Impact of Direct Stenting on Post Procedural TIMI Flow in Patients Undergoing Primary Percutaneous Coronary Intervention

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List of Abbreviations

1^{ry} PCI : Primary percutanous coronary intervention
ACC : American College of Cardiology
ACC/AHA : American College of Cardiology/American Heart Association
ACS : Acute coronary syndrome
ADMIRAL : Abciximab before Direct Angioplasty and Stenting in Myocardial Infarction Regarding Acute and Long Term follow-up
AMI : Acute myocardial infarction
APEX-AMI : Assessment of Pexelizumab in Acute Myocardial Infarction
a-PTT : Activated partial thromboplastin time
BMS : Bare metal stent
CA : Coronary angiography
CA : Coronary artery
CAD : Coronary artery disease
CADILLAC : Controlled Abciximab and Device Investigation to Lower Late Angioplasty Complications
CCU : Coronary care unit
CK : Creatinine kinase
CS : Conventional stenting
c-TFC : The corrected TIMI flow count
DBT : Door to balloon time
DISCO 3 : Direct stenting of coronary arteries
DLP : Dyslipidemia
DM : Diabetes mellitus
DS : Direct stenting
ECG : Electrocardiogram
ED : Emergency department
EDRF : Endothelium derived relaxing factor
ESC : European Society of Cardiology
FMC : First medical contact
GP : Glycoprotein
GPI : Glycoprotein inhibitor

GUSTO : Global Utilization of Stretokinase & Tissue Plasminogen Activator for occluded coronary arteries
HTN : Hypertension
INR : International normalization ratio
IRA : Infarct-related artery
ISAR-2 : Institute for the Study of Academic Racism
IV : Intravenous
LAD : Left anterior descending artery
LBBB : Left bundle branch block
LCX : Left circumflex artery
LV : Left ventricle
MBG : Myocardial blush grade
MI : Myocardial infarction
NO : Nitric oxide
NR : No-reflow
NSTEMI : Non ST elevation myocardial infarction
PAMI : Primary Stenting in Acute Myocardial Infarction
PCI : Percutanous coronary intervention
PTCA : Percutanous trans-luminal coronary angioplasty
RAPPORT : Randomized Placebo Phase Study of Rilonacept in the Treatment of Systemic Juvenile Idiopathic Arthritis
RCA : Right coronary artery
r-PA : Reteplase
SD : Standard deviation
SPECT **:** Single photon emission computed tomography
SPSS : Statistical Package for scientific studies
STEMI : ST-Elevation myocardial infarction
STREAM : Strategic Reperfusion Early After MI
TIMI : Thrombolysis in myocardial infarction
TMPG : TIMI Myocardial perfusion grade
TNK : Tenecteplase
tpa : Altepase
TVR : Target vessel revascularization
UA : Unstable angina
UFH : Unfractionated heparin
URL : Upper reference limit

INTRODUCTION

Acute coronary syndrome **(ACS)** patients on presentation are triaged into ST-elevation acute myocardial infarction **(STEMI)** and non STEMI / unstable angina (UA) categories[1].

Acute myocardial infraction **(AMI)** remains a leading cause of morbidity and mortality worldwide. Myocardial infarction occurs when irreversible myocardial cell damage or death occurs.

STEMI is the most serious presentation of athero-sclerotic coronary Artery Disease **(CAD)** carrying the most hazardous consequences and it is caused by occlusion of major coronary artery **(CA).**[2]

The cardinal goal in treating STEMI is to achieve rapid, complete, and durable restoration of myocardial blood flow.

Primary percutaneous coronary intervention **(1^{ry}PCI)** is the preferred reperfusion strategy especially when performed by an experienced team within the shortest possible time from first Medical contact **(FMC)** PTCA before stenting in 1ry P.C.I may be one of the causes of No-Reflow **(NR)**, direct stenting could be the solution.[3]

No-Reflow phenomenon is the issue of concern among patients undergoing coronary Angiography **(CA)** as it is the failure of blood to reperfuse an ischaemic area after the physical obstruction has been removed or bypassed, it may be associated with micro-vascular damage.[4]

AIM OF THE WORK

To determine the impact of direct stenting on post procedural TIMI flow in patients presenting with acute ST elevation Myocardial Infarction **(STEMI)** undergoing primary percutanous coronary intervention **(1^{ry}PCI)** .

Chapter One

Acute Myocardial Infarction (AMI)

Acute ST elevation myocardial infarction **(STEMI)** is the most serious presentation of athero-sclerotic coronary artery disease **(CAD)** carrying the most hazardous consequences and it is caused by occlusion of major coronary artery **(CA)**[(2)].

Universal Definition of acute myocardial infarction (AMI):

AMI is defined as a Detection of rise and/or fall of cardiac biomarker values (preferably troponin) with at least one value above the 99th percentile of the upper reference limit **(URL)** and with at least one of the following:

- Symptoms of ischaemia;
- New or presumably new significant ST-T changes or new left bundle branch block **(LBBB);**
- Development of pathological Q waves in the electro-cardiogram **(ECG);**
- Imaging evidence of new loss of viable myocardium, or new regional wall motion abnormality;
- Identification of an intracoronary thrombus by angiography or autopsy.
- Cardiac death with symptoms suggestive of myocardial ischaemia, and presumably new ECG changes or new LBBB, but death occurs before blood cardiac

biomarkers values are released or before cardiac biomarker values would be increased.

