

EKG

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Disclosures

- None

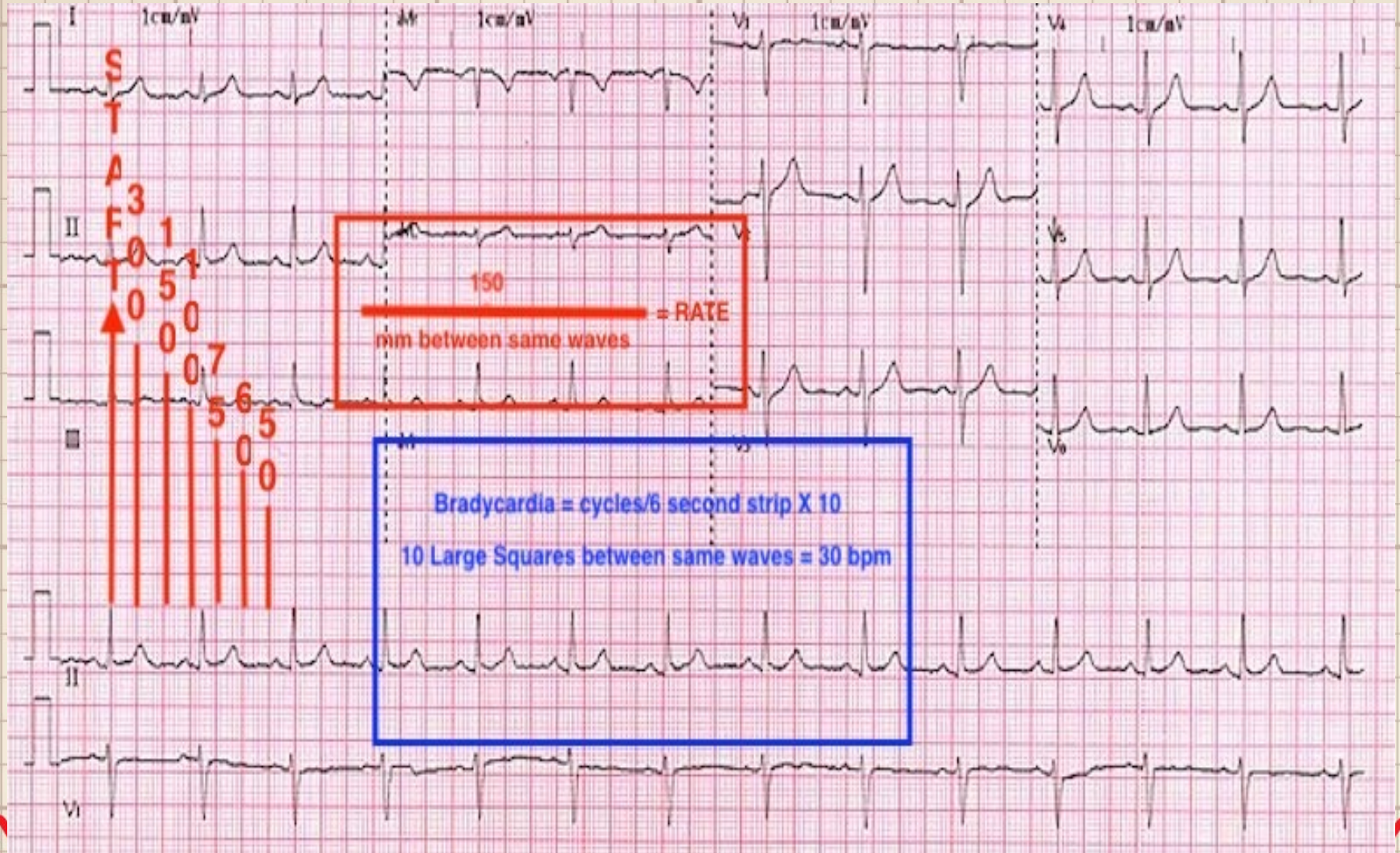


12 lead EKG Interpretation

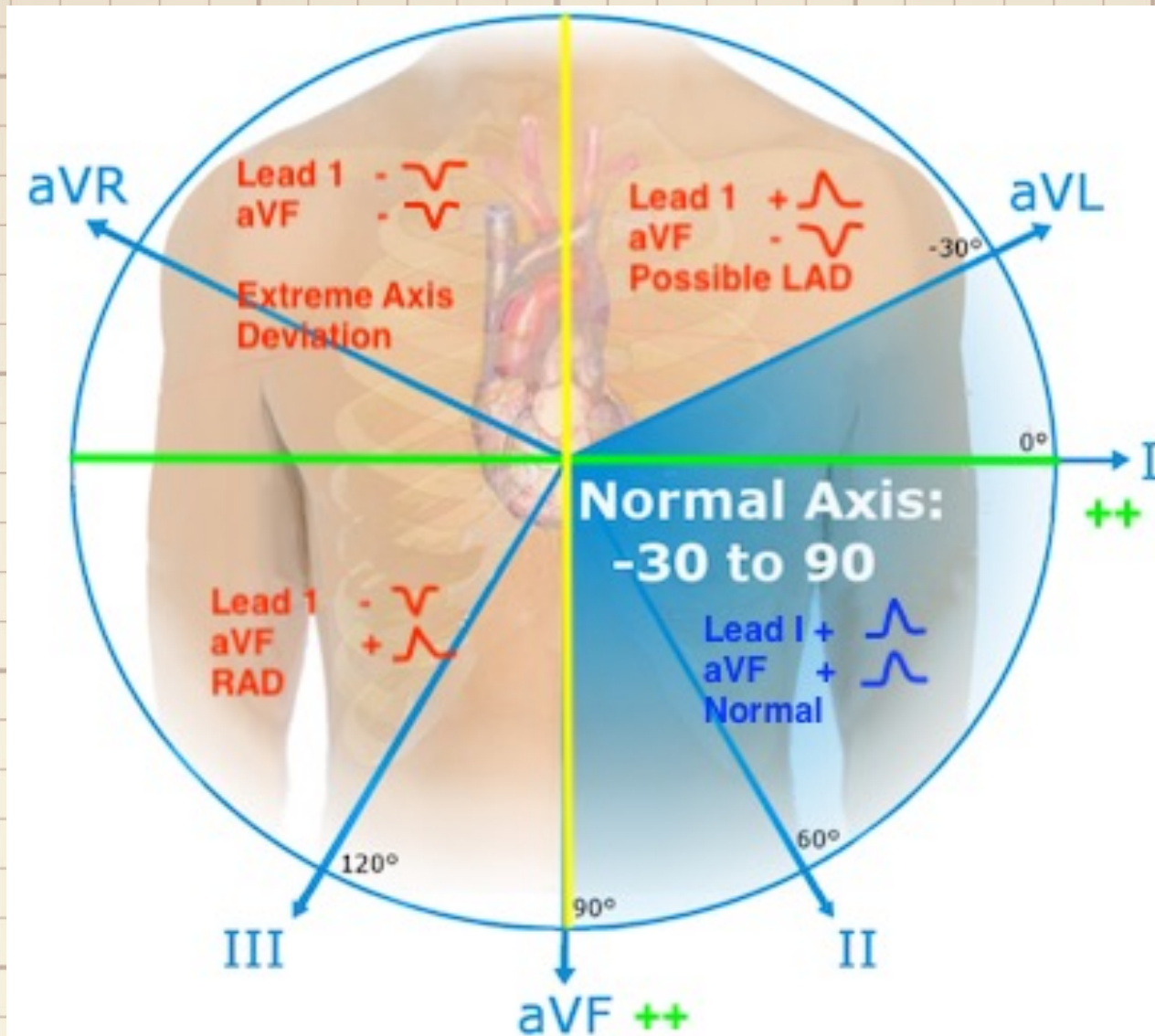
1. Rate
2. Rhythm
3. Axis
4. Hypertrophy
5. Ischemia/Infarction



RATE

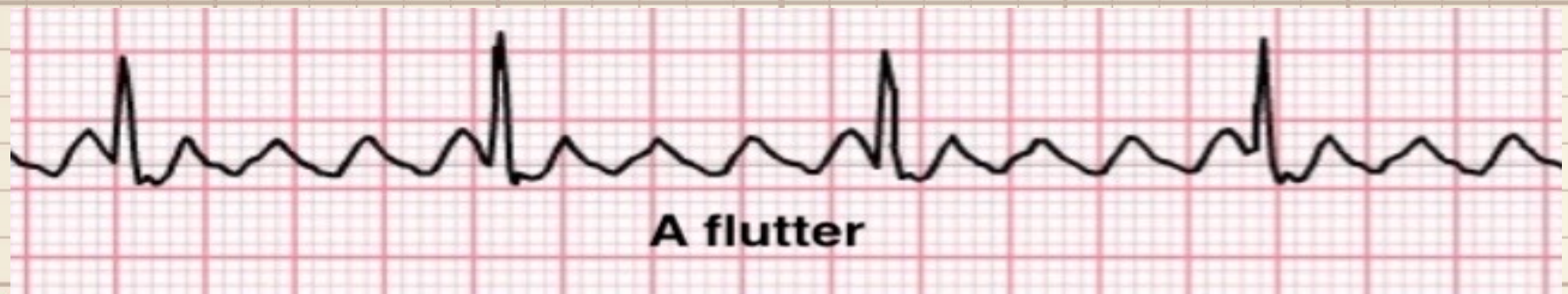
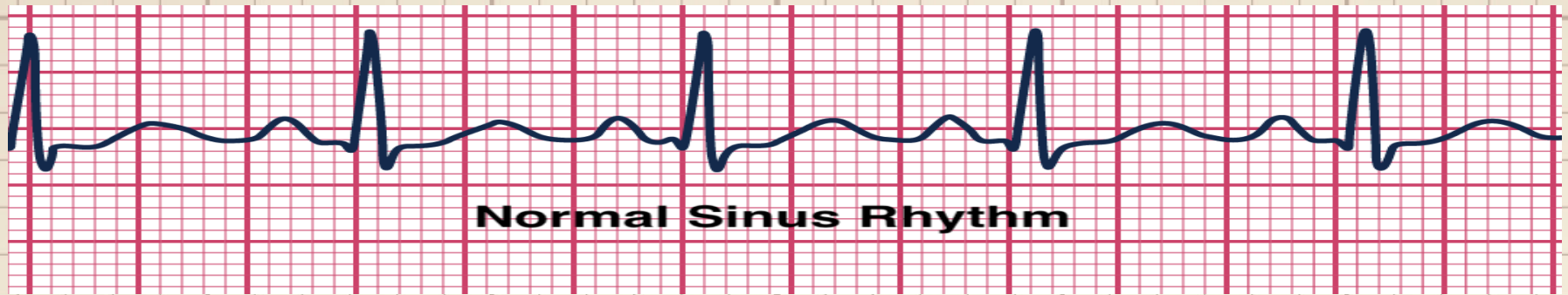


