Approach to ECGs

tachy/brady algorithm

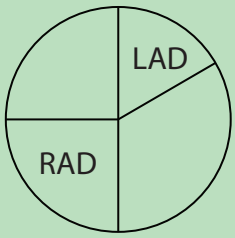
Check
- Age, gender, name
- 25mm/s; 10mm/mV
- 1mm = 40ms; 0.1mV

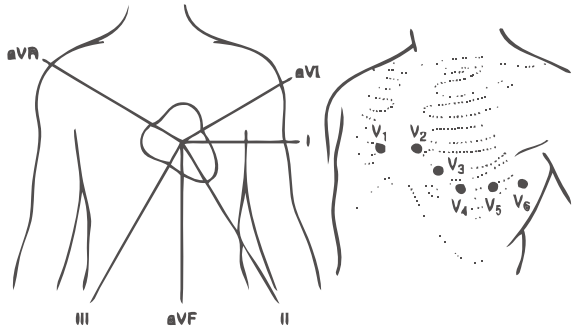
Rate
- 300 / big squares - RR only
- #QRS in 10s x 6
- 2 dots = 3s; #QRS in 6s x 10

Rhythm
(1) P for every QRS and vv
(2) P +ve in **I, II**
(3) 60-100 bpm

Axis
- QRS +ve in **I, II**

LAD: *Inf MI, WPW, LVH, LBBB, LAFB*
RAD: *AntLat MI, WPW, RVH, RBBB, LPFB, dextrocardia, normal*

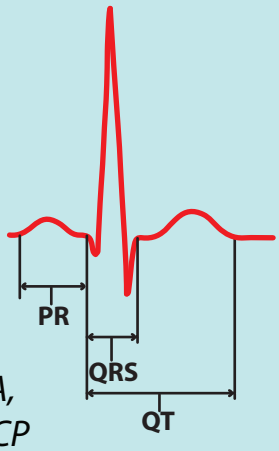




Intervals
- **PR** = 120-200ms (3-5 small boxes)
- **HiPR**: *AV block (1,2,3)*
- **LoPR**: *WPW, ectopic atrial pacemaker*

- **QRS** = <100-120ms (<2.5-3 small boxes)
- **WideQRS**: *RBBB (V1/V2 rsr'; lat leads slurred S), LBBB(V5/V6 rS, qS; lat leads rsr'), V-pacemaker, ↑K, ICD/pacer*

- **QTc** <1/2 RR or M<420ms, F<440ms, no safe #, but >500 DANGER
- **Short QT <300-360 ms**: *↑Ca*
- **Long QT**: *"antis and hypos" - ABx, antipsychotics, antidepressants, TCA, antihistamines, antiarhythmics, hypo K, hypo Mg, congenital, MI, high ICP*



Hypertrophy
- **LAE** = **II** - P wave >100ms (2.5 small boxes) OR **V1** - P wave diphasic p mitrale
- **RAE** = **II** - P wave > 2.5 small boxes tall

- **LVH** = sum of R in **V5** + S in **V1**
  - > 35mm if > 40yo
  - > 40mm if fit or 30-40yo
  - > 45mm if <30yo

  Alternatively,
  - R in **V6** >26mm
  - R in **I** + S in **III** > 25mm
  - *R in **avL** > 11mm

- **DDx**: *HTN, hypertrophic obstructive cardiomyopathy, aortic stenosis*

- **RVH** = R>S or > 7mm in **V1**, R<S in **V5/V6**, RAD
- **DDx:** *pulm HTN, mitral stenosis, pulmonic stenosis*
- **DDx +R in V1:** *RVH, RBBB, post MI, WPW, Duchenne musclar dystrophy, leads wrong*

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Approach to ECGs - Ischemia

Always r/o STEMI first

MI = Biomarkers + ECG or echo/angiogram findings
Pathologic Q - 1/3 height of QRS in 2 leads or 1 small box wide, can be new/old infarct

STEMI - J point STE >0.1mV in any 2 contiguous leads, except
V2-V3: ≥0.25mV men <40; ≥0.2mV men ≥40; ≥0.15mV women
DDx: *Acute STEMI, Aortic dissection, PE, peri/myocarditis (diffuse STE, diffuse PR dep), Takotsubo cardiomyopathy, Prinzmetal/vasospasm, LV aneurysm, LVH, Pacer, LBBB, Brugada, hyperK, hyperCa, hypothermia*