- Stent thrombosis associated with myocardial infarction **(MI)** when detected by coronary angiography or autopsy in the setting of myocardial ischaemia and with a rise and/or fall of cardiac biomarker values with at least one value above the 99th percentile URL.[5]

Clinical classification of different types of myocardial infarction :

- **Type 1 :** spontaneous myocardial infarction related to ischemia caused by a primary coronary event, such as plaque fissuring or rupture.
- **Type 2 :** myocardial infarction secondary to ischemia resulting from an imbalance between oxygen supply and demand.
- **Type 3 :** sudden death from cardiac disease with symptoms of myocardial ischemia, accompanied by new ST-elevation or LBBB, or verified coronary thrombus at angiography and/or autopsy.
- **Type 4 :** myocardial infarction associated with percutanous coronary intervention **(PCI).**
- **Type 5 :** myocardial infarction associated with coronary artery bypass grafting (CABG).[6]

Etiology :

Atherosclerosis is the disease primarily responsible for most acute coronary syndrome **(ACS)** cases. Approximately 90% of myocardial infarctions result from an acute thrombus that obstructs an atherosclerotic coronary artery. Plaque rupture and erosion are considered to be the major triggers for coronary thrombosis. Following plaque erosion or rupture, platelet activation and aggregation, coagulation pathway activation, and endothelial vasoconstriction occur, leading to coronary thrombosis and occlusion. Coronary atherosclerosis is especially prominent near branching points of vessels.[7]

Diagnosis of acute STEMI :

1. History and physical examination.

2. Resting 12 lead ECG :

Diagnosis of acute MI requires ST elevation of 1 mm or more in two or more contiguous leads, often with reciprocal ST depression in the contralateral leads. In leads V_{2-} V_3 2mm of ST elevation in men and 1.5 mm in women.

ST-segment elevation can be divided into sub groups that may be correlated with the infarct-related artery **(IRA)** and risk for death, **(Table 1).**[8]

Table (1) : Distribution of ECG changes in STEMI[8].

Distribution	Name	Artery affected
V1-V3, possibly I,II	Anteroseptal	LAD or a major branch
I,II, aVL, V1-V4/5	Anterlateral	LAD, probably proximal
I,II, aVL, V5/6	Lateral	Diagonal branch of LAD or circumflex
II,III,aVF	Inferior	Right (circumflex if ST elevation in lead III greater than that in lead II)
V1-V3 (ST depression)	Posterior	Circumflex

LAD: left anterior descending artery

3. Laboratory investigations including cardiac biomarkers :

A. Creatinine Kinase. An elevated level of creatinine kinase **(CK)** is rarely helpful in making the diagnosis of acute MI for a patient with ST-segment elevation. Because it takes usually 4 to 6 hours to see an appreciable rise in CK level; a normal value may signify recent complete occlusion. CK levels peak at 24 hours, but the peak CK level is believed to occur earlier among patients who undergo successful reperfusion.

B. Troponin T and troponin I assays are particularly useful in the diagnosis and management of unstable angina **(UA)** and non ST elevation myocardial infarction

(NSTEMI) because of their high sensitivity and ability to be interpreted rapidly at bedside. The lag time (3 to 6 hours) between occlusion and detectable elevation in serum levels limits their usefulness in the diagnosis of acute STEMI. Data have suggested that a single troponin T concentration measured 72 hours after acute MI may be predictive of MI size, independent of reperfusion.[9]

4. Echo cardiography :

May aid in confirmation of the diagnosis of the acute STEMI if the final diagnosis is still doubtful by detecting generalized or regional wall motion abnormality.

Chapter Two
Myocardial Reperfusion

In STEMI patients, the decision as to whether the patient will be treated with thrombolysis or primary percutanous coronary intervention **(1^{ry}PCI)** should be made within the next 10 minutes. Treatment options include the immediate start of intravenous **(IV)** thrombolysis in the emergency department **(ED)** or the immediate transfer of the patient to the cardiac catheterization laboratory for primary per-cutanous trans-luminal coronary angioplasty **(PTCA).** The goal for patients with STEMI should be to achieve a door-to-drug time of within 30 minutes and a door-to-balloon time of within 90 minutes.[10]

Thrombolytic Agents and Mechanical Revascularization

Thrombolytic Therapy (Fibrinolysis and subsequent interventions)

Benefit of fibrinolysis

Fibrinolysis is an important reperfusion strategy, particularly in those settings where 1^{ry}PCI cannot be offered to STEMI patients within the recommended timelines.

The benefit of fibrinolytic therapy in patients with STEMI is well established:[11] compared with placebo, approximately 30 early deaths are prevented per 1000 patients treated within 6 h after symptom onset.

Overall, the largest absolute benefit is seen among patients with the highest risk.[12]

Time to treatment

An analysis of studies in which 6000 patients were randomized to pre-hospital or in-hospital thrombolysis, showed a significant reduction (17%) in early mortality with pre-hospital treatment.[13]

In a meta-analysis of 22 trials,[14] a much larger mortality reduction was found in patients treated within the first 2 h than in those treated later. These data support pre-hospital initiation of fibrinolytic treatment if this reperfusion strategy is indicated.[15] A post-hoc analyses of several randomized trials and data from registries have confirmed the clinical usefulness of pre-hospital fibrinolysis.[16]

Most of these studies reported outcome data similar to those of 1^{ry}PCI, provided that early angiography and PCI were performed in those needing intervention (especially those who appear to have failed lysis).[17]