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FRACTIONAL FLOW RESERVE: AN EXPERIENCE OF 100 PATIENTS AT AFIC-NIHD

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ABSTRACT

Objective: To evaluate the importance of Fractional Flow Reserve (FFR) in decision making in coronary revascularization in moderate lesions.

Methodology: A retrospective descriptive study was conducted at Armed Forces Institute of Cardiology (AFIC) /National Institute of Heart Diseases (NIHD) from June 2008 to December 2012.A total of 100 consecutive patients who underwent FFR were assessed. These were the cases in which decision regarding percutaneous coronary intervention (PCI) was difficult on visual assessment alone. A 0.014″ FFR wire was used and pressure gradients across the lesions were noted. Post procedural follow up was done at six months telephonically for symptoms of angina and heart failure and further treatment was planned accordingly.

Results: A total of 100 patients whose coronary artery lesions were assessed by FFR were analyzed. The mean age was 54.5±8.9 years. Male patients were 89 (89%). The mean FFR score obtained was 0.84. In 25% of patients (n= 25) the coronary stenosis was found to be clinical significant (FFR < 0.80) and in 75% of the patients (n=75) the coronary stenosis was not significant (FFR > 0.80). Based on the above results revascularization was done in 25 patients (21 PCI with stenting and 4 with coronary artery bypass graft surgery). Medical treatment was advised in 75 patients with FFR > 0.80. Only one patient in the >0.80 FFR group required stenting during follow up because of progression of disease and the rest were stable on medical treatment.

Conclusion: FFR is important tool in guiding PCI in moderate lesions.

Key Words: Fractional Flow Reserve (FFR), Percutaneous Coronary Intervention (PCI), Moderate Lesions

INTRODUCTION

Myocardial ischemia secondary to coronary artery disease is associated with increased morbidity and mortality.[1] Any stenotic lesion in the coronary vessel that induce ischemia if revascularized improves clinical outcome.[2] On the contrary revasularization of non ischemic stenotic lesion is not associated with any benefit and medical therapy alone provides similar clinical benefit.[3]

The advent of drug eluting stents have revolutionized the percutaneous coronary interventions of coronary lesions. Because drug-eluting stents are expensive and are associated with potential late complications, their appropriate use is critical.[4] However, in patients with multivessel coronary artery disease, determining which lesions cause ischemia and warrant stenting can be difficult. Noninvasive stress imaging studies are limited in their ability to accurately localize ischemia-producing lesions in these patient and visual estimation of stenosis on coronary angiography can over estimate or under estimate the stenosis.[5,6]

Fractional flow reserve (FFR) is a pressure-wire–based index that is used during coronary angiography to assess the potential of a coronary stenosis to induce myocardial ischemia. It can be easily measured during coronary angiography by calculating the ratio of distal coronary pressure measured with a coronary pressure guidewire to aortic pressure measured simultaneously with the guiding catheter. FFR in a normal coronary artery equals 1.0. An FFR value of 0.80 or less identifies ischemia-causing coronary stenoses with an accuracy of more than 90%.[7] Defering PCI in patients with non-significant stenosis as assessed by FFR is associated with improved outcomes than stenting those lesions.[8,9]

The objective of this study was to determine the role of FFR in patients with moderate coronary stenosis undergoing coronary angiography.

METHODOLOGY

A retrospective descriptive study was conducted at Armed Forces Institute of Cardiology (AFIC) /National Institute of Heart Diseases (NIHD) from June 2008 to December 2012. Patients of both gender and of any age who had undergone coronary angiography with fractional flow reserve were selected from computer data base. FFR measurement was done using a 6F guiding catheter inserted via the femoral or radial artery. FFR was measured by a small sensor on the tip of a 0.014″ PTCA guidewire (Volcano therapeutics Inc, Rancho, Cordova, USA). This determines the exact gradient across the lesion. FFR can be measured both at rest and during maximal blood flow or hyperemia which can be induced by injecting intra-coronary and I/V adenosine in an appropriate dose. A pullback can also be performed and pressures are recorded across the lesion. A value of less than 0.80 was regarded as significant stenosis.

Patients undergoing FFR in our institute undergo post procedure telephonic clinical follow up at six months and patients are questioned about symptoms of angina or heart failure. Those patients who have these symptoms are called to the hospital for further management.

Data was analyzed using SPSS version 14.

RESULTS

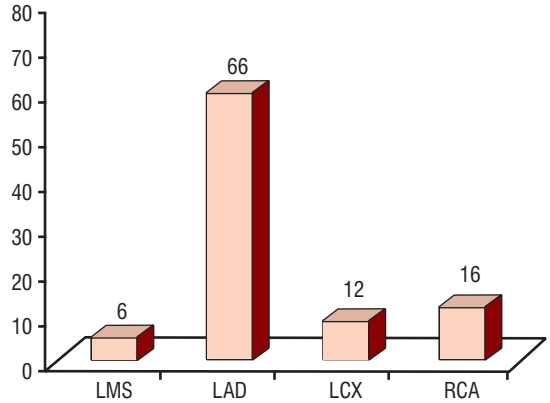
A total of 100 patients whose coronary artery lesions were assessed by FFR were analyzed. The mean age was 54.5±8.9 years. Male patients were 89 and 11 patients were female. Baseline Characteristics are shown in Table 1.

Table 1: Baseline Characteristics

Variables		Percentages (n)
Gender	Male	89% (89)
	Female	11% (11)
	Age in year	54.5±8.9
	Hypertension	80% (80)
	Diabetes	40% (40)
	Smoking	60% (60)
	Hyperlipidemia	30% (30)

The coronary arteries assessed by FFR are shown in Figure 1.

