Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Cardiology

Comparison of Short-Term Outcomes between Fractional Flow Reserve Guided and Intra-Vascular Ultrasound Guided Percutaneous Coronary Intervention in Chronic Coronary Syndrome

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DOI: https://doi.org/10.36347/sjams. 2024.v12i08.011 | **Received:** 18.06.2024 | **Accepted:** 26.07.2024 | **Published:** 19.08.2024

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Abstract **Original Research Article**

Background: Fractional flow reserve (FFR) can provide information about physiologically significant coronary lesions that can be intervened. Intravascular ultrasound (IVUS) is also useful in providing thorough assessment of the intermediate lesions. This study was conducted to compare the short-term outcomes of FFR and IVUS guided percutaneous coronary intervention of intermediate coronary artery lesions in chronic coronary syndrome (CCS) patients. ***Methods:*** This Quasi-experimental study was conducted in the department of Cardiology, NICVD, Dhaka, for 12-months following ethical approval. A total of 100 CCS patients were enrolled in this study and divided into Group-I (FFR guided PCI, n=50) and Group-II (IVUS guided PCI, n=50) after taking written informed consent. Patients were followed up to three months after PCI. Detailed history, thorough clinical examination and necessary investigations were carried out in each patient and recorded in predesigned structured questionnaire. Data were analyzed by SPSS 26.0. ***Results:*** Both groups were statistically similar in terms of demographic profile, clinical findings, risk factors, angiographic findings (p>0.05) and angiographic success. Also, 96% in group-I and 92% in group-II respondents had procedural success. According to in hospital outcome, 1(2%) in group-I and 1(2%) in group-II respondents had myocardial infarction. 1(2%) respondent both in group -I and group-II also had LVF, while only 1(2%) respondent in group-II had death and cardiogenic shock respectively. Considering MACE after 03 months of follow up, 1(2%) death occurred in Group-II. However, no death in Group-I. 1(2%) respondent had NSTEMI in both groups. 1(2%) respondent had target vessel revascularization in Group-I and no respondents had in Group-II. While considering 1(2%) study population had faced cardiogenic shock, 1(2%) respondent had arrhythmia in both groups respectively and 1(2%) respondent had LVF in Group-I and 2(4%) had LVF in Group-II. Post-operative outcomes were statistically similar between groups (p>0.05). ***Conclusion:*** IVUS guidance has similar short-term outcomes to FFR guided percutaneous coronary intervention in chronic coronary syndrome. However, further larger study is recommended.

Keywords: Short-Term Outcomes, Fractional Flow Reserve, Intra-Vascular Ultrasound, Chronic Coronary Syndrome.

INTRODUCTION

Around 30% of all deaths are from cardiovascular disease (CVD) which is the number one cause of mortality worldwide. Among them 60% occur in low and middle-income countries [1]. Ischemic heart disease (IHD) is clinically classified into chronic coronary syndrome (CCS) and acute coronary syndrome (ACS) [2]. CCS may have long stable periods but can also become unstable unexpectedly, although in most cases there is chronic disease progression. A reliable assessment of coronary stenosis severity is

