# Acute myocardial infarction management

Management of a patient with acute myocardial infarction (AMI) is a medical emergency. Local guidelines for the management of myocardial infarction should be followed where they exist.

Patients presenting with chest pain should not be told they have had a heart attack until they meet the universal criteria for myocardial infarction. Up to that point the terminology recommended is 'acute coronary syndrome'. Further details about diagnosis can be found in the separate Acute coronary syndrome article.

Guidance on the standard of care which should be provided to patients with acute coronary syndrome has been published by the National Institute for Health and Care Excellence (NICE).[1]

This article deals principally with the management of AMI, once it has been confirmed that the patient meets the required criteria.

## Pre-hospital management

- Arrange an emergency ambulance if an AMI is suspected. Take an ECG as soon as possible but do not delay transfer to hospital, as an ECG is only of value in pre-hospital management if pre-hospital thrombolysis is being considered.
- Advise any patient known to have coronary heart disease to call for an emergency ambulance if the chest pain is unresponsive to glyceryl trinitrate (GTN) and has been present for longer than 15 minutes or on the basis of general clinical state - eg, severe dyspnoea or pain.
- Cardiopulmonary resuscitation and defibrillation in the event of a cardiac arrest.

- Oxygen: do not routinely administer oxygen but monitor oxygen saturation using pulse oximetry as soon as possible, ideally before hospital admission. Only offer supplemental oxygen to:[2]
    - People with oxygen saturation less than 94% who are not at risk of hypercapnic respiratory failure, aiming for saturation of 94-98%.
    - People with chronic obstructive pulmonary disease who are at risk of hypercapnic respiratory failure, to achieve a target saturation of 88-92% until blood gas analysis is available.
- Pain relief with GTN sublingual/spray and/or an intravenous opioid 2.5-5 mg diamorphine or 5-10 mg morphine intravenously.[2] Avoid intramuscular injections, as absorption is unreliable and the injection site may bleed if the patient later receives thrombolytic therapy.
- Aspirin 300 mg orally (dispersible or chewed).
- Insert a cannula for intravenous access and take blood tests for FBC, renal function and electrolytes, glucose, lipids, clotting screen, C-reactive protein (CRP) and cardiac enzymes (troponin I or T).
- Pre-hospital thrombolysis is indicated if the time from the initial call to arrival at hospital is likely to be over 30 minutes. When primary percutaneous coronary intervention cannot be provided within 120 minutes of ECG diagnosis, patients with an ST-segment-elevation acute coronary syndrome (ACS) should receive immediate (pre-hospital or admission) thrombolytic therapy.[3] When treating people with fibrinolysis, give an antithrombin at the same time[4]
- NICE recommends using intravenous bolus (reteplase or tenecteplase) rather than an infusion for pre-hospital thrombolysis.[5]

## Management initiated in hospital

- If not already done, insert an intravenous cannula and take blood tests for cardiac enzymes (troponin I or T), FBC, renal function and electrolytes, glucose, lipids, CRP, and clotting screen. See the separate Acute myocardial infarction article for a more detailed discussion of investigations.

- Continue close clinical monitoring (including symptoms, pulse, blood pressure, heart rhythm and oxygen saturation by pulse oximetry), oxygen therapy and pain relief.
- ECG monitoring: features that increase the likelihood of infarction are: new ST-segment elevation; new Q waves; any ST-segment elevation; new conduction defect. Other features of ischaemia are ST-segment depression and T-wave inversion.
- Conduct a risk for future cardiovascular events assessment using a standard scoring system that predicts six-month mortality - eg, the Global Registry of Acute Cardiac Events (GRACE) risk score [6]. Using this assessment as a guide, along with consideration of comorbidities and bleeding risk, determine whether a conservative or invasive strategy should be employed. See the separate Acute coronary syndrome article for more details.
- Consider conservative management without early coronary angiography for people with unstable angina or non-ST-elevation myocardial infarction (NSTEMI) who have a low risk of adverse cardiovascular events (predicted six-month mortality 3.0% or less). In such cases offer prasugrel or ticagrelor with aspirin, unless the bleeding risk is high, in which case use clopidogrel and aspirin.
- For patients with unstable angina or NSTEMI undergoing coronary angiography, offer prasugrel or ticagrelor with aspirin, once coronary anatomy has been determined and PCI is intended. Consider bleeding risk in patients offered prasugrel who are over 75. If there is a separate indication for ongoing oral anticoagulation, use clopidogrel with aspirin.

