Approach to acute chest pain and acute coronary syndrome in adults

Opening Vignette

A 65-year-old Chinese woman with a background of diabetes mellitus, hypertension and hyperlipidaemia presented with sudden-onset retrosternal chest tightness that started 1 h ago, and this was associated with dyspnoea and diaphoresis. On examination, her haemodynamics were stable and cardiovascular and respiratory examination were unremarkable. Electrocardiogram (ECG) showed new widespread ST segment depressions in the anterolateral leads, with mildly elevated high-sensitivity troponins at 50 ng/L (reference range: ≤26.2 ng/L). As part of the on-call medical team attending to the patient, you diagnosed her with non-ST segment elevation myocardial infarction (NSTEMI).

DEFINITIONS OF KEY TERMS

Acute chest pain (ACP) refers to pain/discomfort over the anterior thoracic region. The traditional Diamond classification characterises typical angina based on the presence of three cardinal features — substernal chest discomfort, precipitated by exertion and relieved by rest or glyceryl trinitrate (GTN).[1] Ischaemic chest pain is also described as crushing, heavy or tight in character,[2,3] and may radiate to the left arm, neck or jaw.[2] Currently, stratification of chest pain into typical and atypical angina is discouraged due to clinical ambiguity,[2] with the 2021 American Heart Association/American College of Cardiology guidelines proposing the use of 'cardiac', 'possible cardiac' and 'noncardiac' descriptors when assessing the likelihood of ischaemic chest pain based on symptom characteristics, patient's age and cardiovascular risk factors.[2]

Acute coronary syndrome (ACS) is a subset of unstable/life-threatening forms of ischaemic heart disease (IHD) comprising unstable angina (UA), NSTEMI and ST segment elevation myocardial infarction (STEMI),[4] which typically warrant early coronary evaluation/intervention. In particular, UA is characterised by a crescendo pattern of angina, with increased frequency, duration (>15–20 min) and intensity, or pain at rest or refractory to GTN. Unstable angina is distinguished from NSTEMI by the absence of elevated cardiac biomarkers.

The fourth universal definition of myocardial infarction (MI) describes five aetiological categories of MI [Table S1, Supplemental Digital Appendix],[4] of which type 1 MI (T1MI; atherothrombotic disease) and type 2 MI (T2MI; myocardial oxygen supply/demand mismatch) are most commonly encountered. Diagnosis of MI requires a ≥20% rise and/or fall in troponin levels with at least one value >99th percentile of the upper reference limit, and at least one of the following:[2] (a) Clinical criteria: typical ischaemic symptoms; (b) Electrocardiographic criteria: new ischaemic ECG changes (e.g., new ST–T wave changes or new pathological Q waves); (c) Imaging criteria: imaging evidence of new regional wall motion abnormalities on echocardiography or new loss of viable myocardium on myocardial perfusion imaging (MPI); and (d) Anatomical criteria: identification of intracoronary thrombus on coronary angiography or during autopsy (for T1MI). Unlike MI, myocardial injury occurs when there is isolated hypertroponinaemia, without evidence of myocardial ischaemia.

PREVALENCE AND CAUSES

Acute chest pain accounts for 5%–11% of emergency department (ED) visits,[5,6] of which 5% have ACS[5] and 3% have a missed ACS diagnosis.[7] Chest pain can be broadly classified into cardiac and non-cardiac (e.g., respiratory, mediastinal, gastrointestinal, musculoskeletal/soft tissue) aetiologies [Table S2, Supplemental Digital Appendix], including life-threatening causes such as ACS, aortic dissection, pulmonary embolism, tension pneumothorax and perforated viscus.

CLINICAL APPROACH TO ACUTE CHEST PAIN

History taking

There are two components of history taking for ACP. Firstly, characterise the nature of chest pain using the SOCRATES tool:[8] (a) Site: retrosternal/central (stable angina/ACS, pericarditis, gastro-oesophageal reflux disease [GERD]), right/left anterior chest (lung/pleural pathology, chest wall syndromes), epigastrium (gallstone disease, pancreatitis, peptic ulcer disease [PUD]), costochondral junction (costochondritis); (b) Onset: sudden (ACS, aortic dissection, perforated viscus), gradual (other subacute pathologies); (c) Character: heavy/crushing/tightness (anginal), pleuritic (pleurisy), sharp/stabbing (pericarditis, pleurisy, neuropathic, chest wall syndromes), burning (GERD, PUD); (d) Radiation: to neck/jaw/arm (ACS), back (aortic dissection, pancreatitis), right shoulder (gallstone disease); (e) Alleviating factors: rest/GTN use (anginal), sitting up and leaning forwards (pericarditis, pancreatitis), antacids)(GERD), analgesia/anti-inflammatory medications (musculoskeletal); (f) Timing: association with meals (GERD,

PUD, gallstone disease); (g) Exacerbating factors: exertion/emotional stress (anginal), lying flat (GERD, pericarditis, pancreatitis), deep inspiration (pleurisy), palpation/chest wall movement /coughing (musculoskeletal); and (h) Severity: pain score 1–10.

Secondly, identify associated symptoms, significant negatives and predisposing risk factors to assess the likelihood of clinical differentials. For example, patients with MI may have anginal chest pain associated with breathlessness, palpitations and diaphoresis, with a background of significant cardiovascular risk factors. However, we must also be cognisant of atypical presentations of MI, which are more commonly observed in elderly, female and diabetic patients.[9]

Physical examination

Clinical examination comprises four main objectives. Firstly, haemodynamic assessment is required to identify patients who need urgent resuscitation, stabilisation and escalation of care. For example, the presence of hypotension in MI may be concerning for cardiogenic shock, whereas inter-arm differential systolic blood pressures >20 mmHg may be suggestive of aortic dissection. Secondly, a detailed cardiovascular examination is required to identify complications of myocardial ischaemia, such as acute decompensated heart failure, ventricular septal rupture, ischaemic mitral regurgitation and tachy/bradyarrhythmias. Thirdly, a targeted examination to exclude other differentials should be performed, such as respiratory examination for features of pneumonia/pneumothorax, abdominal examination for peritonism in perforated viscus and chest wall inspection/palpation for musculoskeletal pathologies. Finally, observe for features suggestive of atherosclerotic disease (e.g., Frank's earlobe crease sign[10]), underlying cardiovascular risk factors (insulin injection marks, xanthelasma/tendon xanthoma, nicotine/tar stains) and microvascular/macrovascular end-organ complications (e.g., previous coronary artery bypass graft and vein harvesting scars, residual hemiplegia from previous stroke, stigmata of end-stage renal disease or presence of dialysis vascular access, signs of peripheral arterial disease, peripheral neuropathy).

INVESTIGATIONS FOR ACUTE CHEST PAIN

Broadly, investigations for ACP include ECG, biomarkers (cardiac enzymes and other laboratory tests) and imaging modalities.

Firstly, ECG is a standard point-of-care test in all patients with ACP. In patients with persistent symptoms or high clinical suspicion of ACS, serial ECG should be repeated to look for evolving ST–T wave changes of myocardial ischaemia. There are classical ECG features of STEMI [Figure S3A, Supplemental Digital Appendix] and STEMI equivalents, including left main coronary artery occlusion [Figure S3B, Supplemental Digital Appendix], Wellen's syndrome (suggestive of critical proximal left anterior descending [LAD] coronary artery stenosis) [Figure S3C, Supplemental Digital Appendix] and de Winter T waves (suggestive of acute proximal LAD occlusion) [Figure S3D, Supplemental Digital Appendix]. A new-onset left bundle brunch block (LBBB) used to be considered a STEMI or occlusion MI equivalent; however, this finding should be interpreted in the context of clinical and biochemical findings to determine if there is concern of ongoing myocardial ischaemia that warrants urgent reperfusion therapy.[11] In cases of pre-existing LBBB, modified Sgarbossa's criteria are used to identify STEMI.[12] New-onset right bundle brunch block in occlusion MI may also suggest an occlusion of a proximal septal perforating branch of LAD,[13] which is associated with a large infarct size, higher rates of heart failure, heart block and overall mortality.[14] On the other hand, ECG features of NSTEMI typically include ST depressions and/or T wave inversions [Figure S3E, Supplemental Digital Appendix]. Recently, the Aslanger pattern was described in 6.3% of NSTEMI patients, which portends an inferior occlusive MI, associated with larger infarct size, multivessel disease and higher mortality rates.[15]

