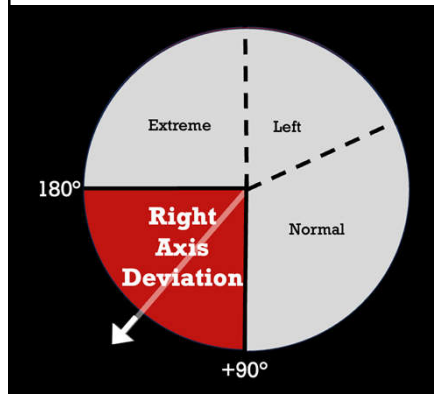


R.A.D RESCUES in the ED: saving lives by finding new right axis deviation!



Ali Farzad, MD

@alifarzadmd

Emergency Physician / #ECGNerd

Baylor University Medical Center, Dallas TX

UMEM Categorical EM - Class of 2013

UMEM Cardiovascular Emergencies Fellowship - 2014



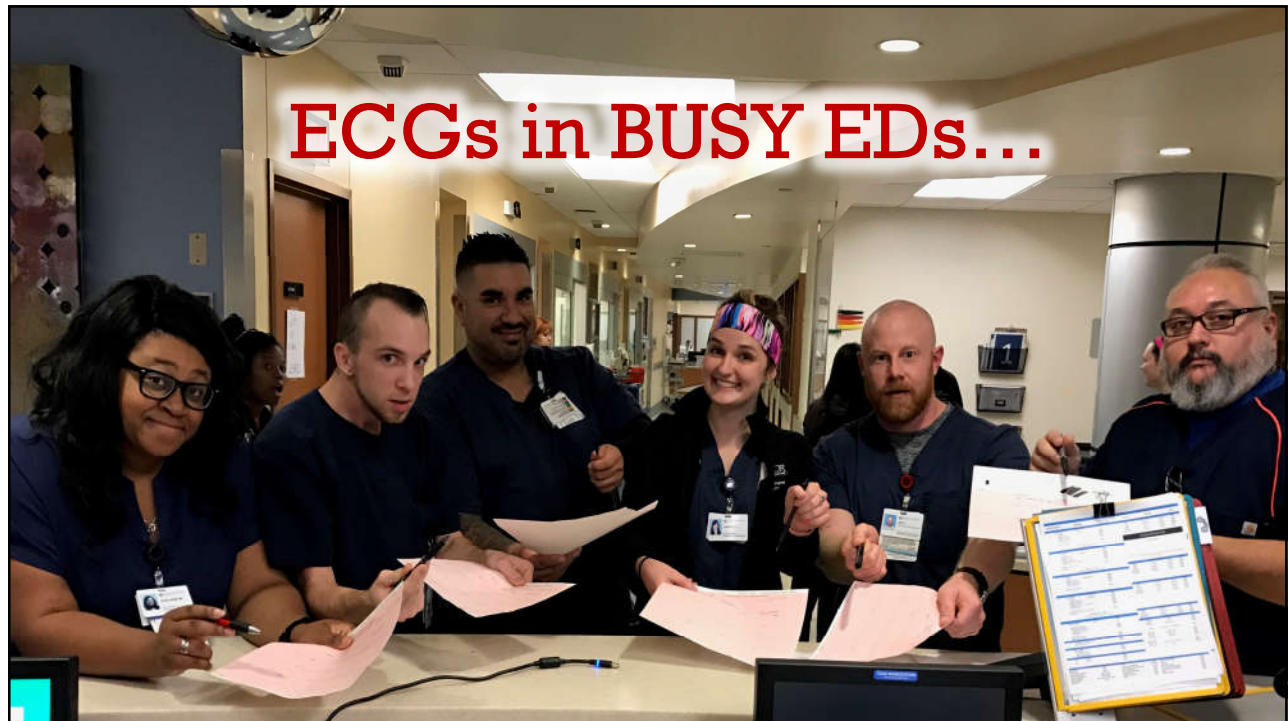
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THE OBJECTIVE

Review the conditions that cause new right axis deviation and discuss how identifying this ECG abnormality can help you save & improve more lives.

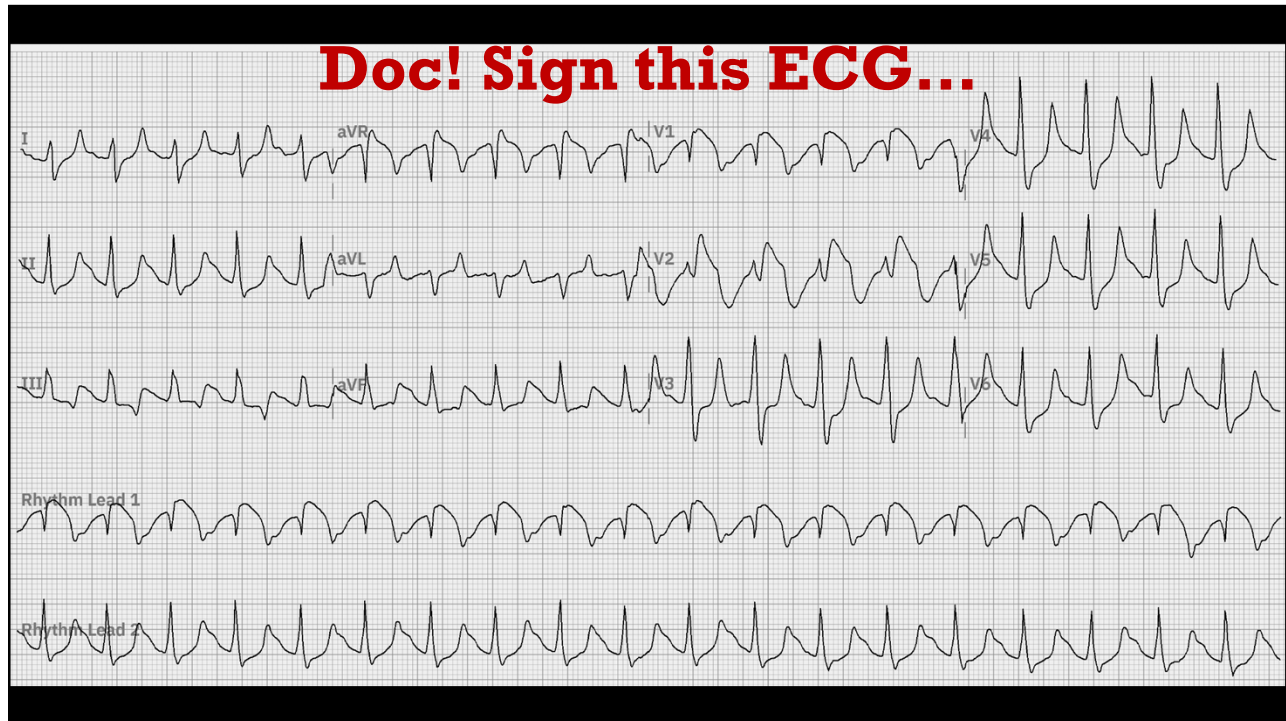
THE GOAL

Inspire you to continue learning about ECGs and use your expertise to make a difference!

