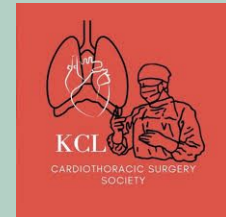# ECG Interpretation for OSCEs

MSA Education

Madihah Ali – Intercalating
Cardiovascular Medicine ibsc
MSA x Cardiothoracic Society
12th April 2024

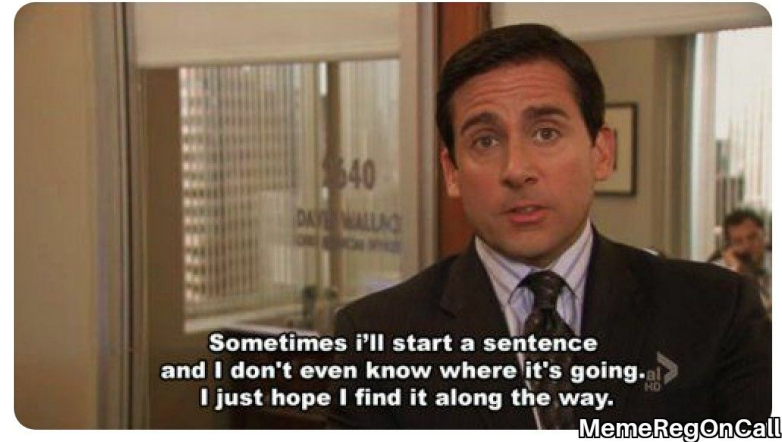KCL
CARDIOTHORACIC SURGERY SOCIETY

Learning Objectives

- To understand how and why ECG is performed and what the various leads and waves correspond to

- To recall common indications to request an ECG

- To be able to use a systematic approach when interpreting ECGs

- To be able to recognise common ECG pathologies and outline their management

- Practice presenting common ECGs for OSCEs

MSA
Education

ECGs: How do you feel?

When I'm asked to describe an ECG

Sometimes i'll start a sentence and I don't even know where it's going. I just hope I find it along the way.
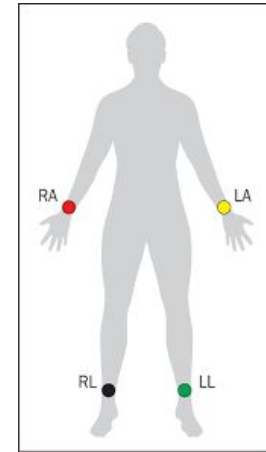
MemeRegOnCall

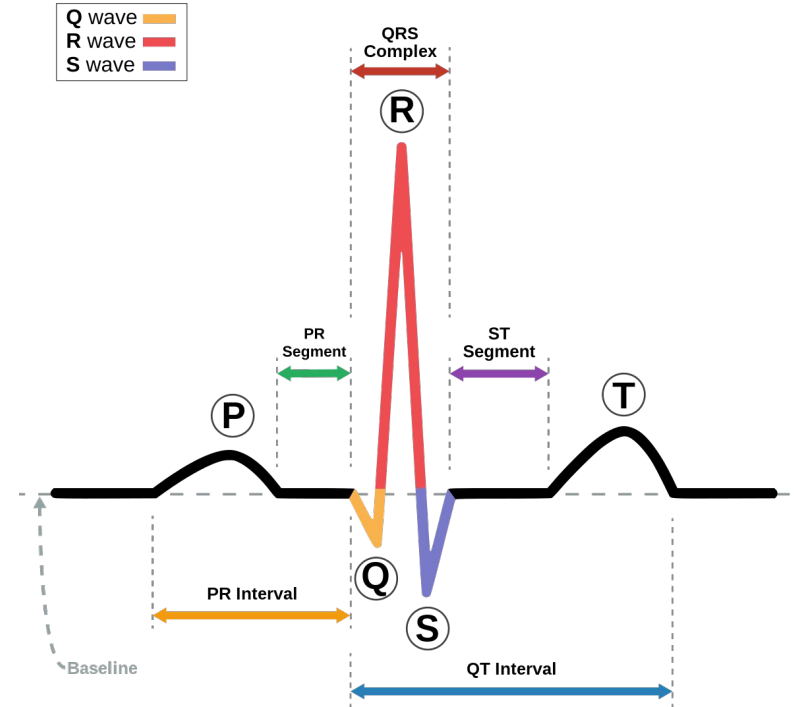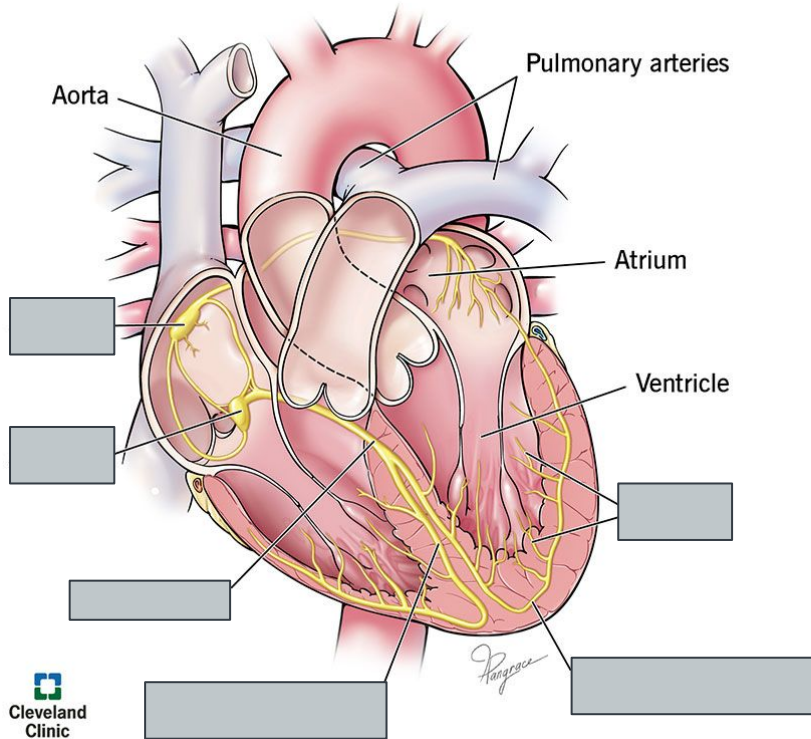This won't be you after today's session!

What is the ECG?

An ECG is an electrocardiogram which is used to record the electrical activity of the heart assessing for abnormalities of heart rhythm and also function.

It is a quick bedside non-invasive investigation which involved placing electrodes (stickers) onto the chest, arms and legs. It shouldn't be painful. When the recording is taking place the patient should lie extremely still.

