



McGill University
Health Centre

Centre universitaire
de santé McGill

ECG Session

Family Medicine Refresher 2022

Jacqueline Joza

McGill University Health Centre



Disclosures

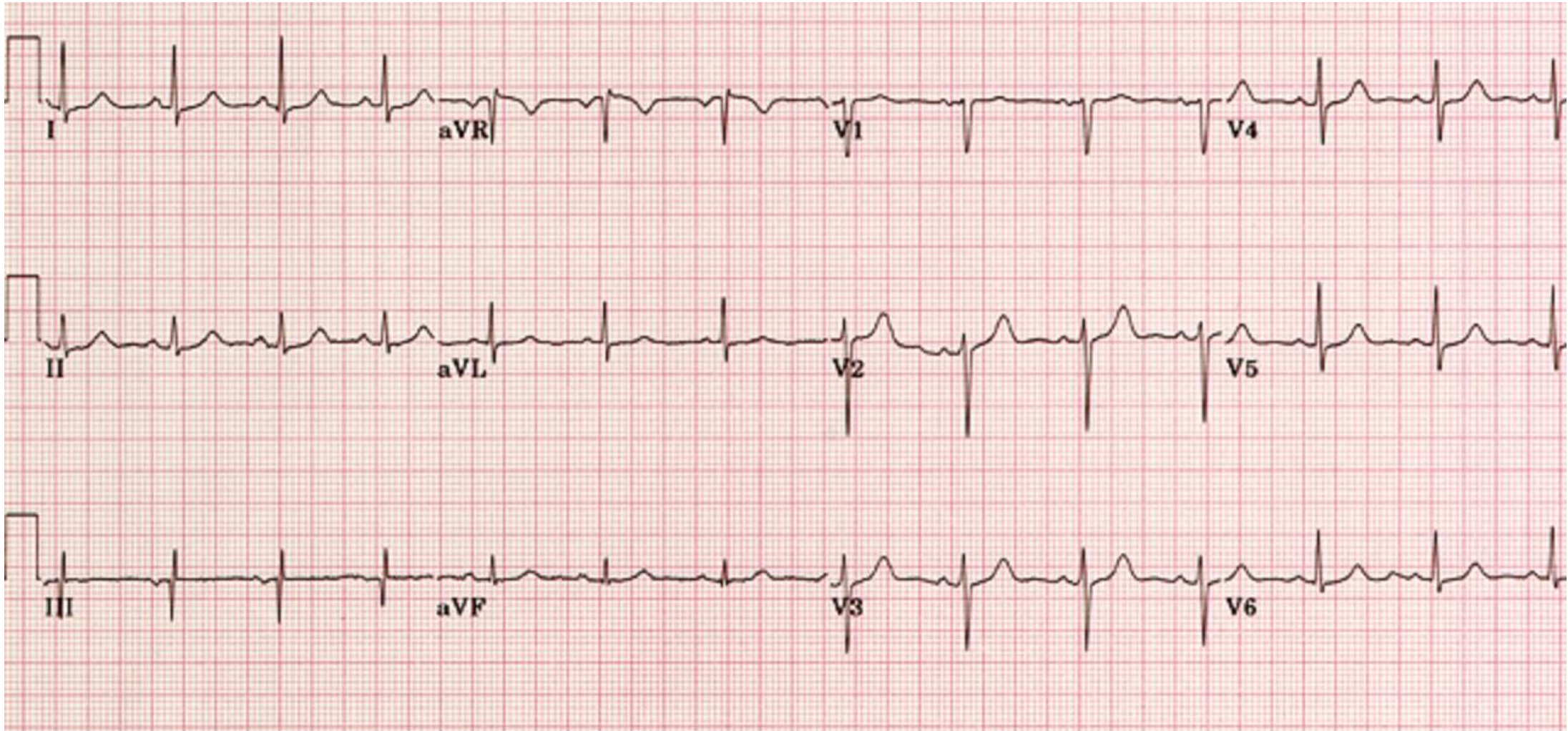
Medtronic: Grant – Investigator-initiated external research program

