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RECENT ADVANCEMENT IN THE MANAGEMENT OF ST-ELEVATION MYOCARDIAL INFARCTION (STEMI)

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ABSTRACT

Heart Attack or Myocardial Infarction is a medical emergency caused by the blockage of blood flow to the heart. Without sufficient blood flow, the myocardial cells become deprived of oxygen and get infarcted and eventually death of myocardial cells occurs. Later it can lead to heart failure and life threatening condition. ST- elevation myocardial infarction (STEMI) is more dangerous than Non ST-elevation myocardial infarction as it is caused by complete occlusion of coronary artery. Therefore the management of STEMI is very important. The treatment procedure includes Fibrinolysis, Percutaneous Coronary Intervention (PCI), Coronary Artery Bypass Grafting (CABG) and these primary preventive methods followed by secondary preventive methods.

KEYWORDS: STEMI, PCI, CABG, Fibrinolytics.

INTRODUCTION

Myocardial infarction, which is also known as heart attack occurs when blood flow to the heart decreases or stops to a part of the heart causing permanent damage to the heart.[1] Now a days MI are the most reported case among cardiovascular disease and major reason for death among cardiovascular patients. Based on the severity of occlusion and ST–Elevation on ECG findings, MI can be classified into 2 categories ie; ST-Elevation Myocardial Infarction (STEMI) and Non ST-Elevation Myocardial Infarction (NSTEMI). STEMI are more dangerous than NSTEMI and the treatment includes surgical procedures rather than drug therapy. STEMI occurs when complete occlusion of artery occurs and tissues become deprived of oxygen due reduced blood supply. Therefore the management of STEMI is very important.

Pathogenesis
- Cholesterol deposits in the coronary artery.
- The deposited cholesterol forms plaques within the artery, known as atherosclerotic plaque.
- This plaque may rupture to form thrombus within the artery by the activation of clotting mechanism.
- This occlusive thrombus interrupts blood supply to the heart by the complete occlusion of the coronary artery.
- It can cause death or irreversible damage to the myocardial cells which results in the development of ST-Elevation Myocardial Infarction.

Aims of management
The primary concern is to prevent death, to minimize patient's discomfort and distress and to limit the extend of myocardial damage.
1. Emergency care is given to relieve pain and also to prevent cardiac arrest when main considerations are to make rapid diagnosis.
2. Initiating reperfusion therapy as soon as possible to limit infarct size and infarct extension.
3. Subsequent care in which the complications that usually ensure later are addressed.
4. Risks are assessed and measures to prevent progression of coronary artery disease, new infarction, heart failure and death.

Emergency care
Initial diagnosis and early risk stratification
A working diagnosis of myocardial infarction should be made first. This is usually based on severe chest pain lasting for 20min, evidence of autonomic nervous system activation (pallor, sweating) irregularities of pulse, bradycardia or tachycardia, faintness or syncope, previous history of coronary artery disease etc.

An electrocardiogram should be obtained as soon as possible. Repeated ECG recordings should be taken and when possible it should be compared with previous one.[2,3] In case of ST-Elevation (in case of STEMI) reperfusion therapy needs to be given and measures to initiate this treatment must be taken as soon as possible. Blood test should be done to check elevated cardiac

markers, but not wait for the results to initiate reperfusion treatment.

Two- dimensional echocardiography is also a useful technique to check motion abnormalities after coronary occlusion. Myocardial perfusion scintigraphy is also helpful to rule out acute myocardial infarction.

Relief of pain, breathlessness and anxiety
Relief of pain is the first aim to be achieved. Intravenous opioids like morphine (4-8mg), diamorphine are the commonly used analgesics. If the opioids fail to relieve the pain after repeated administration, intravenous beta-blockers or nitrates can be used. Oxygen (2-4 L/min) should be administered to people suffering from breathlessness. Tranquilizers should be used in addition to opioids in excessively disturbed patients.