Cardiac Conduction system and ECG waves

Aorta

Pulmonary arteries

Atrium

Ventricle

Cleveland Clinic
©2021

Q wave
R wave
S wave

QRS Complex

R

PR Segment

ST Segment

P

T

Q

S

PR Interval

Baseline

QT Interval

The 12 lead ECG

Limb Leads:

Unipolar: measure the electrical ac

AVr, AVL, and AVf. (these are your au

Bipolar: register the voltage betwee

Leads I, II and III

Chest Leads: V1-V6 all are unipolar
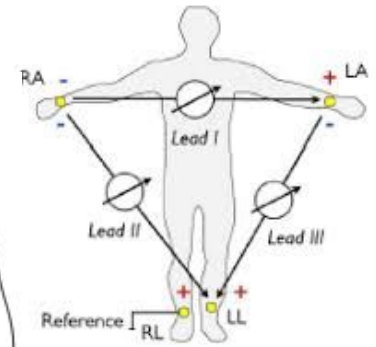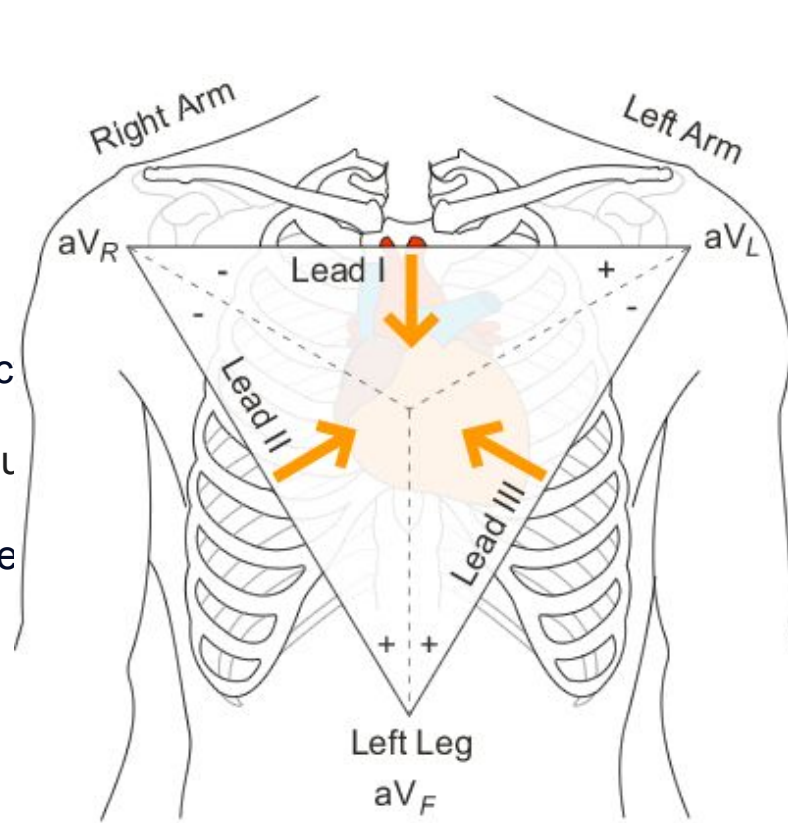
ECG Indications

Indications for an ECG

- Chest Pain
- SOB
- Palpitations
- Syncope
- Dizziness
- Pre-operatively and Post-operatively
- Screening- FHx cardiomyopathies, athletes
- Health Check

- Psychiatry- before starting new medications and increasing the dose
- Seizure
- Electrolyte abnormalities- especially hyperkaleamia
- Tachycardia (A-E assessment acutely unwell patient)

Questions?

Systematic Approach towards ECG interpretation

Overall guide to ECG Interpretation

Details

Calibration

Rate

Rhythm

Axis

P waves

P-R interval

QRS

ST segment

T waves

Summarise

Step 1: Details

- Always start by confirming the patient's: name, DOB and hospital number
- Date and Time ECG was taken- out of hours- emergency?
- Where was the ECG taken- in patient vs outpatient, ward, A&E, GP , Ambulance, CCU
- Any additional information- observations BP, RR, sPO2, CP, SOB
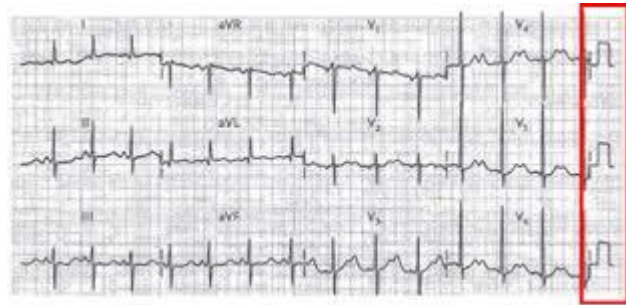
Step 2: Calibration

- Always check that the ECG is calibrated correctly especially when deciding if there's ST elevation

X axis calibration: horizontal= time

- The ECG machine moves one inch per second,
- 1 inch=25mm
- check to see that the calibration iss. written as 25mm/s on the ECG paper

Y axis calibration: vertical= volts

- 1mv=10mm= 2 big squares

Step 3: Rate

- Use the rhythm strip
- If regular- 300/R-R interval (number of big squares) 1 big square= 0.2 seconds
- 300= 1mins
- R-R interval=1->300bpm, 2->150bpm, 3->100bpm, 4->75bpm,
- If irregular count the number of QRS and multiply by 6 as the rhythm strip is 10 seconds long

Normal HR is 60-100

Bradycardic <60

Tachycardic >100

Step 4: Rhythm

- Regular or Irregular look at the R-R intervals- any variation if so irregularly irregular, regularly irregular

Questions to ask yourself:
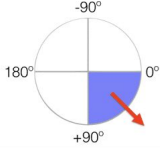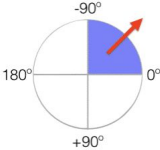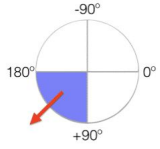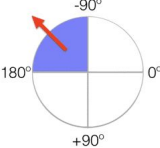
- Can you see p waves? If you can't ant its irregularly irregular- AFib

P waves present:

	Normal	First	Second (TI)	Second (T2)	Third (CHB)
1.	Y	Y	Y	Y	Y
2.	N	N	Y	Y	Y
3.	Y	N (>200mS)	N	Y (usually)	N

- Is there a P wave before each QRS
- Are there any extra P waves?
- Is the PR interval constant and less than 200ms (5 small squares)

Step 4: Axis

Lead 1	Lead aVF	Quadrant	Axis
POSITIVE	POSITIVE		**Normal Axis** (0 to +90°)
POSITIVE	NEGATIVE		****Possible LAD** (0 to -90°)
NEGATIVE	POSITIVE		**RAD** (+90° to 180°)
NEGATIVE	NEGATIVE		**Extreme Axis** (-90° to 180°)

EINTHOVEN'S TRIANGLE
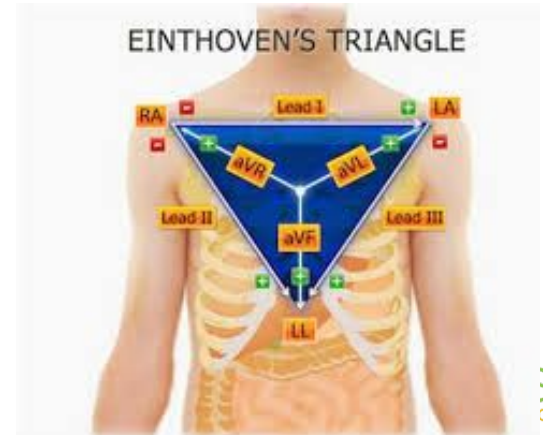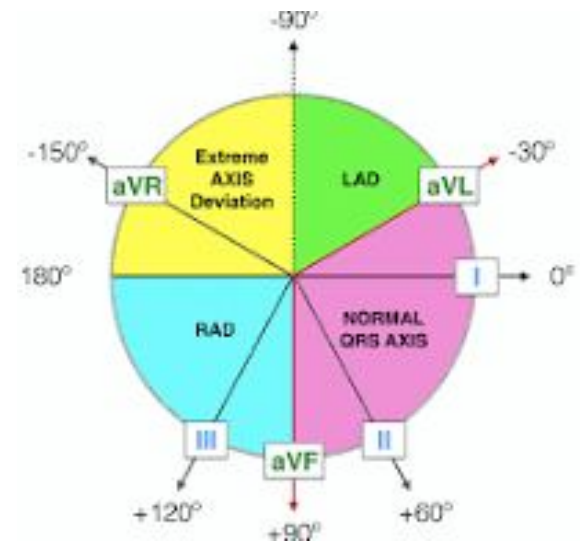
Step 6: P waves

