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

A Thesis

Submitted for partial fulfillment of the MD degree in Cardiology

Presented By

Mina Magued Abdalla Iskandar

M.B.B.Ch.

Faculty of Medicine, Ain Shams University

Under Supervision of

Prof. Dr. Nireen Khalifa Okasha

Professor of Cardiology, Ain Shams University

Prof. Dr. Ahmed Ahmed Abd El Monem Khashaba

Professor of Cardiology, Ain Shams University

Prof. Dr. Yasser Gomaa El Kashlan

Professor of Cardiology, Ain Shams University

Dr. Diaa El Din Ahmed Kamal

Lecturer of Cardiology, Ain Shams University

Dr. Khaled Aly Abd El Kader

Lecturer of Cardiology, Ain Shams University

Faculty of Medicine

Ain Shams University

2019

Acknowledgment

First and foremost, I feel always indebted to ALLAH, the Most Kind and Most Merciful.

I was honored to work under the supervision of ***Prof. Dr. Nireen Khalifa Okasha,*** *Professor of Cardiology, Ain Shams University, for her vital assistance and unlimited co-operation. She had generously offered me much of her time, precious advice and variable guidance throughout this work.*

I wish to express my deepest thanks and gratitude to ***Prof. Dr. Ahmed Ahmed Abd El Monem Khashaba,*** *Professor of Cardiology, Ain Shams University, for his close supervision ,generous efforts and constant encouragement. He had scarified a lot of her busy time to teach me and revise over step of this thesis.*

I would like to express my sincere thanks to ***Prof. Dr. Yasser Gomaa El Kashlan,*** *Professor of Cardiology, Ain Shams University, who kindly offered me much of his time, experience, valuable help and effort in the immunohistochemical aspect*

I would like to express my sincere thanks to ***Dr. Diaa El Din Ahmed Kamal,*** *Lecturer of Cardiology, Ain Shams University, who kindly offered me much of his time, experience, valuable help and effort in the immunohistochemical aspect.*

I would like to express my sincere thanks to ***Dr. Khaled Aly Abd El Kader,*** *Lecturer of Cardiology, Ain Shams University, who kindly offered me much of his time, experience, valuable help and effort in the immunohistochemical aspect.*

To my family, all my colleagues and all those who helped me in this work, I am so thankful for their support and co-operation.

Last but not least my sincere thanks and appreciation to all patients participated in this study.

Mina Magued Abdalla Iskandar

List of Contents

List of Tables

List of Figures

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

Percutaneous 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

Aim 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[a]	Level[b]
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	Haemodinamically 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 < 45º.
  - Smooth contour.
  - Little or no calcification.
  - Less than totally occlusive.
  - Not ostial in location.
  - No major branch involvement.
  - Asbsence 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, 45-90º.
    - 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, > 90º.
  - 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