Differentiate STEMI > Benign Early Repol (BER): "Q2-R-ST4"
- Q waves, new
- QR-T complex (✓ sign)
- Reciprocal change
- Straight/Convex STE
- III > II STE or T in V1>V6
- STE >25% of T in V6
- STE I and II is not STEMI

Repeat ECG r/o dynamic Δ

Classic STEMI localization:

(1) II, III, avF	**inferior**	**marginal R coronary**
(2) V1, V2	**septal**	**proximal LAD**
(3) V3, V4	**anterior**	**distal LAD**
(4) I, aVL, V5, V6	**lateral**	**circumflex**
(5) STD in V1-V3	**posterior**	

Ischemia without acute occlusion (i.e. NSTEMI/UA) does not localize!

STEMI Equivalents / Don't Miss Signs of Ischemia
- **hyperacute T waves** - *broad, prominent asymmetrical, similar or bigger than QRS*
- **deWinter T waves** - *starts below isoelectric line; upsloping ST dep and peaked T in precordial leads with STE in avR*
- **Wellen's T -** *biphasic/deep-symmetric inverted T V2-4 can have no pain - LAD stenosis*
- **U wave inversion**
- **STE avR with diffuse depression** - *left main, prox LAD, 3VD, or general ischemia*
- **ST depression or T wave inversion in avL** - *early inferior MI*
- **R/S >1 or ST depression in V1-V2** - *posterior infarct, get a 15 lead*
- **STE V1 > V2 or STE/isoelectric in V1 with depression in V2** - **RV infarct**
- **New tall T wave in V1 -** *normal T is inverted in V1, unless LBBB/LVH/high voltage*

Modified Sgarbossa's Criteria for LBBB - any of:
≥ 1 lead with ≥1 mm of concordant ST elevation
≥ 1 lead of V1-V3 with ≥ 1 mm of concordant ST depression
≥ 1 lead with ≥ 1 mm STE and discordant STE ≥ 25% of the depth of S-wave.

DDx inverted T - *Acute/old ischemia, HyperK, LVH, RVH, strain (PE, HOCM, etc.), BBB, high voltage, Normal finding in children / persistent juvenile T wave, raised ICP*

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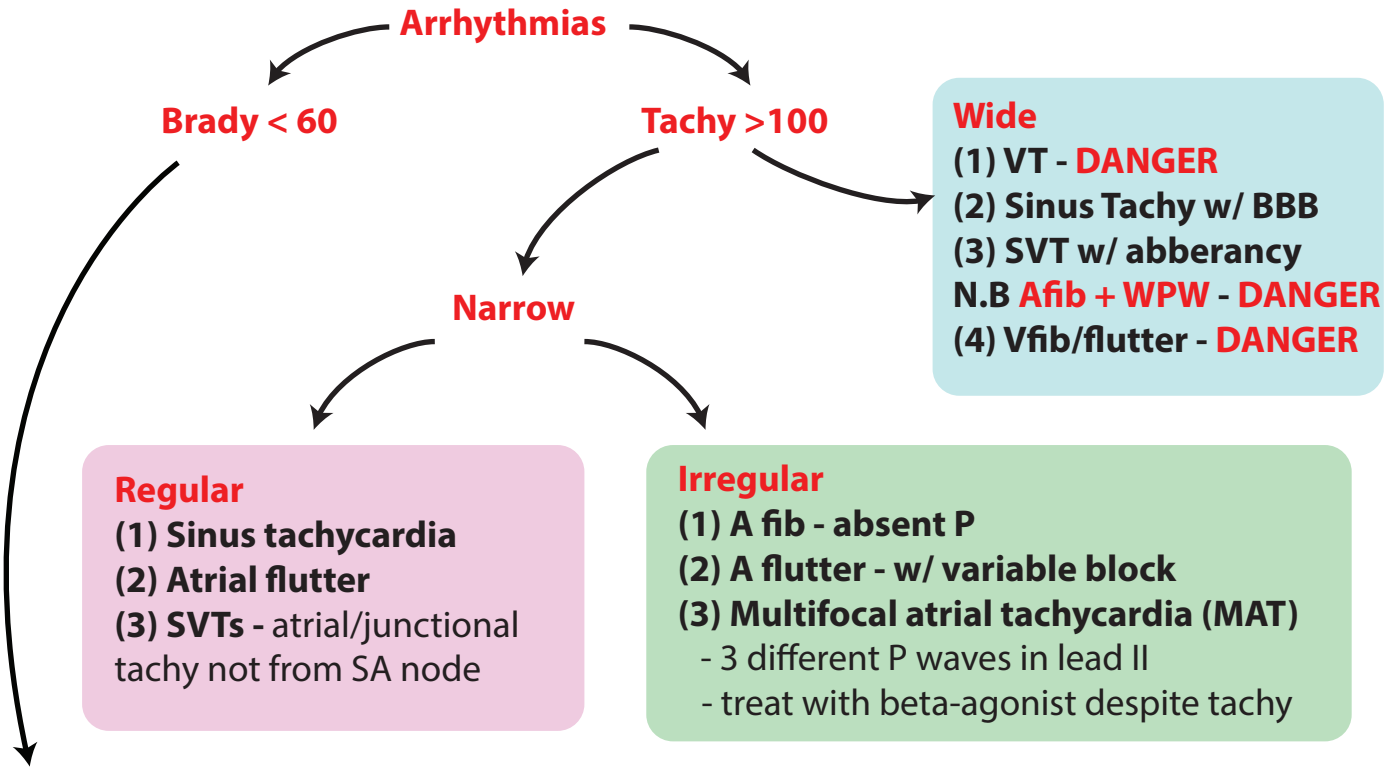
Approach to ECGs - Tachy/Bradyarrhythmias



