Approach to ECGs

**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 rs'; 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 >40mm if fit or 30-40yo
  > 45mm if <30yo
- **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 muscular 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/isolectric 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

**Brady < 60**
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**

**Tachy > 100**
1. VT - **DANGER**
2. Sinus Tachy w/ BBB
3. SVT w/ abberancy
   - N.B Afib + WPW - **DANGER**
4. Vfib/flutter - **DANGER**

**Narrow**
1. VT - **DANGER**
2. Sinus Tachy w/ BBB
3. SVT w/ abberancy
   - N.B Afib + WPW - **DANGER**
4. Vfib/flutter - **DANGER**

**Regular**
1. Sinus tachycardia
2. Atrial flutter
3. SVTs - atrial/junctional tachy not from SA node

**Irregular**
1. A fib - absent P
2. A flutter - w/ variable block
3. Multifocal atrial tachycardia (MAT)
   - 3 different P waves in lead II
   - treat with beta-agonist despite tachy

**Wide**
1. VT - **DANGER**
2. Sinus Tachy w/ BBB
3. SVT w/ abberancy
   - N.B Afib + WPW - **DANGER**
4. Vfib/flutter - **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

WPW - delta wave and short PR

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

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

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
**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 minimum 120-130 bpm**

*Consider metabolic tachycardia if really wide (i.e. hyperkalemia, acidosis, etc.)*

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