Figure 1: Number of Vessels Assessed by FFR



LMS=Left Main Stem, LAD=Left Anterior Descending Artery, LCX= Left Circumflex Artery, RCA=Right Coronary Artery

In 25% of patients (n= 25) the coronary stenosis was found to be clinical significant (FFR < 0.80) and in 75% of the patients (n=75) the coronary stenosis was not significant (FFR > 0.80)

Table 2: Individual Coronary Artery Assessment by FFR and its Management (Total Patient, n=100)

FFR Value	Coronary Artery Assessed by FFR				Total
	LMS	LAD	CX	RCA	
FFR > 0.8*	05	49	09	14	77
FFR <0.8	01	19	03	02	25
1: CABG	01	03	00	00	04
2: PCI	00	16	03	02	21
Total	06	68	12	16	102#

*FFR>0.8 All treated medically, # In two patients more than one artery FFR was performed that is why its 102.
LMS=Left Main Stem, LAD=Left Anterior Descending Artery,
CX= Left Circumflex Artery,RCA=Right Coronary Artery,
CABG=Coronary Artery Bypass Grafting,
PCI=Percutaneous Coronary Intervention

Based on the above results revascularization was done in 25 patients (21 PCI with stenting and 4 with coronary artery bypass graft surgery). Medical treatment was advised in 75 patients with FFR > 0.80. Individual coronary arteries assessment and their treatment according to FFR measurement is shown in Table 2.

At six month follow up, three patients who were on medical treatment came with aggravation of symptoms. Two of the patients improved with optimisation of medical treatment and did not require any further intervention. The third patient required coronary angiography. There was 90% stenosis in the left circumflex artery which previously was a 50% stenosis five months ago, and at that time the FFR was insignificant. The lesion was stented and the patient became asymptomatic(Table 3). Long term follow is also planned for these patients.

DISCUSSION

Fractional flow reserve (FFR) measurement involves determining the ratio between the maximum achievable blood flow in a diseased coronary artery and the theoretical maximum flow in a normal coronary artery. An FFR of 1.0 is widely accepted as normal. An FFR lower than 0.80 is generally considered to be associated with myocardial ischemia.[10] The ability of the cardiologist to discriminate between lesions that can cause MI and lesions that are physiologically insignificant on the basis of coronary angiography alone is limited.[11] The use of FFR measurement provides the cardiologist with a straightforward, readily available, quantitative technique for evaluating the physiologic significance of a coronary stenosis.

Three landmark studies DEFER, FAME I and FAME II have established the role of FFR in establishing the severity of coronary artery stenosis thus guiding appropriate revascularization with improved clinical outcomes. In the DEFER study, which assessed patients with single-vessel CAD and angiographically intermediate 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 higher than 0.75 do not benefit from revascularization of the stenosis.[6] The Fractional Flow Reserve versus Angiography for Multivessel Evaluation (FAME) study, which studied the role of FFR in the evaluation of multivessel CAD, reported results suggesting that a revascularization strategy using FFR yields superior clinical outcomes in patients with multivessel CAD.[12] Similarly in FAME II trials patients with clinical significant coronary artery stenosis as determind by FFR who were stented had better clinical outcomes in terms of TVR than those on medical treatment in their follow ups.

Although routine FFR is not done in our clinical settings. However in patients with moderate coronary artery stenosis it is often done before a decision regarding revascuilarization can be made. but in our study, myocardial ischemia was observed in only 25% of the patients in which FFR was done in suspected critical stenosis. This helped us in guiding and selecting appropriate patients who would benefit from revascularization. A large number of the patients (75%) had FFR > 0.80 and were not revascularized. No study was available from Pakistan with which we could compare our results. However, in a similar study carried out at Korea by Kim et al , the invstigators found that FFR based PCI strategy for intermediate coronary artery disease was associated with a favourable outcomes.[13]

Our study, gives the analysis of 100 patients in whom FFR was done to asses clinically significant ischemia. In our institute all those patient who undergo FFR have a telephonic follow up at six months post procedure. Patients are asked about any symptoms of angina or heart failure. If these symptoms are present then the patients are asked to report back to the hospital for further management. All the patients

Table 3: Clinical Follow-up at 06 Month (Total Patients, n=100)

Variables	FFR < 0.80 (n=25)	FFR > 0.80 (n=75)
Angina Symptoms	NIL	03 (4 %)
Heart Failure Symptoms	NIL	NIL
MACE	NIL	NIL
Medical Treatment	NIL	02 (2.6 %)
PCI with Stenting	NIL	01 (1.4 %)

who had undergone stenting after FFR in our study were asymptomatic at six months follow up. In patients who had an FFR of >0.80 and were on medical treatment, three patients out of seventy five reported symptoms of angina on telephonic follow up. Out of these three two improved with optimization of medical treatment. One patient required PCI to LCx for disabling angina after five months of doing initial FFR. No MACE were observed at six months follow up in both these groups. These findings are consistent with the findings of previous major studies carried out on FFR. FFR based treatment not only helps in reduction of costs from un necessary intervention but also prevents various complications that may arise from PCI and dual anti platelet therapy. However long term follow up will be required in these patients to assess the real difference of MACE between the two groups.

CONCLUSION

We conclude that FFR is a valuable tool in assessing the clinically significant ischemia in intermediate lesions and hence helps in planning their revascularization.

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