- Present or absent
- P wave before each QRS
- Extra P waves
- Morphology- sawtooth=A flutter, bifid- LA dilatation or ectopics
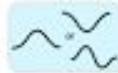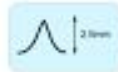
Step 7: P-R Interval

- The time taken from depolarisation of the atria til depolarisation of the ventricles A-V nodal delay 0.12-0.2s (3-5 small squares)
- Measured from the start of the P wave to the beginning of the R wave

Common Pathologies:

Prolonged or narrow
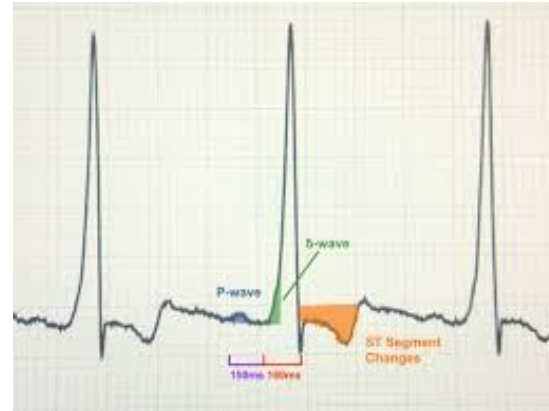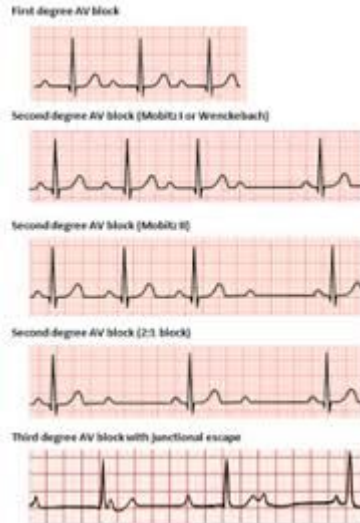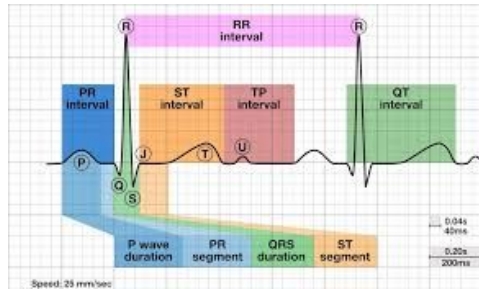
Step 8: QRS Complex

- Represents ventricular depolarisation
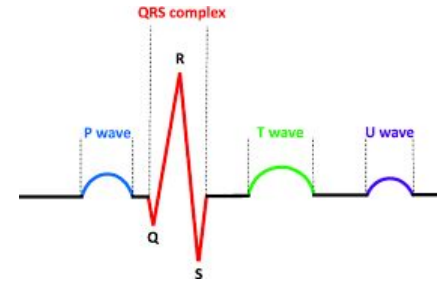
Look at the:

- Width- narrow< 120ms (3 small squares) broad>120ms
- Height:**small complexes** < 5mm in the limb leads or < 10 mm in the chest leads.
- **Tall complexes** imply ventricular hypertrophy
- Morphology
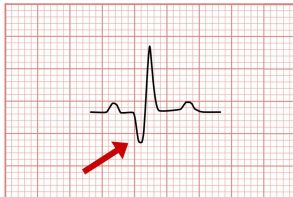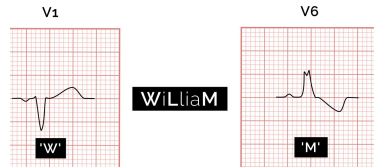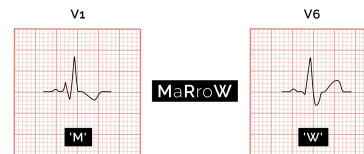
Step 9: ST Segment
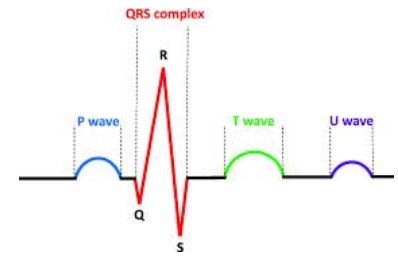
- Represents the time between ventricular depolarisation and repolarisation
- From the end of the S wave to the beginning of the T wave

Look for:

- Elevation- significant when it is **greater than 1 mm** (1 small square) **in 2 or more contiguous limb leads** or **>2mm in 2 or more chest leads**.
- Depression-significant when it is **greater than 1 mm** (1 small square) **in 2 or more contiguous limb leads** or **>2mm in 2 or more chest leads**.

ST Depression
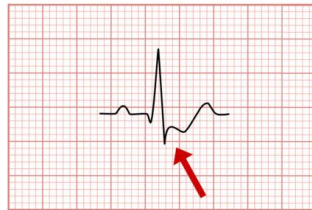
ST Elevation

Step 10: T wave

- Represents ventricular repolarisation
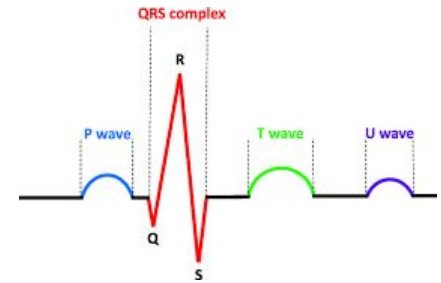
Look at the:

- Height: Tall if >5mm in limb leads and >10mm in chest leads- hyperkaelamia or hyperacute STEMI
- Morphology
- Inversion- normal in leads III, aVR, and V1
- Additional waves

U Wave

GEEKY MEDICS

T Wave Inversion

GEEKY MEDICS

Tall T Waves
Hyperkalaemia

GEEKY MEDICS

Step 11: Q-T interval
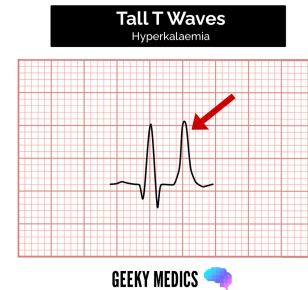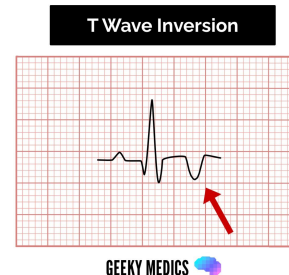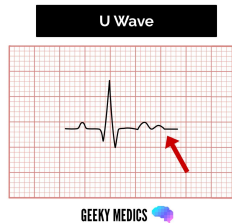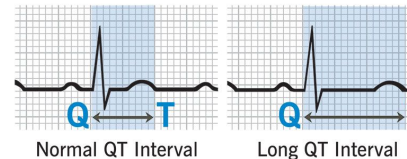
Normal QT Interval   Long QT Interval
Cleveland Clinic ©2023

- Represents one cardiac cycle ventricular depolarisation and repolarisation
- Measured from the start of the Q/R wave and the end of the T wave
- Is corrected for HR as increasing HR shortens QT interval
- Normal QTc 350-450ms in men and 360-460ms in females
- Prolonged QT interval can predispose to lifethreatening arrhythmias torsades de point

Male		Female
470 ms	**Very long QT**	480 ms
440 ms	**Long QT** (Symptoms or family history)	460 ms
390 ms	**Long QT possible** (Need further evidence)	400 ms
360 ms	**Normal QT**	370 ms
330 ms	**Short QT** (need further evidence)	340 ms
	Very short QT	

Table 2

Drugs Associated with QT Prolongation and TdP				
Antiarrhythmics	Antimicrobials	Antidepressants	Antipsychotics	Others
Amiodarone	Levofloxacin	Amitriptyline	Haloperidol	Cisapride
Sotalol	Ciprofloxacin	Desipramine	Droperidol	Sumatriptan
Quinidine	Gatifloxacin	Imipramine	Quetiapine	Zolmitriptan
Procainamide	Moxifloxacin	Doxepin	Thioridazine	Arsenic
Dofetilide	Clarithromycin	Fluoxetine	Ziprasidone	Dolasetron
Ibutilide	Erythromycin	Sertraline		Methadone
	Ketoconazole	Venlafaxine		
	Itraconazole			

Source: References 1, 3, 4, 8, 9, 14.