(1) Sinus bradycardia
(2) Sick Sinus Syndrome (runs of tachy/brady)
(3) SA node block - escaped beats
(4) SA node arrest - escape rhythms
(5) AV block

1° - long PR intervals >120-200ms from longer pause
2° - Mobitz I / Wenkebach - successively longer PR intervals (2:1, 3:2, 4:3, etc.)
2° - Mobitz II / Mobitz - 2:1, 3:1, 4:1, etc. - **DANGER**
3° - P running through QRS - **DANGER**

Narrow QRS - Proximal AV block (lower AV cells can function)
Wide QRS - Distal AV block - ventricular pacemaker

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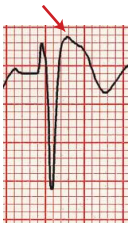
Approach to ECGs - Syncope Syndromes

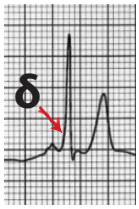
Rule out relevant tachy/brady-arrhythmias, and consider these 8 syndromes

BE WHAT QT PiE



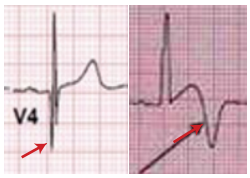
Brugada 1 - Coved STE >2mm in >1 of V1-V3 + negative T

Electrolytes
↑K - brady, peak T, wide QRS, no P, sine wave, "the great imitator"
↓K - STdep, T inv, U wave, long P
↑Ca - short QT, Osborn J (see below)
↓Ca - long QT via long ST
↑Mg - assoc with ↑K, AV block
↓Mg - long QT, assoc with↓K

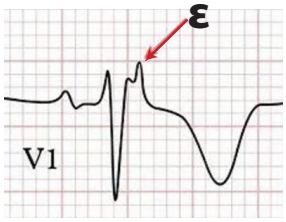


WPW - delta wave and short PR

associated



HOCM- dagger Q lat>inf leads, LVH, LAE, giant T inversion precordial



ARVD - epsilon wave, T wave inversion, QRS widening/prolonged S wave V1-V3

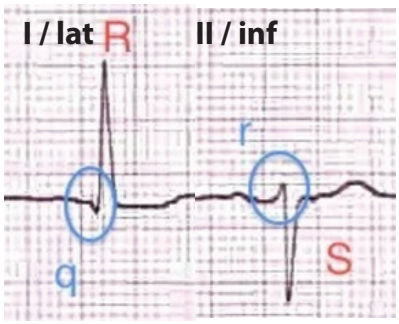
Trifascicular block - RBBB, LAFB/LPFB (see below), 1st degree heart block