Pre- hospital or early in-hospital care
Restoring coronary flow and myocardial tissue perfusion For patients with presentation of myocardial infarction and with persistent ST-segment elevation, early mechanical or pharmacological reperfusion should be performed unless clear contraindications are present.

Fibrinolytic treatment
The evidence for benefit
For patients within 12 hours of onset of symptoms of infarction, evidence for the benefit of fibrinolytic treatment is overwhelming.

According to the Fibrinolytic Therapy Trialists(FTT) analysis, approximately 30 deaths are prevented per1000 patients treated within 6 hr of symptom onset and 20 deaths prevented per 1000 patients treated for those between 7-12 hr.

Fibrinolytic regimen
Fibrinolytics are the preferred pharmacological class for the management of STEMI due to their ability to achieve reperfusion when administered within 12 hours of symptom onset. The US approved fibrinolytic agents for the treatment of STEMI are streptokinase, alteplase, reteplase and tenecteplase. Alteplase is given as iv infusion. Reteplase is administered as double bolus and tenecteplase is given as single bolus. Fibrinolytic therapy should not begiven to patients with symptoms more than 12 hr, because there is no convincing evidence of benefit beyond 12 hr.[4-9]

Table 1: Fibrinolytic regimen for acute myocardial infarction.ss.

Drugs	Initial treatment	Antithrombin cotherapy	Specific contraindications
Streptokinase (SK)	1.5 million units in 100ml of 5% saline over 30-60min.	None or i.v heparin for 24 to 48 hr	Prior SK or anistreplase
Alteplase (tPA)	15 mg i.v bolus 0.75mg/kg over 30 min then 0.5mg/kg over 60min i.v Total dosage not exceed 100 mg	i.v heparin for 24 to 48 hr	
Reteplase (r-PA)	10 U +10 U i.v bolus given 30 min apart	i.v heparin for 24 to 48 hr	
Tenecteplase (TNK-tPA)	Single i.v bolus 30 mg if <60 kg 35 mg if 60 to <70 kg 40 mg if 70 to <80 kg 45 mg if 80 to <90 kg 50 mg if ≥90 kg	i.v heparin for 24 to 48 hr	

N.B. Aspirin should be given to all patients without contraindications.

Table 2: Contra-indications to fibrinolytic therapy.

Absolute contraindication	Relative contraindications
Haemorrhagic stroke or stroke of unknown origin at any time **Ischaemic stroke in preceding 6 months** **Central nervous system damage or neoplasms** **Recent major trauma/surgery/head injury (within preceding 3 weeks)** **Gastro-intestinal bleeding within the last month** **Known bleeding disorder** **Aortic dissection**	Transient ischaemic attack in preceding 6 months Oral anticoagulant therapy Pregnancy or within 1 week post partum Non- compressible punctures Traumatic resuscitation Refractory hypertension (systolic blood pressure >180 mm hg) Advanced liver disease Infective endocarditis Active peptic ulcer

Percutaneous Coronary Intervention (PCI)
Percutaneous coronary intervention is the first choice of treatment for STEMI, if it is available. PCI can be divided into primary PCI, PCI combined with pharmacological reperfusion therapy and 'rescue PCI' after failed pharmacological reperfusion.

Primary PCI
This is defined as angioplasty and stenting are performed without prior or concomitant fibrinolytic therapy and it is the preferred option when performed within 90min after the first medical contact. It is only performed in hospitals with an established interventional cardiology programme.

The PCI procedure involves the insertion of a catheter into the blood vessels of the arm or groin. Using fluoroscopy X-ray technique the catheter is threaded through the coronary artery where it is blocked. When the catheter tip is in place, the balloon tip covered with stent is inflated and compresses the plaque and expands the stent. Once the plaque is compressed and stent is in place, the balloon is deflated and withdrawn. The stent stays in the artery, holding it open and now a days, dug eluting stents are used to prevent tissue proliferation.[10,11]

