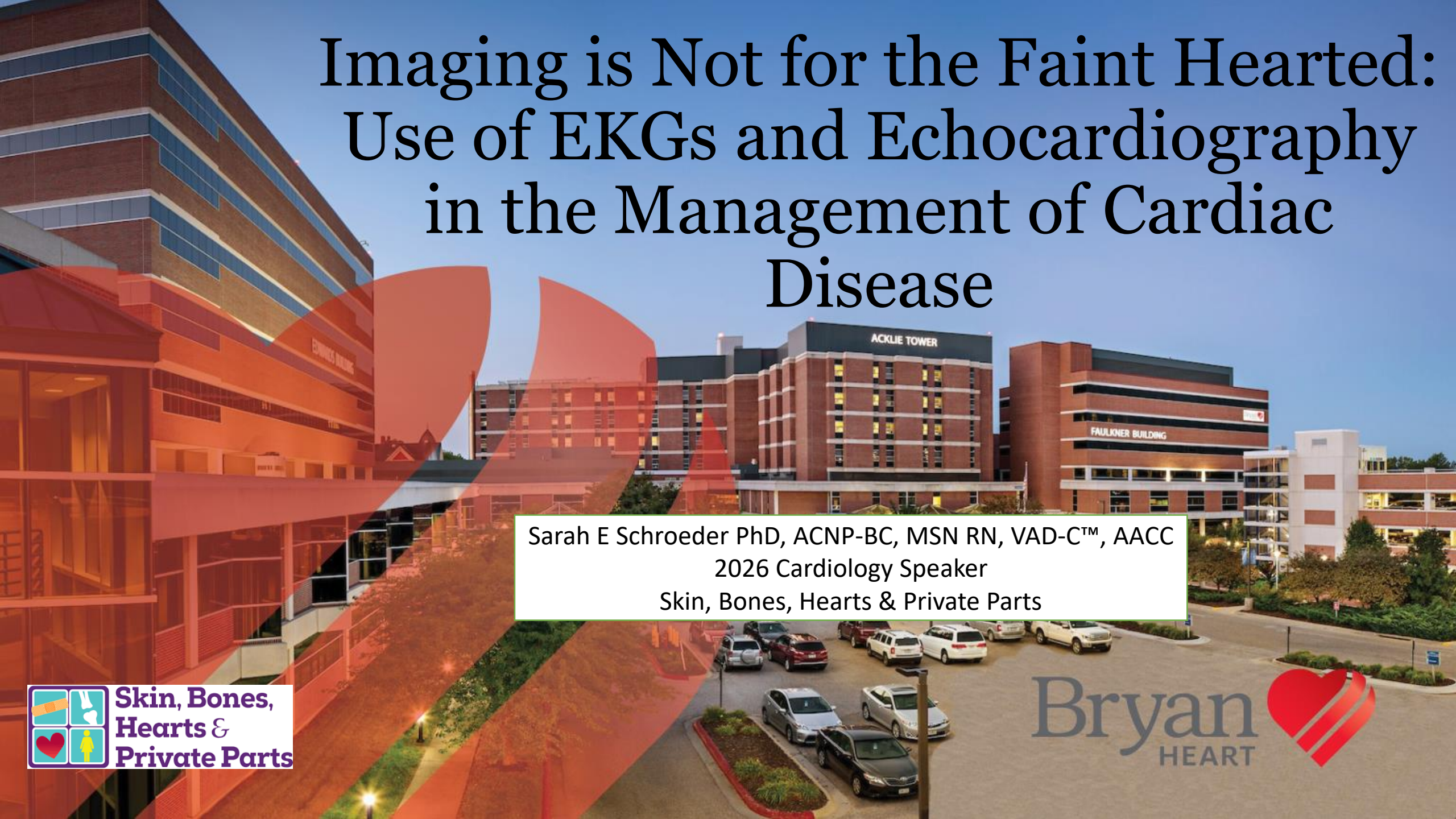
Imaging is Not for the Faint Hearted: Use of EKGs and Echocardiography in the Management of Cardiac Disease



Sarah E Schroeder PhD, ACNP-BC, MSN RN, VAD-C™, AACC
2026 Cardiology Speaker
Skin, Bones, Hearts & Private Parts

Skin, Bones, Hearts & Private Parts

Disclosures

- Investigator-Driven Research Grant, Abbott Labs, 2023-2026
- VAD Coordinator Professional Development Grant, ICCAC, 2024-2026

I will occasionally discuss patient scenarios – any pictures directly of patients are displayed following consent and will be noted

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Objectives

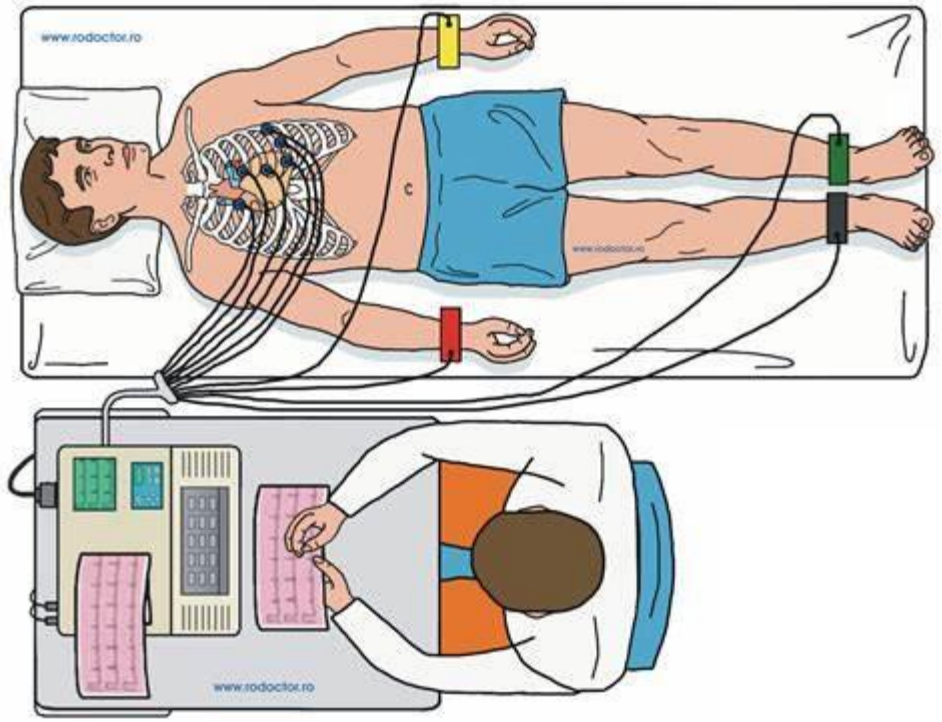
- The Use of EKGS and Echocardiography in Assessment of Cardiac Disease
- Systematic Evaluation of EKGs
  - Steps
  - When they are beneficial (… and when they are not)
  - What NOT to miss
- The 4-1-1 on Echocardiography in Cardiac Disease
  - The primary views
  - What are we looking for
  - What NOT to miss
- A little Snippet on Transesophageal Echocardiograms
- Final PEARLS for Understanding the Utility of EKGs and Echos

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The Purpose of an EKG

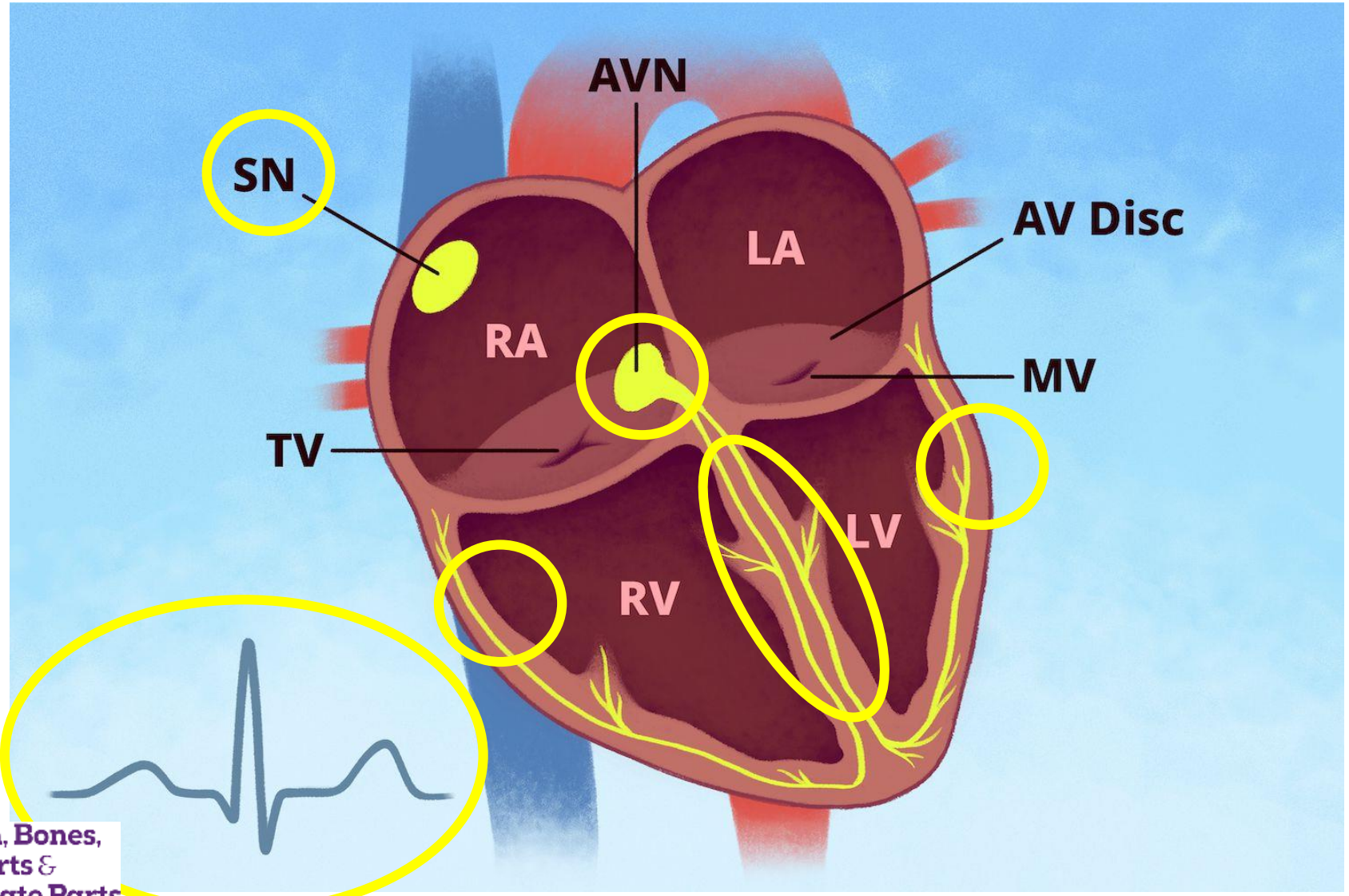
- Non-invasive, PAINLESS study
- Records electrical activity of heart
- Diagnose many common heart problems
  - Myocardial infarctions/Heart Attacks (NEW OR OLD)
  - Arrhythmias
  - Enlarged heart and heart failure
  - Congenital defects



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Cardiac Electrical Conductivity



Sinus Node

↓

AV Node

↓

Bundle Branches

↓

Purkinje Fibers

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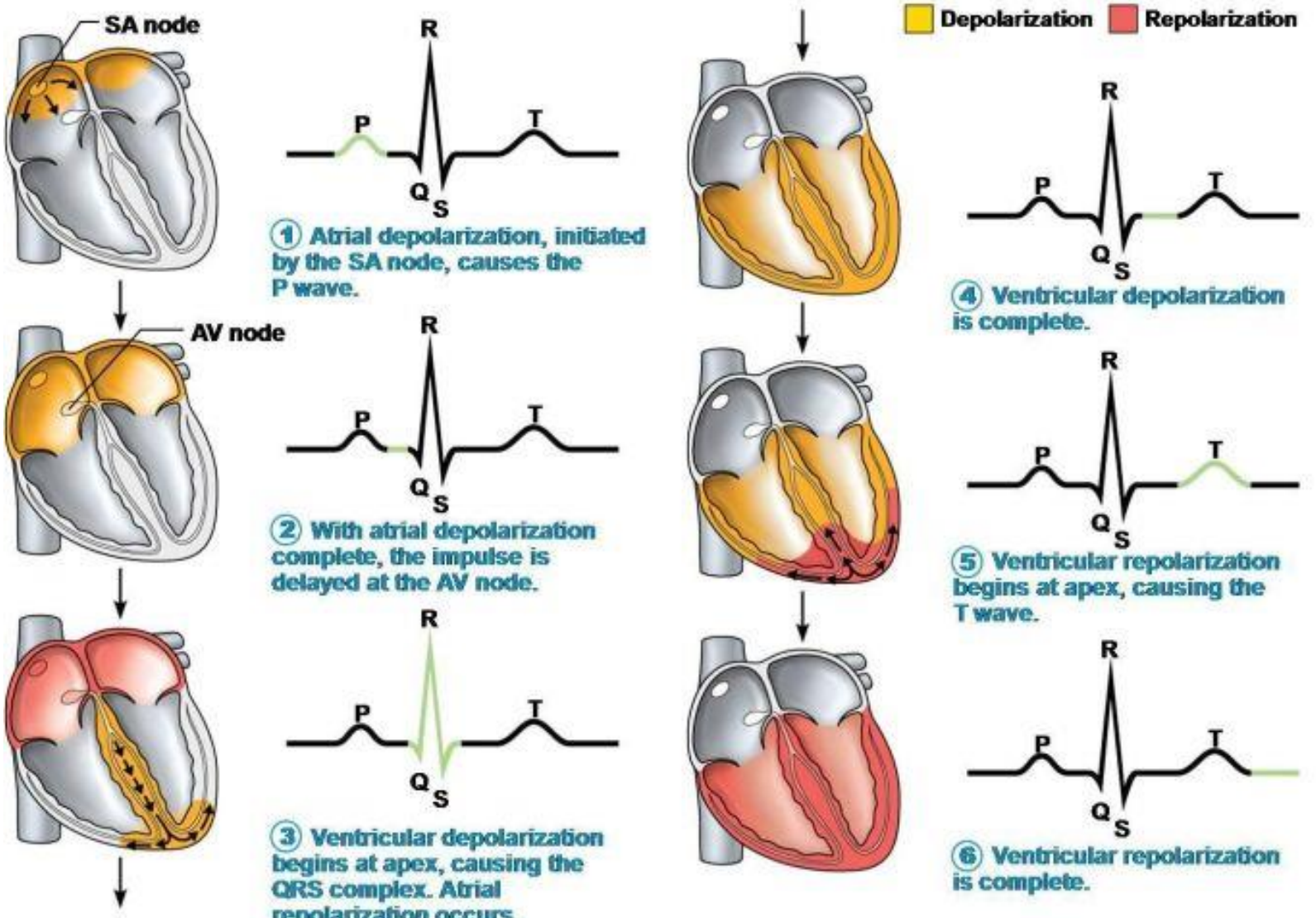


Figure 18.17





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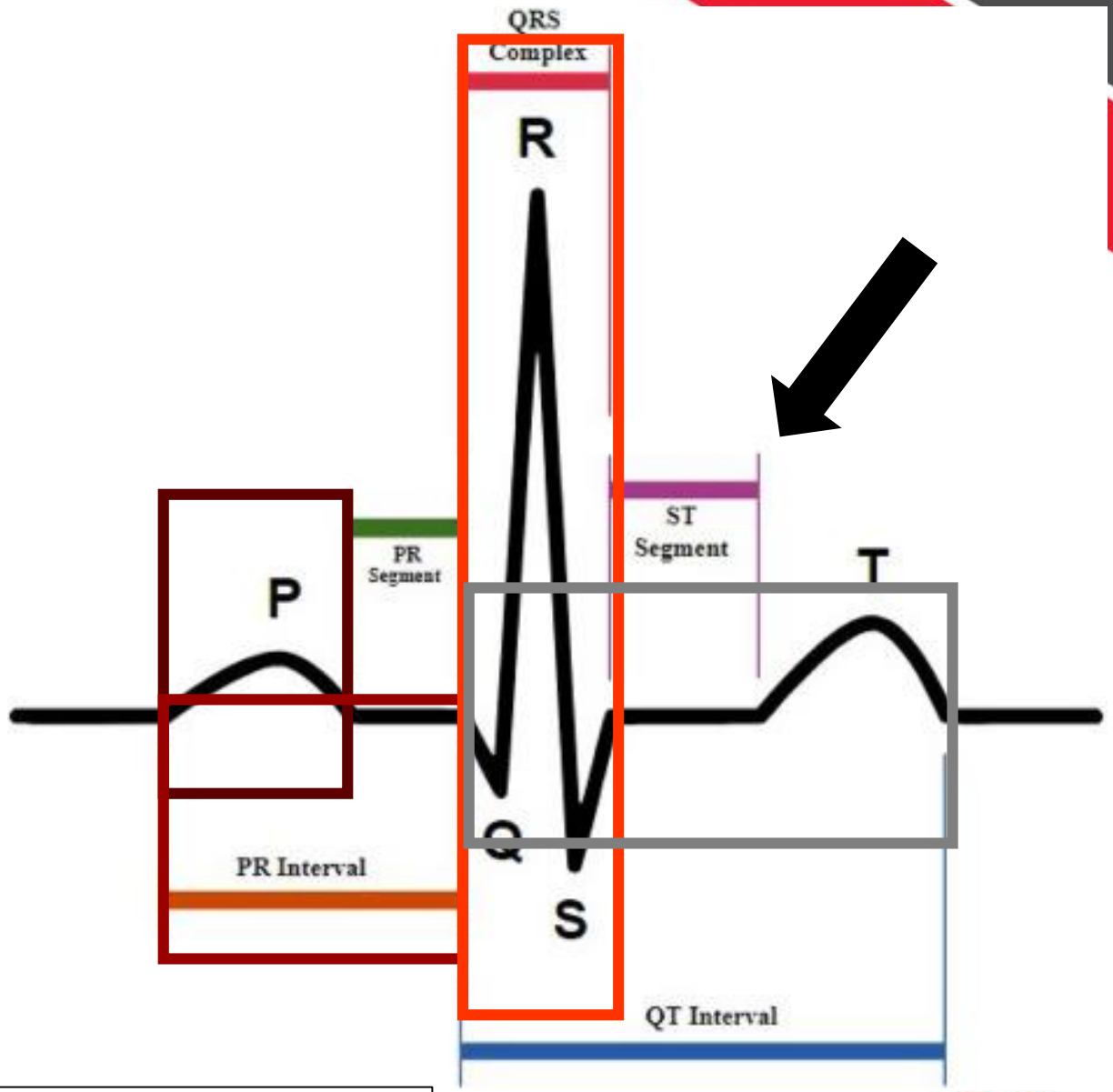
Bried Teaching, 2018. ECG – The Basics – BRI ED Teaching (wordpress.com)

P Wave created when SINUS NODE conduction travels to ATRIA

PR interval represents time between squeeze of ATRIA to squeeze of VENTRICLES

QRS represents the squeeze of the VENTRICLES

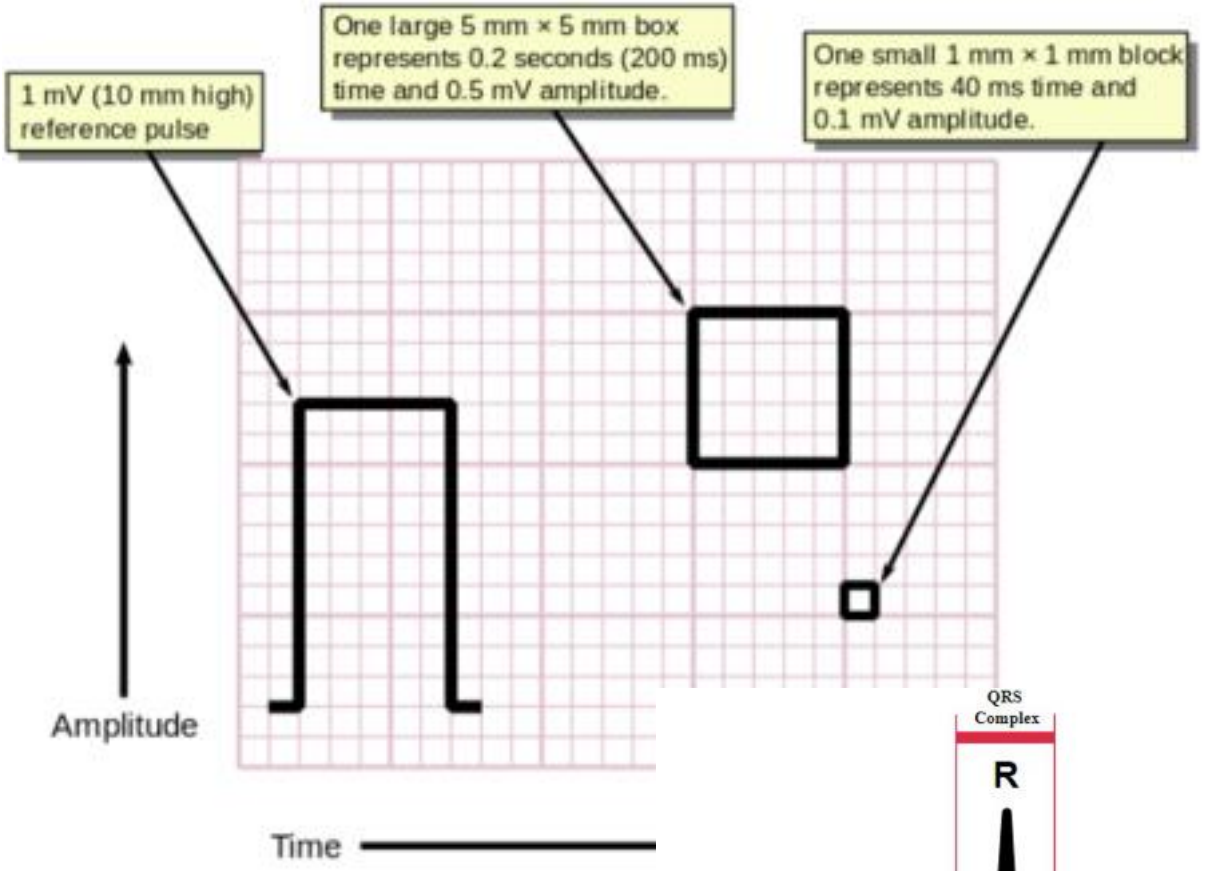
QT interval represents time from VENTRICLE squeeze to full rest and next cycle

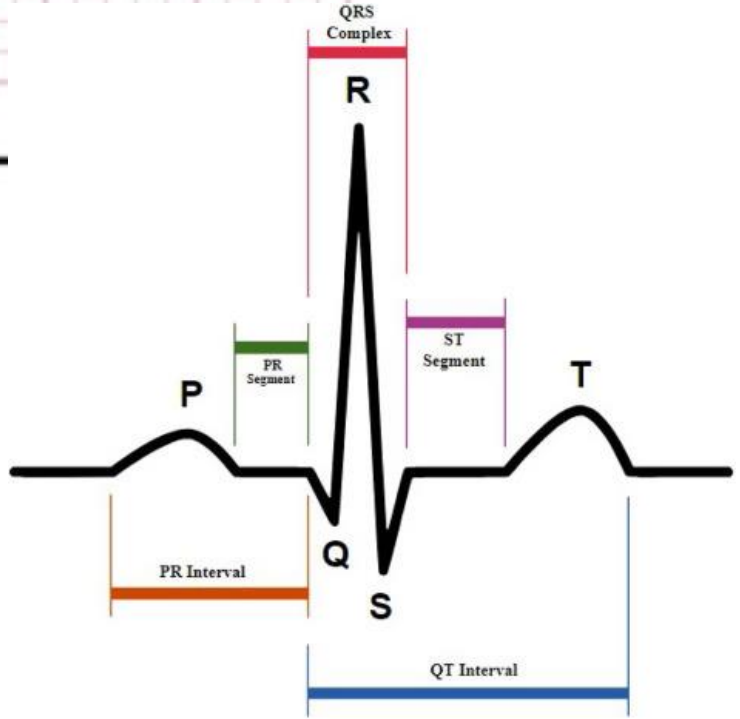


ST Segment is VERY important as well, and represents the phase between contraction and relaxation of the VENTRICLES

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PR Interval: 0.12-0.20

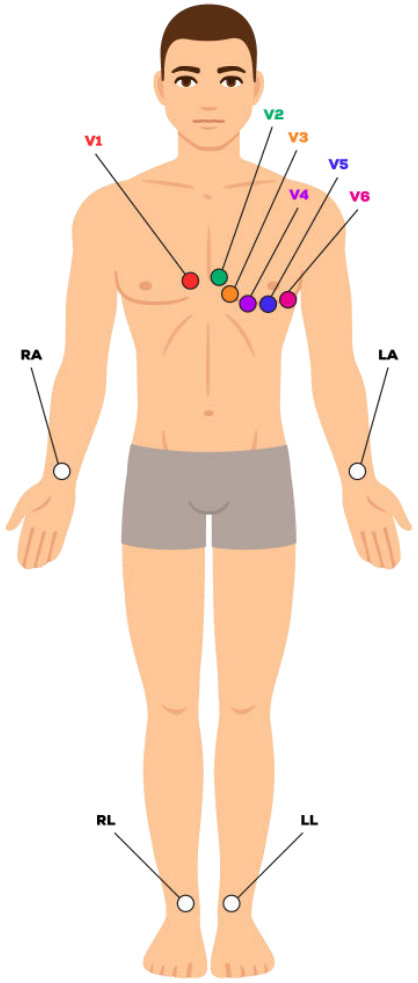
QRS 0.08-0.12

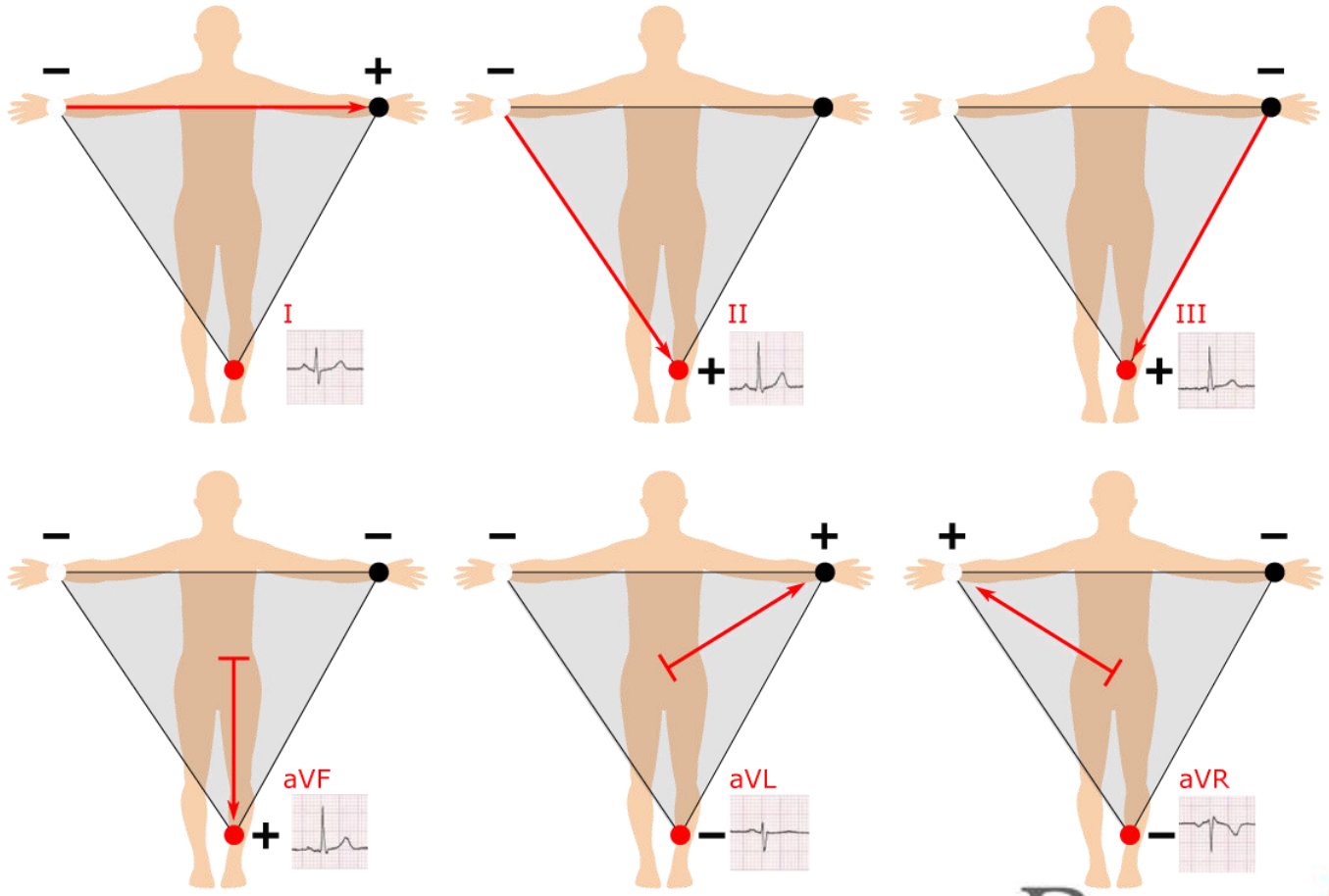
QT Interval: (0.36-0.44)
Males: 0.35 – 0.45
Females: 0.36-0.46