required to ensure clinicians make appropriate revascularization decisions. Traditionally, invasive coronary angiography has been the gold standard investigation to assess severity and extent of CAD. However, angiography is a two-dimensional representation of a more complex three-dimensional structure. Also, there are difficulties in interpretation of images due to vessel foreshortening or overlay, assessing stenosis severity in highly eccentric lesions and inter-observer variance in diameter stenosis of 15-45%. Thus, visual estimation of stenosis severity assessment is found to be erroneous in up to 30% cases. Given these inherent difficulties in accurate stenosis assessment on angiography, patients often fall into a category termed 'intermediate' stenosis severity [3]. Intermediate coronary artery stenosis, defined as visual angiographic stenosis severity of between 30-70%, is present in up to 35% of patients undergoing coronary angiography [4]. International guidelines appropriately recommend physiological pressure-based assessment of these lesions utilizing fractional flow reserve (FFR). Recent data also support the role of hyperemia-free pressure derived indices, such as the instantaneous wave-free ratio (iwFR). Both physiological approaches are supported by current European Society of Cardiology (ESC) Guidelines on myocardial revascularization [3]. FFR is defined as the ratio between maximum coronary blood flow in a stenotic artery compared with normal maximal blood flow [5]. In contrast to two-dimensional angiography, intravascular ultrasound (IVUS) is able to assess the lumen, the features of the arterial wall and has higher tissue penetration [6]. More-over, IVUS can guide PCI to improve stent placement and minimize stent-related problems and improves clinical outcomes [7]. FFR or IVUS is used to determine for performing PCI. In the FFR group, the criterion for revascularization is 0.80 or less. In the IVUS group, two alternative criteria for PCI are minimal luminal area (MLA) measuring either 3 mm2 or less or measuring 03-04 mm2 with plaque burden of more than 70% [7]. Procedural success and complication rates are used to measure outcomes after PCI. Major adverse cardiac events (MACE) are death, post procedural myocardial infarction, target vessel revascularization (TVR) and other adverse events are heart failure, cardiogenic shock, significant arrhythmia, stent thrombosis, transient ischemic attacks, vascular complications, contrast-induced nephropathy, and angiographic complications [8]. Although the basic concepts underlying the use of FFR and IVUS during PCI are distinct, both are the most commonly used adjunctive tools in the diagnosis and treatment of CAD during cardiac catheterization. However, robust data are lacking regarding the difference between the two strategies in respect to clinical outcomes [7]. So, we wanted to perform a head-head comparison of FFR and IVUS guided procedures regarding clinical and patient reported outcomes in those with intermediate coronary stenosis, in our perspective.

METHODOLOGY OF THE STUDY

Study design: Quasi-experimental study.

Study place: This study was carried out in the Department of Cardiology, National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh.

Study period: This study was conducted from July 2022 to June 2023 for a period of twelve (12) months.

Study population: Patients with chronic coronary syndrome admitted into NICVD, Dhaka, Bangladesh.

Sample size: Due to time and resource constraints, a total of 100 patients was taken finally for this study. Study subjects were divided into two groups. Group I: 50 patients, FFR guided PCI. Group II: 50 patients, IVUS guided PCI.

Inclusion criteria:

- The patient ≥18 years of age.
- Patients with chronic coronary syndrome (CCS).
- Coronary artery disease with intermediate stenosis (30-70%).

Exclusion criteria both:

- Previous history of CABG
- Left main coronary artery (LMCA) disease.
- Left ventricular ejection fraction (LVEF) < 35%
- Cardiomyopathy
- Valvular or congenital heart disease
- Cardiogenic shock
- Serum creatinine > 2 mg/dl
- Life expectancy <2 years.

Data collection Procedure: Patients with chronic coronary syndrome admitted in the Department of Cardiology, NICVD, Dhaka, who fulfilled the inclusion and exclusion criteria were considered for the study. A total of 100 CCS patients were enrolled in this study. Informed written consent was taken from each patient before enrollment. Meticulous history was taken and detailed clinical examination was performed and recorded in predesigned structured questionnaire. Demographic data such as, age, sex, BMI were recorded. Risk factor profile including smoking, hypertension, diabetes, dyslipidemia and family history of coronary artery disease was noted. Investigations findings of hemoglobin, serum creatinine, ECG, Lipid profile, Echocardiography were performed and enlisted.

Coronary angiography was performed through trans-radial, trans-femoral or distal trans-radial approach. Intermediate lesions were identified. Interventional cardiologist who routinely perform FFR and IVUS was involved in this study. FFR or IVUS was performed at the discretion of the operators. Patients

