

Overview

Acute myocardial ischaemic states often with typical presentation (heavy/constricting central chest pain \pm radiation to arms, neck, R shoulder; SOB; N & V). Atypical chest pain or no chest pain (up to 30% silent ischaemia) occur too. [NB. stable angina not included in definition.]

Diagnosis Summary

ECG + ST Elevation criteria met: **STE-ACS** \rightarrow **STEMI**

Otherwise: **NSTE-ACS** \rightarrow **NSTEMI** (\uparrow Trp/CKMB) or **Unstable angina** (new, \uparrow freq or rest pain)

Management

1. Symptoms consistent with ACS

- Triage Category 2
- **O₂** if ongoing pain, SOB, SaO₂<93% (<88-92% in COAD), shock or overt HF
- **Aspirin** 150-300mg PO - dispersible/chewed (unless CI - anaphylaxis, bleeding disorder)
- Attach cardiac monitoring
- Insert cannula, take blood (TrpT, CK, FBC, UEC, Coags, BSL), 12-lead ECG & order CXR
- Give analgesia (**anginine** 600mg SL, **morphine** 2.5mg IV prn)

2. If ECG meets reperfusion criteria (≥ 1 mm ST \uparrow in 2 contiguous limb leads, or ≥ 2 mm in 2 contiguous chest leads, or new LBBB (\neq RBBB), <12h from onset or if ongoing ischaemic ECG/clinical signs >12 hrs from onset.)

- Choose reperfusion therapy (A, B or C):

N.B. DTBT=Door to balloon time, DTNT=Door to needle time, PCIRD=PCI related delay = DTBT - DTNT.

PCI only choice if thrombolysis CI. Otherwise decided on time from symptom onset:

<1h: PCI if DTBT<60min, else thrombolysis

1-3h: PCI if DTBT<90min or PCIRD \leq 60min, else thrombolysis

3-12h: PCI if DTBT<90min at PCI centre or PCIRD with tfr \leq 120min, else thrombolysis

12-36h: Consider PCI if patient symptomatic or unstable, esp if >75 y

A. PCI (in high-volume centre) [serious Cx 0.5%, mort reduction 6-7%]

Best outcomes for cardiogenic shock, large MI, <6hr, RV MI, prev CABG, elderly.

Cx: Embolic, dissection, tamponade, perforation, arrhythmia, contrast allergy/ARF, infection, bleeding, AV fistula.

B. Thrombolysis (Fibrinolysis) [serious Cx up to 2.5%, mort reduction 5%]

Best outcomes if DTNT<30min, <3h from onset, Ant MI, <65y.

Onset<6hr, <75y or SK CI:

- **tenecteplase** (TNK-tPA) - single bolus 30-50mg dep on wt.
- **reteplase** (r-PA) - 2 x 10u boluses 30min apart
- **alteplase** (t-PA) - 15mg IV, then 0.75mg/kg over 30min & 0.5mg/kg over 1hr. Max 100mg

Otherwise **streptokinase**(SK): 1.5million units over 30-60min IV \pm delayed heparin

CI: previous SK, recent sore throat/skin infection, sev. \downarrow BP, indigenous.

If given pre-H or in non-PCI centre, should tfr to PCI centre for angio/rescue PCI.

General Thrombolysis CI

- **Absolute**
 - ICH risk: PHx ICH, ischaemic CVA >3 h and ≤ 3 m, Brain AVM or Ca, \neq SAH, sig. HI/facial inj<3w
 - Bleeding risk: Active bleeding/diathesis, suspect aortic dissection
- **Relative**
 - ICH risk: Hx sev HT or SBP $>180 \pm$ DBP >110 , ischaemic CVA >3 m, dementia, other intracranial dz
 - Bleeding risk - oral anticoagulant, CPR >10 min, major trauma/surgery <3w, int bleeding<4w, active PUD, non-compressible vascular punctures, pregnancy (except in PE)

Sometimes pericarditis, endocarditis, advanced liver disease and diabetic retinopathy are listed too.

Thrombolysis Complications:

- CVA - ICH/ischaemic: Risks: >65yr, wt<70kg, HT, TPA use. ICH risk 0.25-2.5%
- Other haemorrhage risk = 10%
- Others: Allergy - SK 5%, TPA 1.5%, myocardial rupture (late use), bone pain (SK)

If thrombolysis fails to reperfuse by 90min, should perform rescue PCI within 12hr.