Axis

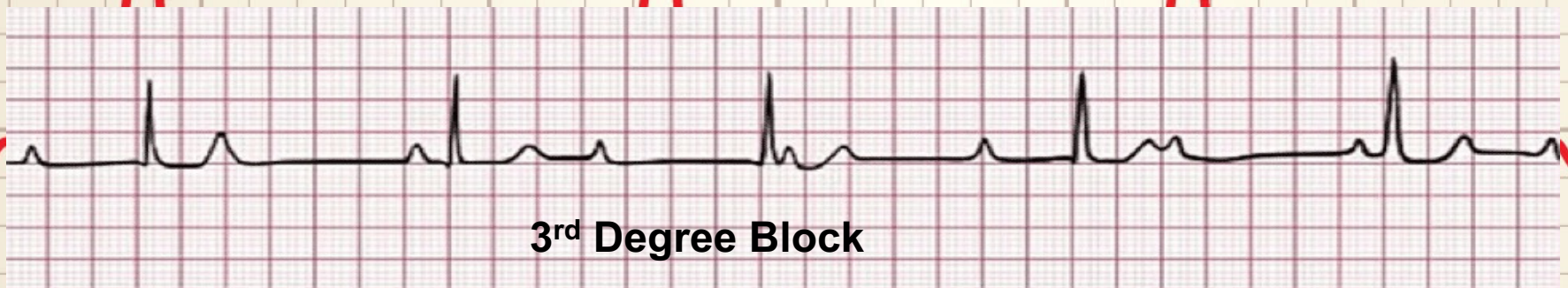
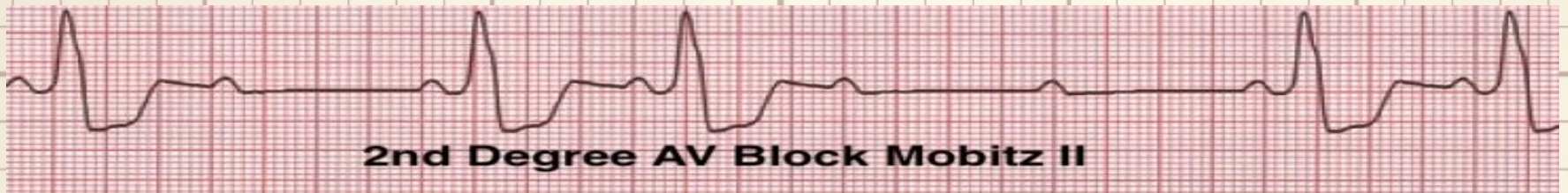
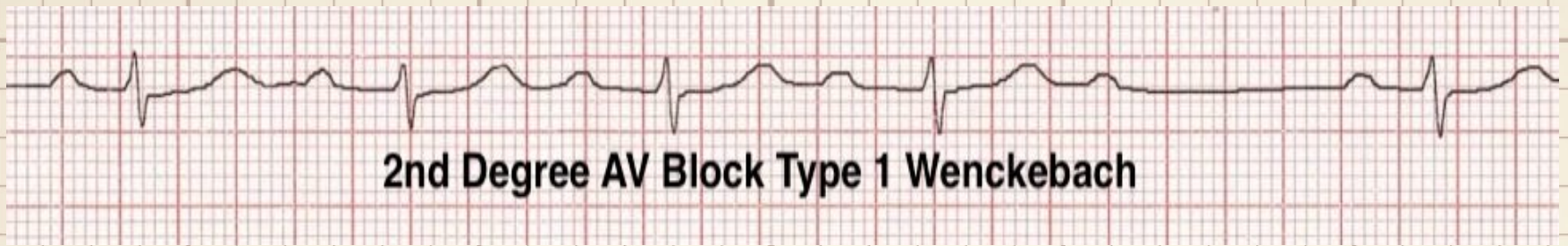
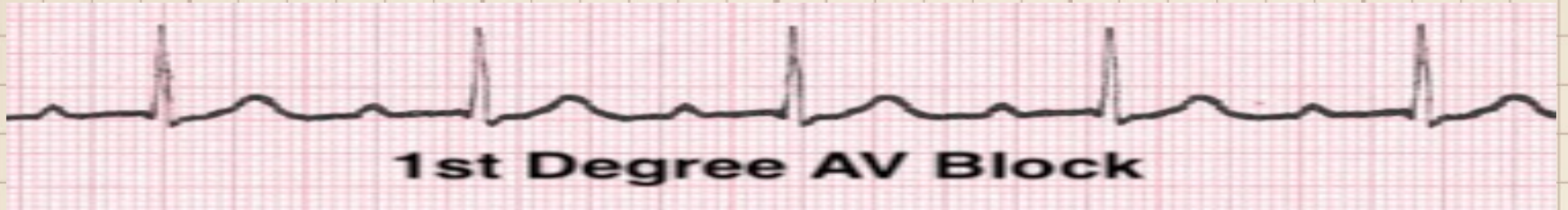


(Npatchett, 2015)

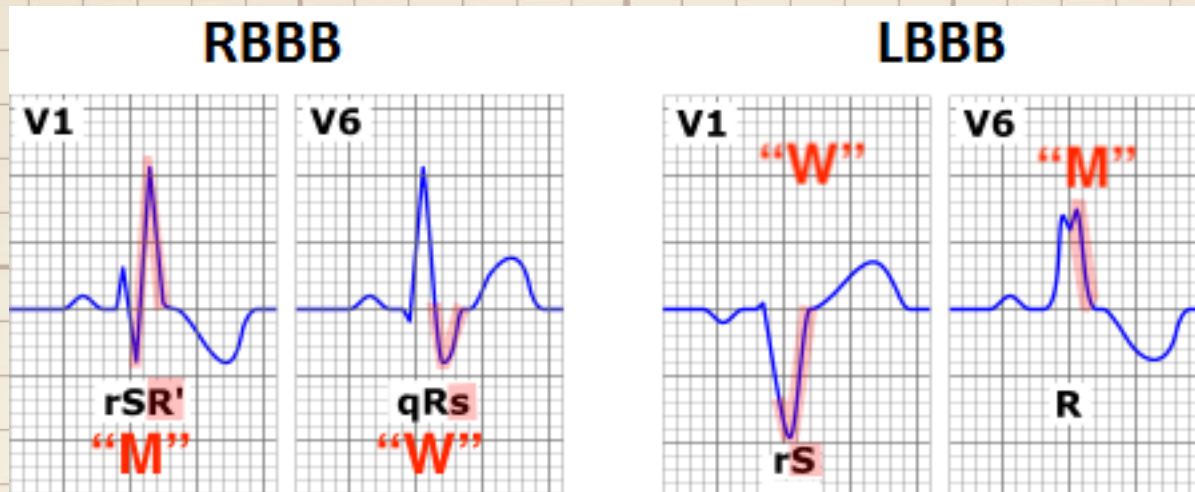
Rhythm



Blocks



Bundle Branch Blocks

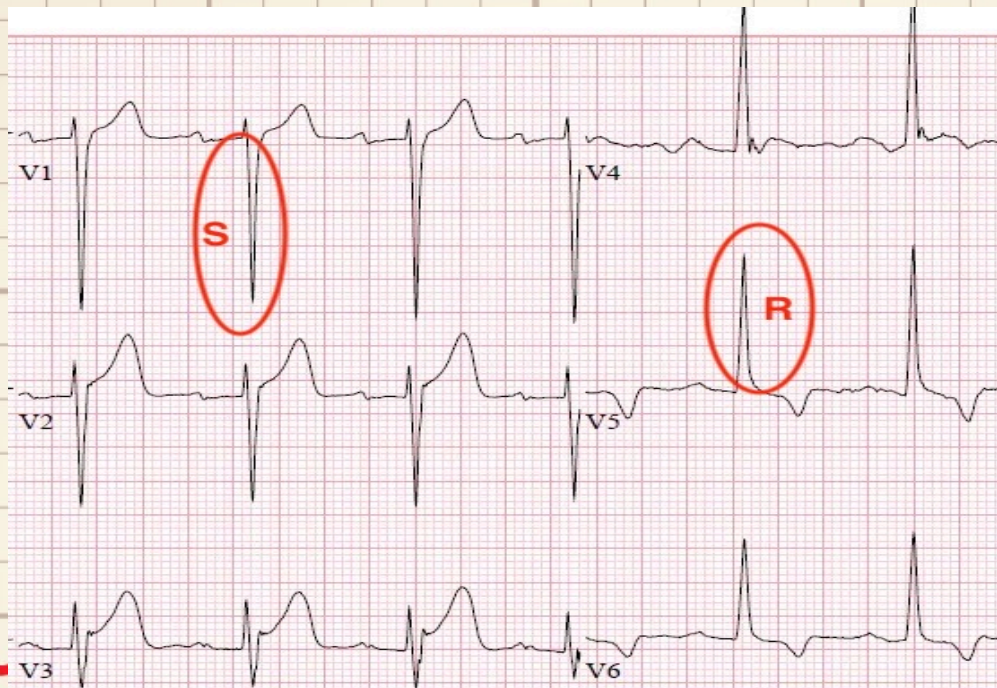


(Npatchett, 2015)

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LVH Criteria

- Most common for LVH: *Sokolov-Lyon criteria* defined as S wave depth in V1 + tallest R wave height in V5-V6 > 35 mm



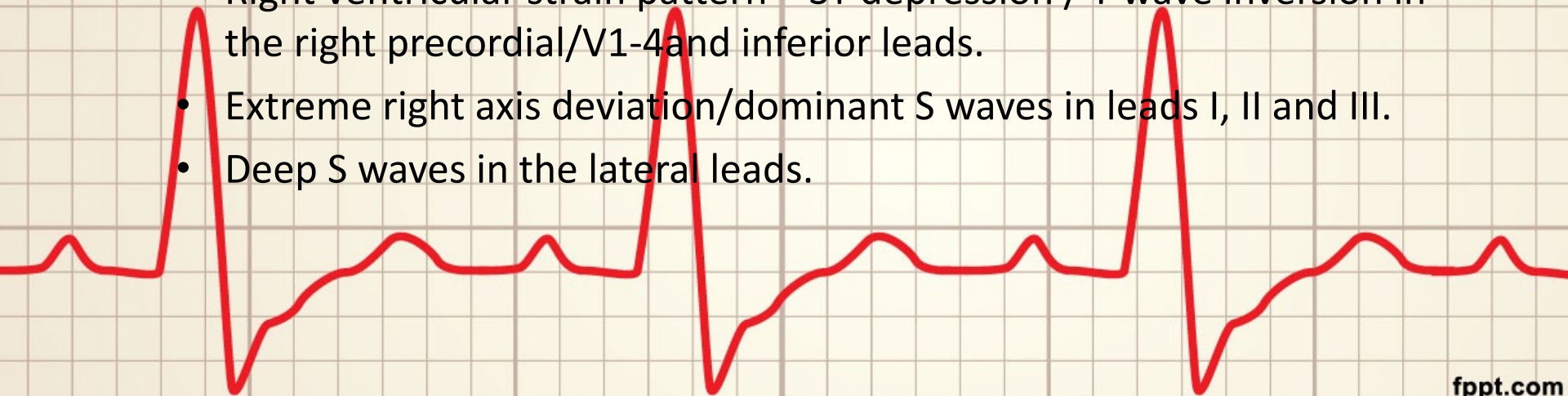
LVH Causes

- HTN
- Aortic Valve Stenosis
- Long term and intense strength and endurance training (unknown if results in stiffening of the muscle long term)
- Amyloidosis