Putting it all together: Summarising

- This is an ECG for patient details, taken on … at location.. Any relevant details
- The most obvious abnormality was…
- HR was… and in sinus rhythm or comment on rhytm abnormalities
- Axis was normal/ abnormal
- P waves were present/absent, P-R interval was 120-200ms/ prolonged
- QRS was narrow normal
- ST segment was not/ was elevated
- Normal T waves
- Normal Q-T interval

In summary this was a normal/abnormal ECG consistent with a diagnosis of X due to…

You don't need to comment on every negative finding- don't bore the examiner

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Questions?

ECG Interpretation Time!

ECG 1
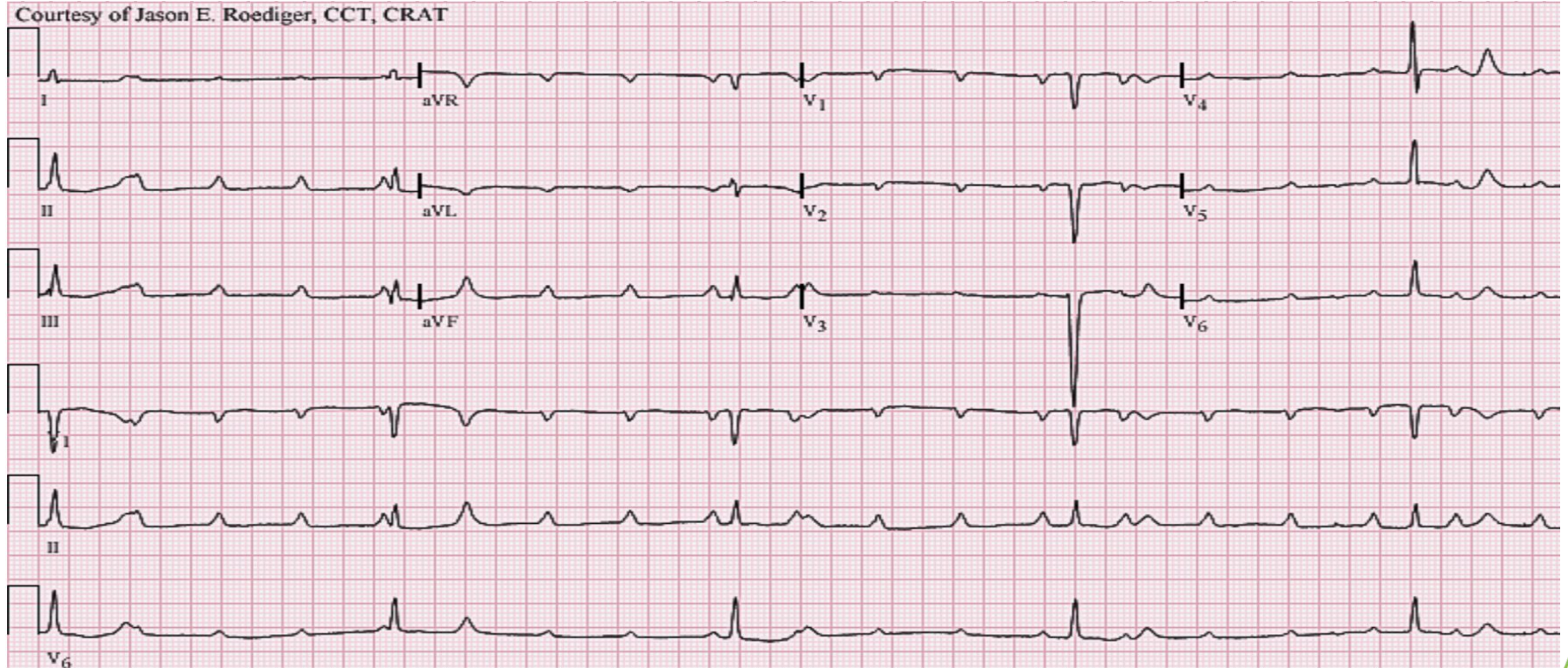
ECG 2
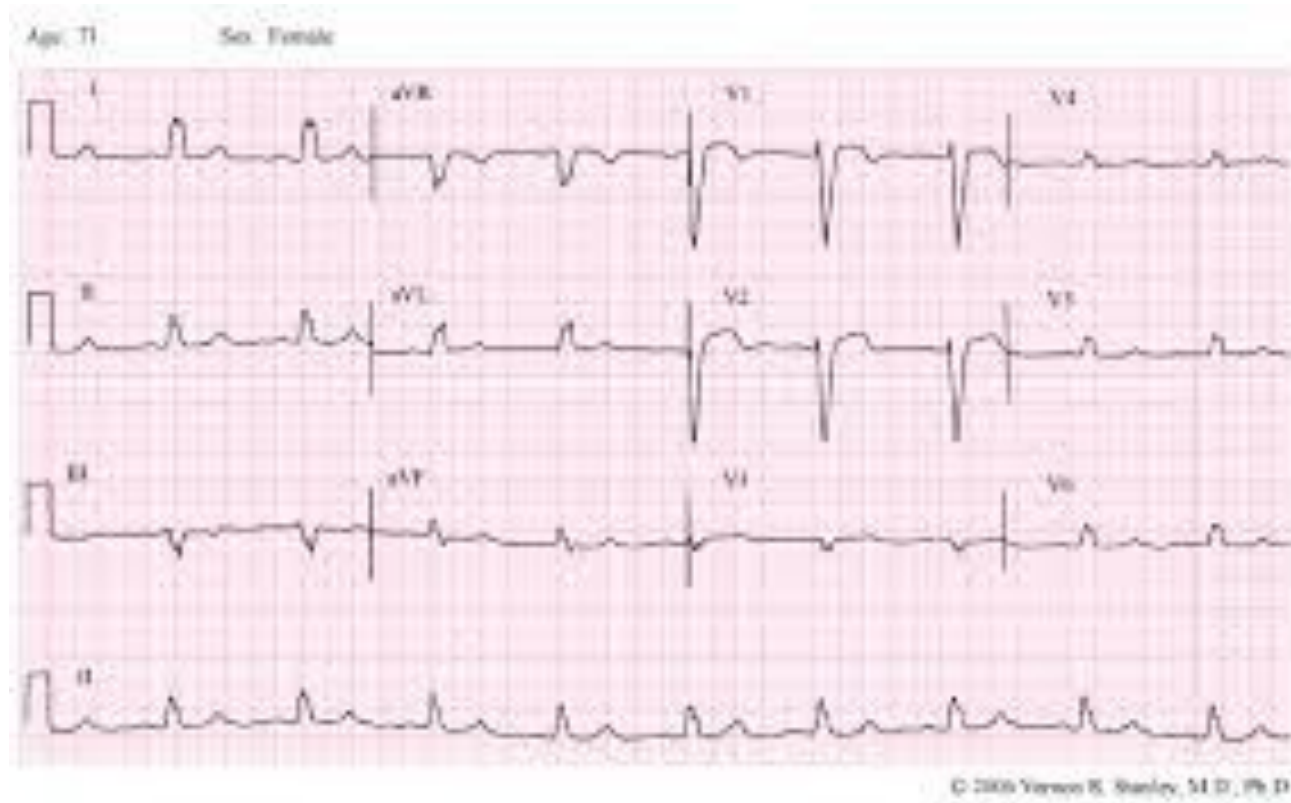
ECG 3
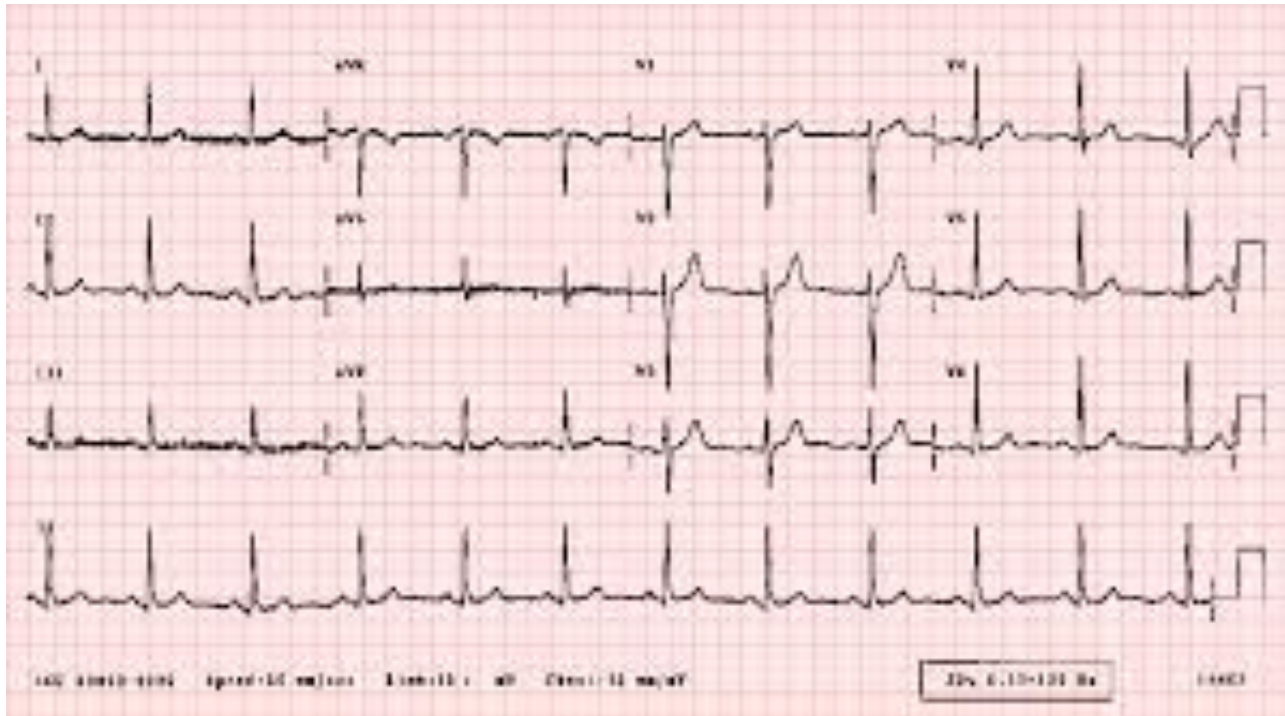
SBA 1