C. Surgery - CABG if suitable anatomy

Failed PCI, 3-vessel disease, structural damage, cardiogenic shock or ongoing ischaemia

- Also give:
 - **Clopidogrel** 300mg PO (600mg if PCI planned), unless acute CABG likely.
 - Or **prasugrel** 60mg PO if for PCI. **CI:** Hx of CVA/TIA, age>75, wt<60kg
 - Heparin:
 - **Unfractionated heparin** IV (60u/kg bolus then 12u/kg/hr) or
 - **Enoxaparin** 1mg/kg bd SC (0.75mg/kg if PCI, ↓dose if elderly/renal dysfn) or
 - **Fondaparinux** 2.5mg od SC if not for PCI or
 - **Bilvalirudin** IV (0.75mg/kg bolus then 1.75mg/kg/hr) if avail, PCI planned and renal dysfn or ↑bleeding risk, and anticoag not CI
 - β-blocker, statin, ±ACEI/ARB (if HT, CCF, LV dysfunction) started before d/c
 - Stress test/cardiac imaging before discharge
 - (?Glycoprotein IIb/IIIa inhibitor (**tirofiban**, **abciximab**, **eptifibatide**) at time of PCI)
- Other AMI Mx that may be required before reperfusion:
 - Treat arrhythmias: e.g. temporary AV block more common in inf AMI - may need:
 - **Atropine**, **isoprenaline** or pacing esp if complete block
 - Cardiogenic shock higher risk in ant AMI. May need nitrates, inotropes, CPAP, etc
 - If RV infarct avoid nitrates and give fluid to support preload and BP
 - Treat electrolyte abnormalities (esp hypo- & hyperkalaemia), maintain euglycaemia
 - Transfuse severe anaemia
 - Hypothermia (32-34°C) for 24h if <6h since arrest, ROSC<1h & not following cmds

3. If doesn't meet reperfusion criteria:

- Monitor chest pain, perform serial ECG & cardiac enzymes, usually 6-10hr post onset.
 - However if high sensitivity Troponin I assay available then when:
 - **Neg** (<99th centile) on pres & **Neg** (or ↑<50%) 3hr later & >6hrs post onset: **MI 'ruled out'**
 - **Neg** on pres but **Pos** (or ↑>50%) 3hr later: **MI likely**
 - **Pos** on pres & rising 6hr later: **late MI/DDx** (PE, CCF, myocarditis, dissection, RF, drugs)
- **Risk stratify:**

High Risk	Intermediate Risk
Hx: Repetitive / >10min ongoing CP	Hx: Resolved CP in last 48hr (repetitive / >10min)
PCI in last 6mo or prev CABG	Known coronary disease, PCI>6mo ago
Nocturnal pain	Peripheral or cerebrovascular disease
Syncope	DM & atypical ACS symptoms
LVEF<40%	CRF & atypical ACS symptoms
DM + typical ACS symptoms	Any 2 RF (HT, smoking, ↑lipids, FHx)
CRF + typical ACS symptoms	Age>65
ECG: Persistent/dynamic ST↓ ≥0.5mm	Regular aspirin for last 7d
New T inversion ≥2mm	ECG: No high risk changes on ECG
Transient ST↑ ≥0.5mm in 2 contiguous leads	Pathological Q waves
Sustained VT	
O/E: BPsyst<90mmHg or diaphoresis	Low Risk
Pulmonary oedema or LVF	ACS consistent pain
New/worsening MR	No high or intermediate features
Inv: TrpT>0.01mcg/L or ↑CK-MB	Normal ECG

High risk [or confirmed NSTEMI] (Admit monitored bed):

- **Aspirin** 100mg PO od unless CI.
- **Clopidogrel** 300mg PO stat then 75mg PO od, unless immediate PCI or CABG likely.
 - Alternative. **ticagrelor** not available in Australia currently
- Beta-blocker e.g. **metoprolol** 25mg PO bd. Consider ACEI, statin.
- **GTN** & **morphine** IV prn for pain: (**Nitrate CI**: RV MI, Viagra, hypoBP)
- Heparin (But discontinue **warfarin**):
 - **Unfractionated heparin** IV (60u/kg bolus then 12u/kg/hr) or
 - **Enoxaparin** 1mg/kg bd SC (0.75mg/kg if PCI, ↓dose if elderly/renal dysfn) or
 - **Fondaparinux** 2.5mg od SC if not for PCI or
 - **Bilvalirudin** IV (0.75mg/kg bolus then 1.75mg/kg/hr) if avail, PCI planned and renal dysfn or ↑bleeding risk, and anticoag not CI
- Glycoprotein IIb/IIIa inhibitor (**tirofiban**, **abciximab**) if DM OR STEMI/NSTEMI (i.e. ↑Trp + ECG changes + recurrent pain) OR invasive Mx planned.
- Invasive Mx: early angiography ± revascularisation unless severe co-morbidities.

Intermediate:

After further assessment period & serial ECG/cardiac enzymes:

If ECG changes or ↑Trp or recurrent pain → High Risk Mx.

