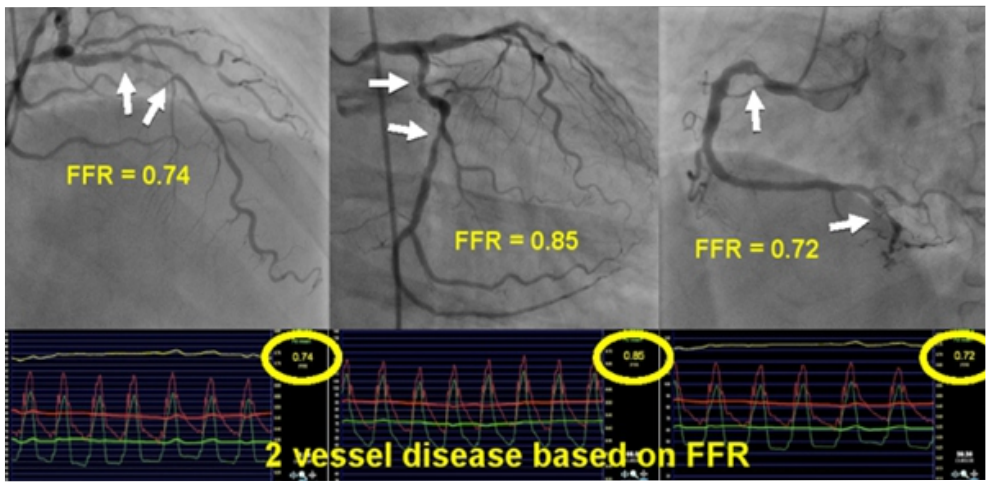
INDICATIONS OF FFR

The most common indication for measuring FFR is evaluating an intermediate stenosis to assess whether it is responsible for myocardial ischemia and to decide for revascularization. FFR measurements can save patients from undergoing unnecessary procedures.

Indications for FFR measurement are as follows:

- To determine the physiologic and hemodynamic significance of an angiographically borderline or intermediate coronary stenosis (usually when 40-70% stenosis)

- To identify appropriate culprit lesion(s) in multivessel coronary artery disease
- To measure the functional importance of stenosis in the presence of distal collateral flow
- To identify the precise location of a coronary lesion when the angiographic image is unclear



FFR in multivessel CAD: FFR is helpful to detect hemodynamically important obstructions within the coronary arteries [significant lesions are those with FFR <0.75] and is helpful in guiding for PCI or CABG

FFR is now considered the gold standard for guiding percutaneous or surgical coronary revascularisation with class IA European Society of Cardiology (ESC) and class IIA American Heart Association (AHA) practice guideline recommendations.

WHAT FFR VALUE DEFINES ISCHEMIA?

Normal value of FFR is 1.0. Coronary stenosis can be arbitrarily classified into 3 groups on the basis of FFR values as mentioned in below table.

FFR value		
1.0	Normal	
>0.80	Non-ischemic stenosis	Deferral of revascularization is safe
0.75-0.80	Gray zone	
<0.75	Ischemia-producing stenosis (significant stenosis)	Revascularization (PCI or CABG) is recommended

LIMITATIONS OF FFR

In acute coronary syndrome (NSTEMI or STEMI) FFR measurement is not reliable due to micro-vascular dysfunction as well as endovascular injury results in a pro-coagulant and pro-inflammatory state. The clinical impact of these changes on FFR measurements in non-culprit stenosis in ACS is, however, minimal.