## Reperfusion [3] [4] [7]

Patency of the occluded artery can be restored by percutaneous coronary intervention (PCI) or by giving a thrombolytic drug. PCI is the preferred method. Compared to a conservative strategy, an invasive strategy (PCI or coronary artery bypass graft (CABG) surgery) is associated with reduced rates of refractory angina and rehospitalisation in the shorter term and myocardial infarction in the longer term. However, there is a doubled risk of procedure-related heart attack and increased risk of bleeding and procedural biomarker leak. [8]

## Primary PCI

- Primary angioplasty provides an early assessment of the extent of the underlying disease. See the separate Percutaneous coronary intervention article.
- Any delay in primary PCI after a patient arrives at hospital is associated with higher mortality in hospital. Time to treatment should therefore be as short as possible.
- There is general agreement that PCI should be considered if there is an ST-elevation ACS, if symptoms started up to 12 hours previously. The relevant NICE Quality Standard for adults advises that patients with acute ST-segment-elevation myocardial infarction (STEMI) who present within 12 hours of onset of symptoms have primary percutaneous coronary intervention (PCI), as the preferred coronary reperfusion strategy, as soon as possible but within 120 minutes of the time when fibrinolysis could have been given [1]. There is no consensus whether PCI is also beneficial in patients presenting more than 12 hours from the onset of symptoms in the absence of clinical and/or ECG evidence of ongoing ischaemia.
- Patients should receive a glycoprotein IIb/IIIa inhibitor as an adjunct to PCI in patients with intermediate to high risk, to reduce the risk of immediate vascular occlusion, and should also receive either unfractionated heparin, a low molecular weight heparin (eg, enoxaparin), or bivalirudin.
- Prasugrel in combination with aspirin is recommended as an option for preventing atherothrombotic events in adults with unstable angina, NSTEMI or STEMI having primary or delayed PCI. In patients with increased bleeding risk, consider ticagrelor or clopidogrel as alternatives.
- Balloon angioplasty following myocardial infarction reduces death, non-fatal myocardial infarction and stroke compared with thrombolytic reperfusion. However, up to 50% of patients experience re-stenosis and 3-5% recurrent myocardial infarction. [9]
- There is no evidence to suggest that primary stenting reduces mortality when compared with balloon angioplasty but stenting seems to be associated with a reduced risk of re-infarction and target vessel revascularisation. [9]

- NICE therefore recommends that intracoronary drug-eluting stent implantation should be used in patients with STEMI, NSTEMI and unstable angina undergoing primary PCI.

### Facilitated PCI

- Facilitated PCI is the use of pharmacological reperfusion treatment delivered prior to a planned PCI.
- There is no evidence of a significant clinical benefit and so facilitated PCI is currently not recommended.

### Rescue PCI

- Rescue PCI is defined as PCI performed on a coronary artery which remains occluded despite fibrinolytic therapy.
- Rescue PCI is associated with a significant reduction in heart failure and re-infarction and a lower all-cause mortality and so should be considered when there is evidence of failed fibrinolysis based on clinical signs and insufficient ST-segment resolution, if there is clinical or ECG evidence of a large infarct and if the procedure can be performed less than 12 hours after the onset of symptoms.

### Fibrinolytic drugs

For patients who cannot be offered PCI within 120 minutes of the time when fibrinolysis should have been given, a thrombolytic drug should be administered along with either unfractionated heparin (for maximum two days), a low molecular weight heparin (eg, enoxaparin) or fondaparinux. Thrombolytic drugs break down the thrombus so that the blood flow to the heart muscle can be restored to prevent further damage and assist healing.

Reperfusion by thrombolysis is often gradual and incomplete and may be inadequate. There is a risk of early or late reocclusion and a 1-2% risk of intracranial haemorrhage.