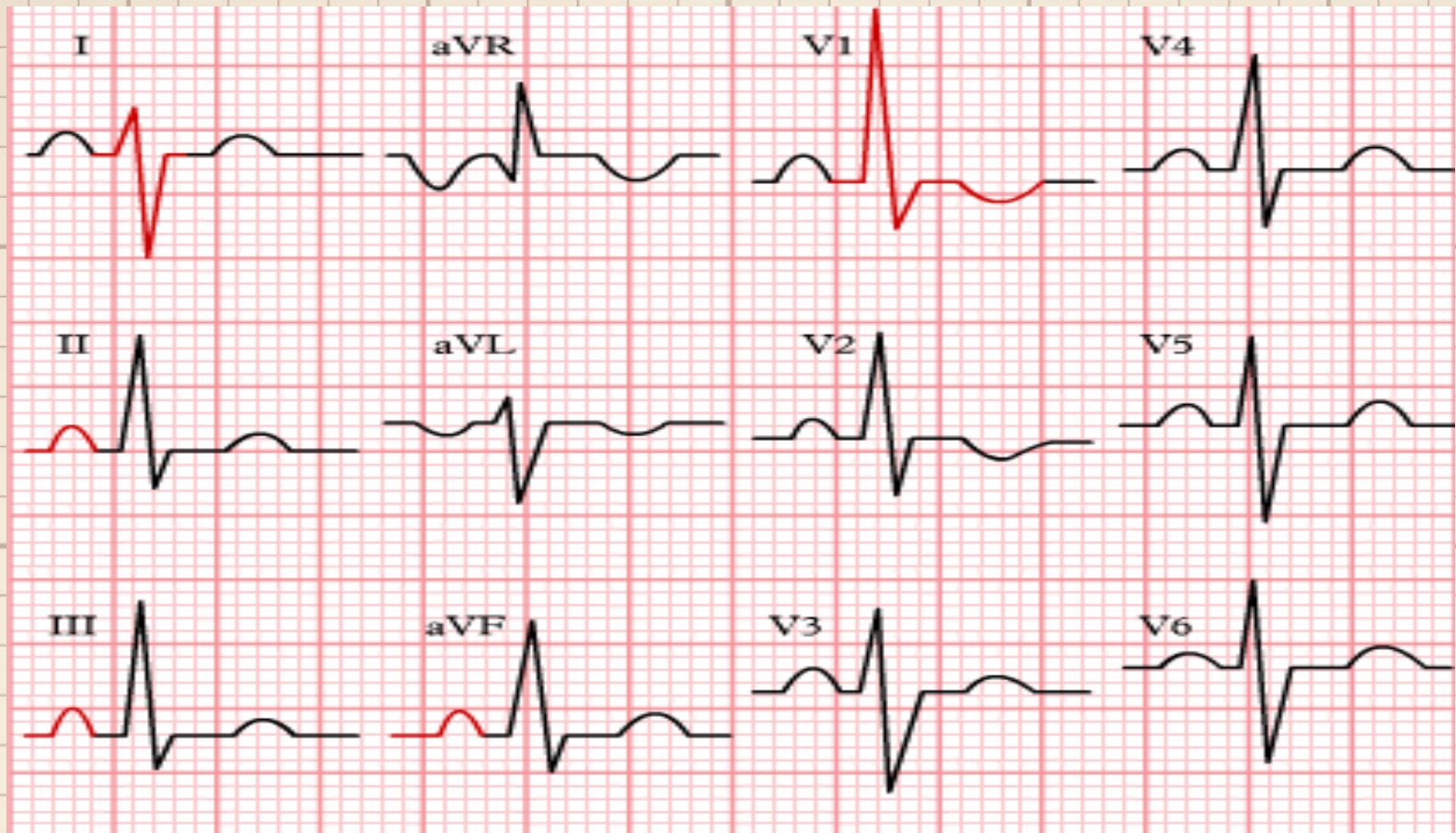


RVH Criteria

- Right axis deviation exceeding 110°
- Dominant R wave in V1, $> 7\text{mm}$.
- Dominant S wave in V5 or V6, $> 7\text{mm}$ deep.
- *QRS duration $< 120\text{ms}$, excluding RBBB.*
- Additional supportive criteria
 - REA/P pulmonale
 - Right ventricular strain pattern = ST depression / T wave inversion in the right precordial/V1-4 and inferior leads.
 - Extreme right axis deviation/dominant S waves in leads I, II and III.
 - Deep S waves in the lateral leads.



RVH



right ventricle hypertrophy

ECG PEDIA.ORG

(ECG Pedia, 2010b)

RVH Causes

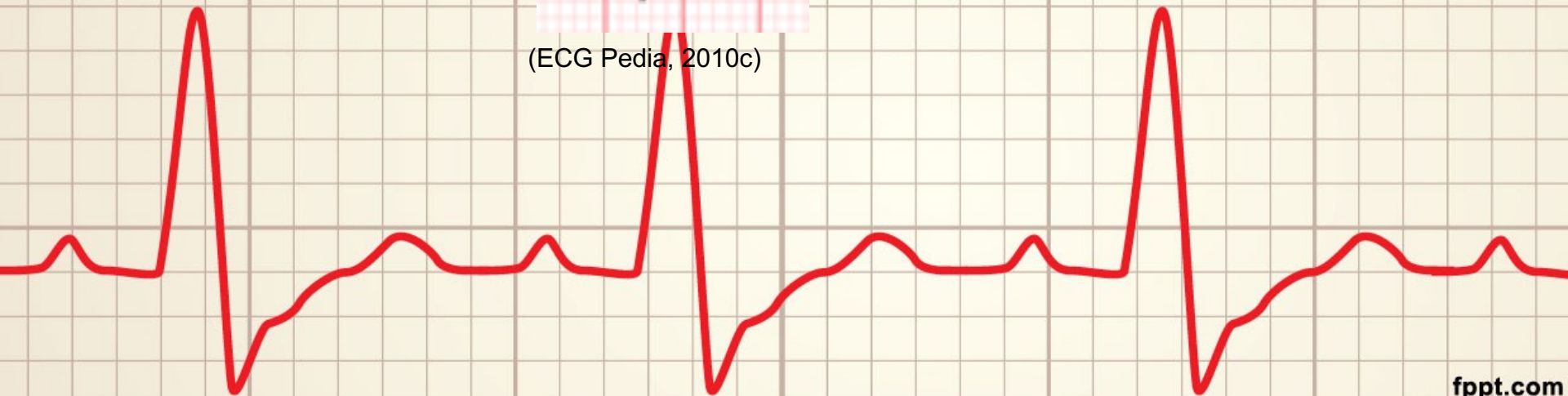
- Mitral Stenosis
- Chronic Lung Disease
 - COPD
 - Sarcoidosis
 - Pulmonary Fibrosis
- Pulmonary Emboli
- Pulmonary Hypertension
- Congenital Heart Defects

RAH

1. P wave amplitude in lead II $>$ 2.5 mm,
2. The upward deflection of the P wave in lead V1 $>$ 1.5 mm in amplitude.



(ECG Pedia, 2010c)



RAH Causes

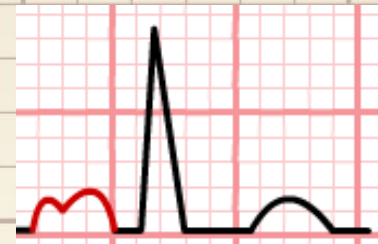
- Tricuspid Stenosis
- Chronic Lung Disease
- Congenital Heart Disease
- Primary Pulmonary HTN



LAH

- **Lead II** with a bifid P wave greater than 40 ms between the two peaks

- Total P wave duration > 110 ms



(Zorkun, 2008)

- **In V1**

- Biphasic P wave with terminal negative portion > 40 ms duration

- Biphasic P wave with terminal portion > 1mm deep



(Zorkun, 2008)

negative

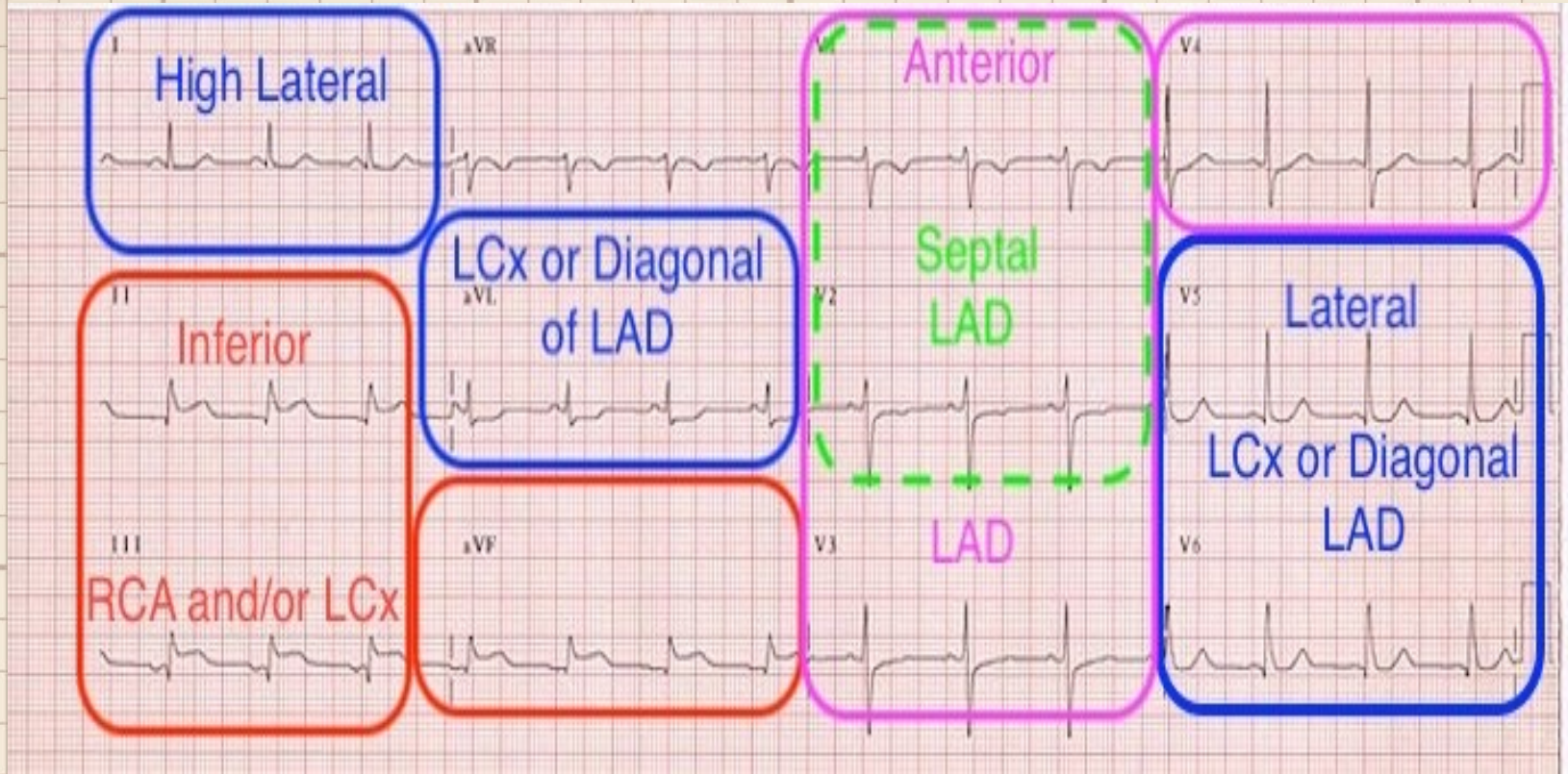


LAH Causes

- Aortic Stenosis
- HTN
- Mitral Stenosis



Coronary Anatomy & ECG Leads

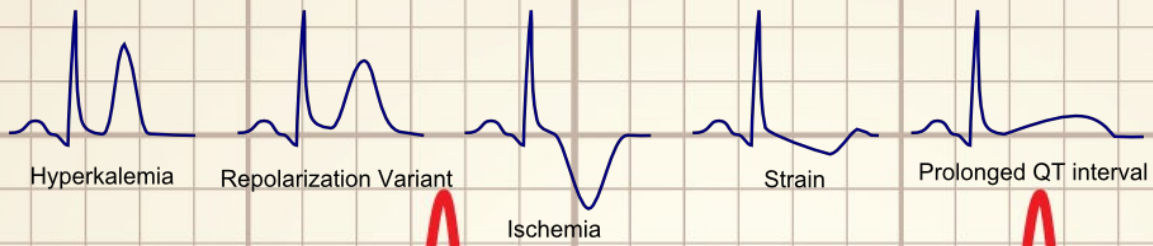
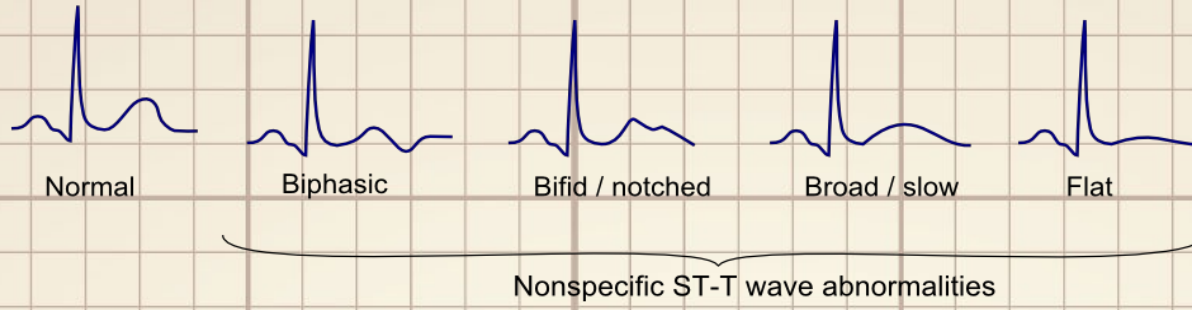