Boston Scientific – Advisory Board

Objectives

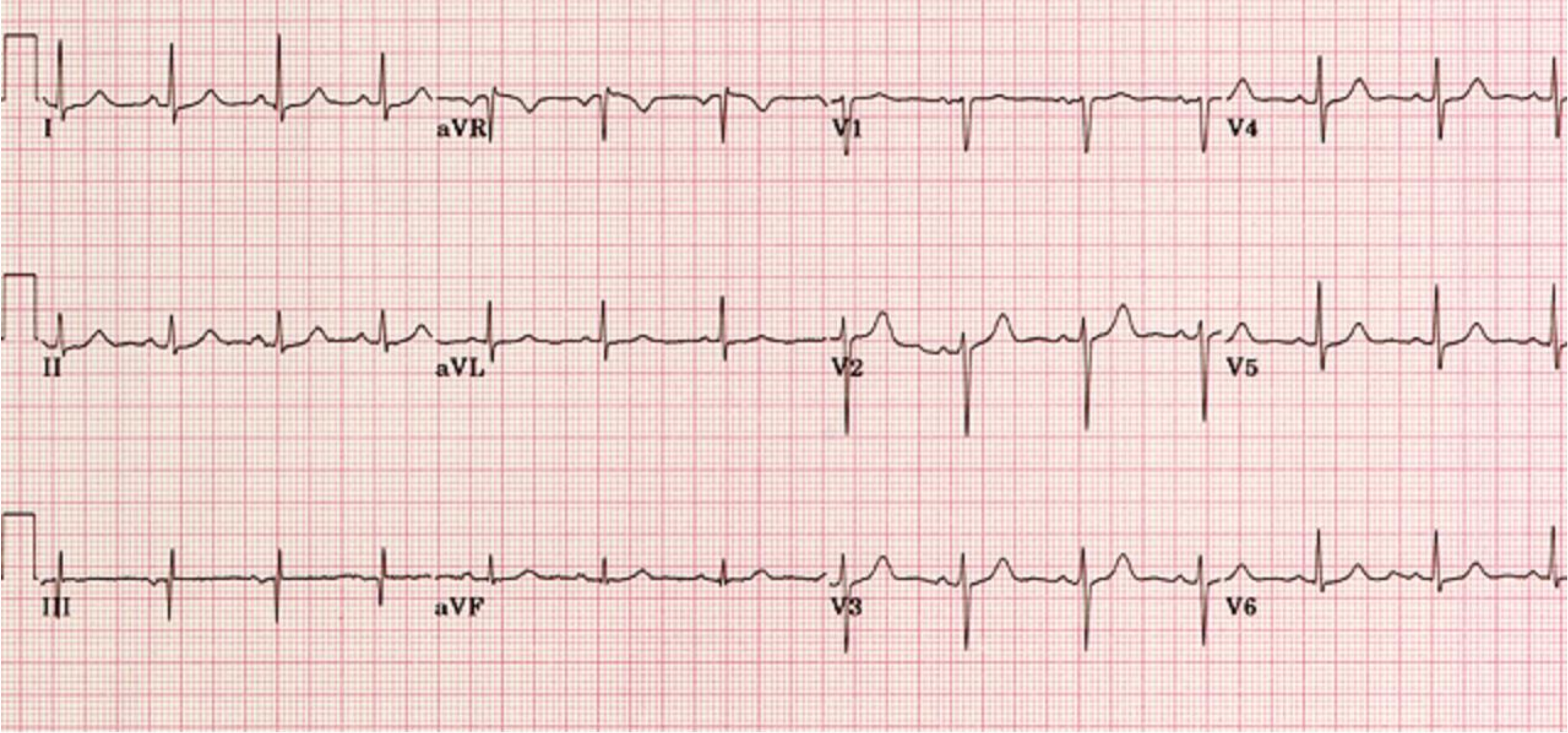
1. Review the normal ECG
2. Identify the bundle branch blocks
3. Evaluate the underlying arrhythmia
4. Discover pacing
5. Learn how to measure the QT interval

Poll Question 1: 50 year-old asymptomatic female sent for a routine ECG.