A 45 M attends ED complaining of persistent palpitations and dizziness. He has an immediate ECG which is shown below. What's the diagnosis?

1. Atrial Fibrillation
2. Ventricular Fibrillation
3. Supraventriuclar Tachycardia
4. Ventricular Tachycardia
5. Torsades de point

SBA 1 Answer

A 45 M attends ED complaining of persistent palpitations and dizziness. He has an immediate ECG which is shown below. What's the diagnosis?
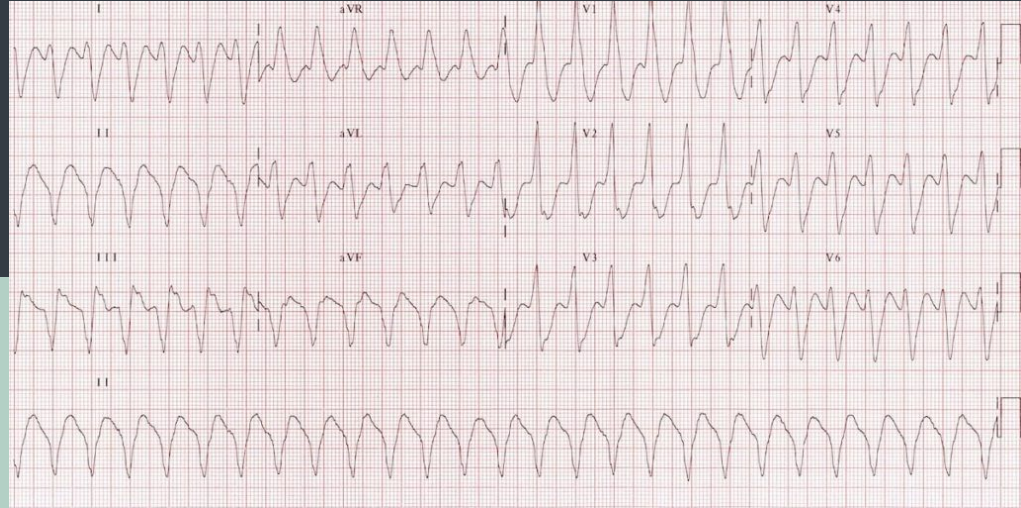
1. Atrial Fibrillation
2. Ventricular Fibrillation
3. Supraventriuclar Tachycardia
4. **Ventricular Tachycardia**
5. Torsades de point

Broad Complex Tachycardia

Adult tachycardia (with pulse) algorithm

- Assess using the ABCDE approach
- Give oxygen if appropriate and obtain IV access
- Monitor ECG, BP, SpO₂, record 12-lead ECG
- Identify and treat reversible causes (e.g. electrolyte abnormalities)

Adverse features?
- Shock
- Syncope
- Myocardial ischaemia
- Heart failure

Yes/Unstable →

Synchronised DC Shock
Up to 3 attempts

- Amiodarone 300 mg IV over 10-20 min and repeat shock; followed by:
- Amiodarone 900 mg over 24 h

No/Stable ↓

Is QRS narrow (< 0.12 s)?

Broad ← | → **Narrow**

Broad QRS
Is rhythm regular?

Irregular | **Regular**

Seek expert help ⚠️

Possibilities include:
- **AF with bundle branch block** treat as for narrow complex
- **Pre-excited AF** consider amiodarone
- **Polymorphic VT** (e.g. torsade de pointes - give magnesium 2 g over 10 min)

If **ventricular tachycardia** (or uncertain rhythm):
- Amiodarone 300 mg IV over 20-60 min; then 900 mg over 24 h

If previously confirmed **SVT with bundle branch block:**
- Give adenosine as for regular narrow complex tachycardia

Narrow QRS
Is rhythm regular?

Regular | **Irregular**

- Use vagal manoeuvres
- Adenosine 6 mg rapid IV bolus; if unsuccessful give 12 mg; if unsuccessful give further 12 mg.
- Monitor ECG continuously

Sinus rhythm restored?

Yes | **No**

Probable **re-entry paroxysmal SVT**:
- Record 12-lead ECG in sinus rhythm
- If recurs, give adenosine again & consider choice of anti-arrhythmic prophylaxis

Irregular Narrow Complex Tachycardia
Probable **atrial fibrillation**
Control rate with:
- β-Blocker or diltiazem
- Consider digoxin or amiodarone if evidence of heart failure

Seek expert help ⚠️

Possible **atrial flutter**
- Control rate (e.g. β-Blocker)

SBA 2

A 25 F has a routine ECG which is shown below. What does it show?