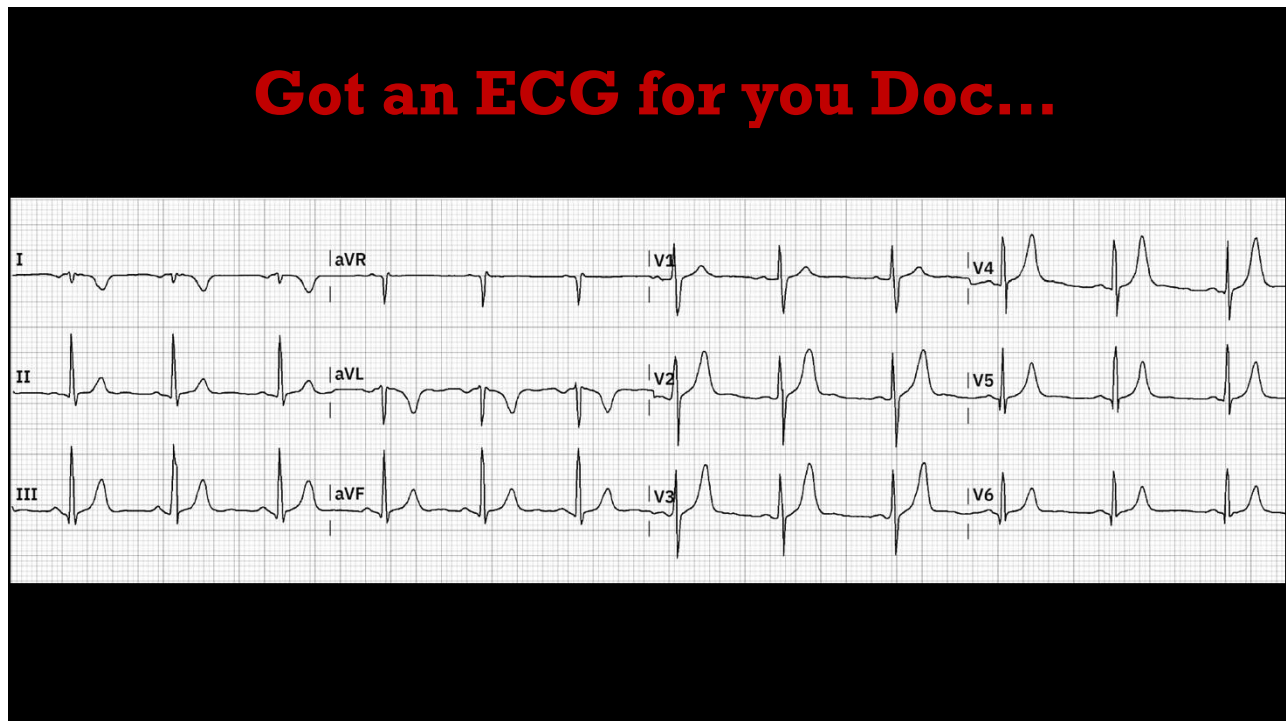
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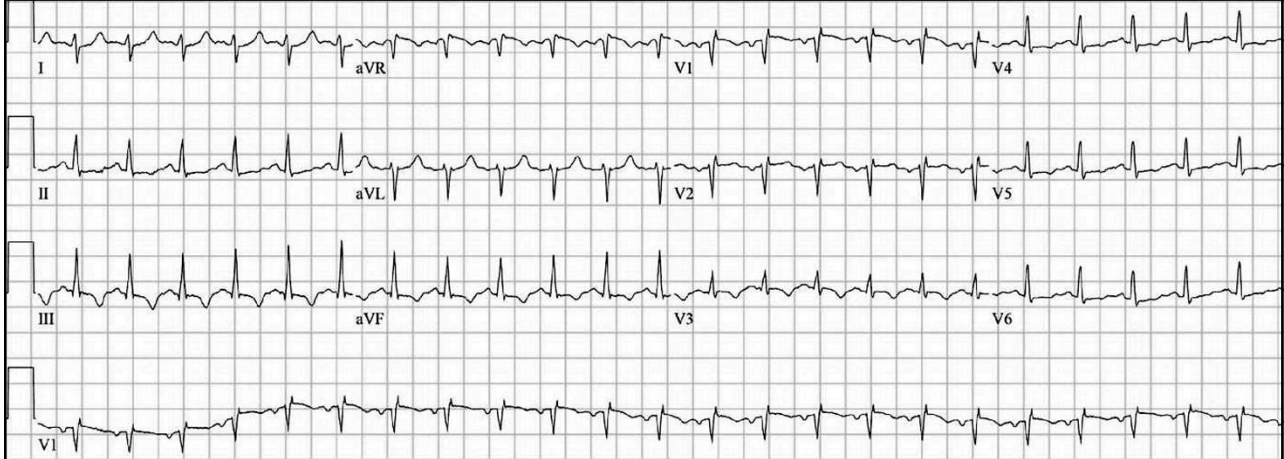


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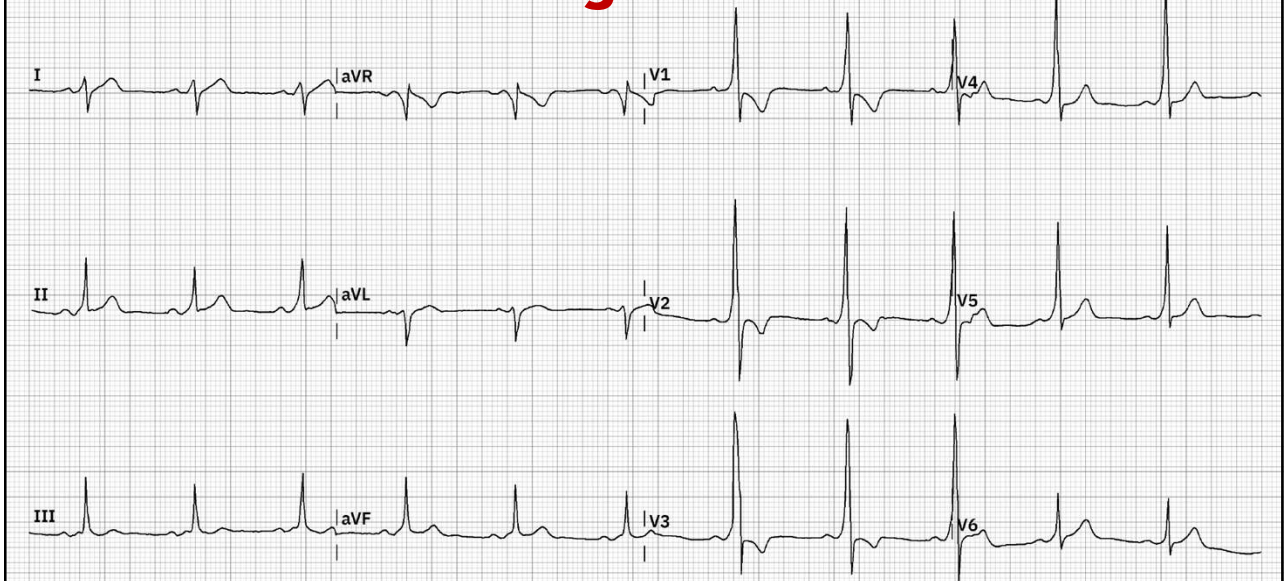
8

Doc! Sign this one please...