included in the study were divided into FFR-guided PCI group (Group-I, n=50) and IVUS-guided PCI group (Group-II, n=50). The procedure was considered 'Guided' when the procedure was performed before and after percutaneous coronary intervention. All patients received Drug Eluting Stent (DES) and were pretreated with standard dual antiplatelet therapy (DAPT) comprising of aspirin and clopidogrel or ticagrelor or prasugrel. In the FFR group, successful PCI was defined as the post procedural FFR value of at least 0.88 or a difference in FFR across the stent of less than 0.05. In the IVUS group, successful PCI was defined as minimal stent area of 5.5 mm2 or more and a plaque burden at the stent edge of 55% or less or minimal stent area that is equal to or greater than the distal reference lumen area. Angiographic success was defined as TIMI grade 3 and residual stenosis <20%. During hospital stay, patients were examined to find out any major complications following PCI. All patients underwent follow up at three months after PCI. During follow up, following parameter were observed: hemodynamics (pulse, blood pressure), ECG change and complications including MACE (death, post-procedural myocardial infarction, target vessel revascularization, stroke) and other adverse events including heart failure, cardiogenic shock, significant arrhythmia, stent thrombosis. Follow up evaluation was done by telephone interview for those who could not attend directly and all parameters were recorded. The 03 months outcomes between these two groups were compared.

Data processing and analysis: The numerical data obtained from the study were analyzed and significance of differences were estimated by using statistical methods. The Statistical Package for Social Sciences (SPSS) version 26.0 software was used for data analysis. Categorical variables were expressed as absolute number and percentages and compared through the proportion test and the chi-square test. Continuous variables were expressed as mean and standard deviation and compared through the student's t-test and Mann-Whitney U test, where necessary. Logistic regression analysis was done to find out the factors associated with in-hospital outcome and after 3months outcome. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total 100 patients undergoing percutaneous coronary intervention (PCI) during index hospitalization were considered in this study. Patients included in the study were divided into two groups. Group I (n=50): FFR-guided PCI and Group II (n=50): IVUS-guided PCI. After 3-month follow-up, the incidence of composite events in the FFR guided and IVUS-guided group was similar (8.0% vs. 12.0%, p=0.74).

Table-1: Demographic status of respondents (N=100)

Variable	Group-I n=50 (%)	Group-II n=50 (%)	p-value
Age (year)			
30-49	7(14)	4(8)	
50-69	35(70)	39(78)	
≥70	8(16)	7(14)	
Mean age	57.8±10.3	57.38±8.07	0.821**
Sex			**0.488***
Male	36(72)	39(78)	
Female	14(28)	11(22)	

*Chi-square test and ** student t tests were done. Values were expressed in frequency with percentage in parenthesis over column.

Majority of the respondents were between 50-69 years old in both groups of respondents (70% and 78%). And the mean age was 57.8±10.3 years and 57.38±8.07 years in both groups respectively. Also, most of the respondents were male in both groups (72% and 78%) (Table-1).

Table 2: Distribution of study patients by risk factors (N=100).

Risk factors	Group I (n=50)		Group II (n=50)		Total (N= 100)		P value
	Number	%	Number	%	Number	%	
Smoking	25	50	23	46	48	48	0.689
Hypertension	21	42	35	70	56	56	**0.008**
Diabetes mellitus	23	46	19	38	61	61	0.418
Dyslipidemia	36	72	32	64	68	68	0.396
Family H/O CAD	16	32	15	30	31	31	0.829

p value reached from Chi-square test.

Majority of the respondents had smoking history, however, in Group-I, 50% were smoker while in Group-II, 48% were smoker. In Group-I, the prevalence of hypertension was 42% whereas Group-II had prevalence of 70%. The difference in hypertension rates between the two groups was statistically significant (p=0.008). Among group-I, 46% of respondents had diabetes mellitus and 72% had

dyslipidemia. In Group-II, 38% had diabetes mellitus and 64% had dyslipidemia. According to family history of CAD, 32% were in Group-I and 30% were in Group-II (table-1).