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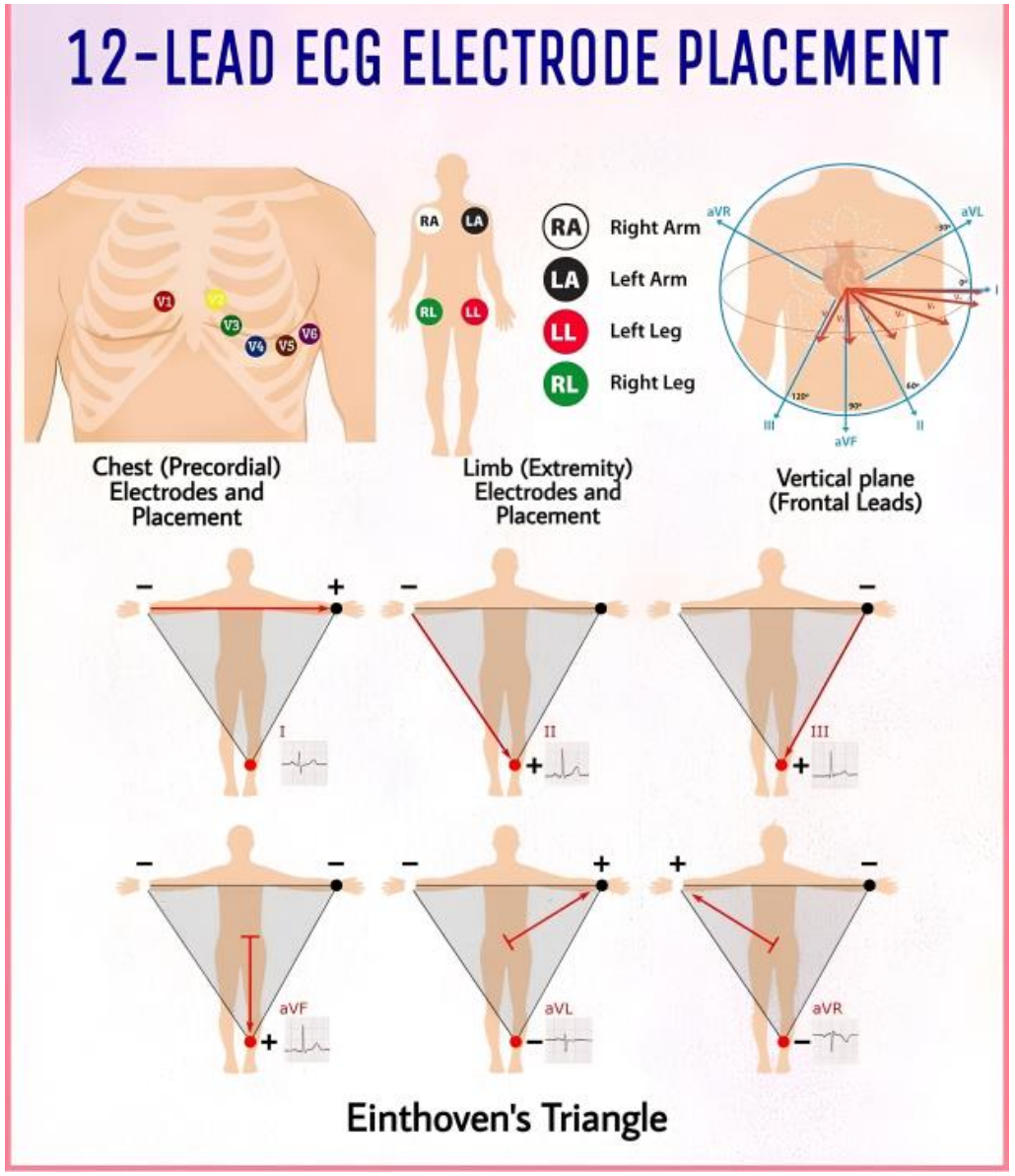
Importance of Lead Location for EKGs

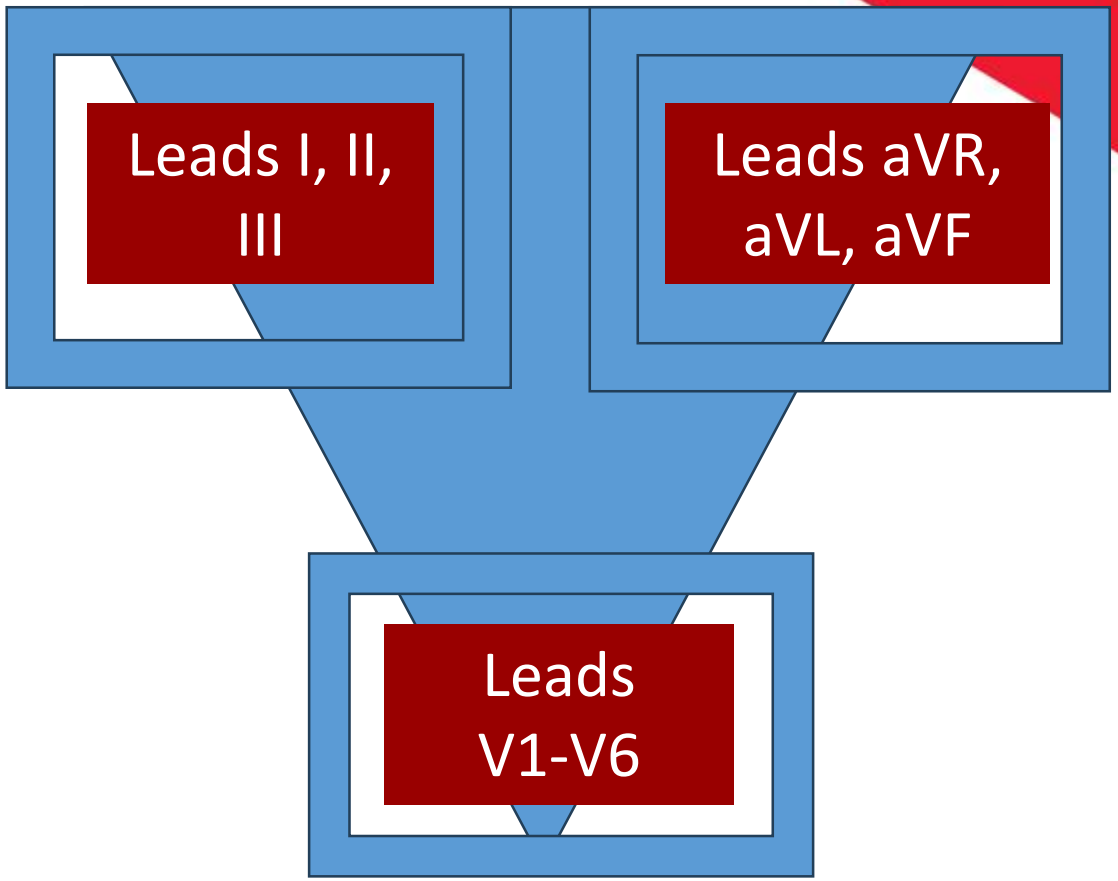




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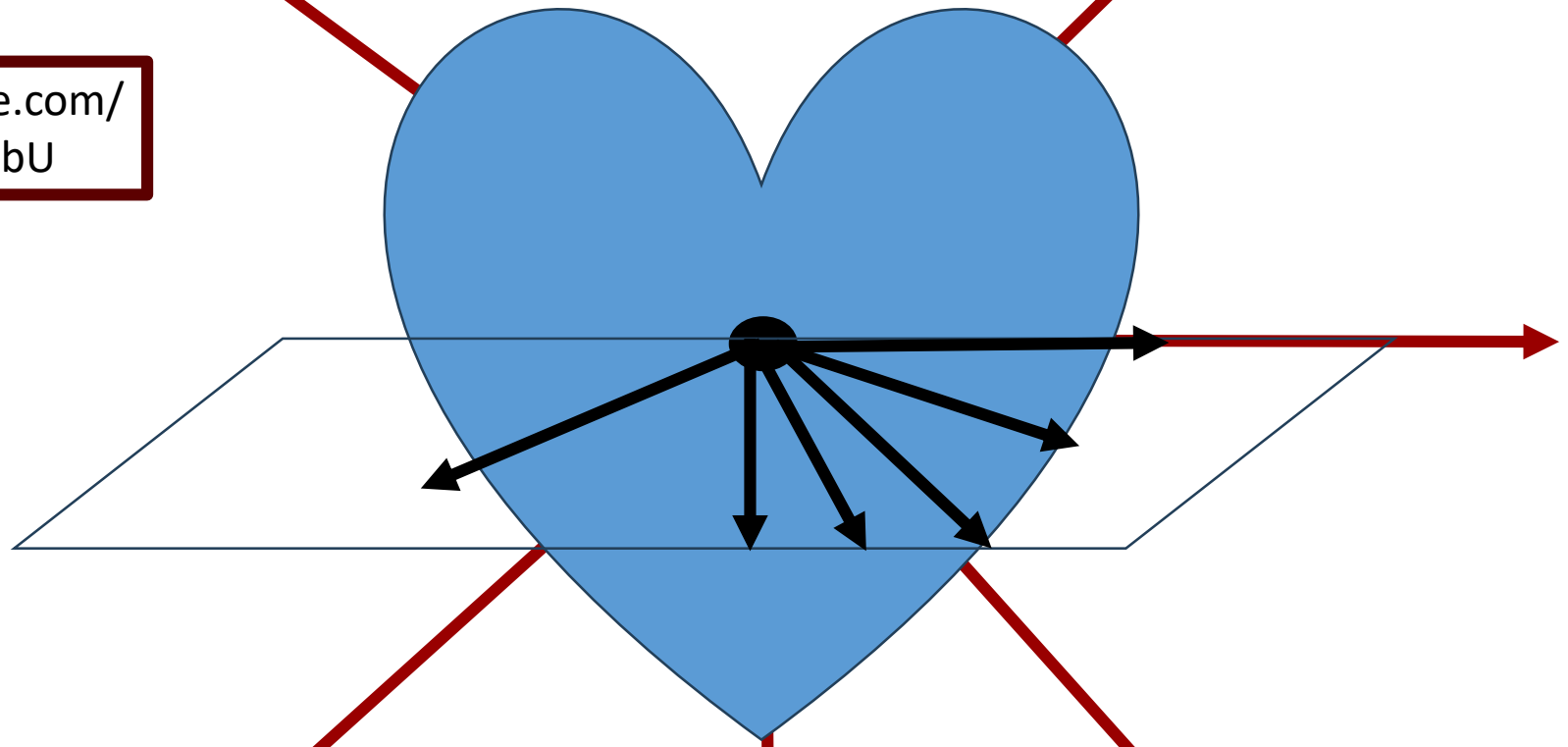
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A Complete Guide to Einthoven's Triangle & ECG Testing (linkedin.com)

SHOULDER

SHOULDER

https://www.youtube.com/watch?v=kwLbSx9BNbU



Left Side

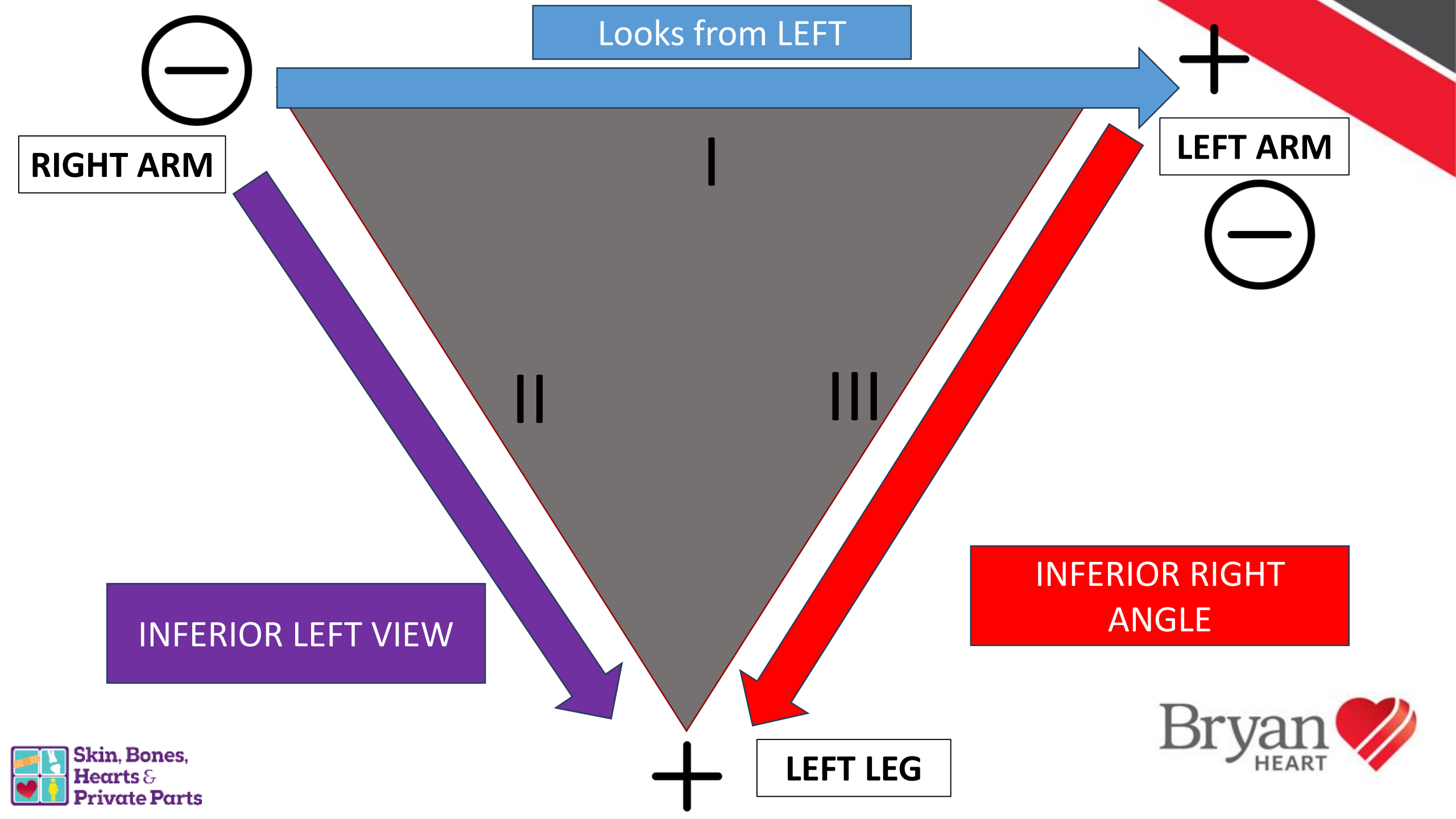
RIGHT LEG

BELLY BUTTON

LEFT LEG

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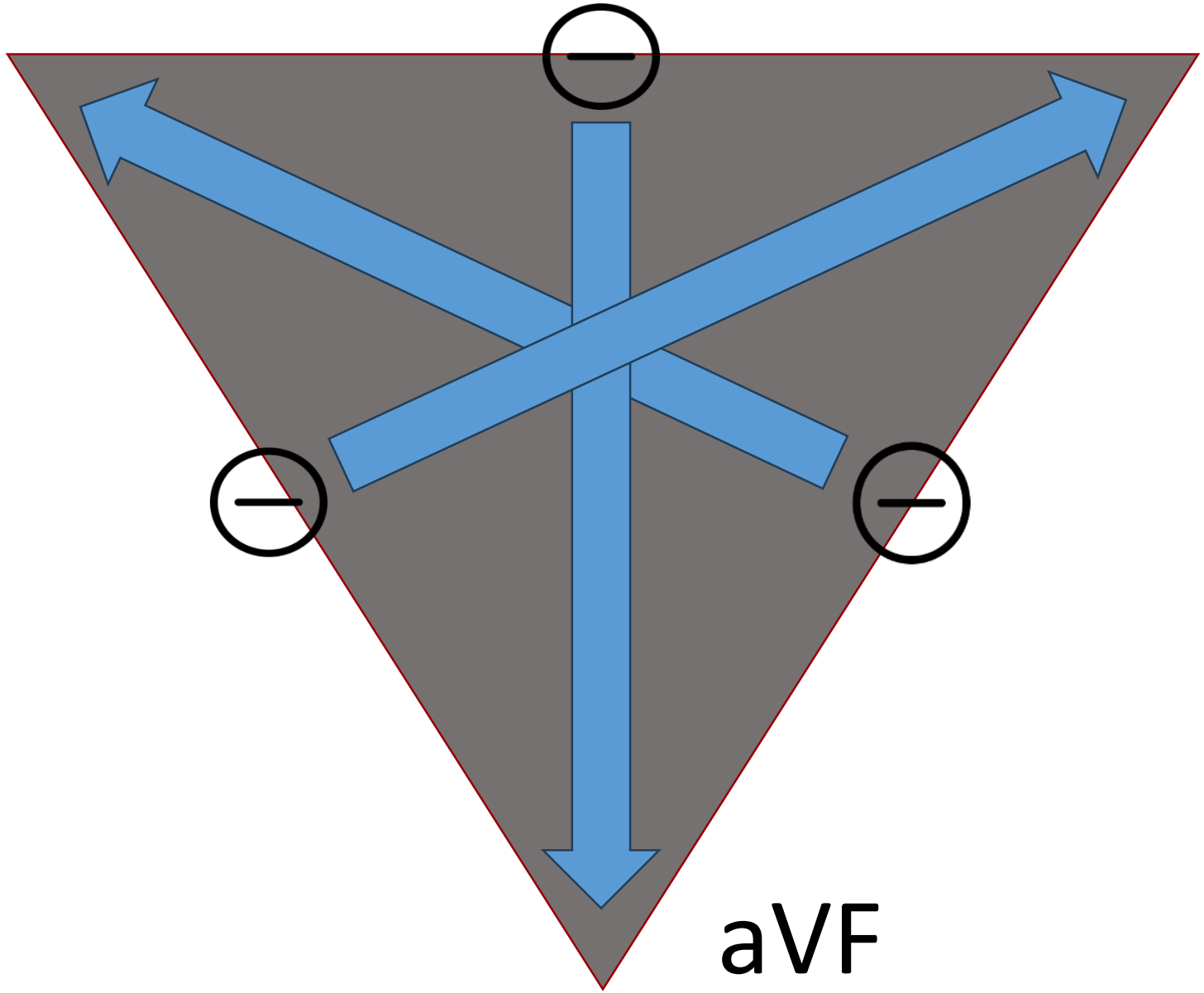


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RIGHT ARM

aVR



LEFT ARM

aVL

aVF

LEFT LEG

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DEPOLARIZATION=CONTRACTION

DEPOLARIZATION TOWARDS A LEAD=POSITIVE DEFLECTION

DEPOLARIZATION AWAY FROM A LEAD=NEGATIVE DEFLECTION



REPOLARIZATION=RELAXATION

REPOLARIZATION TOWARDS A LEAD=NEGATIVE DEFLECTION

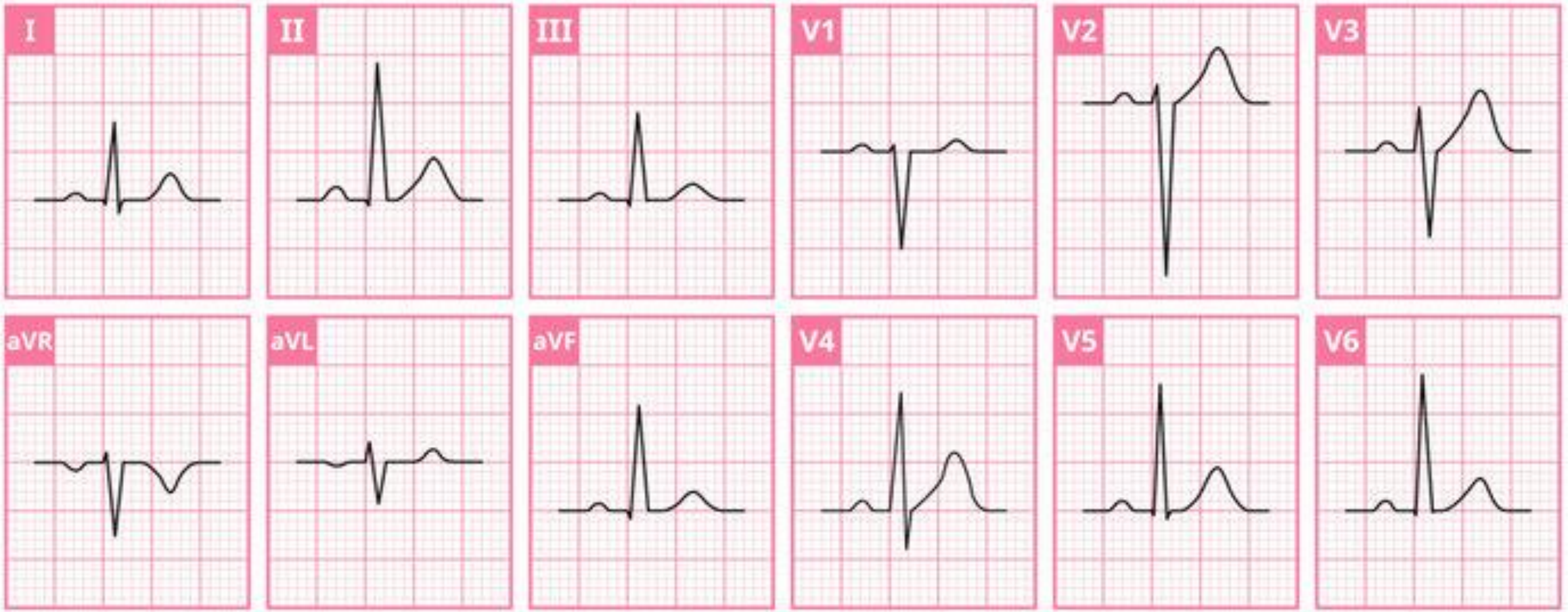
REPOLARIZATION AWAY FROM A LEAD=POSITIVE DEFLECTION

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Electro-Cardio-Gram

Normal 12-Lead ECG



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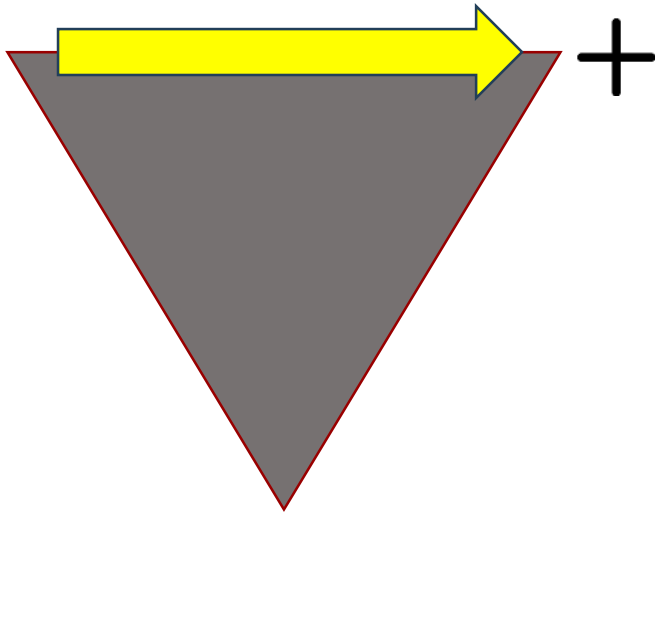
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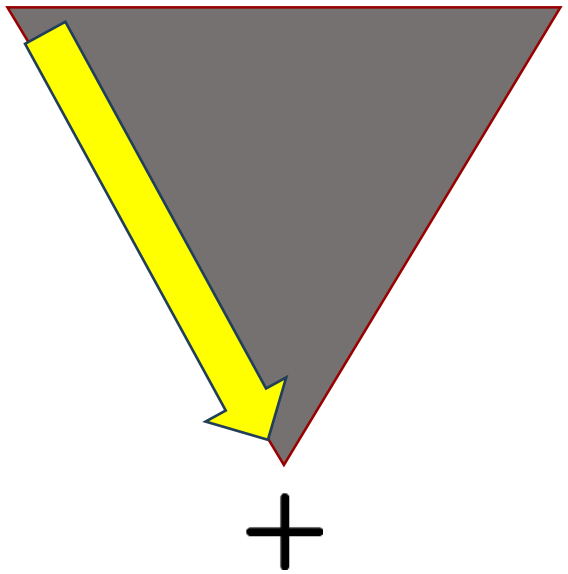
“II, aVF and **III:** are called **inferior limb leads** and they primarily observe the inferior aspect of the left ventricle”

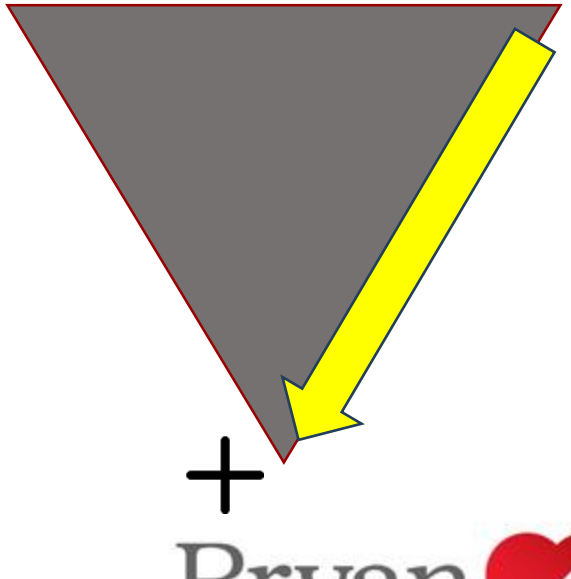










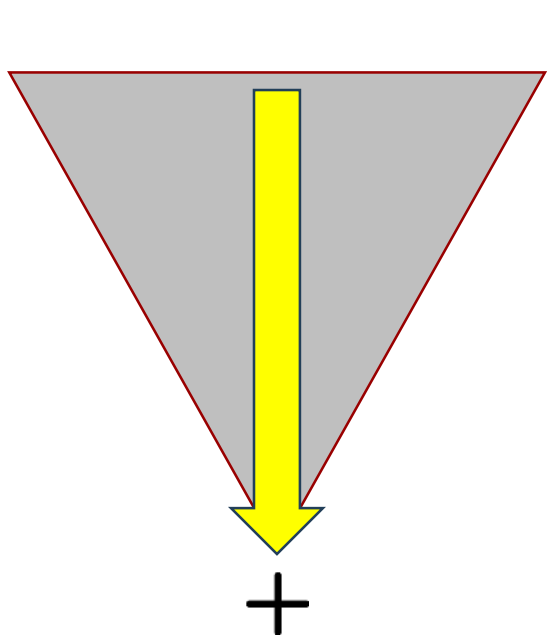


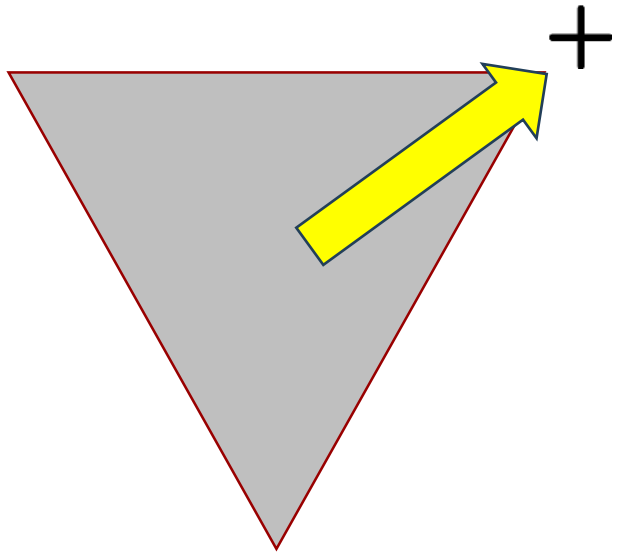
Exploring Electrode = Positive Reference Electrode

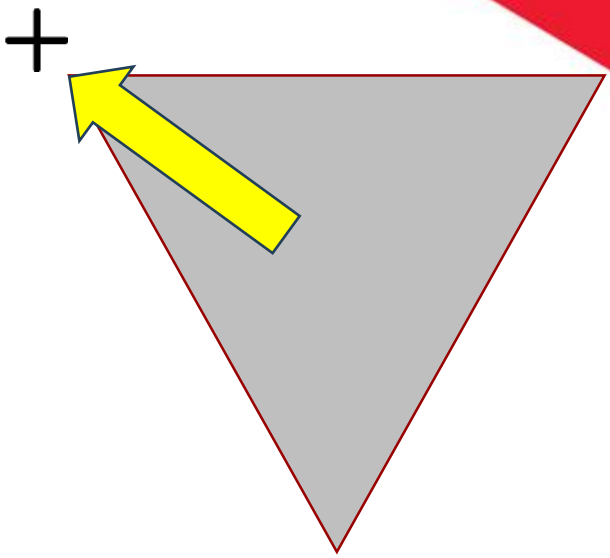
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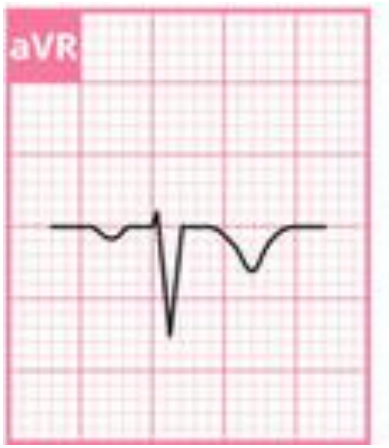
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[The ECG leads: Electrodes, limb leads, chest (precordial) leads and the 12-Lead ECG – The Cardiovascular]











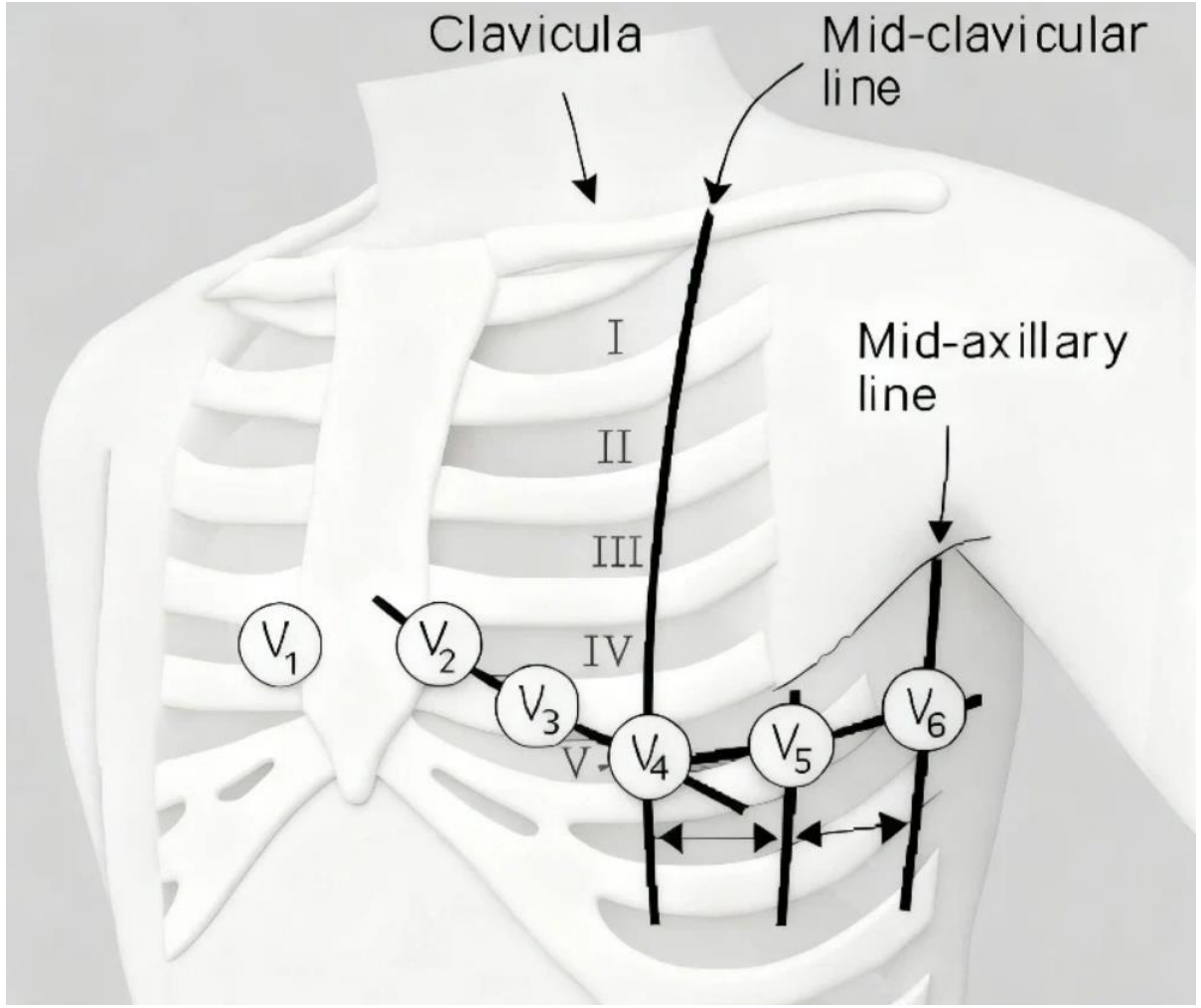


“aVL, I and **-aVR:** are called **lateral limb leads** and they primarily observe the lateral aspect of the left ventricle”

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The ECG leads: Electrodes, limb leads, chest (precordial) leads and the 12-Lead ECG – The Cardiovascular



5 Steps in EKG Lead Preparation

- Patient Positioning
- Skin Prep
- Hair Management
- Equipment Check
- Patient Communication

> ⚠ Critical Rule: Place V4 Before V3
>
> V4 has a defined anatomical position (5th ICS, midclavicular line). V3 is defined as the midpoint between V2 and V4. Always place V4 first, then V3 is simply the measured midpoint—no guessing required.