Secondly, high-sensitivity cardiac troponins are gold standard biomarkers for diagnosing MI.[4] High-sensitivity troponin I has a higher diagnostic accuracy than troponin T, with sensitivity and specificity >90% when performed on admission.[16] In patients presenting <6 h from the onset of chest pain with a normal first set of high-sensitivity troponins, trending of a second set of troponins at the 3-h mark confers at least 98% negative predictive value for MI.[17] Nonetheless, serial troponin testing beyond the initial two sets may occasionally be helpful to assess for re-infarction in the presence of new/recurrent ischaemic chest pain and/or ECG changes[4] or for prognostication in acute myocarditis.[18]

Thirdly, imaging modalities often include chest radiographs (CXR), point-of-care ultrasound (POCUS) and formal transthoracic echocardiogram. The CXR is useful to assess for cardiopulmonary pathologies such as pulmonary oedema from acute decompensated heart failure, pneumonia or pneumothorax. The POCUS may identify territorial regional wall motion abnormalities suggestive of myocardial ischaemia or reduction in left ventricular ejection fraction,[19] left ventricular apical hypokinesia with basal sparing that may suggest Takotsubo cardiomyopathy in the appropriate context,[20] and look for cardiopulmonary features of aortic dissection,[19] pulmonary embolism, pneumothorax, pneumonia, pericardial and pleural effusion.[21] Advanced imaging modalities include anatomical and functional imaging studies for stable patients with intermediate pretest probability of coronary artery disease (CAD), as well as cardiac magnetic resonance imaging for diagnosis of myocarditis based on Lake Louise criteria.[22]

Finally, coronary angiography should be offered to all patients with ACS, in the absence of contraindications, but the timing

of coronary evaluation and revascularisation depends on the type and risk stratification of MI. The overall approach to differentiating the causes of ACP is summarised in Table S3 [see Supplemental Digital Appendix], with a summarised algorithm presented in Figure 1.

DIAGNOSTIC EVALUATION OF CORONARY ARTERY DISEASE

Diagnostic workup for CAD may be performed through invasive or non-invasive coronary evaluation, anatomical or functional imaging, and stress or non-stress testing modalities, depending on the pretest probability of CAD.[2] This is because in low pretest probability cases, an abnormal test is more likely to be a false positive, whereas in high pretest probability situations, a normal test is more likely to be a false negative.[23] Hence, patients with low pretest probability of CAD should avoid cardiac testing, while patients with intermediate pretest probability of CAD may undergo cardiac stress testing (e.g., exercise ECG, stress myocardial perfusion imaging, stress echocardiogram, stress cardiac magnetic resonance imaging) or non-stress cardiac imaging (e.g., computed tomography coronary angiogram), and patients with high pretest likelihood of CAD should directly undergo diagnostic coronary angiogram to detect and quantify the severity of coronary athero-occlusive disease.

Several predictive models exist for risk stratification of patients with suspected CAD, including the updated Diamond–Forrester (UDF) classification,[24] CAD consortium 2[25] and CONFIRM registry scores.[26] In a multicentre study of the utility of the above risk scores in predicting obstructive CAD in patients with suspected CAD detected on computed tomography coronary angiogram, the CAD consortium 2 score had the best discrimination with area under the receiver-operating curve and ability to reclassify low-risk patients at 10% probability threshold.[27] Locally, a novel PRECISE risk score has recently been developed and validated for use in Southeast Asian patient cohorts.[28]

Importantly, cardiac stress testing should be avoided in haemodynamically unstable patients, within 48 h post-MI, in high-risk UA and in the presence of significant cardiac arrhythmias.[2,29] Moreover, decision to work up suspected CAD should take into consideration the patient's goals of care, benefits and risks of testing, and how the diagnostic findings will change the overall management.

RISK STRATIFICATION OF ACUTE CHEST PAIN

The History, ECG, Age, Risk factors and Troponin (HEART) score[30] is a practical tool in ED settings for risk stratification of patients presenting with ACP into low-risk (0–3), moderate-risk (4–6) and high-risk (7–9) categories to guide disposition and subsequent management of ACP and ACS.

In cases of proven ACS (UA, NSTEMI, STEMI), the Thrombolysis in MI[31,32] and Global Registry of Acute

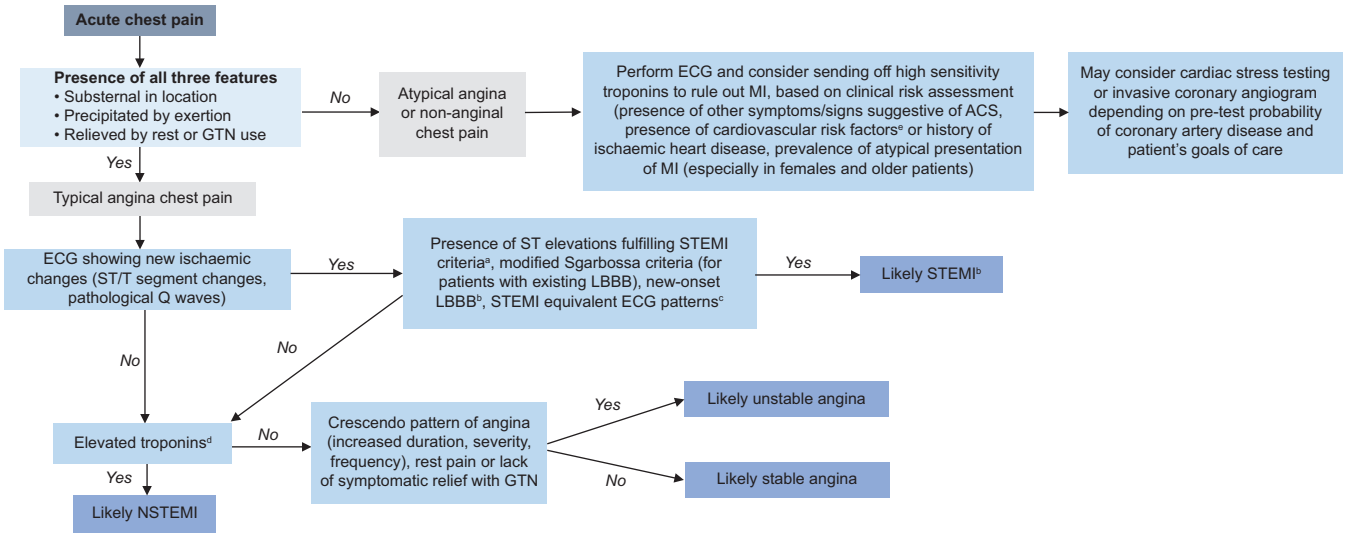

Figure 1: Simplified clinical algorithm for acute chest pain. [a]ST segment elevation myocardial infarction (STEMI) electrocardiogram (ECG) criteria: new-onset ST segment elevation in ≥2 contiguous leads (with J-point elevation ≥2.5 mm in men aged <40 years, ≥2 mm in men aged ≥40 years and ≥1.5 mm in women for leads V2–3, and J-point elevation ≥1 mm in all other leads). [b]New-onset left bundle brunch block (LBBB) used to be considered STEMI equivalent; however, it is now recognised that a presumed new LBBB should not be interpreted in isolation, but rather in the context of clinical findings and cardiac enzymes to determine its significance. [c]STEMI equivalent ECG patterns: left main coronary artery occlusion, Wellen's syndrome, de Winter's T waves. [d]Elevated troponins in the context of myocardial ischaemia is defined as ≥20% rise and/or fall in serially trended troponins with at least one value >99th percentile of the upper reference limit. [e]Cardiovascular risk factors: smoking, obesity, diabetes mellitus, hypertension, hyperlipidaemia, family history of premature coronary artery disease (first-degree relative; for men aged <55 years, for women aged <65 years) ACS: acute coronary syndrome, GTN: glyceryl trinitrate, MI: myocardial infarction, NSTEMI: non-ST segment elevation myocardial infarction

Coronary Events (GRACE)[33] scores scores are useful for predicting clinical outcomes. In particular, a high GRACE score >140 portends poorer prognosis and is considered a high-risk feature in NSTEMI that warrants early intervention within 24 h.[17]

APPROACH TO HYPERTROPONINAEMIA

There are many causes of hypertroponinaemia [Table S4, Supplemental Digital Appendix], as serum troponins can be elevated in any condition that leads to myocardial injury/necrosis, from acute (e.g., sepsis, acute kidney injury, myocarditis) and chronic (e.g., chronic heart failure with elevated left ventricular end-diastolic pressure, chronic kidney disease) myocardial injury to full-blown MI (e.g., T1MI or T2MI).