Table-3: Investigation parameter and echocardiography findings of respondents(N=100)

Variable	Group-I n=50 mean±SD	Group-II n=50 mean±SD	P value
Hb% (gm/dl)	13.91±1.38	13.88±1.47	0.905*
S. creatinine (mg/dl)	1.16±0.22	1.18±0.25	0.615*
Total cholesterol (mg/dl)	203.82±34.85	190.08±40.42	0.072*
LDL-C (mg/dl)	97.34±31.79	89.5±33.94	0.236*
HDL-C (mg/dl)	42.46±6.21	39.58±6.84	**0.030***
TG (mg/dl)	190.64±66.15	170.18±59.78	0.108*
Echocardiography LVEF (%)	56.43±7.90	50.44±9.76	0.007*

*Student t test was done. Values were expressed in frequency with percentage in parenthesis over column.

There was no statistically significant difference (p>0.50) between two groups in terms of biochemical parameters, such as Hb%, serum creatinine, total cholesterol, LDL-C, triglyceride. In Group-I, the average HDL-C was 42.46mg/dl whereas in Group-II it was 39.58 mg/dl which was statistically significant (p=0.03). According to echocardiography, both EF (%) and wall motion abnormality between two groups were also statistically insignificant (p>0.50) (table-3).

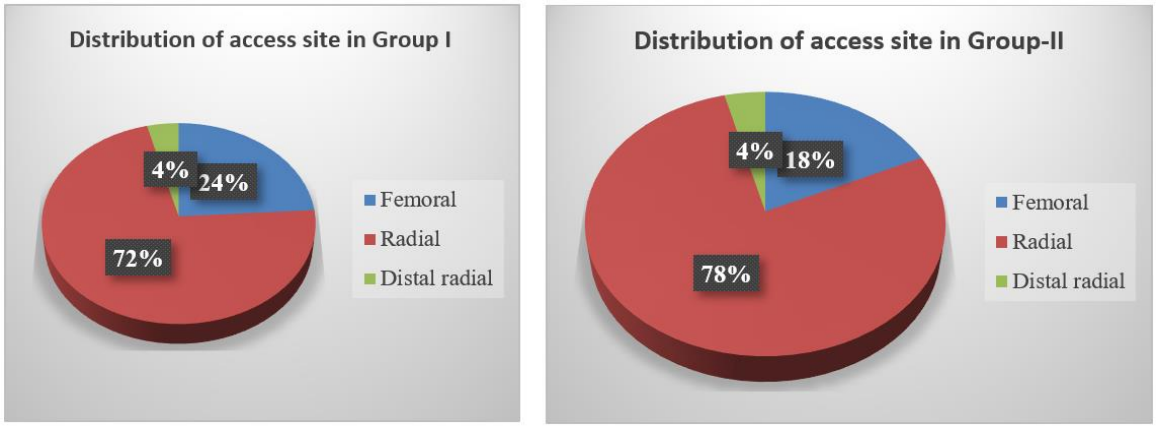

Figure 1: Distribution of angiographic access site in Group-I and Group-II(N=100)

Majority of the respondents had radial artery access site for angiography in both Group-I and Group-II (fig-1).

Table-4: Angiographic findings of respondents in both groups (N=100)

Variable	Group-I n=50 (%)	Group-II n=50 (%)	P value
LAD lesion location			
Proximal	23(46)	24(48)	0.230
Mid	13(26)	14(28)	
Distal	9(18)	12(24)	
LCX lesion location			
Proximal	21(42)	22(44)	0.337
Distal	13(26)	16(32)	
RCA lesion location			
Proximal	27(54)	25(50)	0.055
Mid	11(22)	20(40)	
Distal	2(4)	1(2)	

*Chi-square test was done. Values were expressed in frequency with percentage in parenthesis over column.

Most of the LAD lesion (46% and 48%), RCA lesion (54% and 50%) and LCX lesion (42% and 44%) were proximal in Group-I and Group-II respectively. All respondents in Group-I (FFR guided PCI) had shown that before procedure their average FFR value was 0.68±0.07 and after stenting the value is increased to 0.91±0.04 (table-4).