- A. Normal ECG
- B. Left bundle branch block
- C. Right bundle branch block
- D. Long QT interval

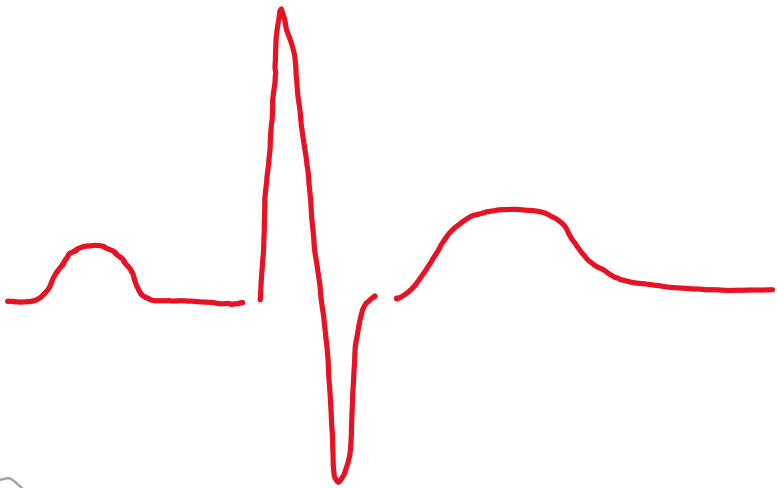