For simplicity, a 'three-step approach' to hypertroponinaemia can be adopted [Figure 2]:

1. Exclude chronic myocardial injury (in the appropriate clinical context, e.g., chronic structural heart disease, chronic kidney disease) by the absence of an acute >20% rise and/or fall in troponin levels on serial measurements.
2. Differentiate between acute myocardial injury and acute MI by looking for symptoms/ECG/radiological/angiographic changes suggestive of myocardial ischaemia.
3. In patients with acute MI, differentiate between T1MI and T2MI by looking for clinical precipitants of myocardial oxygen supply/demand mismatch (e.g., severe anaemia, sepsis, acute kidney injury).

In practice, differentiating between T1MI and T2MI is often challenging. In general, T2MI patients are commonly older,[34] female[34,35] and have multiple comorbidities (e.g., renal insufficiency),[34-36] whereas T1MI patients are more likely to have prior MI[35] or revascularisation.[34,35] However, both the absolute cardiac troponin levels and percentage change over time are not useful to discriminate between T1MI and T2MI.[37] Coronary angiography is useful to detect coronary atherothrombotic disease with plaque rupture if T1MI is suspected.[36]

In MI cases with clear precipitants of myocardial oxygen supply/demand mismatch and a low pretest probability of T1MI, it is reasonable to treat the underlying clinical event first without pursuing urgent coronary evaluation. Nonetheless, in patients with significant cardiovascular risk factors or known CAD, a low threshold for coronary evaluation is often required, especially if patients develop high-risk features such as recurrent/persistent chest pain, haemodynamic or electrical instability or dynamic ECG changes suggestive of myocardial ischaemia.

In hospitalised patients, common events precipitating myocardial ischaemic imbalance include anaemia, sepsis, renal impairment, cardiac arrhythmias and postoperative state.[36] For example, in severe anaemia, there is reduced oxygen-carrying capacity and myocardial oxygen delivery, while the concomitant hyperdynamic circulation increases myocardial oxygen demand. In sepsis, MI may be inflicted through infective, cytokine and catecholamine-mediated mechanisms.[38] In renal impairment, hypertroponinaemia may be related to clinically silent micro-infarctions or associated left ventricular hypertrophy.[39]

Finally, in unexplained cases of elevated troponins without evidence suggestive of myocardial injury/ischaemia, there is an entity of spurious hypertroponinaemia caused by laboratory assay interference, for instance, due to the presence of heterophile antibodies that may be acquired from iatrogenic (e.g., blood products, monoclonal antibody therapies, vaccinations) and non-iatrogenic (e.g., rheumatoid factor in rheumatoid arthritis and other autoimmune conditions) sources.[40] The possibility of heterophile antibody interference with laboratory troponin assay may be investigated through repeat testing on different analyser platforms or by adding heterophile-blocking reagents.[40]

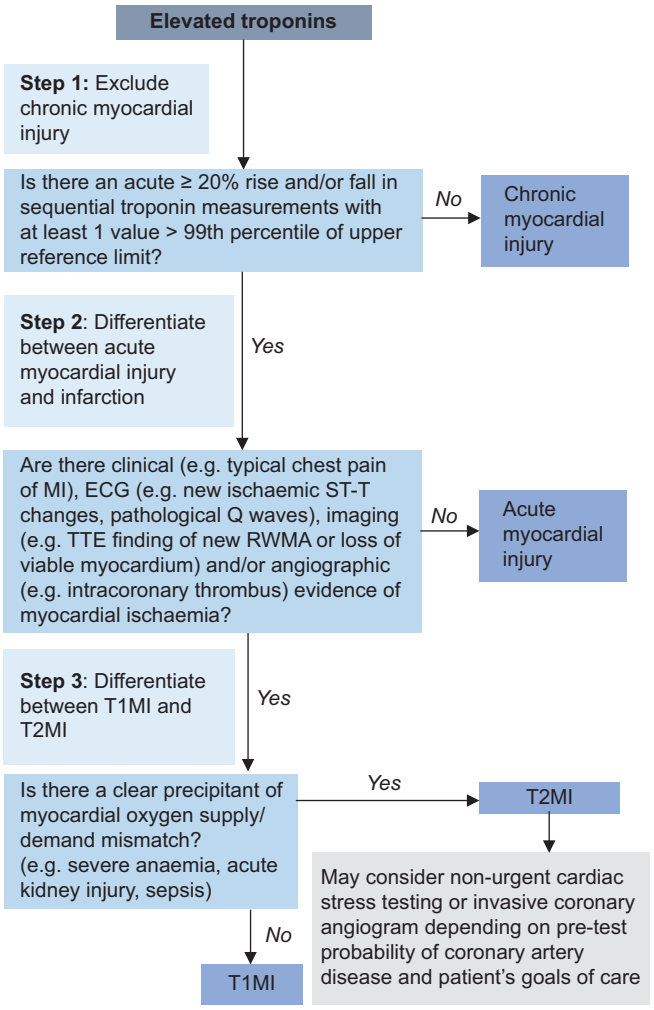

Figure 2: Chart shows a 'three-step' approach to hypertroponinaemia. T1MI: type 1 myocardial infarction, T2MI: type 2 myocardial infarction, TTE: transthoracic echocardiogram

MANAGEMENT OF ACUTE MYOCARDIAL INFARCTION

In general, management of MI depends on the aetiological subtype (T1MI vs. T2MI) and extent/severity of MI (STEMI vs. NSTEMI).

The management of T1MI (atherothrombotic MI) comprises the following five key components, with differences in the choice of antithrombotic agents and timing of revascularisation depending on the extent of ischaemia (STEMI vs. NSTEMI):

1. Acute resuscitation and stabilisation: airway, breathing, circulation for the haemodynamically unstable patient, advanced cardiac life support in cardiac arrests, 'cath lab activation' for confirmed STEMI and high-risk NSTEMI cases;
2. Revascularisation therapy: target immediate percutaneous coronary intervention (PCI) ('door-to-balloon time') within 90 min for STEMI; target PCI within 72 h for NSTEMI in the absence of high-risk features that may warrant earlier or immediate intervention (e.g., recurrent or persistent chest pain, haemodynamic or electrical instability or presence of dynamic ECG ST–T wave changes suggestive of myocardial ischaemia);[41] in 2018, the TRANSIENT trial studied the entity of 'transient STEMI' (i.e., attaining ST segment normalisation and symptomatic relief before definitive revascularisation) and found that these patients generally had small infarct sizes and had no significant differences in major adverse cardiac events between adopting an immediate (as for STEMI) versus delayed (as for NSTEMI) reperfusion strategy;[42]
3. Symptomatic treatment: sublingual GTN (500 mcg pro re nata, can be repeated 5 min apart) or intravenous GTN (initiate at 15–20 mcg/min, then uptitrate by 10–15 mcg/min at 15–30 min intervals to the desired effect) for symptomatic relief of anginal chest pain;
4. Guideline-directed medical therapy: (a) dual antiplatelet therapy (DAPT) with aspirin (300 mg loading dose, followed by 100 mg OM maintenance dose) and either clopidogrel (300/600 mg loading dose, followed by 75 mg OM maintenance dose), ticagrelor (180 mg loading dose, followed by 90 mg BD maintenance dose) or prasugrel (60 mg loading dose, followed by 10 mg OM maintenance dose); (b) heparin: consider subcutaneous low-molecular-weight heparin for NSTEMI planned for early PCI (e.g., subcutaneous enoxaparin 1 mg/kg BD, with dose reduction to 1 mg/kg OD if estimated glomerular filtration rate [eGFR] 15–29 mL/min and contraindicated if eGFR <15 mL/min), or intracoronary heparin during PCI; (c) beta-blockers (e.g., carvedilol, metoprolol and bisoprolol); (d) angiotensin converting enzyme inhibitors (ACE-I; e.g., captopril, enalapril and lisinopril); and (e) statins (e.g., atorvastatin);
5. Post-MI cardiac rehabilitation, preventive health (vaccinations), lifestyle modifications, optimisation of cardiovascular risk factors and longitudinal follow-up.

