

## ECG Expert-ease!

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# ECG complexes are vectors

- They have magnitude and direction, and occur over time
- The signal in a given lead is the **summation** of wavefronts moving towards and away from that lead (e.g. 10V towards, and 3V away makes a 7V complex)
- Thus a vector moving away from a given lead produces a predominantly negative complex, and those moving towards give a predominately positive vector

Cell to cell spread of depolarisation is (relatively) slow compared to specialised conduction tissue

- Hence why
  - -P waves are often as broad as the QRS complex
  - -Delta waves are slurred
  - -VT onset is (usually) not sharp
  - -Paced complexes are slurred
  - –Bundle branch blocks are usually sharp at onset with delay "in the middle"

# Tips & Reminders

- VT v SVT:
  - Slurred onset, 'bizarre' axis, not "like a typical LBBB or RBBB", capture beats, fusion beats, AV dissociation, history of IHD or other structural heart disease
  - All the above favour VT > SVT

- The Wellens criteria for VT v SVT is basically asking you to decide how much the QRS looks like a typical BBB complex
- It is because the onset of the VT is most outside of normal specialised conduction tissue - i.e. cell to cell spread (at least initially, but the wavefront may then invade the His Purkinje system)



# QRS in VT can be used to localise the exit of the VT via 2 main factors

- Does the VT look more like a RBBB pattern v. a LBBB pattern?
  - If it looks RBBB-ish i.e. the RV is being activated late then it is likely exiting in the left ventricle.
    (Compare this to RV apical paced QRS complexes too).
- Where do the complexes lie on the hex-axial reference system?









SVT with BBB:

- atrial tachy
- atrial flutter
- atrial fibrillation
- AV nodal tachy
- CMT with AV conduction over AV node and VA conduction over Acc pathway

SVT with AV conduction over Acc pathway:

- atrial tachy
- atrial flutter
- atrial fibrillation
- AV nodal tachy
- CMT with AV conduction over Acc pathway and VA conduction over AV node or second Acc pathway

Figure 1. Different types of SVT with BBB (diagram A), SVT with AV conduction over an accessory pathway (diagram B), and VT (diagram C) resulting in a broad QRS tachycardia. Acc, accessory; AV, atrioventricular; BBB, bundle branch block; CMT, circus movement tachycardia; SVT, supraventricular tachycardia; VA, ventriculo-atrial; VT, ventricular tachycardia.

VT





The same principle is largely applicable to delta waves and AP localisation

 However it is the negative delta wave that "points" to the accessory pathway

 Seeing a fully pre-excited QRS looks just like a VPB or paced QRS and will localise just the same as VT





# **Tips & Reminders**

• Use a piece of paper or callipers!

- Mark QRS complexes on paper to map any regularity or 'regular irregularity'
- Mark out potential P waves or F waves is the rhythm 2:1, 3:1, 4:1, variable block etc.

"Group beating" is often a sign of Wenckebach phenomenon and hence AV nodal conduction



ECG PEDIA.ORG



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# Additional tips

- Clinical scenario is vital!
- Befriend an EP and share anonymised ECGs via secure email for your own quality control most EPs love a good ECG!
- Memorise the "classics"
  - –Fascicular VT
  - -Bidirectional VT
  - -Brugada
  - –L & S QT
  - –ARVC, epsilon waves and T wave inversion V1-3
  - -Changes in cycle length with BBB

#### **Re-entrant SVTs**

• AVNRT v AVRT

– No retrograde P waves?

- "r prime" sign in lead V1 (or deeper S wave in II)

• These features suggest AVNRT > AVRT

• Bluffers – it's at least 60/40 AVNRT!



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I → 1	2820 ms 🔫		
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# AP localisation: Left or Right?