The Normal ECG



SA Node

AV Node

His Bundle



K out

Ca in

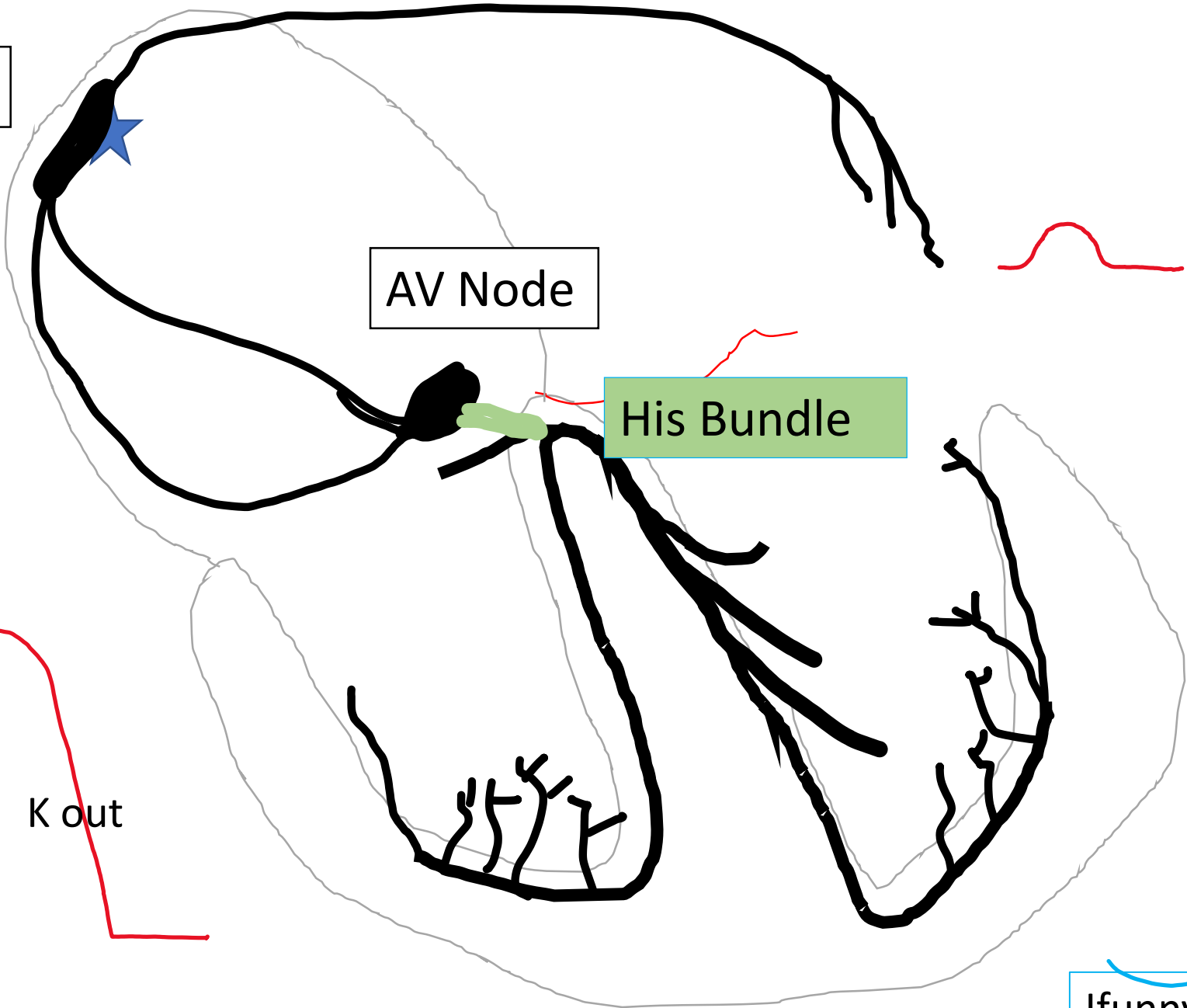
Na in