For T2MI, guideline-directed medical treatment remains fairly scarce. In the presence of clear clinical precipitants of myocardial ischaemic imbalance, management largely involves treating the underlying cause, with the potential role of beta-blockers to reduce myocardial oxygen demand, provided there are no contraindications such as hypotension, bradycardia or acute heart failure.[36] Depending on the patient's pretest probability of IHD and goals of care, non-urgent cardiac evaluation for underlying CAD may be considered.[36]

TAKE HOME MESSAGES

1. Acute chest pain can be caused by cardiac and non-cardiac (respiratory, mediastinal, gastrointestinal, musculoskeletal and others, e.g., psychogenic) pathologies.
2. Approach to chest pain involves clinical characterisation of the chest pain with its associated features and risk factor assessment, with appropriate use of investigations including ECG, cardiac biomarkers and radiological investigations.
3. Myocardial injury refers to isolated hypertroponinaemia, whereas MI requires clinical, electrocardiographic, imaging or angiographic evidence of acute myocardial ischaemia.
4. T1MI is caused by acute atherothrombosis in the presence of underlying atherosclerotic coronary disease, whereas T2MI is precipitated by clinical insults that lead to significant myocardial oxygen supply/demand mismatch.
5. Treatment of MI comprises five key components of acute resuscitation/stabilisation, revascularisation therapy, symptomatic treatment, guideline-directed medical therapy, and post-ACS rehabilitation, follow-up and optimisation of cardiovascular risk factors.

Closing Vignette

The patient was commenced on DAPT (aspirin and ticagrelor) and high-intensity statin. She was also given sublingual GTN with prompt symptomatic relief of chest pain. The following morning, the patient underwent coronary angiogram, which revealed 80% proximal LAD stenosis, and revascularisation was performed with implantation of a drug-eluting stent. Echocardiogram revealed mid-range left ventricular ejection fraction of 45% with regional wall motion abnormalities in the LAD territory. Postprocedure, she was also commenced on other guideline-directed medical therapies including ACE-I and beta-blockers. On discharge, she was given a cardiac rehabilitation appointment, with follow-up at the cardiology clinic.

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Supplemental digital content

Appendix at http://links.lww.com/SGMJ/A84

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SMC CATEGORY 3B CME PROGRAMME

Online Quiz: https://www.sma.org.sg/cme-programme

Deadline for submission: 6 pm, 15 March 2024

Question	True	False
1. Typical anginal chest pain is classically described as left-sided chest pain that is worse on inspiration or chest wall movements and relieved by analgesia.		
2. In patients with known history of anginal chest pain, the presence of unstable angina may be characterised by chest pain of increasing frequency, duration and severity, or pain that occurs at rest or does not improve with glyceryl trinitrate (GTN) use.		
3. Acute coronary syndrome (ACS) is a specific form of ischaemic heart disease that comprises only non-ST segment elevation myocardial infarction (NSTEMI) and ST segment elevation myocardial infarction (STEMI).		
4. Hypertroponinaemia may be present in both myocardial injury and myocardial infarction (MI).		
5. The presence of elevated troponins in a patient with end-stage renal failure is always suggestive of an acute cardiac event such as acute MI or acute myocardial injury.		
6. Approximately 30% of undifferentiated patients who present to the emergency department with acute chest pain (ACP) are found to have ACS.		
7. Atypical presentations of MI are more commonly observed in females and elderly patients as compared to males and younger patients.		
8. It is not relevant to measure systolic blood pressure differentials of the two limbs when examining a patient with sudden-onset tearing chest pain that radiates to the back.		
9. Commonly performed initial investigations in a patient with ACP include electrocardiogram (ECG), cardiac biomarkers and imaging modalities like chest radiograph.		
10. The presence of a single, elevated troponin value >99th percentile of the upper reference limit is sufficient to diagnose NSTEMI.		
11. Wellen's syndrome refers to specific ECG changes that are suggestive of significant right coronary artery stenosis.		
12. The presence of a new-onset left bundle brunch block on ECG is always equivalent to a STEMI and warrants immediate 'cath lab activation' for revascularisation therapy.		
13. In a patient with ACP, assessing the pretest probability of coronary artery disease can be useful to guide subsequent cardiac diagnostic work up.		
14. Cardiac stress testing, such as stress myocardial perfusion imaging, should always be performed in a patient with newly diagnosed MI.		
15. In rare instances, laboratory assay interference may lead to falsely elevated troponin levels.		
16. In the acute inpatient setting, common clinical precipitants of type 2 MI (T2MI) include anaemia, sepsis, renal impairment, cardiac arrhythmias and postoperative state.		
17. The presence of heterophile antibodies in the patient's serum may cause troponin assay interference, leading to false-positive results.		
18. Management of STEMI involves emergency percutaneous coronary revascularisation and initiation of guideline-directed medical therapy including dual antiplatelet therapy (DAPT), heparin, beta-blocker, angiotension-converting enzyme inhibitors/ angiotensin receptor blockers and statin.		
19. The target 'door-to-balloon' time for STEMI is 120 min.		
20. Treatment of T2MI involves prompt initiation of DAPT (loading and maintenance dose), that usually comprises aspirin with either clopidogrel, ticagrelor or prasugrel.		

APPENDIX

Table S1: Classification of Myocardial Infarction (MI)

a) 4th Universal Definition of MI: aetiological classification (1)

Category	Description	MI criteria		Treatment
		Troponin criteria	Supporting Evidence of Myocardial Ischaemia	
Type 1 MI	Spontaneous MI due to primary coronary occlusion from acute plaque rupture, erosion causing coronary artery thrombosis	≥ 20% rise and/or fall of troponin levels with at least one value > 99th percentile of upper reference limit	Clinical symptoms of myocardial ischaemia; new ischaemic ECG changes; imaging evidence of new regional wall motion abnormalities or new loss of viable myocardium or angiographic finding of intra-coronary thrombus	Coronary revascularisation, guideline-directed medical therapy (DAPT +/- heparin, ACEIs, BBs, statins)
Type 2 MI	Secondary to a clinical event that causes myocardial oxygen supply/demand mismatch (e.g. anaemia, hypotension/hypertension, cardiac arrhythmias, sepsis)	≥ 20% rise and/or fall of troponin levels with at least one value > 99th percentile of upper reference limit	Clinical symptoms of myocardial ischaemia; new ischaemic ECG changes; imaging evidence of new regional wall motion abnormalities or new loss of viable myocardium	Treat underlying cause of myocardial ischaemic imbalance, consider judicious use of BBs to reduce myocardial oxygen demand
Type 3 MI	Sudden cardiac death (e.g. cardiac arrest) based on clinical symptomatology, electrocardiographic findings or presence of new coronary artery thrombus identified by angiography or at post-mortem examination, without the availability of cardiac biomarkers	Not applicable	Clinical symptoms of myocardial ischaemia; new ischaemic ECG changes or presence of ventricular fibrillation; post-mortem analyses revealing intra-coronary thrombus	Not applicable
Type 4 MI	4a – MI occurring within 48 hours of PCI	≥ 20% rise in post-procedural troponins to at least 5x upper reference limit	New ischaemic ECG changes; imaging evidence of new regional wall motion abnormalities or new loss of viable myocardium; angiographic finding of post-procedural flow-limiting complication (coronary thromboembolism, dissection)	Same as for type 1 MI
	4b – MI due to coronary in-stent thrombosis (acute –> 0 to 24 hours, subacute – >24 hours to 30 days, late – >30 days to 1 year, very late – more than 1 year)	Same as for type 1 MI	Same as for type 1 MI	Same as for type 1 MI
	4c – MI due to coronary in-stent re-stenosis	Same as for type 1 MI	Same as for type 1 MI	Same as for type 1 MI
Type 5 MI	MI after CABG surgery	≥ 20% rise in post-procedural troponins to at least 10x upper reference	New ischaemic ECG changes; imaging evidence of new regional wall motion abnormalities; angiographic finding of either graft vessel or native coronary artery occlusion	Same as for type 1 MI