Upwards of 50% of Leads V1-V2 are placed too high

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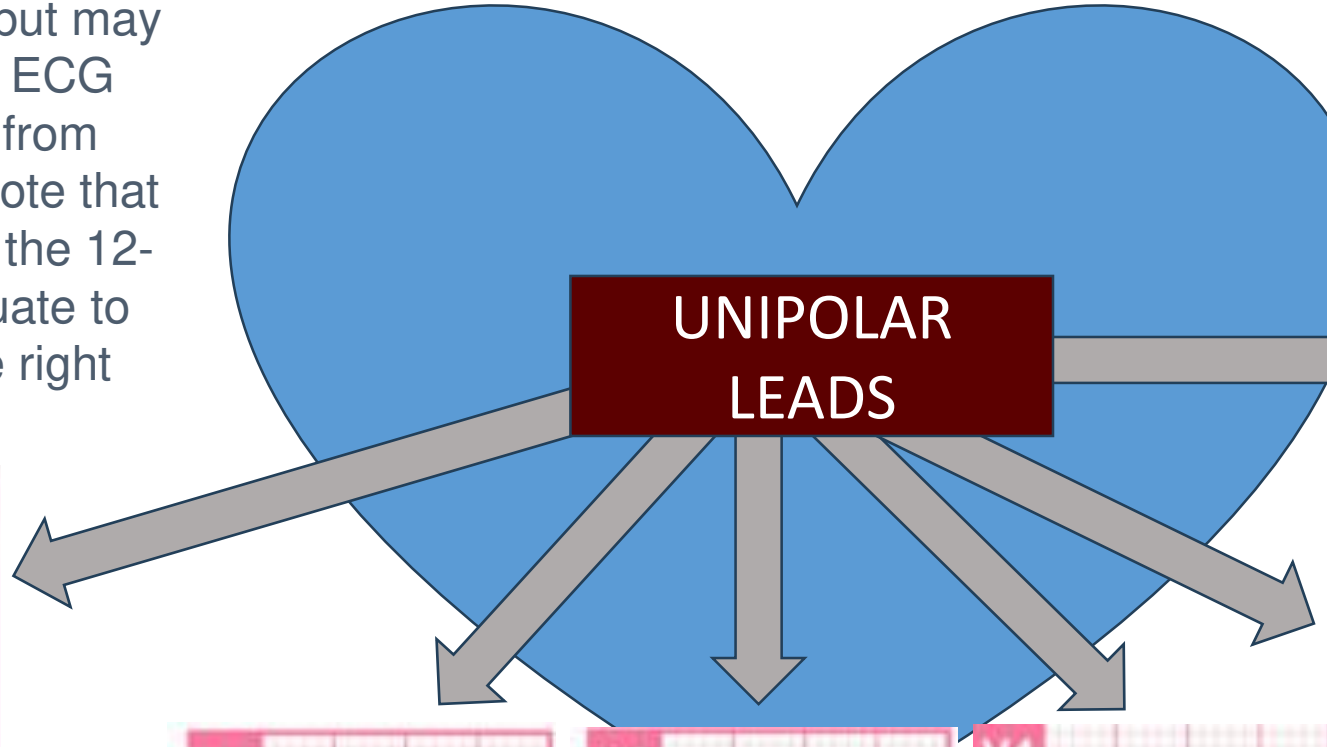
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12 Lead ECG Placement: The Complete Guide (2025)

"V1-V2 ("septal leads"): primarily observes the ventricular septum, but may occasionally display ECG changes originating from the right ventricle. Note that none of the leads in the 12-lead ECG are adequate to detect vectors of the right ventricle".

"V3-V4 ("anterior leads"): observes the anterior wall of the left ventricle"

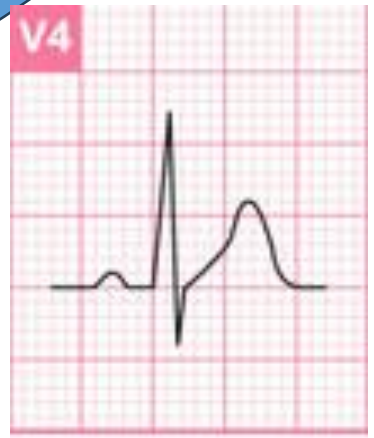
"V5-V6 ("anterolateral leads"): observes the lateral wall of the left ventricle"















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The ECG leads: Electrodes, limb leads, chest (precordial) leads and the 12-Lead ECG – The Cardiovascular

The Use of EKGS and Echocardiography in Assessment of Cardiac Disease

Diagnosis



Symptoms

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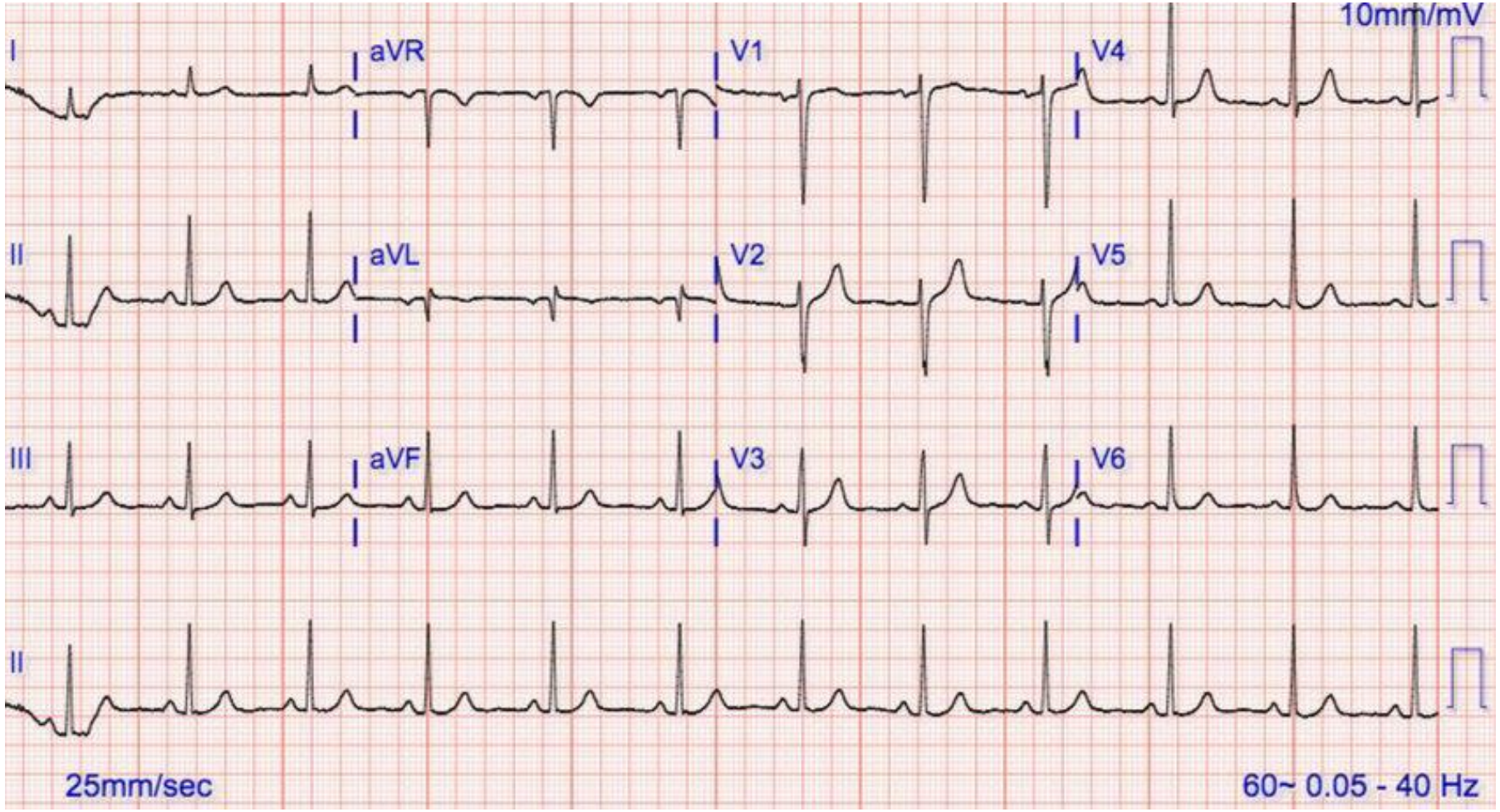
Systematic Evaluation of EKGs



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1. Look at the WHOLE EKG first

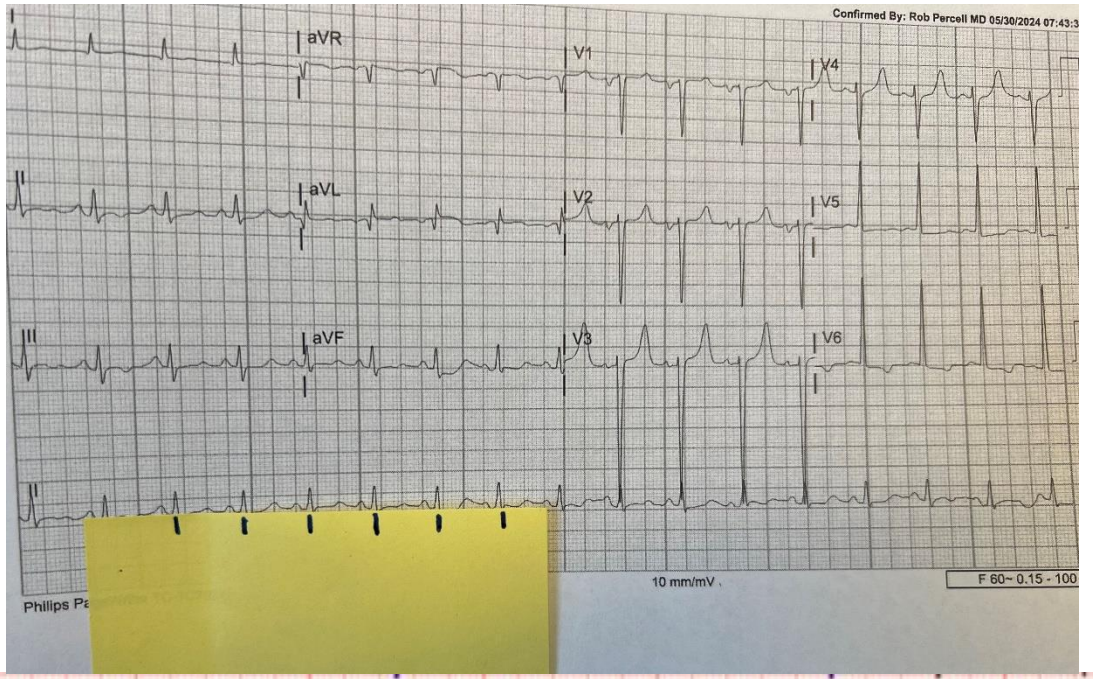


a) P waves
b) QRS
c) T Waves
d) REGULAR???

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MEASURE!!!!!!!!!!!



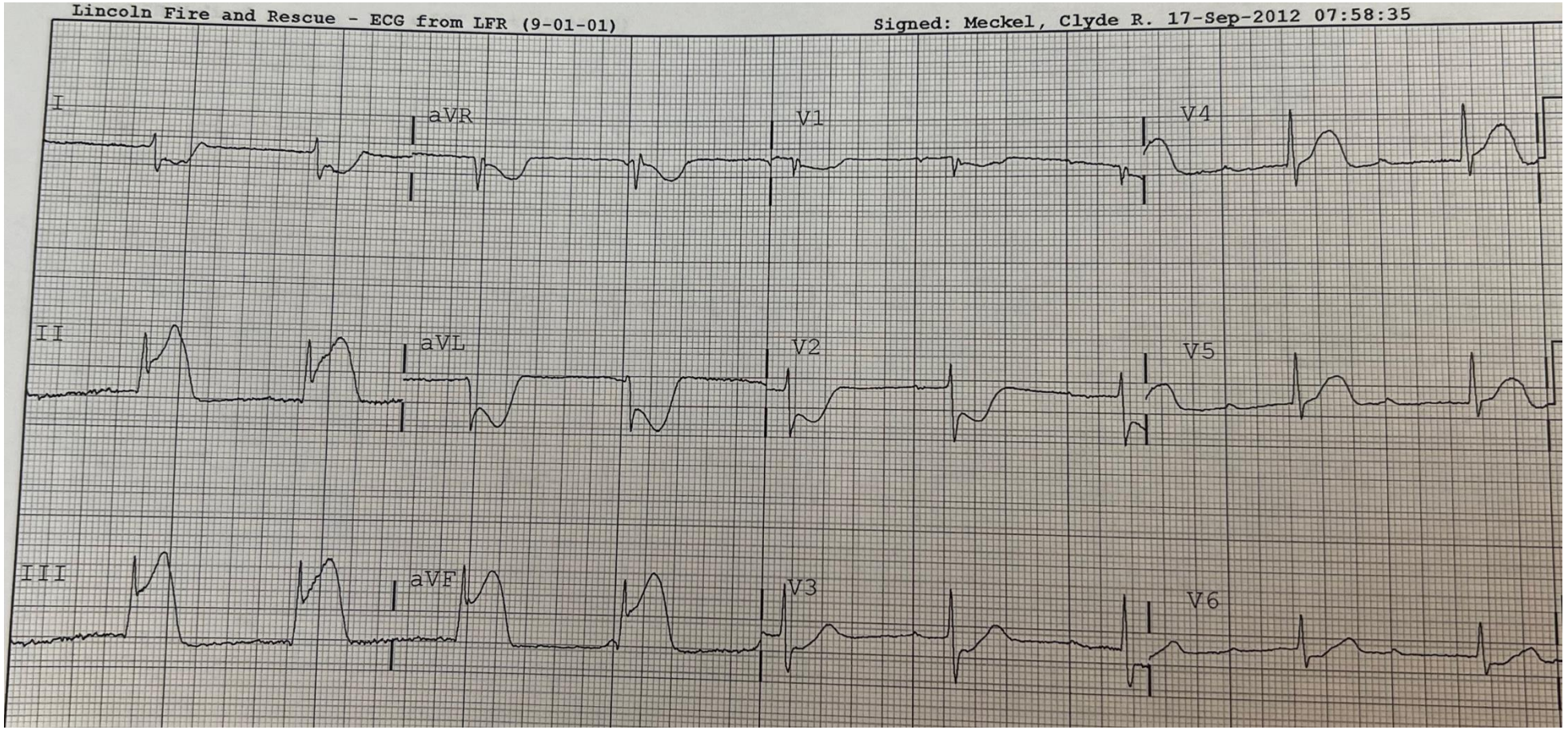




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2. ST Segment Abnormalities

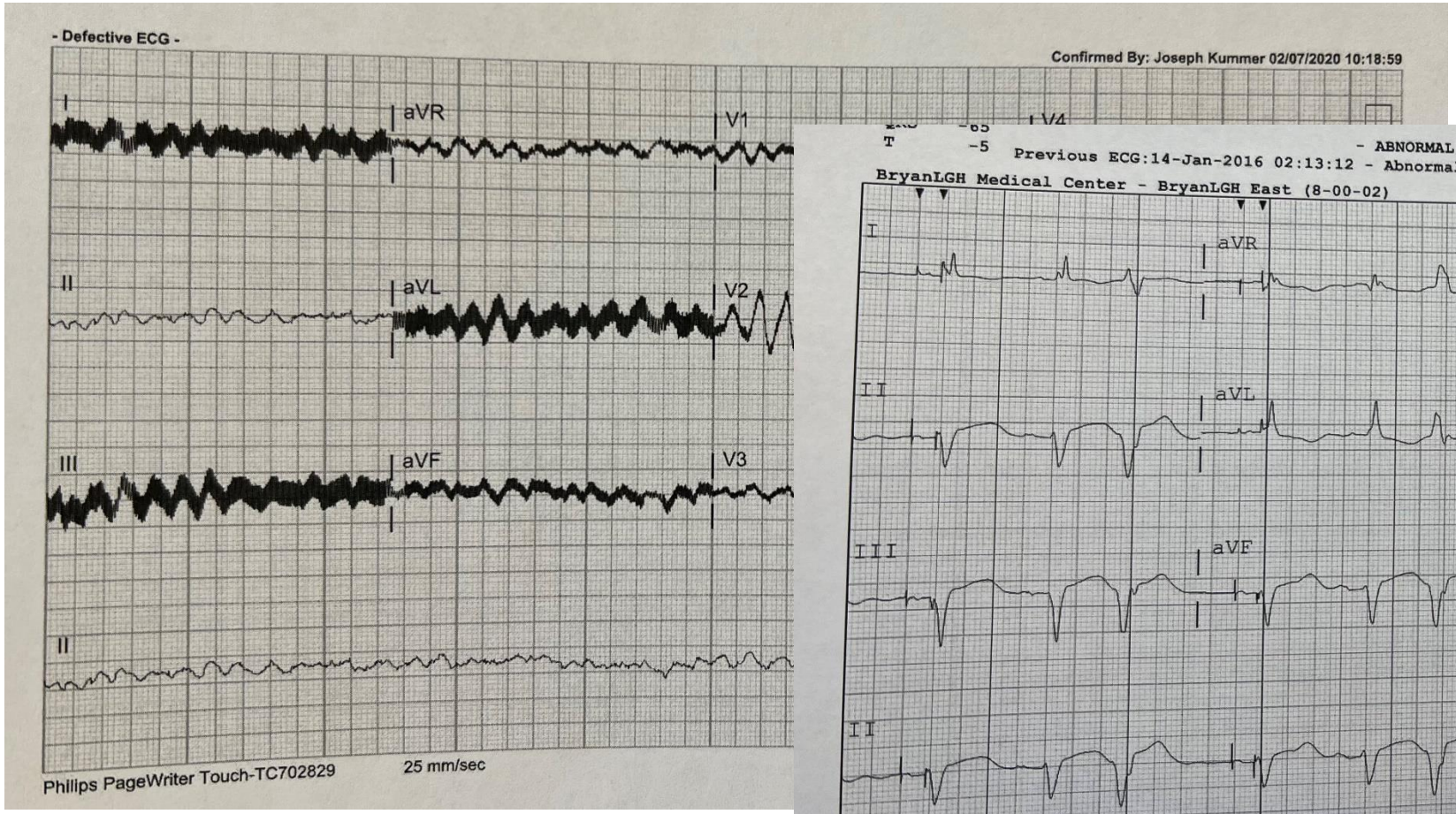


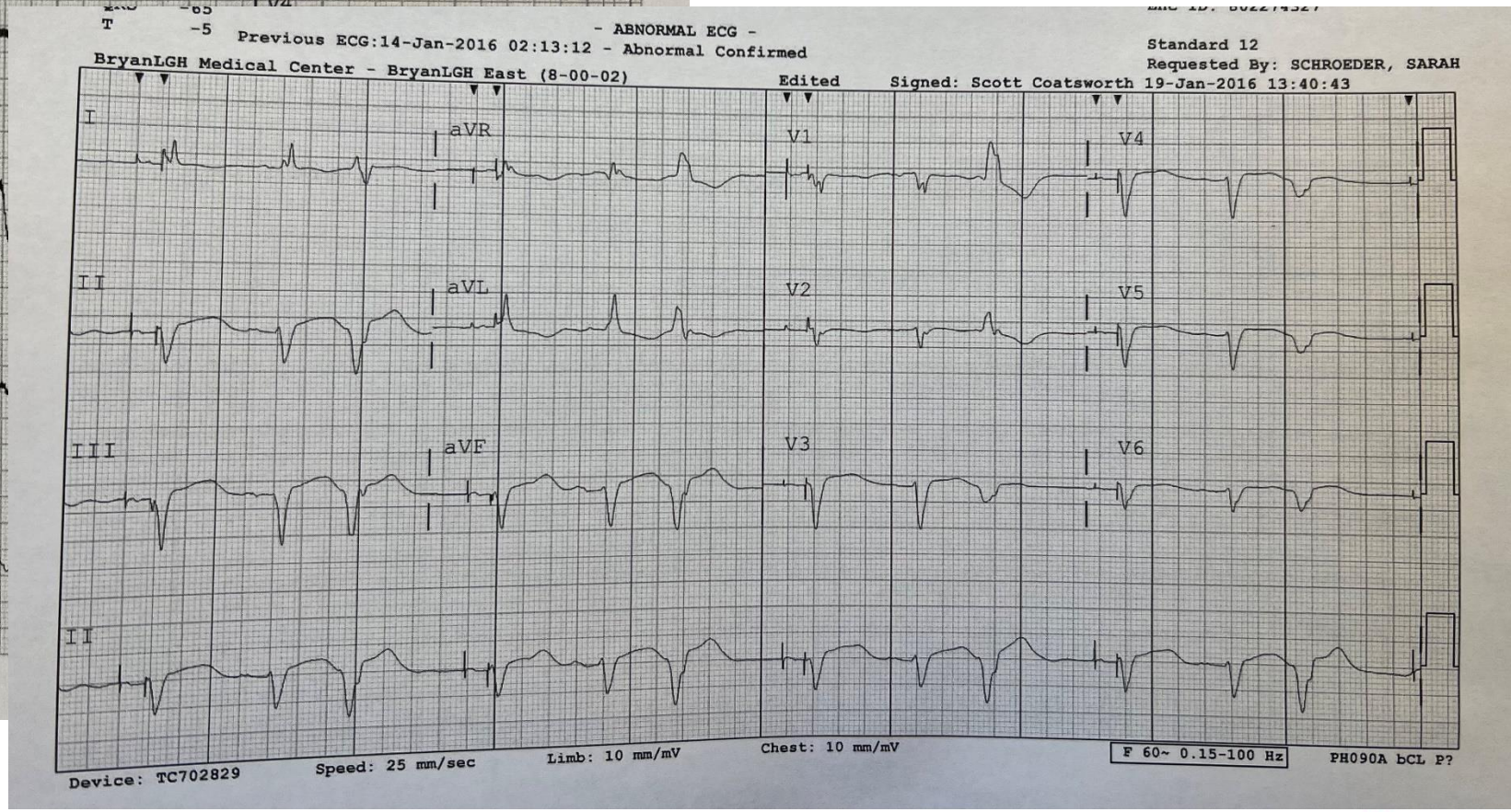
a) ST Depression
b) ST Elevation
c) CONTIGUOUS LEADS???

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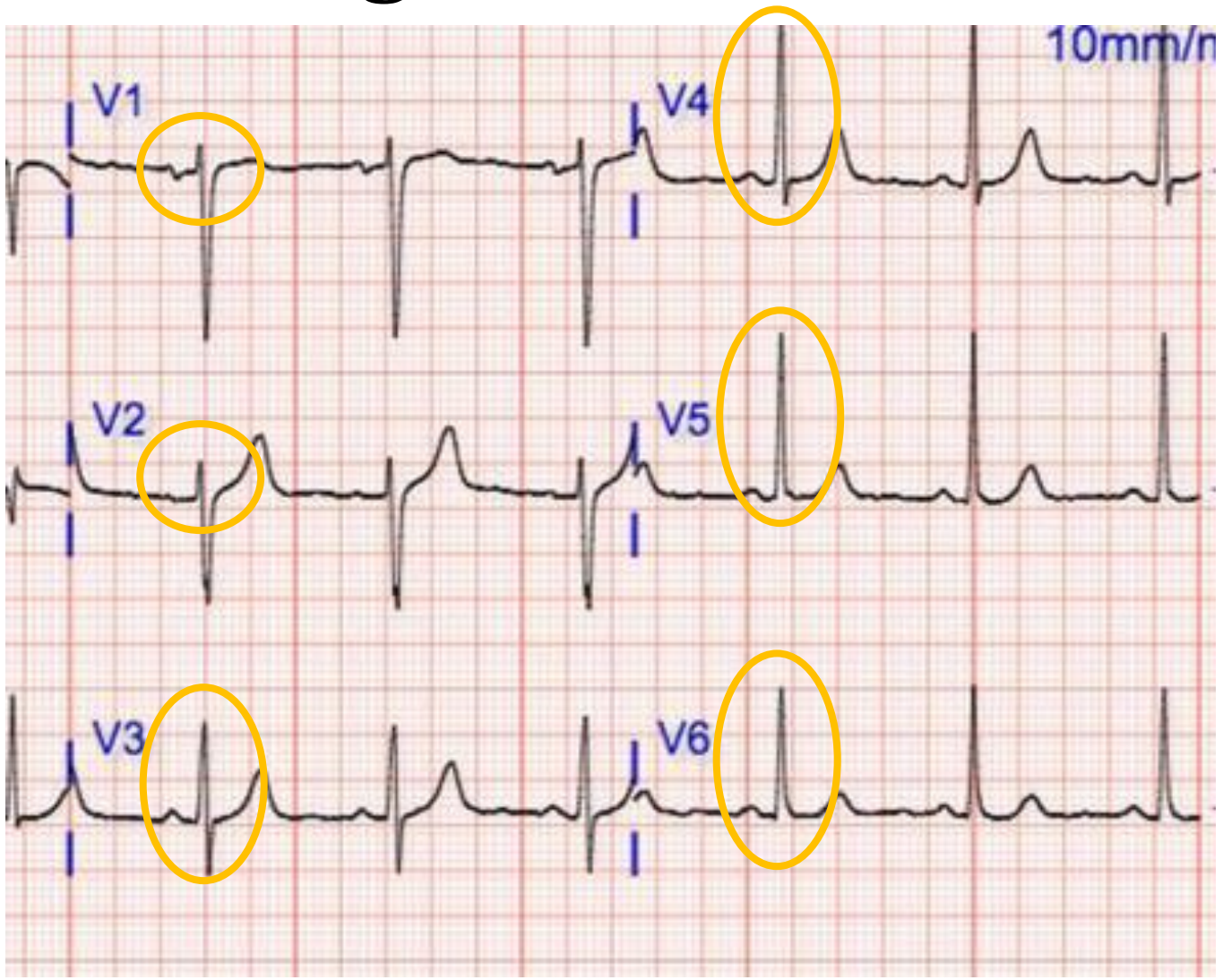
3. Extra Rhythm Parts