Table-5: Intravascular ultrasound characteristics (n=50)

Variables	Frequency (n)	Percentage (%)
Plaque morphology		
Soft	08	16
Fibrous	10	20
Mixed	28	36
Calcified	04	08
MLA (mm²)	3.28±0.82	
Plaque burden (%)	62.38±4.56	
MSA (mm²)	6.34±0.45	

All respondents in Group-II (IVUS guided PCI) had shown that plaque morphology was predominantly mixed (36%) and fibrous, soft and calcified plaque were 20%, 16% and 8% respectively. Mean minimal lumen area, plaque burden and Minimal stent area were 3.28±0.82 mm², 62.38±4.56% and 6.34±0.45 mm², respectively (table-5).

Table-6: Angiographic and percutaneous coronary intervention related characteristics (N=100)

	Group-I n=50 n(%)	Group-II n=50 n(%)	P value
Number of disease vessel			
Single	28(56)	30(60)	0.577*
Double	19(38)	18(42)	
Triple	3(8)	2(4)	
Stent data			
Stented Lesion number	58	61	
Average stent length, (mm)	38(25-55)	38(30-60)	0.775**
Average stent diameter, (mm)	2.95(2.5-3.5)	3.20(2.5-3.5)	0.349**
Average stent number	1.16	1.22	
Post-dilatation, n(%)	46(92)	50(100)	0.012*
Post-dilatation balloon diameter, (mm)	3.25(2.5-3.5)	3.50(3-4.5)	0.039**
Post-dilatation pressure, (atm)	18(15.7-20)	18(16-20)	0.426**

*Chi square test and **Mann Whitney tests were done. Values were expressed in frequency with percentage in parenthesis over column and as median with interquartile range.

Majority of the respondents had single vessel involved (56% and 60%) in both groups. The median number of stents was (1.16 1nd 1.22) in Group-I and Group-II respectively. Average stent length was 38(25-55) in Group-I and 38(30-60) in Group-II. Average stent diameter was 2.95(2.50-3.50) in Group-I and 3.20(2.5-3.50) in Group-II. All respondents in Group-II had post-dilatation, while 92% had post dilatation in FFR groups (p=0.0012). Also, maximum post dilatation balloon diameter was higher in Group-II [3.50(3-4.5)] compared to Group-I [3.25(2.5-3.5)] which is statistically significant (p=0.039). Maximum post-dilatation pressure had no significant difference in between two group (table-6).

Table-7: In hospital outcome of respondents in both groups (N=100)

Outcome	In hospital outcome		P value
	Group-I n=50 (%)	Group-II n=50 (%)	
Cardiac death	0	1(2)	0.315
Myocardial infarction	1(2)	1(2)	>0.999
STEMI	0	0	-
NSTEMI	1(2)	1(2)	>0.999
Target vessel revascularization (TVR)	0	0	-
Cardiogenic shock	0	1(2)	0.315
Left ventricular failure	1(2)	1(2)	>0.999
Arrhythmia (AF/VT/VF/Others)	0	0	-
Stent thrombosis	0	0	-

*Chi-square test was done. Values were expressed in frequency with percentage in parenthesis over column.

According to in hospital outcome, 1(2%) in Group-II respondent had cardiac death. 1(2%) had NSTEMI in each group respectively and 1 (2%) respondent had LVF each group respectively. 1(2%) respondent had cardiogenic shock in Group-II. No respondents had cardiac death or cardiogenic shock in Group-I of respondents (table-7).