Primary PCI is effective in maintaining and securing coronary artery potency and avoids bleeding risk of fibrinolytics. Primary PCI is the preferred treatment for patients in shock.
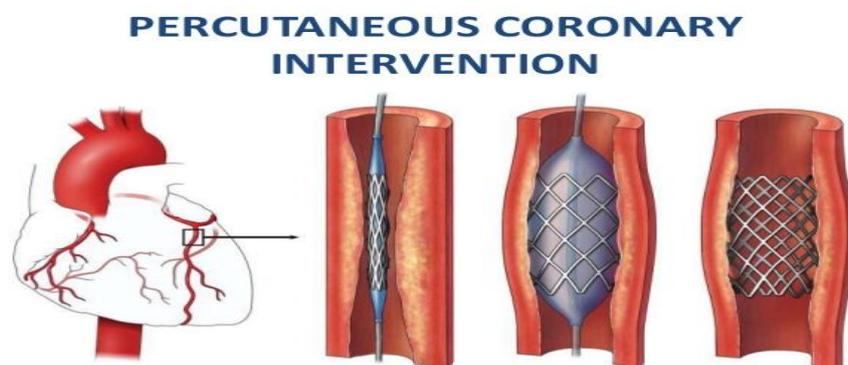

Figure 1: Percutaneous Coronary Intervention (PCI).

PCI combined with fibrinolysis
PCI is performed immediately after fibrinolytic therapy in order to enhance reperfusion or reduce the risk of reocclusion. The availability of stents and more potent antiplatelet agent have made PCI after fibrinolysis effective and safe. The combined pre-hospital pharmacological and mechanical reperfusion strategy is proved to be beneficial.[12,15]

Rescue PCI
'Rescue PCI' is defined as the PCI performed on a coronary artery which remains occluded despite fibrinolytic therapy. Limited data from a number of

studies indicate that transfer to a tertiary care hospital for rescue PCI can be performed safely. Coronary intervention in patients who received full-dose fibrinolytics and glycoprotein IIb/IIIa antagonist may lead to excessive bleeding complications.[16]

Coronary Artery Bypass Grafting (CABG)
A number of patients need coronary artery bypass surgery in the acute phase of myocardial infarction. In the CABG procedure, a healthy artery or vein from the body is grafted to the blocked coronary artery. The grafted artery bypasses the blocked coronary artery and thus becomes a new path for blood flow to the heart.
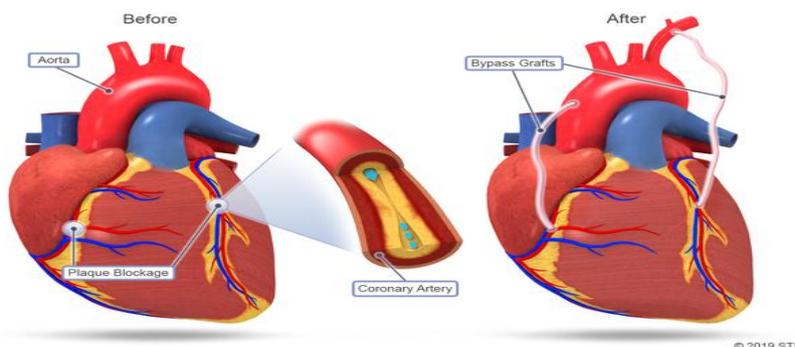

Figure 2: Coronary Artery Bypass Grafting (CABG).

Secondary prevention
Diet and dietary supplements
According to the Lyon Diet Heart study, all patients should be advised to take Mediterranean type diet which is low in saturated fat, high in polyunsaturated fat and high in fruits and vegetables.

Antiplatelet therapy
The Antiplatelet Trialists collaboration meta analysis demonstrated about a 25% reduction in reinfarction and death in post infarction patients. Aspirin is the most prescribed antiplatelet drug and doses ranged from75 to 325 mg daily. Oral anticoagulation can be considered in patients who cannot tolerate aspirin. In patients who do not tolerate aspirin, clopidogrel-a thienopyridine, is considered to be good alternate antiplatelet therapy.