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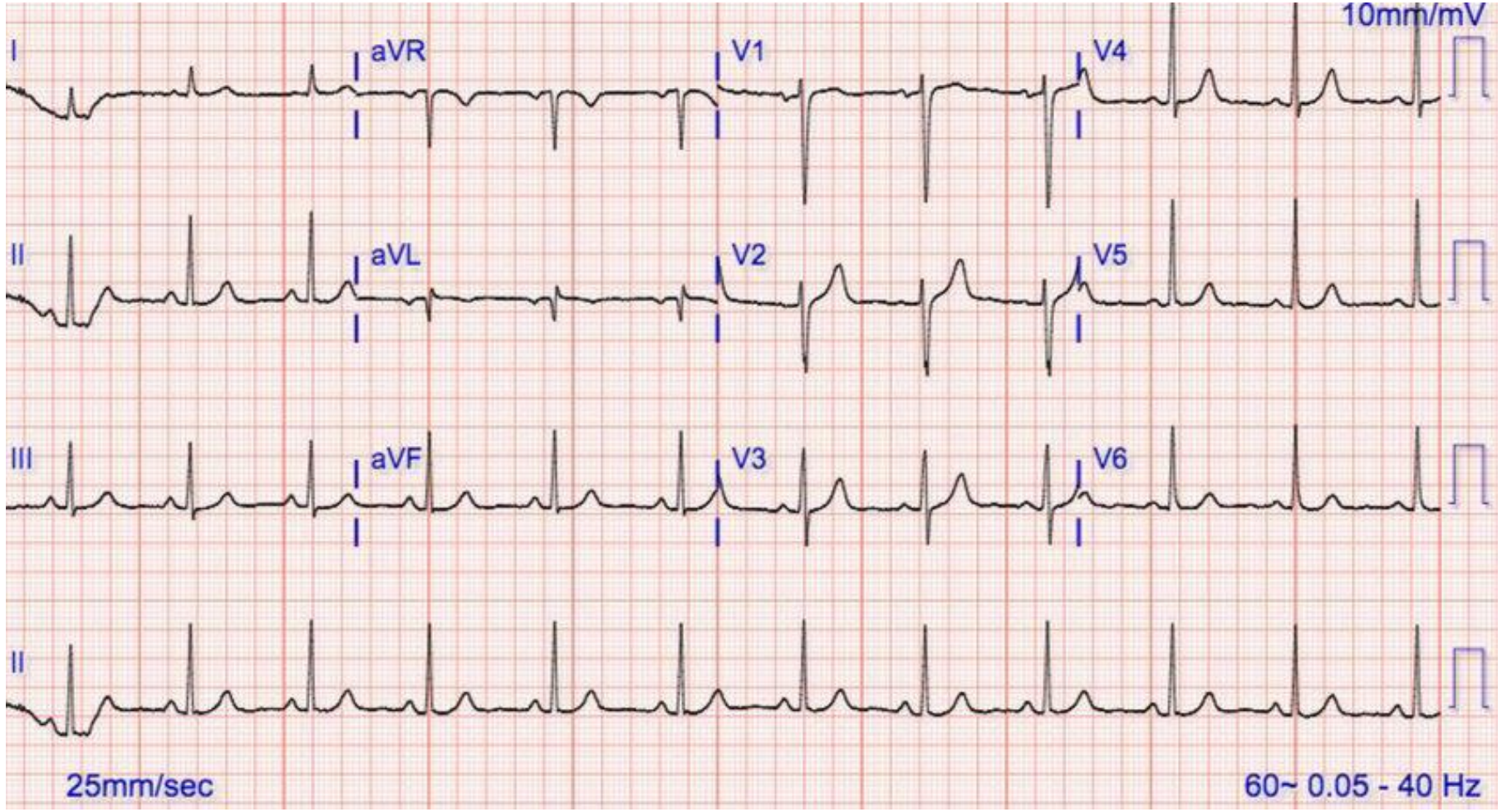
4. R Wave Progression



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5. Look at the WHOLE EKG AGAIN

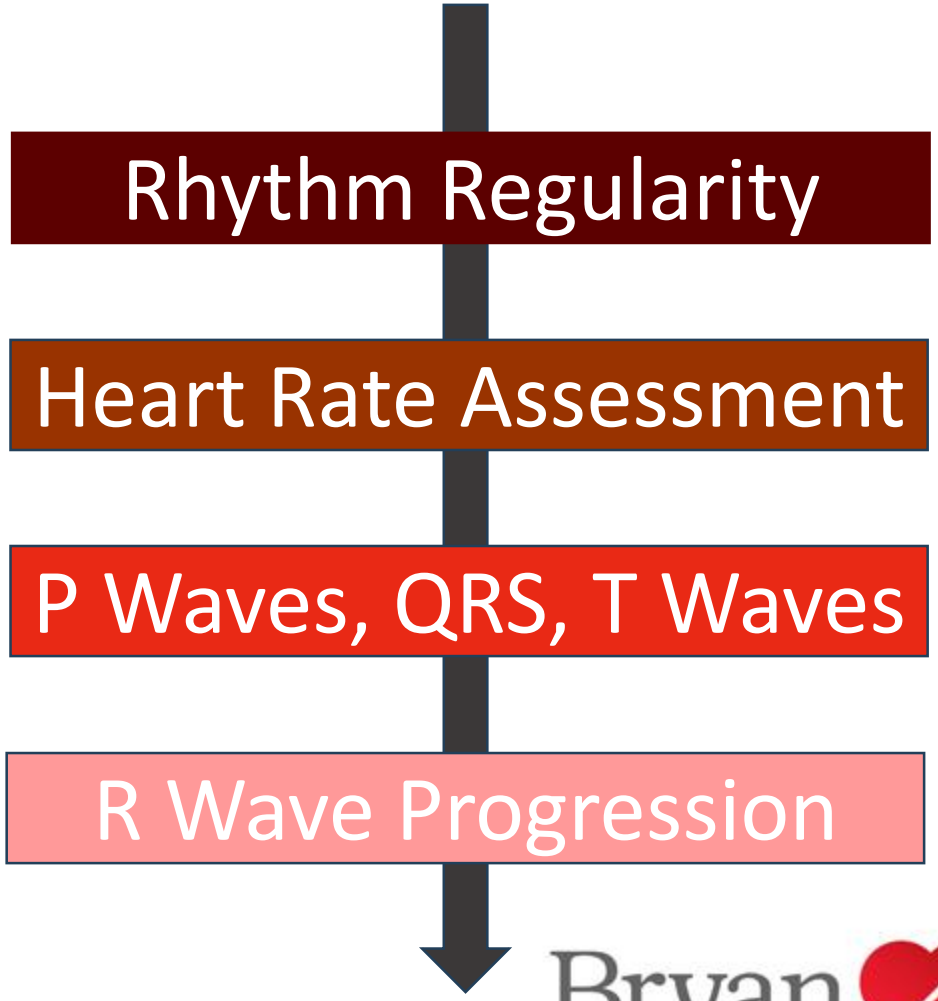


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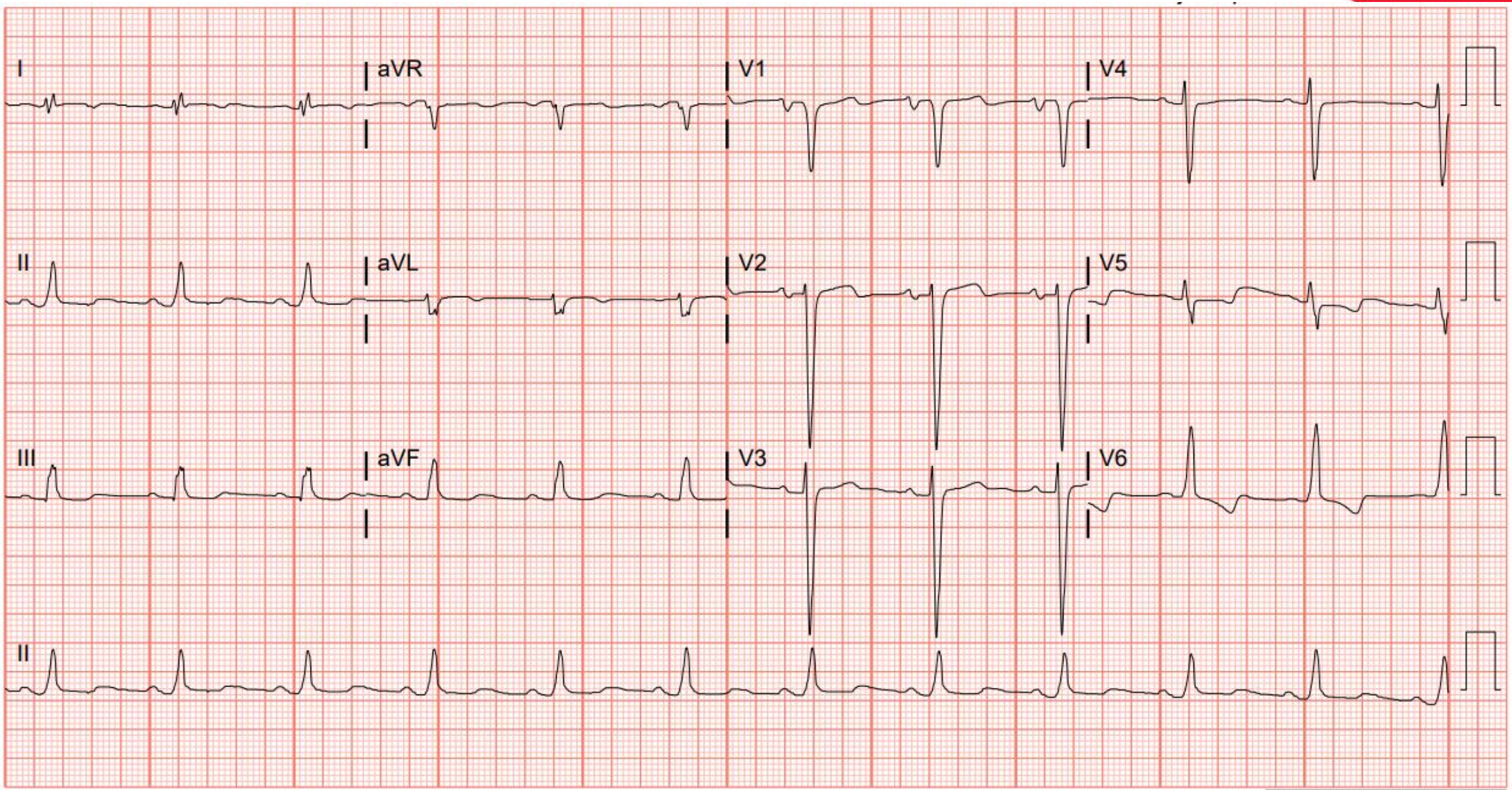
Practice EKG's with Q/A options

- Will review SR, SB, ST
- RBBB and LBBB
- 1st Degree, 2nd Degree T1 and T2, 3rd Degree AVB
- Asystole
- Atrial Tachycardia vs AFF
- Ventricular Arrhythmias



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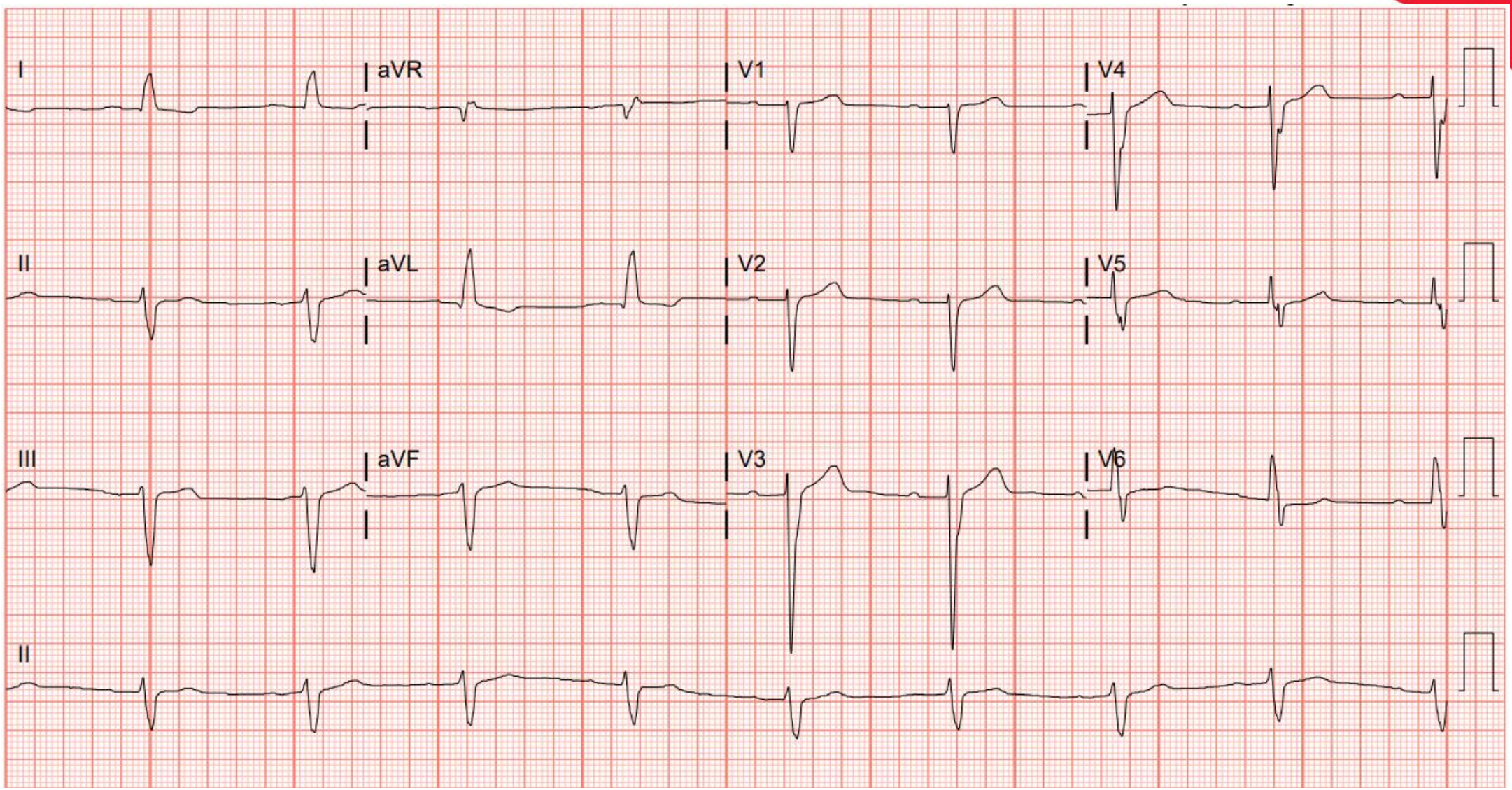
Sinus rhythm
Probable left atrial enlargement
Left ventricular hypertrophy
Abnormal T, consider ischemia, lateral leads
Minimal ST elevation, lateral leads
Prolonged QT interval

Sinus Rhythm

Rate	68
PR	178
QRSd	123
QT	516
QTc	549

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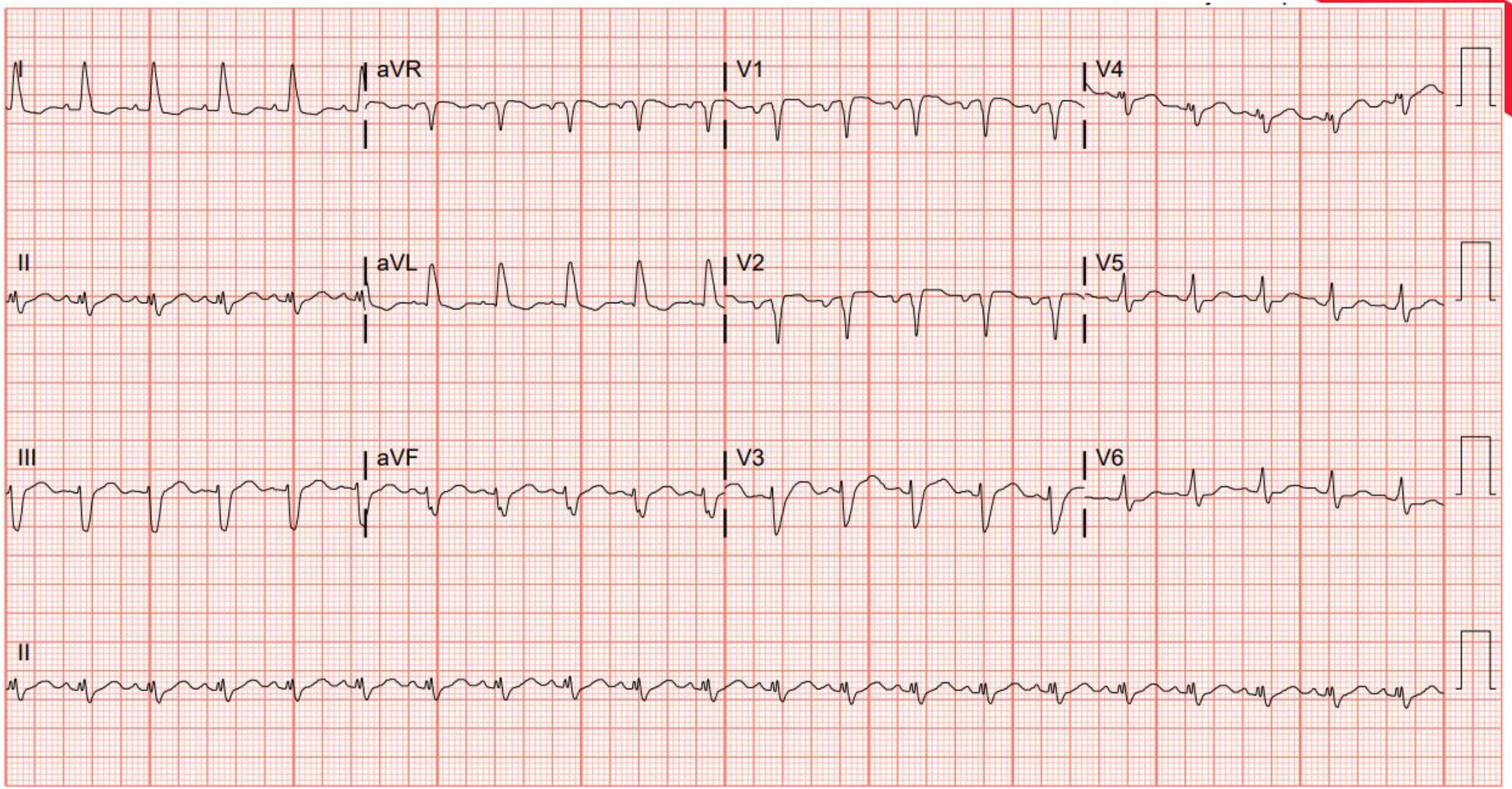
Sinus rhythm
Prolonged PR interval
Nonspecific IVCD with LAD
Left ventricular hypertrophy

Sinus Bradycardia

Rate	54
PR	269
QRSd	128
QT	445
QTc	422

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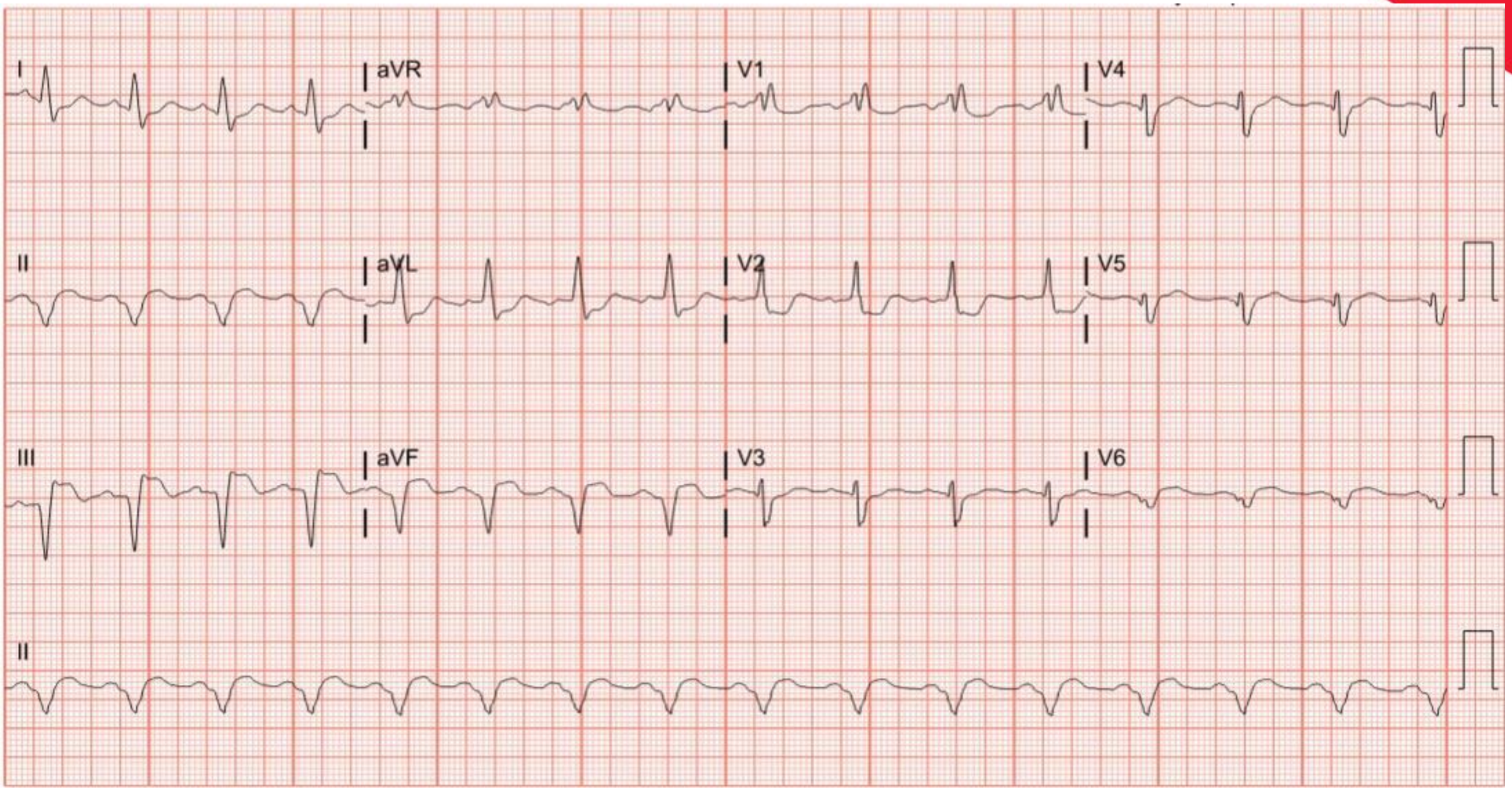
Sinus Tachycardia

Rate	124
PR	146
QRSd	118
QT	307
QTc	441

Sinus tachycardia

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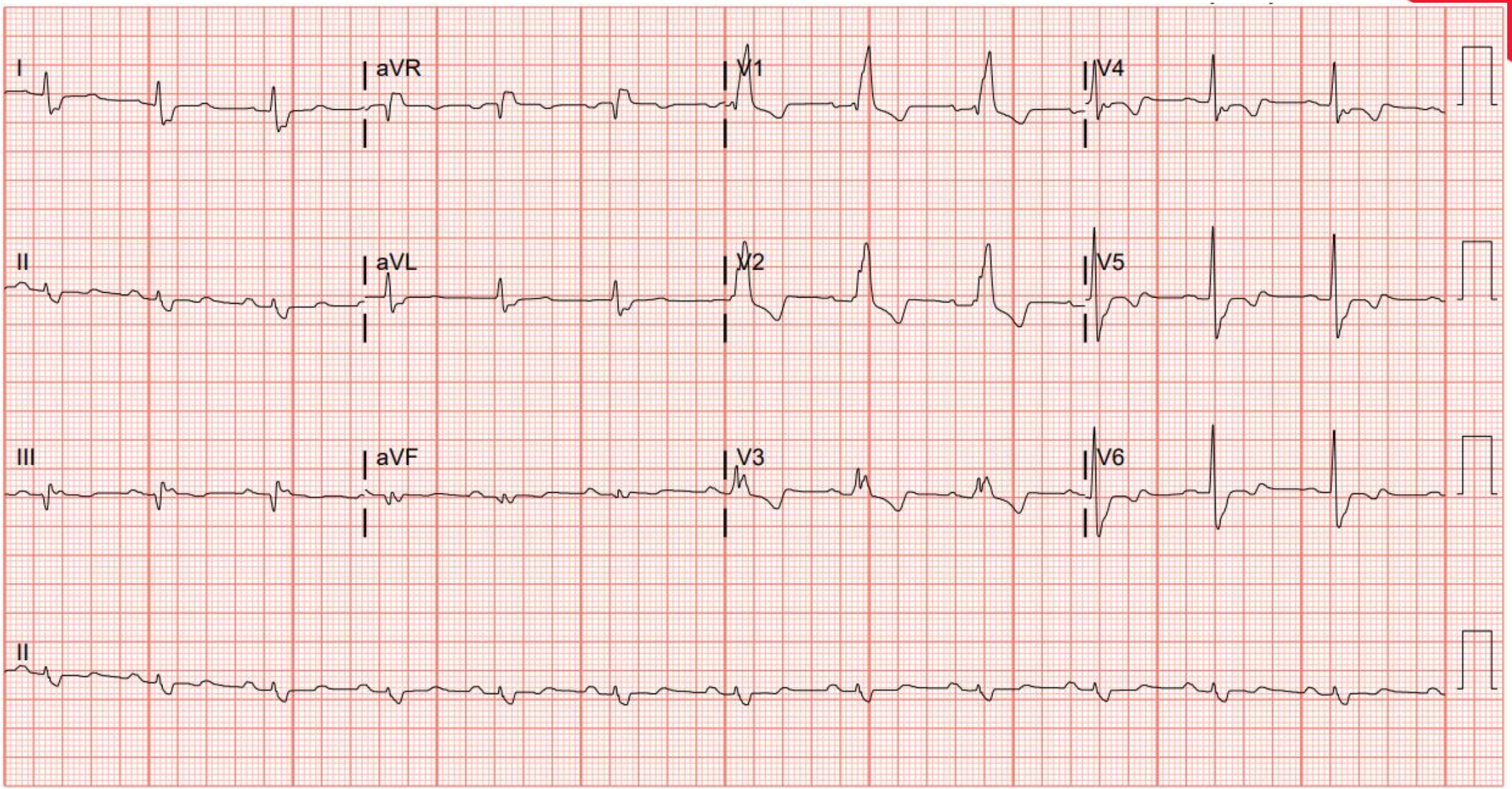
Sinus rhythm
Right bundle branch block
Inferior infarct, acute (RCA)
Lateral leads are also involved
Probable RV involvement, suggest recording right precordial leads

RBBB

Rate	93
PR	177
QRSd	153
QT	332
QTc	413

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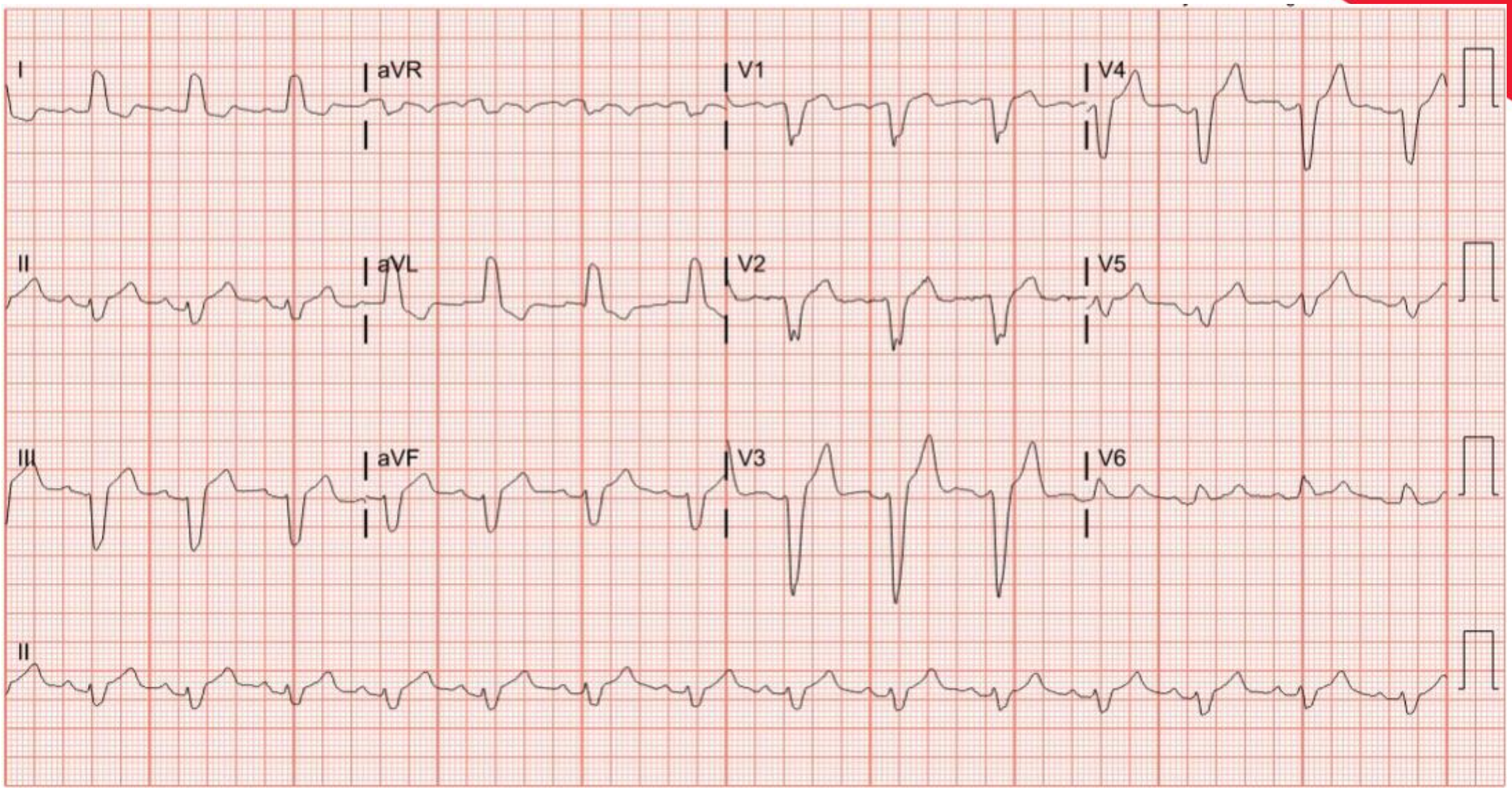