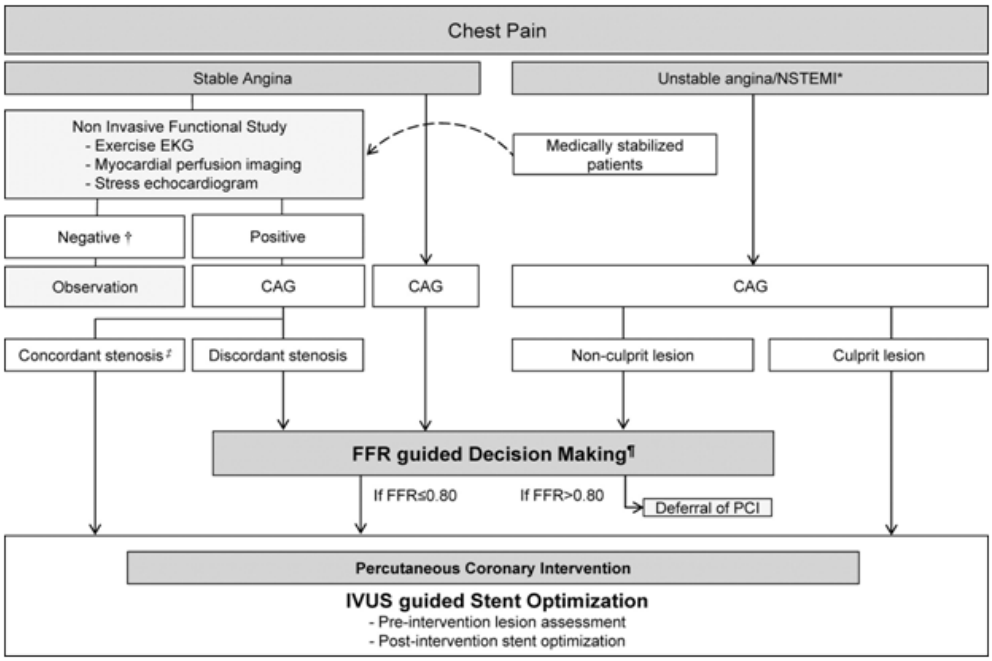
FFR - WHAT IS THE EVIDENCE?

Role of FFR to guide in various clinical situations has been seen in various randomized clinical trials. In landmark DEFER study, which assessed patients with single-vessel CAD and angiographically borderline coronary stenosis, patients with an FFR above 0.75 were randomized to either medical management or stent implantation; at 5-year follow-up, those who did not receive a stent had the same risk of death or acute MI as those who did, which suggests that patients with an FFR > 0.75 do not benefit from revascularization of the stenosis and can safely put on medical management.

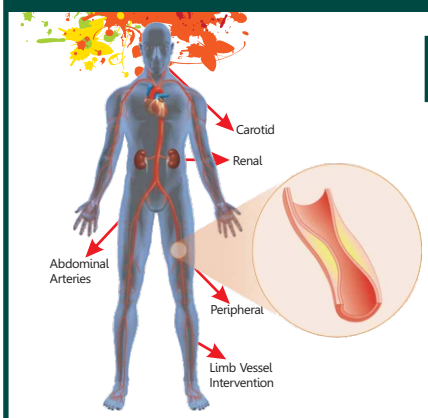
The Fractional Flow Reserve versus Angiography for Multivessel Evaluation (FAME) study, another landmark study, demonstrated the role of FFR in the evaluation of multivessel CAD. The results suggested that a revascularization strategy using FFR yields superior clinical outcomes in patients with multivessel CAD.

FUNCTIONAL ANGIOPLASTY: INCORPORATION OF FFR INTO CLINICAL PRACTICE

Functional angioplasty means ischemia guided appropriate angioplasty with integrated use of FFR and IVUS [Intravascular Ultrasound] for optimal result. In other words, FFR can be used to determine the functional significance of a stenotic lesion. Much clinical evidence indicates that use of this dedicated invasive functional method may help to select appropriate patients and lesions for revascularization, avoid unnecessary procedures, achieve reductions in medical costs, and improve clinical outcomes of patients.



Algorithm of functional angioplasty



Endovascular Peripheral Workshop

with

Dr. Ramesh Gowda

Mount Sinai Beth Israel & Brooklyn hospital (USA)

August 26, 2016

PATIENTS WHO ARE ELIGIBLE :