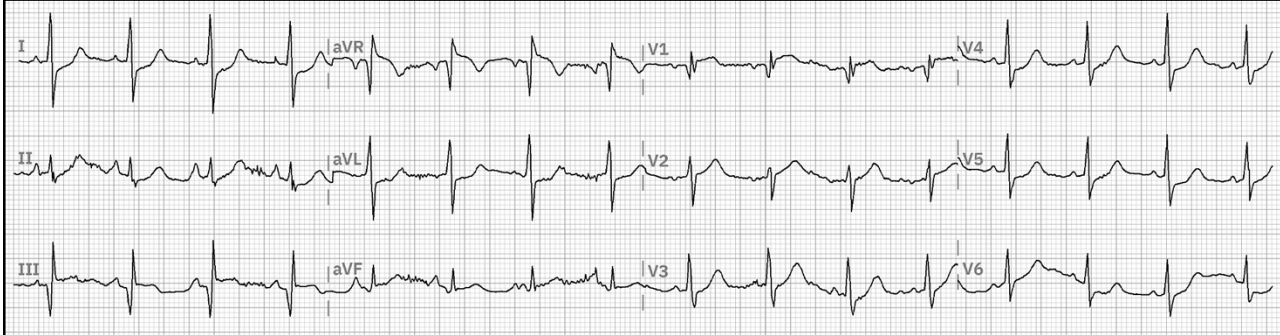
9

Want to bring this one back?



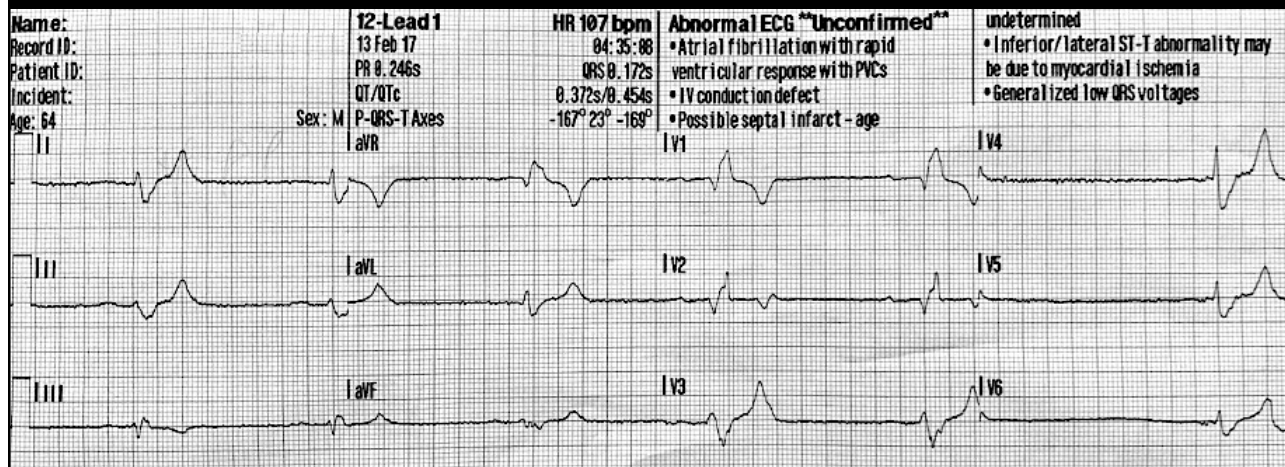
10

C'mon Doc! Sign this!



11

This one looks weird, Doctor...



SIGN IT!!!

12

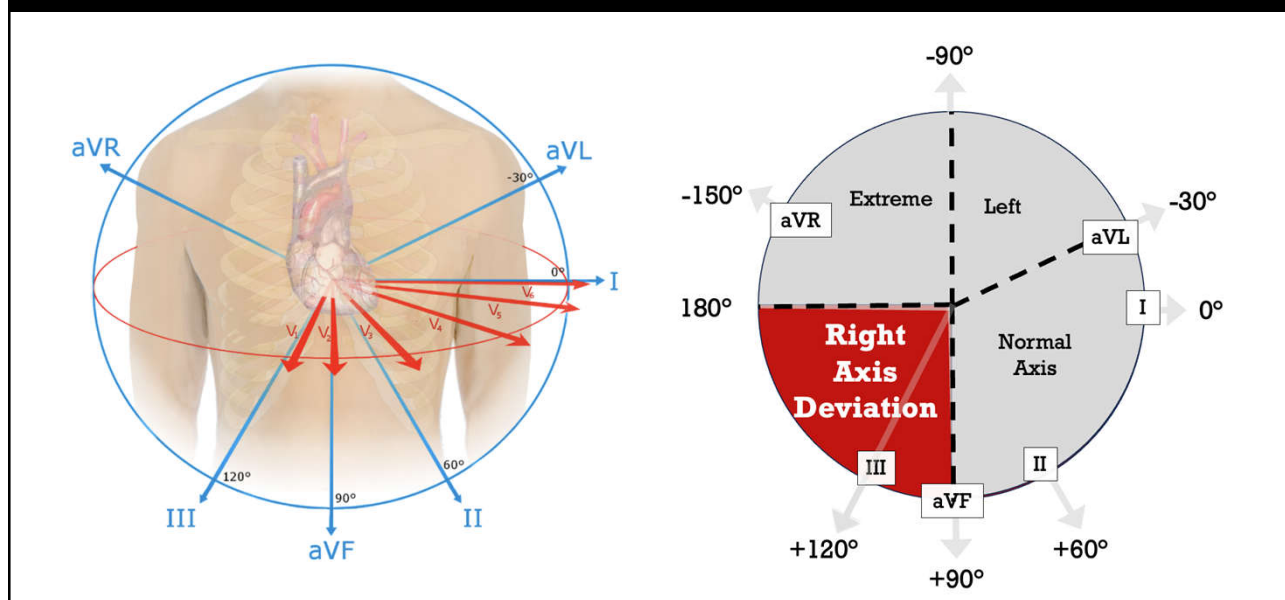
Pretty sure I felt a pulse...



SIGN HERE PLEASE!!!

13

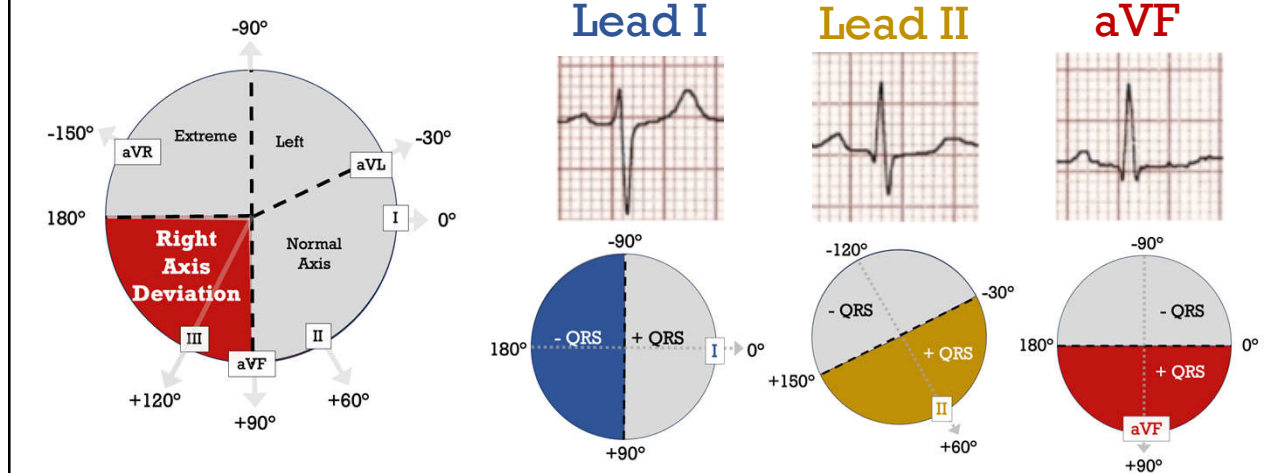
Right Axis Deviation (RAD)