Sinus rhythm
Right bundle branch block

Rate	74
PR	175
QRSd	165
QT	452
QTc	502

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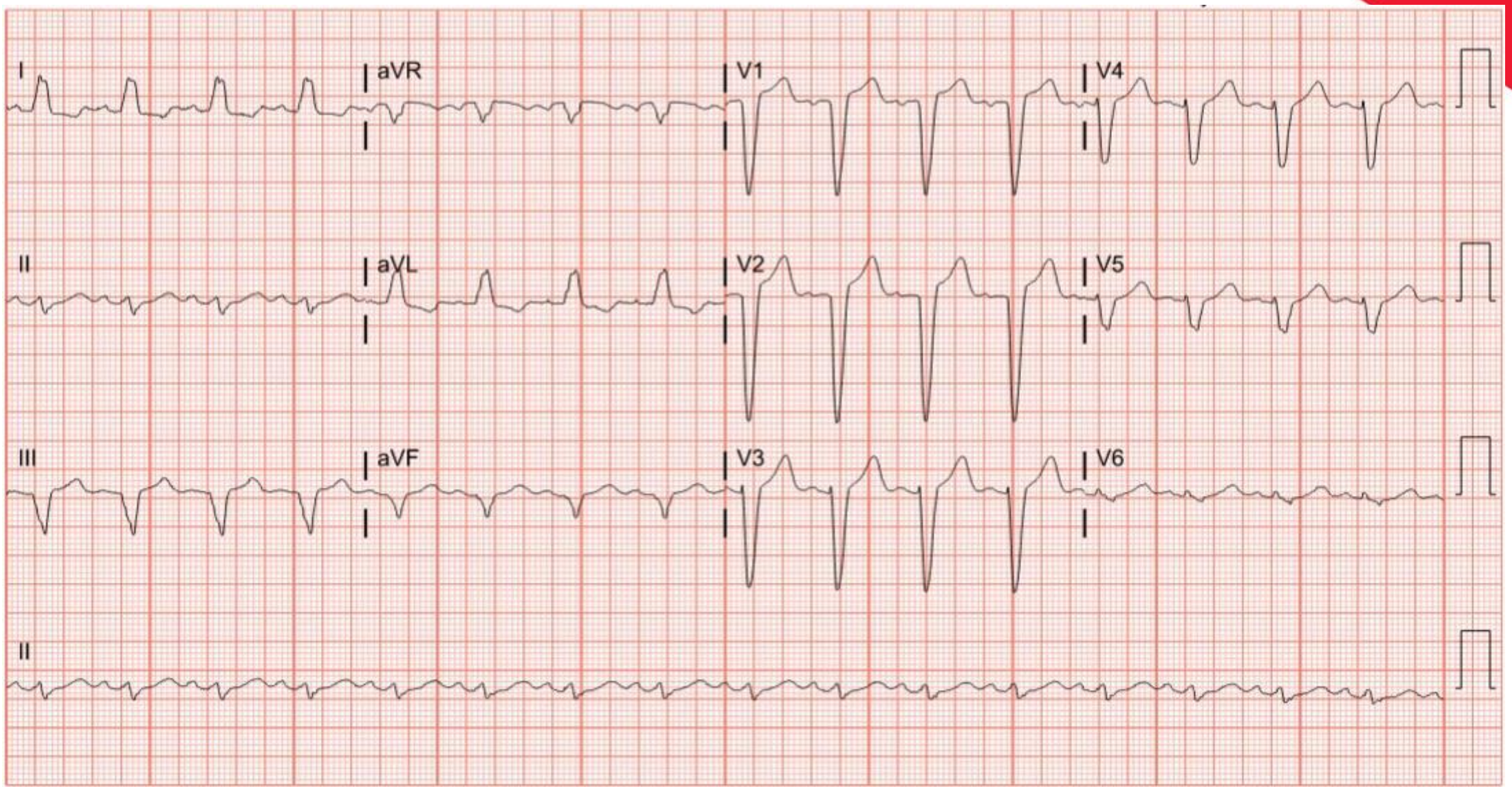
Sinus rhythm
Left bundle branch block
Compared to ECG 03/19/2022 15:19:26
Left bundle-branch block now present
Short PR interval no longer present
ST (T wave) deviation no longer present

LBBB

Rate	86
PR	180
QRSd	161
QT	410
QTc	491

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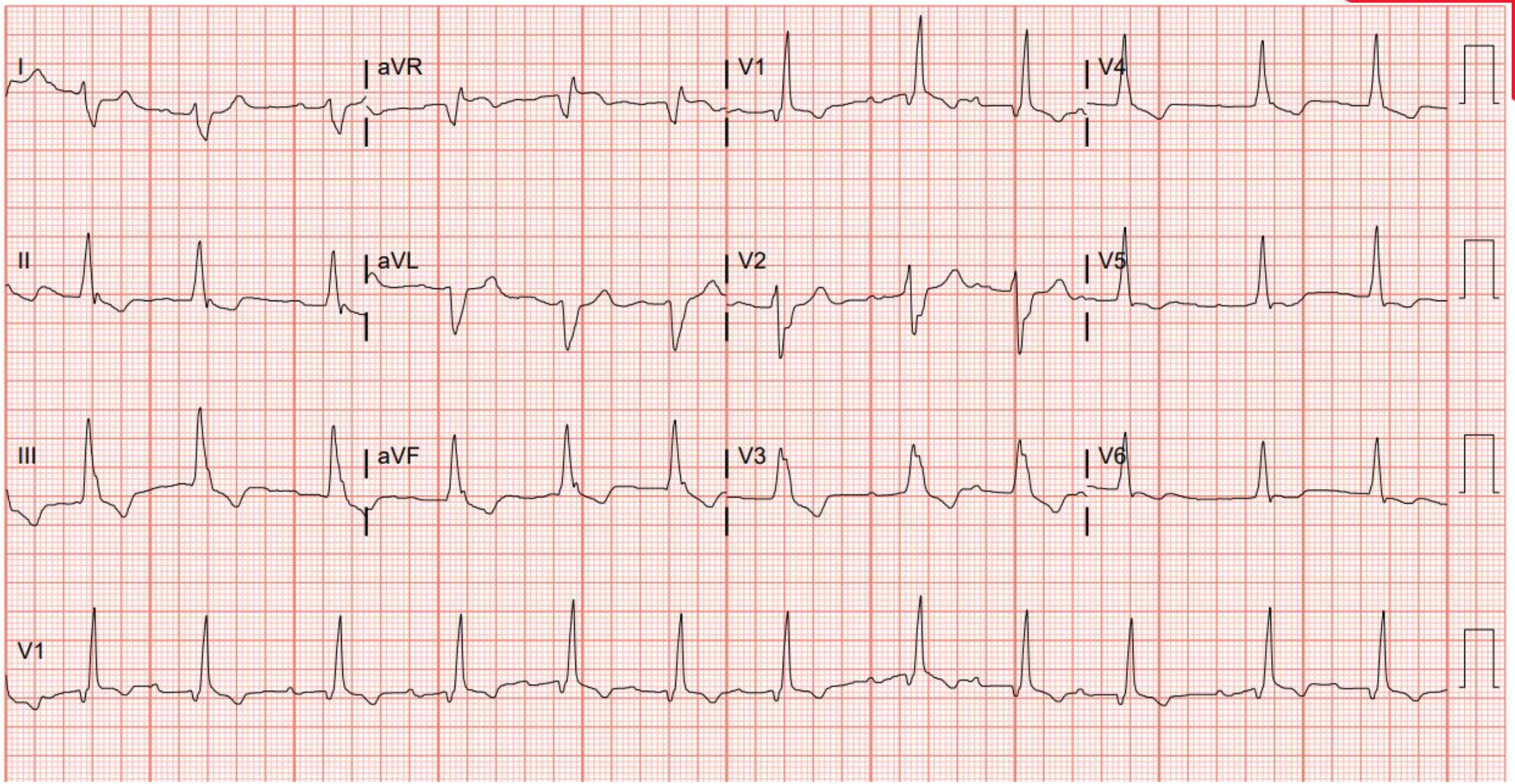


Sinus rhythm
Left bundle branch block

Rate	97
PR	175
QRSd	149
QT	421
QTc	535

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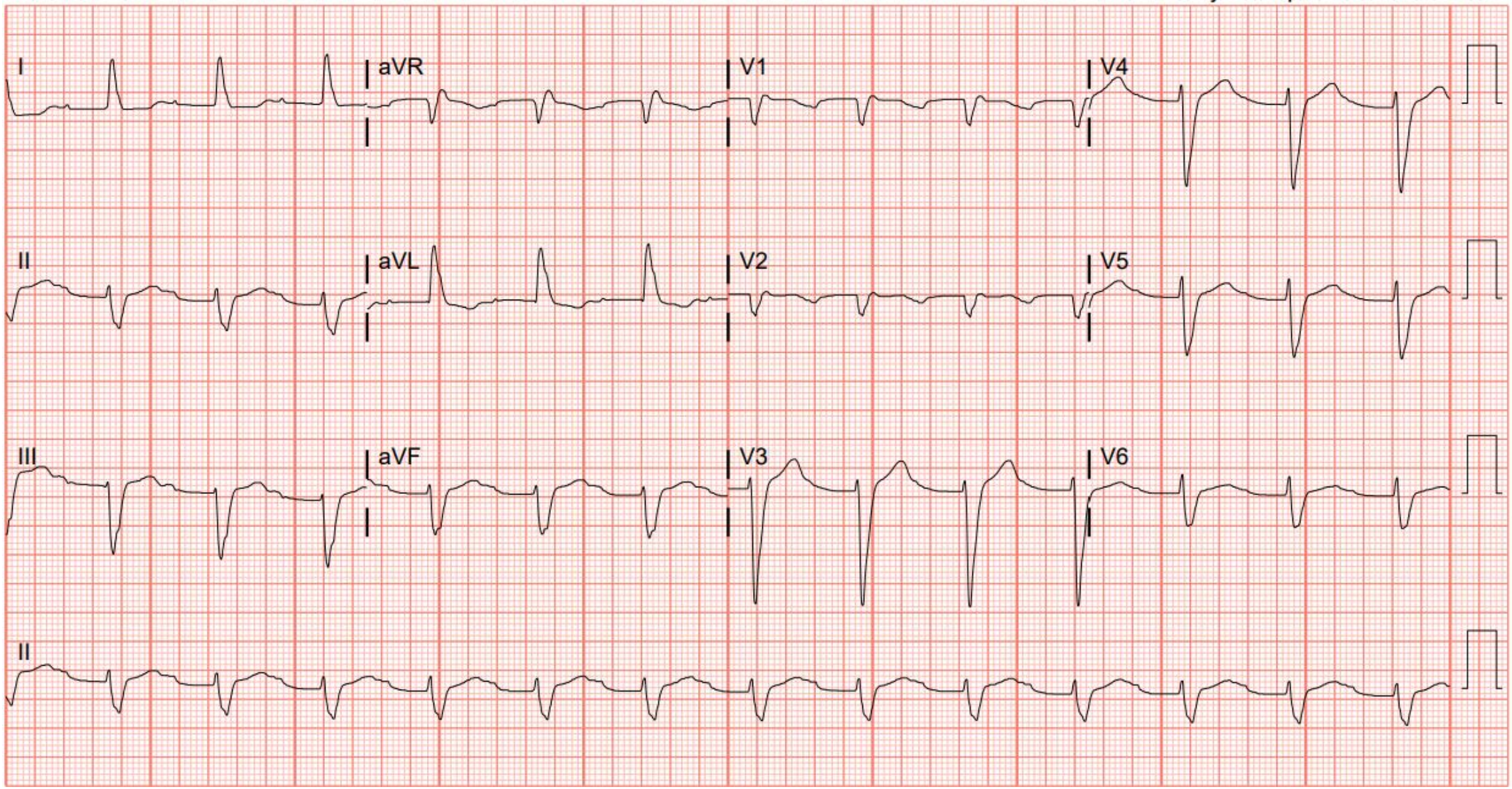
SINUS RHYTHM
FIRST DEGREE AV BLOCK
ATRIAL PREMATURE COMPLEX
RBBB and LPFB

1st Degree AVB

Rate	74
PR	271
QRSd	160
QT	408
QTc	453

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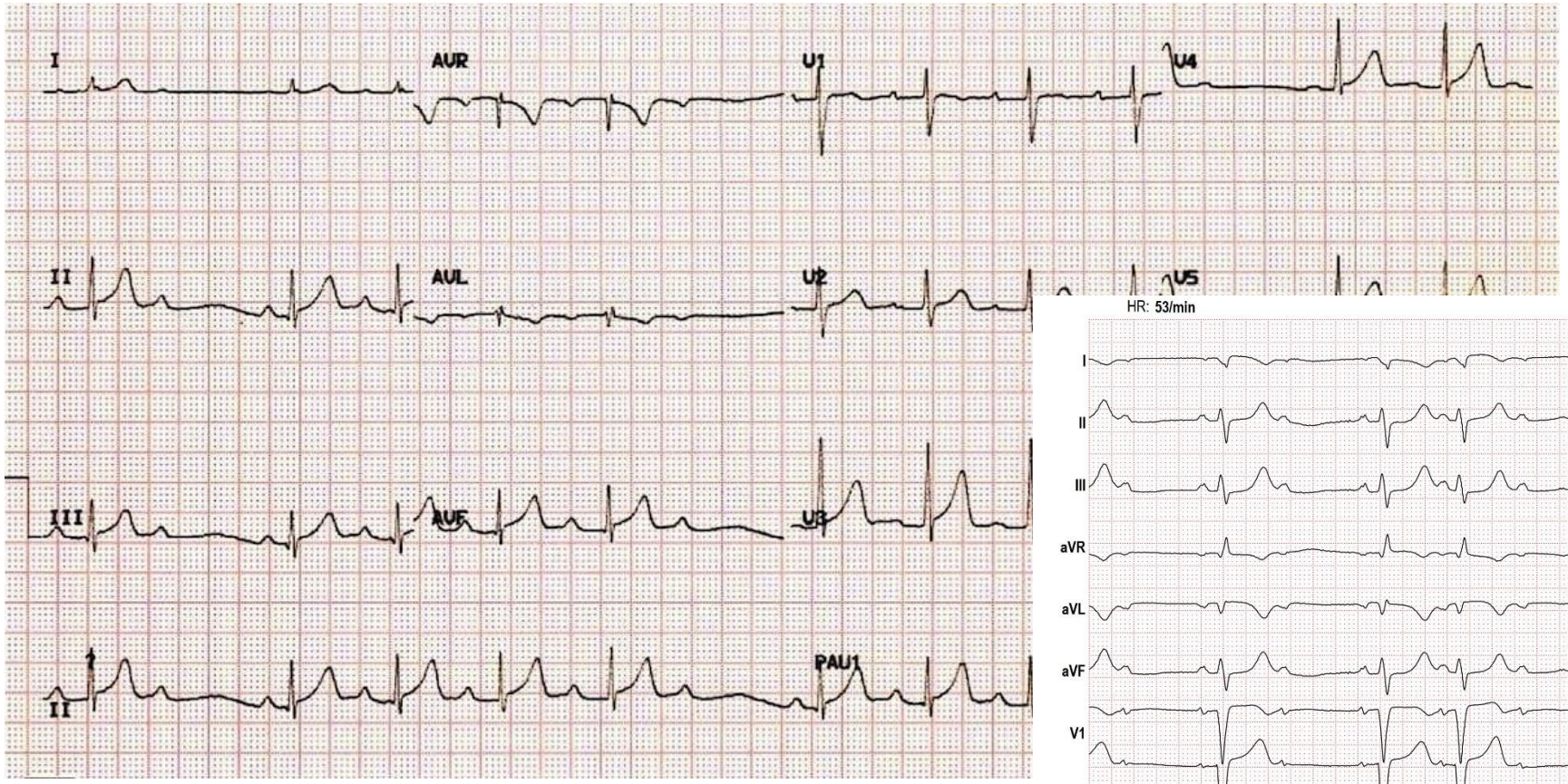


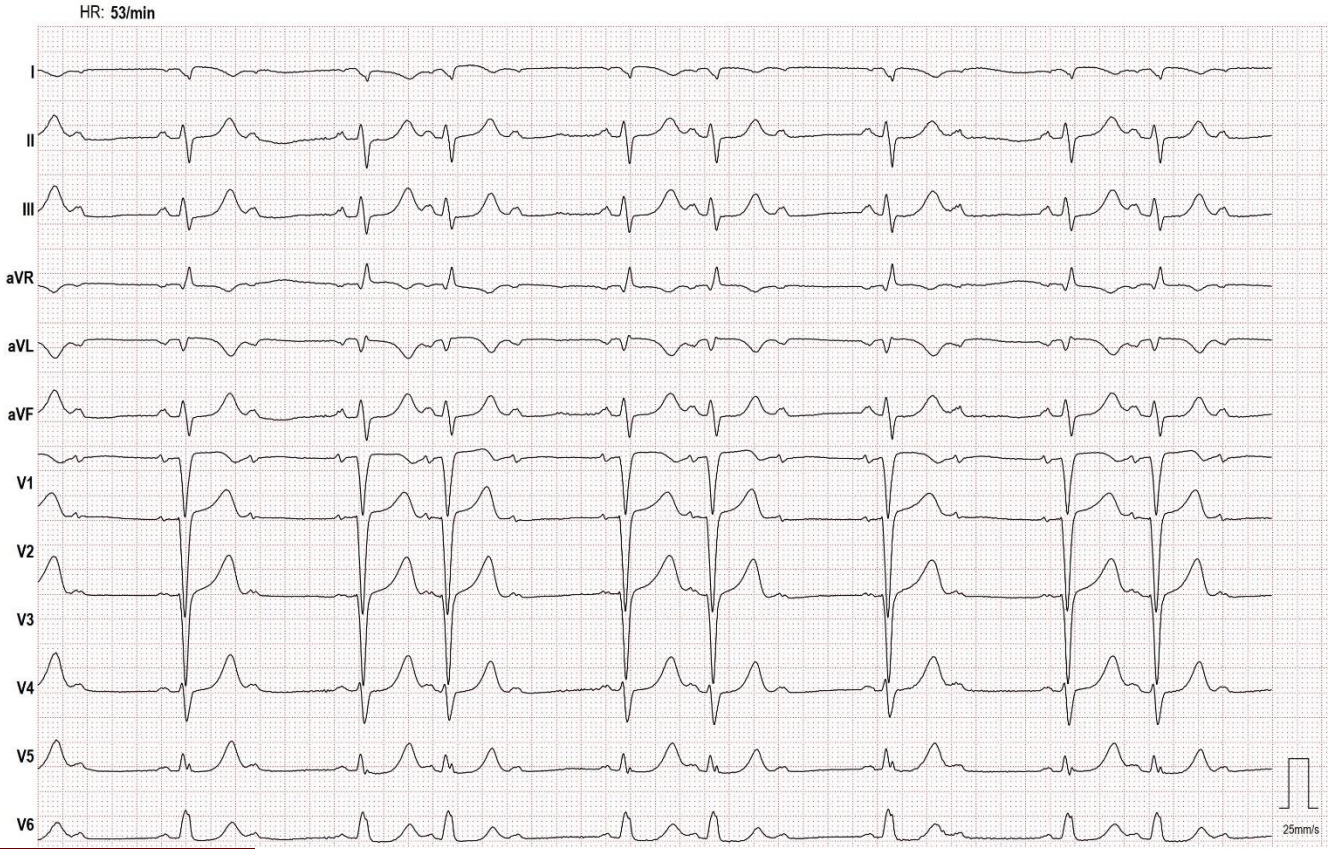
SINUS RHYTHM
FIRST DEGREE AV BLOCK
NONSPECIFIC IVCD WITH LAD

Rate	81
PR	289
QRSd	157
QT	404
QTc	469

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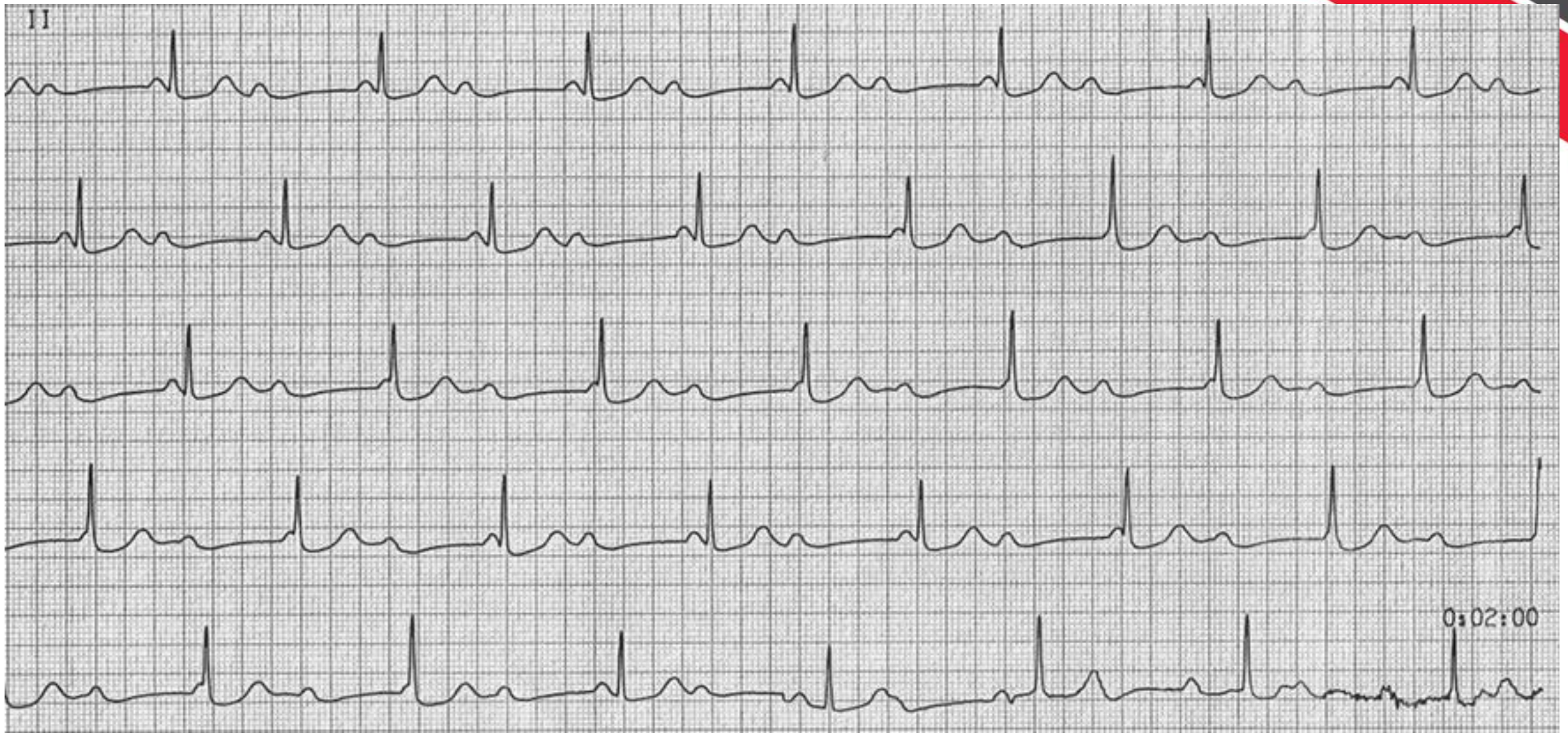




2nd Degree AVB

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3rd Degree AVB

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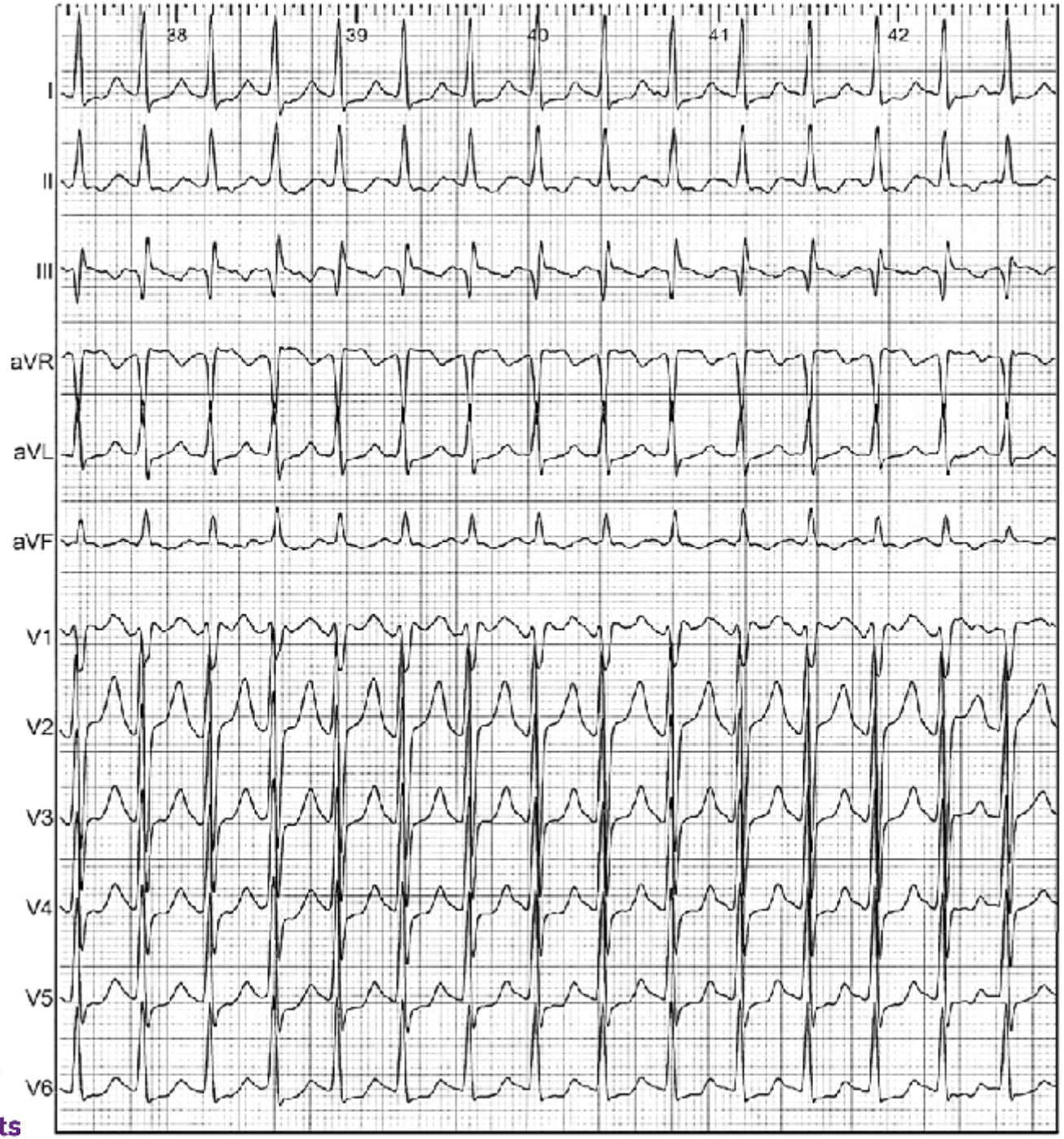
Asystole
LVAD artifact
Compared to ECG 07/19/2021 13:10:18
No significant change

Asystole

Rate	192
PR	100
QRSd	158
QT	340
QTc	608

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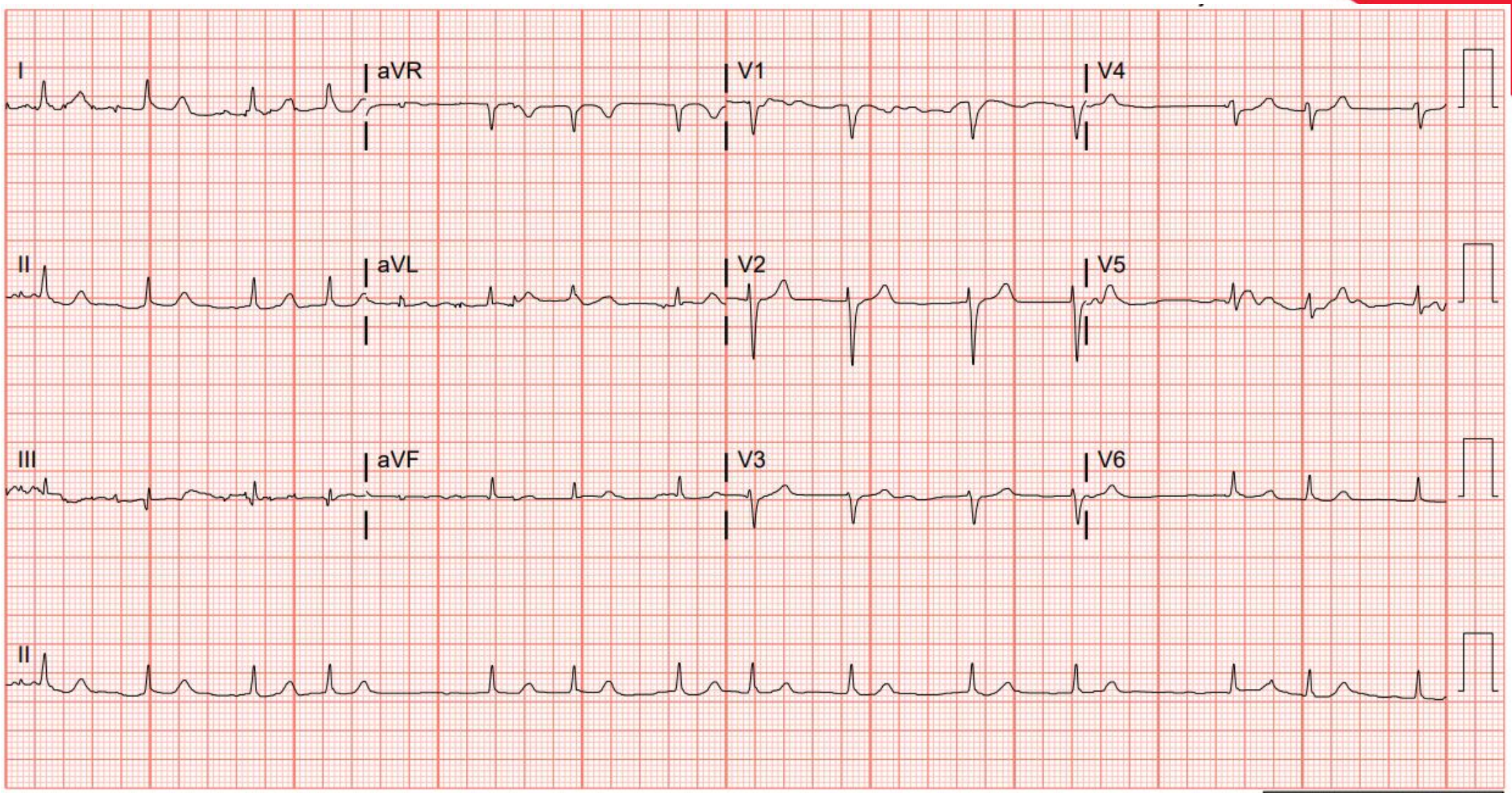
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Atrial Tachycardia