K out

Ca in

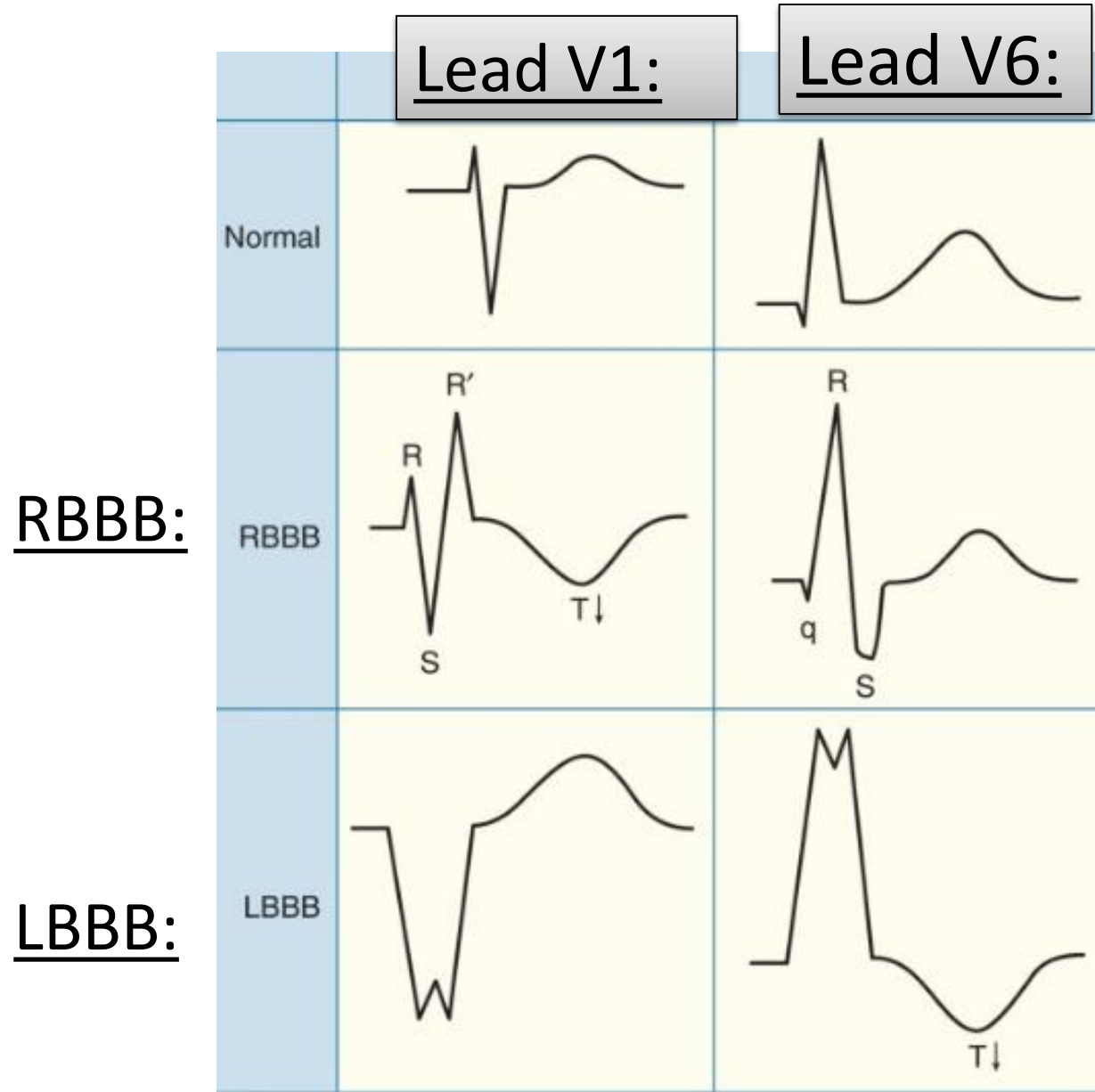
K out

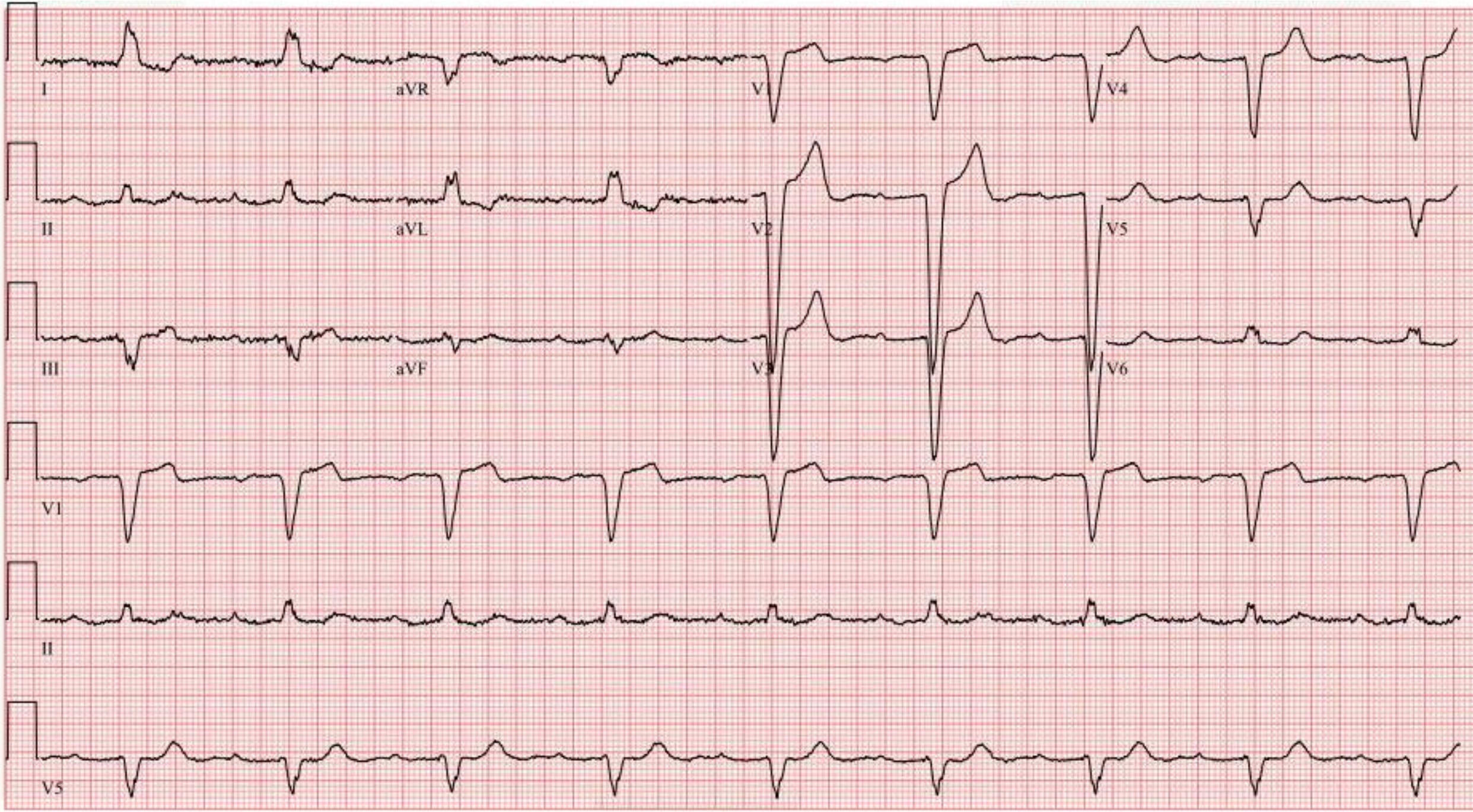
Ifunny Na/K + (SA node)

