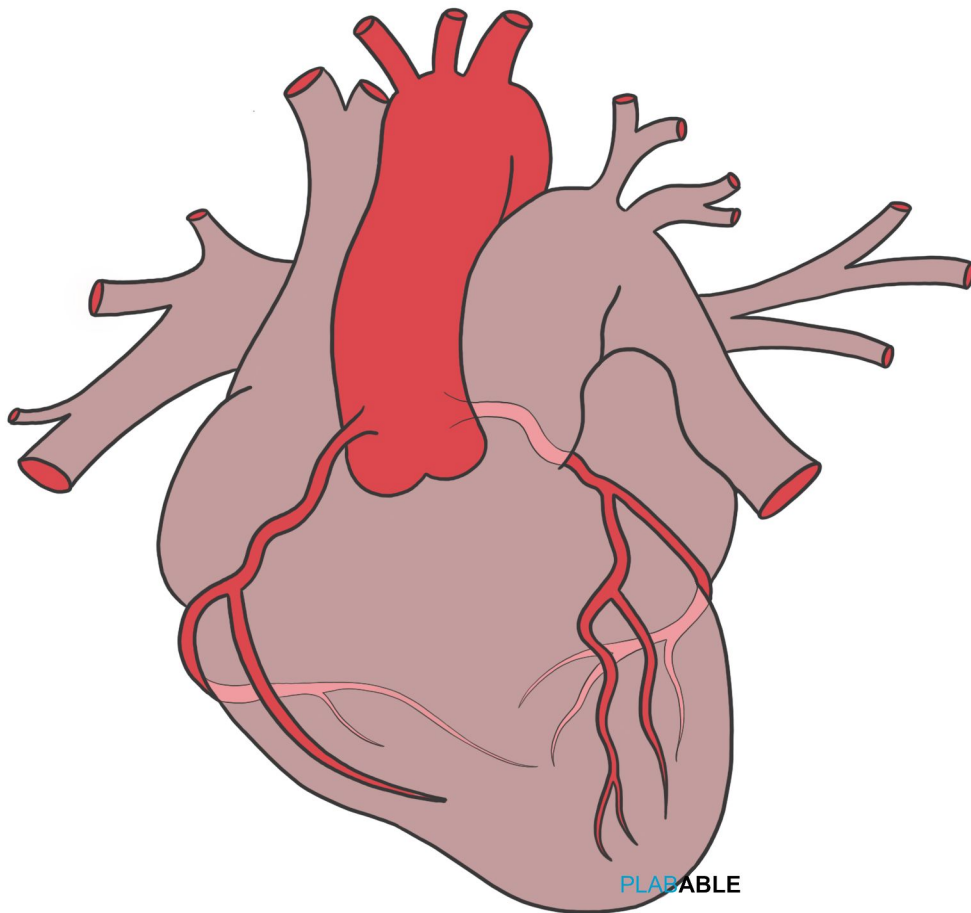


PLABABLE

GEMS

VERSION 1.2

CARDIOLOGY



PLABABLE

Cardiac Tamponade

Fluid accumulation in the pericardial space causing obstruction to the inflow of blood into the ventricles

Causes

- Acute pericarditis
- Aortic dissection
- Trauma

Beck's triad

- Hypotension
- Muffled heart sounds
- Raised JVP - prominent x descent and absent y descent

Paradoxical pulse

- **>10 mmHg inspiratory drop** of systolic BP
- During inspiration ↑ blood flow to the right ventricle bulges the interventricular septum towards the left ventricle and ↓ its volume → ↓ cardiac output

Cardiac Tamponade

Diagnosis:

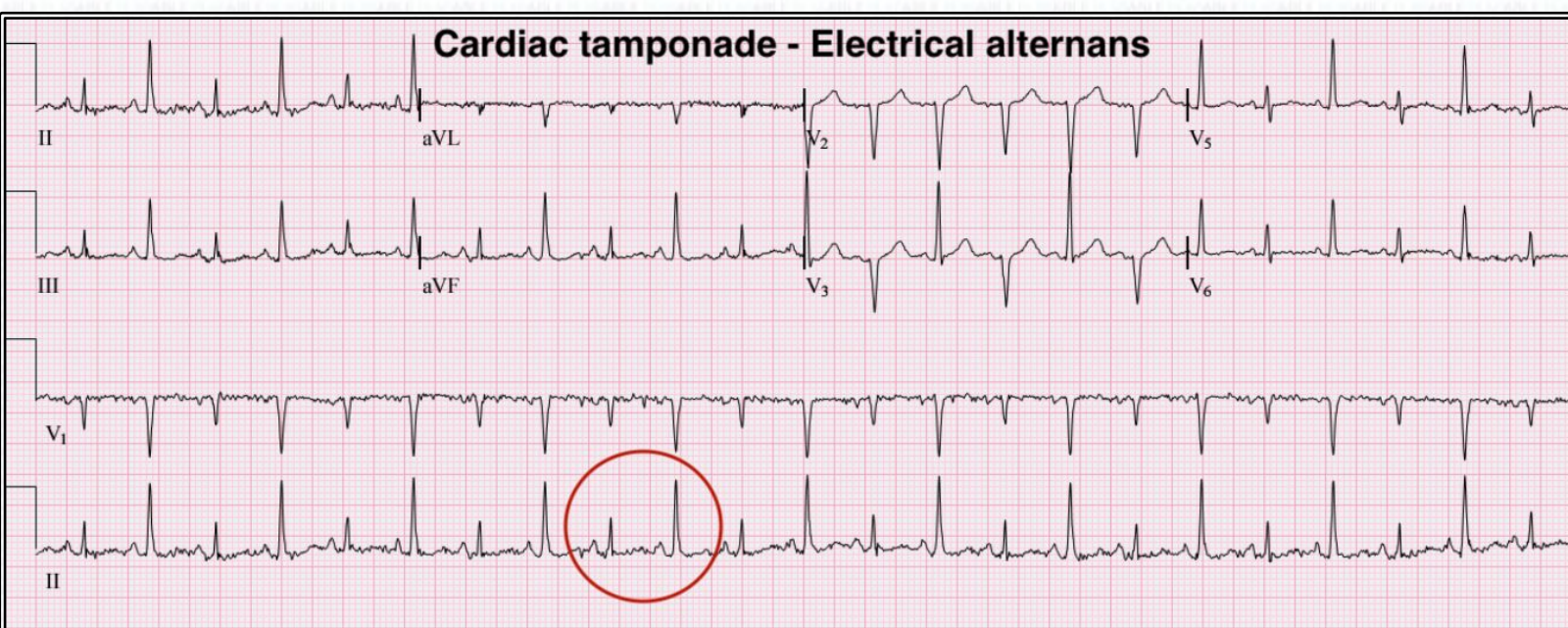
- Echocardiography is the investigation of choice

ECG finding:

- Reduced amplitude QRS complexes
- Electrical alternans

Treatment:

- Pericardiocentesis
- IV fluid (choose if the patient is in shock)



Acute Pericarditis

Presentation

- **Symptoms:** Sharp **pleuritic pain** increases during inspiration and relieved by leaning forward
- **Auscultation:** Friction rub
- **ECG:** Widespread **saddle-shaped ST elevation**

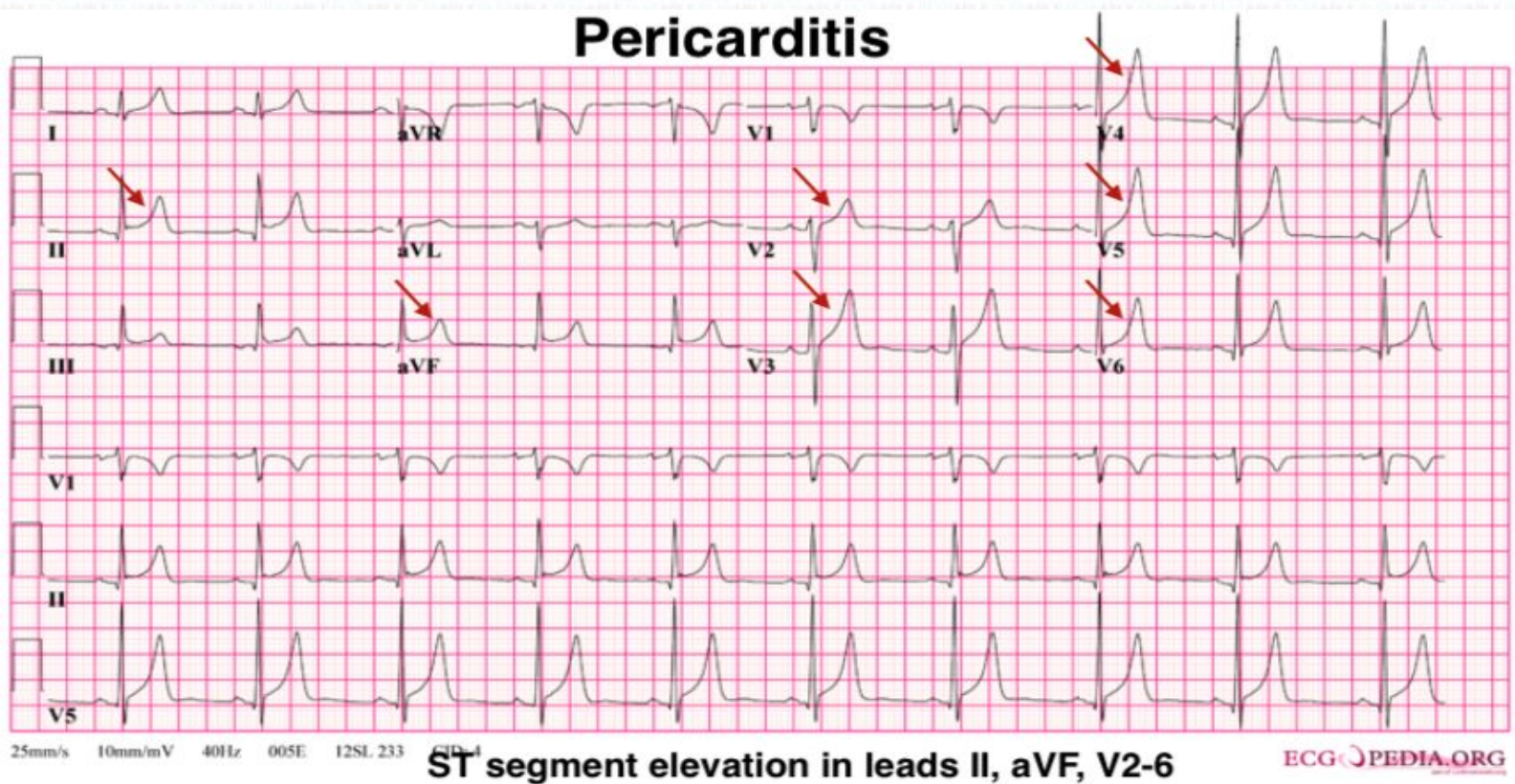
Causes

- Viral infection - coxsackievirus B
- Post MI (fibrinous pericarditis) and Dressler syndrome
- Autoimmune (SLE, RA)
- Uraemia
- Radiation therapy

Treatment

- NSAIDs
- Colchicine
- Corticosteroids

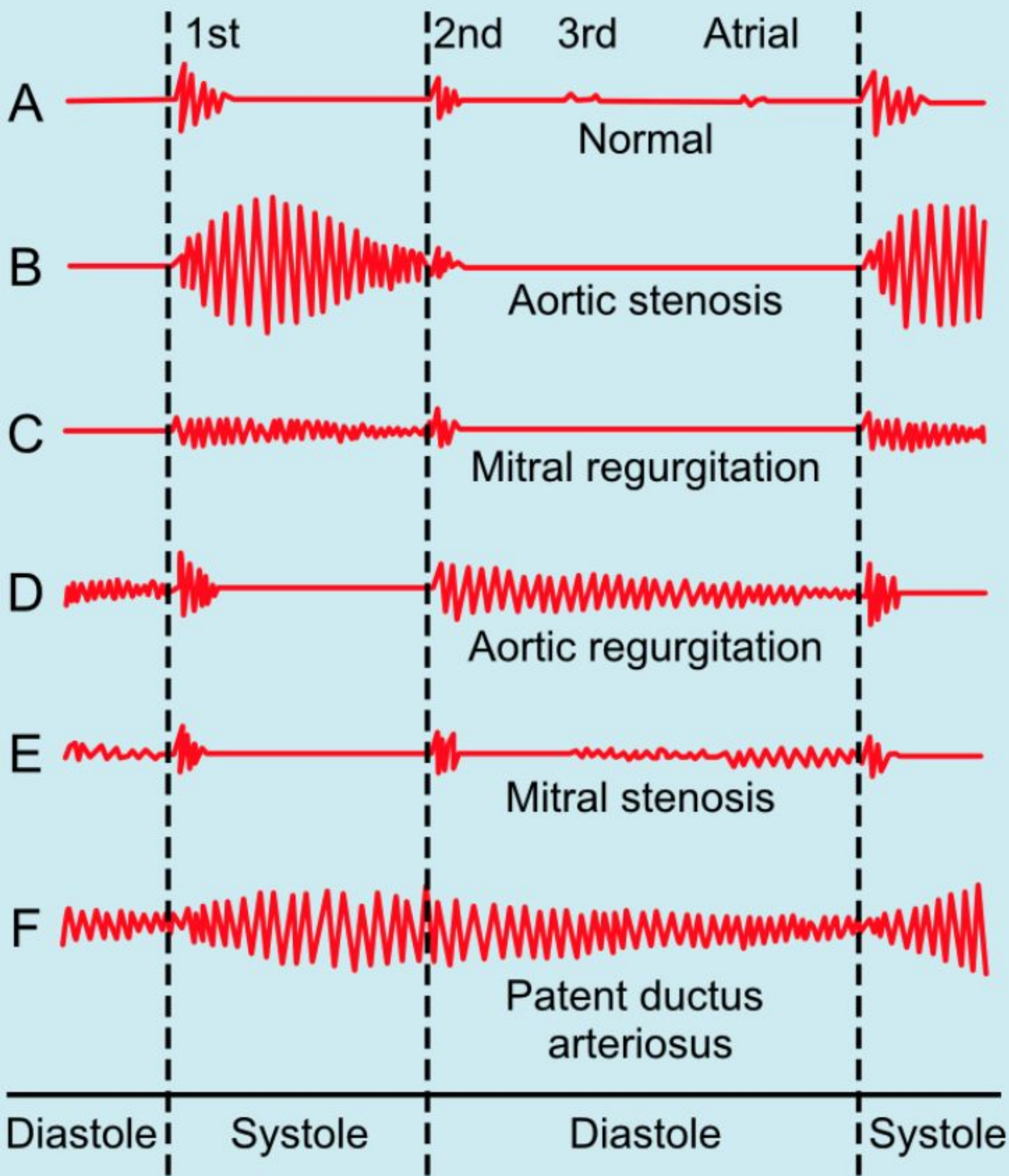
Acute Pericarditis



Cardiac Murmurs

Cardiac defect	Associated murmur	
Mitral stenosis	• Mid-diastolic murmur at the cardiac apex • Associated with opening snap	
Mitral regurgitation	Pansystolic murmur at the apex radiating to the axilla	
Aortic stenosis	Crescendo/decrescendo systolic murmur	
Aortic regurgitation	• Diastolic decrescendo murmur • Bounding pulse • Wide pulse pressure	