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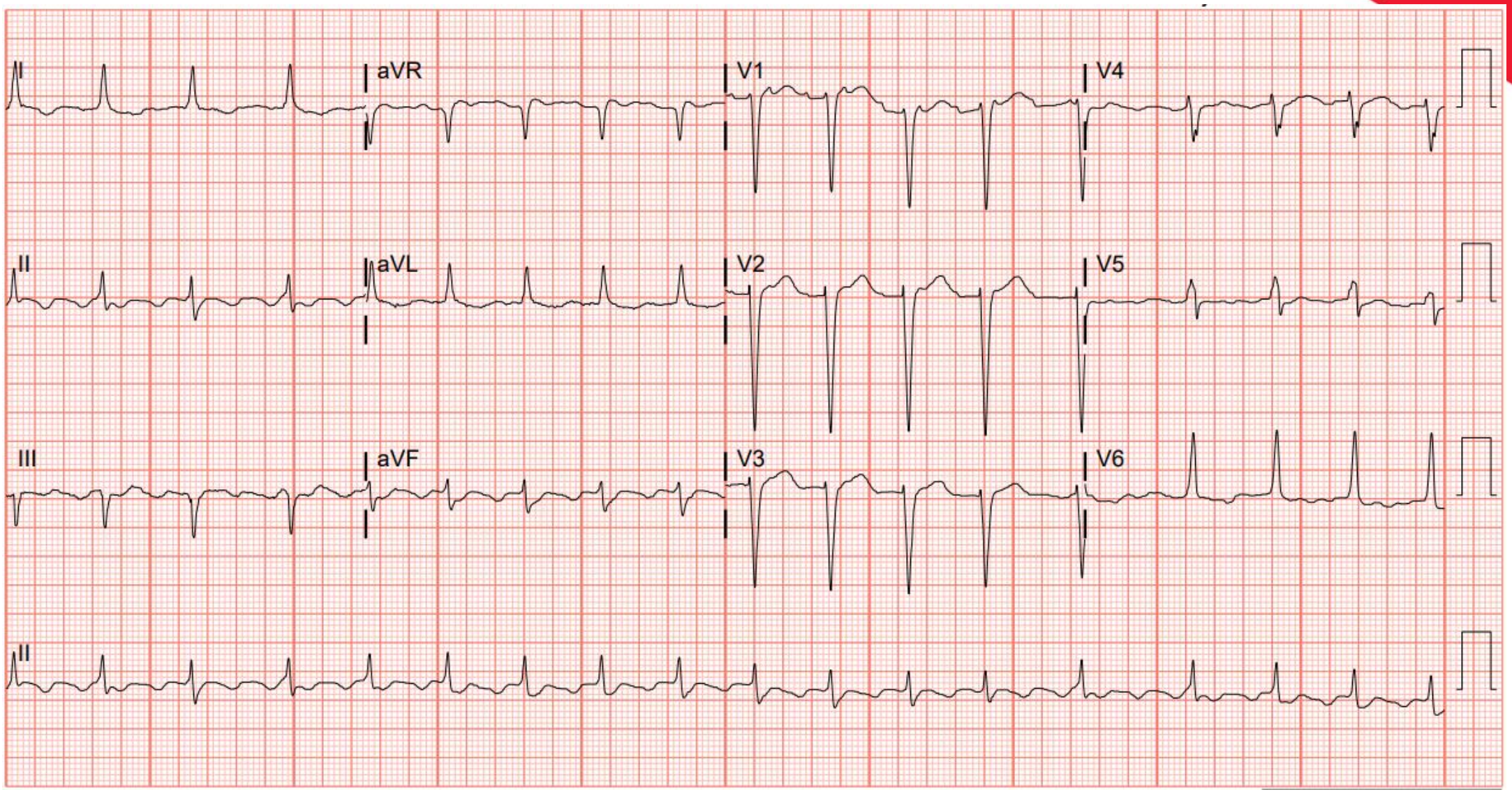
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Atrial Fibrillation

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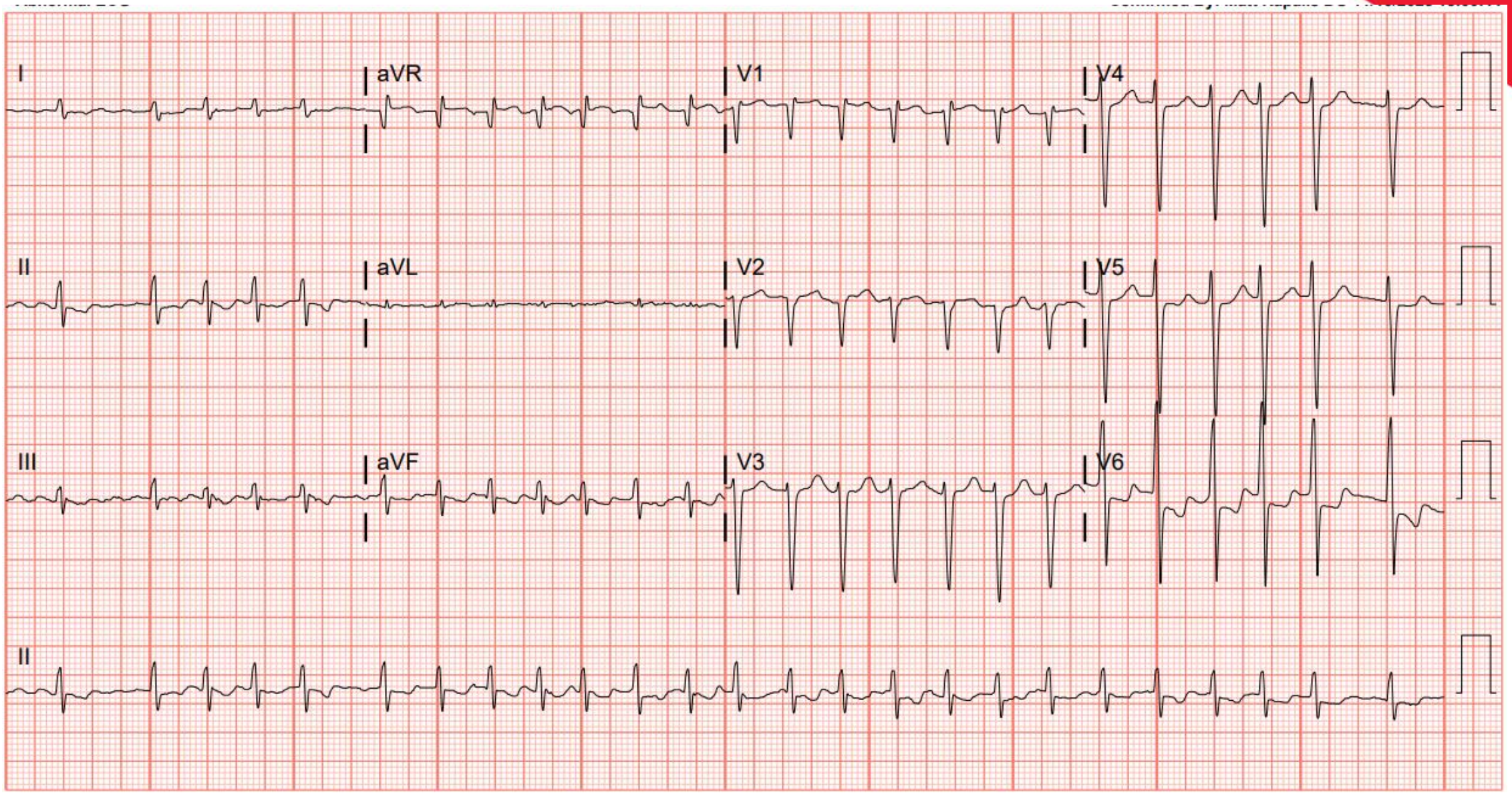


Atrial flutter/fibrillation
Probable LVH with secondary repol abnrm
Anterior Q waves, possibly due to LVH
Prolonged QT interval

Rate	105
PR	
QRSd	105
QT	383
QTc	507

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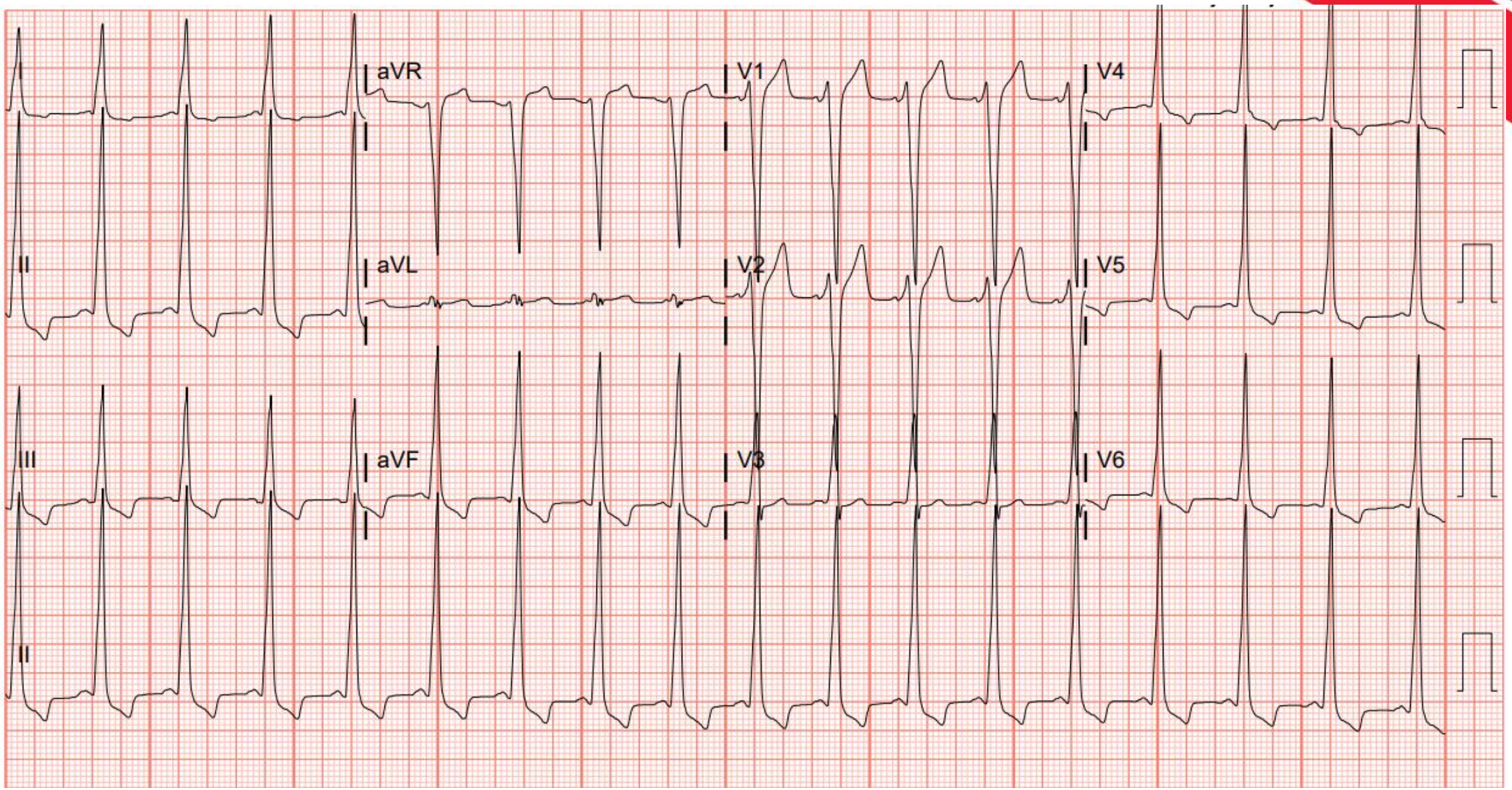


ATRIAL FIBRILLATION WITH RAPID V-RATE
NONSPECIFIC ST and T wave changes, multiple leads

Rate	158
PR	
QRSd	88
QT	260
QTc	422

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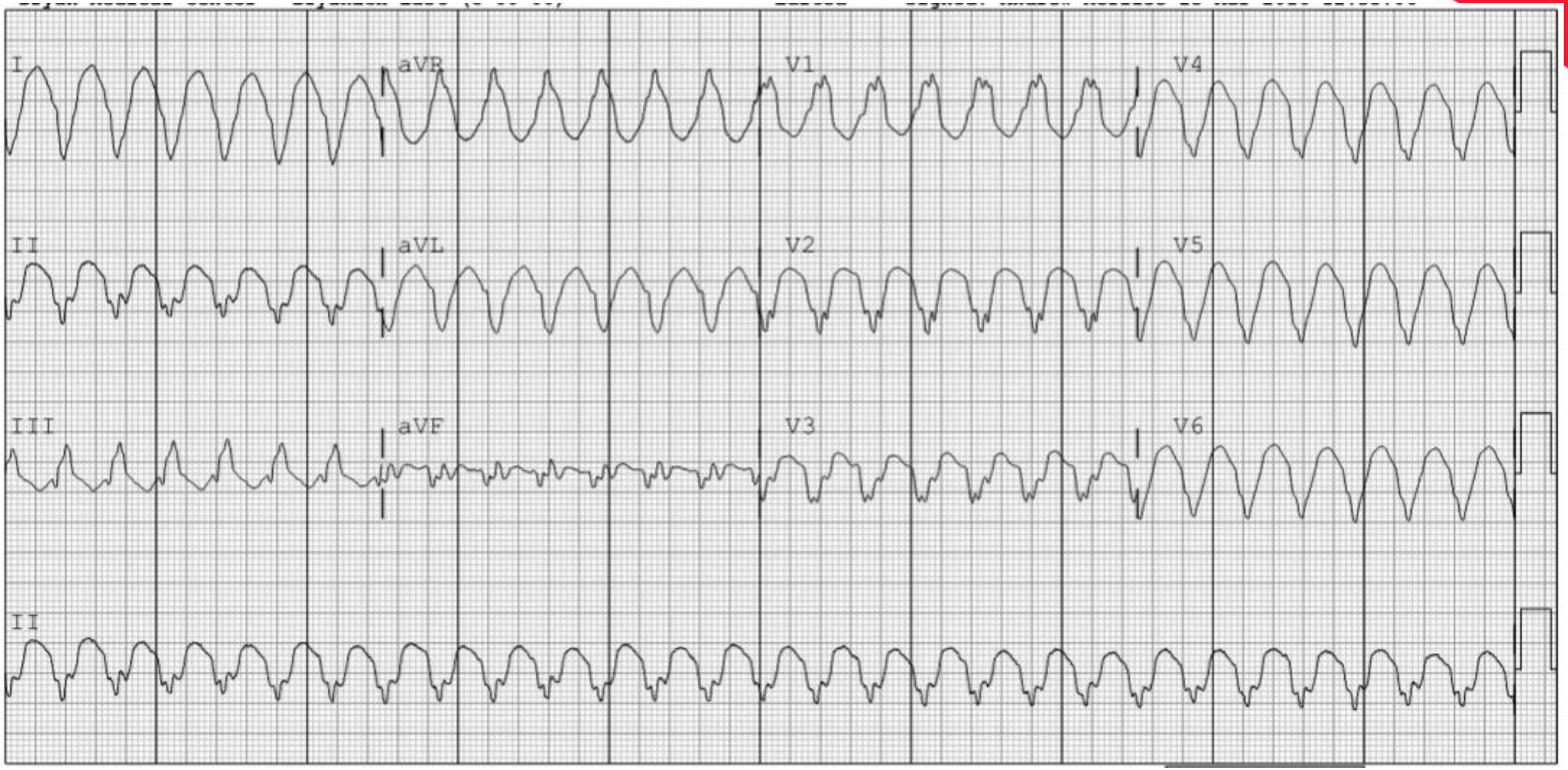
Sinus tachycardia
Probable left atrial enlargement
LVH with IVCD and secondary repol abnrm
ST depr, consider ischemia, inferior leads

LVH

Rate:	105
PR:	106
QRSD:	110
QT:	316
QTc:	418

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EXTREME TACHYCARDIA WITH WIDE COMPLEX
VENTRICULAR TACHYCARDIA

Ventricular Tachycardia

HR	168
RR	357
QRSD	264
QT	320
QTc	536

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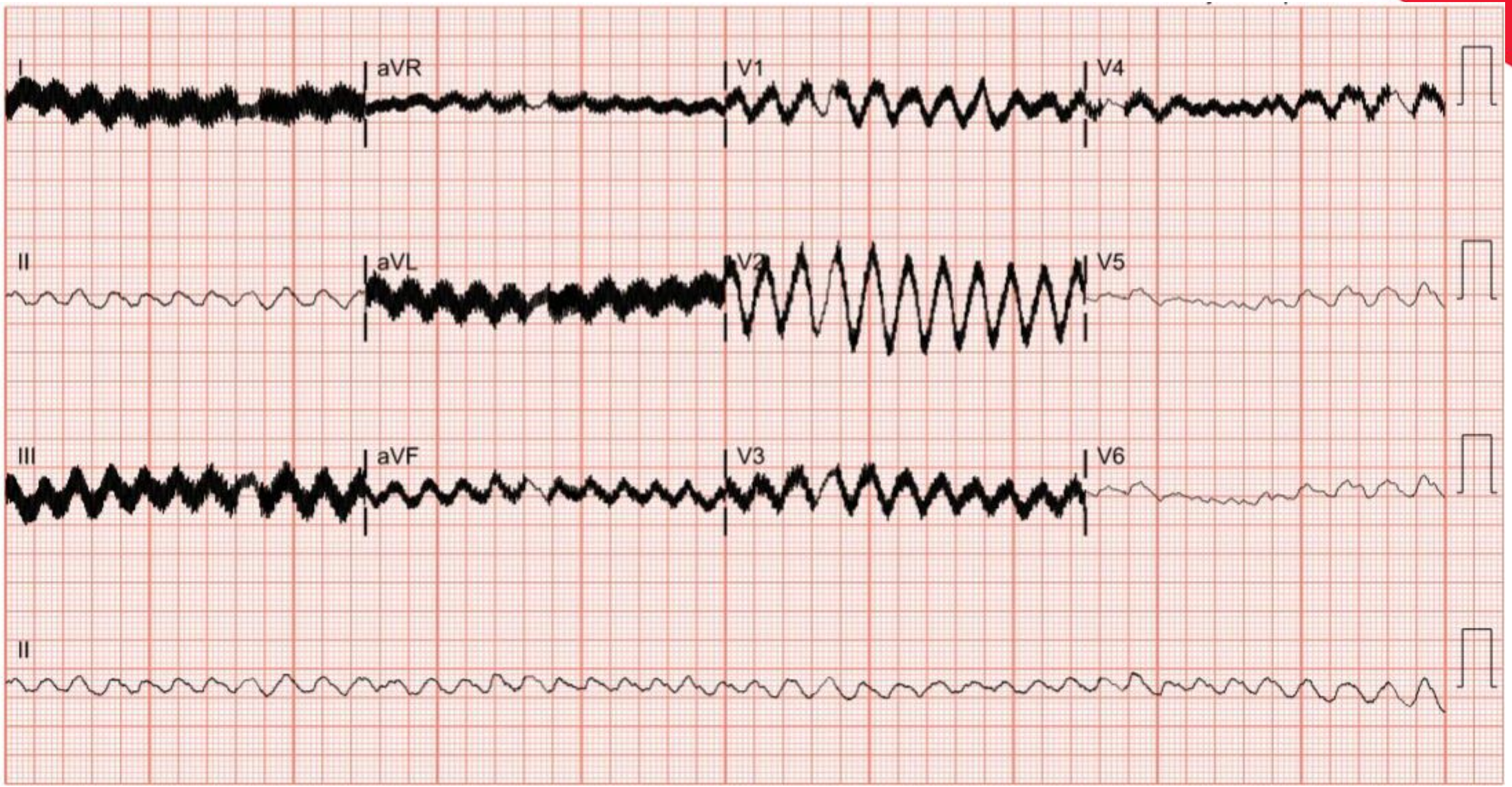
Ventricular Fibrillation

Ventricular Fibrillation

Rate	136
PR	
QRSd	208
QT	418
QTc	629

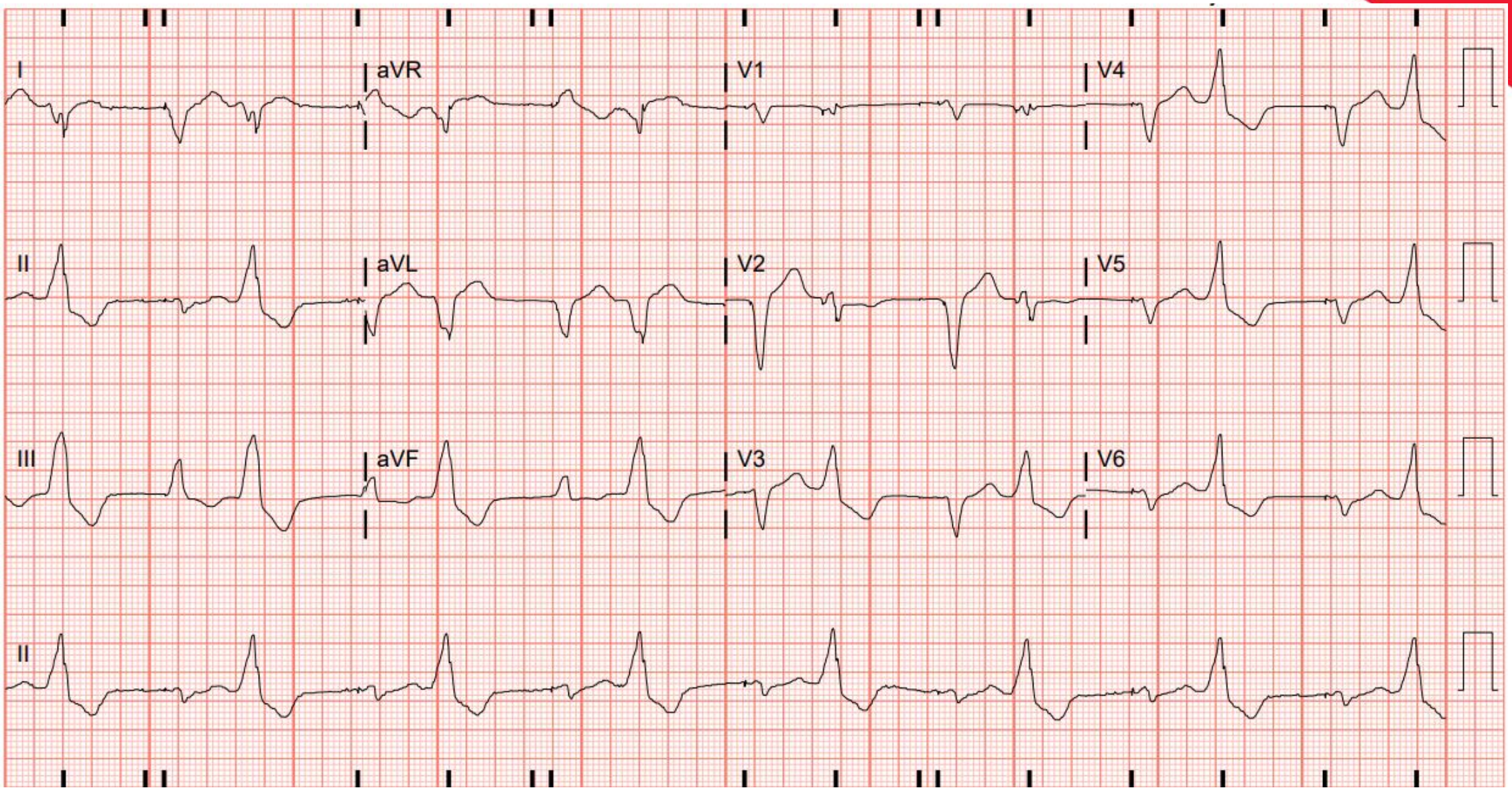
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Skin, Bones, Hearts & Private Parts

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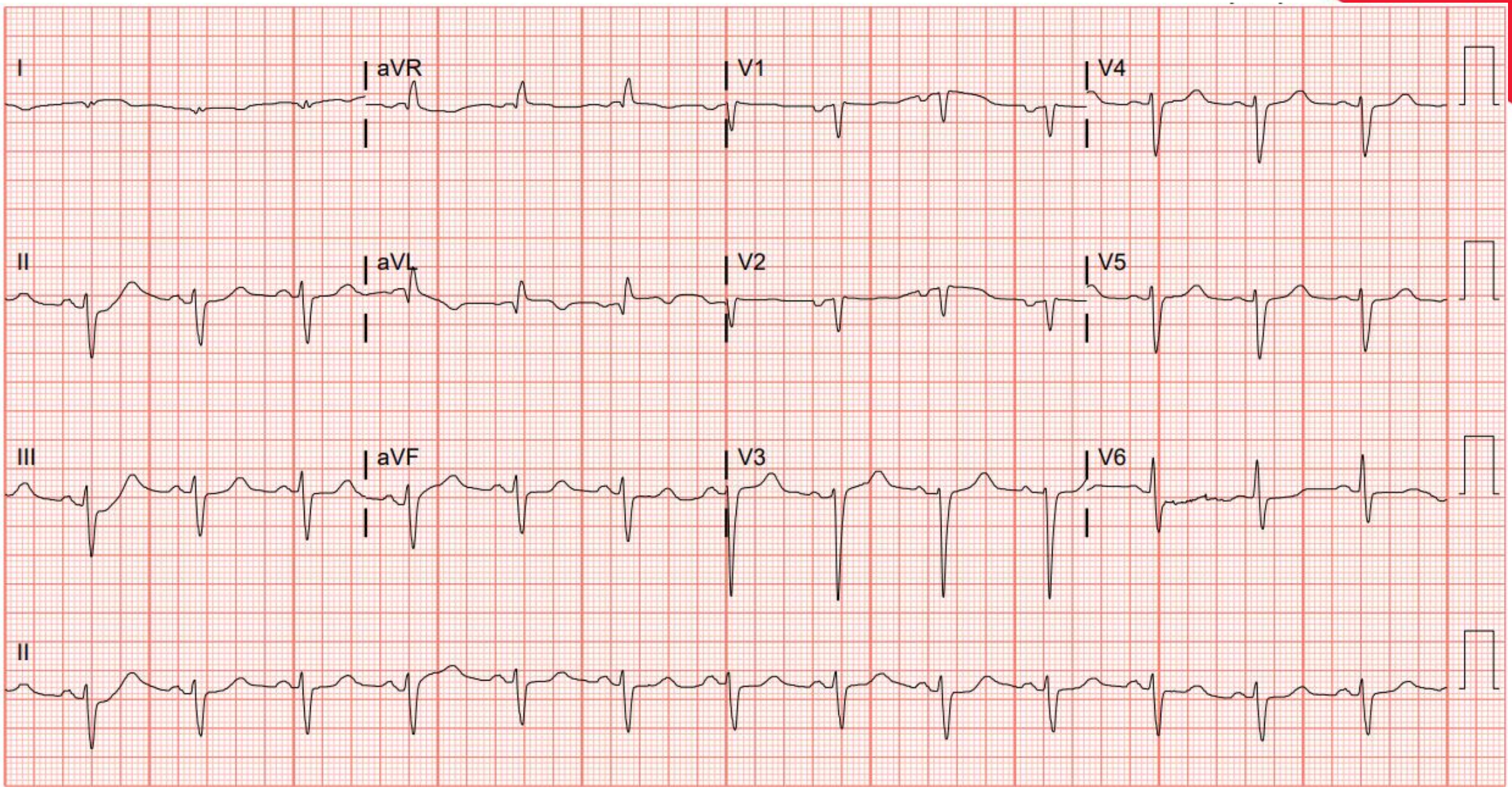
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A-V dual-paced complexes w/ some inhibition
Ventricular bigeminy

PVC's

Rate	94
PR	61
QRSd	182
QT	441
QTc	552

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Sinus rhythm
Probable left atrial enlargement
Left anterior fascicular block
Consider left ventricular hypertrophy
Anterior Q waves, possibly due to LVH
Nonspecific T abnormalities, lateral leads
Prolonged QT interval

LAFB

Rate	82
PR	156
QRSd	111
QT	442
QTc	517

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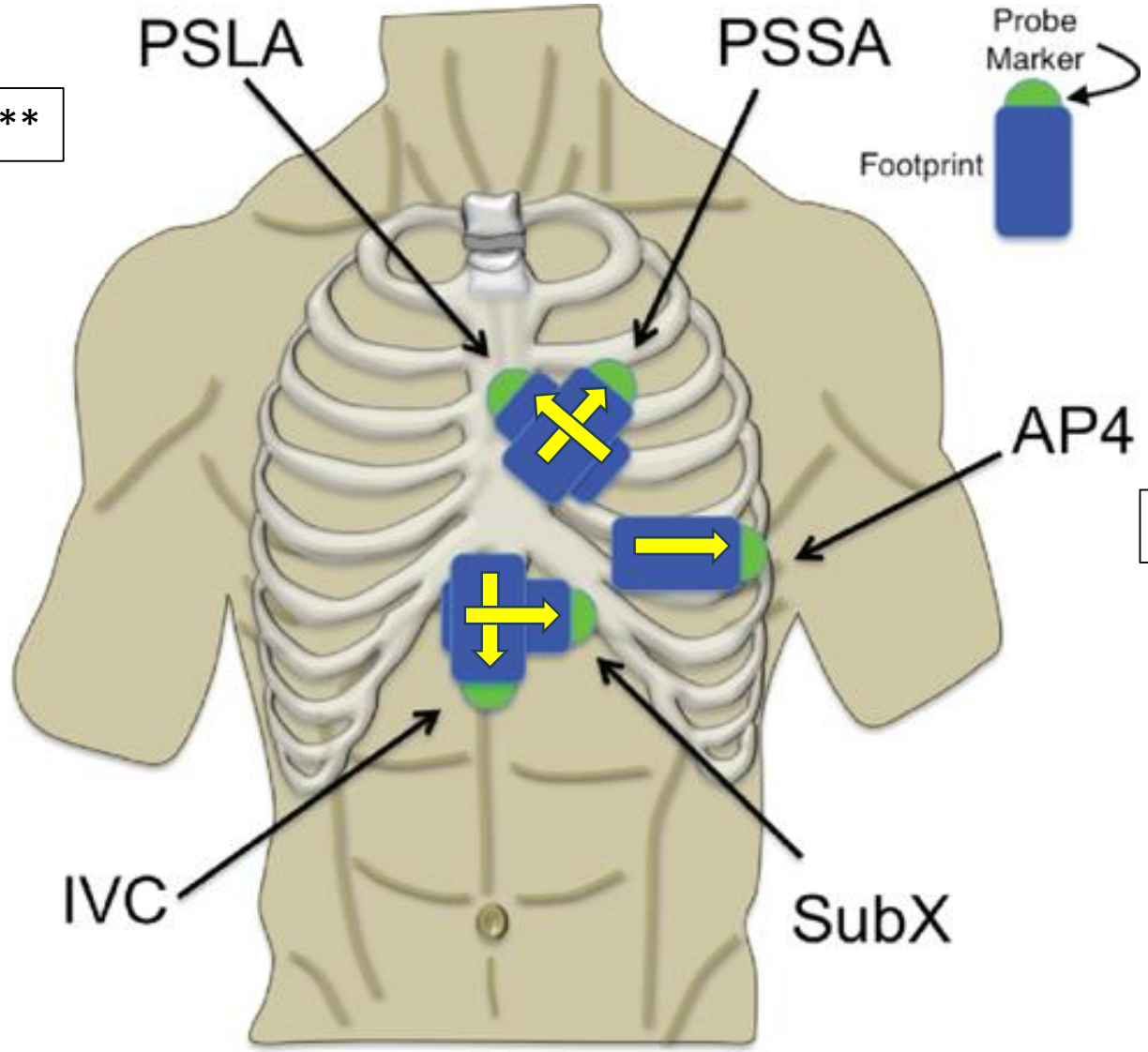
The 4-1-1 on Echocardiography in Cardiac Disease