- Fibrinolytic drugs act as thrombolytics by activating plasminogen to form plasmin, which degrades fibrin and so breaks up the thrombi.
- Streptokinase and alteplase have been shown to reduce mortality. Reteplase and tenecteplase are also licensed for AMI.

- Streptokinase and alteplase are given by intravenous infusion. Reteplase and tenecteplase can be given by rapid bolus injection.
- The benefit is greatest in those with ECG changes that include ST-segment elevation (especially in those with anterior infarction) and in patients with bundle branch block.
- The earlier the treatment is given, the greater the absolute benefit. Alteplase, reteplase and streptokinase need to be given within 12 hours of symptom onset, ideally within one hour. Tenecteplase should be given as early as possible and usually within six hours of symptom onset.
- Bleeding complications are the main risks associated with thrombolysis. Contra-indications for thrombolysis include patients with bleeding disorders, or a history of recent haemorrhage, trauma, surgery or acute cerebrovascular event.
- Persistence of antibodies to streptokinase can reduce the effectiveness of subsequent treatment and so streptokinase should not be used again after the first administration.

### Patients not given reperfusion therapy[4]

- In patients with STEMI presenting within 12 hours after the onset of symptoms but reperfusion therapy is not given, or in patients presenting after 12 hours, offer ticagrelor, as part of dual antiplatelet therapy with aspirin, unless they have a high bleeding risk.
- Consider clopidogrel, as part of dual antiplatelet therapy with aspirin, or aspirin alone, for people with acute STEMI not treated with PCI, if they have a high bleeding risk.
- For patients who do not receive reperfusion therapy, angiography before hospital discharge is recommended (as for patients after successful fibrinolysis) if no contra-indications are present.

### Coronary bypass surgery

- Only a few patients need a CABG in the acute phase but CABG may be indicated:
    - After failed PCI, coronary occlusion not amenable for PCI, or the presence of refractory symptoms after PCI.
    - Cardiogenic shock, or mechanical complications - eg, ventricular rupture, acute mitral regurgitation, or ventricular septal defect.
    - Multivessel disease.
- In patients with a non-emergency indication for CABG (eg, multisystem disease), it is recommended to treat the infarct-related lesion by PCI and to perform CABG later in more stable conditions if possible.

## Other initial management

- Antiplatelet agent:
    - Long-term low-dose aspirin reduces overall mortality, non-fatal re-infarction, non-fatal stroke and vascular death.
    - Clopidogrel, in combination with low-dose aspirin, is recommended for AMI with ST-segment elevation; the combination is licensed for at least four weeks but the optimum treatment duration has not been established. Treatment with clopidogrel and aspirin for up to one year following PCI has also been shown to be cost-effective.[10]
    - Clopidogrel monotherapy is an alternative when aspirin is contra-indicated.
    - Ticagrelor in combination with low-dose aspirin is recommended by NICE for up to 12 months as a treatment option in adults with STEMI that cardiologists intend to treat with primary PCI.[11] This combination is also offered where PCI is not contemplated, unless there is a high bleeding risk. In such cases, clopidogrel with aspirin, or aspirin alone, should be considered.

- Beta-blockers:
    - When started within hours of infarction, beta-blockers reduce mortality, non-fatal cardiac arrest and non-fatal re-infarction.
    - Unless contra-indicated, the usual regime is to give intravenously on admission and then continue orally - titrate upwards to the maximum tolerated dose.
    - The calcium-channel blockers diltiazem or verapamil can be used if a beta-blocker cannot be used but diltiazem and verapamil are contra-indicated in patients with left ventricular dysfunction.
- Angiotensin-converting enzyme (ACE) inhibitors:
    - These reduce mortality whether or not patients have clinical heart failure or left ventricular dysfunction. They also reduce the risk of non-fatal heart failure.
    - Titrate the dose upwards to the maximum tolerated or target dose. Measure renal function, electrolytes and blood pressure before starting an ACE inhibitor (or angiotensin-II receptor antagonist) and again within 1-2 weeks.
- Cholesterol-lowering agents:
    - Ideally, initiate therapy with a statin as soon as possible for all patients with evidence of cardiovascular disease (CVD) unless contra-indicated.
- Patients who have a left ventricular ejection fraction of 0.4 or less and either diabetes or clinical signs of heart failure should receive the aldosterone antagonist eplerenone (started within 3-14 days of the myocardial infarction and ideally after ACE inhibitor therapy) unless contra-indicated by renal impairment or hyperkalaemia (left ventricular function should be assessed in all patients with AMI during the initial hospital admission).[3]