Cardiac Murmurs



Cardiac Murmurs

Cardiac defect	Associated murmur
Tricuspid regurgitation	Pansystolic murmur
Ventricular septal defect	Pansystolic murmur at left lower sternal border In chronic VSD shunt reversal with a right to left flow can happen (Eisenmenger syndrome)
Patent ductus arteriosus	Continuous machinery murmur Best heard in the left infraclavicular area
Hypertrophic obstructive cardiomyopathy	Crescendo/decrescendo systolic murmur Increases on valsalva maneuver and standing up (decreased preload)

Aortic Stenosis

Brain trainer:

A 77 year old woman presents with mild exercise intolerance and a ejection systolic murmur is found. What is the likely diagnosis?

→ **Aortic stenosis**

Pulmonary Regurgitation

Brain trainer:

A 40 year old man with cardiac surgery when he was a child has a diastolic murmur at the left upper sternal border. What is the likely diagnosis?

→ **Pulmonary regurgitation**

Mitral Regurgitation

Brain trainer:

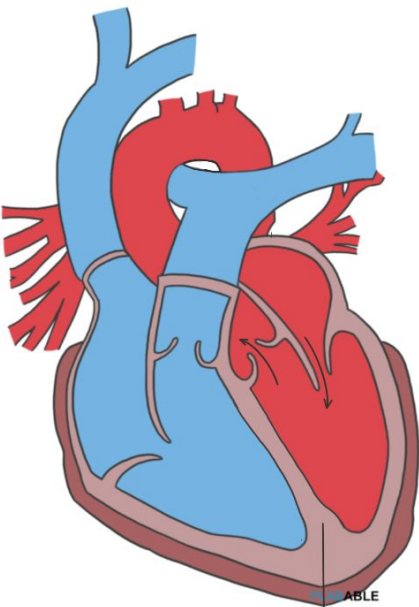
A woman presents with orthopnea, widespread bibasilar crepitations and a pansystolic murmur .
What is the likely diagnosis?

→ Mitral regurgitation

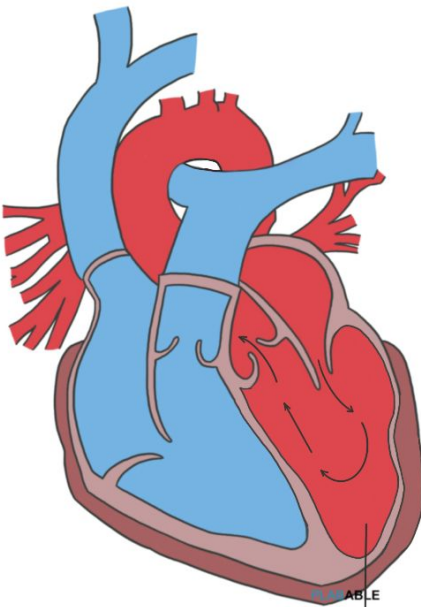
Cardiomyopathy			
	Dilated	Hypertrophic	Restrictive
Causes	Alcohol Viral-myocarditis Doxorubicin	Autosomal dominant mutation	Amyloidosis Sarcoidosis Postradiation fibrosis
Dys-function	Systolic	Diastolic	Diastolic
Salient features	Heart failure S3 heart sound	Syncope during exercise Sudden ventricular arrhythmia	Right-sided symptoms: - Oedema - Ascites
Treatment	ACE inhibitors Beta blocker Diuretics Digoxin	Beta-blocker or CCB ICD (arrhythmia)	Diuretics

Cardiomyopathy

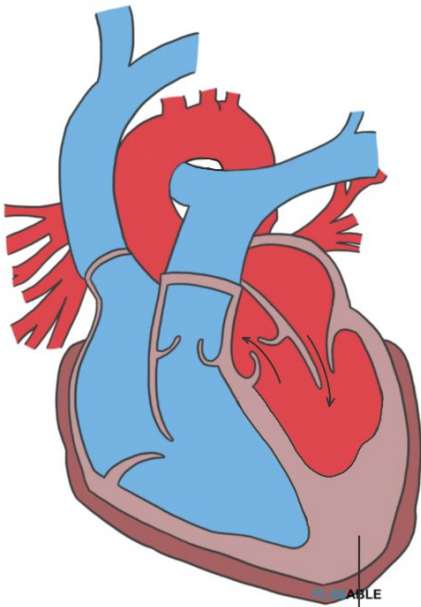
Normal Heart



Dilated Cardiomyopathy



Hypertrophic Cardiomyopathy



Interventricular Septum

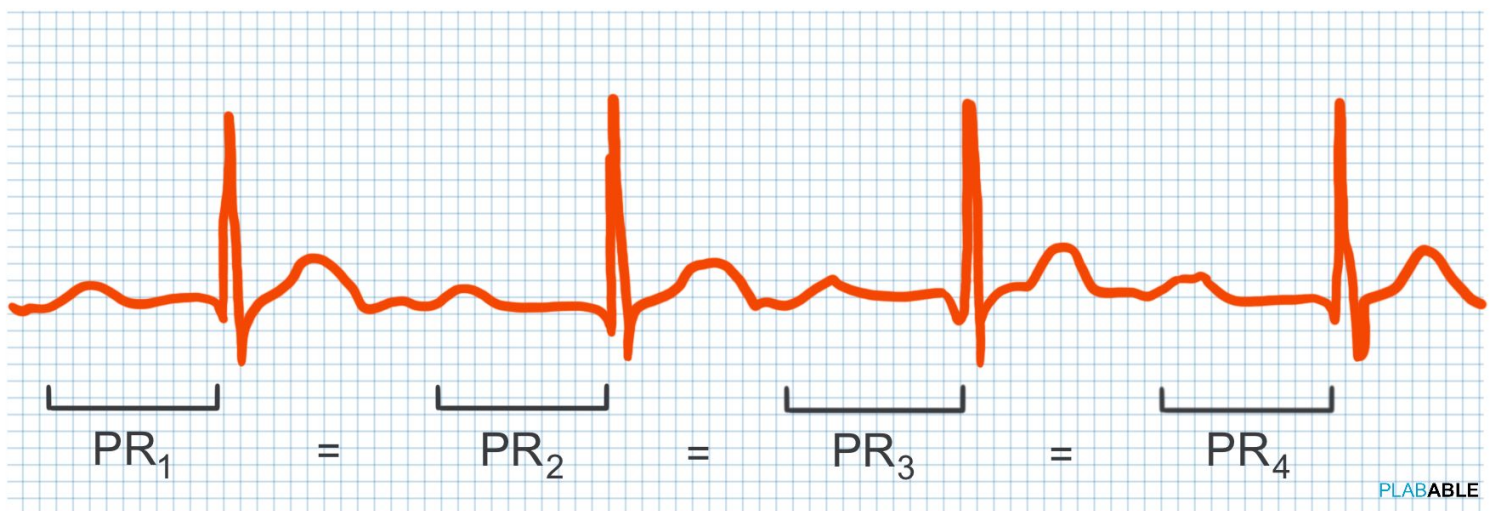
Ventricular dilation (Muscle fibres have stretched)

Excessive wall thickening of cardiac muscles

AV Conduction Block

First-degree AV block

- Prolonged PR interval ($>200\text{ms}$)
- No treatment is required

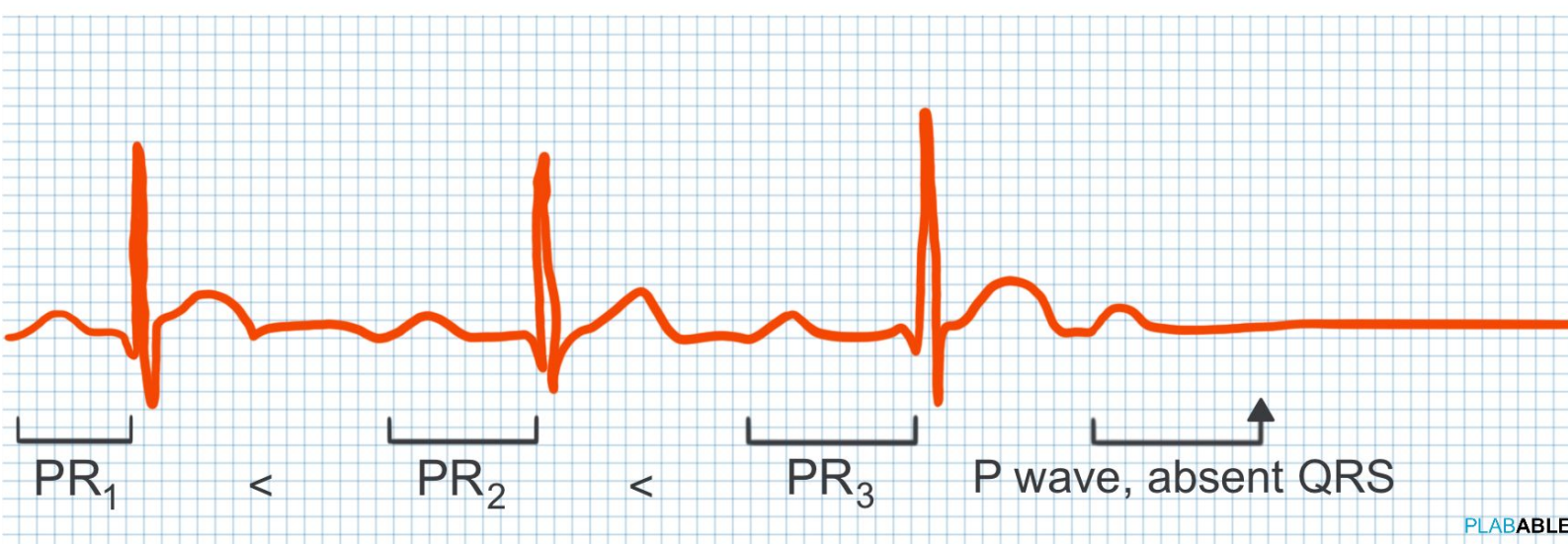


First-degree AV Block

Second-degree AV block

Mobitz type I

- PR interval lengthens progressively until a beat is missed RR interval is variable
- Hypotension or bradycardia $\rightarrow$ Rx with Atropine

