Original Article

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Patient characteristics and outcome of IVUS-facilitated Management in Intermediate Coronary Lesion

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Abstract

Background and Aims: Intravascular ultrasound enables better quantitative assessment of the vessel wall. In this study we aim to investigate the patient characteristics, lesion characteristics and outcome of IVUS facilitated coronary angiography and angioplasty in patients with Intermediate coronary lesion.

Method: Cross-sectional, Quantitative study done at MCVTC (IOM) for 1 year. Random, Nonprobability sampling was used. All the patients with Intermediate coronary artery disease who underwent IVUS were included in the study. Patient characteristics, lesion characteristics, PCI and outcome were studied.

Result: 33 cases who underwent IVUS were included in the study. The mean age was 56 years with 78% being male. On CAG LAD was the most common artery involved with 42% of cases followed by, RCA (30%) and LCx Involvement (21%) while only 7% cases had Left Main artery involvement. 23 (70%) of patient were managed medically and 10 (30%) were managed by PCI. Out of those managed with PCI, 2 (20%) had PCI in LAD, 4 (40%) had PCI in LCX and 4 (40%) had PCI in RCA. The mean MLA of LAD undergoing PCI was 3.8mm2 and % stenosis was 72%. Similarly, MLA in LCx undergoing PCI was 3.7mm2 and % stenosis was 76%. In RCA who underwent PCI mean MLA was 3.5mm2 and % stenosis was 78%.

Conclusion: Routine use of IVUS in intermediate coronary artery lesion has a significant impact on identifying anatomically significant lesion which requires revascularization.

Key Words: Coronary angiography; Intermediate Coronary artery lesion; IVUS; Percutaneous Coronary Intervention; Patient characteristics.

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Introduction

Coronary artery disease (CAD) is a major cause of morbidity and mortality worldwide. Traditionally, invasive coronary angiography has been the gold standard investigation to assess severity and extent of CAD. Animal studies and human clinical correlations have demonstrated that functional significance (the induction of ischemia) occurs with the anatomic presence of a 50% diameter stenosis[1].

However, angiography is limited as it is a two-dimensional representation of a more complex three-dimensional structure that comes with inherent limitations to comprehensively assess atherosclerotic burden, discern plaque characteristics and define vessel diameter[2]. Also, there is significant interobserver and intra-observer variability in interpretation of the severity of stenoses on coronary angiography[3]. The fallibility of stenosis severity on angiography has been documented in previous studies, which demonstrate an inter-observer variance in diameter stenosis of 15–45%. Thus, visual estimation of stenosis severity lacks precision with up to 30% of angiographic assessments found to be erroneous[4].

Given these inherent difficulties in accurate stenosis assessment on angiography, patients often fall into a category termed 'intermediate' stenosis severity. An intermediate coronary lesion on angiography is defined as a luminal narrowing with a diameter stenosis greater than 50% but less than 70%[5]. Although its prevalence in the general population is not well known, registry data suggests it may be present in up to 25% of patients undergoing coronary angiography[6]. Intermediate lesion presents a distinct clinical challenge with uncertainty in regard to optimal assessment and management strategy[7]. Whether active revascularization therapy is necessary for intermediate lesions has always been a hot topic of debate[8].

Intravascular ultrasound makes use of a miniaturized piezoelectric transducer mounted to a catheter tip to produce ultrasound signals, enabling quantitative assessment of the vessel wall and intimal atherosclerotic lesions. IVUS is now widely utilized as an adjunct to coronary angiography, allowing clinicians to better identify and characterize plaque morphology, measure reference luminal dimensions and optimize stent size, placement and deployment[9].

In this study, we aim to investigate the patient characteristics, lesion characteristics, and outcomes of IVUS-guided assessment in patients with intermediate coronary lesions.

Methods

A Cross-sectional, Quantitative study done at Manmohan Cardio-Thoracic Vascular and Transplant Centre (MCVTC), Institute of Medicine between January 2025 and December 2025. Random sampling was used in which all the patients with Intermediate coronary artery disease who underwent IVUS were included in the study. Patients with prior history of CABG, Pregnancy and lactation and Patients not giving consent were excluded from the study. Patient characteristics, lesion characteristics, PCI and outcome were studied. Study period was of 1 year duration between January 2025 to December 2025. Patient were followed up till discharge. Outcome was assessed in the form of proportion of patient undergoing IVUS guided PCI and discharge. Complications were reported in the form of death, revascularization and heart failure. Ethical approval was obtained from the Institutional Review Committee of MCVTC/IOM (Ref no: 516 (081/082)). Written informed consent was obtained from all participants.

