ECG Interpretation Workshop

TACHYARRHYTHMIAS

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Approach to ECG interpretation of tachydysrhythmias

First step: Is rhythm sinus tachycardia (ST)?

Second step: QRS complexes: narrow or wide (wide > 0.12 seconds)

Third step: determine regularity

Regular
- Sinus tachycardia
- Atrial flutter + fixed AVNB
- Non-sinus atrial tachycardias
- Re-entrant tachycardias
- Junctional tachycardias

Irregular
- Sinus tachycardia + frequent PACs
- Atrial Fib
- Atrial flutter + variable AVN block
- MAT

Regular
- Sinus tachycardia + aberrancy
- VT
- SVT + BBB/WPW

Irregular
- A Fib + BBB
- A Fib + preexcitation
- VF
Sinus Tachycardia

- **Rhythm**: Regular
- **Rate**: 150
- **P Wave**: upright in II, III and avf and negative aVR
- **QRS**: narrow
Sinus Tachycardia

- One P wave for every QRS complex.
- Upright P Wave in (I, II, III, aVF) & inverted in aVR.
- Max SN rate is 220 - age.
Next ECG
(2)
Atrial Flutter

- **Rhythm**: regular
- **Rate**: 140/min
- **P Wave**: flutter waves
- **QRS**: Narrow
- **Special features**:  
  - Regular narrow complex tachycardia at a rate of 140/min with clear ‘saw-tooth’ patterned atrial activity.
  - The flutter waves are conducting with a 2:1 ratio [Every other atrial beat gets conducted].
Next ECG
Supraventricular tachycardia

AVNRT

- **Rhythm**: Regular
- **Rate**: 160
- **P Wave**: not seen
- **QRS**: narrow
- **Special Feature**:
  - regular short R-P narrow complex tachycardia (differential diagnosis includes AVNRT, AVRT and AT)
  - R-P interval is extremely short (p wave buried within QRS complex) this is most consistent with AVNRT
Supraventricular tachycardia

AVNRT

• No distinct P waves.

• P-waves may be hidden or may follow the QRS complex (retrograde atrial activity).

• Different types but treatment essentially the same.

• SVT may cause rate dependent ST depression or electrical alternans. It disappears when SR restored.
Next ECG
(4)
Atrial Fibrillation

- **Rhythm**: irregularly irregular
- **Rate**: 135/min
- **P Wave**: No distinct P waves
- **PR Interval**: Can not be measured
- **QRS**: narrow
Atrial Fibrillation

- Irregularly irregular NCT.
- No distinct P waves.
- Absence of flutter waves.
Differential Diagnosis of irregular NCT

- The DDx of regular NCT is: A fib, Aflutter with variable blocks, and MAT.
- The presence of distinct P wave excludes Afib.
- The presence of three different P waves at irregular interval conducted with variable PR intervals proves MAT.
Next ECG
SVT - Antidromic

- **Rhythm**: regular
- **Rate**: 170/min
- **P Wave**: not seen or retrograde
- **PR Interval**: can not be estimated
- **QRS**: wide (with overt delta-waves suggesting antegrade conduction down the accessory pathway).
SVT - Antidromic

- The conduction through the accessory pathway and retrograde through the normal conduction.
- It looks like VT.
- Its regular wide complex tachycardia.
- Rate usually 200-300 bpm.
- The QRS complexes are not changing in morphology.
(6)
SVT - Orthodromic

- **Rhythm**: Regular
- **Rate**: Fast
- **P Wave**: Present (after QRS)
- **PR Interval**: Not measurable
- **QRS**: Narrow
SVT - Orthodromic

- Paroxysmal supraventricular tachycardia: orthodromic reciprocating tachycardia (ORT) = atrioventricular re-entry tachycardia (AVRT)
- 30% of paroxysmal SVTs
- Tachycardia initiated by a PAC. QRS alternans observed significantly more often in ORT
- Patients younger in comparison to those with AVNRT
- Retrograde conduction by way of an accessory pathway (in contrast to AVNRT), P wave likely visible and displaced from QRS
Next ECG
MAT – Multiple Atrial Tachycardia

- **Rhythm**: Irregular
- **Rate**: Fast
- **P Wave**: Present (different origins)
- **PR Interval**: Variable
- **QRS**: Narrow
MAT – Multiple Atrial Tachycardia