14

Identifying RAD

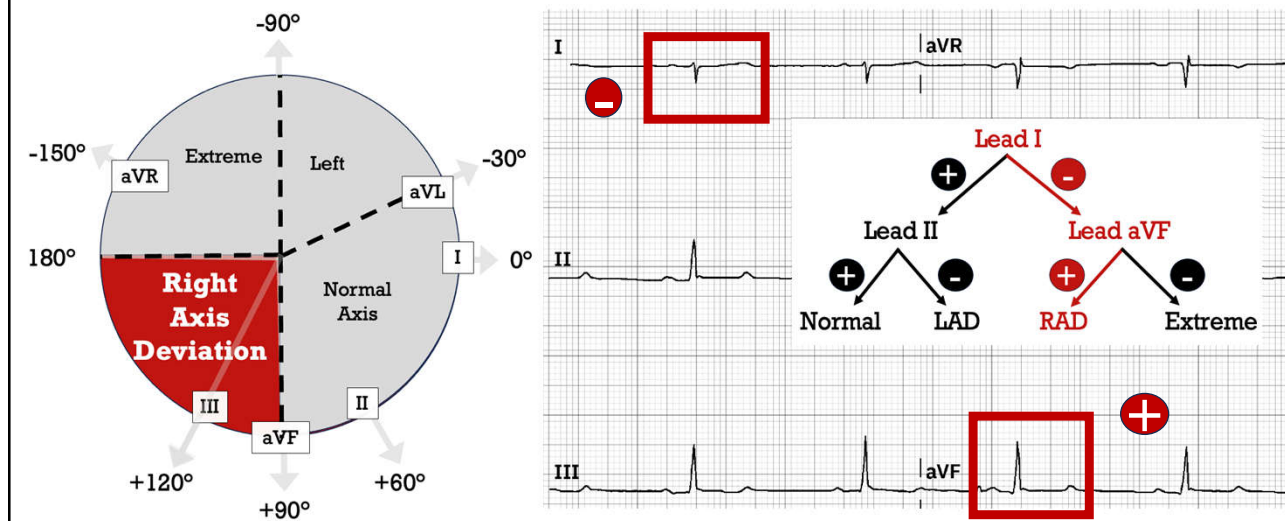
QRS axis = $+90^\circ - 180^\circ$



15

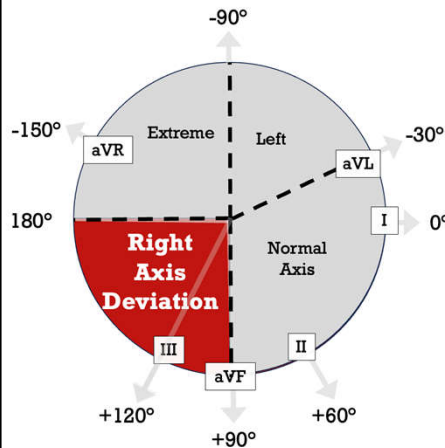
Identifying RAD

Always look for an S wave in lead I!



16

5 Main Categories of RAD:

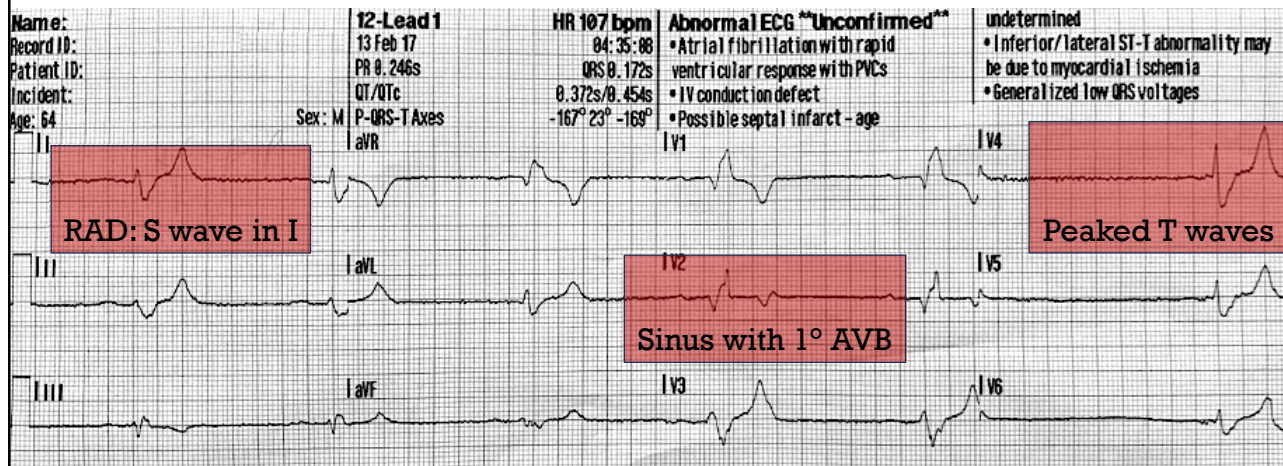


- **RV Strain**
- **Toxicologic / Metabolic**
- **Mechanical (position/shifting)**
- **Conduction Problems**
- **Normal variants/Misplaced Leads**