*ACEIs: ACE inhibitors; BBs: beta blockers; CABG: coronary artery bypass graft; DAPT: dual antiplatelet therapy; MI: myocardial infarction; PCI: percutaneous coronary intervention

b) STEMI vs NSTEMI:

Category	ECG criteria	Extent of Myocardial Ischaemia	Prognosis
STEMI	New onset ST segment elevation in ≥ 2 contiguous leads (with J-point elevation ≥ 2.5 mm in males < 40 years, ≥ 2 mm in males ≥ 40 years and ≥ 1.5 mm in females for leads V2-3, and J-point elevation ≥ 1 mm in all other leads) (1); or Modified Sgarbossa criteria in patients with existing left bundle brunch block (LBBB) (2); or New-onset LBBB in the appropriate clinical context and biochemical profile	Transmural ischaemia	Poorer short-term outcome and higher inpatient mortality risk
NSTEMI	New onset ST segment depression ≥ 0.5 mm in ≥ 2 contiguous leads; and/or New onset T wave inversion > 1 mm in ≥ 2 contiguous leads that have prominent R wave or R/S ratio > 1 (1)	Subendocardial ischaemia	Poorer long-term outcome (possibly contributed by poorer pre-morbid conditions, less likely to be prescribed guideline-directed medical therapy)

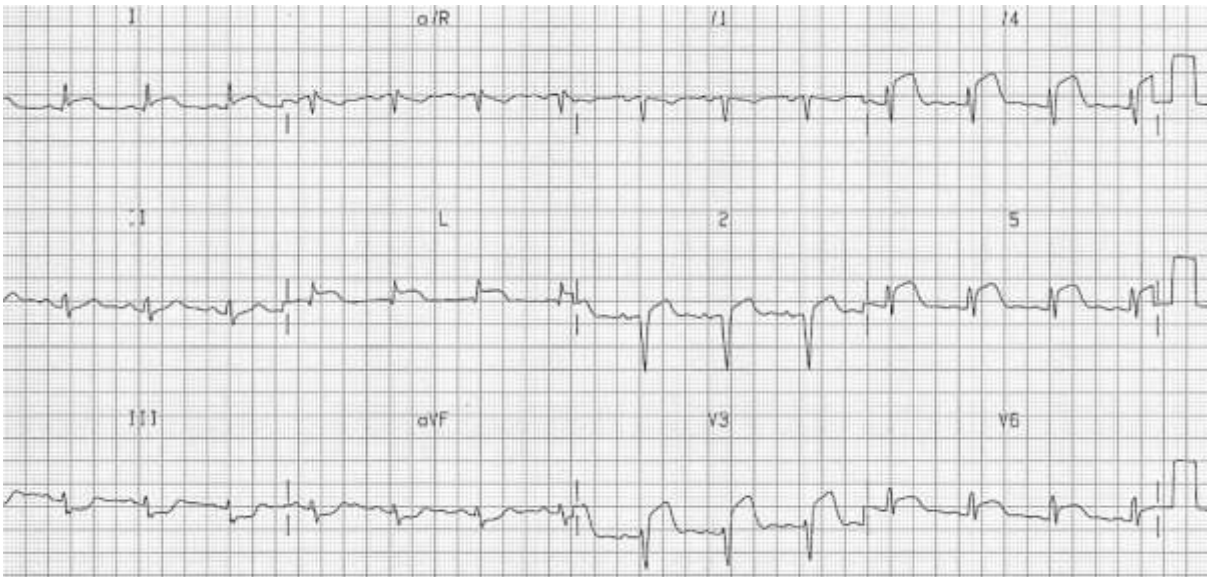
*ECG: electrocardiogram; NSTEMI: non-ST segment elevation myocardial infarction; STEMI: ST segment elevation myocardial infarction

Table S2: Cardiac and Non-Cardiac Causes of Acute Chest Pain

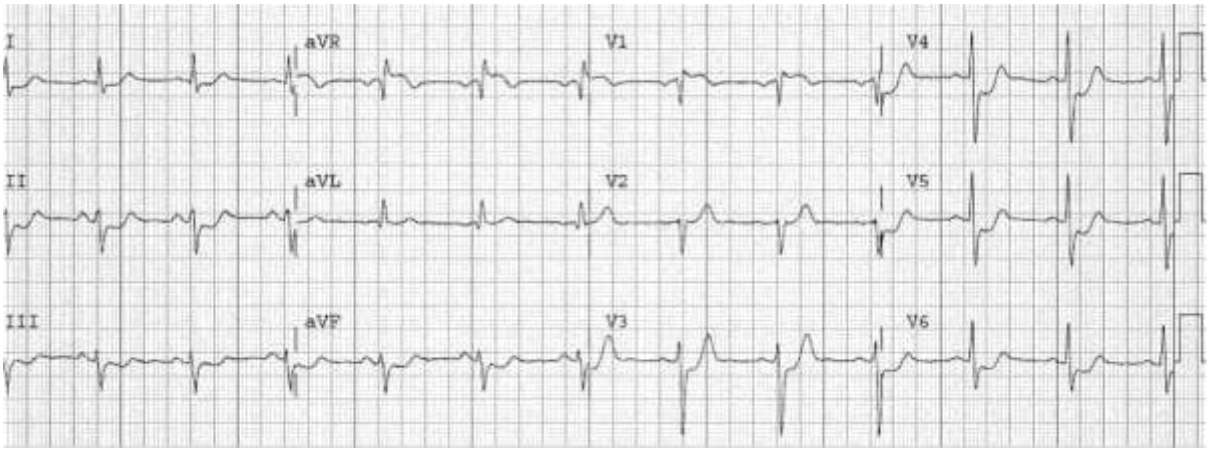
Cardiac	
Pericardium	**Acute pericarditis**
Myocardium	**Acute coronary syndrome (UA, NSTEMI, STEMI)** **Stable angina/chronic ischemic heart disease** Vasospastic (Prinzmetal's) angina Coronary microvascular dysfunction Takotsubo (stress) cardiomyopathy Hypertrophic cardiomyopathy **Acute myocarditis**
Valvular heart disease	Aortic stenosis Mitral valve prolapse
Non-Cardiac	
Respiratory	**Pneumonia** **Pleuritis** **Pulmonary embolism** **Pneumothorax** Pulmonary hypertension Asthma/chronic obstructive pulmonary disease (COPD) exacerbation Acute bronchitis Lung cancer Acute chest syndrome (in patients with sickle cell anaemia)
Mediastinum	**Aortic dissection/aortic aneurysm** Mediastinitis Pneumomediastinum Mediastinal masses
Gastrointestinal	**Gastroesophageal reflux disease (GERD)/reflux esophagitis** **Oesophageal motility disorders** Boerhaave's syndrome **Peptic ulcer disease** **Gallstone disease** Acute pancreatitis Perforated viscus
Musculoskeletal and **Soft Tissue Pathologies**	**Muscle sprain** **Rib fractures/trauma** **Costochondritis (Tietze's syndrome)** **Cervical/thoracic spine pathologies** (**referred pain**) **Herpes zoster (Shingles)** Intercostal neuralgia (post-thoracotomy pain syndrome, post-herpetic neuralgia) Xiphoidalgia
Others	**Psychogenic (panic attacks, anxiety, somatization disorder)**

Bold: **common causes**, highlighted: life-threatening causes
*NSTEMI: non-ST segment elevation myocardial infarction, STEMI – ST segment elevation myocardial infarction, UA – unstable angina

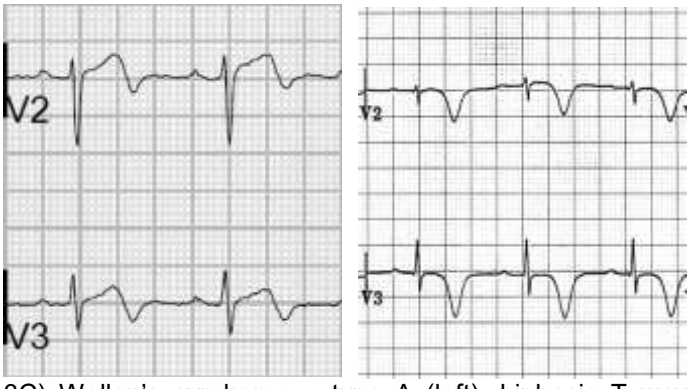
Figure S3: **Electrocardiograms of Myocardial Infarction**