Ischemia

- ST depression – horizontal or downsloping > 0.5 mm in two contiguous leads.
 - > 1 mm is more specific
- T wave flattening or inversion



T wave morphology

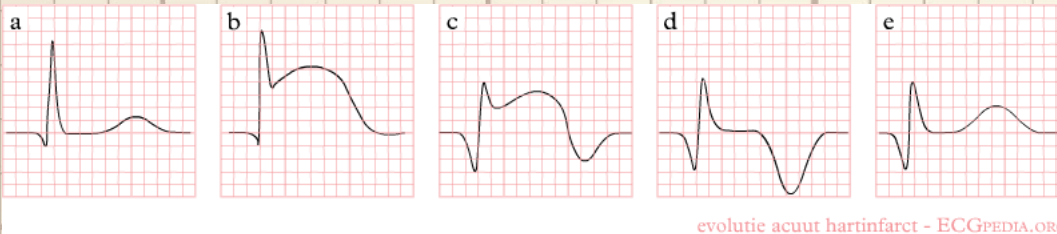


(ECG Pedia, 2010c)

ECG PEDIA.ORG
part of cardiacnettech.org

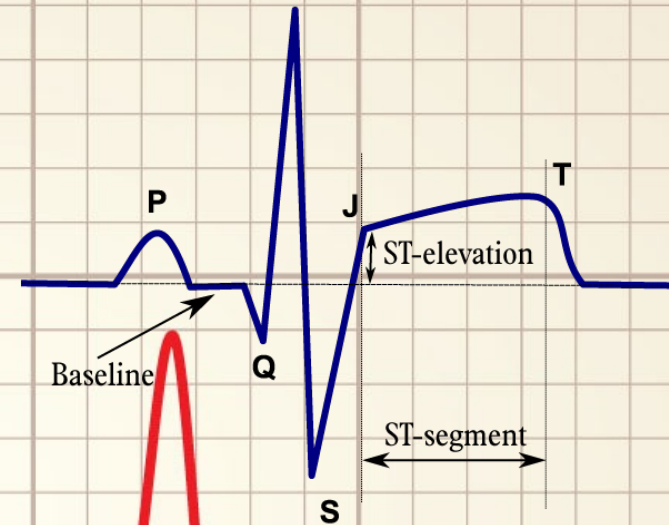
Infarction

- New ST elevation in 2 contiguous leads > 0.1 mV in all leads except V2 or V3
- Leads V2-V3 requires >0.2 mV in men 40 yo or more and >0.25 in men <40 yo , or >0.15 mV in women



Evolution of AMI

(ECG Pedia, 2010a)



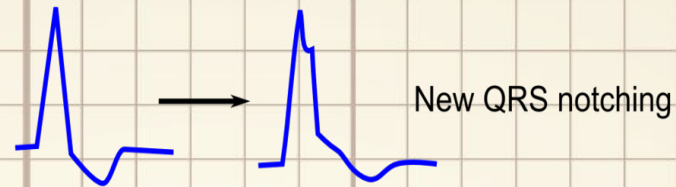
How to measure ST elevation?

(ECG Pedia, 2010a)

Infarction LBBB

- Sgarbossa's criteria for LBBB

- ST elevation of ≥ 1 mm that is in the same direction as the QRS
- ST depression of ≥ 1 mm in leads V1, V2, or V3
- ST ≥ 5 mm in the opposite direction the QRS



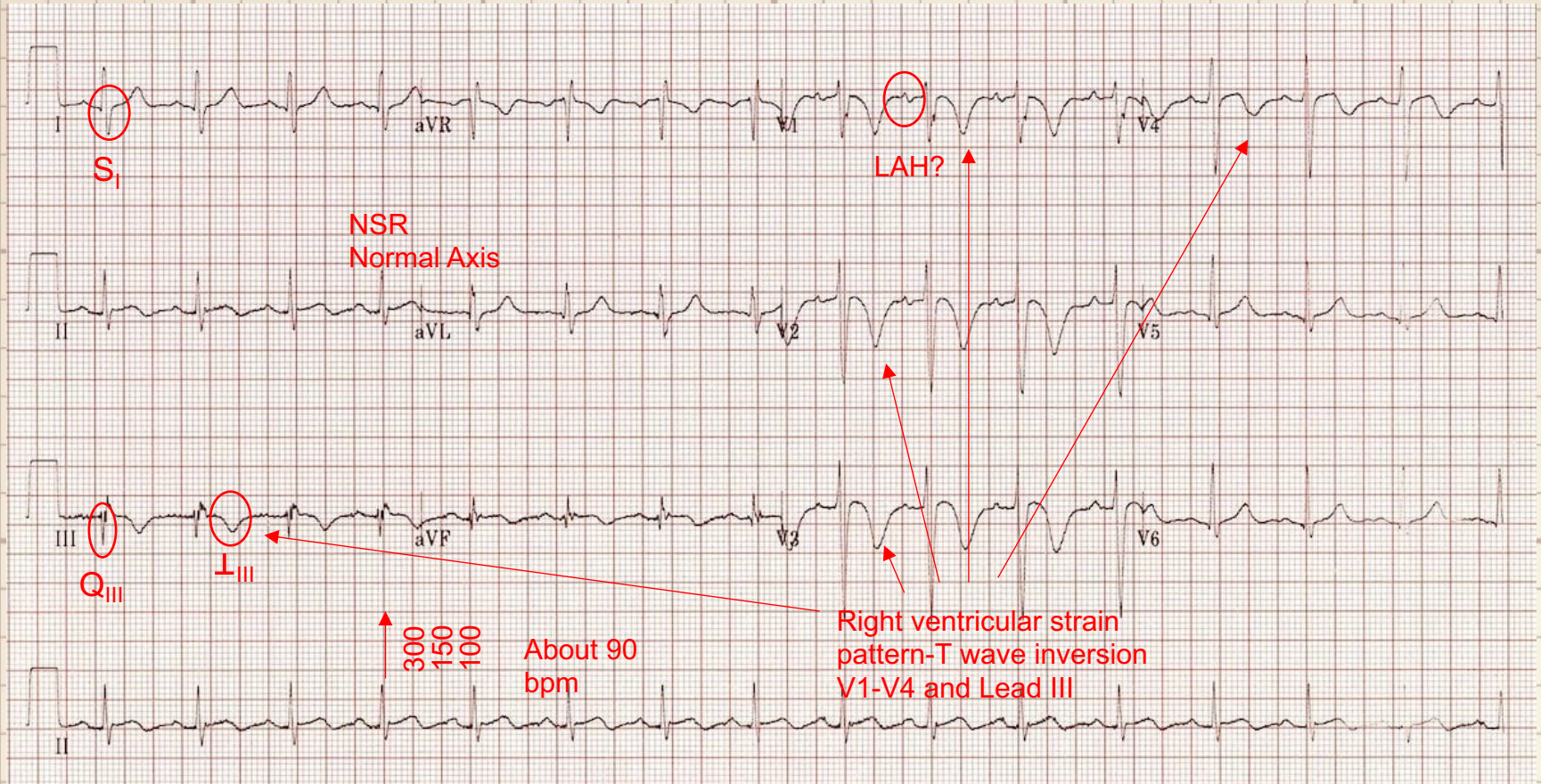
(ECG Pedia, 2009)





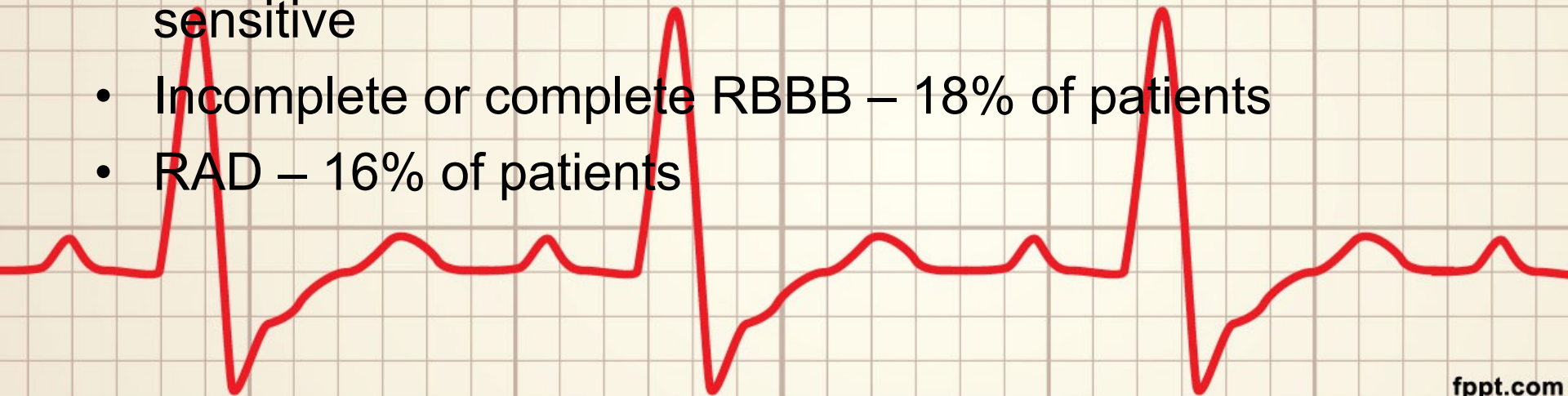


Case #1



Pulmonary Embolism

- Sinus Tachycardia – most FREQUENT sign, 44%
- [Right ventricular strain pattern](#) – T wave inversions within right precordial leads ± the inferior leads. Occurring in 34% of PE's high pulmonary artery pressures.
- $S_I Q_{III} T_{III}$ deep S wave in lead I, Q wave in III, inverted T wave in lead III. Occurs in 20% of PE's, nonspecific nor sensitive
- Incomplete or complete RBBB – 18% of patients
- RAD – 16% of patients