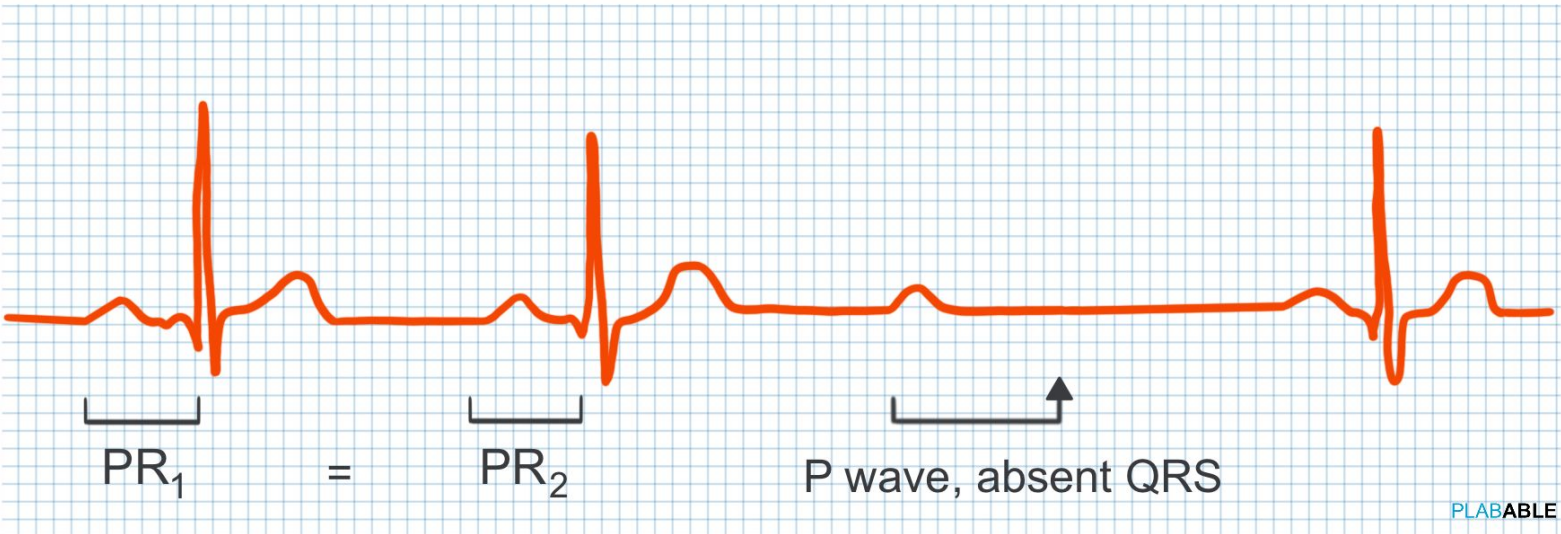


Second-degree AV Block - Mobitz Type I

AV Conduction Block

Mobitz type II

- Dropped beats (QRS complex)
- Treated with a pacemaker

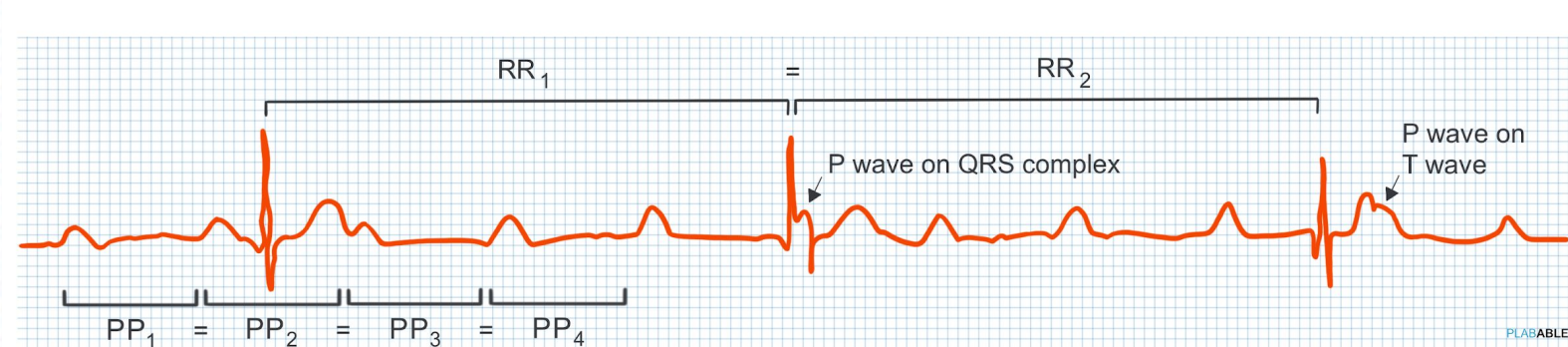


Second-degree AV Block - Mobitz Type II

AV Conduction Block

Third-degree AV block (complete)

- Atria and ventricles contract independently
- No association between the P wave and QRS complex
- **Causes:** Myocardial infarction and lyme disease
- **Immediate treatment:** Atropine 500 mcg IV followed by transcutaneous pacing
- **Definitive treatment:** pacemaker



Third-degree AV Block

AV Conduction Block



**All symptomatic bradycardia despite rhythm
→ Start with atropine**



Anti-arrhythmic Medications

Type	Uses	Side-effects
CLASS I Sodium channel blockers	Quinidine & lidocaine - atrial and ventricular arrhythmias	Quinidine -cinchonism (headache and tinnitus)
CLASS II Beta-blocker	Metoprolol - SVT Rate control for AF and atrial flutter	Exacerbation of COPD and asthma AV block
CLASS III Potassium channel blockers	Amiodarone - ventricular tachycardia	Amiodarone - ● Pulmonary fibrosis ● Hepatotoxicity ● Hypo or hyperthyroidism ● Corneal deposits Sotalol and ibutilide - Torsades de pointes

Antiarrhythmic Medications

Type	Uses	Side-effects
CLASS IV CCB	Verapamil - Rate control in AF	● Oedema ● Constipation ● AV block
Others	Adenosine - SVT	● Hypotension ● Flushing ● Bronchospasm

Antianginal Medications

Class	Drugs	Mechanism	Side-effects
Nitrates	Nitroglycerin	Reduces preload and decreases myocardial oxygen requirements	Headache
	Isosorbide dinitrate		Tolerance Interaction with sildenafil
Calcium channel blockers	Verapamil	↓ Cardiac contractility	Bradycardia
	Diltiazem	Vasodilation ↓ Afterload	Transient asystole
Beta-blockers	Atenolol	↓ Myocardial oxygen requirements by ↓ heart rate	Bradycardia
	Bisoprolol		AV block
	Metoprolol		
Ivabradine		↓ Heart rate	Phosphenes

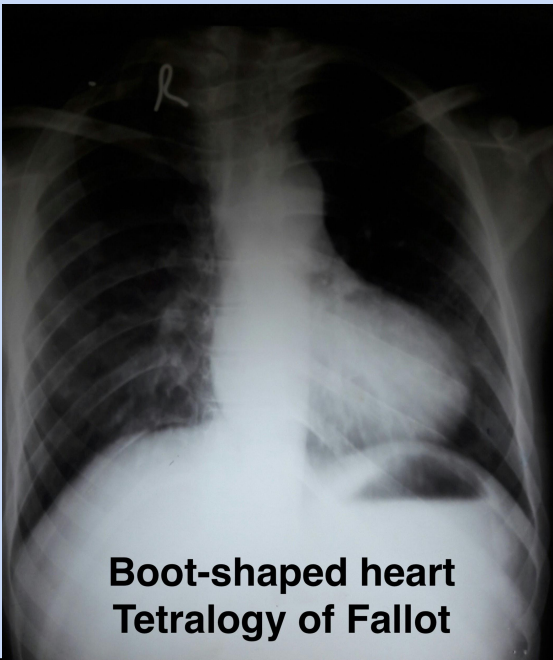
Amiodarone

The following are test to perform before starting a patient on amiodarone:

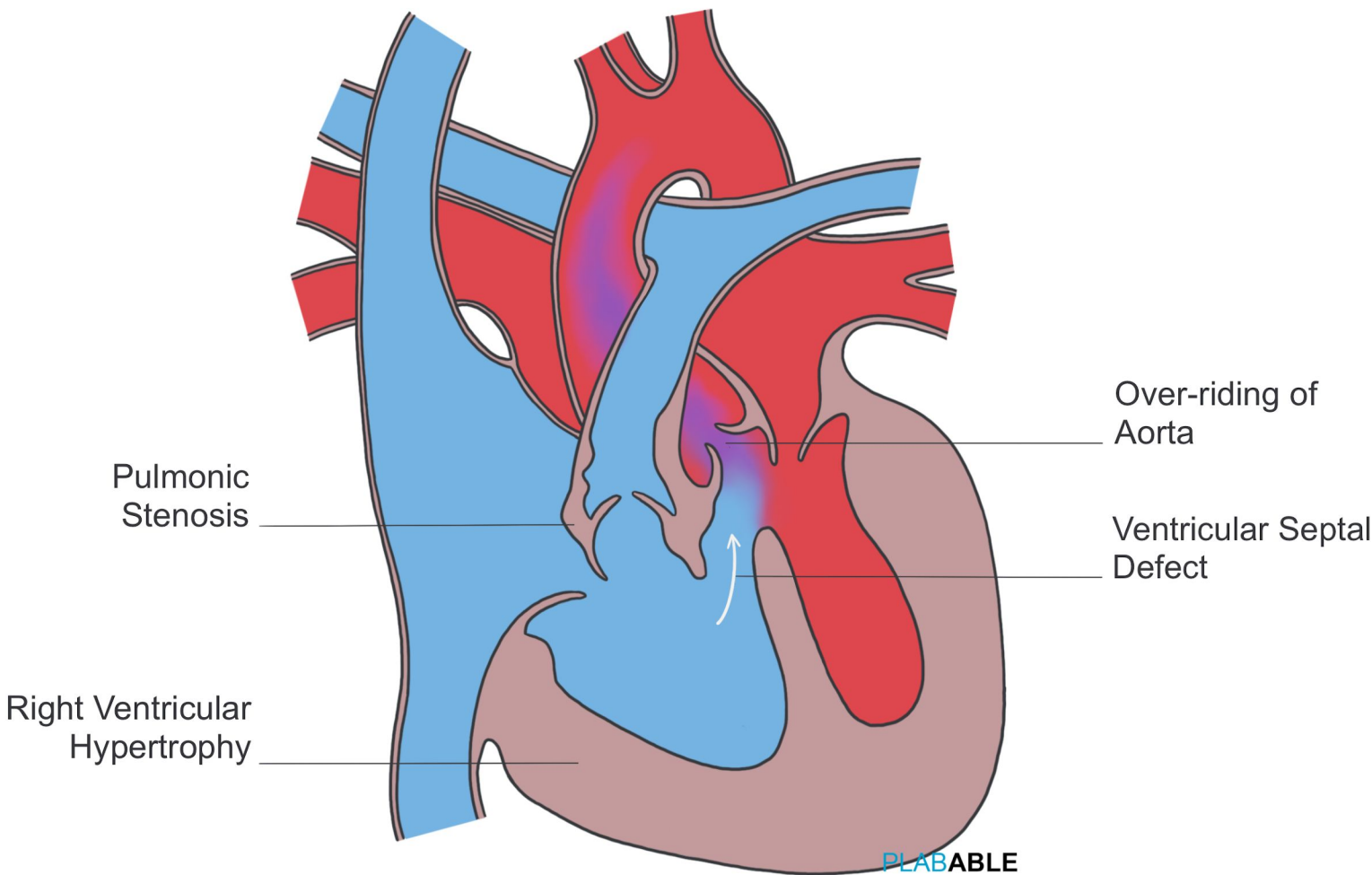
- Thyroid function tests
- Liver function tests
- Serum electrolyte and urea measurement
- Chest radiography
- Electrocardiography

Pay special attention to serum electrolyte and urea measurements

Congenital Heart Disease (Cyanotic)

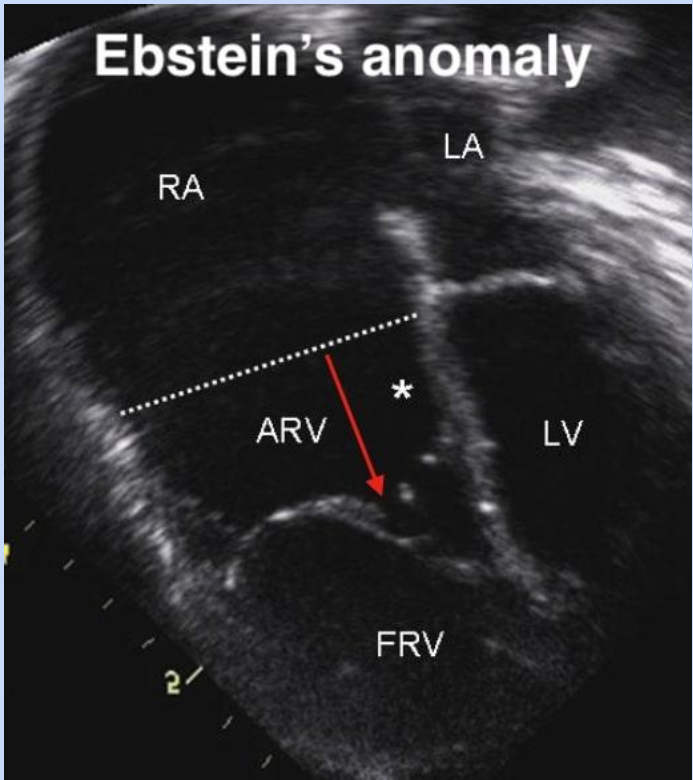
Tricuspid atresia	Absent tricuspid valve Associated with ASD and VSD
Transposition of great arteries	Pulmonary artery exits from left ventricle and aorta leaves from right ventricle.
Tetralogy of Fallot  Boot-shaped heart Tetralogy of Fallot	● Pulmonary stenosis ● Right ventricular hypertrophy ● Overriding of aorta ● VSD X-ray: Boot-shaped heart Squatting spells are seen

Congenital Heart Disease (Cyanotic)



Tetralogy of Fallot

Congenital Heart Disease (Cyanotic)

Persistent Truncus Arteriosus	Failure of truncus arteriosus to form pulmonary trunk and aorta
Ebstein Anomaly	Atrialization of the right ventricle Associated with lithium use during pregnancy. 
Total Anomalous Pulmonary Venous Connection	Pulmonary vein drains into the right heart

Congenital Heart Disease (Acyanotic)

Ventricular septal defect (Most common)	Pansystolic murmur
Atrial septal defect	Fixed split S2
Patent ductus arteriosus	Continuous machinery murmur in the left infrascapular region
Coarctation of aorta	Associated with Turner syndrome Hypertension is seen in the upper limb with brachiofemoral delay Increased risk of Berry aneurysms and cerebral hemorrhage