- Why do we use Echos
- Basic Understanding of the probe direction for what we see…
- Understanding the views of Echocardiography and what we can find in each view

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Parasternal Long Axis



Source: K.J. Knoop, L.B. Stack, A.B. Storrow, R.J. Thurman: The Atlas of Emergency Medicine, 4th Edition, www.accessemergencymedicine
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Parasternal Short Axis

Apical 4-Chamber View

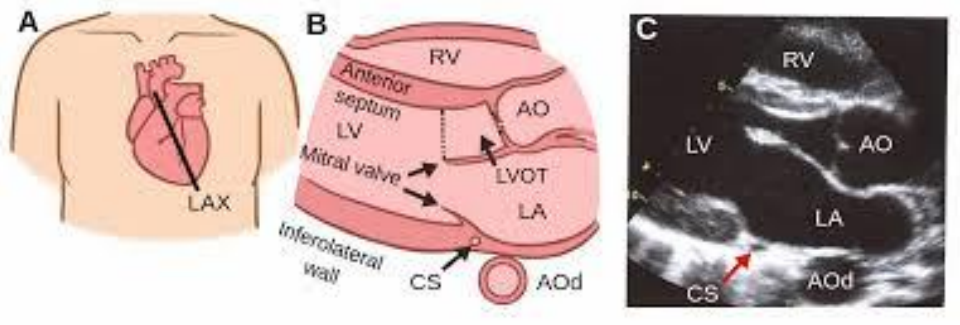
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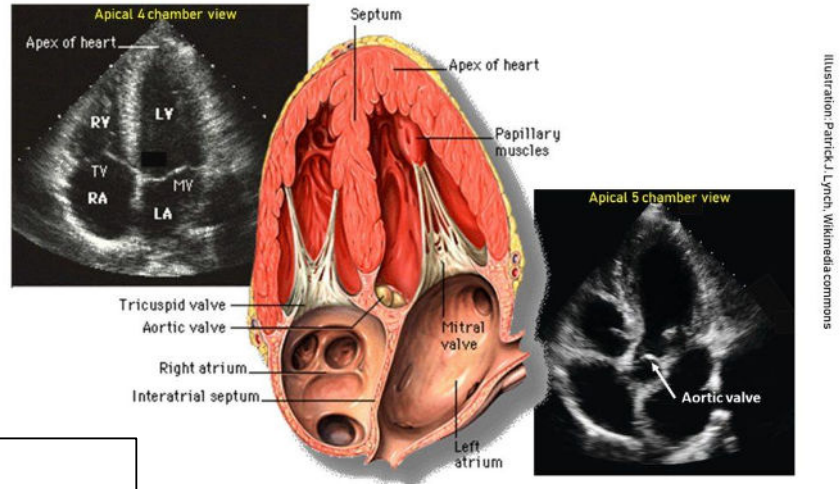
Dechick & McAfferty, 2022. Intern Ultrasound of the Month: A Left Atrial Aneurysm & Review of the Basics — University Hospitals Emergency Medicine Residency

4 Views to Know and Understand

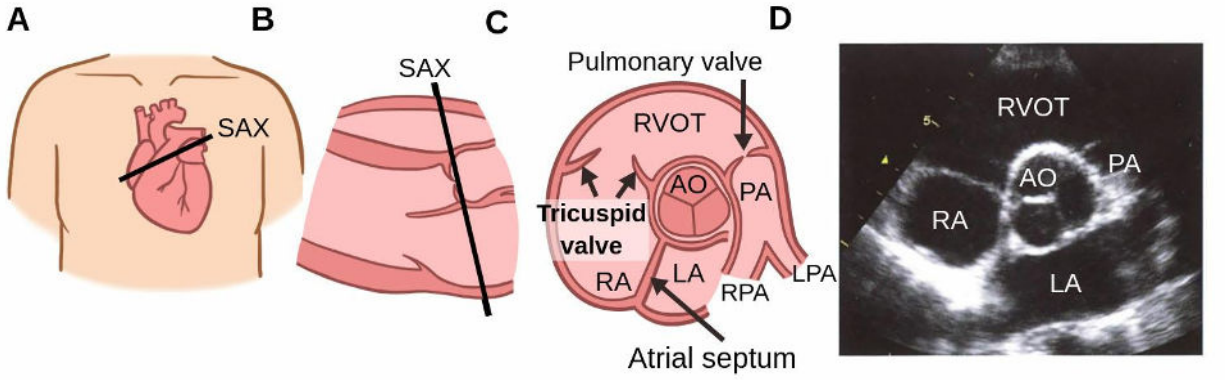
Parasternal Long Axis

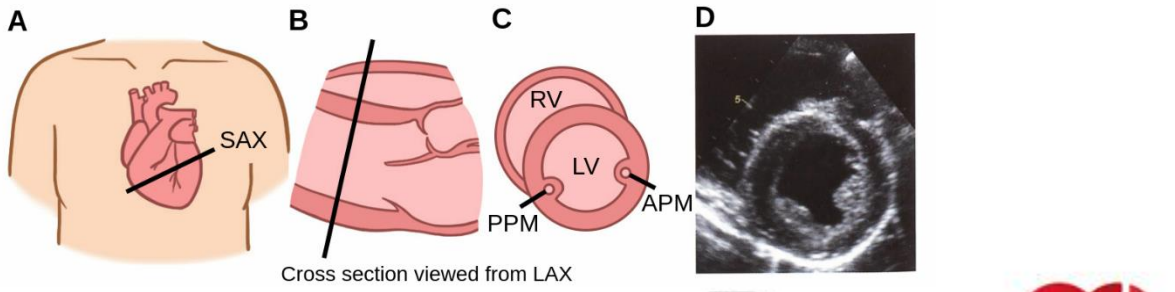


Apical 4-Chamber View



Short Axis and LV Short Axis





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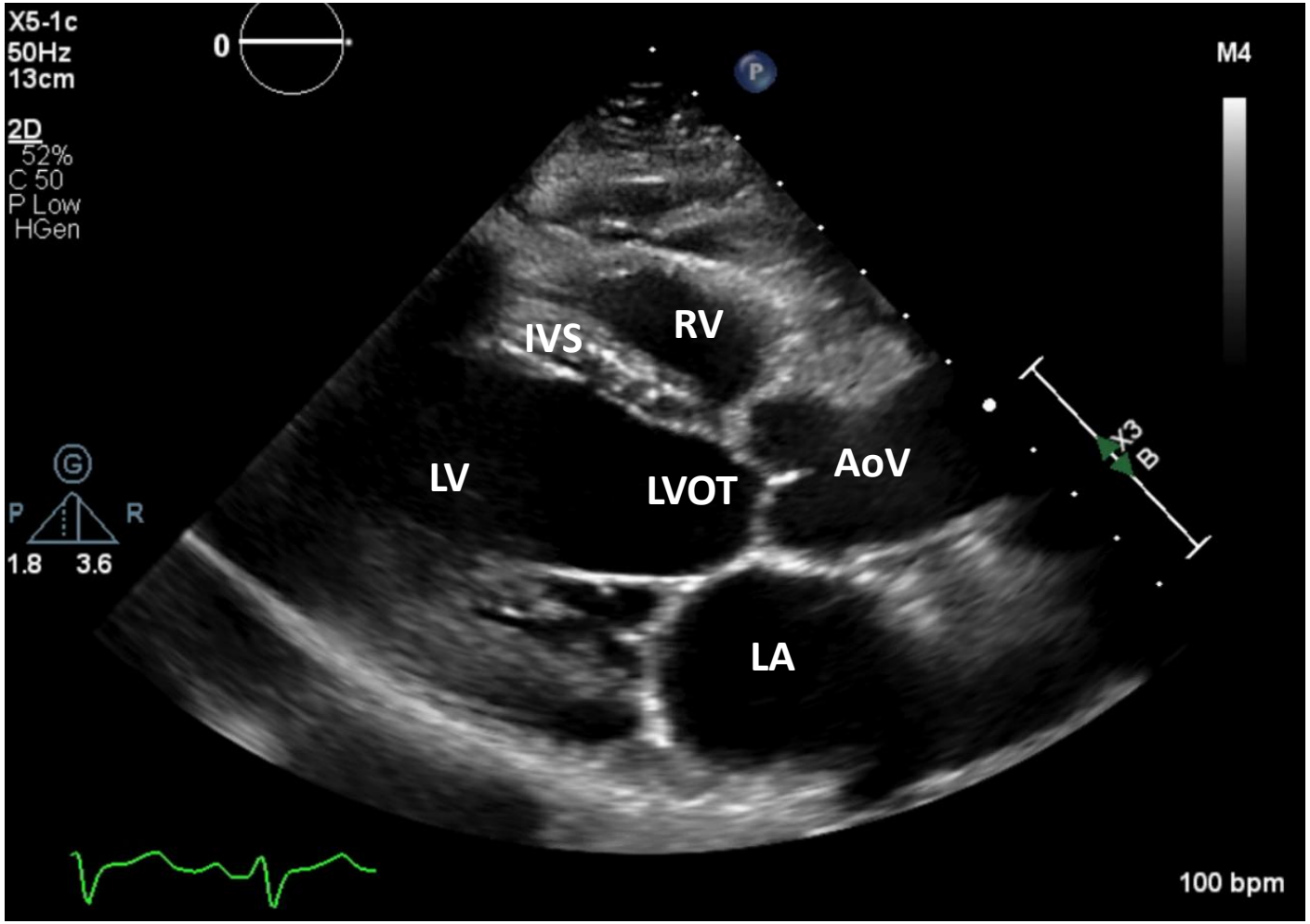
Labster (nd). Parasternal long axis view – Labster

Labster (nd). Parasternal short axis view – Labster

Koratala, A. (2019). Focused Cardiac Ultrasound for the Nephrologist: The apical window - Renal Fellow Network

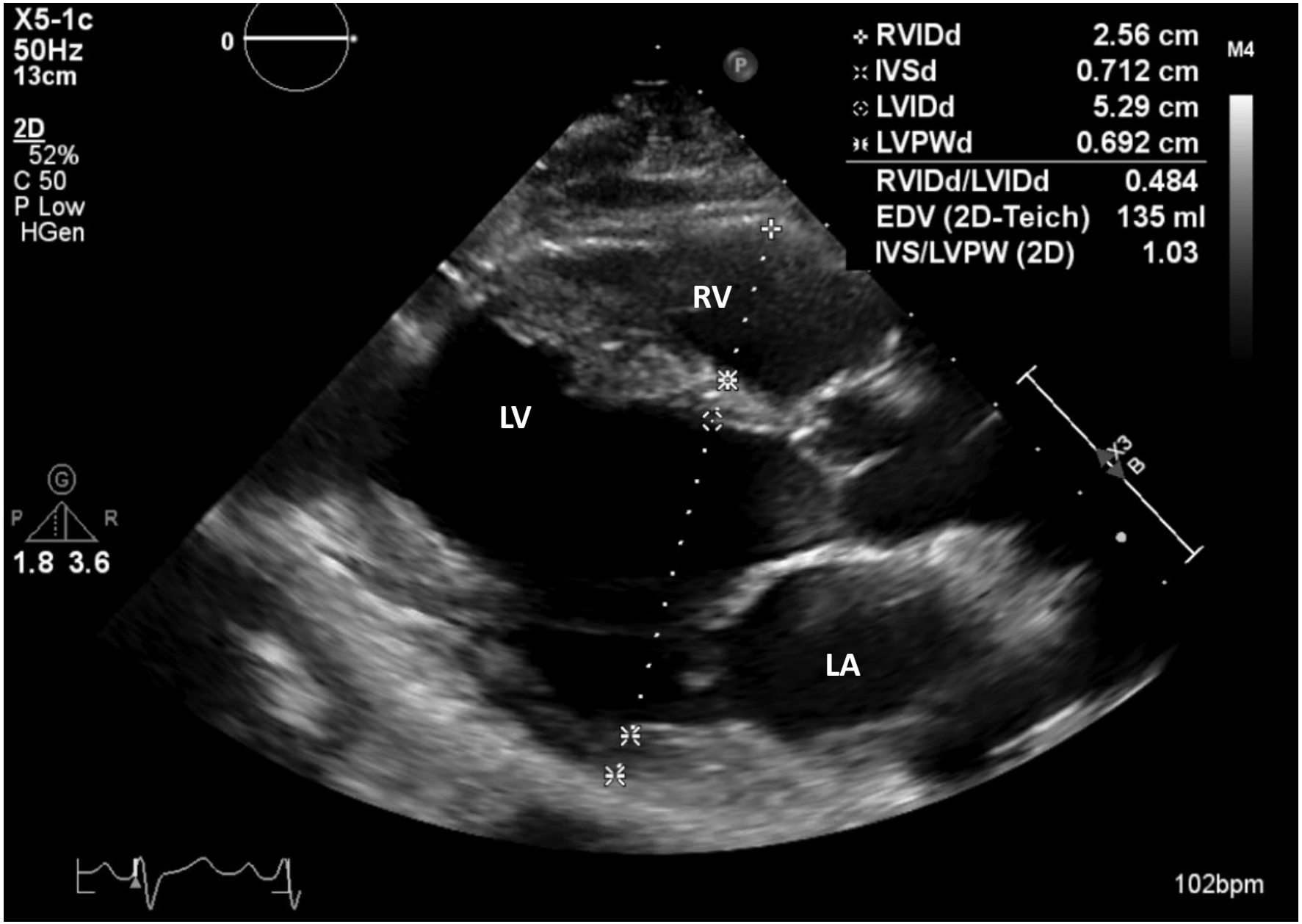
Labster (nd). Parasternal short axis view in the papillary plane - Labster

Normals vs Abnormals



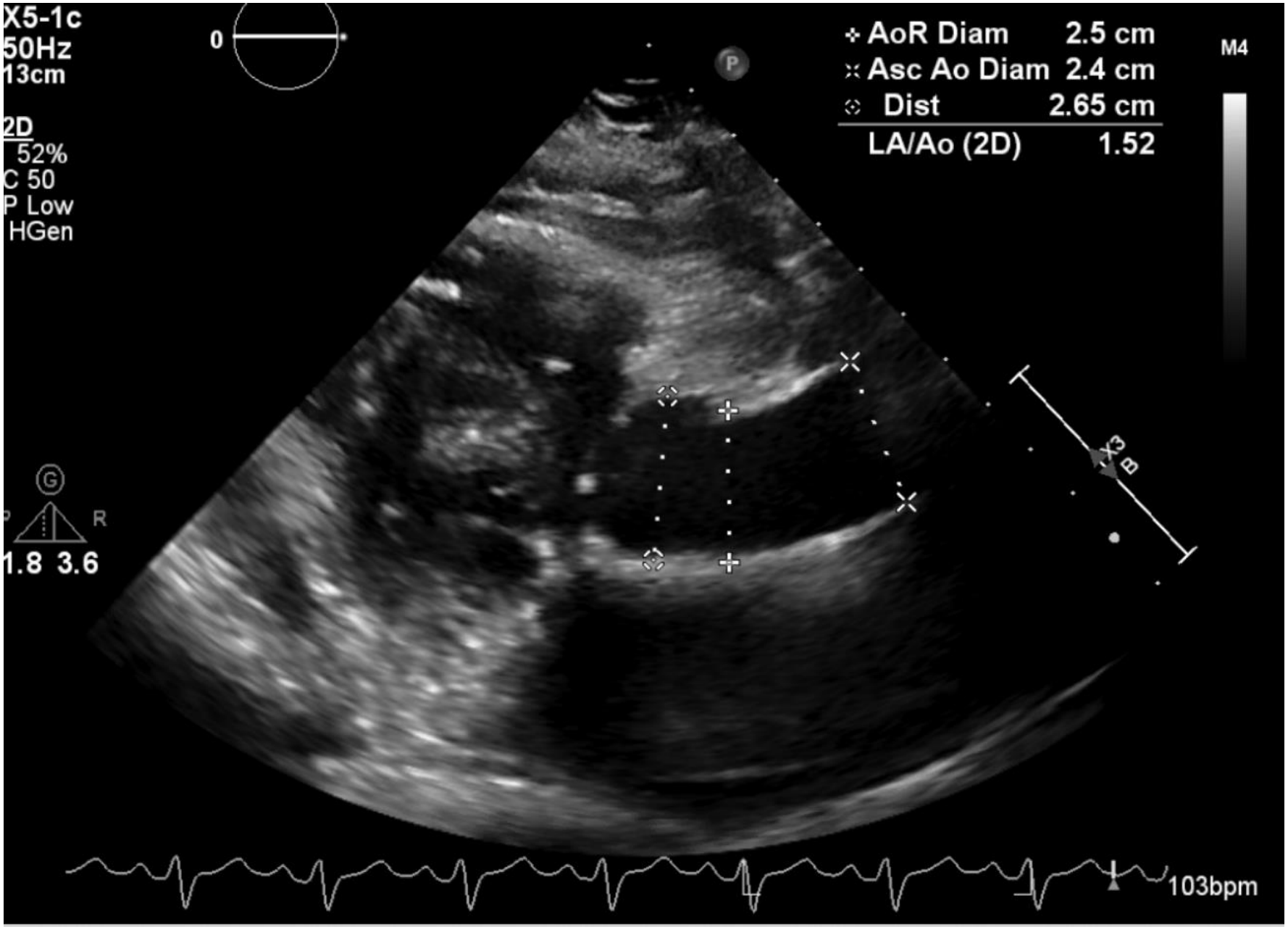
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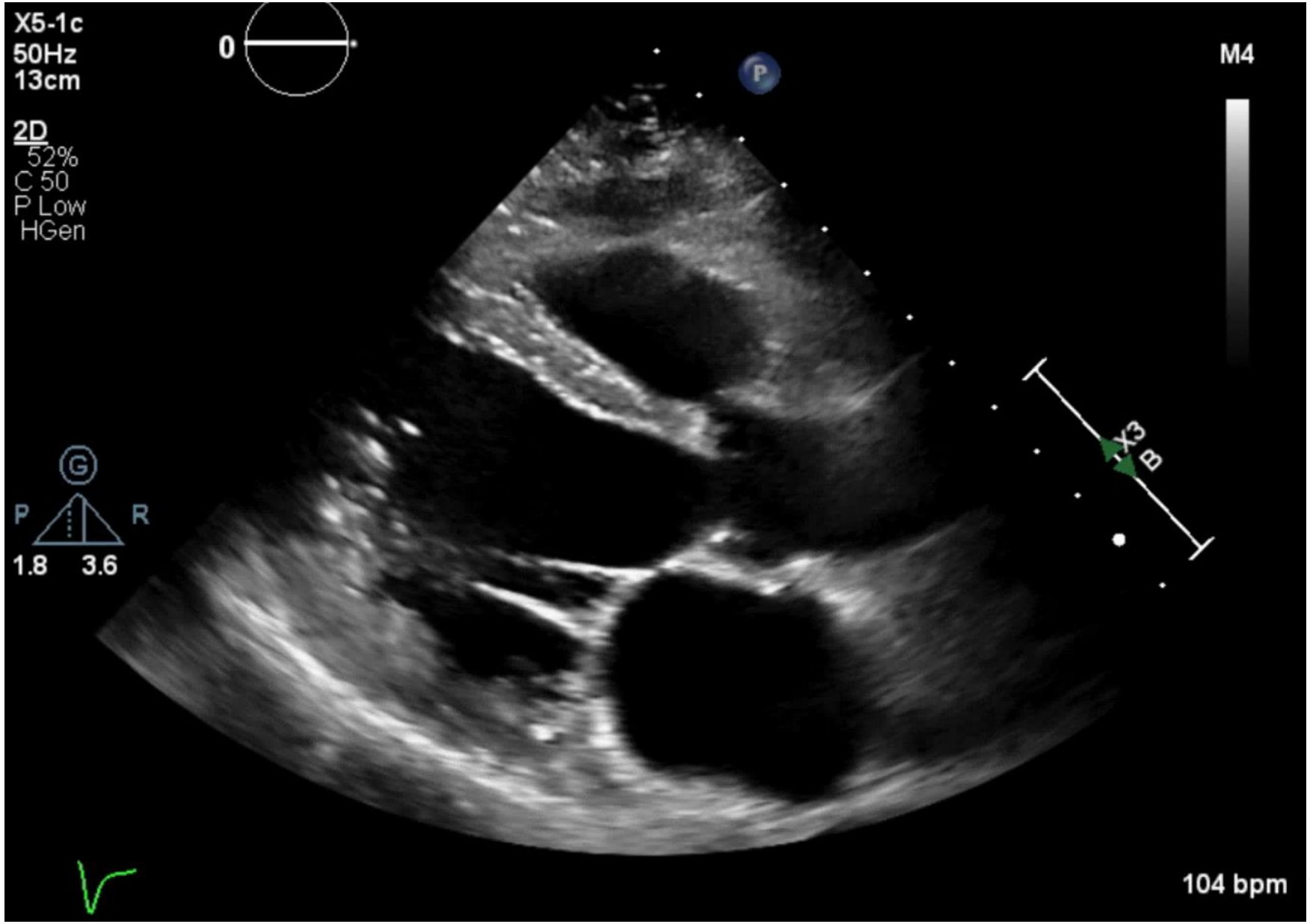
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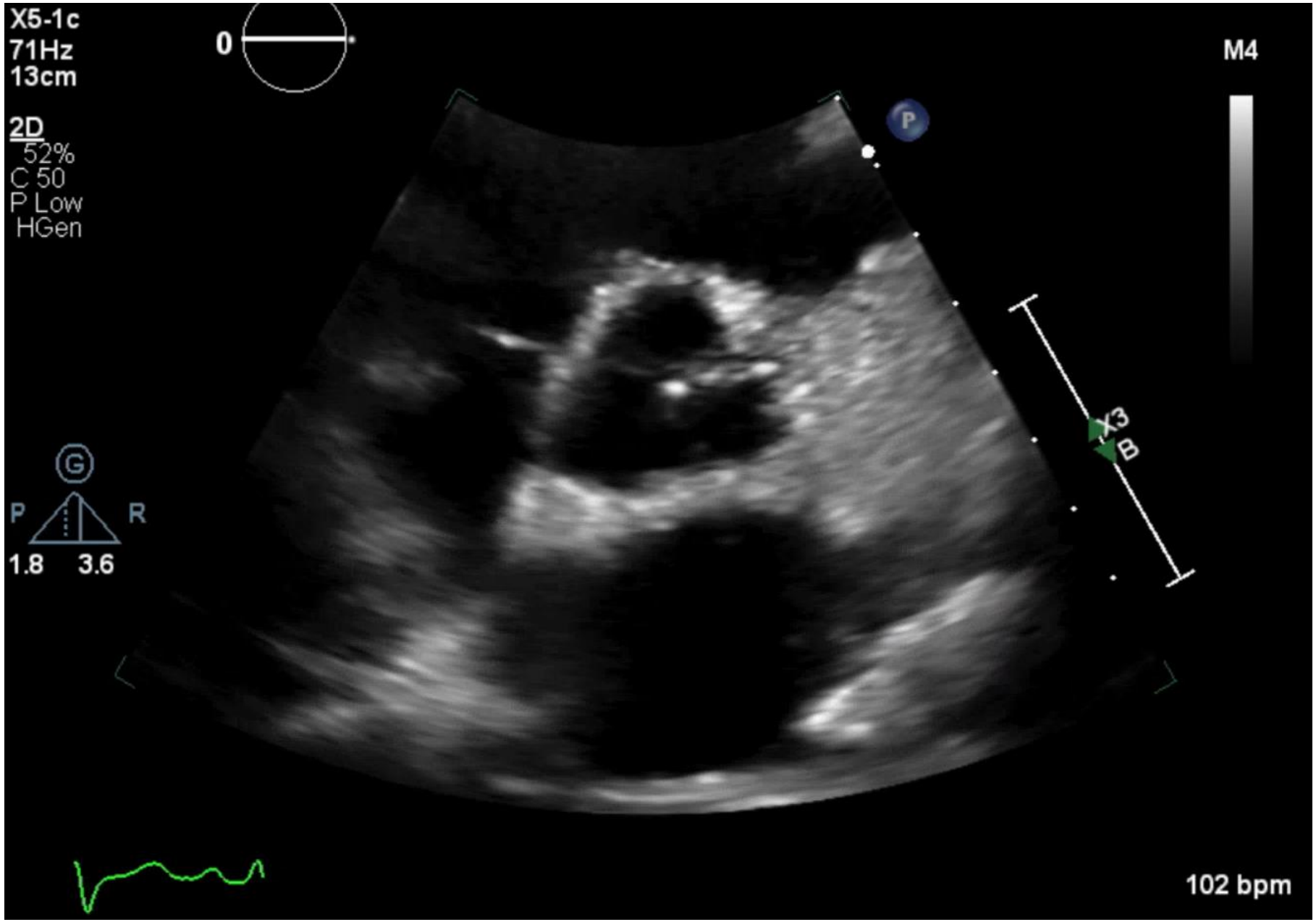
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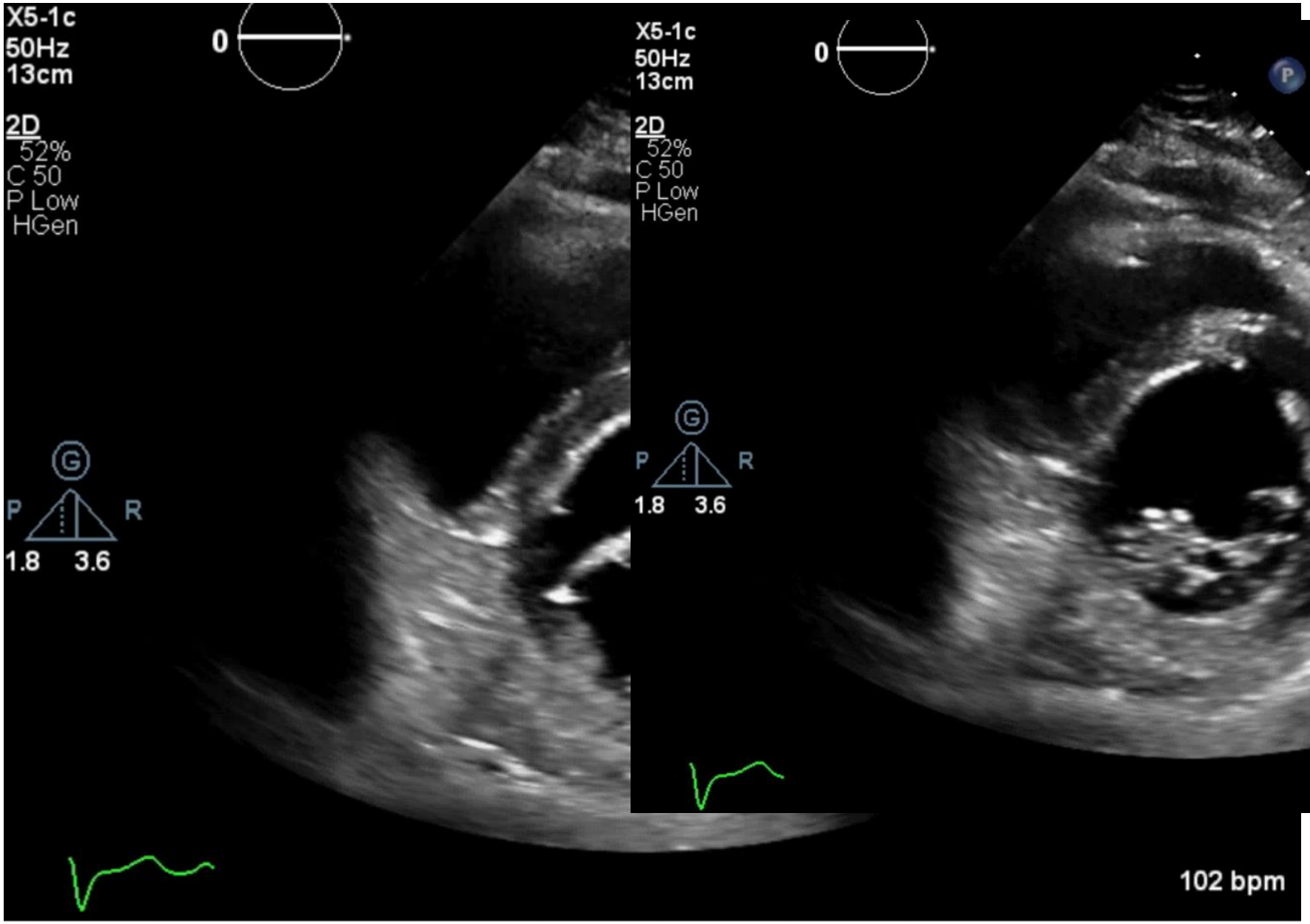
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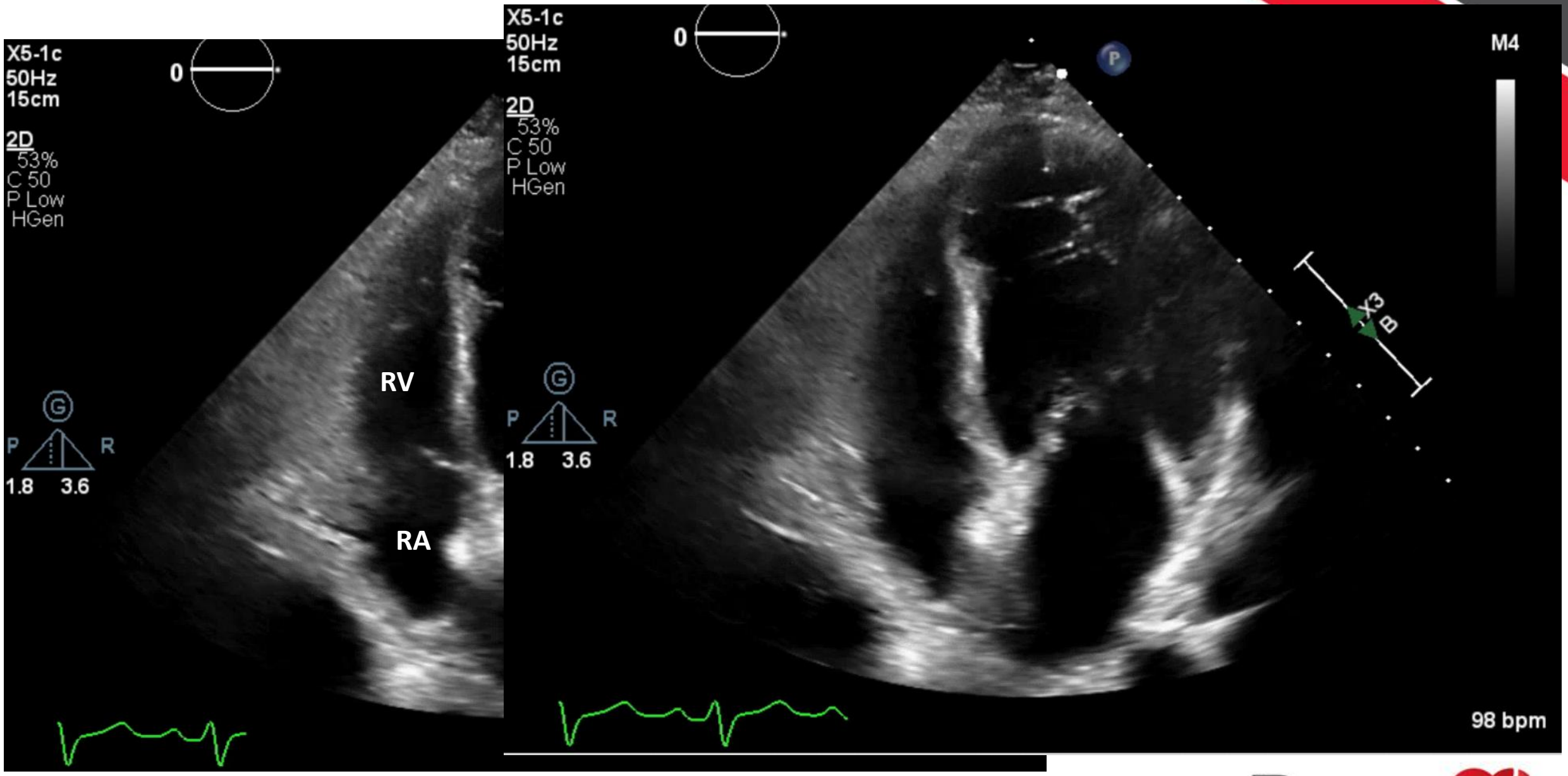
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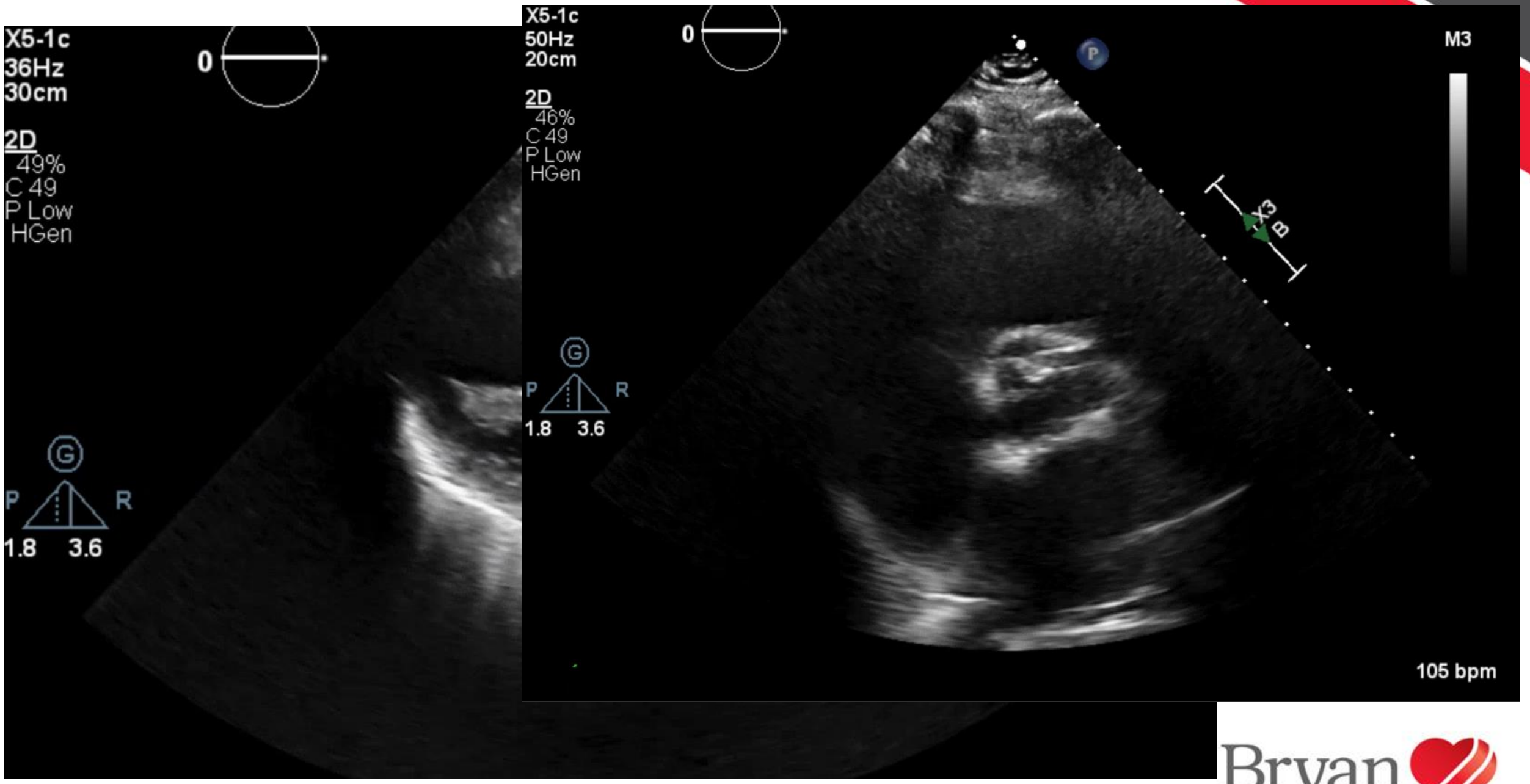
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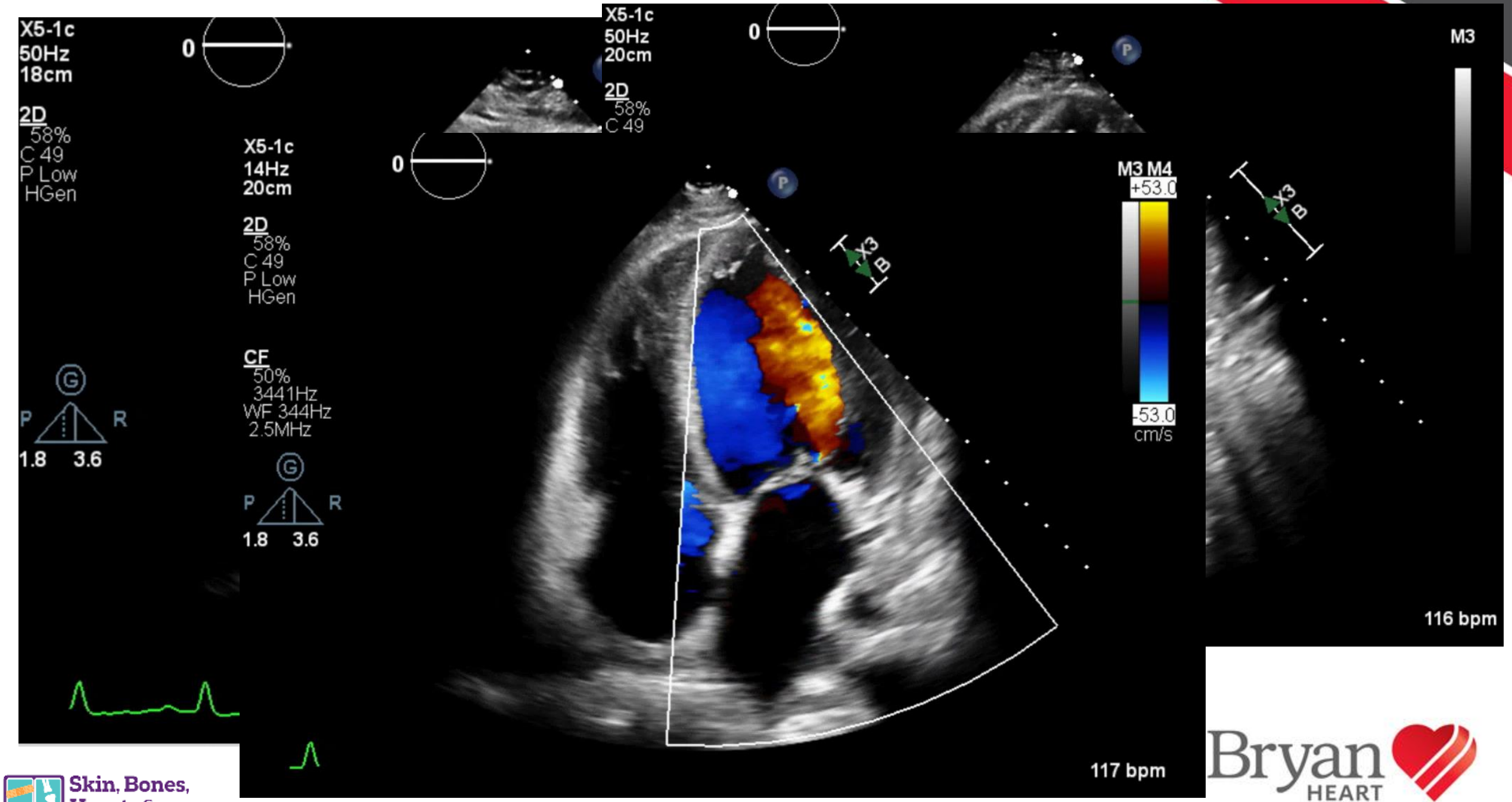
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Aortic Stenosis

