

**IVUS Guided Versus Multi-Slice CT Coronary  
Angiography Planned Percutaneous Coronary  
Intervention Compared To The Conventional  
Coronary Angiography Guided Intervention**

*A Thesis*

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## *List of Abbreviations*

Abb.	Full term
ACS .....	Acute coronary syndrome.
BMI .....	Body mass index.
CABG.....	Coronary artery bypass grafting.
CCTA .....	Coronary computed tomography angiography.
CIN .....	Contrast induced nephropathy.
CKD .....	Chronic kidney disease.
CT.....	Computed tomography.
CTA.....	Computed tomography angiography.
DBP .....	Diastolic blood pressure.
DES .....	Drug eluting stent.
DM .....	Diabetes mellitus.
HR .....	Heart Rate.
HVB .....	Harsh vesicular breathing.
IVUS.....	Intra-vascular Ultrasound.
MACCEs .....	Major cardiovascular and cerebrovascular events.
MI.....	Myocardial infarction.
MLA .....	Minimal luminal area.
MLD .....	Minimal luminal diameter.

## *List of Abbreviations*

Abb.	Full term
MSCT .....	Multi-slice computed tomography.
NC .....	Non-compliant.
NHS .....	Normal Heart sound.
PCI.....	Percutaneous coronary intervention.
QCA .....	Quantitative coronary analysis.
RVD .....	Reference vessel diameter.
SBP.....	Systolic blood pressure.
VD .....	Vessel diameter.
VM .....	Viral markers.

## INTRODUCTION

**P**ercutaneous coronary intervention (PCI) is an integral part of treatment of ischemic heart disease. With the increasing prevalence of coronary artery disease, coronary catheterization has become even more important. (1)

Coupled with evidence-based pharmacological strategies, the use of coronary catheterization in appropriate patients reduces morbidity and mortality across the spectrum of risk. Continuous evolution of antithrombotic therapy and device technology has resulted in the application of PCI to a wider population of patients. (2)

Despite the fact that PCI is being performed in increasingly more complex lesions and patients, the advent of the stents and other new interventional devices, as well as adjunctive antithrombotic pharmacology, has improved the procedural success rate of PCI to approximately 95%. (3)

Intravascular ultrasound (IVUS) is a reliable imaging tool to guide percutaneous coronary intervention. There has been increasing evidence supporting the clinical utility of IVUS-guided stent implantation. IVUS provides cross-sectional views of the coronary artery wall, and allows us to assess stenosis severity, identify plaque morphology, optimize stent implantation, and



understand mechanism of stent failure. IVUS guidance can increase stent efficacy and decrease clinical adverse events. (4)

Coronary computed tomography angiography has been gaining popularity due to its ability to identify coronary artery disease, give information about coronary anatomy, plaque morphology and length, and its calcium content. (5)

Not only it can help in identification of the coronary artery disease and identify plaques, but also it can help planning coronary intervention, especially the complex ones. (6)

## **AIM OF THE STUDY**

**A**im of the study is comparing the procedural outcome and major adverse cardiovascular and cerebrovascular events (MACCEs) of IVUS guided PCI, multi-slice CT coronary angiography planned PCI, and conventional coronary angiography guided interventions.

## Chapter 1

# PERCUTANEOUS CORONARY INTERVENTION

Percutaneous coronary intervention (PCI) is an important part of treatment of ischemic heart disease. With the increasing prevalence of coronary artery disease, the appropriate use of PCI results in significant reduction of the morbidity and mortality. (1)

### Angiographic indications for elective PCI

Cardiac catheterization is a combined hemodynamic and angiographic procedure undertaken for diagnostic and therapeutic purposes. Similar to other invasive procedures, the decision to perform cardiac catheterization must be based on a careful balance of the risk of the procedure against the anticipated benefit to the patient. (7)

**Table (1):** Angiographic indications for revascularization in patients with stable CAD according to the ESC guidelines of myocardial revascularization 2018. (8)

	Subset of CAD by anatomy	Class <sup>a</sup>	Level <sup>b</sup>
For prognosis	Left main disease with stenosis >50%	I	A
	Proximal LAD stenosis >50%	I	A
	Two or three vessel disease with stenosis >50% with impaired LV function (EF<35%)	I	B
	Large area of ischemia detected by functional testing (>10% of LV) or abnormal invasive FFR.	I	B
	Single remaining patent vessel with >50% stenosis	I	C
For symptoms	Haemodynamically significant coronary stenosis in the presence of limiting angina, with insufficient response to optimized medical therapy.	I	A

CAD: coronary artery disease.

a: Class of recommendations. b: Level of evidence.