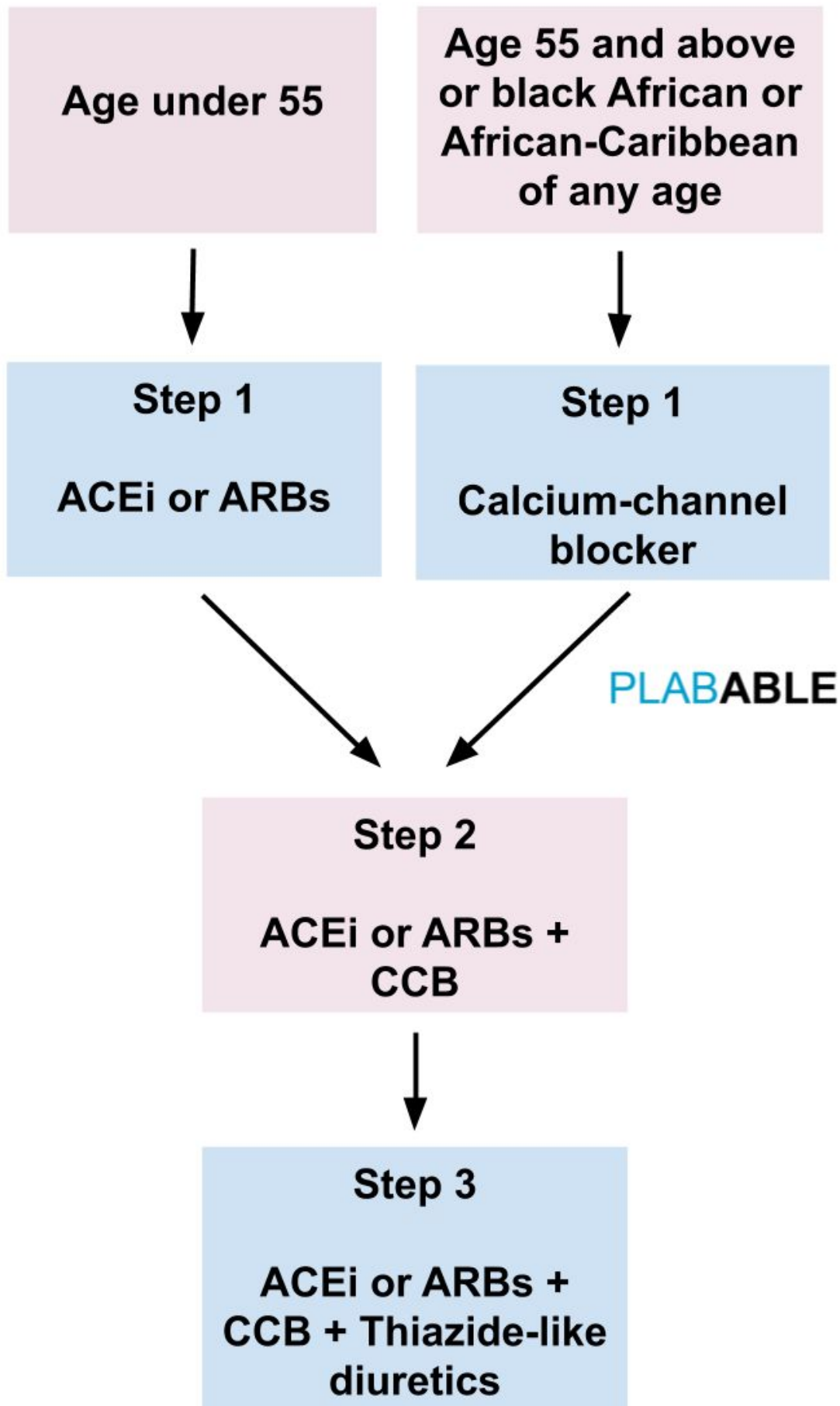
Eisenmenger syndrome:

Long standing left to right shunts (VSD, ASD and PDA) → Pulmonary hypertension → Shunt reversal (Right to left) → Late cyanosis and clubbing

Hypertension

Clinic BP $\geq 140/90$ mmHg

Ambulatory BP measurement $\geq 135/85$ mmHg



Hypertension

Medication	Side effects
ACE Inhibitors	● Cough (angioedema) ● Hyperkalemia
Calcium channel blockers	● Peripheral oedema ● Dizziness ● Flushing
Thiazide diuretic	● Hypokalemia ● Hyperuricemia ● Postural hypotension ● ↑ Serum lithium levels



Postural Hypotension

Brain trainer:

A 64 year old man previously diagnosed with hypertension is having recurrent falls. He takes enalapril, amlodipine and indapamide. Chest sounds are normal. ECG is normal. What is the likely underlying cause of his falls?

→ **Postural hypotension**

Always consider if patients are on multiple antihypertensive medications

Infective Endocarditis

Risk factors

- Valvular heart disease
- Valve replacement
- Previous episode of IE (highest risk)
- Intravenous drug users

Signs

- **Murmur and fever**
- **Roth spots:** White spots on retina surrounded by hemorrhage
- **Osler nodes:** Raised and tender on the fingers
- **Janeway lesions:** Painless, erythematous lesions on palm or sole
- **Splinter hemorrhages** on the nail beds

Common cause: *Streptococci* and *S. aureus*

Mitral valve is commonly affected

Injection drug users:

- Tricuspid valve commonly involved
- Commonly caused by *S. aureus*

New murmur + Fever → Think of IE

Initial step → Blood culture → Echo

Infective Endocarditis

Modified Duke criteria

- Two major criteria (or)
- One major criterion and three minor criteria (or)
- Five minor criteria

Major criteria

- Positive blood culture on two different occasions
- Evidence of endocardial involvement either by echo or new onset murmur

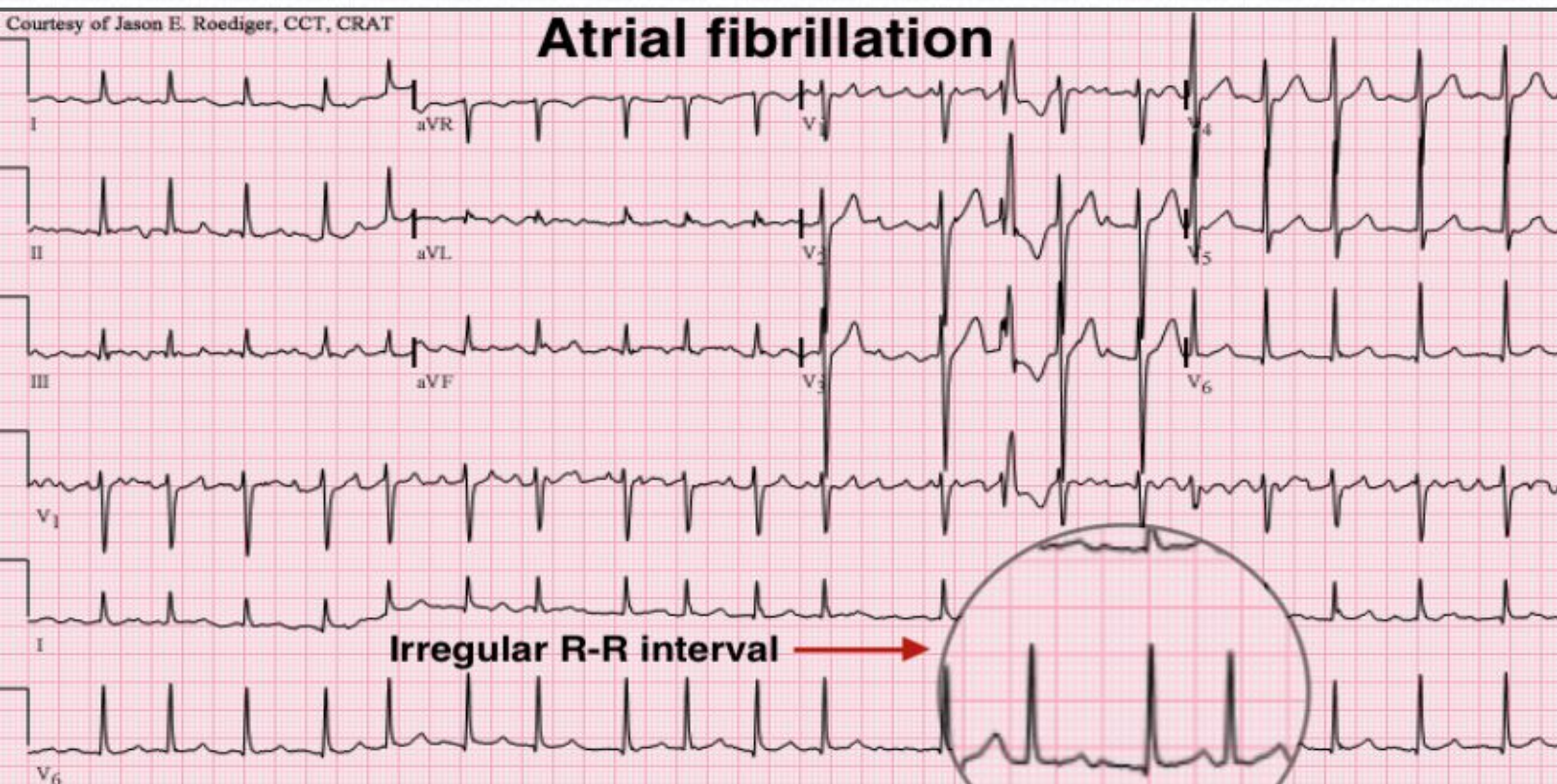
Minor criteria

- Predisposing heart condition or injection drug use
- Fever ≥ 38 degrees
- Vascular phenomenon such as Janeway lesions
- Immunological phenomenon such as Roth's spot
- Positive blood culture not meeting major criteria

Management

- **Native valve:**
 - Amoxicillin + Gentamicin
 - MRSA: Vancomycin + Gentamicin
- **Prosthetic valve:**
 - Vancomycin + Gentamicin + Rifampin

Atrial Fibrillation



- Irregular RR interval
- No discrete P waves
- Irregularly irregular pulse rate

Treatment

1. Unstable vitals: Electrical cardioversion
2. Stable vitals:
 - a. Rate control - beta-blockers
 - b. Rhythm control - amiodarone, flecainide
 - c. Anticoagulation - warfarin or NOAC

CHA2DS2-VASc score is used to determine the need for anticoagulation

Need not know how to calculate the score for PLAB

Atrial Fibrillation

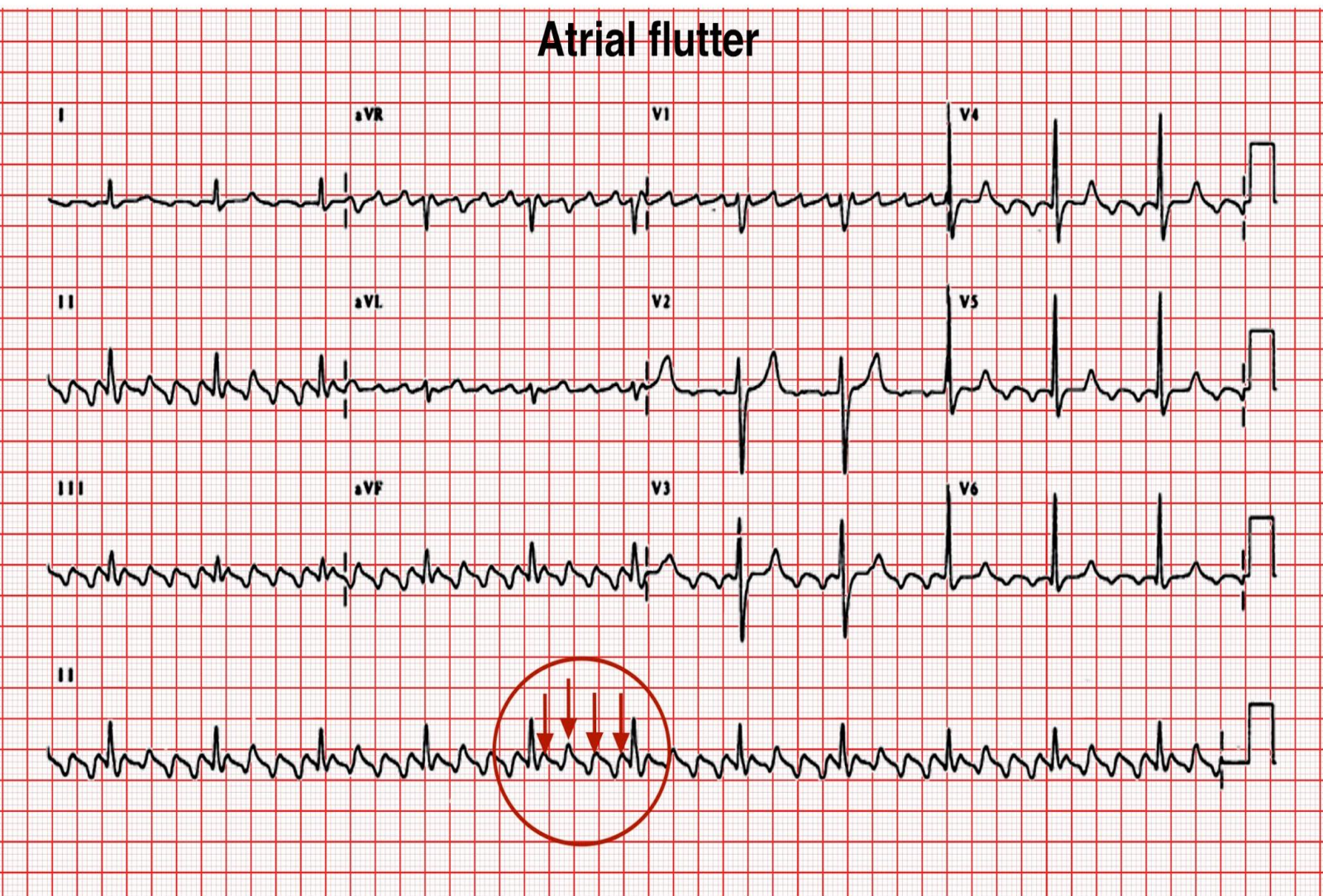
Brain trainer:

A 72 year old woman is confused, pale with an irregularly irregular pulse. Her blood pressure is **80/50** mmHg and heart rate is 130 bpm. ECG shows narrow **QRS complexes and absent P waves**. What is the next step in management?