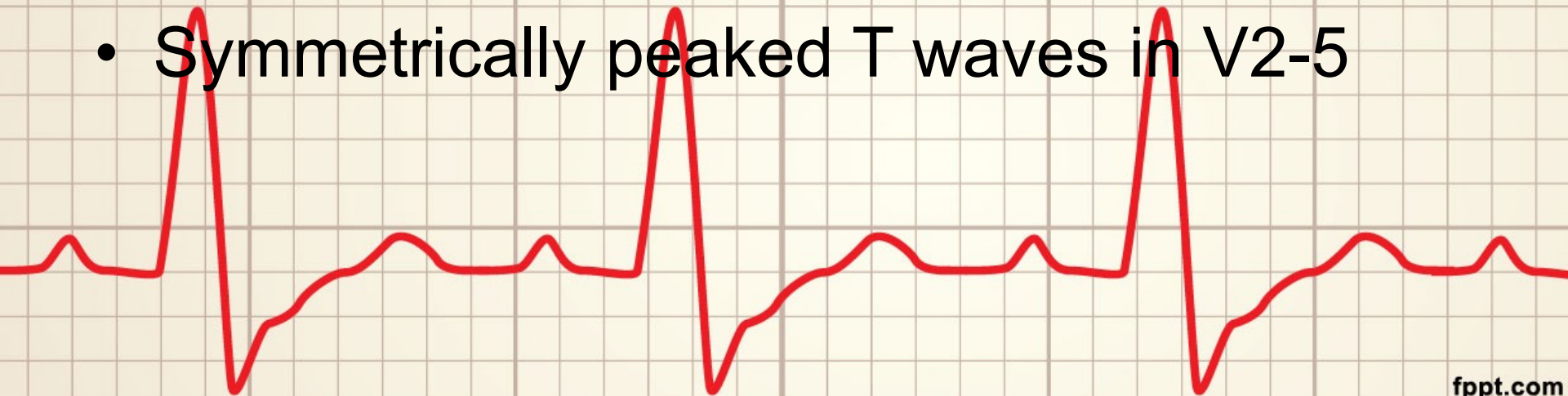


Pulmonary Embolism

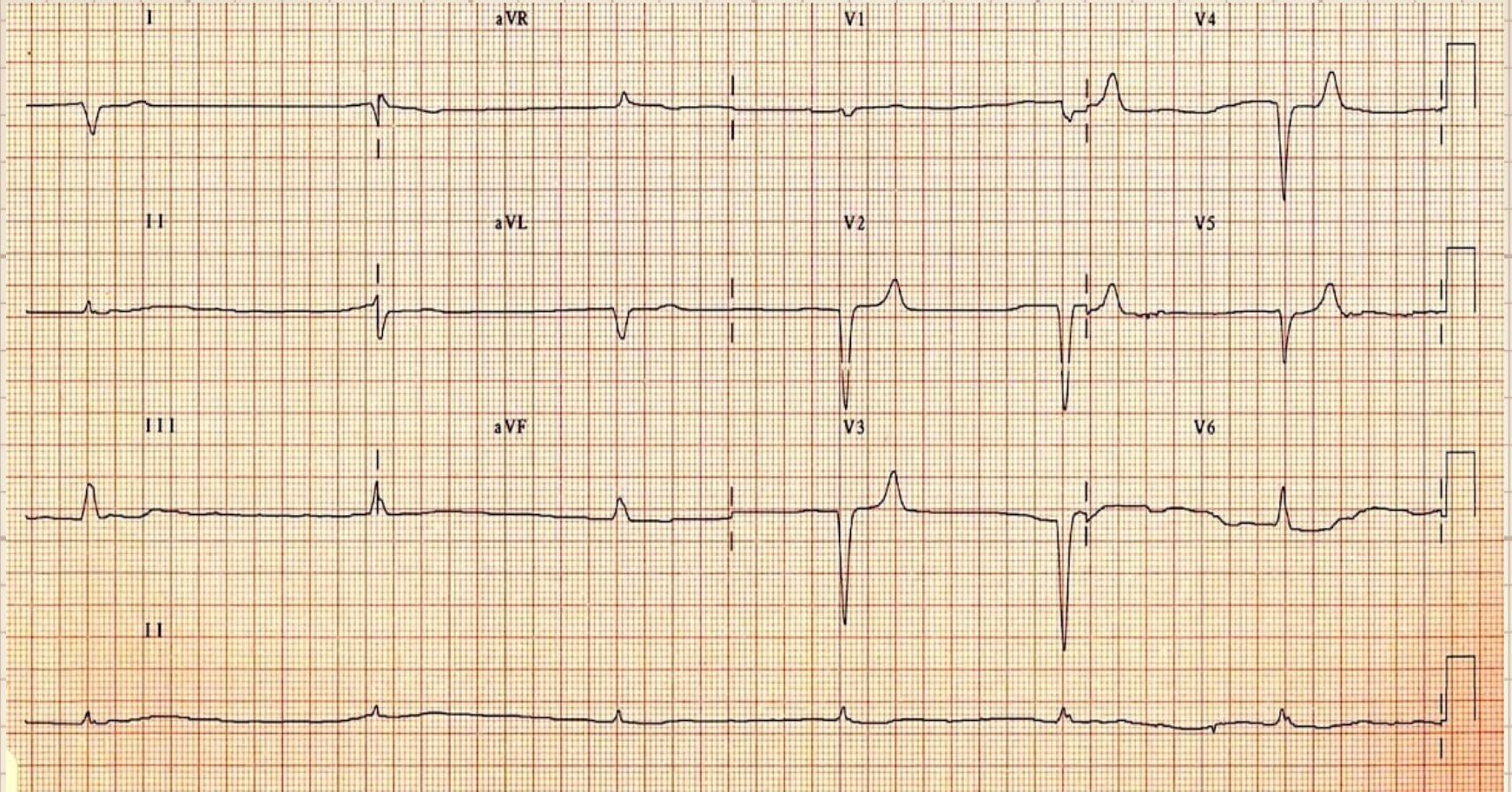
- Dominant R wave in V1 – representative of acute right ventricular enlargement
- Right atrial enlargement (P pulmonale) – tall P wave > 2.5 mm in height in lead (9% of patients)
- Clockwise rotation – shift of the R/S transition point towards V6 with a persistent S wave in V6 (“pulmonary disease pattern”), implying rotation of the heart due to right ventricular dilatation.
- Atrial tachyarrhythmias – AF, flutter, atrial tachycardia. Seen in 8% of patients.
- Non-specific ST segment and T wave changes, including ST elevation and depression. Reported in up to 50% of patients with PE.

Hyperkalemia

- Marked bradycardia (HR ~ 30 bpm)
- Wide QRS complexes (~120 ms)
- Flat, broad and almost imperceptible P waves (somewhat visible in V1-3)
- Prolongated PR interval
- Symmetrically peaked T waves in V2-5

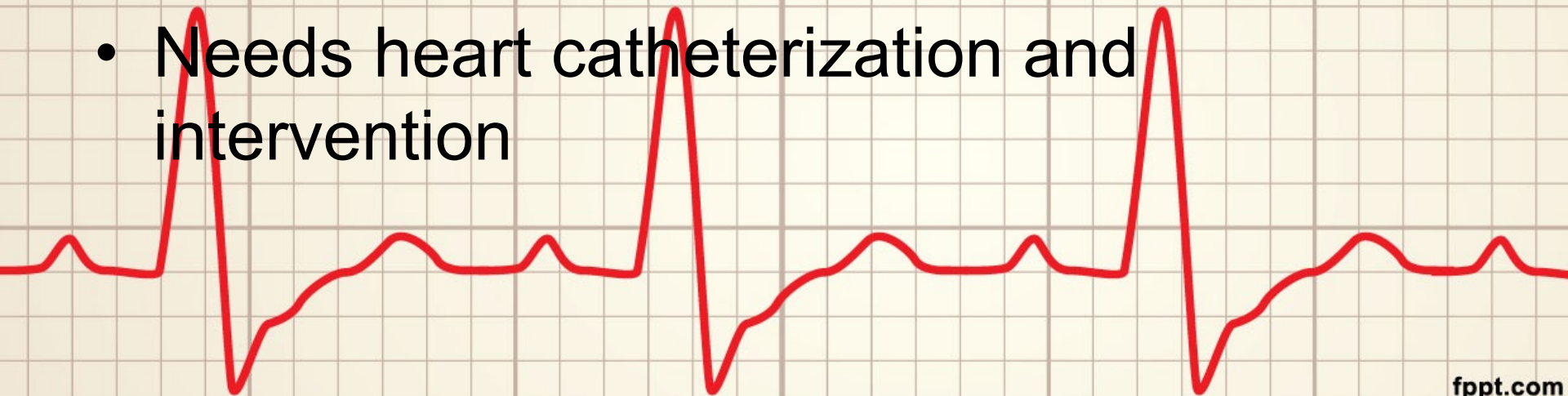


Hyperkalemia



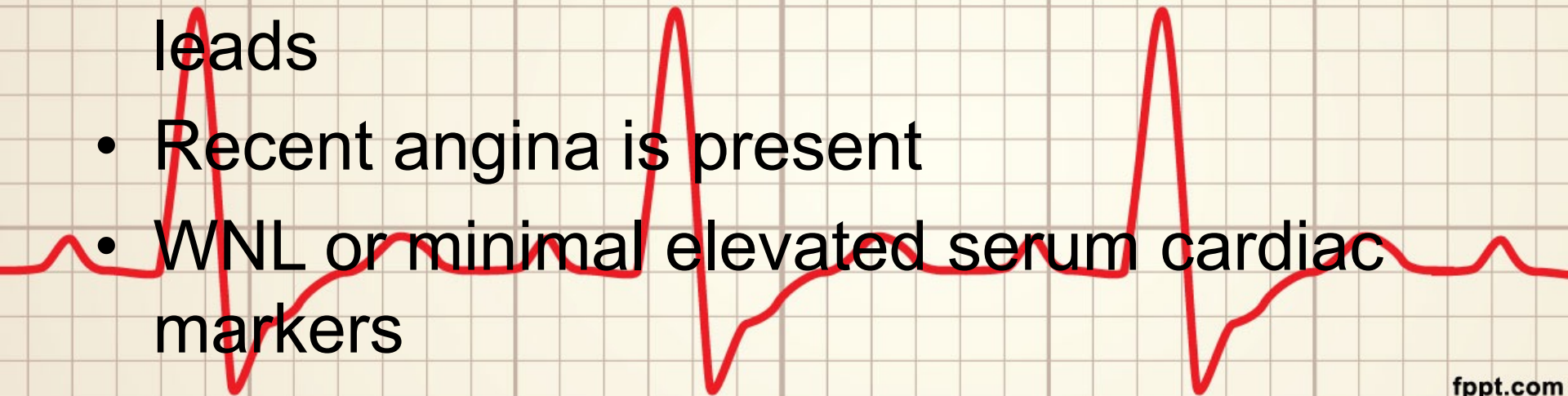
Wellen's Syndrome

- Very specific for severe LAD stenosis
- Pt's often are pain free by presentation
- Minimal CE elevations
- Look for this prior to stress testing (can cause a MI or cardiac arrest)
- Needs heart catheterization and intervention



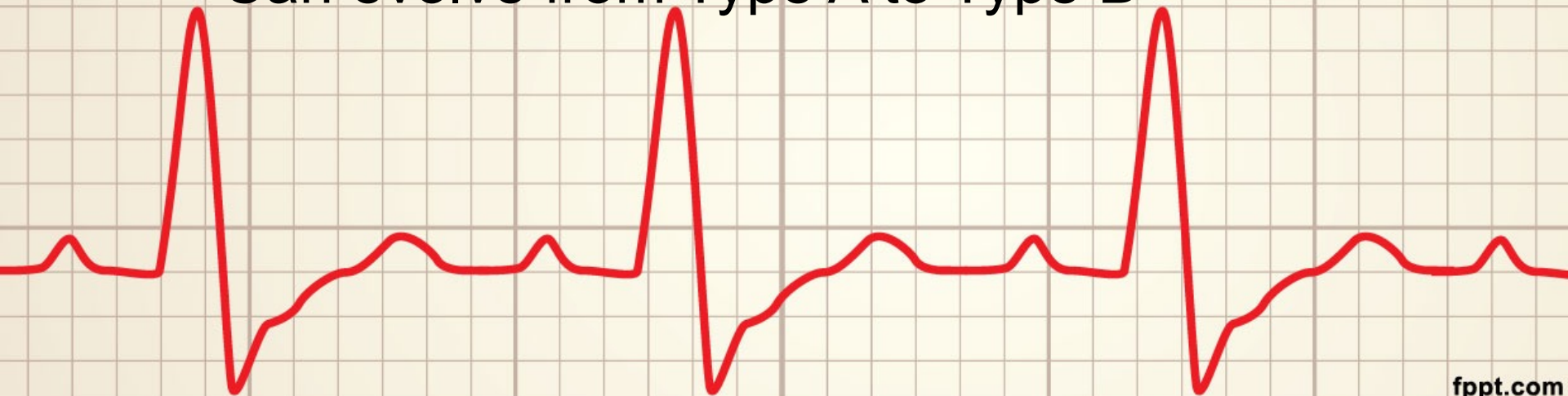
Wellen's Syndrome Criteria

- Deep-inverted or biphasic T waves in V2-3, can extend to V1-6
- Equivocal or slightly-elevated ST segment (< 1mm)
- Q waves not present in precordial leads
- R wave progression remains in precordial leads
- Recent angina is present
- WNL or minimal elevated serum cardiac markers