• "LBBB-ish" = R sided accessory pathway

• "RBBB-ish" = Left sided

• Septal pathways reveal their location in the inferior leads (II, III and aVF)

# Localisation of AP

 Posterior septal APs give negative delta waves in II, III and aVF

• Antroseptal APs tend to have positive delta waves in II and aVF, but III may be negative

 Mid-septal tend to have something in between





## Capture & fusion beats



# End of part 1



Ċ 08-Oct-2002 21:29:00

C.C.U. JOHN RADCLIFFE HOSPITAL OXFORD

Rate 137 PR 0 QRSD 187 QT 382 QTc 577 --Axis--Р QRS 244 ν2 1 Λ Λ Λ U/U/M/U/M/ . V 

AAAAAAA 

883 864 863 864 20554944 8 329 26 349 Bat Agleny OK

#### 'Slower' VT (note AV Dissociation)







#### $AF \rightarrow VF$





21-Feb-2003 20:51:40

C.C.U. JOHN RADCLIFFE HOSPITAL OXFORD



ge: 23 Years ender: Male leight: 180 Cm	Weight: 84.6 Kg Vent Rate (BPM): 146 RR (msec): 410	PR (msec): 338 QRS dur (msec): 97 QT / QTC (msec): 307 / 479	Display speed: 25 mm/sec Display Scale: 10 mm/mV	

#### CASE 16

#### A 48-year-old man with palpitations



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- Marin Marin Marin Marin Marine







## End of part 2

# ECG checklist

 Here are my tips and tricks for improving your ECG skills

 These are suggestions for your own study, and were not presented on the day

- 1. Is it a funny looking ECG?
- Check the technical set up:

Paper speed

- Voltage settings/filters
- Limb lead placement
- **Pro tip:** consider memorising the classic limb lead reversal patterns

- 2. Put a Post-it Note over the automated analysis to hide it; instead consider writing the salient history or your analysis flow-chart (See next tip)
- A 20 year old squaddie having a routine medical ECG will be vastly different to a 70 year old smoker with diabetes and hypertension being investigated for chest tightness!

- 3. Do a systematic "run through" of the trace especially if it's a 'barn-door' diagnosis:
  - Rate -> Rhythm -> P waves -> PR interval -> QRS -> ST -> QT
- Pro tip: AF is always irregular but sometimes you might need a longer rhythm strip to be sure, and callipers or pen and paper
- **Classic pitfalls:** AF and complete heart block, junctional rhythm with hidden P waves, very fast V rates in AF looking regular at first glance

 4. Be liberal with the test and repeat often if the acute clinical picture is not clear or at odds with each other.

- **Pro tip:** "The changing ECG is the hallmark of coronary disease until proven otherwise"
- Dr N. Paul Silverton

- 5. Memorise the hexaxial (i.e. 6 lead) reference system and how to estimate the axis (*Maybe put this on your Post-it Note!*)
- Start by drawing the augmented leads (aVR, aVL and aVF) as if looking at a stickman, remembering the 3 lines divide a circle
   so angles are 360 divided by 3 = 120 degrees.
- Then remember lead I comes out at 90 degrees to avF, and then II and III move 30 degrees in each step (note that II is 90 degrees to aVL)

• Super advanced pro tip!

 Plotting the axis of VT will massively help tell you where it is breaking out from

 Also the leads with negative delta waves in pre-excitation essentially "point" to where the pathway is  6. Memorise the rare things you can do something about! (Brugada, ARVC, LQTS, SQTS, ASDs, J wave syndromes, ...)

 7. Befriend an ECG expert and share anonymised traces securely for quality assessment and feedback; a true expert **loves** ECGs and **loves even more** looking clever explaining the tricky ones!

- Suggested online resources:
- <u>https://www.healio.com/cardiology/learn-the-heart/ecg-</u> <u>review</u>
- This is an excellent online course and quiz set from the <u>heart.org</u> learning site.
- <u>https://bhrs.com/ecg-egm-challenge/</u>
- Test yourself on the BHRS website both ECGs and EGMs!