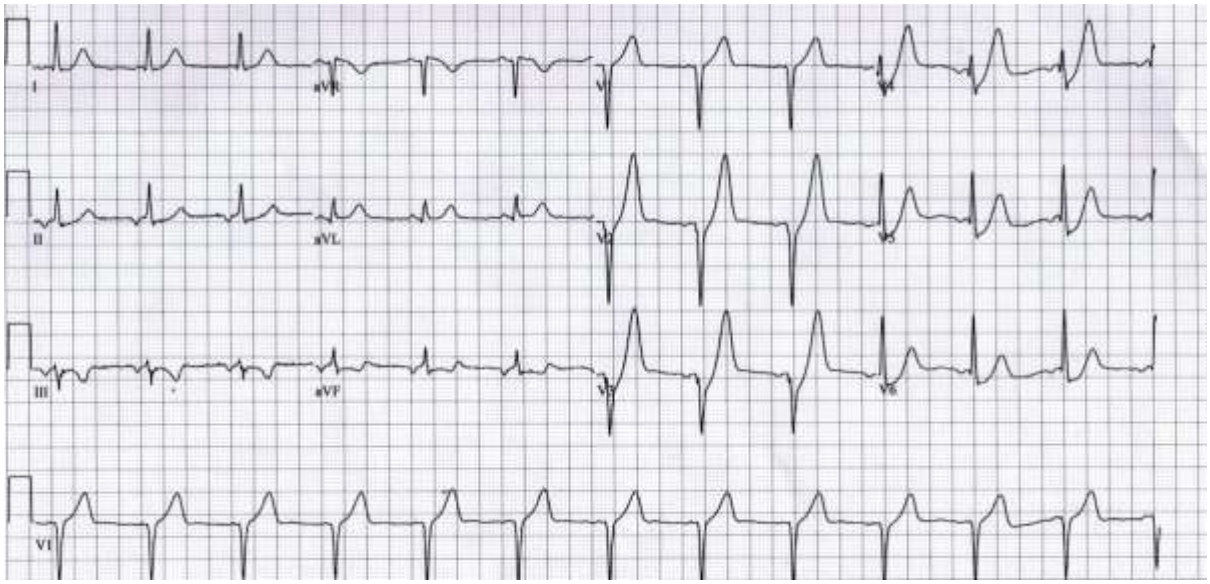
3A) ST segment elevation myocardial infarction (STEMI): this ECG shows ST segment elevation in V2V6, I and aVL, and reciprocal ST depression in III and aVF, suggestive of anterolateral STEMI. Reference: Life in the Fast Lane, 2022 (3).



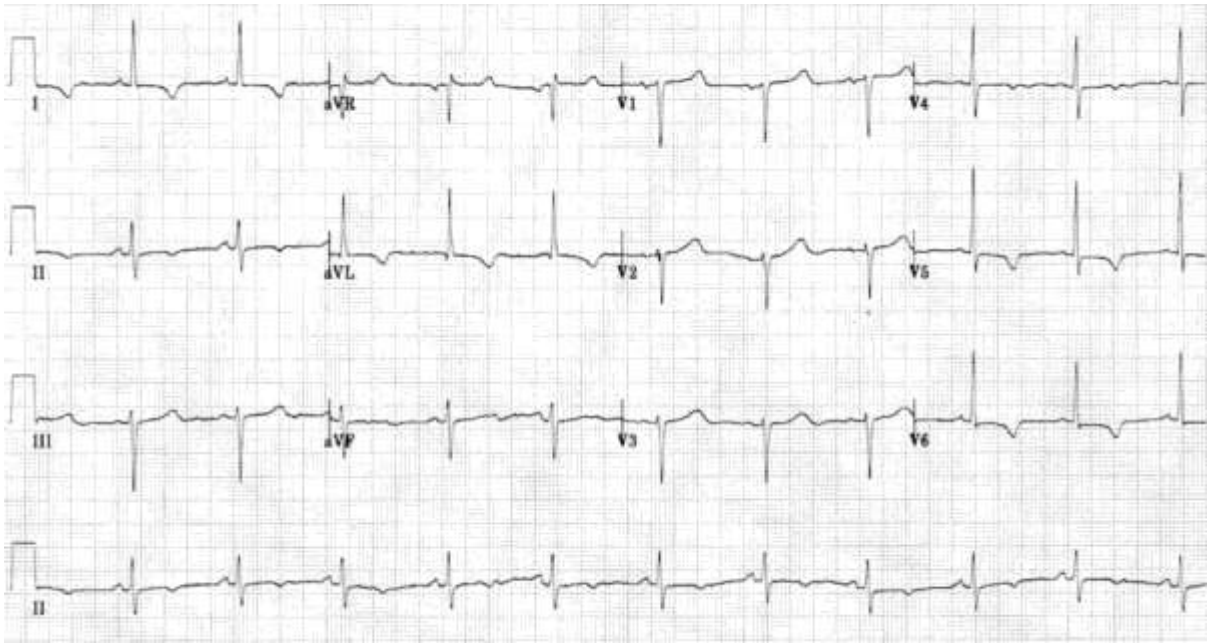
3B) Left main coronary artery (LMCA) occlusion: this ECG shows ST segment elevation in aVR, with global ST segment depressions in multiple leads (V3-V6, I, II, III and aVF). Reference: Life in the Fast Lane, 2021 (4).



3C) Wellen's syndrome – type A (left): biphasic T waves in V2-V3, type B (right): deep T wave inversions in V2-V3. Reference: Life in the Fast Lane, 2021 (5).



3D) de Winter's T waves: this ECG shows upsloping ST segment depression with tall, peaked and symmetrical T waves in precordial leads (V2-6), and ST segment elevation in aVR. Reference: Life in the Fast Lane, 2022 (6).



3E) Non-ST segment elevation myocardial infarction (NSTEMI): this ECG shows T wave inversions predominantly in the lateral leads (I, aVL, V5, V6), which in the appropriate clinical context with hypertroponinaemia showing an acute rise and/or fall in serial troponins, is suggestive of NSTEMI. Reference: Life in the Fast Lane, 2022 (7).

Table S3: Clinical, Biochemical, Electrophysiological and Imaging Features to Differentiate Amongst the Common Causes of Acute Chest Pain

Condition	History-taking	Physical examination	Biochemical tests	ECG	Imaging findings
Stable angina/ chronic IHD	*Chest pain phenotype:* retrosternal/central, crushing/heavy/squeezing pain/discomfort, worse on exertion/emotional stress, better with rest/GTN; may radiate to the neck/jaw/arm *Associated symptoms:* exertional dyspnoea, reduced effort tolerance *Risk factors:* CVRFs (smoking, obesity, DM, HTN, HLD, family history of IHD)	*Vitals*: usually stable *Stigmata of atherosclerosis or cardiovascular disease or microvascular/macrovascular end-organ damage*: Frank's sign (diagonal earlobe crease; associated with atherosclerotic coronary artery disease), Levine's sign (clenched fist over anterior chest; sign of ischaemic chest pain), nicotine stains (teeth/fingers; smoking), obese habitus, xanthelasma/tendon xanthoma (hypercholesterolaemia), insulin injection marks/glucometer needle marks (diabetes mellitus), fundoscopic features of diabetic/hypertensive retinopathy, sallow appearance/presence of dialysis catheters or arteriovenous fistula (end-stage renal disease), "gloves-and-stockings" sensory loss (diabetes mellitus-associated peripheral neuropathy); CABG/GSV harvest scar (IHD), unilateral paraparesis (stroke), poorly felt peripheral pulses/limb pallor/trophic skin changes (smooth, shiny, dry hairless skin)/tissue loss (ulcers, gangrene, amputations) (PAD)	*Troponins*: not elevated	*ECG*: no new ischaemic changes	*CXR*: usually normal *TTE*: may show known regional wall motion abnormality, depressed left ventricular/right ventricular systolic function
Unstable angina	*Chest pain phenotype:* crescendo pattern of angina (more severe/intense, longer duration >15 minutes, increased frequency), rest angina/less responsive to GTN; may radiate to the neck/jaw/arm	*Vitals*: usually stable *Stigmata of atherosclerotic disease or cardiovascular disease or end-organ damage*: same as for stable angina/chronic IHD	*Troponins*: not elevated	*ECG*: may or may not have acute ischaemic ECG changes (new ST depression or T wave inversions in ≥ 2 contiguous leads)	