→ Immediate **DC cardioversion**

As unstable (confusion, hypotensive) → Cardiovert

Atrial Flutter

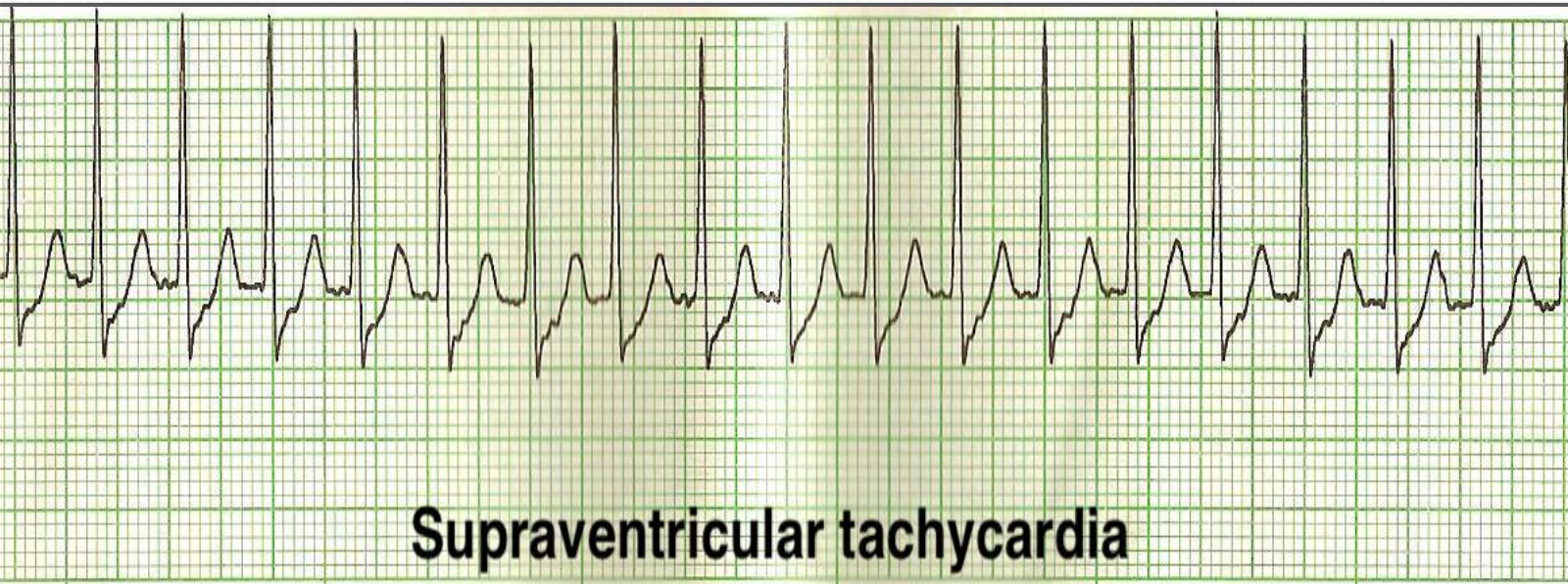


Atrial flutter

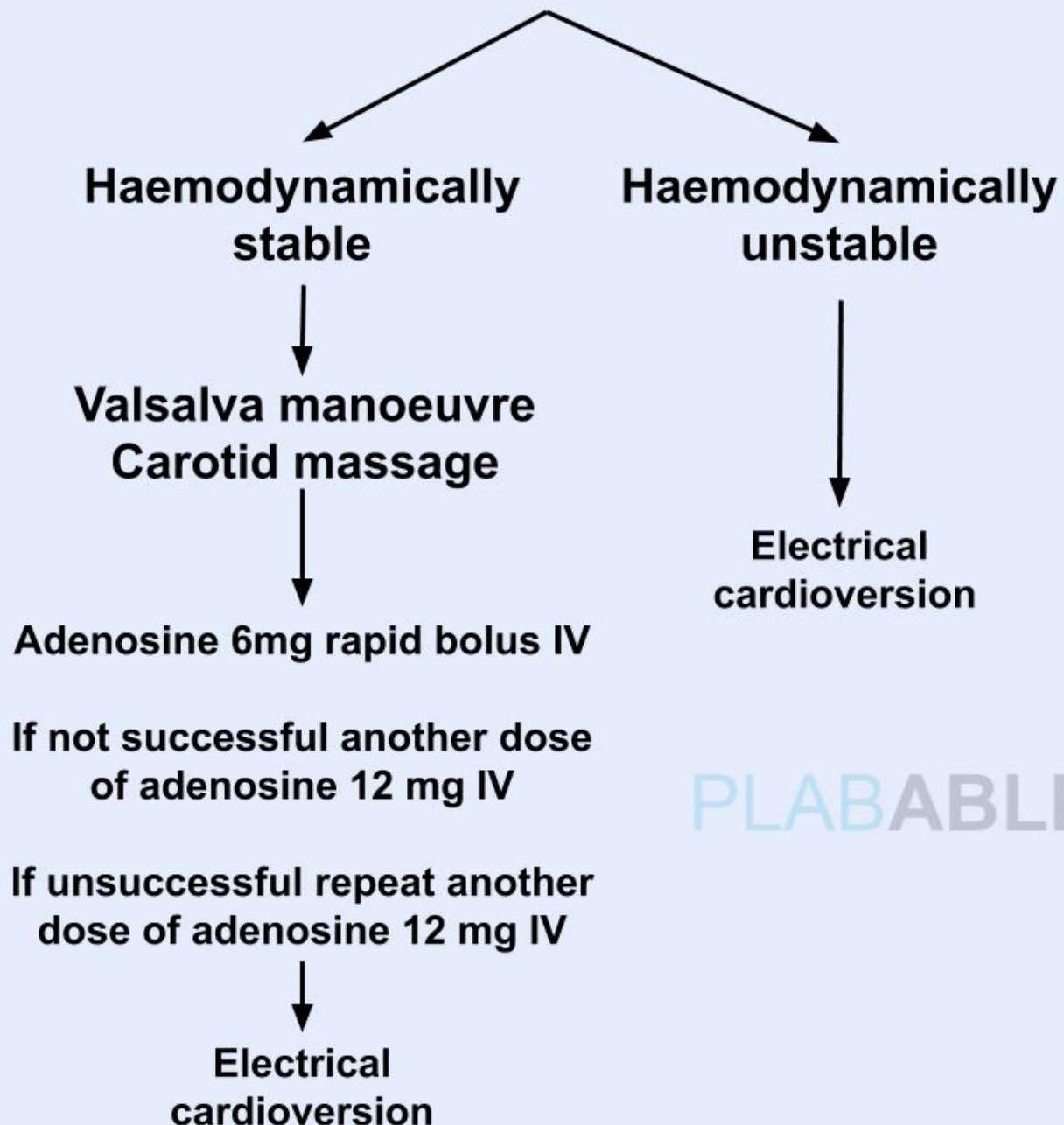
- Identical and rapid back to back P waves
- Sawtooth appearance

Treatment is same as AF

Supraventricular Tachycardia



Treatment of paroxysmal supraventricular tachycardia



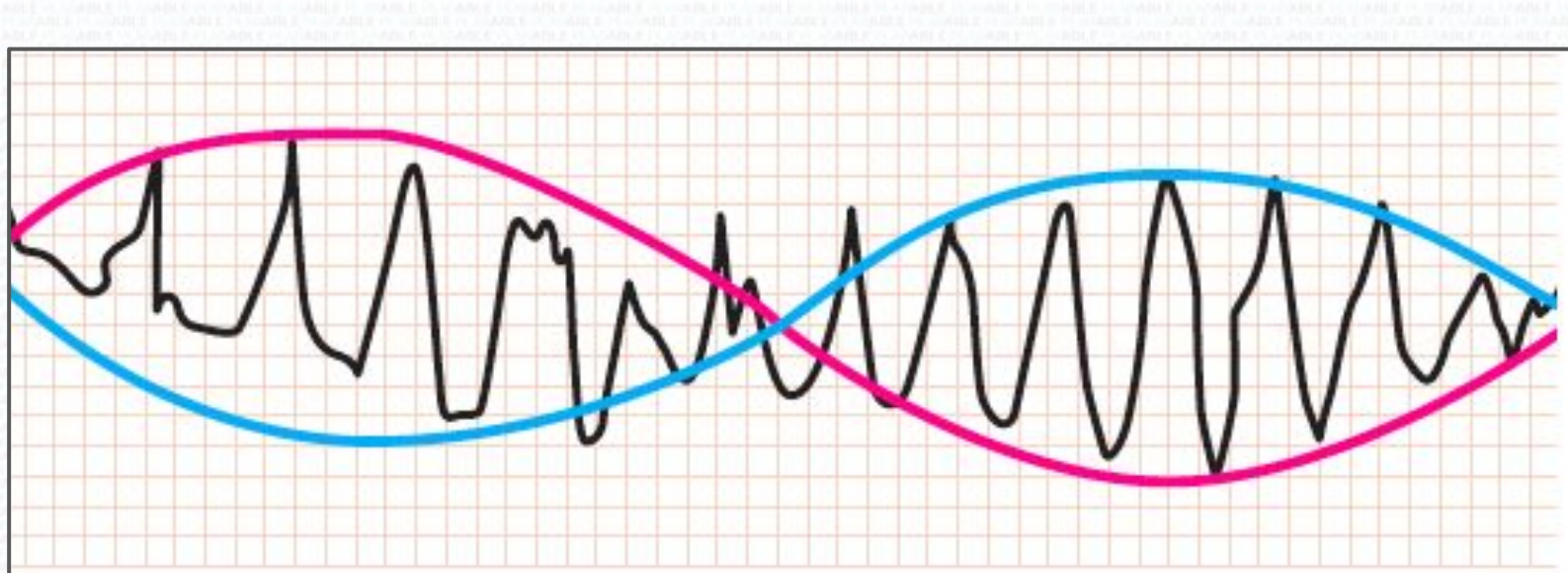
PLABABLE

Torsades de Pointes

- Type of polymorphic ventricular tachycardia where the QRS complexes appears to be twisting around the base in the ECG
- QT prolongation is the cause
- Can degenerate to VF

Causes

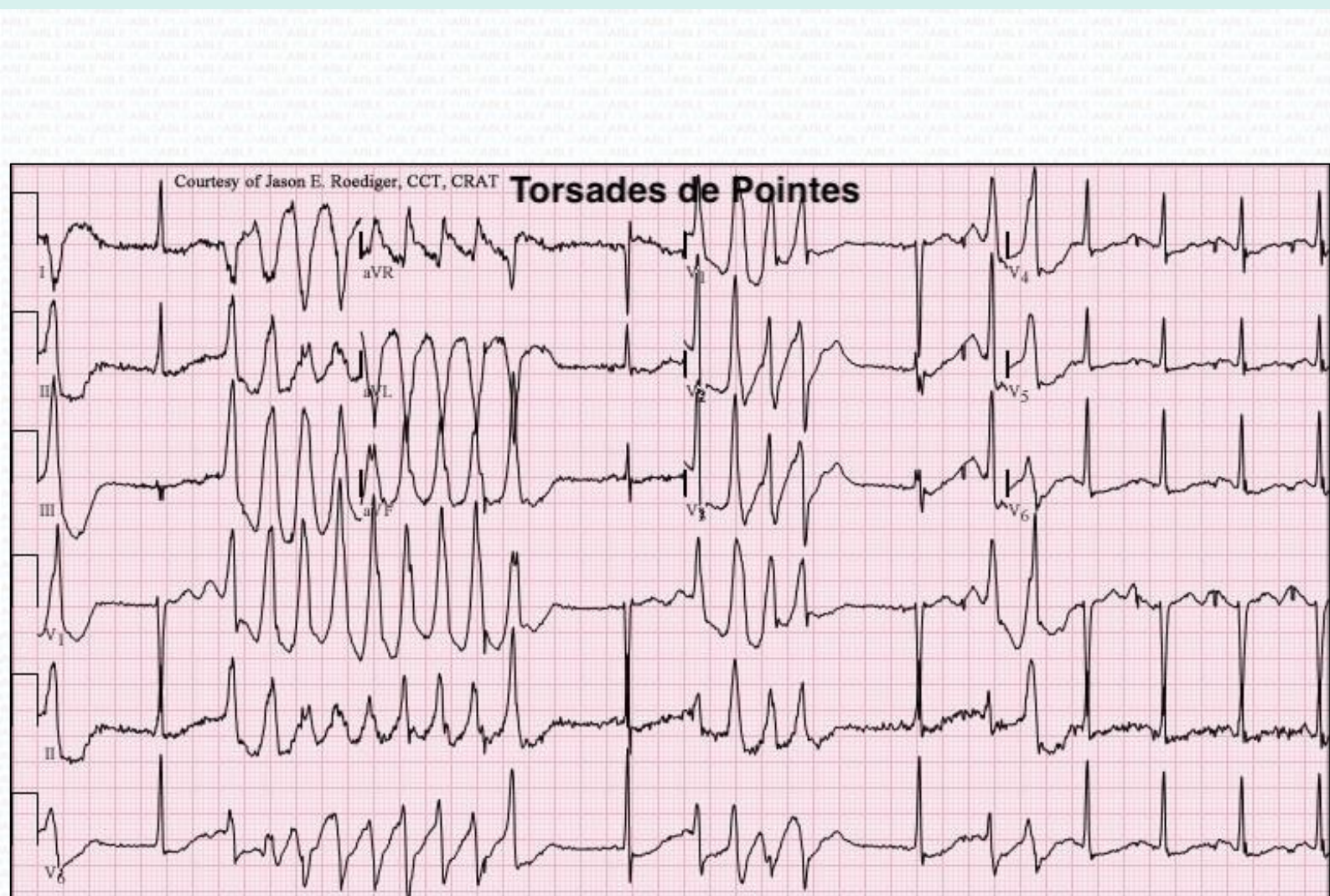
- Long QT syndrome
- Electrolyte abnormalities:
 - Hypomagnesemia
 - Hypokalemia
 - Hypocalcemia
- Antipsychotics
- Antibiotics: erythromycin