1. Sinus rhythm
2. AtrialFibrillation
3. Supraventriuclar Tachycardia
4. Snus Bradycardia
5. Wolf Parkinsons White Syndrome

SBA 2 Answer

A 25 F has a routine ECG which is shown below. What does it show?
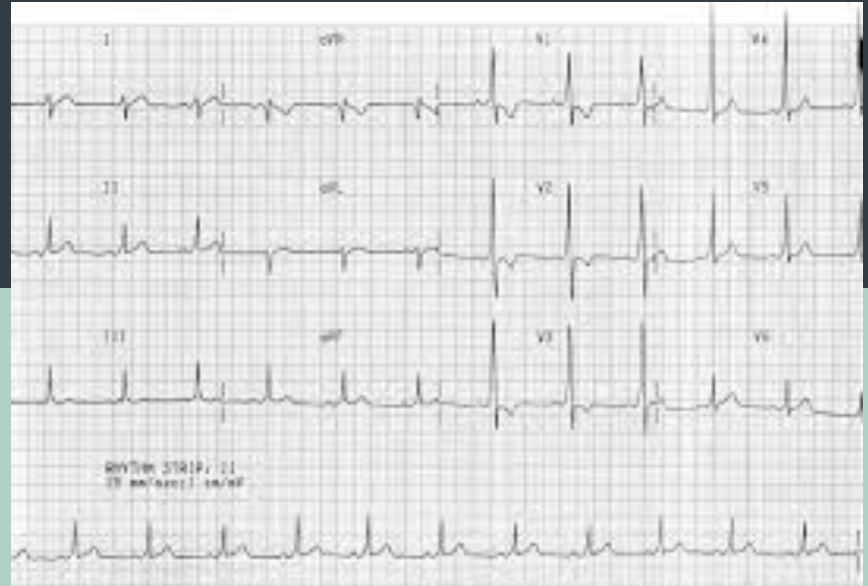
1. Sinus rhythm
2. AtrialFibrillation
3. Supraventriuclar Tachycardia
4. Snus Bradycardia
5. **Wolf Parkinsons White Syndrome**

Wolff–Parkinson White
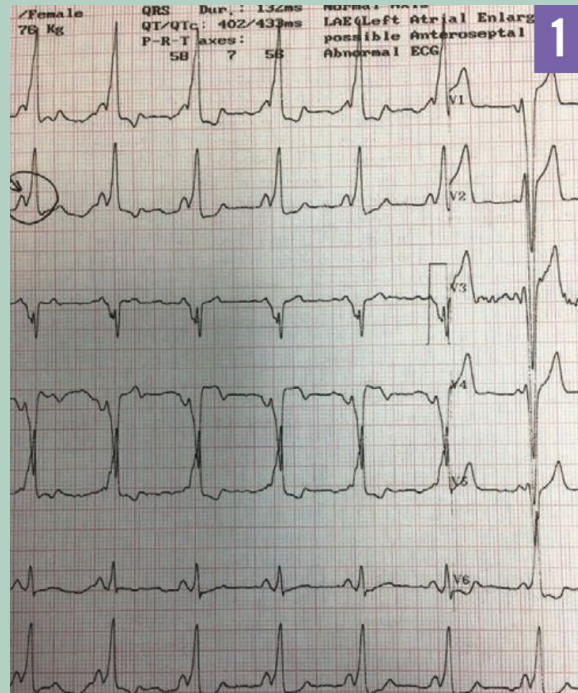
- A type of SVT characterised by a short PR interval<3small squares due to the presence of an accessory pathway outside AVN
- WPW syndrome- presence of the accessory pathway and symptoms
- WPW pattern- ECG pattern of short P-R interval <3 small squares and delta wave (slurred upstroke) no symptoms
- Accessory pathway has the potential to form a re-entrant circuit leading to sustained ectopics by passes the atria
- Patients are at increased risk of Afib dangerous can lead to VF
- Management- ablation of the accessory pathway

SBA 3

A 65M attends ED with central crushing chest pain radiating to his L arm and jaw . His ECG is shown below and a diagnosis of an MI is made which coronary artery is occluded?

1. Right Coronary artery
2. Left main coronary artery
3. Left circumflex
4. Left Anterior descending
5. Right marginal

SBA

A 65M attends ED with central crush[...]
ECG is shown below and a diagnosis[...]
occluded?
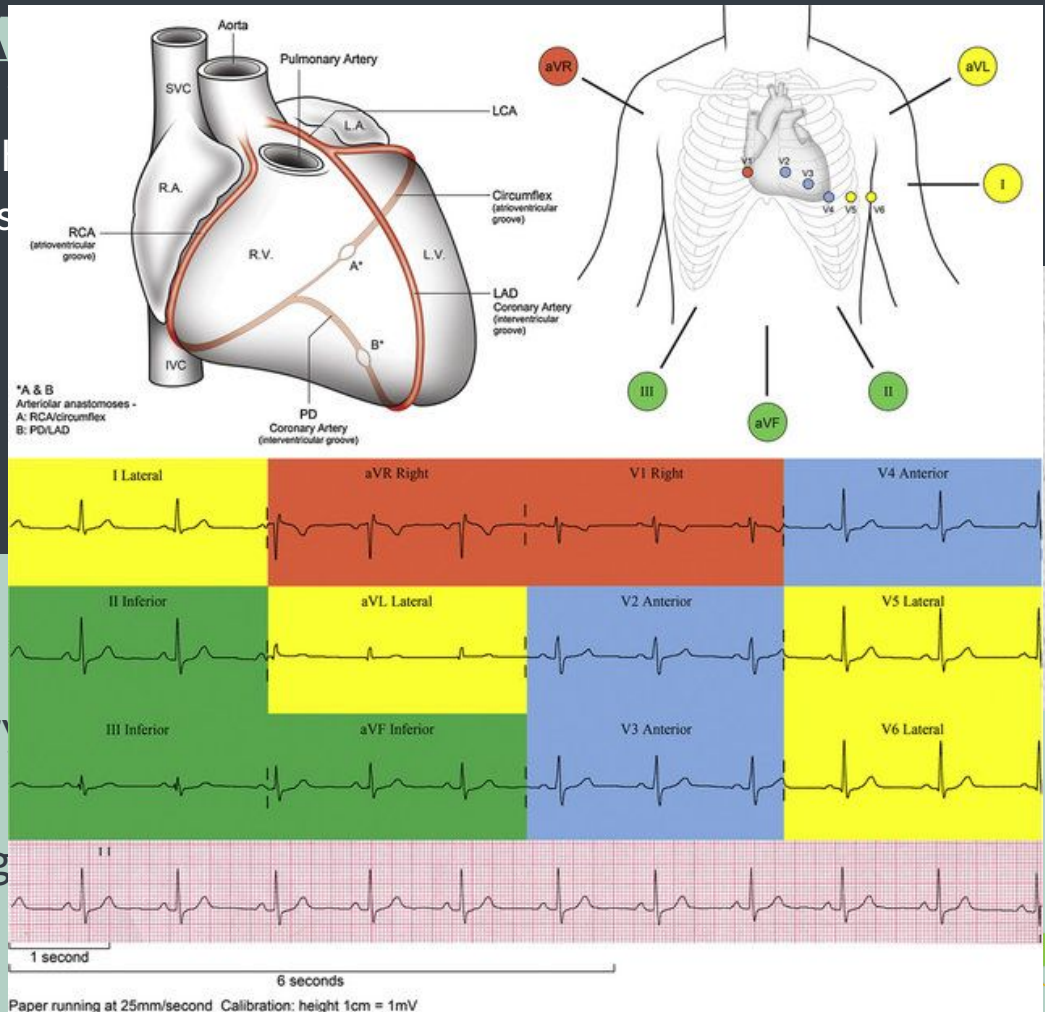
1. **Right Coronary artery**
2. Left main coronary artery
3. Left circumflex
4. Left Anterior descending
5. Right marginal