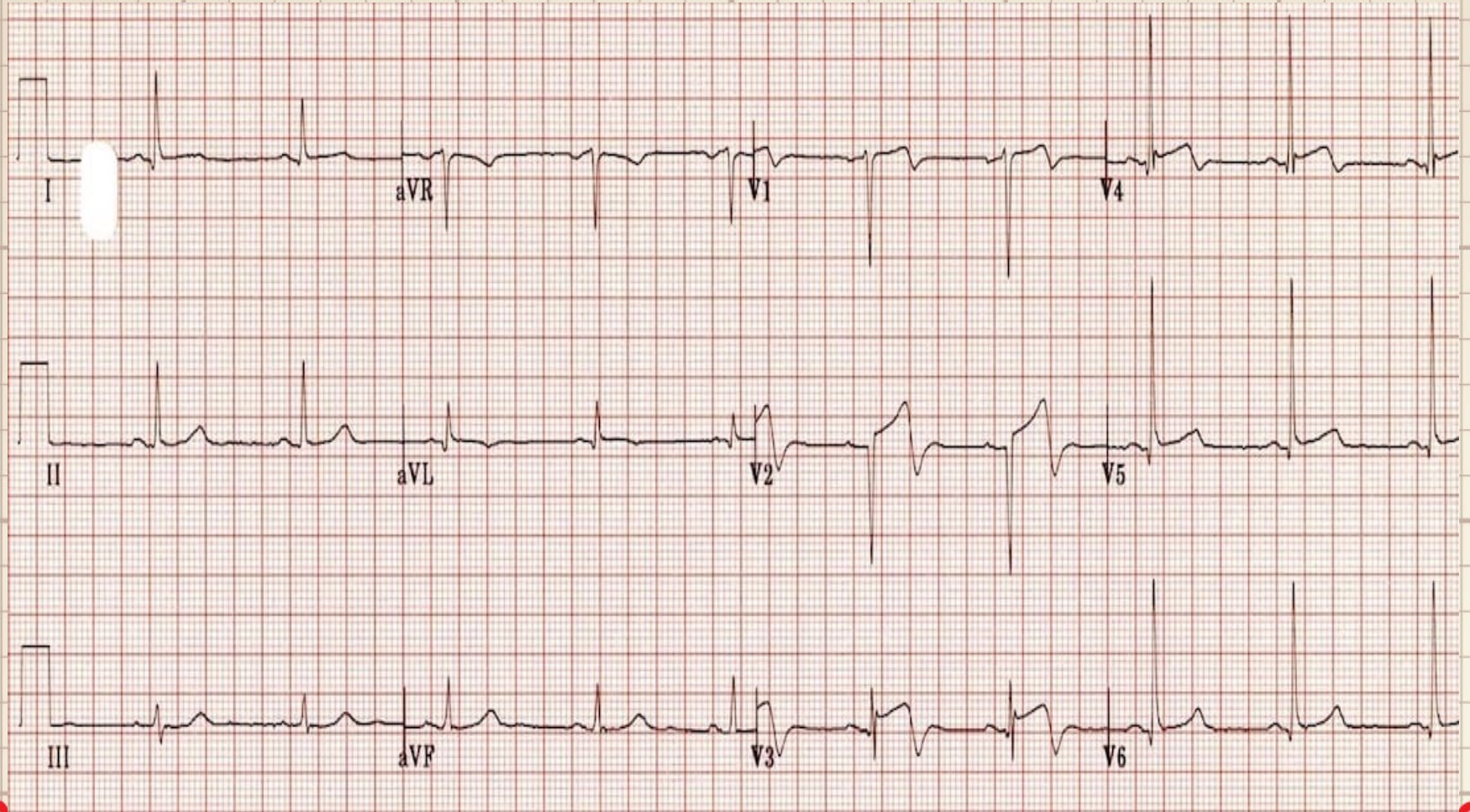


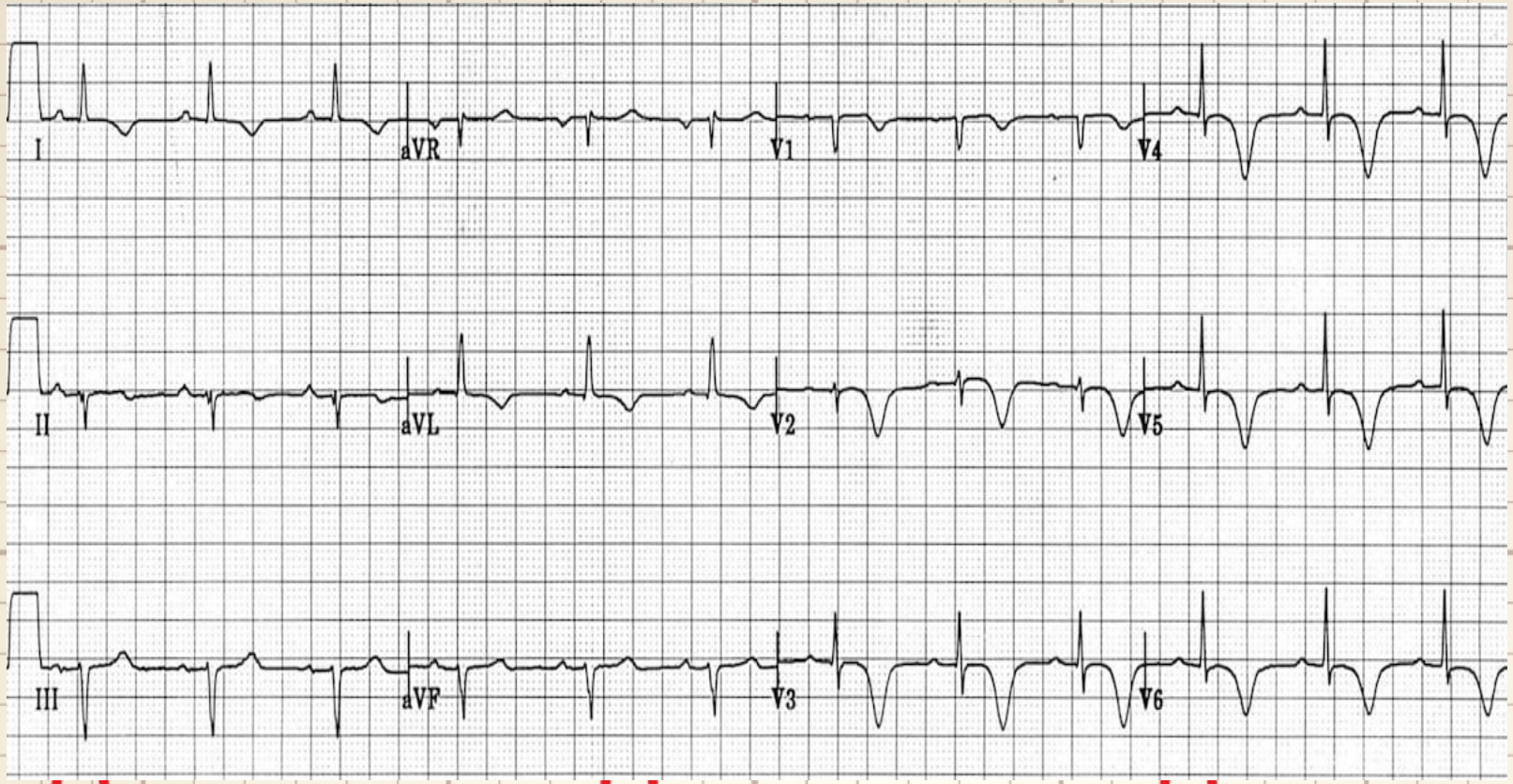
Wellen's Syndrome

- Two Types of T-wave abnormalities
 - Type A is a biphasic T-wave, starts positive and ends negative (25%)
 - Type B is a deep symmetrical inversion of the T-wave (75%)
 - Can evolve from Type A to Type B



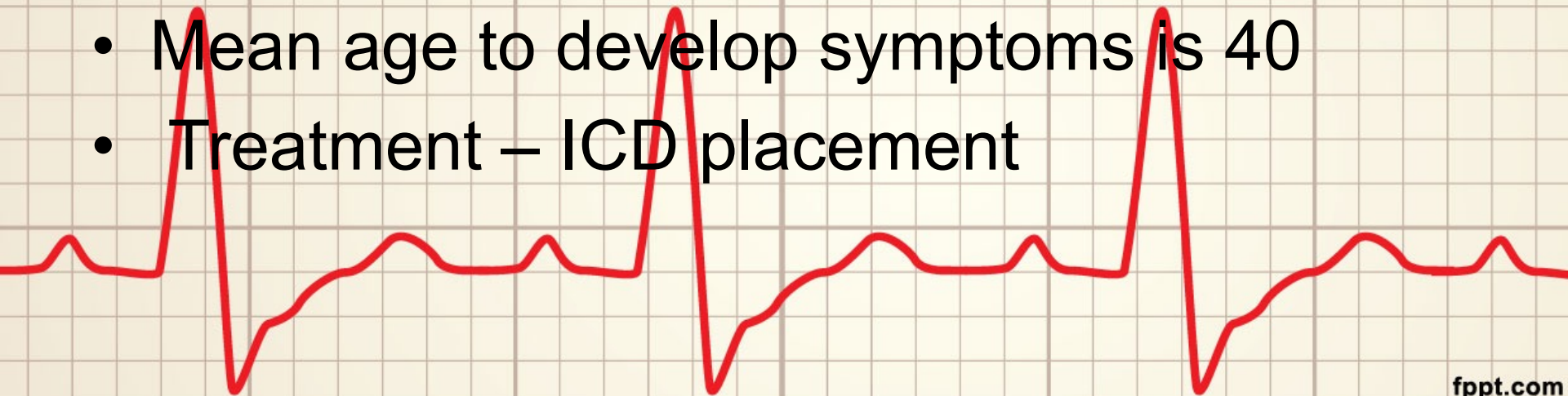
Wellen's Type A





Brugada Syndrome

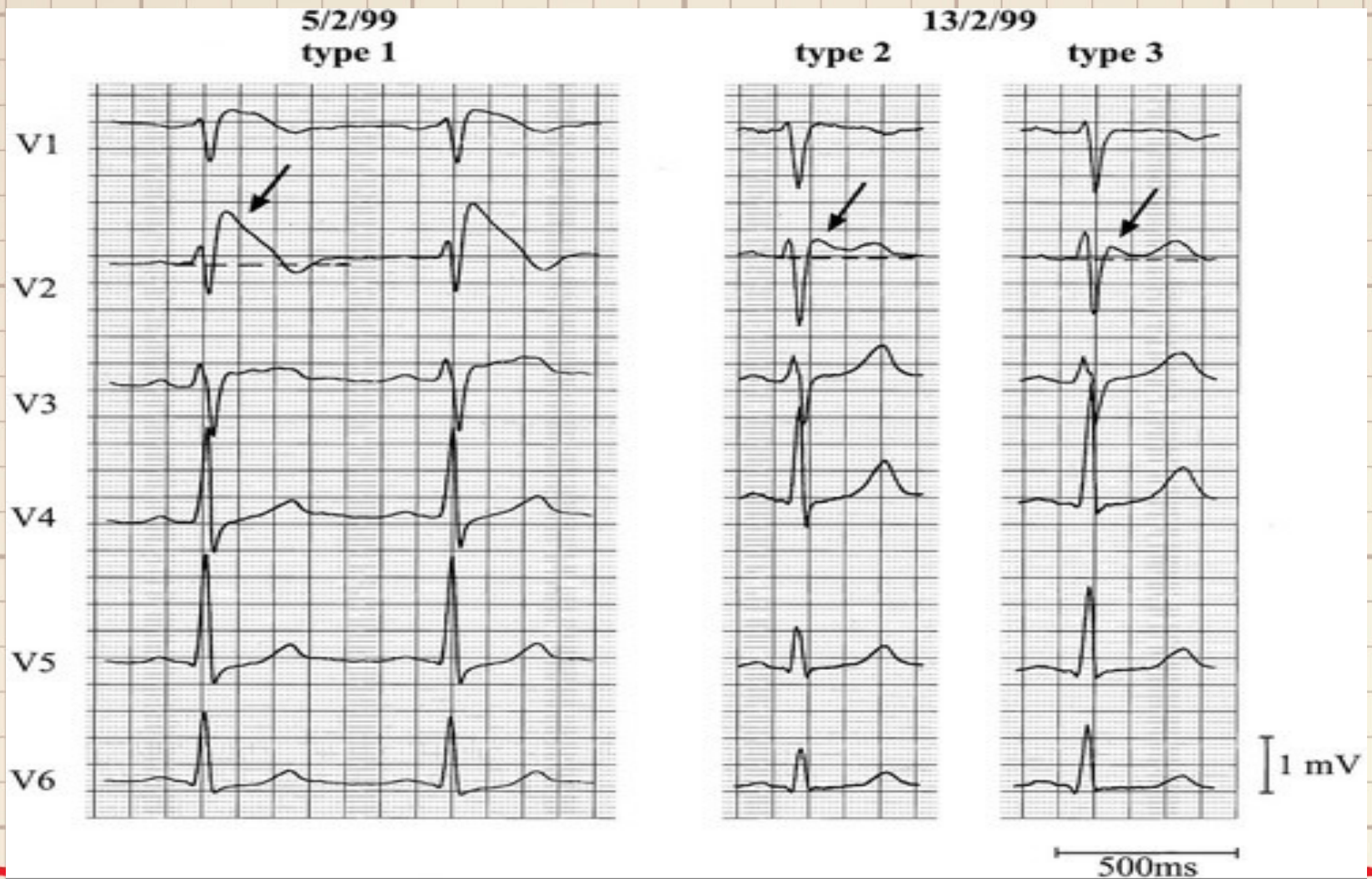
- Genetic autosomal dominant inheritance, *SCN5A* (50% chance in offspring)
- Irregular ventricular heart rhythm that can result in sudden cardiac death
- Syncope, unexplained SHOB, sudden cardiac death
- Mean age to develop symptoms is 40
- Treatment – ICD placement