Beta-blockers
Beta-blockers are used in patients after PCI, because of their potential to limit infarct size, to reduce the incidence of fatal arrhythmias, and to relieve pain. Normally beta-blockers are used to control high blood pressure and metoprolol were the most prescribed one. Evidence from available studies suggests that beta-blockers should be used indefinitely in all patients who recovered from acute myocardial infarction and without any contraindications.

Calcium antagonists
The benefit of calcium channel antagonists are much weaker than beta-blockers. Verapamil and diltiazem can be used in patients when beta-blockers are contraindicated.

Angiotensin-converting enzyme (ACE) inhibitors
ACE Inhibitors reduce the mortality after acute myocardial infarction with reduced residual left ventricular function. The co-administration of aspirin and beta-blockers along with ACE Inhibitors reduce the chance of reinfarction after PCI.

Lipid-lowering agents
Lipid lowering agents are given to post MI patients to reduce the chance of reocclusion. Statin treatment should be extended to those with even lower lipid levels, including elderly patients. In patients with low HDL-cholesterol levels, a fibrate should be considered.

Table 3: Secondary prevention.[17]

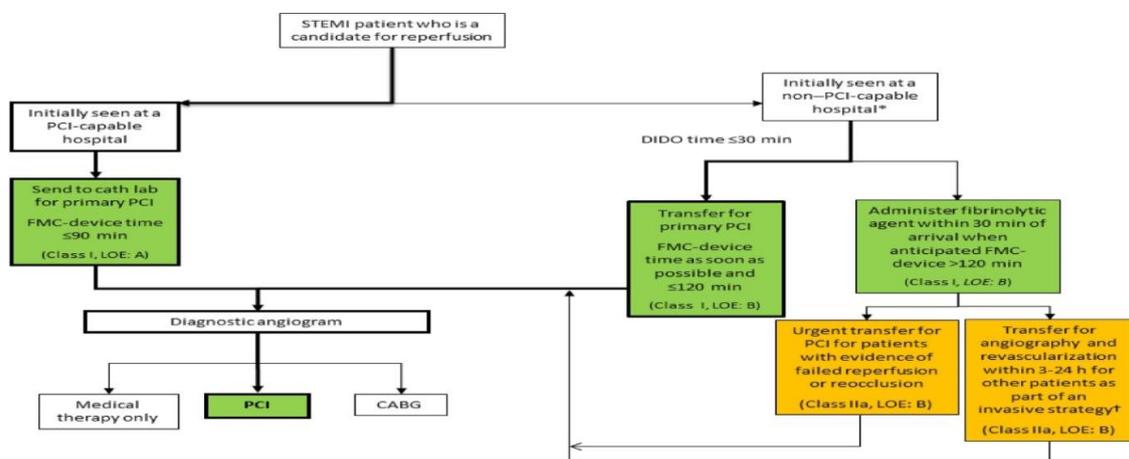| Recommendations |
|---|
| • **Stop smoking**
• **Optimal glycaemic control in diabetic patients**
• **Blood pressure control in hypertensive patients**
• **Mediterranean type diet**
• **Supplementation with 1g fish oil n-3 poly-unsaturated fatty acids**
• **Aspirin: 75-325 mg daily**
If aspirin is not tolerated
Clopidogrel (75mg daily)
Oral anticoagulant
• **Oral beta-blockers: to all patients if no contraindications**
• **Continuation of ACE-Inhibition started on the first day**
• **Statins:**
If in spite of dietary measures total cholesterol>190mg/dl and LDL cholesterol>115mg/dl
• **Fibrates:**
If HDL cholesterol ≤45mg/dl and triglycerides ≥200mg/dl
• **Calcium antagonists (diltiazem or verapamil) if contra indications to beta-blockers and no heart failures** |

Figure 3: Treatment algorithm for STEMI.

CONCLUSION

Most of the MI occurs due to coronary artery disease and STEMI is the most life threatening among them. Therefore the management of STEMI is very important. Surgical intervention along with pharmacological therapy is the mostly used pattern and secondary prevention of STEMI is very important as same as primary prevention.

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