Statistical Analysis

Demographic details, comorbidities, clinical characteristics and angiographic findings, lesion characteristics, minimal luminal area, IVUS facilitated PCI, procedural risks, were collected from patients after obtaining informed consent. Data was compiled, edited and checked daily to maintain consistency. The data was collected in Microsoft Excel (Ver. 2013). For statistical analysis, SPSS 21(IBM Corp. Released 2012. IBM SPSS Statistics for Windows,

Version 21.0. Armonk, NY: IBM Corp.) was used. Descriptive analysis was done to identify

the demographic component, comorbidities, smoking, distribution of clinical characteristics of patients, angiographic features, lesion characteristics, minimal luminal area, proportion of patients undergoing IVUS guided PCI, procedural risk factors and association will be measured using parametric and non-parametric tests (depending upon the distribution of data).The continuous variables was presented as means and standard deviations or medians with interquartile ranges. The categorical variables were reported as frequencies and percentages and was compared between the 2 mentioned groups using the $\chi 2$ test or the Fisher exact test. Proportion of patient undergoing IVUS mediated PCI was noted.

Result

Demographics and Baseline Characteristics

33 cases with Intermediate coronary lesion who underwent IVUS were included in the study. The mean age was 56 years with 78% being male and 22% female. 24% of patients had history of diabetes mellitus, 22% had hypertension, 22% had dyslipidemia. 36% cases were smoker and 18% patient had previous history of MI. Angina on Exertion (58%) was the most common symptom followed by Dyspnea on Exertion 24% followed by both 18%. Key baseline characteristics are summarized in table 1.

TABLE 1: BASELINE CHARACTERISTICS OF STUDY POPULATION

Demographics	Patient (n=33)
Age (Mean+/-SD, years)	56 +/- 5.2 years
Female	7 (22%)
Male	26 (78%)
Medical History	
Diabetes Mellitus	8 (24%)
Hypertension	7 (22%)
Dyslipidemia	7 (22%)
Chronic Kidney Disease	4 (12%)
Cerebrovascular Disease	2 (6%)
Peripheral Artery Disease	1 (3%)

Demographics	Patient (n=33)
Smoking	12 (36%)
Previous MI	6 (18%)
Presenting symptoms	
Angina on Exertion	19 (58%)
Dyspnea on Exertion	8 (24%)
Both Angina on Exertion and Dyspnea on Exertion	6 (18%)
LVEF %(mean+/-SD)	50+/-5 %

Vessel assessed by IVUS

2 (7%) cases with Left Main artery involvement were assessed by IVUS, 14 (42%) cases with Left anterior descending artery involvement,7 (21%) with Left Circumflex artery Involvement and 10 (30%) cases with Right Coronary artery involvement were assessed by IVUS.

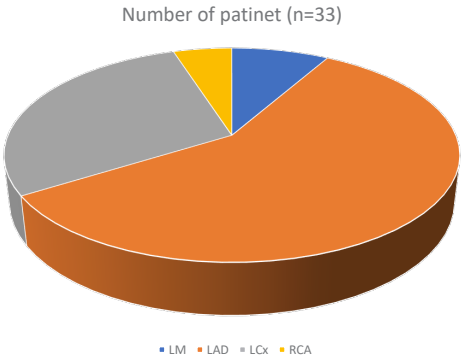

FIGURE1: *VESSEL ASSESSED BY IVUS*

Lesion Characteristics determined by IVUS

The most common lesion type was lipid rich 51%, followed by fibrous 33%. Calcified lesion was present in 6% of patients whereas mixed lesion was present in 9% of patients.

TABLE 2: LESION CHARACTERISTICS DETERMINED BY IVUS

Lesion Characteristics	Prevalence (%), n=33
Lipid rich (Soft)	17 (51%)
Fibrous	11 (33%)
Calcified	2 (6%)
Mixed	3 (9%)

Management Plan after accessing IVUS

23 (70%) of patient were managed medically and 10 (30%) were managed by IVUS facilitated by PCI. Out of those 10-patient managed with PCI, 2 (20%) had PCI in LAD, 4 (40%) had PCI in LCX and 4 (40%) had PCI in RCA.

TABLE 3: CULPRIT VESSELS UNDERGOING IVUS FACILITATED PCI

Culprit Vessel undergoing IVUS directed PCI	Number of patient (n=10)
LM	0
LAD	2 (20%)
LCx	4 (40%)
RCA	4 (40%)

-Minimum Luminal Area (MLA) and % stenosis of Coronary artery as assessed by IVUS

The mean MLA in LM vessel not undergoing PCI was 6.2mm2 and % stenosis was 38%. The mean MLA in LAD vessel not undergoing PCI was 4.6mm2 and % stenosis was 56% whereas the mean MLA of LAD undergoing PCI was 3.8mm2 and % stenosis was 72%. Similarly MLA in LCx not undergoing PCI was 4.3mm2 and % stenosis was 64%wheras MLA in LCx undergoing PCI was 3.7mm2 and % stenosis was 76%. In RCA not undergoing PCI MLA was 4.5mm2 and % stenosis was 62% whereas MLA in RCA undergoing PCI was 3.5mm2 and % stenosis was 78%.