Brugada Syndrome

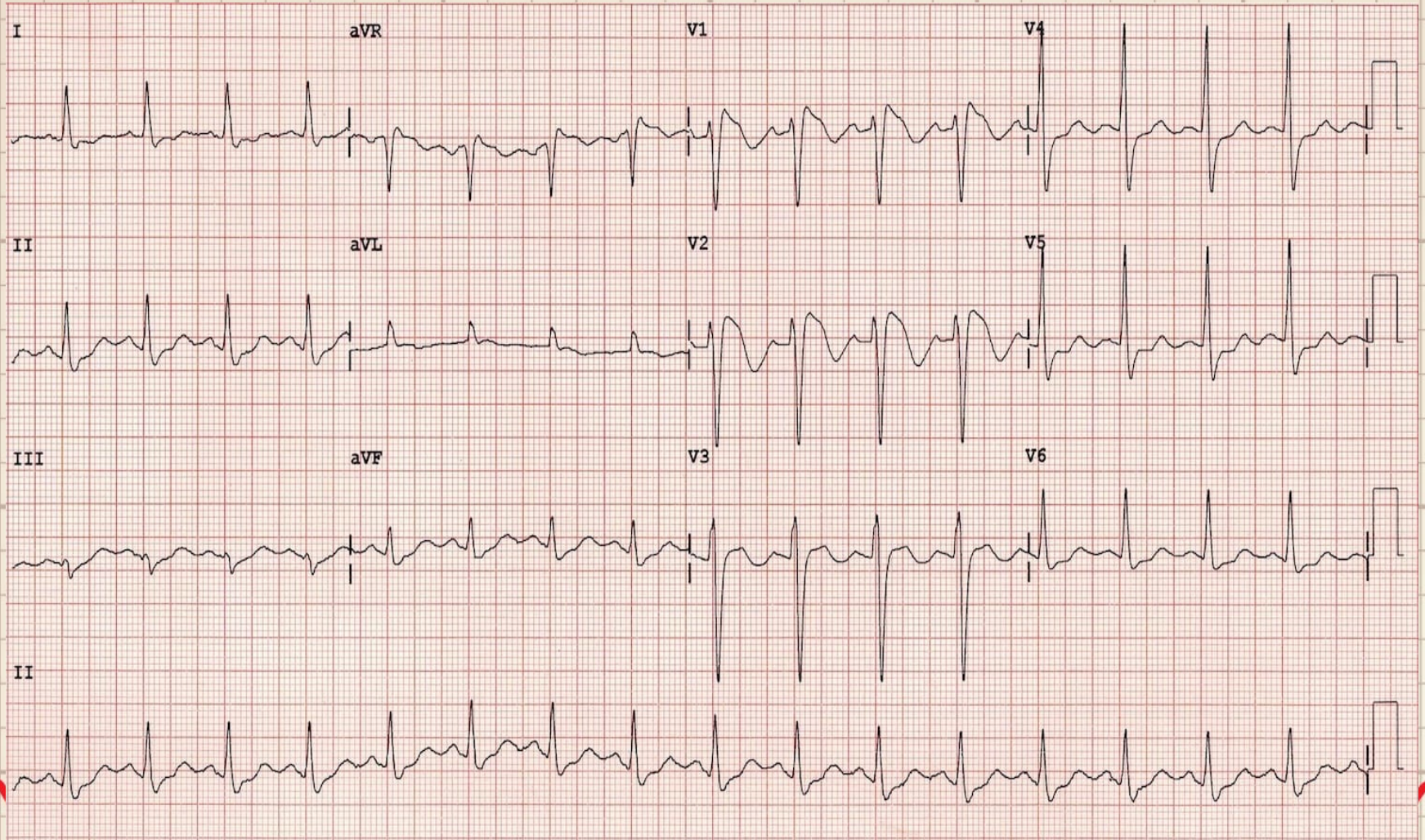
- Type 1- Coved ST elevation $>2\text{mm}$ in >1 of V1-V3 followed by a negative T wave
- Type 2 - "Saddle back" ST-T wave configuration (Type 2 and 3 combined)
 - + one of the following
- FH of sudden cardiac death at <45 yrs old
- FH Coved-type ECGs in family members
- Hx of syncope
- Hx of VF
- Agonal respiration while sleeping.

Brugada Syndrome

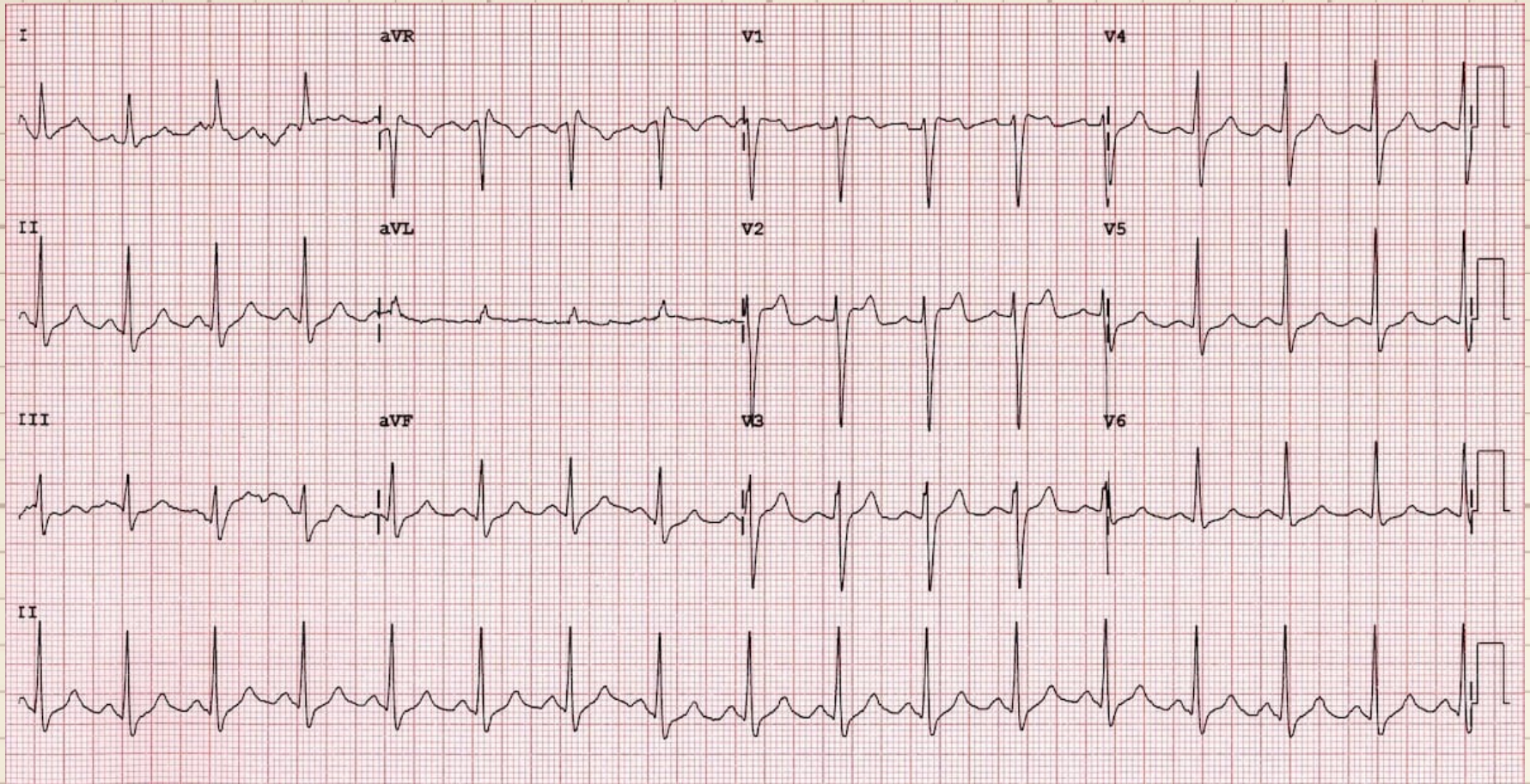


Arthur A.M. Wilde. Circulation. Proposed Diagnostic Criteria for the Brugada Syndrome, Volume: 106, Issue: 19, Pages: 2514-2519, DOI: (10.1161/01.CIR.0000034169.45752.4A)

Brugada Type 1

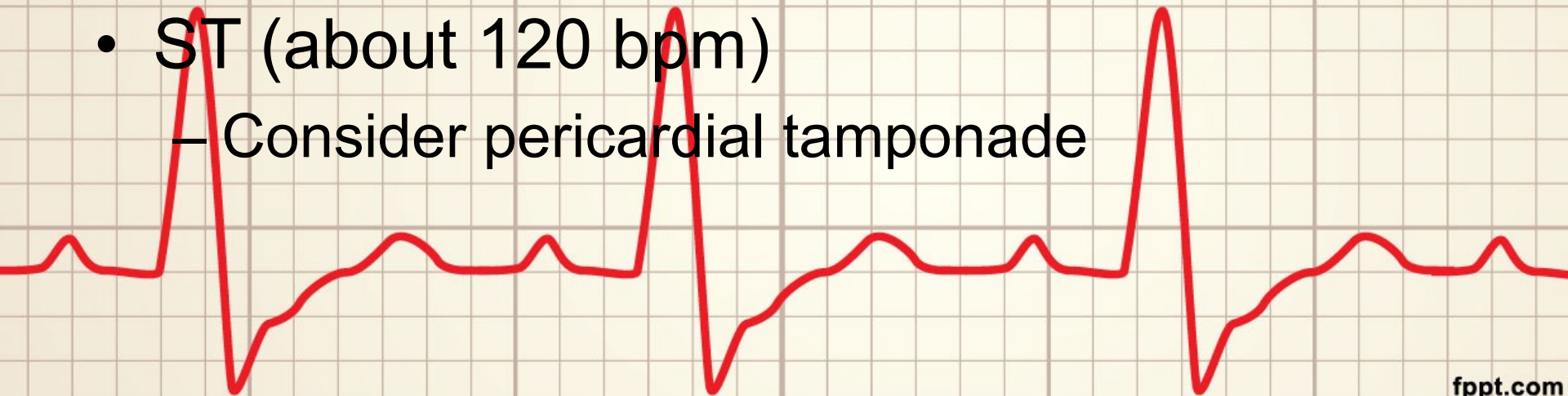


Brugada Type 2



Electrical Alternans

- Likely large pericardial effusion
- Alternating tall/short QRS complexes
- QRS complex voltages are decreased
 - Less than 5mm in limb leads
 - Less than 10mm in the precordial leads
- ST (about 120 bpm)
 - Consider pericardial tamponade