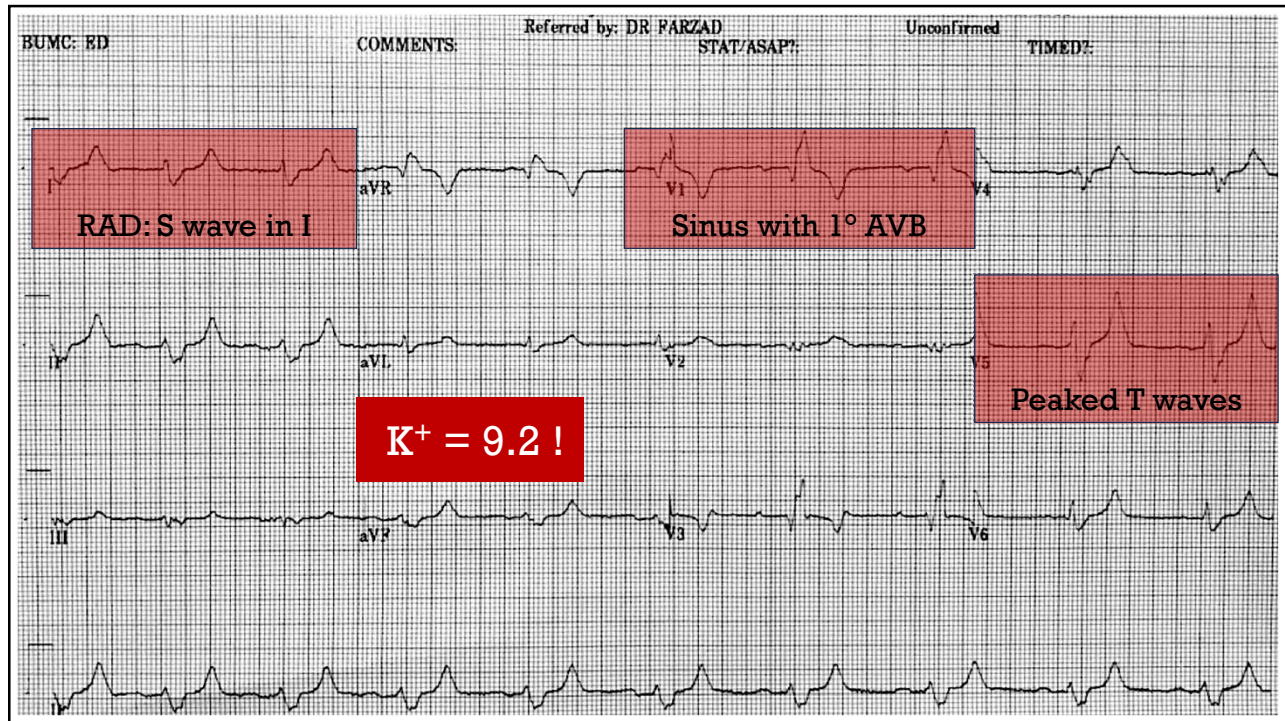
17

RAD Rescue #1: 64 YOM

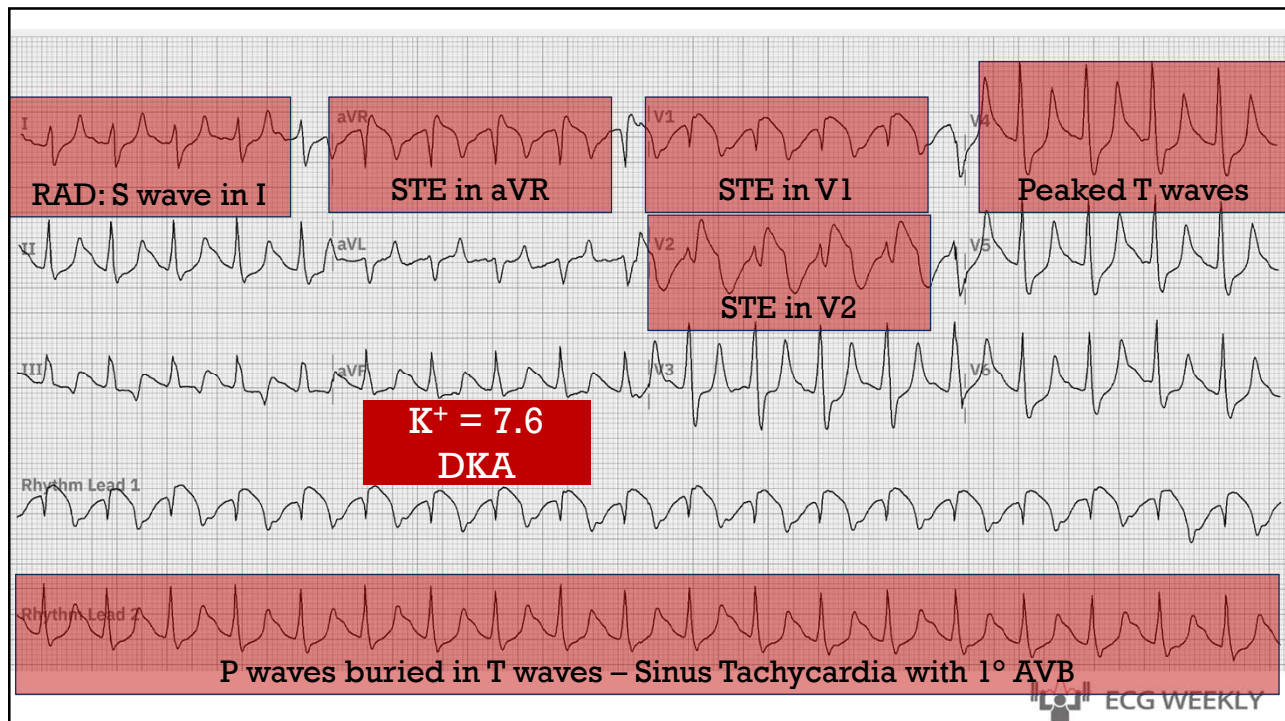
EMS: Altered, brady, hypotensive...nothing is working!



18



19



20

Hyperkalemia ECG Pearls

BEWARE HYPERKALEMIA!
IT DOES WHATEVER IT WANTS TO THE ECG...

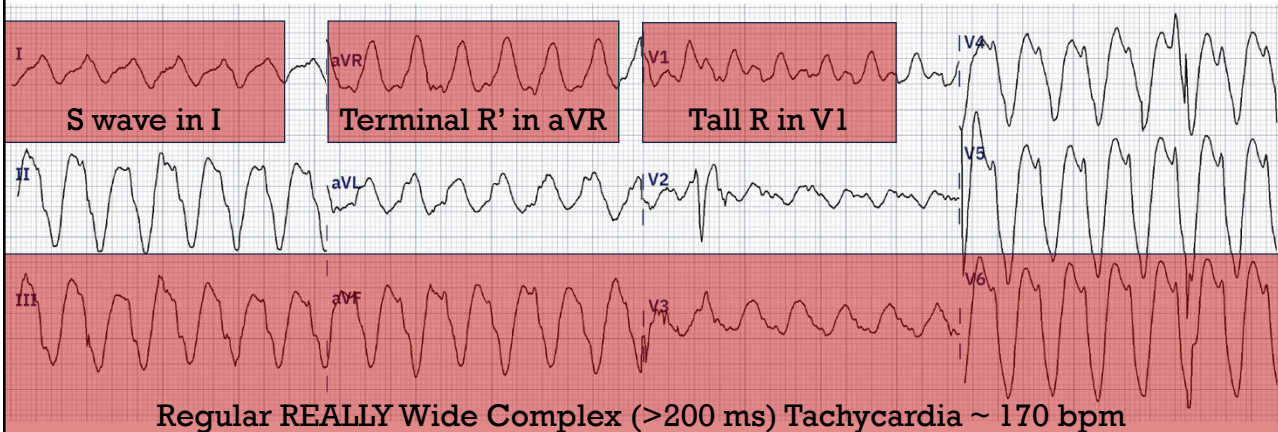
Suspect hyperkalemia in any patient with new
right axis deviation (look for S wave in lead I)

Bizarre brady or tachyarrhythmia?
Consider $\uparrow K^+$ and empiric
calcium & bicarb when unstable!

21

RAD Rescue #2: 20 YOF

EMS: Altered, tachycardic, with dilated pupils...



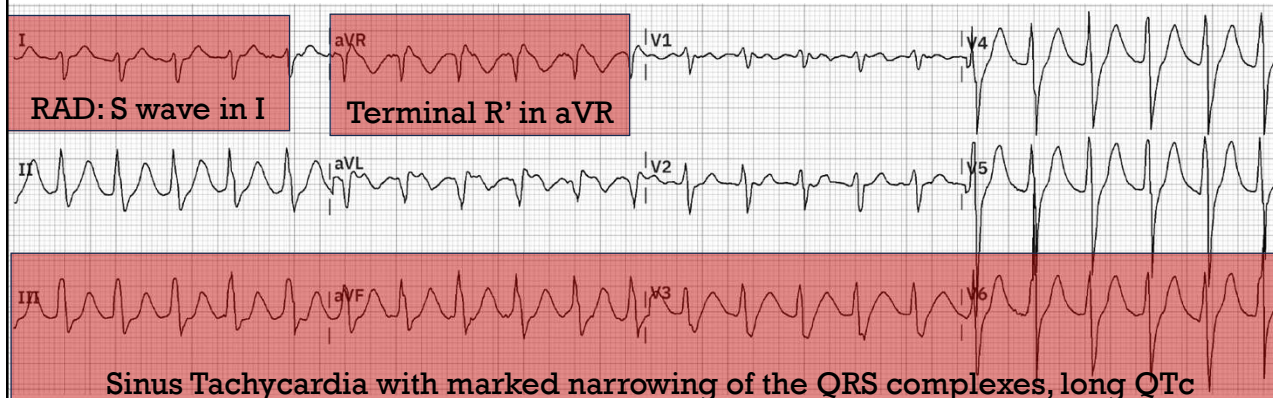
Would you treat this as VT ???