TABLE 4: MINIMUM LUMINAL AREA (MLA) IN MM2 AND % STENOSIS OF CORONARY ARTERY

LM	With PCI	Without PCI
MLA (Mean) (mm2)	None	6.2 mm2
% stenosis (Mean)	None	38%
LAD		
MLA (Mean)	3.8 mm2	4.6mm2
% stenosis (Mean)	72%	56%
LCx		
MLA (Mean)	3.7 mm2	4.3mm2
% stenosis (Mean)	76%	64%
RCA		
MLA (Mean)	3.5 mm2	4.5mm2
% stenosis (Mean)	78%	62%

Complication

No patient studied had complication of Myocardial Infraction, repeat revascularization or Heart failure in the study population.

Discussion

The mean age of patients in our study was 56 years with male preponderance (78%), which was comparable to the study done by Parajuli et al., which showed that the mean age of CAD presentation was in the sixth decade with a higher prevalence among males[10,11]. Diabetes mellitus (24%), hypertension (22%), and dyslipidemia (22%) were the most common comorbidities associated with coronary artery disease, while smoking (36%) was the most common modifiable risk factor observed in our study, which is consistent with previous studies[12–14]. Angina on exertion (58%) was the most common symptom, followed by dyspnea on exertion (24%), while 18% of patients had both symptoms. These findings were similar to previous studies that identified chest pain as the most common presenting symptom[15,16].

The use of IVUS has been recommended for angiographic intermediate coronary lesions (50–70% stenosis) and for guiding revascularization decisions[17]. Accordingly, IVUS in the current study was utilized in patients with intermediate coronary lesions. The left anterior descending artery was the most commonly involved artery, accounting for 42% of cases, followed by right coronary artery involvement (30%). Left circumflex artery involvement was seen in 21% of patients, while only 7% had left main artery involvement. These findings are consistent with the study done by Yong Kyun Kim et al.[18]

IVUS is also recommended for lesion characterization. In our study, the most common lesion characteristic was lipid-rich plaque, which was present in 51% of cases, followed by fibrous lesions in 33% and calcified lesions in 6%. Mixed lesion characteristics were present in 9% of cases. These findings are consistent with the study done by Sidonio Mesquita Viana et al., which showed lipid-rich followed by fibrous lesions as the most common lesion characteristics[19].

Out of 33 patients undergoing IVUS, 23 (70%) patients were managed medically, while 10 (30%) underwent IVUS-guided PCI. Among those undergoing PCI, 2 (20%) had PCI in the LAD, 4 (40%) in the LCX, and 4 (40%) in the RCA. The decision to undertake PCI versus medical management was based on minimal luminal area (MLA) and percentage stenosis. It is recommended that an MLA of <6.0 mm^2 in the left main coronary artery and an MLA of <3.0–4.0 mm^2 in non-left main epicardial vessels are commonly used cutoffs for intervention[20].

The mean MLA in LM vessels not undergoing PCI was 6.2 mm^2, and the mean percentage stenosis was 38%. The mean MLA in LAD vessels not undergoing PCI was 4.6 mm^2 with 56% stenosis, whereas the mean MLA of LAD vessels undergoing PCI was 3.8 mm^2 with 72% stenosis. Similarly, the MLA in LCX vessels not undergoing PCI was 4.3 mm^2 with 64% stenosis, whereas the MLA in LCX vessels undergoing PCI was 3.7 mm^2 with 76% stenosis. In RCA vessels not undergoing PCI, the MLA was 4.5 mm^2 with 62% stenosis, whereas the MLA in RCA vessels undergoing PCI was 3.5 mm^2 with 78% stenosis.

No patients in the study developed complications such as myocardial infarction, repeat revascularization, or heart failure during hospitalization.

Conclusion:

This study underscores the critical role of Intravascular Ultrasound (IVUS) as a decisive tool in the management of angiographically intermediate coronary lesions. In conclusion, IVUS-facilitated assessment of intermediate coronary lesions is a safe and effective strategy that helps bridge the gap between anatomical suspicion and functional significance. Its routine integration in the catheterization laboratory can optimize resource utilization by preventing unnecessary stenting while ensuring that high-risk, hemodynamically significant lesions are treated with precision.

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