	Associated symptoms: same as for stable angina/chronic IHD *Risk factors*: same as for stable angina/chronic IHD				
Type 1 NSTEMI	*Chest pain phenotype:* typical anginal chest pain, but may have atypical features (esp. in females, elderly) or even silent; may radiate to the neck/jaw/arm *Associated symptoms*: dyspnoea, palpitations, nausea/vomiting, diaphoresis, giddiness/syncope *Risk factors*: CVRFs (same as above)	*Vitals*: may have hemodynamic instability (e.g. hypotension/tachycardia due to cardiogenic shock) *Complications of myocardial ischaemia*: post-MI pericarditis (pericardial friction rub), new-onset pansystolic murmur (e.g. papillary muscle rupture, ventricular septal rupture), acute decompensated heart failure (S3 gallop, bibasal lung crepitations, raised jugular venous pressure, bilateral pedal oedema), cardiac tamponade ("Beck's triad" of muffled heart sounds, elevated jugular venous pressure and hypotension), tachy/bradyarrhythmias *Stigmata of atherosclerotic disease or cardiovascular disease or end-organ damage*: same as for stable angina/chronic IHD	*Troponins*: elevated with ≥ 20% rise and/or fall, with at least one value > 99th percentile of upper reference limit	*ECG*: may or may not have acute ischaemic ECG changes (new ST segment depression or TW inversions in ≥ 2 contiguous leads)	*CXR*: may be normal or show congestive features of pulmonary oedema due to acute heart failure *TTE*: shows new regional wall motion abnormalities *Diagnostic coronary angiogram*: shows significant occlusive coronary artery disease
Type 1 STEMI				*ECG*: new ST segment elevation in ≥ 2 contiguous leads (significant ST elevation fulfils J-point criteria which differs according to age and gender), new-onset LBBB, fulfilment of Sgarbossa's criteria for existing LBBB	
T2MI	*Clinical features*: chest pain and associated clinical features inconsistent with T1MI; in clinical context of current condition(s)/medical comorbidities that can lead to myocardial ischaemic imbalance; anaemia, sepsis, AKI, tachyarrhythmias, hypotension			*ECG*: may or may not have acute ischaemic ECG changes (new ST segment depression or T-wave inversions in ≥ 2 contiguous leads, ST elevation may also occur if there is transmural ischaemia from the supply/demand mismatch); may show other pathologies (e.g. tachyarrhythmias like atrial fibrillation)	*CXR*: usually normal or shows other pathologies (e.g. consolidative changes of pneumonia) *TTE*: shows new, regional wall motion abnormalities *Diagnostic coronary angiogram*: may or may not show significant occlusive coronary artery disease (the latter if patient has underlying CAD)
Acute pericarditis	*Chest pain phenotype:* sudden-onset sharp, stabbing, pleuritic chest pain, worse on lying supine, better on sitting up and leaning forward *Associated symptoms*: dyspnoea, low-grade fever *Risk factors*: infections, trauma, autoimmune conditions, malignancy, uraemia, recent MI, cardiothoracic surgery, mediastinal irradiation	*Vitals*: usually stable; if unstable (e.g. hypotension), consider possibility of concomitant pericardial effusion/cardiac tamponade *Key signs*: pericardial friction rub	*Troponins*: usually normal, but may be elevated in myopericarditis *CRP*: may be elevated	*ECG*: global saddle-shaped ST segment elevation and PR segment depression in anterolateral leads (V2-V4, I, aVL, V5-V6) and inferior leads (II, III, aVF), reciprocal ST depression and PR segment elevation in aVR, Spodick's sign (downsloping TP segment)	*CXR*: may be normal or show cardiomegaly *TTE*: may show concomitant pericardial effusion

Acute myocarditis	*Chest pain phenotype*: non-specific chest pain/discomfort, but may be pleuritic (myopericarditis) *Associated symptoms*: dyspnoea, prodromal flu-like symptoms (fever, upper respiratory tract symptoms, myalgia) *Risk factors*: recent infection (esp. viral), autoimmune conditions, allergic/ hypersensitivity reactions, toxins	*Vitals*: presence of fever, with tachycardia out of proportion to fever, may be haemodynamically unstable (cardiogenic shock) *Key signs*: may have normal cardiovascular examination (if uncomplicated) *Complications* (*acute decompensated heart failure*): new S3 gallop, bibasal lung crepitations, raised jugular venous pressure, bilateral pedal oedema	*Troponins*: usually significantly elevated *CRP*: may be elevated	*ECG*: sinus tachycardia, non-specific ST-T changes	*CXR*: may show cardiomegaly or congestive features suggestive of pulmonary oedema in heart failure *TTE*: may show non-coronary regional wall motion abnormalities and depressed left ventricular ejection fraction *CMR*: diagnostic aid based on Lake Louise criteria
Takotsubo cardiomyopathy	*Chest pain phenotype:* anginal type chest pain *Associated symptoms:* dyspnoea, palpitations, giddiness, syncope *Risk factors:* post-menopausal females, significant physical/emotional stressor	*Vitals:* may have hemodynamic instability (e.g. hypotension/tachycardia due to cardiogenic shock) *Complications* (*acute heart failure*): see above *Complications* (*left ventricular outflow tract obstruction): systolic murmur*	*Troponins: may be elevated*	*ECG: may show non-specific ST-T changes*	*TTE: most commonly shows ballooning of left ventricular apical region (i.e. apical akinesis), with compensatory hyperkinesis of basal segments – in the apical form of Takotsubo cardiomyopathy* *Diagnostic coronary angiogram*: shows no significant occlusive coronary artery disease
Valvular heart disease (e.g. aortic stenosis)	*Chest pain phenotype* (aortic stenosis): anginal chest pain *Associated symptoms*: dyspnoea, syncope *Risk factors*: advanced age, rheumatic heart disease	*Vitals*: usually stable; if unstable, consider acute decompensated heart failure *Key signs*: presence of cardiac murmurs (e.g. aortic stenosis – ejection systolic murmur loudest at right upper sternal edge that radiates to the carotids) *Complications* (*acute heart failure*): see above	*Troponins*: usually normal	*ECG*: may show left ventricular hypertrophy (in aortic stenosis), associated atrial fibrillation (in rheumatic heart disease)	*CXR*: may show congestive features suggestive of pulmonary oedema in heart failure *TTE*: shows valvular stenosis/insufficiency
Pneumonia	*Chest pain phenotype*: may be pleuritic *Associated symptoms*: infective/respiratory symptoms such as productive cough, rhinorrhoea, sore throat, fever, chills	*Vitals*: may have fever, tachypnoea, poor oxygen saturation *Key signs*: reduced chest expansion, dullness to percussion, bronchial breath	*Troponins*: usually normal, but may be elevated in infection-precipitated Type 2 MI *ABG*: may	*ECG*: usually normal	*CXR*: may show consolidation, with air bronchograms, loss of Silhouette sign, occasionally with parapneumonic effusion *POCUS*: may show hepatisation of lung