STEMI

Acute Management of STEMI
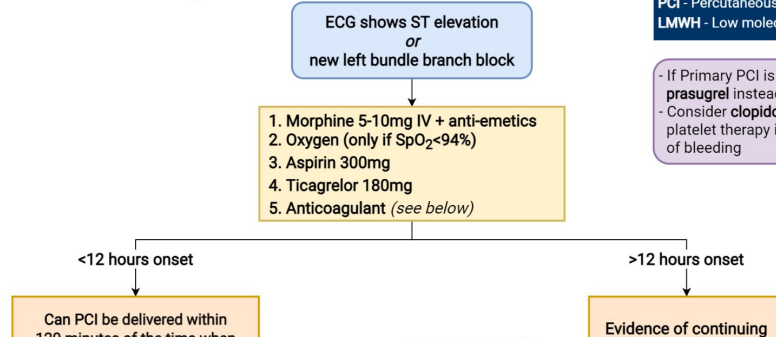
Legend:
PCI - Percutaneous coronary intervention
LMWH - Low molecular weight heparin

- If Primary PCI is performed, offer **prasugrel** instead of ticagrelor
- Consider **clopidogrel** as anti-platelet therapy instead if high risk of bleeding

ECG shows ST elevation
or
new left bundle branch block

1. Morphine 5-10mg IV + anti-emetics
2. Oxygen (only if SpO_2<94%)
3. Aspirin 300mg
4. Ticagrelor 180mg
5. Anticoagulant *(see below)*

<12 hours onset

Can PCI be delivered within 120 minutes of the time when

>12 hours onset

Evidence of continuing

Offe

Simplified management of NSTEMI/unstable angina

NSTEMI/unstable angina identified

Aspirin 300mg
Fondaparinux if no <u>immediate</u> PCI planned

LOW RISK (≤ 3%)

Estimate 6-month mortality (e.g. GRACE)

INTERMEDIATE/HIGH RISK (>3%)

Conservative management
- Give **ticagrelor**

PCI
- Offer immediately if clinically unstable, otherwise offer within 72 hours
- Give **prasugrel or ticagrelor**
- Give **unfractionated heparin**
- Drug-eluting stents should be used in preference

PassMedicine

Assumptions
- Patient is not a high bleeding risk. If patient is a high bleeding risk consider:
  - Swapping fondaparinux for an alternative antithrombin/dose
  - Swapping prasugrel for ticagrelor / swapping ticagrelor for clopidogrel
- Patient is not on oral anticoagulants
  - If patient is taking oral anticoagulants swap praugrel/ticagrelor for clopidogrel

SBA 4

A 75F attends ED following syncope . Her ECG is shown below and what is the diagnosis?
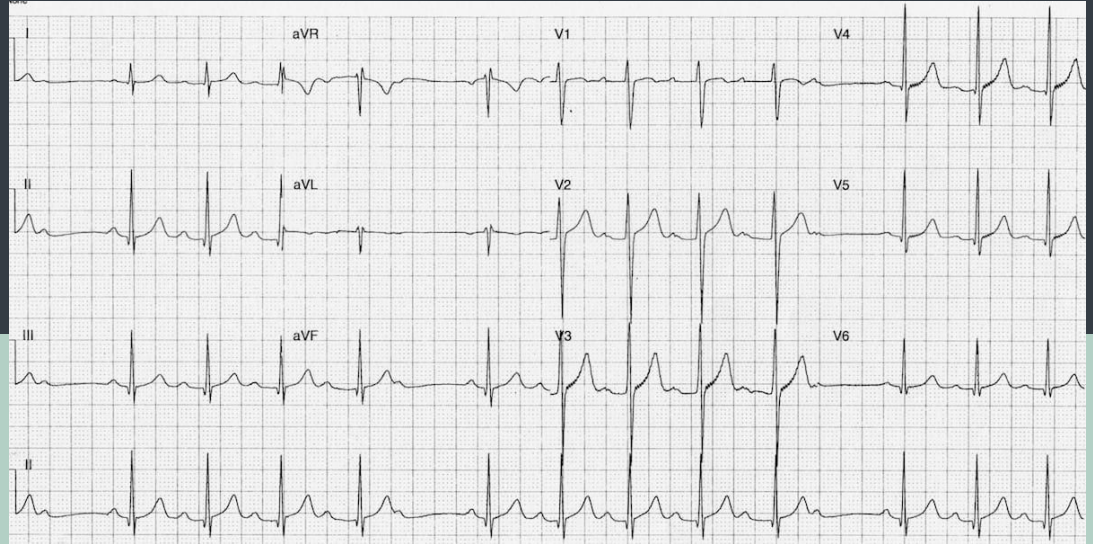
1. Sinus Bradycardia
2. First degree heart block
3. Second degree Mobitz type 1
4. Second degree Mobitz type 2
5. Complete heart block

SBA 4

A 75F attends ED following syncope . Her ECG is shown below and what is the diagnosis?

Mobitz I or Wenckebach

Mobitz II

2:1 block

1. Sinus Bradycardia
2. First degree heart block
3. Second degree Mobitz type 1
4. **Second degree Mobitz type 2**
5. Complete heart block
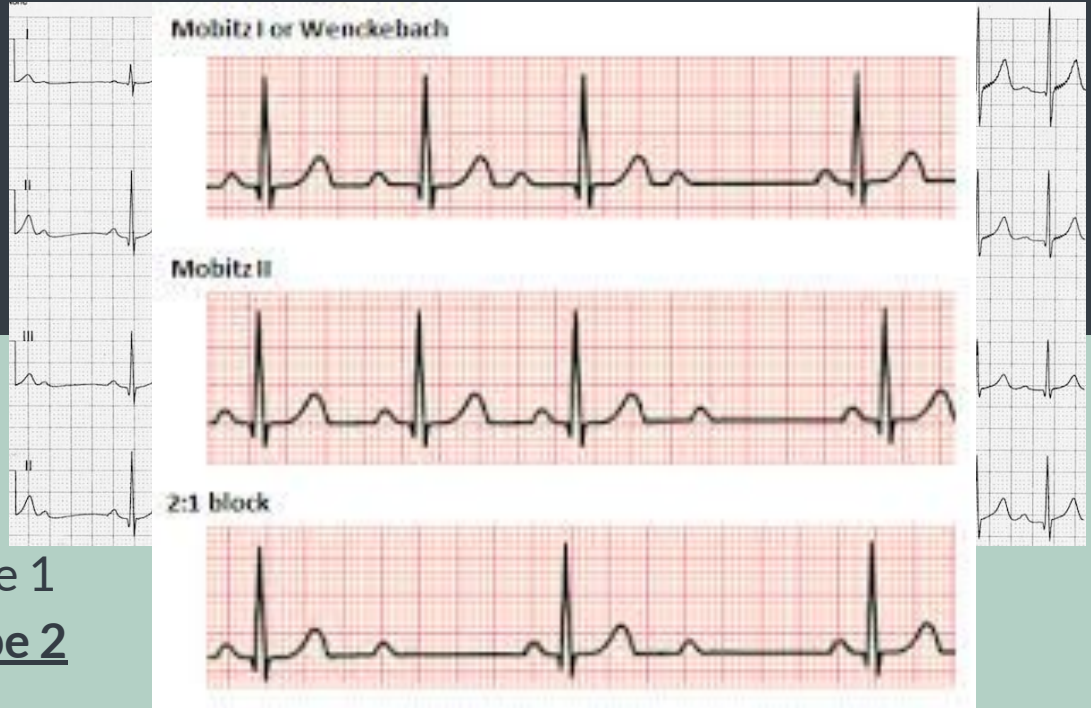
SBA 5

A 65F attends ED complaining of recurrent palpitations. Her ECG is shown below and what is the diagnosis?