- Carotid Artery Stenosis
- Renal Artery Stenosis
- Acute Limb Ischemia
- Critical Limb Ischemia
- Varicose Veins
- Dialysis Access Procedures
- Pulmonary Embolism
- Thoracic Outlet Syndrome
- Uterine Fibroids
- Vascular Malformations
- Venous Insufficiency and Venous Ulcers
- Claudication
- Femoropopliteal Disease
- Brachiocephalic Arterial Disease
- Venous Thromboembolic Disease
- Thoracic Abdominal Aortic Aneurysms
- Mesenteric Disease
- Catheter-Based Interventions for Failing Hemodialysis Accesses
- Infrapopliteal Peripheral Arterial Disease
- Intracranial Arterial Stenotic Disease
- Vertebral Arterial Disease

Kindly refer your PVD, AAA patients for consultation (complimentary) and intervention.
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Radial Artery as a Coronary Artery Bypass Conduit

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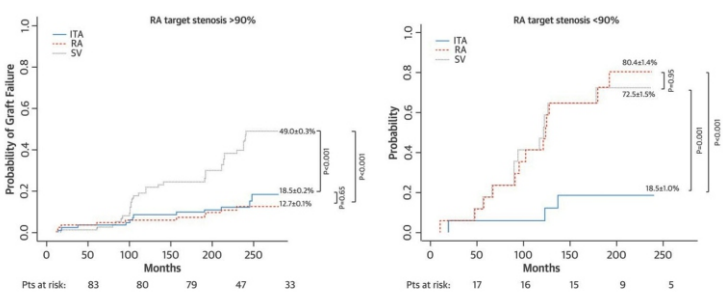
J Am Coll Cardiol. 2016;68(6):603-610. doi:10.1016/j.jacc.2016.05.062

20-Year Results Since the reintroduction of the RA as a conduit in coronary surgery in the early 1990s , its morphofunctional features, biological properties, and vasoreactive profile of RA grafts have been mostly elucidated . The early and intermediate angiographic patency rates have been published (2), and the Radial Artery Patency and Clinical Outcome trial should be reporting its 10-year angiographic and clinical results this year. There is growing evidence that the patency rate of the RA is better than that of the SV . The RA contends with the right ITA for the role of the second artery for CABG, and is probably a better choice in patients at high risk of sternal complications .

Despite that, the RA is markedly underused. In a recent report from the Society of Thoracic Surgeons Adult Cardiac Surgery Database, this conduit was used in slightly more than 5% of all primary isolated CABG procedures performed in the United States from 2000 to 2009). Possible reasons for this underuse are the lack of very-long-term data and concerns regarding accelerated atherosclerosis of the ulnar artery after RA removal .

To date, only 1 group has reported a RA follow-up of >10 years. Acar's group (who rediscovered the RA in the 1990s) reported their 20-year experience in a cohort of 563 patients. At a 9.2-year mean follow-up, freedom from overall and cardiovascular death was 80.3% and 92.7%, respectively. Angiographic follow-up was obtained in 351 patients at a mean interval of 7.0 years from surgery, and the RA patency rate was 87.9%. In patients with the longest follow-up interval, the RA patency rate was 81.4% at 13.1 years .



In our series, the RA patency rate in the group of patients who reached the 20-year follow-up was 84.8%, with a perfect patency rate of 72.7%. The status of the graft remained substantially stable in the very long term, with only 2 occlusions occurring between the 10- and 20-year control studies in the group of patients who underwent both . Overall, the long-term patency rate of the RA was not statistically different than that of the gold standard ITA.

Confirming previous observations , we found a strong correlation between the severity of the target vessel stenosis and the RA patency. When the RA was used to revascularize target vessels with =90% stenosis, the patency rate of the conduit was similar to that of the left ITA, whereas for a lower degree of coronary stenosis, the angiographic outcome was more similar to that of the SV .

As in our previous reports , the location of the target vessel did not influence the graft outcome. In fact, the circumflex and right coronary artery distributions had similar RA graft patency rates .

Conclusions

The 20-year angiographic outcome of RA conduits used for CABG is not inferior to that of the gold standard left ITA. The status of the artery remains stable during the very-long-term follow-up. The location of the target vessel does not influence graft status, whereas the severity of the coronary stenosis is a major determinant of patency. Finally, after harvesting of the RA, the ulnar collateral circulation provides sufficient flow to the arm and clinically evident forearm or hand ischemia never occurs, even at extended follow-up.

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