**Table (2):** Class of recommendations:

Class of recommendations	Definition	Suggested wording to use
Class I	Evidence and or general agreement that a given treatment or procedure is beneficial, useful and effective.	Is recommended, is indicated.
Class II	Conflicting evidence and or a divergence of opinion about the usefulness/efficacy of the given treatment or procedure.	
Class IIa	Weight of evidence/opinion is in favour of usefulness/efficacy.	Should be considered.
Class IIb	Usefulness/efficacy is less well established by evidence/opinion.	May be considered.
Class III	Evidence or general agreement that the given treatment or procedure is not useful/effective and in some cases it may be harmful.	Is not recommended.

**Table (3):** Level of evidence:

Level of evidence A	Data derived from multiple randomized clinical trials or meta-analysis.
Level of evidence B	Data derived from a single randomized clinical trial or large non-randomized studies.
Level of evidence C	Consensus of opinion of the experts and/or small studies, retrospective studies or registries.

## **American Heart Association (AHA) classification of coronary lesions (9)**

It is a system used to classify coronary arterial plaque burden. It is classified as:

- **Type A**
  - Discrete (< 10 mm).
  - Concentric.
  - Non-angulated segment < 45°.
  - Smooth contour.
  - Little or no calcification.
  - Less than totally occlusive.
  - Not ostial in location.
  - No major branch involvement.
  - Absence of thrombus.
- **Type B:** This can be sub classified into two sub categories.
  - **Type B1:** Having one of the below characteristics.
  - **Type B2:** Having two or more of the below characteristics.
    - Tubular (10-20 mm).
    - Eccentric.
    - Moderate tortuosity of proximal segment.
    - Moderately angulated, 45-90°.
    - Irregular contour.
    - Moderate to heavy calcification.

- Ostial in location.
- Bifurcation lesions requiring double guidewires.
- Some thrombus present.
- **Type C**
  - Diffuse.
  - Excessive tortuosity of proximal segment.
  - Extremely angulated,  $> 90^\circ$ .
  - Inability to protect major side branch.
  - Degenerated vein graft with friable lesions.

### **Complications of cardiac catheterization:**

Cardiac catheterization is a relatively safe procedure but has a well- defined risk of morbidity and mortality. The potential risk of major complications during cardiac catheterization is often related to comorbid disease. Several large studies provide insight into the incidence of major events and delineate cohorts of patients that are at increased risk. (10,11)

Death related to diagnostic cardiac catheterization occurs in 0.08% to 0.75% of patients, depending on the population studied. Data from the Society for Cardiac Angiography identified subsets of patients with an increased mortality rate. In an analysis of 58,332 patients, multi-variate predictors of significant complications were moribund status, advanced New York Heart Association functional class, hypotension, shock, aortic valve

disease, renal insufficiency, unstable angina, mitral valve disease, acute myocardial infarction within 24 hours, congestive heart failure, and cardiomyopathy. (11)

The risk of myocardial infarction varies from 0.03% to 0.06%; of significant brady-arrhythmias or tachy-arrhythmias, from 0.56% to 1.3%; and of neurologic complications, from 0.03% to 0.2%. (11,12)

Stroke can be peri-procedural in the cath-lab or can occur within a few hours after the procedure. The standard stroke management with a multidisciplinary team is important to improve prognosis. Predictors of stroke include diabetes mellitus, hypertension, prior stroke, and renal failure. The procedure length, contrast volume, and urgent indications are known to increase the risk of stroke. (13)

The most common complication is arterial access site bleeding, which is usually manifested by minor oozing or small hematomas but it can severe leading to major vascular complications. (14)

The incidence of major vascular complications has decreased during the last decade and is currently reported as approximately 0.20%. Major vascular complications include occlusion requiring arterial repair or thrombectomy, retroperitoneal bleeding, hematoma