1. Atrial Fibrillation
2. Supraventricular tachycardia
3. Atrial flutter
4. Sinus Tachycardia
5. Wolf Parkinsons White Syndrome

SBA 5 Answer

A 65F attends ED complaining of recurrent palpitations. Her ECG is shown below and what is the diagnosis?

1. Atrial Fibrillation
2. Supraventricular tachycardia
3. **Atrial flutter**
4. Sinus Tachycardia
5. Wolf Parkinsons White Syndrome

Narrow Complex Tachycardia

Resuscitation Council (UK)

Adult tachycardia (with pulse) algorithm

- Assess using the ABCDE approach
- Give oxygen if appropriate and obtain IV access
- Monitor ECG, BP, SpO$_2$, record 12-lead ECG
- Identify and treat reversible causes (e.g. electrolyte abnormalities)

Adverse features?
- Shock
- Syncope
- Myocardial ischaemia
- Heart failure

Yes / Unstable →

Synchronised DC Shock
Up to 3 attempts

- Amiodarone 300 mg IV over 10-20 min and repeat shock; followed by:
- Amiodarone 900 mg over 24 h

No / Stable

Is QRS narrow (< 0.12 s)?

Broad ← → **Narrow**

Broad QRS
Is rhythm regular?

Irregular / **Regular**

Seek expert help ⚠

Possibilities include:
- **AF with bundle branch block** treat as for narrow complex
- **Pre-excited AF** consider amiodarone
- **Polymorphic VT** (e.g. torsade de pointes - give magnesium 2 g over 10 min)
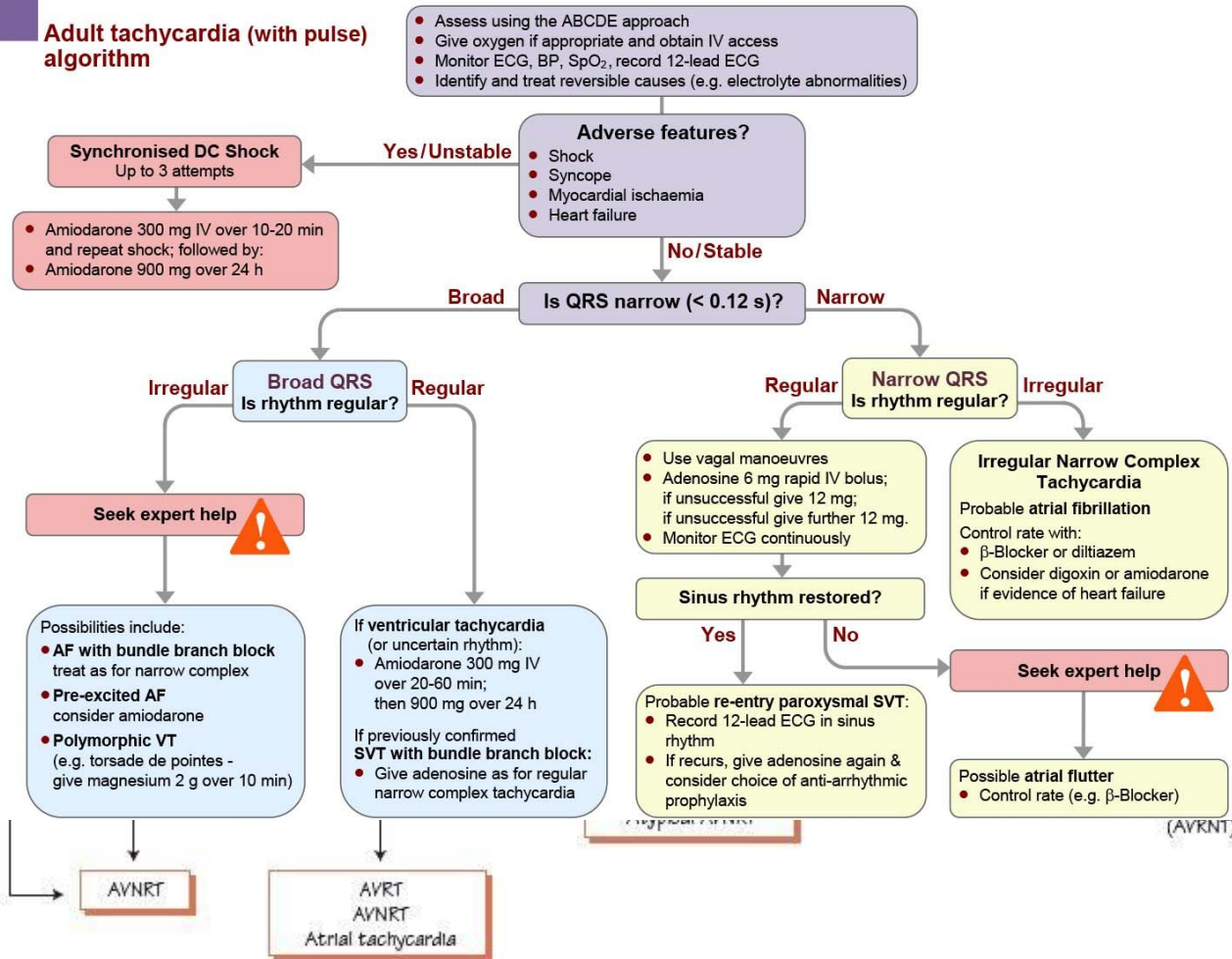
→ AVNRT

If **ventricular tachycardia** (or uncertain rhythm):
- Amiodarone 300 mg IV over 20-60 min; then 900 mg over 24 h

If previously confirmed **SVT with bundle branch block:**
- Give adenosine as for regular narrow complex tachycardia

AVRT
AVNRT
Atrial tachycardia

Narrow QRS
Is rhythm regular?

Regular / **Irregular**

- Use vagal manoeuvres
- Adenosine 6 mg rapid IV bolus; if unsuccessful give 12 mg; if unsuccessful give further 12 mg.
- Monitor ECG continuously

Sinus rhythm restored?

Yes / **No**

Probable **re-entry paroxysmal SVT**:
- Record 12-lead ECG in sinus rhythm
- If recurs, give adenosine again & consider choice of anti-arrhythmic prophylaxis

Irregular Narrow Complex Tachycardia
Probable **atrial fibrillation**
Control rate with:
- β-Blocker or diltiazem
- Consider digoxin or amiodarone if evidence of heart failure

Seek expert help ⚠

Possible **atrial flutter**
- Control rate (e.g. β-Blocker)

(AVRNT)

Questions?

Top Tips:

- Have a structure for approaching ECGs and Interpretation
- Take some time to actually look at the ECG- don't rush this is the station where you will most likely not run out of time so take a minute
- Say what you see- don't make stuff up if you can't see the p waves say that
- Be confident- You've got this! OSCEs are all about confidence
- Use your 2 minutes outside the station- everything in the vignette will be giving you clues come up with differentials
- Learn the common ECG patterns-Afib, flutter, MIs, heart block, VT and VF Bundle branch block
- Learn their basic management as well- Hx, Obs, bedside, bloods and imaging

You should now be able to:

- Understand how and ECG is performed and what the various leads and waves correspond to
- Recall common indications to request an ECG
- Use a systematic approach when interpreting ECGs
- Recognise common ECG pathologies and outline their management

MSA Education

Useful Resources:

- Geeky Medics
- Life in the fast lane
- The ECG made easy- has lots of examples to practice
- Vascular block- wards find an ECG and present to a DR
- Mike Marbers lectures

Feedback Form

Thank you for attending today's session! Please fill in the feedback form:
https://docs.google.com/forms/d/10_CEm0QiWlPsMj04g-kl9_Dvi240HRhdUbTypvKQnJU/viewform?edit_requested=true

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