 ECG WEEKLY

22

RAD Rescue #2: 20 YOF

ED arrival ECG after 2 amps of NaHCO_3 !



23

ECG Findings: Na^+ channel blocker toxicity

Sinus Tachycardia

- P waves commonly buried, may mimic VT

Prolonged QTc Interval

- Torsades in uncommon

Terminal Right Axis Deviation

- S wave (large/wide) in I & V6
- Taller R' wave in aVR ($> 3\text{mm}$ or $R/S > 0.7$)
- Tall R wave in V1 (Brugada Pattern)

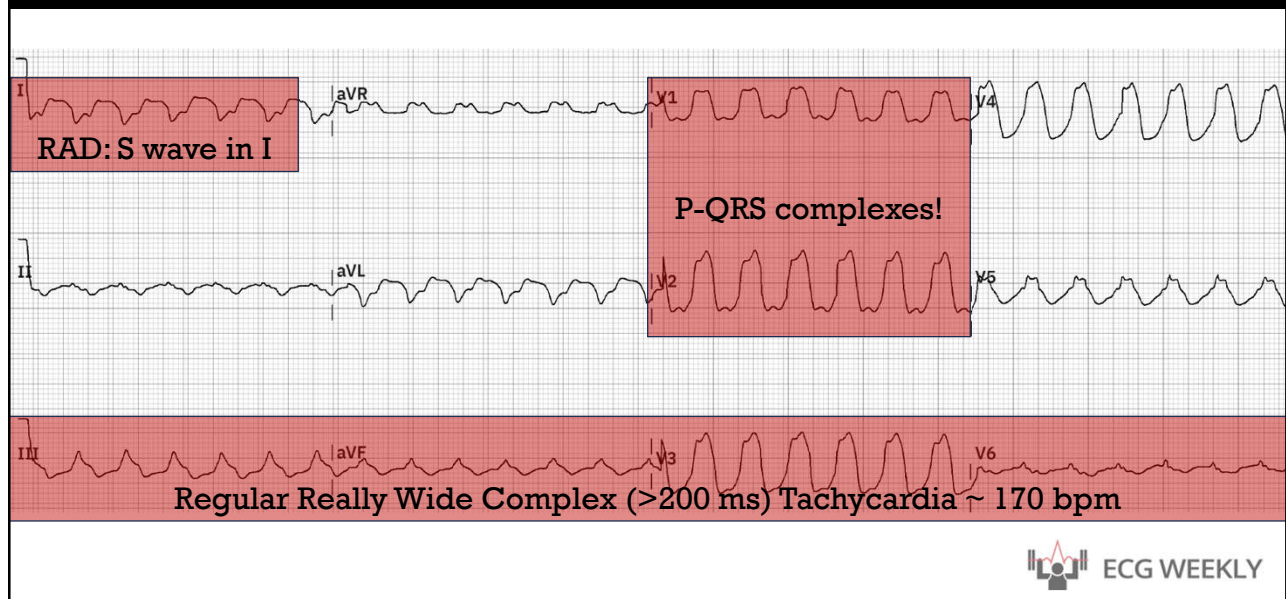
Wide QRS (Intraventricular Conduction Delay)

- >100 ms, risk of seizures, start bicarb
- >160 ms, risk of arrhythmia (VT)
- May progress to sine wave like HyperK⁺



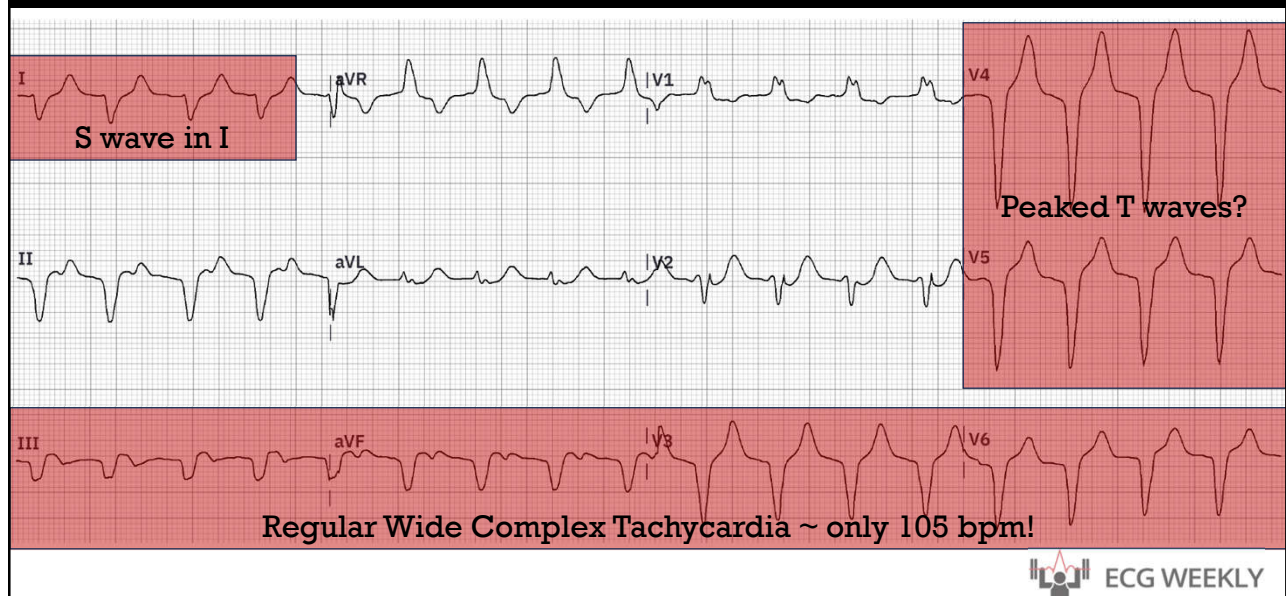
24

Is this Ventricular Tachycardia?



25

Is this Ventricular Tachycardia?



26

REALLY Wide Complex Tachycardia Pearls

Both HyperK⁺ & Na⁺ channel blocker tox mimic VT!

- True VT is typically at least 130 bpm
- True VT is wide (>120 ms) but not way too wide (> 200 ms)
 - Suspect a mimic when HR is < 130 bpm
- Suspect a mimic when QRS is way too wide (> 200 ms)
 - Suspect a mimic when you see P-QRS complexes!



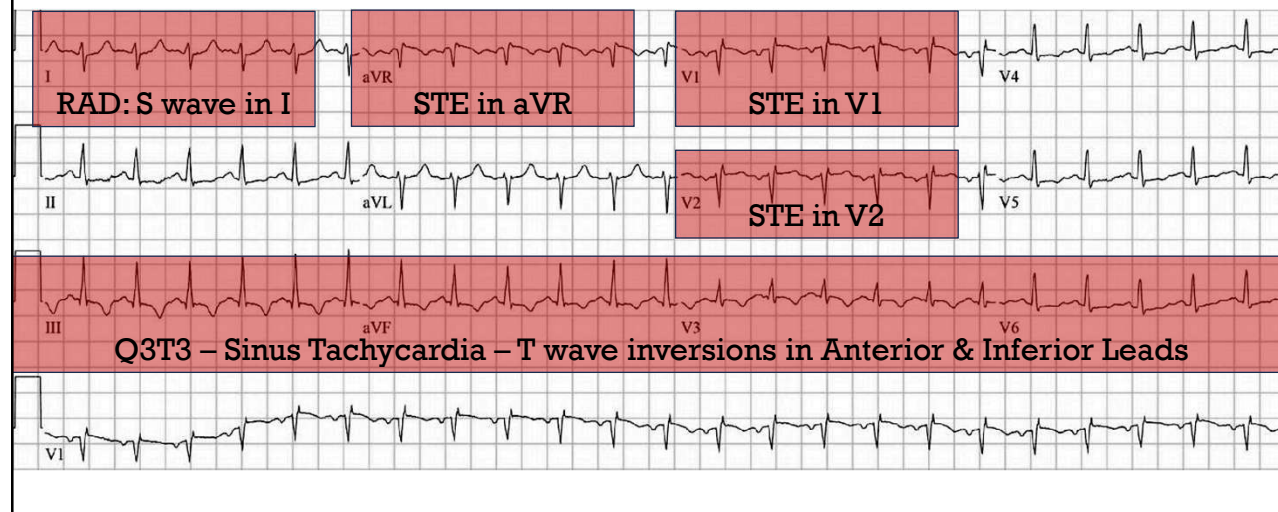
**When in doubt?
Consider empiric treatment!**
Avoid medications like amiodarone,
lidocaine, and procainamide which
may worsen toxicity!