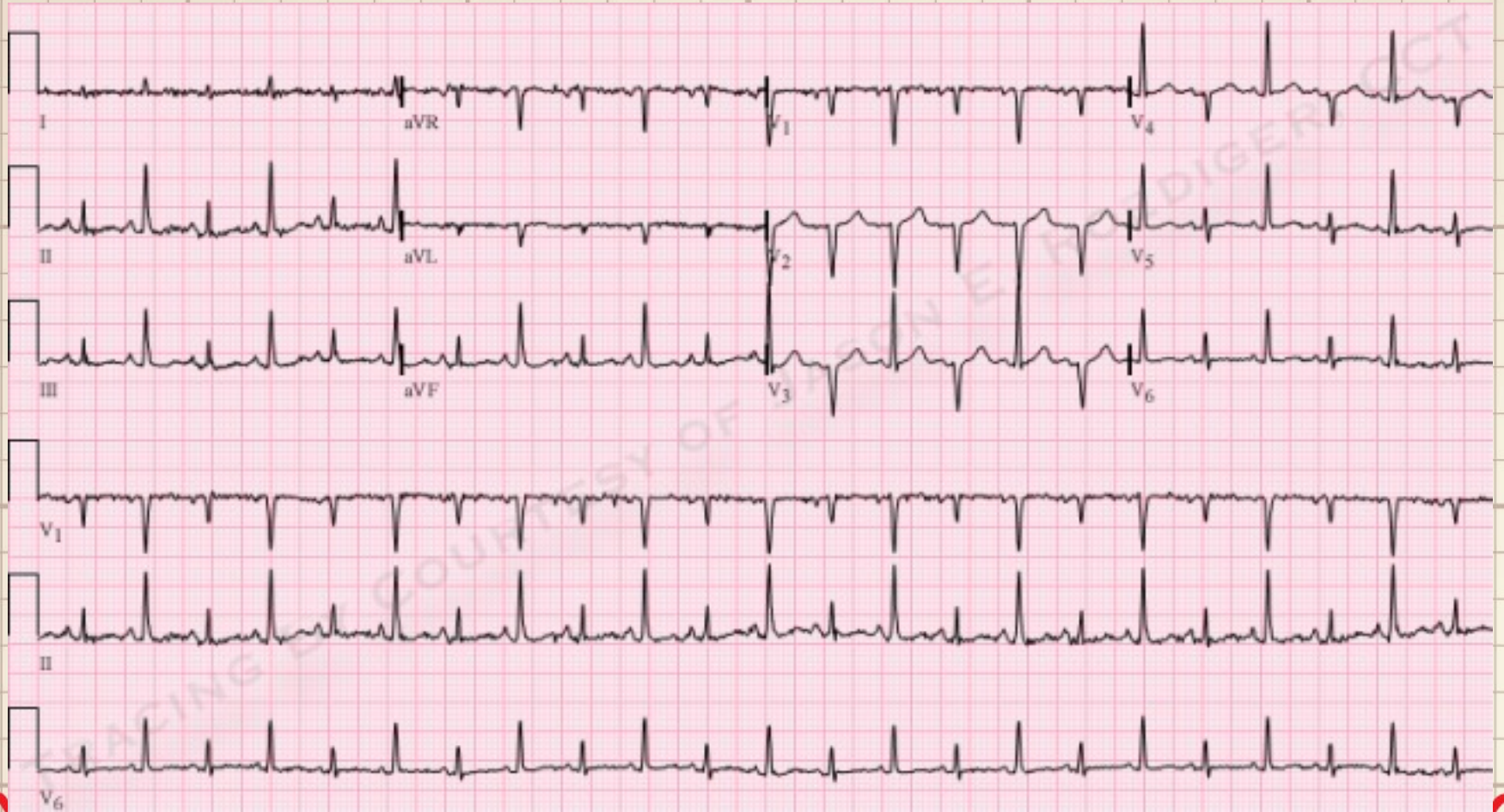


Electrical Alternans

- Bedside echo
- Inotropes
- Emergency pericardiocentesis

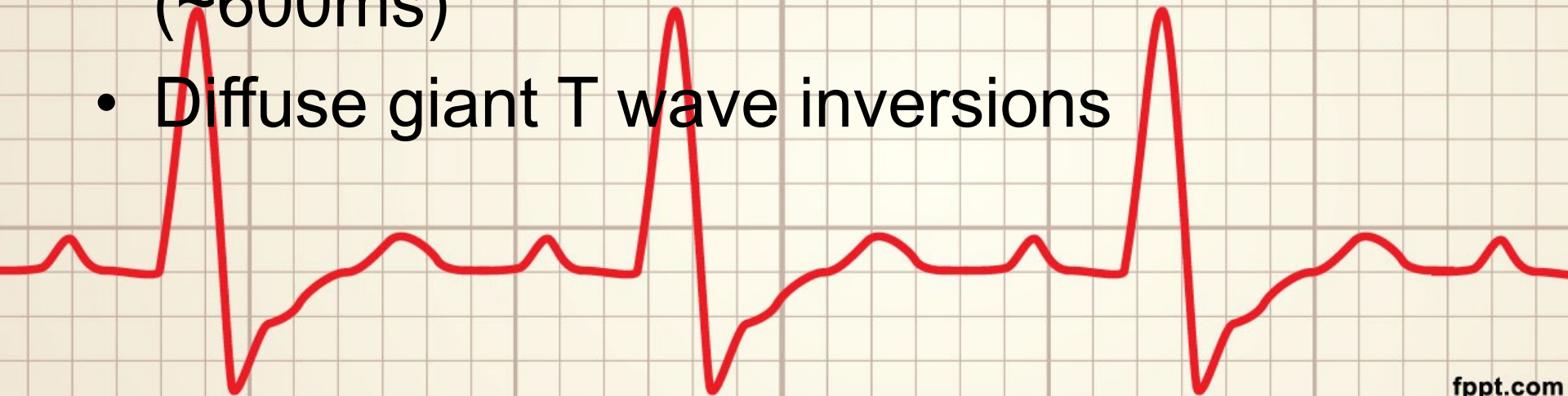


Electrical Alternans



Increased ICP

- Hemorrhagic Stroke, spontaneous subarachnoid hemorrhage, TBI, large ischemic stroke resulting in cerebral edema
- Significantly increase in QT interval (~600ms)
- Diffuse giant T wave inversions

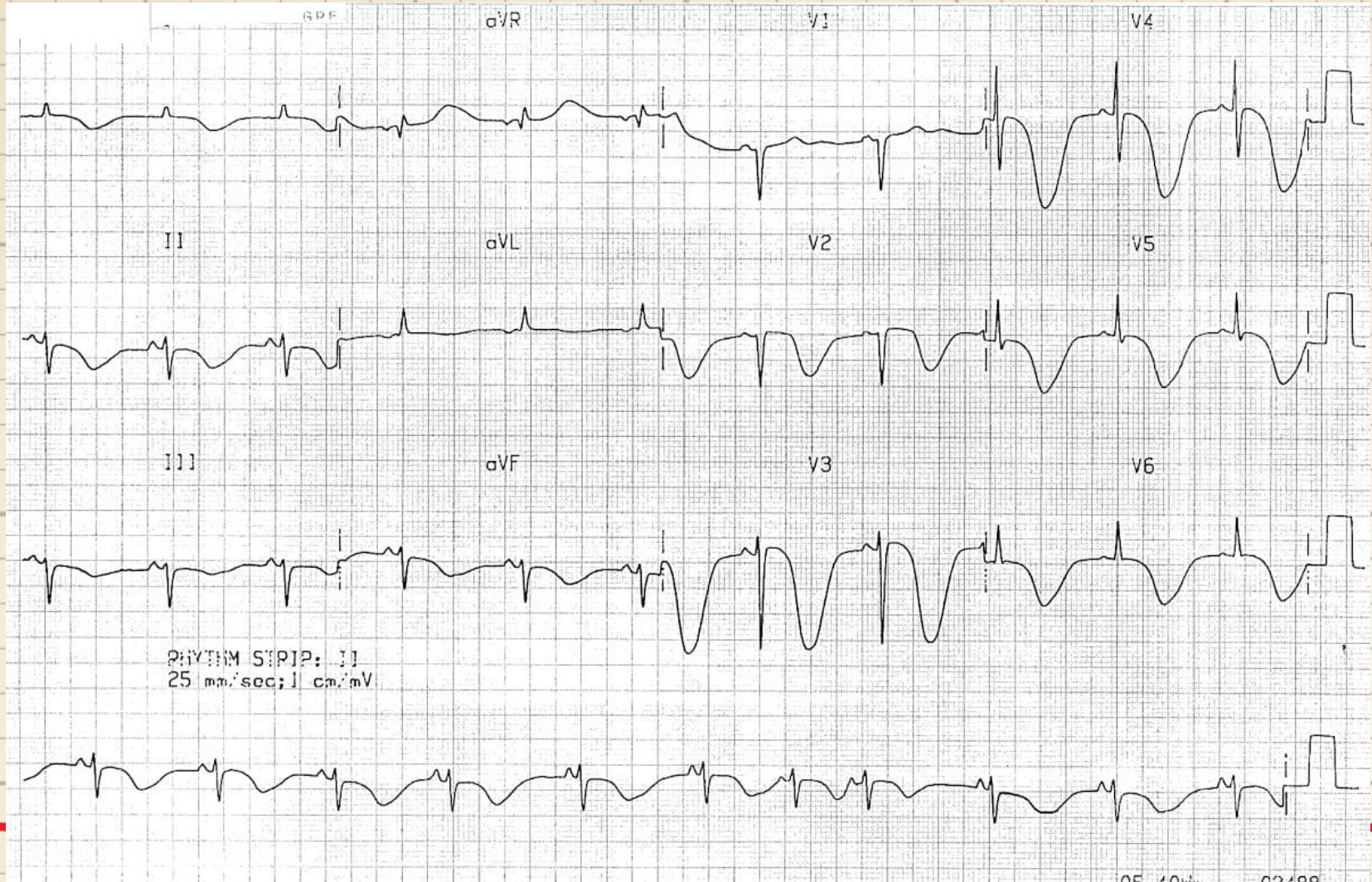


Increased ICP

- Secure airway if needed and measures to decrease
- Neuroimaging to confirm Dx
- Neurosurgery consult



Increased ICP



References

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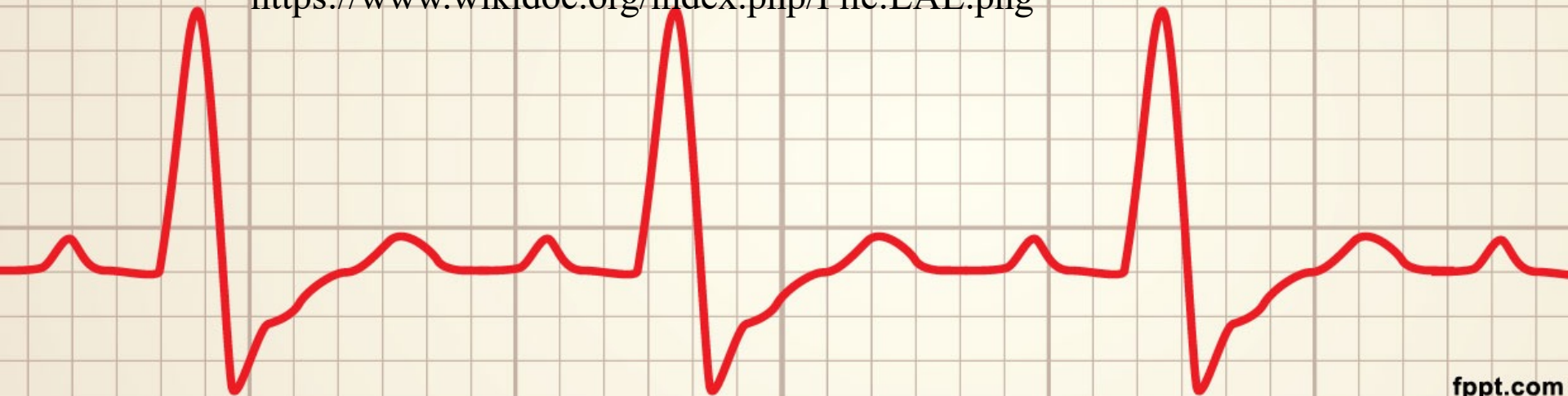
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<https://www.wikidoc.org/index.php/File:LAE.png>



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