	Risk factors: Elderly, multiple medical comorbidities, immunocompromised, positive contact history, recent viral respiratory tract infection, aspiration risks (dysphagia, impaired consciousness, bedridden)	sounds, crepitations/rhonchi	show type 1 or type 2 respiratory failure *CRP*, *procalcitonin*: may be elevated		tissue, air bronchograms, parapneumonic effusion with septations
Pulmonary embolism	*Chest pain phenotype*: may be pleuritic *Associated symptoms*: dyspnoea, cough/haemoptysis, giddiness/syncope, calf pain/swelling (suggestive of deep vein thrombosis) *Risk factors*: long haul flight/prolonged immobility, recent surgery, smoking, pregnancy/post-partum state, use of oral contraceptive pills/hormone replacement therapy/tamoxifen, recent COVID-19 infection, previous venous thromboembolic events, known thrombophilias	*Vitals*: may have fever, tachycardia, tachypnoea, poor oxygen saturation; if presence of persistent hypotension ≥15 minutes or requiring inotropes, this suggests massive PE *Key signs*: features of right heart failure (e.g. raised jugular venous pressure, pedal oedema), cold/clammy peripheries with weak, thready pulses and increased capillary refill time (obstructive shock)	*Troponins*: may be elevated (suggestive of right heart strain, with poor prognosis) *D-dimer*: sensitive, but not specific; consider only in low pre-test probability to rule out pulmonary embolism *ABG*: may show type 1 respiratory failure	*ECG*: may show sinus tachycardia, right heart strain patterns (e.g. ST depression, T wave inversion in anteroinferior leads, RBBB, right axis deviation, p pulmonale), S1Q3T3	*CXR*: usually non-specific changes, rarely may show Fleischner sign, Hampton's hump or Westermark sign *POCUS*: may show right ventricular dilatation with reduced contractility, poor left ventricular filling, subpleural consolidation, right ventricular thrombus; also may show non-compressible femoral/popliteal vein (concurrent deep vein thrombosis) *CTPA*: shows filling defect in pulmonary artery, may show right ventricular dilatation
Pneumothorax	*Chest pain phenotype*: may be pleuritic *Associated symptoms*: dyspnoea *Risk factors*: tall/thin young male (primary spontaneous pneumothorax), connective tissue disease, underlying lung disease, trauma, thoracic surgery/procedures	*Vitals*: if presence of haemodynamic instability (hypotension, tachycardia), suggestive of tension pneumothorax with obstructive shock *Key signs*: tracheal deviation, elevated jugular venous pressure, cyanosis (tension pneumothorax), reduced chest expansion, hyperresonant percussion note, decreased air entry, subcutaneous emphysema, traumatic chest wounds	*Troponins*: usually normal *ABG*: may show type 1 or type 2 respiratory failure	*ECG*: non-specific	*CXR*: shows visible visceral pleural edge, devoid of lung markings peripheral to it and a collapsed lung central to it, may demonstrate tracheal deviation/mediastinal shift, subcutaneous emphysema *POCUS*: absent lung sliding, stratosphere sign
Aortic dissection	*Chest pain phenotype*: severe, tearing chest pain, sudden and maximal at onset, radiates to the back *Associated symptoms*: dyspnoea, syncope, neurological	*Vitals*: likely to show haemodynamic instability, inter-arm systolic blood pressure differentials (> 20 mmHg) *Key signs*: presence	*Troponins*: may be elevated (in coronary backflow)	*ECG*: normal or non-specific ST/T changes	*CXR*: widened mediastinum (> 8 cm), widened right paratracheal stripe, "calcium sign", tracheal deviation to the right *TTE*: more

	symptoms *Risk factors*: hypertension, connective tissue disease, trauma	of radial-radial delay, new-onset aortic regurgitation *Complications* (*acute heart failure*): see above			sensitive/specific for type A dissection than type B dissection *TEE*: preferred in clinically unstable patients *CT aortogram*: preferred in clinically stable patients
Boerhaave's syndrome	*Chest pain phenotype*: sudden onset, severe, subxiphoid chest pain *Associated symptoms*: preceding vomiting/retching, dyspnoea *Risk factors*: binge-eating, alcoholism **Mackler's triad*: chest pain, preceding vomiting, subcutaneous emphysema	*Vitals*: likely to show haemodynamic instability *Key signs*: reduced breath sounds over lung fields on affected side, subcutaneous emphysema, Hamman's sign (crunching sound over the precordium in sync with heartbeat; suggests pneumomediastinum)	*Troponins*: usually normal	*ECG*: usually normal	*CXR*: may show mediastinal widening, pneumomediastinum, subcutaneous emphysema, "V" sign *CT thorax*: shows oesophageal wall thickening, soft tissue gas in thoracic cavity, pneumomediastinum
Gastro-oesophageal reflux disease	*Chest pain phenotype*: burning, retrosternal chest pain, worse after meals/lying flat, better with antacids *Associated symptoms*: sour/bitter taste at back of the throat, nocturnal cough *Risk factors*: smoking, alcohol, obesity, consumption of fatty/spicy food	*Vitals*: stable *Key signs*: usually normal examination	*Troponins*: normal	*ECG*: normal	Not required, unless presence of red-flag symptoms
"Acute abdomen" (e.g. PUD, acute cholecystitis/ pancreatitis, perforated viscus)	*Chest pain phenotype*: usually substernal, extremely severe; pain radiation to right shoulder (cholecystitis), back (pancreatitis) *Associated symptoms*: nausea/vomiting, bloating/belching *Risk factors*: NSAIDs use (PUD), history of *H. pylori* colonisation (PUD), known gallstone disease (cholecystitis, pancreatitis), alcoholic binge (pancreatitis)	*Vitals*: may show haemodynamic instability *Key signs*: epigastric/right hypochondrial tenderness, features of peritonism (guarding/rebound tenderness)	*Troponins*: may be normal or elevated if underlying condition precipitates myocardial injury	*ECG*: usually normal	*CXR*: may show air under the diaphragm (in perforated viscus) *US abdomen* or *CTAP*: may aid in diagnosis of intra-abdominal or hepatobiliary pathology
Musculoskeletal/ soft tissue pathologies (e.g. rib fractures, muscle sprain, costochondritis, Herpes zoster, intercostal	*Chest pain phenotype*: usually localised, sharp/stabbing, reproducible with palpation of affected area or on chest wall movements	*Vitals*: usually stable *Key signs*: focal tenderness on palpation of affected region, superficial wounds/bruises, presence of	*Troponins*: normal	*ECG*: normal	Not required

neuralgia)	*Associated symptoms*: recent chest wall trauma *Risk factors*: previous VZV infection (for Herpes zoster, post-herpetic intercostal neuralgia)	vesicular rash over anterior chest wall in a dermatomal distribution (Herpes zoster)			
Psychogenic (e.g. somatisation, anxiety, panic attacks)	*Chest pain phenotype*: non-specific *Associated symptoms*: perioral anaesthesia, numbness/tingling sensation, other non-specific symptoms *Risk factors*: history of psychiatric disorders (anxiety, somatisation disorders), recurrent admissions for atypical chest pain	*Vitals*: usually stable *Key signs*: normal examination	*Troponins*: normal	*ECG*: normal	Not required

* ABG: arterial blood gas; AKI: acute kidney injury; CABG: coronary artery bypass graft; CAD: coronary artery disease; CKD: chronic kidney disease; CRP: C-reactive protein; CMR: cardiac magnetic resonance imaging; CT: computed tomography; CTPA: computed tomography pulmonary angiogram; CVRFs: cardiovascular risk factors; CXR: chest X-ray; DM: diabetes mellitus; GERD: gastroesophageal reflux disease; GSV: great saphenous vein; GTN: glyceryl trinitrate; HLD: hyperlipidaemia; HTN: hypertension; IHD: ischaemic heart disease; NSTEMI: non-ST segment elevation myocardial infarction; PAD: peripheral arterial disease; POCUS: point-of-care ultrasound; PUD: peptic ulcer disease; STEMI: ST segment elevation myocardial infarction; T1MI: type 1 myocardial infarction; T2MI: type 2 myocardial infarction; TEE: transoesophageal echocardiogram; TTE: transthoracic echocardiogram

Table S4: Causes of Hypertroponinaemia

	Causes
Cardiac (**coronary artery**)	Myocardial infarction Coronary artery vasospasm Coronary artery dissection Aortic dissection with coronary extension Post-percutaneous coronary intervention
Cardiac (**non-coronary artery**)	Tachyarrhythmias (e.g. atrial fibrillation, supraventricular tachycardia) Myocarditis/myopericarditis Cardiomyopathies Infective endocarditis Infiltrative cardiac disease (e.g. amyloidosis, sarcoidosis) Heart failure (acute, chronic) Hypertensive crises Chest trauma/cardiac contusions Cardiac procedures (e.g. CPR, defibrillation, transvenous pacing, ablation procedures, cardiothoracic surgery) Cardiotoxins (e.g. anthracyclines, herceptin, recreational drugs such as cocaine)
Non-cardiac	Anaemia Sepsis Critical illness Viral infection (e.g. influenza infection) Pulmonary embolism Pulmonary hypertension Acute respiratory distress syndrome Chronic obstructive pulmonary disease (COPD) exacerbation Renal impairment (acute, chronic) Stroke Subarachnoid haemorrhage Seizures Strenuous exercise Rhabdomyolysis Burns
False positives	Heterophile antibodies Positive rheumatoid factor Elevated alkaline phosphatase Presence of fibrin clots

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