27

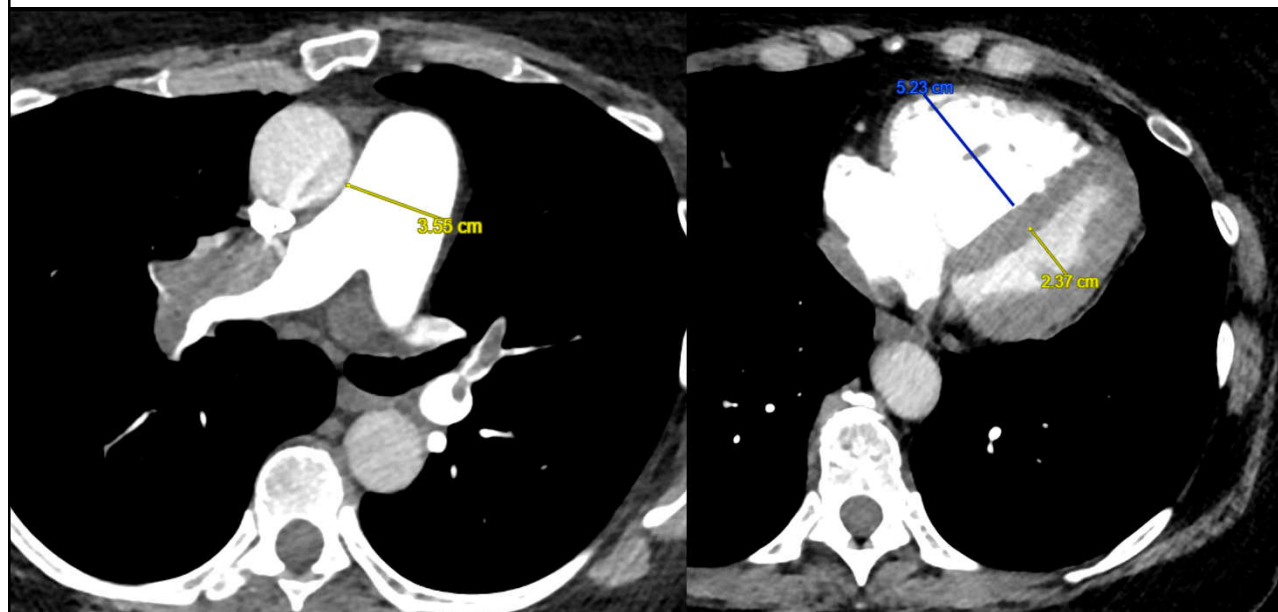
RAD Rescue #3: 17 YOF

EMS: Anxiety, SOB, hyperventilating...very dramatic!



28

RAD Rescue #2: 17 YOF



29

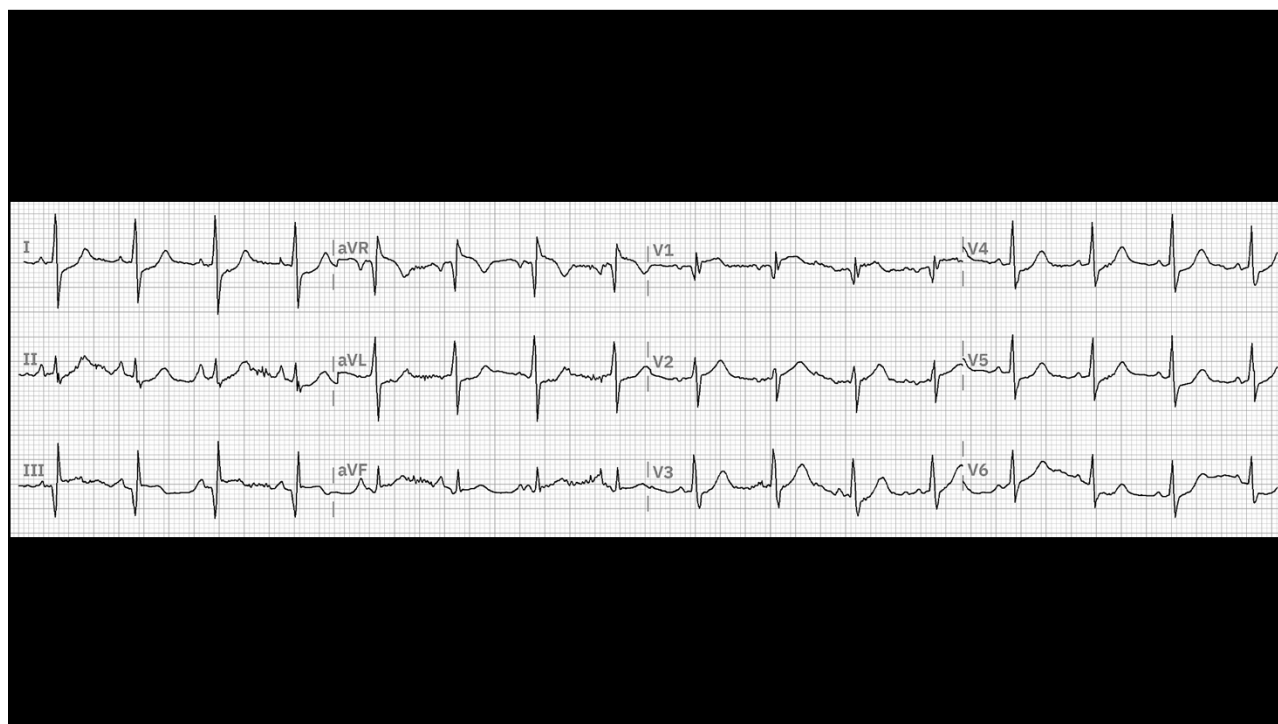
Pulmonary Embolism ECG Pearls

Large PEs will mimic STEMI with ST segment elevation in right sided leads (aVR, V1/V2, III)

- Right axis deviation is rare in STEMI, pay attention to the axis and consider PE
- Tachycardia is also unlikely in STEMI, look for signs of right heart strain



30



31

Pulmonary Embolism ECG Pearls

ECG signs of acute RV strain may predict circulatory shock

Findings associated with hemodynamic instability & ↑ morbidity/mortality:

- Right axis, tall R wave in V1, RBBB
- TWI's in R precordial leads + inf.
 - STE/STD (V1, V2, aVR, III)
- Tachycardia (sinus, fib or flutter)

32

3 Can't Miss Causes of Right Axis Deviation in the ED



- 1. Hyperkalemia**
- 2. Na⁺ channel blocker toxicity**
- 3. Pulmonary Embolism**