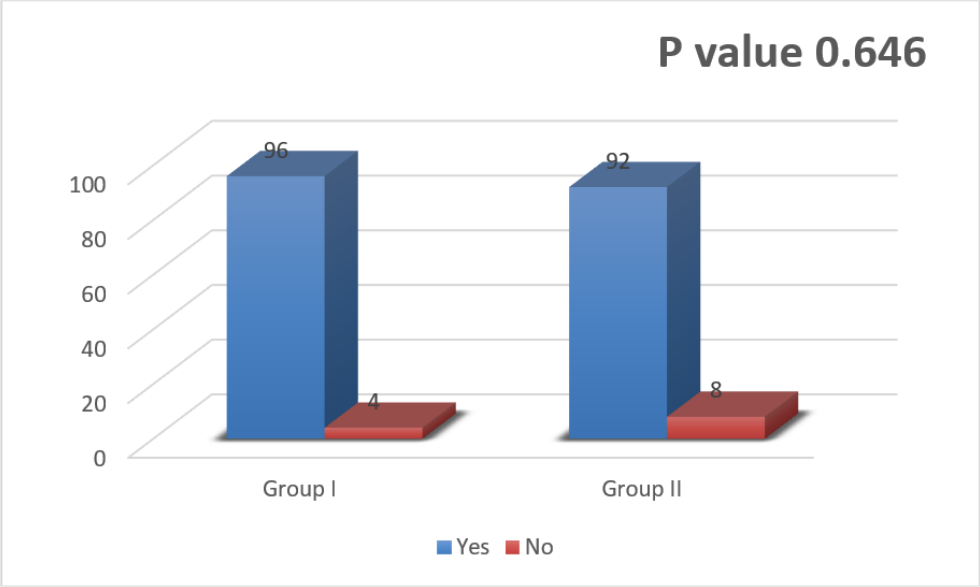

Figure-2: Bar diagram showing procedural success of respondents after PCI (N=100)

Also, 96% in Group-I and 92% in Group-II respondents had procedural success in this study (fig-2).

Table-8: After 3 months follow-up outcome in both groups (N=100)

Outcome	After 3 months		P value
	Group-I n=50 (%)	Group-II n=50 (%)	
Cardiac death	0	1(2)	0.315
Myocardial infarction	1(2)	1(2)	0.588
STEMI	0	0	-
NSTEMI	1	1	0.588
Target vessel revascularization (TVR)	1(2)	0	0.315
Cardiogenic shock	0	1(2)	0.315
Left ventricular failure	1(4)	2(4)	0.558
Arrhythmia (AF/VT/VF/Others)	1(2)	1(2)	>0.588
Stent thrombosis	0	0	-

*Chi-square test was done. Values were expressed in frequency with percentage in parenthesis over column.

Considering MACE after 03 months of follow up, 1(2%) death occurred in Group-II. Luckily no death in Group-I. 1(2%) respondent had NSTEMI in both groups. 1(2%) respondent had target vessel revascularization in Group-I and no respondents had in Group-II. 1(2%) study population had faced cardiogenic shock in Group-II. 1(2%) respondent had arrhythmia in both groups respectively and 1(2%) respondent had LVF in Group-I and 2(4%) respondents had arrhythmia in Group-II (table-8).

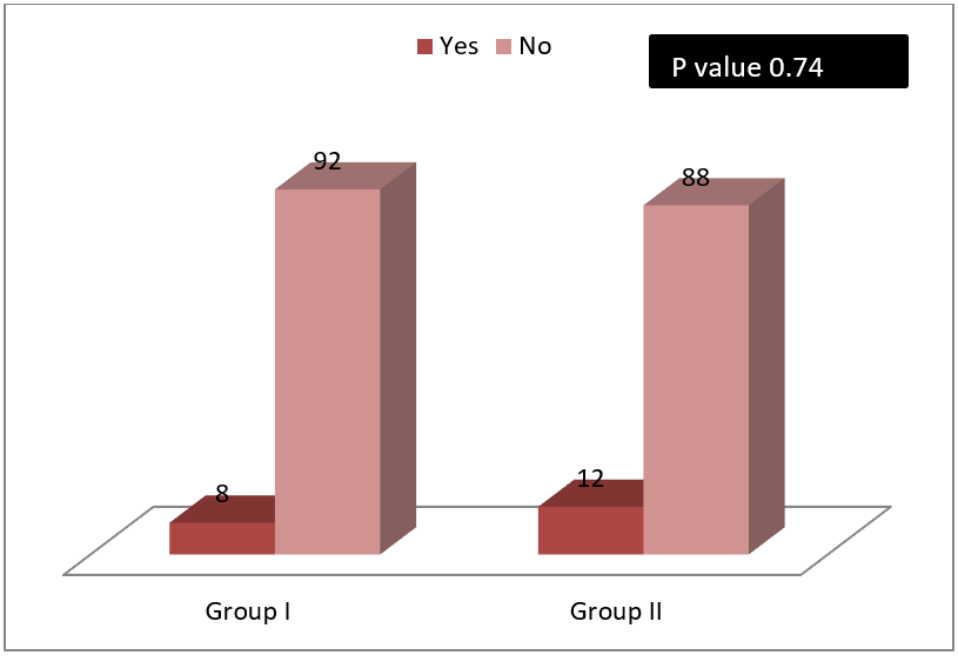

Figure-3: Bar diagram showing 03 months outcome after PCI (N=100)