- Seen in patients with underlying pulmonary disease
- Narrow complex, irregular tachycardia that is caused by abnormal automaticity of multiple atrial foci
- P waves demonstrate at least three different morphologies in one lead with variable PR intervals
- Frequently is mistaken for sinus tachycardia with frequent PACs or atrial fibrillation
- Treatment should focus on reversing the underlying disease process; rarely is the rhythm responsible for acute symptoms
Next ECG
Ventricular tachycardia - Monomorphic

- **Rhythm**: Regular
- **Rate**: Fast (>200)
- **P Wave**: Present (buried)
- **PR Interval**: Not measurable
- **QRS**: Wide (>0.12s)
Ventricular tachycardia - Monomorphic

- VT = series of >3 consecutive wide complex beats with HR >100

- Usually regular

- Criteria vary in reliability when applied individually. Interpret in conjunction with patient’s clinical presentation, PMH and prior ECGs (if available)
Wide Complex Tachycardia

Consider Patient Age & Cardiovascular History
- Favoring VT
  - Age > 50 years
  - Past MI or CHF

Supraventricular Tachycardia With Aberrant Conduction
Ventricular Tachycardia

Management Considerations Must Focus On Patient Stability

Electrocardiographic Distinction Between These 2 Entities May Not Be Possible
Diagnosis of wide QRS complex tachycardia with a regular rhythm

Step 1:
Is there absence of an RS complex in all precordial leads V1–V6?

If yes, then the rhythm is VT.

When the ventricular rate is slow, faster rates make identification of dissociated P waves particularly difficult. In slower VT, the sinus pacemaker may have the opportunity to send an impulse at a time when the ventricle is fully or partially recovered. It may completely or partially depolarize the ventricle in the normal pattern of activation, resulting in capture or fusion beats, respectively. Capture beats have a morphology identical to that of the ECG in normal sinus rhythm, whereas fusion beats have a morphologic appearance that is a fusion of the supraventricular and ventricular pattern of activation (Figs. 16a and 17).

A final step is to examine the QRS complex morphology and determine whether the QRS complex most closely resembles a right or left BBB. If the complex is upright in lead V1 of a standard 12-lead ECG, then it is defined as a right bundle branch type. Although many lead V1-positive VTs resemble an RBBB, findings indicative of VT include reversal of the normal rSR# pattern (to RSr#) and an R/S ratio >1 in V6 (Fig. 18)[21–24]. The later makes sense if one considers that in RBBB the initial activation of the ventricle is by way of the left bundle branch and should be manifest as an initial positive deflection in V6.

Table 1

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<th>Diagnosis of wide QRS complex tachycardia with a regular rhythm</th>
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Step 2:
Is the interval from onset of R wave to nadir of S wave greater than 100 msec in any precordial leads?

If yes, then the rhythm is VT.
Step 3: Is there AV dissociation?

- If yes, then the rhythm is VT.
Step 4: Are morphology criteria for VT present?

Morphologic criteria for ventricular tachycardia

- **Right bundle type requires waveform from V1 and V6**
  - V1: Monophasic R wave
  - V6: Reversal of rsR#

- **Left bundle type requires any of the below morphologies V1 or V2**
  - V1: R waveO 30 msec
  - Notched downstroke of S wave
  - Greater than 100 msec (0.10 sec) nadir S wave

If yes, then the rhythm is VT.
Next ECG
Ventricular tachycardia - Polymorphic

- **Rhythm**: Irregular
- **Rate**: Fast
- **P Wave**: Absent
- **PR Interval**: Not measurable
- **QRS**: Wide
Ventricular tachycardia - Polymorphic

- Varying QRS morphology, R-R intervals, electrical axis
- Baseline: long QT (TDP) vs normal QT
- ACS
- Usually unstable
- Defibrillation = treatment of choice
- AF + bypass tract easily mistaken for PVT (QRS variable width and morphology)
Next ECG
Pacemaker-mediated Tachycardia

- Rhythm: Regular
- P Wave: Present
- PR Interval: Normal
- QRS: Wide
- Special features: Re-entry dysrhythmia occur in dual-chamber PMs with abnormal atrial sensing. PM acts as antegrade conductor with retrograde VA conduction completing circuit loop.
Pacemaker-mediated Tachycardia (PMT)

- PVC occurs after the atrial channel refractory period ➔ PM interprets retrograde P wave as native atrial stimulus ➔ triggers ventricular pacing ➔ allows resultant retrograde P wave to again be sensed, and so on
- PMT cannot exceed the maximum programmed rate, usually 160–180 bpm
- Treatment = application of magnet, adenosine or vagal maneuvers