Long QT (>480-500ms)
Short QT (<360ms)

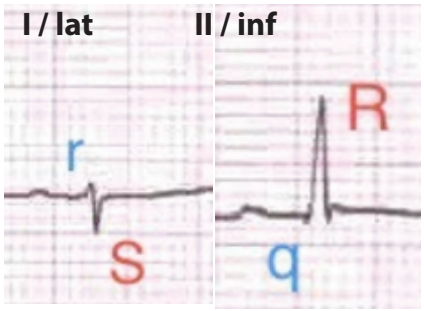
PE: RBBB, S1Q3T3, tall R in V1, RAE, RV strain (neg T V1-V4)

Appendix:

Osborn J waves
DDx - ↑ *Ca, hypothermia, meds, SAH*



L Ant Fascicular Block (LAFB)
Left axis and lat qR, inf rS



L Post Fascicular Block (LPFB)
Right axis and lat rS, inf qR

*The above ECGs are sampled from litfl.com

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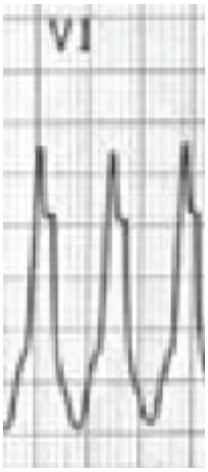
Approach to ECGs - VT vs. SVT - Wide Tachycardias

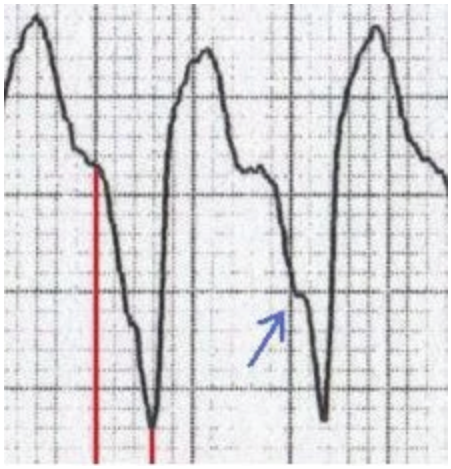
DDx = VT vs. SVT with BBB
All of the below are specific but not sensitive for VT:
- No RS complexes (i.e. entirely positive or negative) in V1-V6
- Absence of typical RBBB or LBBB morphology
- Extreme axis deviation ("northwest axis") — QRS positive in aVR and negative in I + aVF.
- Very broad complexes (>160ms)
- AV dissociation (P and QRS complexes at different rates)
- Capture beats - a QRS complex of normal duration.
- Fusion beats - a sinus and ventricular beat coincides to produce a hybrid complex.
- Brugada's sign – distance from onset of QRS complex to the nadir of the S-wave is > 100ms
- Josephson's sign – Notching near the nadir of the S-wave

RSR' complexes with a taller left rabbit ear. This is the most specific finding in favour of VT.

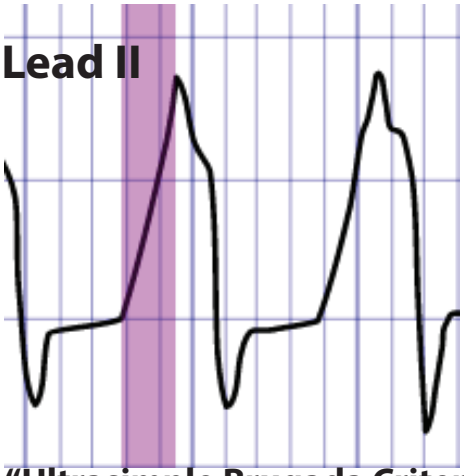
VT should be minimum120-130 bpm
Consider metabolic tachycardia if really wide (i.e. hyperkalemia, acidosis, etc.)



Big Left Rabbit Ear



Brugada sign (red)
Josephson's sign (blue)



"Ultrasimple Brugada Criteria"
R wave to Peak Time (RWPT)
>50ms specific for VT

*The above ECGs are sampled from litfl.com

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