Also, 92% in Group-I and 88% in Group-II respondents had outcome as adverse events after 03 months of PCI in this study which is statistically insignificant (p value 0.74) (fig-3).

DISCUSSION

The assessment of an intermediate-severity coronary lesion remains difficult for interventional cardiologists. Some believe that mild-to-moderate coronary stenosis causes acute myocardial infarctions, which has enhanced the clinical significance of such lesions [9]. As compared to coronary angiography, intravascular imaging and physiological assessment have distinct strengths in guiding PCI. Physiological assessment is more effective in ischemia-directed PCI, whereas intracoronary imaging is more effective in assessment of anatomical characteristics and in the planning of the PCI procedure. Clinicians substitute one method for the other. It is well known that in addition to the presence of ischemia, quantity and quality of plaque and appropriateness of PCI are important prognostic indicators. Therefore, the comparative efficacy of intracoronary imaging and physiology-guided decision making for revascularization and PCI success needs to be defined [7]. According to this study, in both Group-I and Group-II, the majority of respondents (70% and 78%, respectively) were between the ages of 50 and 69. And the mean age in both groups was 57.8±10.3 years and 57.38±8.07 years. In both groups, the majority of respondents (72% and 78%, respectively) were male in this study. In a similar study, it was showed that age of the respondents was 68±11years and male respondents were predominant in both FFR and angiographic PCI [10]. Co-morbidities were observed in this study. Among Group-I, 36% had dyslipidemia and 23% had diabetes mellitus and in Group-II, 64% had dyslipidemia and 38% had diabetes mellitus in this study. This finding were coincided with another study as 67.5% respondents in FFR and 68.9% in IVUS group had hypertension found in another study [7]. Also, most of the respondents had smoking history. It was seen in another study that, 18.4% in FFR and 19% in IVUS group had smoking history, which was quite similar to this study [7]. According to this study, family history of CAD, 32% were in Group-I and 30% were in Group-II. But we observed significant difference of hypertension between the two groups. Hypertension was present in 42% and 70% study population in Group-I and Group-II which was statistically significant (p=0.007). BMI, pulse, systolic blood pressure, diastolic blood pressure, temperature, respiratory rate and SPO2 had no significant difference between these two groups in this study. High density lipoprotein was significantly lower in Group of respondents than Group-II respondents (42.46±6.21 vs. 39.58±6.84 mg/dl). Other parameters, such as Hb%, serum creatinine, total cholesterol, LDL, triglyceride had no statistically significant difference in between groups. According to echocardiography, LVEF% showed differences in Group-I and Group-II (56.43±7.90 and 50.44±9.76 respectively) and was statistically significant according to this study (p=0.007). Angiographic access site was mostly radial artery in both groups of respondents (72% and 78% respectively). Most of the LAD lesion (46% and 48%), RCA lesion (54% and 50%) and LCX lesion (42% and 44%) were mostly distal (42%) in both groups of study population. Left anterior descending artery was most common target vessel in both group (66% and 74% respectively). Left circumferential artery (24% and 34%) and right coronary artery (36% and 30%) also common target vessel next to LAD in both groups. Majority of the respondents had single vessel involved