Otherwise discharge with:

- **Aspirin** 100mg PO od unless CI.
- **Anginine** 600mcg SL prn
- Consider **Imdur** or **GTN** patches
- Action plan for further chest pain with urgent outpatient cardiac follow up
- Rest imaging/stress test before discharge or booked within 24-48hrs

Low (Discharge):

- **Aspirin** 100mg PO od unless CI.
- **Anginine** 600mcg SL prn
- Early cardiac f/u + rest imaging/stress test before discharge or booked within <7d

4. Long-term management:

- Lifestyle advice - smoking cessation, diet, exercise, moderate EtOH intake, weight Mx.
- Chest pain action plan, cardiac rehab and diabetic, hypertension & hyperlipidaemia control
- Implantable cardiac defibrillators - considered if persistently ↓LVEF (<40%).

Prognosis

Mortality: unstable angina: ~4.5% @ 30d, ~8.5% @ 6mo; NSTEMI: ~11 @ 30d, ~19% @ 6mo

STEMI: No Rx 30d mort: Ant (15%), Inf (8-10%) +RV/Post (30%), LBBB (20-30%)

Mort ~halves with aspirin & thrombolysis (each have 25% relative risk reduction).

Abs risk red = 5% (throm + aspirin), 6-7% (PCI+aspirin). Note that Cx rate ↓benefit esp Inf MI

TIMI (Thrombolysis in Myocardial Infarction) risk score for UA & NSTEMI

Score 1 for each of the following:

- Age >65yr
- ≥3 IHD risk factors (HT, hyperlipidaemia, early Fam Hx IHD, DM, active smoking)
- Known coronary artery stenosis ≥50%
- Aspirin use in the last 7d
- Severe angina (>2 episodes of rest pain in 24hr)
- ST deviation on ECG ≥0.5mm
- Elevated cardiac markers troponin or (CK-MB)

Risk of MI/urgent revasc/death within 14d: Total score 0-1: ~5% risk, 4: ~20% risk, 6-7: ~40%

Non-invasive tests for low-intermediate risk ACS

Tests may be at rest (e.g. looking for anatomic sign of disease e.g. >50% stenosis), or stressed (functional disease). Both may be required to establish/exclude the diagnosis in some.

Stress Tests

Particularly useful if pre-existing resting abnormalities, equivocal rest imaging or low risk. However limited in detecting degree of atheroma/vulnerable plaques.

Exercise Stress Test

- Treadmill/exercise bike protocols need to reach 85% of max predicted HR
- Cx 1:2,5000, mort 1:10,000
- CI: recent AMI, CCF, inability to exercise, LBBB, paced, WPW, Wellens', base-line ST changes, sig AV block, fever, HOCM, AS/MS, uncontrolled HT, pulm HT
- May be difficult to interpret if on BB, CCB, digoxin
- Pos if ↓ST (>1mm + pain, >3mm no pain), ↓BPsys>20 or ↑BPdia>15mmHg, STE, arrhythmia
- Unreliable in low risk (20% false pos), and so less predictive in women.
- Sens 70%(M) 60%(F). Spec 75%. Cannot rule ACS in or out, but OK for 1-6mo prognosis

Stress Radionuclide Myocardial Perfusion Imaging (^{99m}Tc sestamibi or tetrofosmin, ²⁰¹Thallium)

- Assess myocardial perfusion, contractility and may assess wall motion
- Useful for mod-low risk ACS and unable to exercise
- Exercise or drugs to dilate coronary arteries (e.g. dipyridamole, adenosine)
- Sens 85-90%. Spec 75%. Annual cardiac event rate<1% if normal.
- Disadvantage: Radiation exposure (~0.5-1x a chest CT)

Stress Echocardiography

- ?impaired myocardial contraction (marker for ischaemia) which precedes ECG changes
- Also evaluates LV impairment in ischaemia, and might detect other cause of CP
- Stressed by exercise, drugs (dobutamine, dipyridamole)
- Results operator dependent. Poor images if obese, lung disease or tachycardic.
- Sens 85%. Spec 75%

MRI Cardiac Stress Test

- Stressed by drugs (dobutamine, adenosine)
- Better sens/spec than stress echo, but less available & more costly

Stress PET

- Little evidence for use yet

Rest Imaging

If done when asymptomatic tests often less sensitive than during/shortly after acute episode.

Coronary CT Angiography

- Looks for plaques & stenosis>50%
- Can look for other causes of CP (PE, dissection - triple rule out"), but at higher rad cost
- Poor images if irreg/fast heart rate
- Disadvantages: Radiation, contrast (CI: renal dys)
- Good negative predictive value if normal.

Coronary Artery Calcium Scoring CT

- Looks for atherosclerotic calcified plaques, but 10-20% obstructive plaques not calcified
- Doesn't assess stenosis or stability of plaques.
- Agatston score (Normal 0 - >400 severe) for major vessels and overall.
- Score predictive of 6mo adverse CV event. Good negative predictive value if normal.
- No contrast req

(Echo or Myocardial Perfusion Imaging can be done at rest but less sensitive than if stressed)

ACS Management Chart

Acute Coronary Syndromes