Torsades de Pointes

Treatment

- **IV magnesium sulphate**
- Correction of electrolyte abnormalities
- Removal of causative drug
- If patient progresses to VF then defibrillation



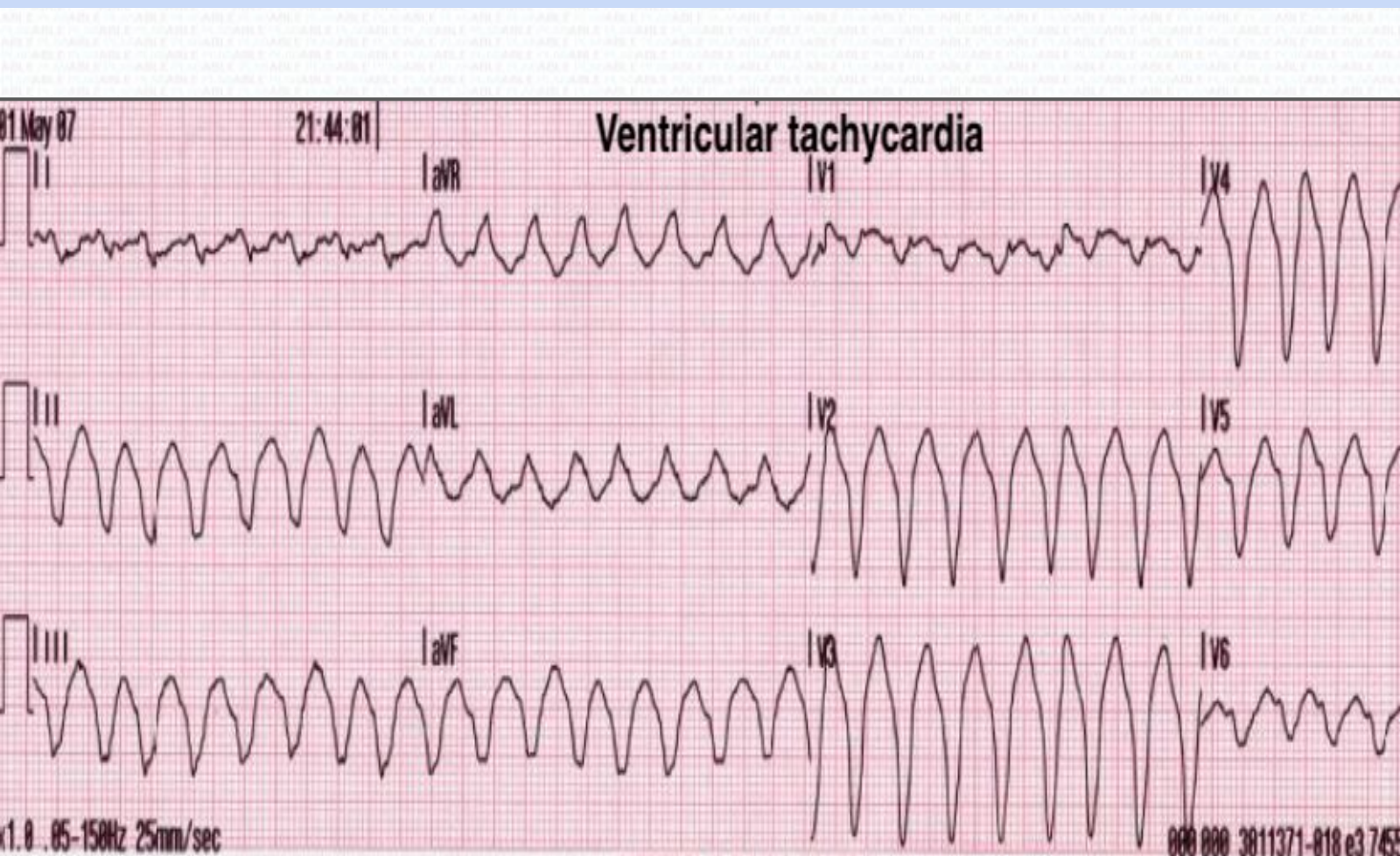
Ventricular Tachycardia

Features

- Wide QRS complex (broad complex tachycardia)
- Can develop into ventricular fibrillation

Management

- **Unstable vitals:**
 - If with pulse → Cardioversion
 - If without pulse → Defibrillation
- **Stable vitals:**
 - Beta-blockers
 - Non-dihydropyridine CCB
 - Sodium channel blockers



Ventricular Fibrillation

Ventricular fibrillation

- Completely disordered ventricular electrical activity
- No identifiable QRS complexes

Treatment: Immediate defibrillation to bring back the sinus rhythm

Courtesy of Jason E. Roediger, CCT, CRAT

Ventricular fibrillation



Ventricular Fibrillation

Brain trainer:

A 49 year old man is semi-conscious, BP 80/60, ECG shows broad complex tachycardia (either V fib or V tach). What is the most appropriate action?

As he is haemodynamically unstable, this depends purely if he has a pulse:

- If pulse → Cardiovert
- If no pulse → Defibrillate (unsynchronised cardioversion)

Remember:

Ventricular fibrillation NEVER has a pulse

Wolff-Parkinson-White Syndrome

Brain trainer:

A 12 year old child presents with sudden onset of pallor, palpitations, and difficulty breathing while running on the school track. After 30 minutes, the symptoms resolved. ECG shows pre-excitation, delta waves, and prolonged QRS.. What is the likely diagnosis?

→ **Wolff-Parkinson-White syndrome**

Hypokalaemia ($K^+ < 3.5\text{mM}$)

Causes

Increased loss:

- Vomiting and diarrhea
- Diuretics - Thiazides and loop diuretic
- Hyperaldosteronism
- Cushing's syndrome
- Proximal renal tubular acidosis
- Magnesium deficiency

Redistribution into cells:

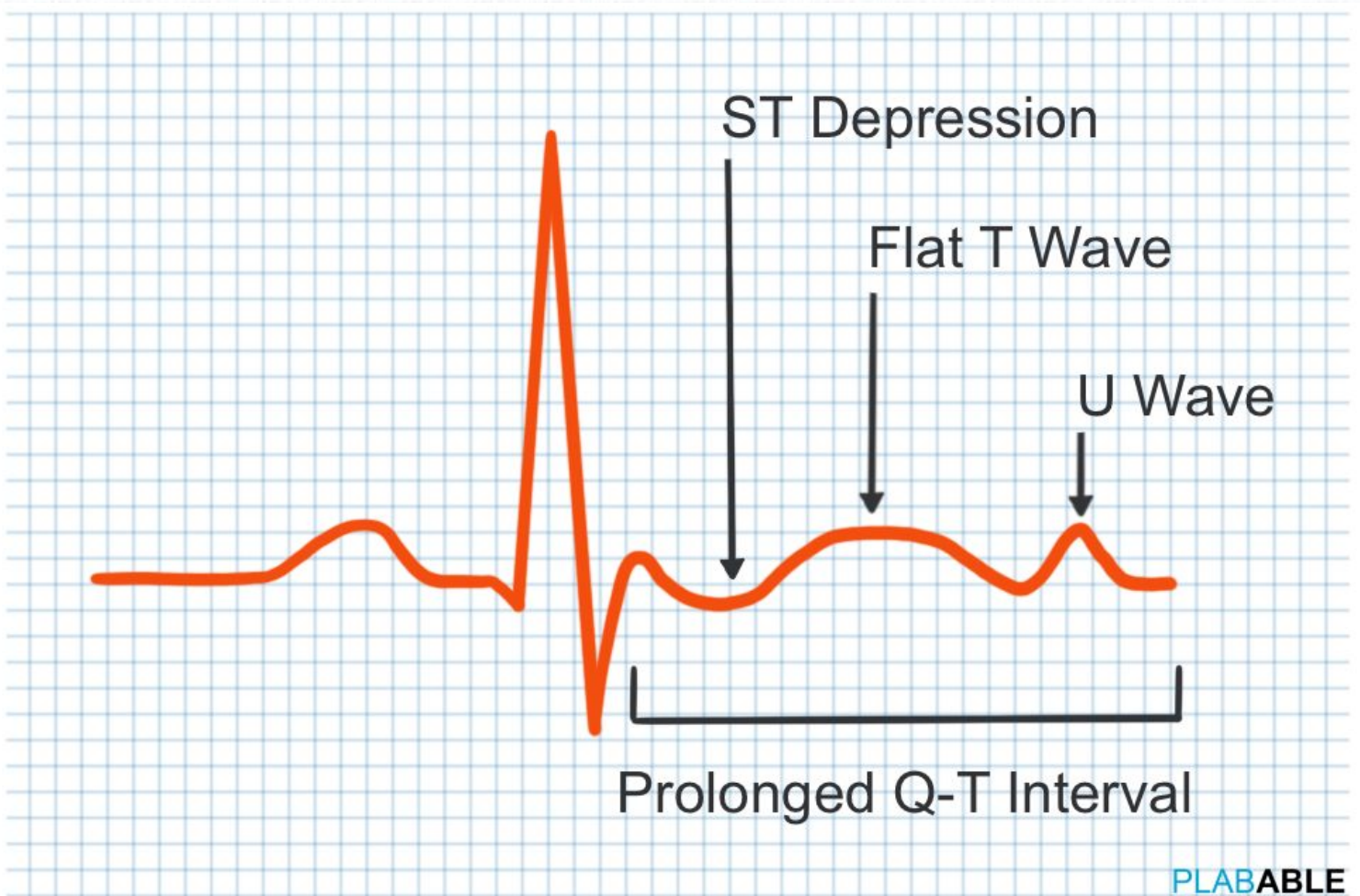
- Insulin
- Metabolic alkalosis

Oral treatment with KCl is commonly employed

ECG changes

- Broad flat T waves
- ST depression
- QT prolongation

Hypokalaemia ($K^+ < 3.5\text{mM}$)



ECG Changes in Hypokalemia

Hyperkalaemia (K⁺ >5.5mM)

Causes

Shift from cells:

- Acidosis
- Tumour lysis

Inadequate excretion:

- Drugs- ACEi, ARBs, spironolactone
- CKD
- Primary adrenal insufficiency

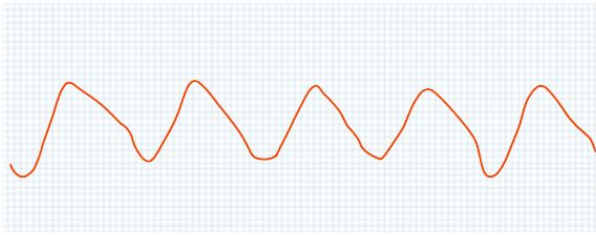
ECG changes

- Tall tented T wave
- Loss of P wave
- Widened QRS complex
- Sine wave pattern

Treatment

- **10% Calcium gluconate** slow IV over 2-3 min to prevent arrhythmias
- **IV insulin infusion** followed by dextrose to reduce K⁺ concentration

Hyperkalaemia (K+ >5.5mM)



Sine Wave Pattern



Ventricular Fibrillation



Wide QRS Complex

7.0



Tall Peaked T Waves

5.0

8.0



Loss of P Waves

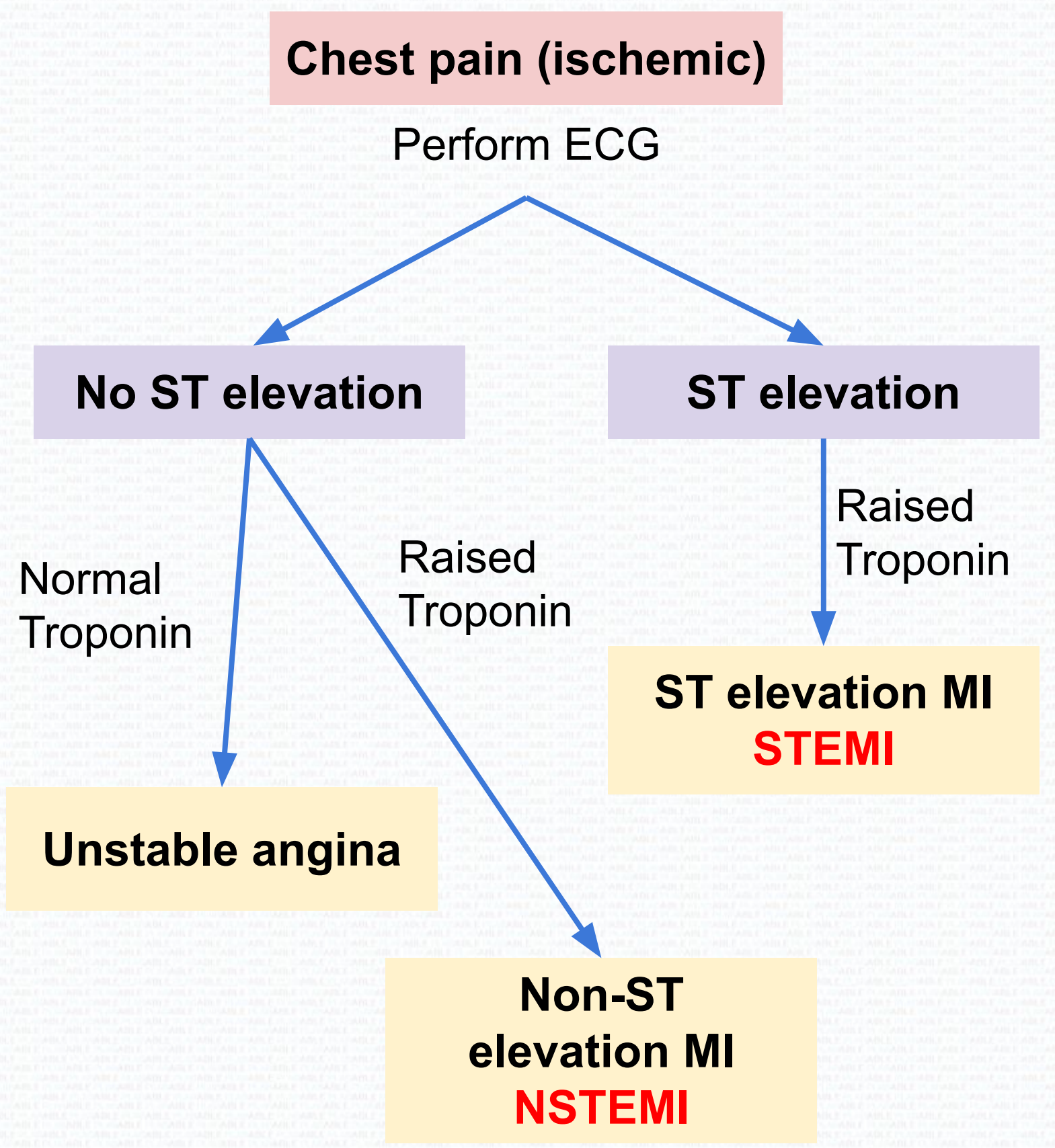
6.0

mmol/l

ECG Changes in Hyperkalemia

PLABABLE

Acute Coronary Syndrome



Acute Coronary Syndrome

Ischemic chest pain:

- Left-sided, substernal or central
- Radiating to the left arm, jaw or shoulder
- **Silent MI** in diabetics without pain
- Sweating
- Hypotension (inferior wall MI)
- **Risk factors:**
 - Smoking
 - Family history
 - Elderly
 - Males
 - Diabetes mellitus
 - Hypertension

STEMI

ECG changes in various type of MI:

Inferior wall MI:

- ST elevation in leads II, III and aVF
- Coronary artery - RCA (80%) and RCX (20%)

Anterior wall MI:

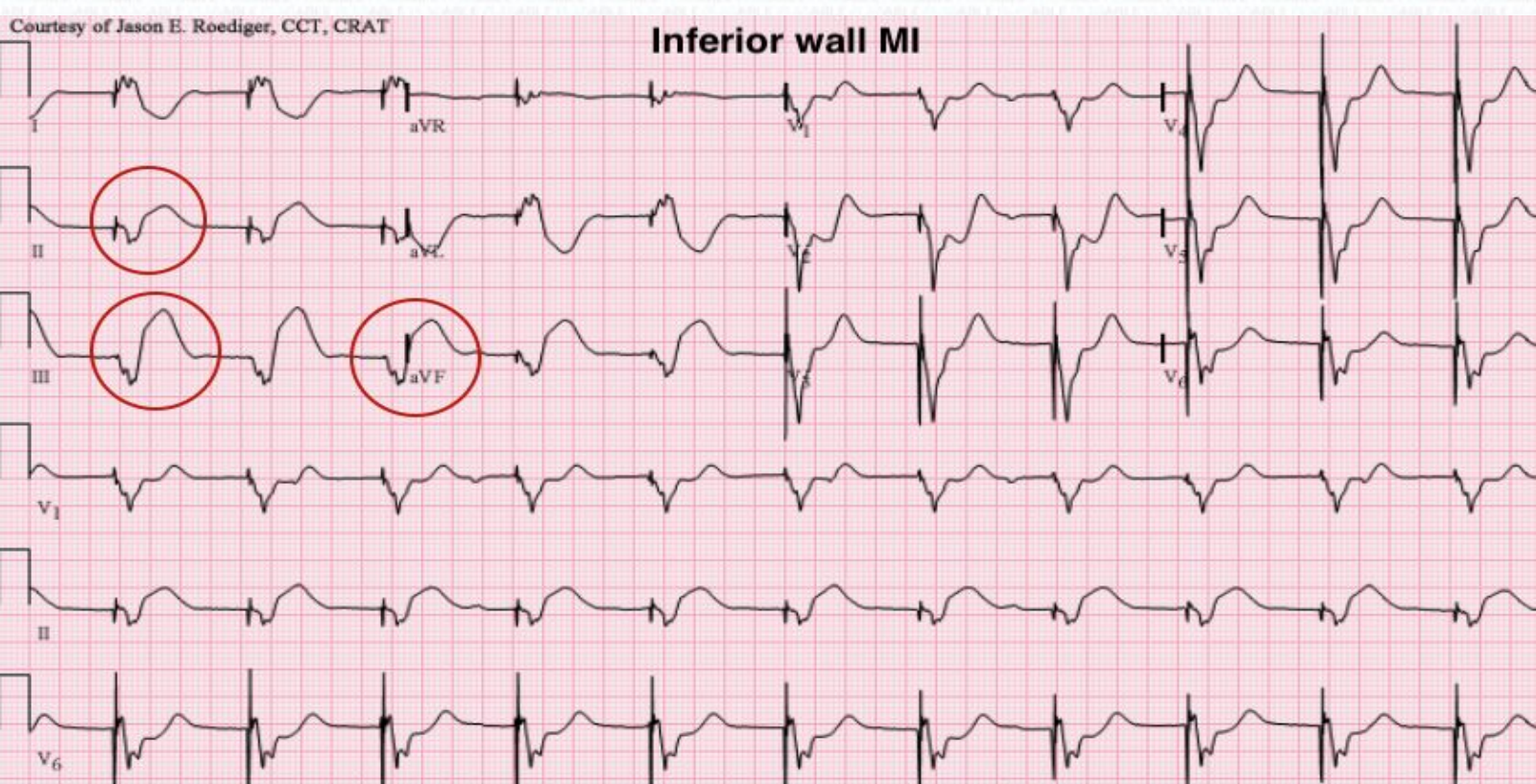
- ST elevation in leads V1 to V6
- Coronary artery - LAD

Lateral wall MI:

- ST elevation in leads I, aVL, V5 and V6
- Coronary artery - LCX

Posterior wall MI:

- ST elevation in leads V7, V8 and V9
- Coronary artery - RCX



STEMI

Immediate treatment: **MONA**

- **M** - Morphine
- **O** - Oxygen
- **N** - Nitroglycerin (avoided in low BP and inferior wall MI)
- **A** - Aspirin 300 mg

Definitive treatment

- **PCI** - Gold standard (If patient presents within 12 hrs after the onset of symptoms)
- **Thrombolysis** - If PCI is unavailable

Long term management

- Aspirin for life
- Ticagrelor or prasugrel or clopidogrel for 12 months
- Beta blockers for 12 months
- ACEi or ARBs for life
- Statins for life

NSTEMI

Treatment

- Aspirin + clopidogrel
- Anticoagulation
 - Enoxaparin
 - Fondaparinux
- Angiography within 96 hrs following admission

Other important anti-ischaemic therapy

- Beta blockers
 - Can be started on presentation
- Statins
 - Can be started on acute presentation

NSTEMI

Brain trainer:

A 58 year old man has acute chest pain radiating to his left arm + features suggestive of ischaemic heart disease. His ECG is normal. What is the next step?

→ **Measure troponin**

If troponin is high → NSTEMI

What is the next most appropriate management?

→ **Give:**

- ◆ **Subcutaneous LMWH or fondaparinux**
- ◆ **+ aspirin**

Risk Factors

Brain trainer:

A 50 year old man drinks 8 units of alcohol per week, smokes 20 cigarettes a day, has a BMI of 27 and has a cholesterol of 4.2. What is the best advice for him?

➔ **Referral to smoking cessation clinic**

Myocardial Infarction

Brain trainer:

A 58 year old man has acute chest pain radiating to his left arm + features suggestive of ischaemic heart disease. His ECG shows ST elevation. What is the next most appropriate management?

→ **Percutaneous coronary intervention**

→ If not among the options then pick → **Alteplase**

Myocardial Infarction

Analgesia while in ambulance

- GTN spray
- Morphine intravenously (or diamorphine)

Do not use opioids intramuscularly as

- Intramuscular absorption is slower and less reliable
- If the patient receives thrombolysis later on, the injection site will bleed

Complications Following MI

0-24 hours following MI:

- Ventricular fibrillation
- Heart failure

1-3 days following MI:

- Fibrinous pericarditis

1-2 weeks following MI:

- Ventricular free wall rupture causing cardiac tamponade
- **Papillary muscle** (posteromedial) **rupture** causing mitral regurgitation
- Interventricular septum rupture causing VSD - Pansystolic murmur
- Left ventricular **pseudoaneurysm**

2 weeks to months following MI:

- **Dressler syndrome** - Autoimmune pericarditis
 - Pleuritic chest pain
 - Fever
 - ECG: Widespread saddle shaped ST elevation
 - Rx: NSAIDs
- True ventricular aneurysm
- Chronic heart failure

Pulmonary Embolism

Symptoms

- Breathlessness
- Chest pain
- Calf pain or swelling (DVT)

Common cause: DVT

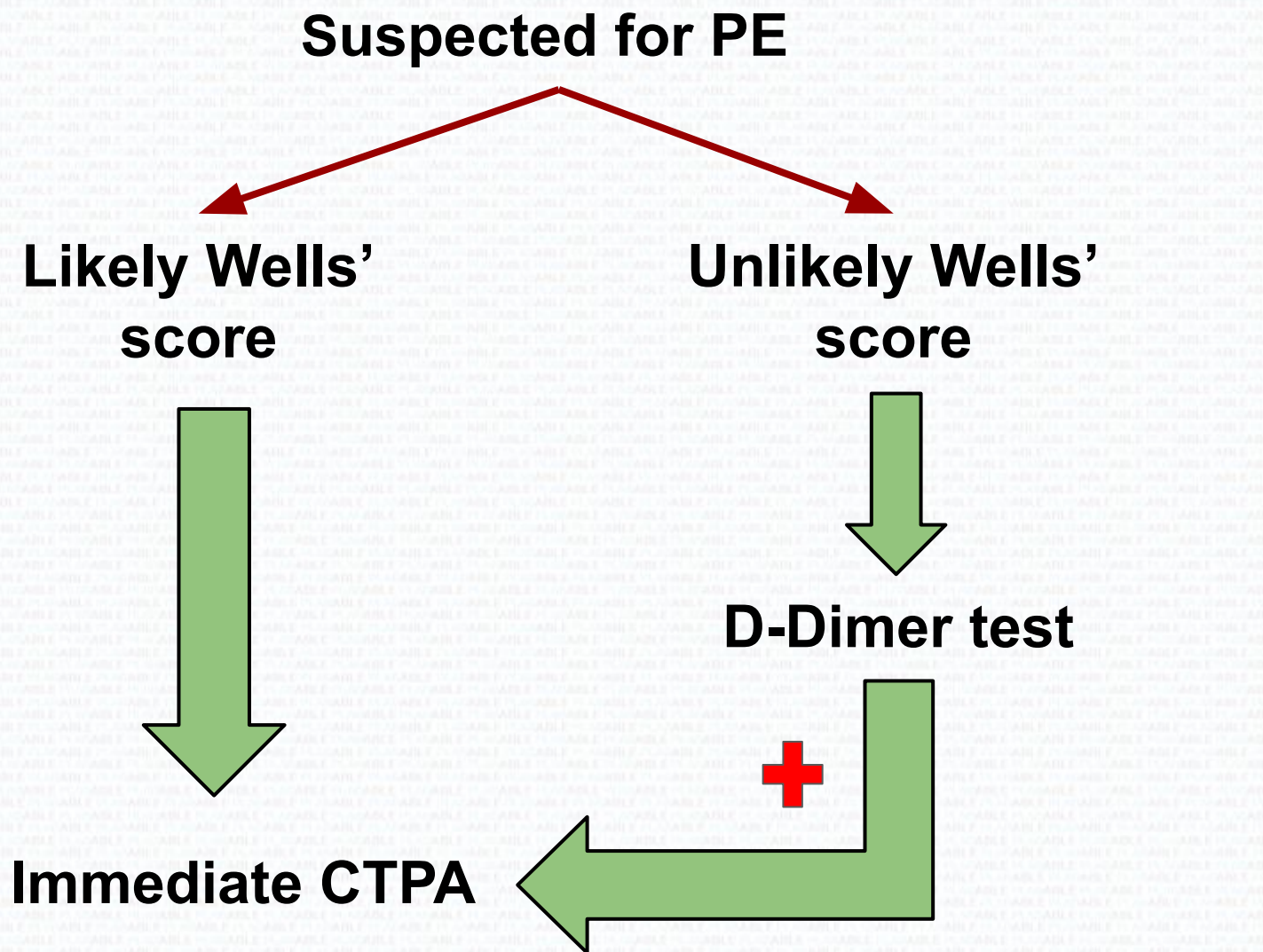
Risk factors

- Immobilization - Surgery, trauma, long-haul air travel, bedridden patients.
- Factor V Leiden and prothrombin gene mutation
- Smoking
- Cancer
- Oestrogen containing contraceptive pills

ECG: S1Q3T3 sign (specific for PE)