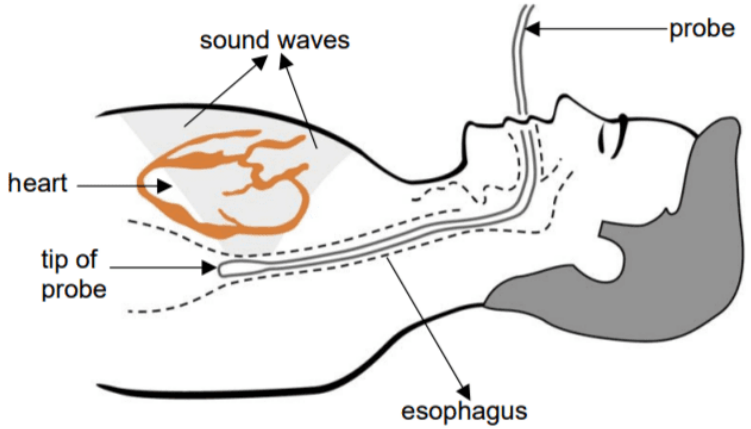
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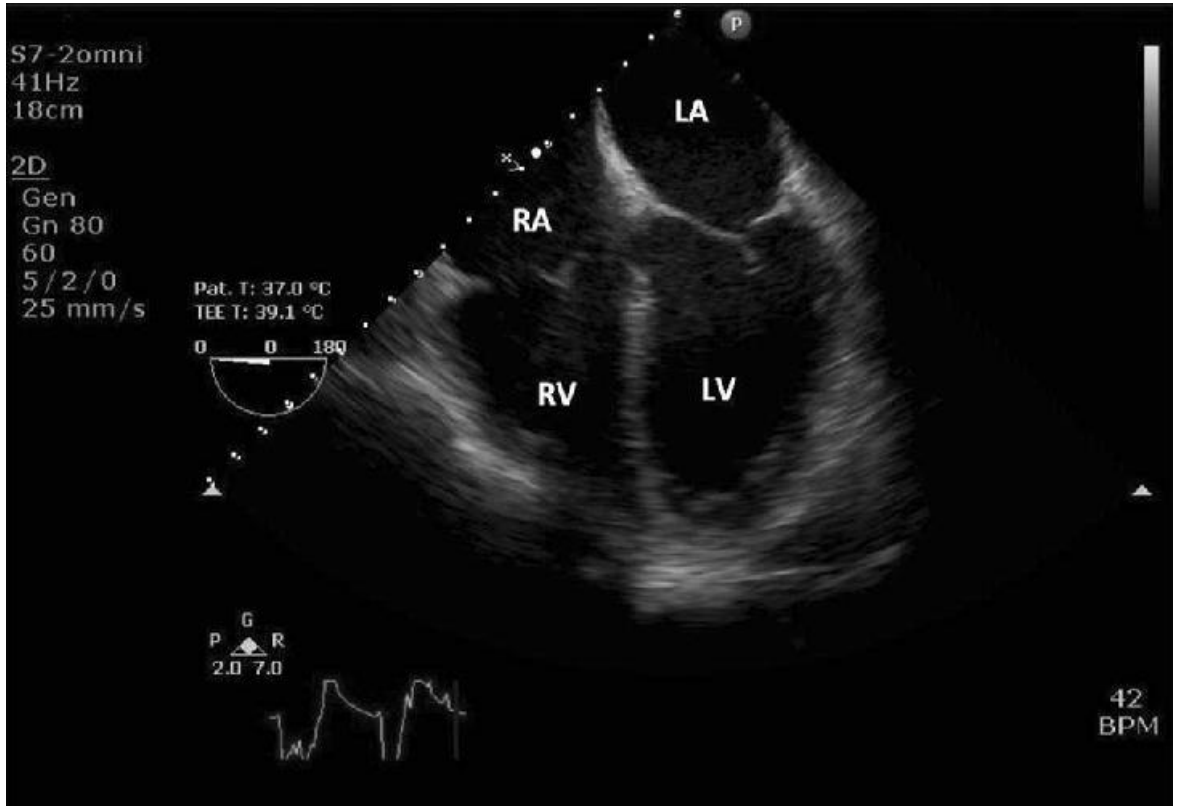


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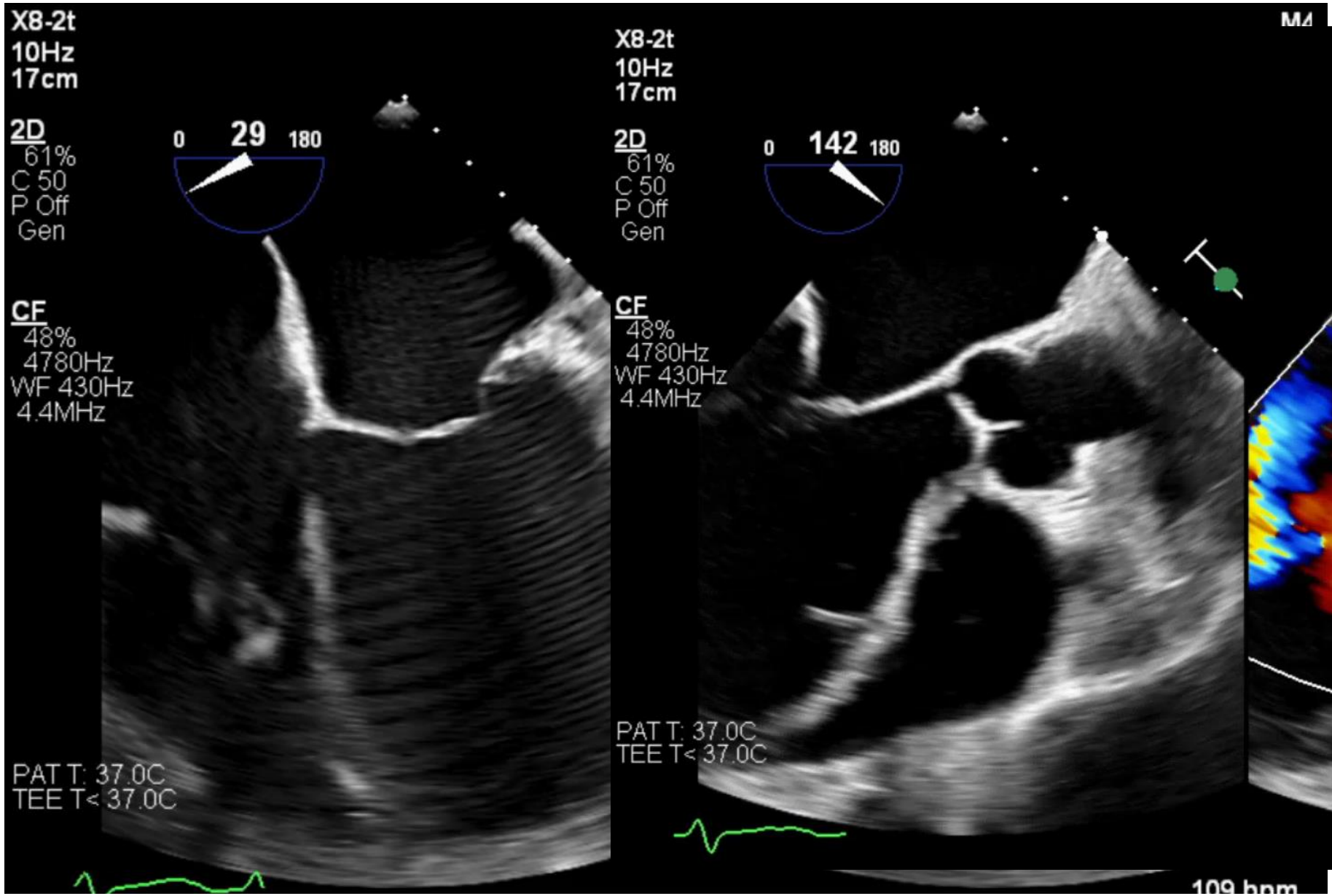
A little Snippet on Transesophageal Echocardiograms

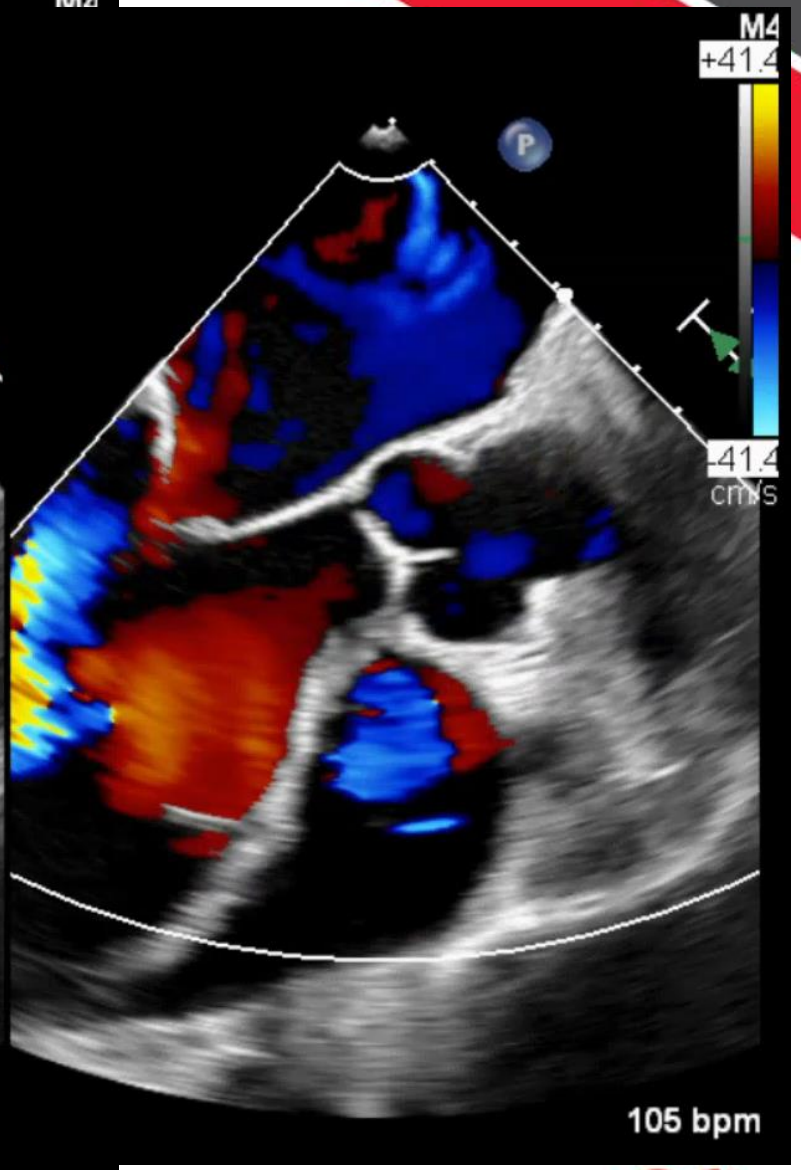




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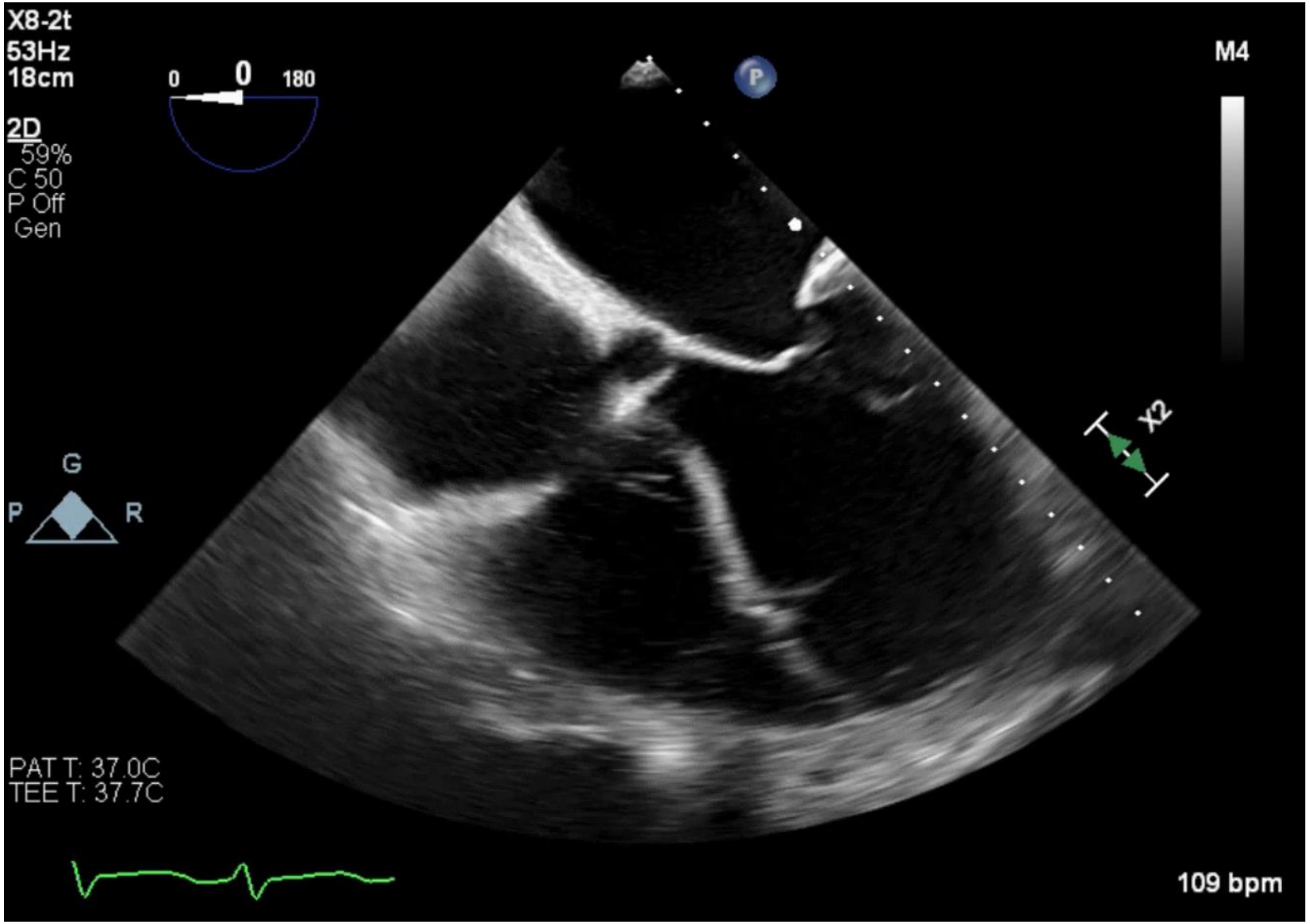
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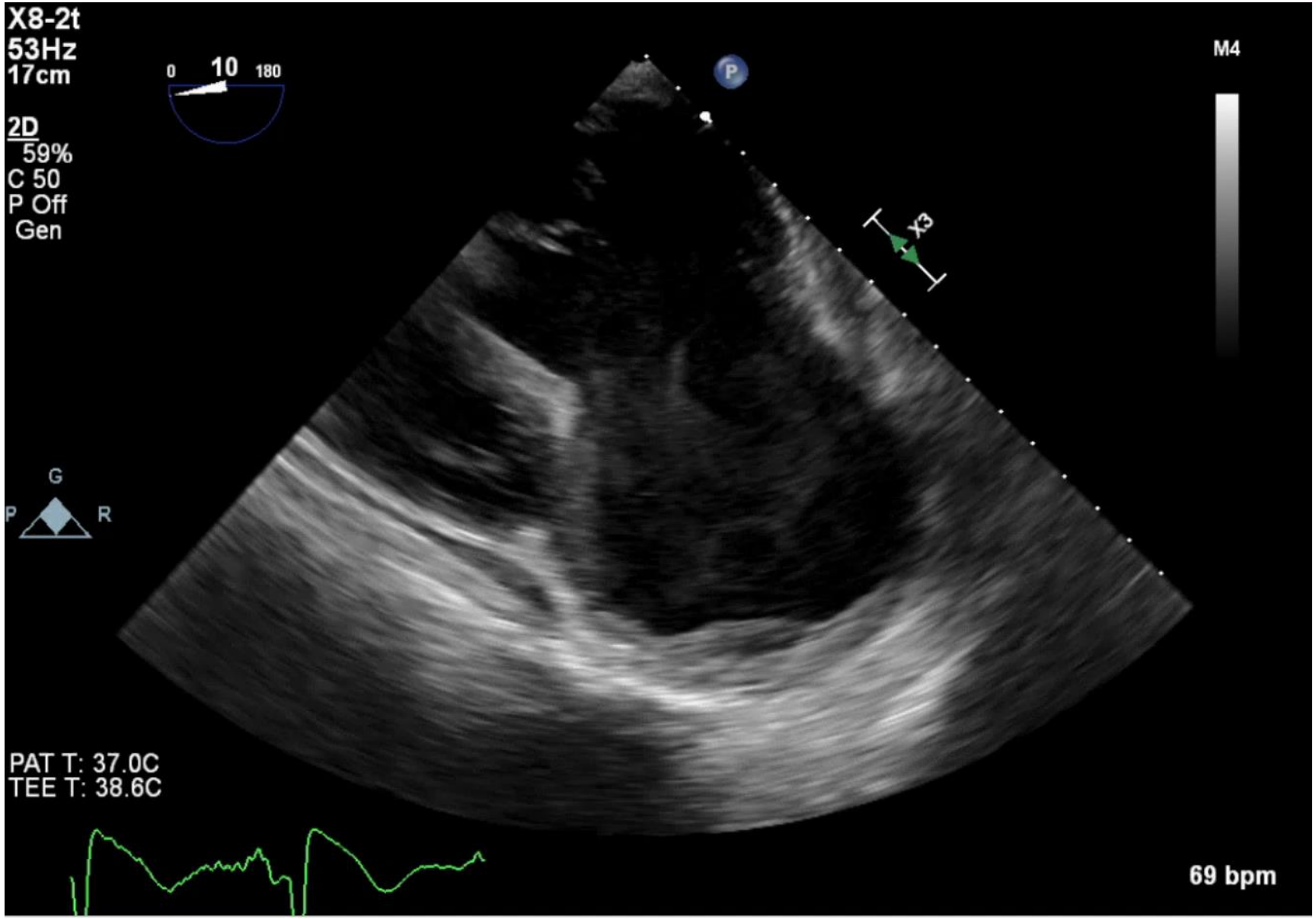
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Final PEARLS…

- EKGs – measure, measure, MEASURE
- Echos – Ask questions, look at images and know view points
- TEEs –Consider WHY you're doing the study in the first place so you know exactly what to expect

Questions?



@sarsch79

Sarah E Schroeder

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402-937-3595

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References

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- Koratala A. (2019). Apical 4-chamber view. Retrieved December 1, 2025, from Focused Cardiac Ultrasound for the Nephrologist: The apical window - Renal Fellow Network
- Labster (nd). Parasternal short axis – papillary view point. Retrieved December 1, 2025, from Parasternal short axis view in the papillary plane – Labster
- Other websites:
  - The ECG leads: Electrodes, limb leads, chest (precordial) leads and the 12-Lead ECG – The Cardiovascular
  - 12 Lead ECG Placement: The Complete Guide (2025)

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