- Other treatment:
    - Heparin infusion is used as an adjunctive agent in patients receiving alteplase but not with streptokinase. Heparin is also indicated in patients undergoing primary angioplasty.
    - Prophylaxis against thromboembolism: if not already receiving heparin by infusion, then patients should be given regular subcutaneous heparin until fully mobile.
    - Insulin-glucose infusion followed by intensive glucose control with subcutaneous insulin for all people with type 1 and type 2 diabetes.
    - The routine use of nitrates, calcium antagonists, magnesium, and high-dose glucose-insulin-potassium infusion is not currently recommended during the acute phase of treatment of AMI.

## Cardiac assessment and revascularisation

Early risk assessment will help identify high-risk patients who may require early further management with angiography, and coronary revascularisation. Methods of cardiac assessment vary according to local availability and expertise.

- Routine exercise ECG testing: submaximal testing is increasingly performed before hospital discharge at 4-7 days. A symptom-limited test can be performed at 3-6 weeks post-infarction in order to assess prognosis and to identify those patients with reversible ischaemia (who should then have an angiogram to assess the need for CABG).
- Myocardial perfusion imaging scintigraphy (MPS) using single-photon emission computerised tomography (SPECT) is recommended by NICE as part of the investigational strategy in the management of established CAD in people who remain symptomatic following myocardial infarction or reperfusion interventions. [12]

- Echocardiography is helpful if the diagnosis is in question, can define the extent of the infarction and can identify complications, such as acute mitral regurgitation, left ventricular rupture or pericardial effusion
- Coronary angiography should ideally be performed for all patients prior to discharge from hospital.

## Further management of patients after a myocardial infarction [4]

See the separate Cardiovascular risk assessment article.

## Driving after acute coronary syndromes (including acute myocardial infarction) [13]

- Group 1 entitlement: ordinary driving licence for car or motorcycle:
  - If successfully treated by coronary angioplasty, driving may recommence after one week, provided:
    - No other URGENT revascularisation is planned (within four weeks from the acute event).
    - Left ventricular ejection fraction (the fraction of blood pumped out of the left ventricle with each heartbeat) is at least 40% prior to hospital discharge.
    - There is no other disqualifying condition.
  - If not successfully treated by coronary angioplasty, driving may recommence after four weeks provided there is no other disqualifying condition.
  - The Driver and Vehicle Licensing Agency (DVLA) does not need to be notified.

- Group 2 entitlement: vocational drivers of large goods vehicles or passenger-carrying vehicles:
    - All acute coronary syndromes disqualify the licence holder from driving for at least six weeks.
    - Relicensing may be permitted thereafter, provided:
        - The exercise/other functional test requirements can be met.
        - There is no other disqualifying condition.
    - A left ventricular ejection fraction of below 40% is considered a bar to Group 2 entitlement.
    - The DVLA must be notified.

## Employment

- Advice will vary according to the type of employment, general health of the patient, severity of infarction and complications.
- In most cases, returning to work should not be delayed beyond three months, as a successful return is less likely as time goes on.
- Patients who have had a cardiac arrest or undergone CABG generally take longer to recover physically and cognitively and may require up to six months off work.

## Complications following a myocardial infarction

See the separate Complications of acute myocardial infarction article.

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## Further reading

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12. Myocardial perfusion scintigraphy for the diagnosis and management of angina and myocardial infarction; NICE Technology Appraisal Guidance, November 2003 (last updated July 2011)
13. Assessing fitness to drive: guide for medical professionals; Driver and Vehicle Licensing Agency

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