(56% and 56%) in both groups. In another study, about 84% respondents had single vessel PCI in both FFR and angiographic PCI procedure [10]. All respondents in Group-I (FFR guided PCI) had shown that before procedure their average FFR value was 0.68±0.07 and after stenting the value is increased to 0.91±0.04. Most respondents in Group-II had good stent apposition, optimal stent symmetry and no significant stent edge dissection and 98% respondents in Group-II had optimal stent expansion. Plaque morphology showed most plaques (36%) had mixed echogenicity with some fibrous (20%) and soft plaque (16%) but calcified plaques were the lowest (08%) according to this study. Mean minimal lumen area, plaque burden and Minimal stent area were 3.28±0.82 mm², 62.38±4.56% and 6.34±0.45 mm², respectively. The median number of stents was 1.16 in Group-I and 1.22 in Group-II respectively. Average stent length was 38(25-55) in Group-I and 38(30-60) in Group-II in this study. In a similar study, number of stents per patient was 1.4 and 1.5 in Group-I and Group-II respectively [7]. The number of stents used per patient in another study was 2.7±1.2 and 1.9±1.3, respectively (P<0.001) [11]. Average stent diameter was 2.95(2.5-3.5) in Group-I and 3.20(2.5-3.5) in Group-II. All respondents in Group-II had post-dilatation, while 92% had post dilatation in Group-I (p=0.012) which is statistically significant. Also, maximum post dilatation balloon diameter was higher in Group-II [3.50(3-4.5)] compared to Group-II [3.25(2.5-3.5)]. Maximum post-dilatation pressure had no significant difference in between two groups. Post-dilatation was performed less frequently in the Group-I again using smaller diameter balloons (3.5 [3.5–3.5] mm vs. 4.0 [3.8–4.5] mm, p = 0.001) [12]. Majority of the respondents had angiographic success in both groups. Also, 94% in Group-I and 92% in Group-II respondents had procedural success in this study. In another study showed, 94% had successful stent procedure in FFR group and 97% had in IVUS group [10]. According to in hospital outcome, 1(2%) in Group-II respondent had cardiac death. 1(2%) had NSTEMI in each group respectively and 1 (2%) respondent had LVF each group respectively. 1(2%) respondent had cardiogenic shock in Group-II. No respondents had cardiac death or cardiogenic shock in Group-I of respondents. However, after 3 months, outcome showed, 1(2%) death occurred in Group-II. Luckily no death in Group-I. 1(2%) respondent had NSTEMI in both groups. 1(2%) respondent had target vessel revascularization in Group-I and no respondents had in Group-II. 1(2%) study population had faced cardiogenic shock. 1 (2%) respondent had arrhythmia in both groups respectively and 1(2%) respondent had LVF in Group-I and 2(4%) respondents had arrhythmia in Group-II in this study. Another study also showed, there were no significant differences in TVR (3.6% in FFR group vs. 2.1% in the IVUS group, p=0.67) [10]. Target vessel revascularization, arrhythmia and left ventricular failure had showed no risk for IVUS in case of in hospital outcome and after 30 days outcome of respondents. FFR was also associated with a higher risk of MACE with no significant differences existed in the remaining comparisons [13]. Intravascular coronary imaging was associated with lower all-cause, in-hospital mortality among patients undergoing cardiac catheterization with or without PCI [14].

Limitations

- Single center study.
- Sample size was quite small.
- Short duration study.
- Outcome depends on operator's selection of cases, so chance of selection bias.
- Sample was taken purposively, so randomization was not done.

CONCLUSION

This study compared the short-term outcomes of FFR and IVUS guided percutaneous coronary intervention of intermediate coronary artery lesions in chronic coronary syndrome (CCS) patients. This study observed that both FFR and IVUS guidance had high angiographic success and procedural success. Besides, IVUS guidance has similar short-term outcomes to FFR guided percutaneous coronary intervention in chronic coronary syndrome. Hence, it can be concluded that IVUS guidance is similar to FFR guided percutaneous coronary intervention in chronic coronary syndrome in terms of safety and efficacy.

Recommendations

- ✓ Further randomized multicenter studies with larger sample size and longer follow-up are recommended.
- ✓ IVUS guided PCI can be a useful alternative to FFR guided PCI as both has similar short-term outcome. Additionally, IVUS can provide comprehensive disease information, including the lesion's specificities and vessel diameter.

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