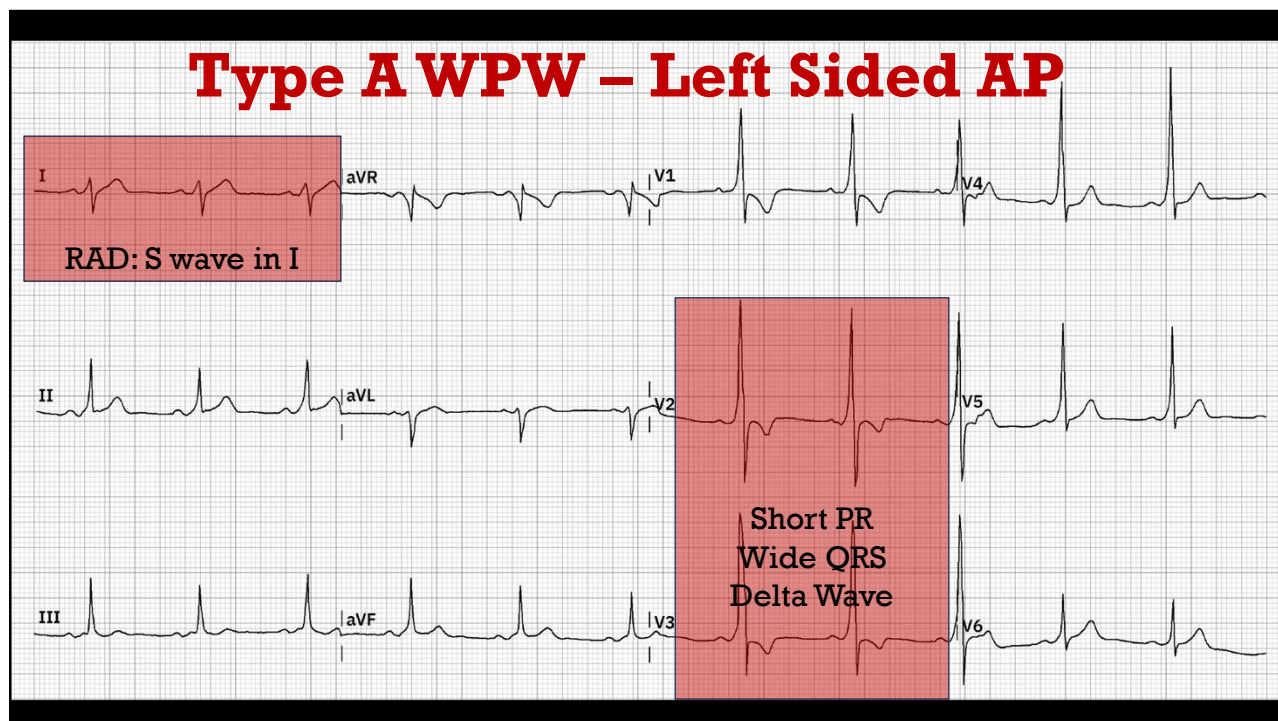
33

More Causes of Right Axis

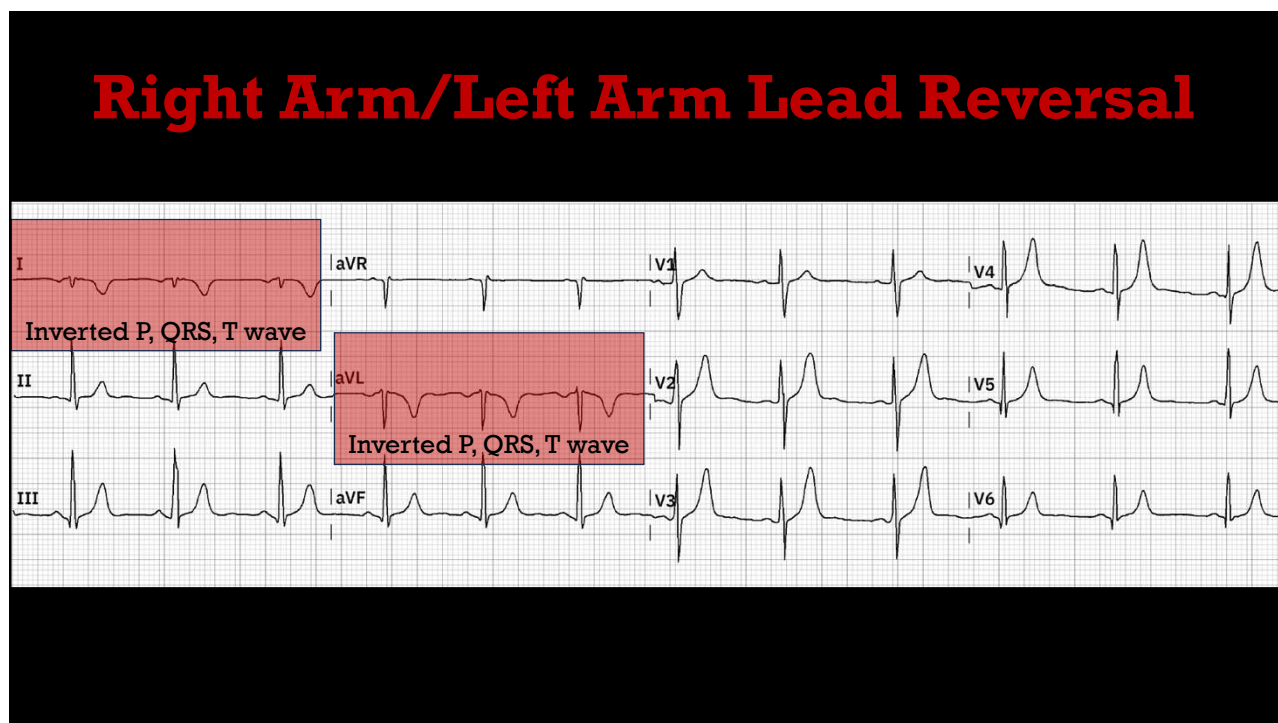


- Na⁺ channel blocker toxicity
- Hyperkalemia
- RV Strain
- Normal Variants (infants, children)
- Misplaced leads
- Mechanical position/shifting
- Lateral wall myocardial infarction
- Ventricular beats/ectopy
- Conduction defects
- WPW (preexcitation syndromes)

34



35



36

Most Causes of Right Axis

- **Na⁺ channel blocker toxicity**
- **Hyperkalemia**
- **RV Strain**
 - PE, Pulmonary hypertension (acute and chronic, e.g. COPD)
 - Pulmonary stenosis, RVH
- **Pediatrics**
 - Normal and expected finding in newborns/infants
 - Large R wave in V1-V2, small S wave in V5-V6
 - Children/young adults
 - May be a normal variant
- **Misplaced leads**
 - Left and right arm electrode reversal
- **Mechanical position/shifting**
 - Left sided pneumothorax, Emphysema, Inspiration
 - Dextrocardia/situs inversus
- **Lateral wall myocardial infarction**
 - Old lateral MI (deep Q-waves in lead I)
- **Ventricular beats/ectopy**
 - VT
- **Conduction defects**
 - RBBB
 - LPFB
- **Type A WPW**

37

RAD Final Pearls

STEMI with new RAD is NOT typical

Consider PE with STE in right sided leads and remember that Toxicologic and Metabolic conditions can also cause STE!

**New R.A.D in the ED =
High index of suspicion for
Pulmonary Embolism,
Hyperkalemia, & Sodium
Channel Blocker Toxicity!**

38



39