- S wave in lead I
- Q wave in lead III
- Inverted T wave in lead III

Pulmonary Embolism



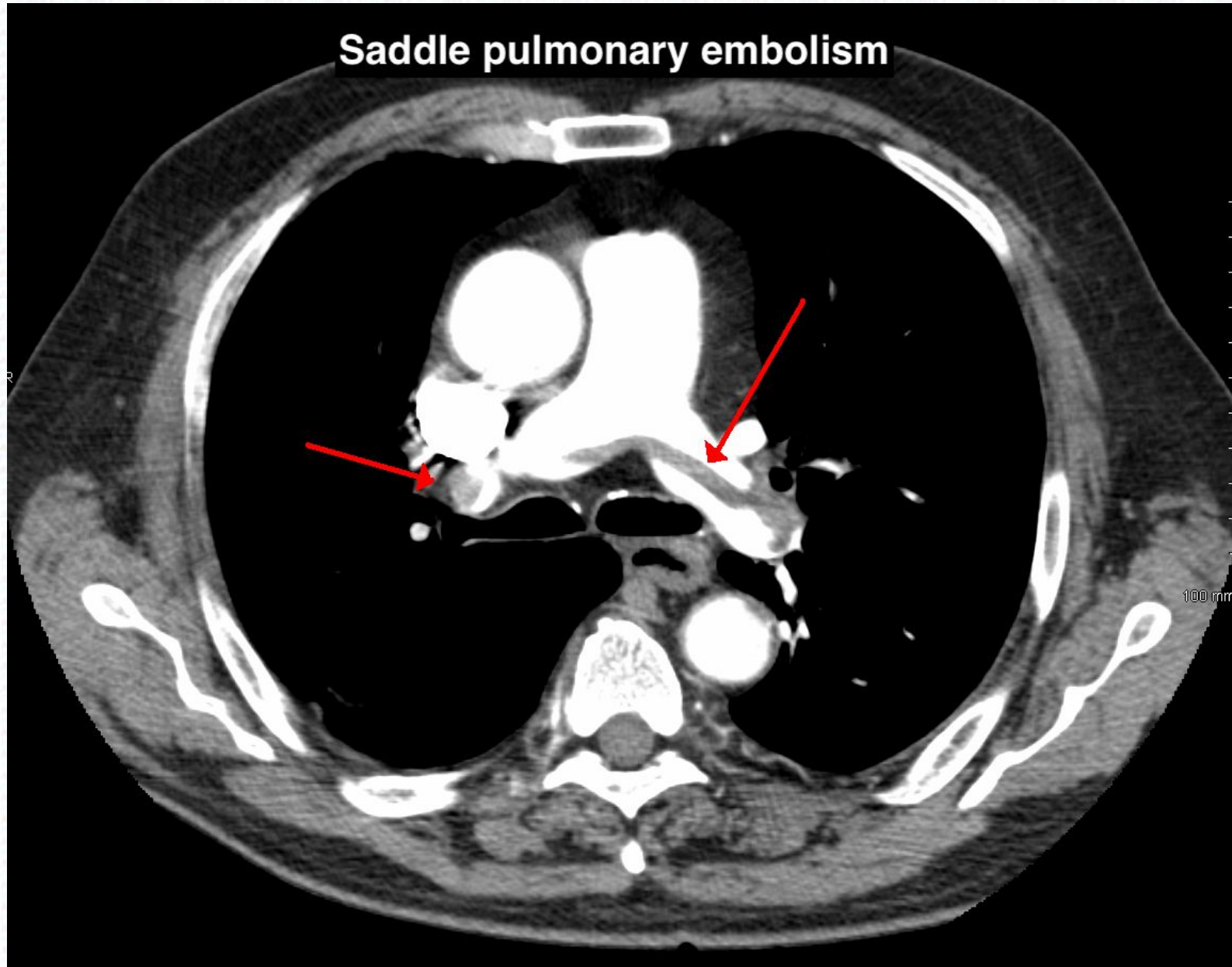
*CTPA - CT Pulmonary Angiography

- Allergy to contrast media
- Renal impairment
- High risk from irradiation (pregnancy)

Ventilation perfusion scan

Pulmonary Embolism

Saddle pulmonary embolism



Treatment

- **Massive PE:** Fibrinolysis or pulmonary embolectomy
- **Small PE:** First line = Apixaban or Rivaroxaban
- Second line = LMWH 5 days → Dabigatran
- **Recurrent PE:** Vena caval filters for patients who have contraindication for anticoagulation

Heart Failure

Presentation

- Breathlessness
- Ankle swelling
- Raised JVP
- Pleural effusion
- Cardiomegaly

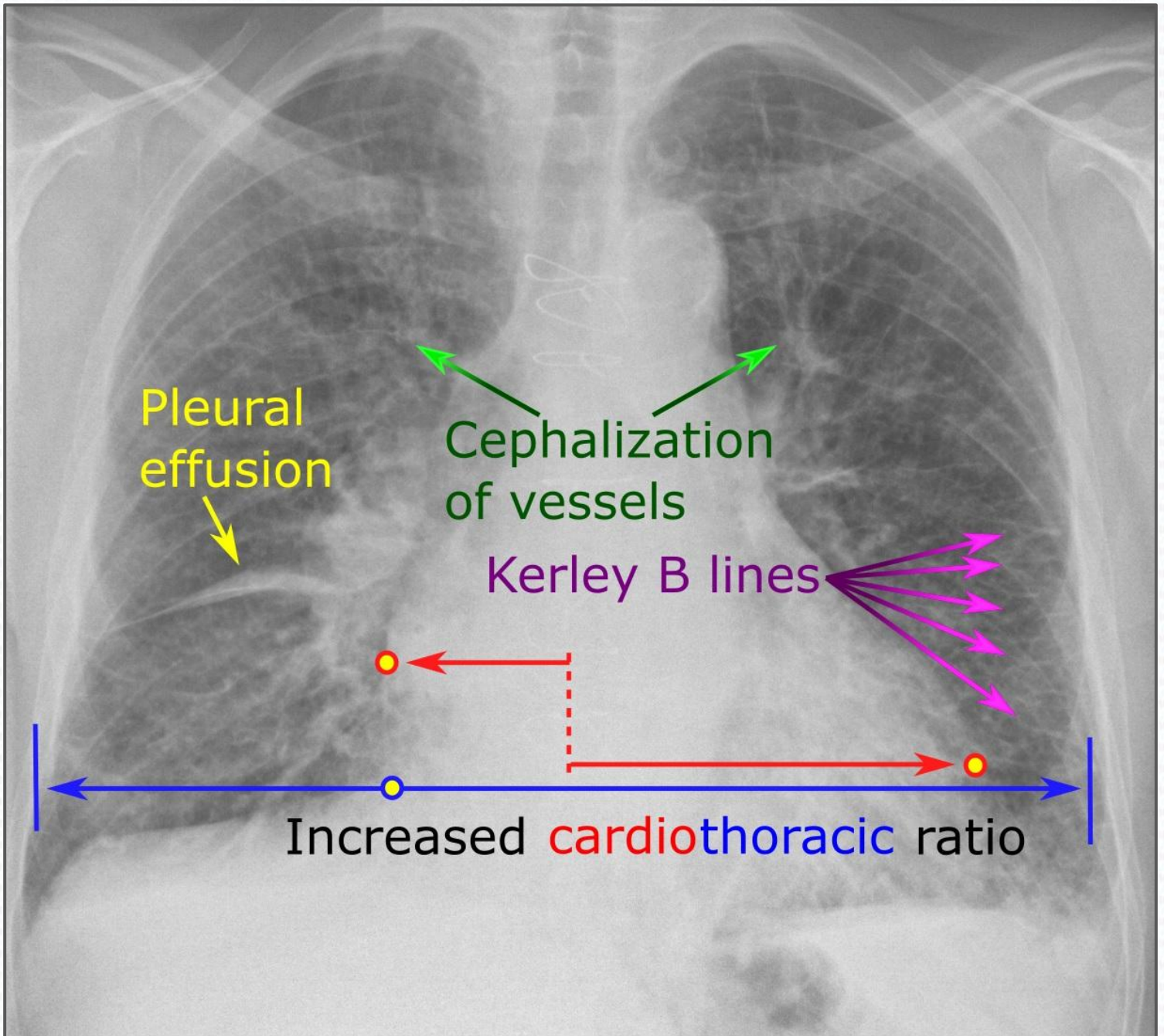
Causes

- Valvular heart diseases
- Myocardial infarction
- Cardiomyopathy
- Hypertension
- Alcohol

Management

- **Diuretics** (Loop - furosemide)
- To reduce mortality
 - ACEi or ARBs
 - Beta blockers
 - Aldosterone antagonist - spironolactone

Heart Failure



Atrial Myxoma

Features

- Benign tumour in the atrium
- Most common in the left atrium

Presentation

- Obstruction of mitral valve:
 - Mid-diastolic murmur
 - Dyspnoea
 - Syncope
 - Tumour plop sound on auscultation
- Embolisation
- Arrhythmias

Investigation

- Echo - Gold standard

Pulmonary Oedema

Features

- Sudden onset of breathlessness
- Orthopnea
- Falling O2 saturation
- Auscultation Bilateral lower zone crepitations
- Tachycardia
- Commonly seen in heart failure

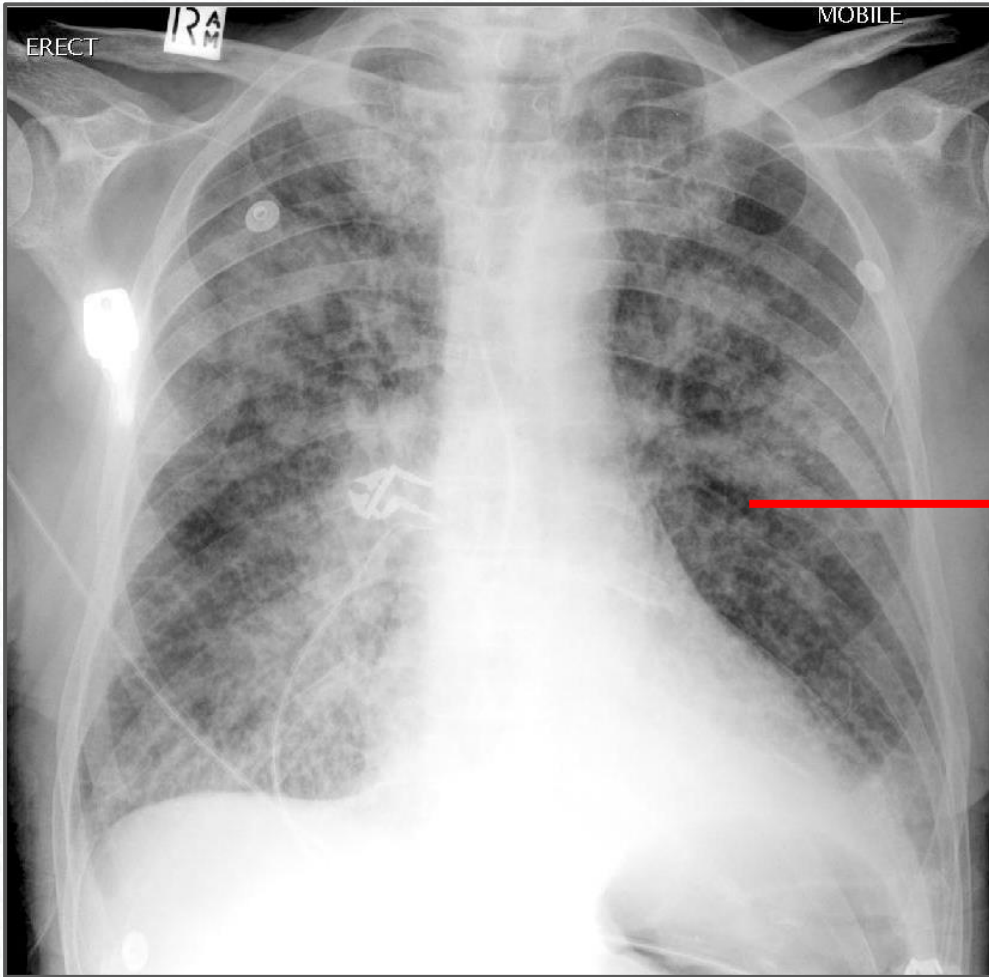
Investigation

- **X-ray chest** - Interstitial and alveolar oedema
- **Echo** - To find out the underlying cause

Management

- Oxygen
- Nitrates (reduce venous return to heart)
- IV furosemide
- Morphine (reduce pain and anxiety)

Pulmonary Oedema



Patchy
shadowing

If the echocardiogram shows an ejection fraction of less than 40% → heart failure

Treat with:

- ACEi
- Beta blockers

Use one at a time

If asthmatic, avoid beta blockers

Digoxin Toxicity

Features

- Nausea, vomiting
- Confusion
- Yellow haloes
- Arrhythmias

Investigation

- Digoxin levels

Management

- Digibind

Image Attributions

https://commons.wikimedia.org/wiki/File:Blausen_0164_CardiacTamponade_02.png

Bruce Blaus CC BY 3.0

[https://commons.wikimedia.org/wiki/File:De-12leadpericarditis_\(CardioNetworks_ECGpedia\).png](https://commons.wikimedia.org/wiki/File:De-12leadpericarditis_(CardioNetworks_ECGpedia).png)

CardioNetworks CC BY-SA 3.0

https://commons.wikimedia.org/wiki/File:Phonocardiograms_from_normal_and_abnormal_hear_t_sounds.png

[Madhero88](#) CC BY-SA 3.0

https://commons.wikimedia.org/wiki/File:Boot-shaped_heart.jpg

Medicalpal CC BY-SA 4.0

<https://commons.wikimedia.org/wiki/File:TAn16.png>

James Heilman, MD CC BY-SA 4.0

https://commons.wikimedia.org/wiki/File:Ventricular_fibrillation.png

Jer5150 CC BY-SA 3.0

https://en.wikipedia.org/wiki/File:Torsades_de_Pointes_TdP.png

Jer5150 CC BY-SA 3.0

https://commons.wikimedia.org/wiki/File:V-paced_with_acute_IWMI.png

Jer5150 CC BY-SA 3.0

<https://commons.wikimedia.org/wiki/File:SaddlePE.PNG>

James Heilman, MD CC BY-SA 3.0

<https://commons.wikimedia.org/wiki/File:Ebstein4.jpg>

Luis munoz-Castellanos et al CC BY 2.0

https://commons.wikimedia.org/wiki/File:Chest_radiograph_with_signs_of_congestive_heart_failure_-_annotated.jpg

Mikael Häggström Public Domain

https://commons.wikimedia.org/wiki/File:Pulmonary_oedema.jpg

Frank Gaillard CC BY-SA 3.0