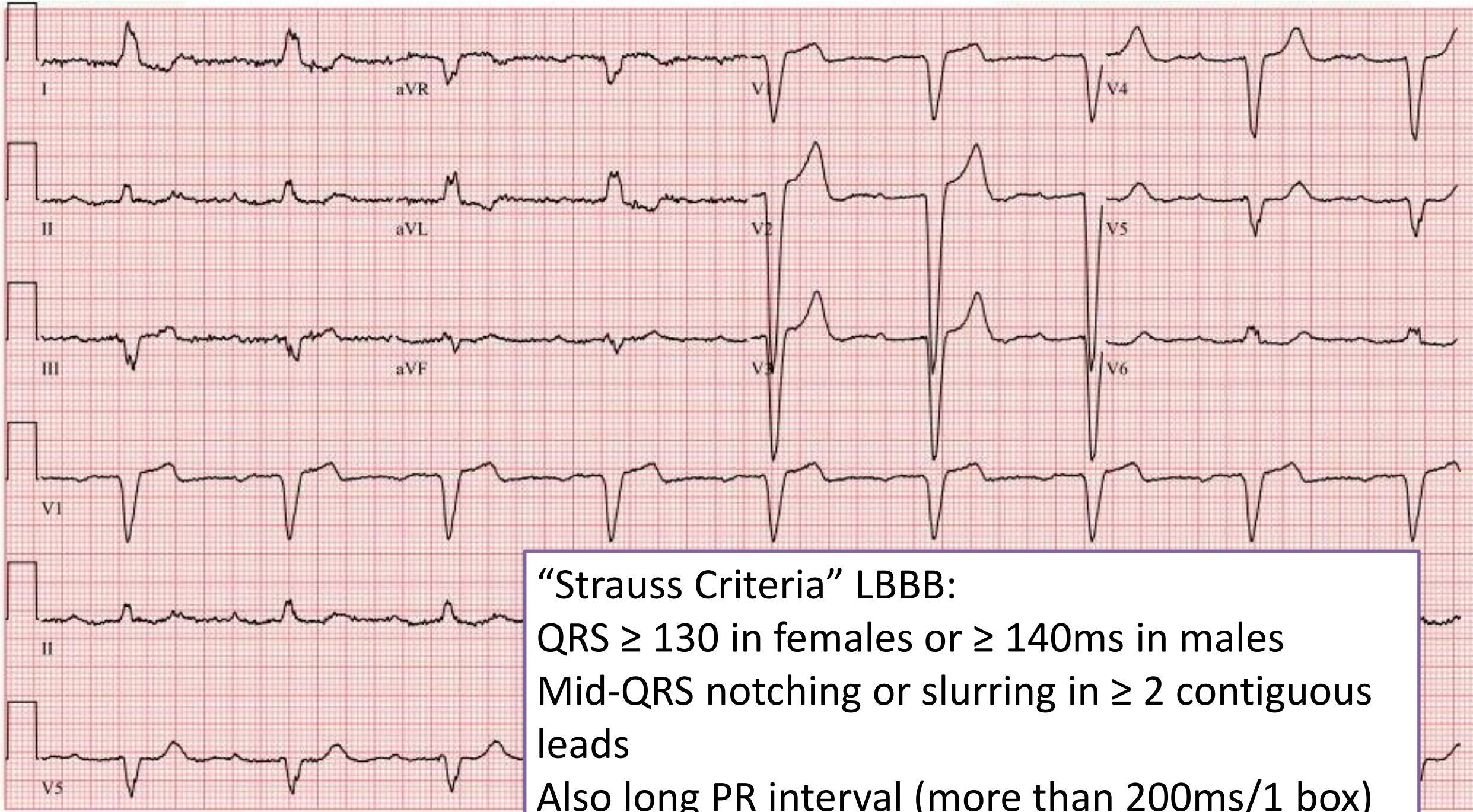


Add ecg here with long AV delay
Then one with a very long AV delay

Draw a typical RBB; typical LBBB

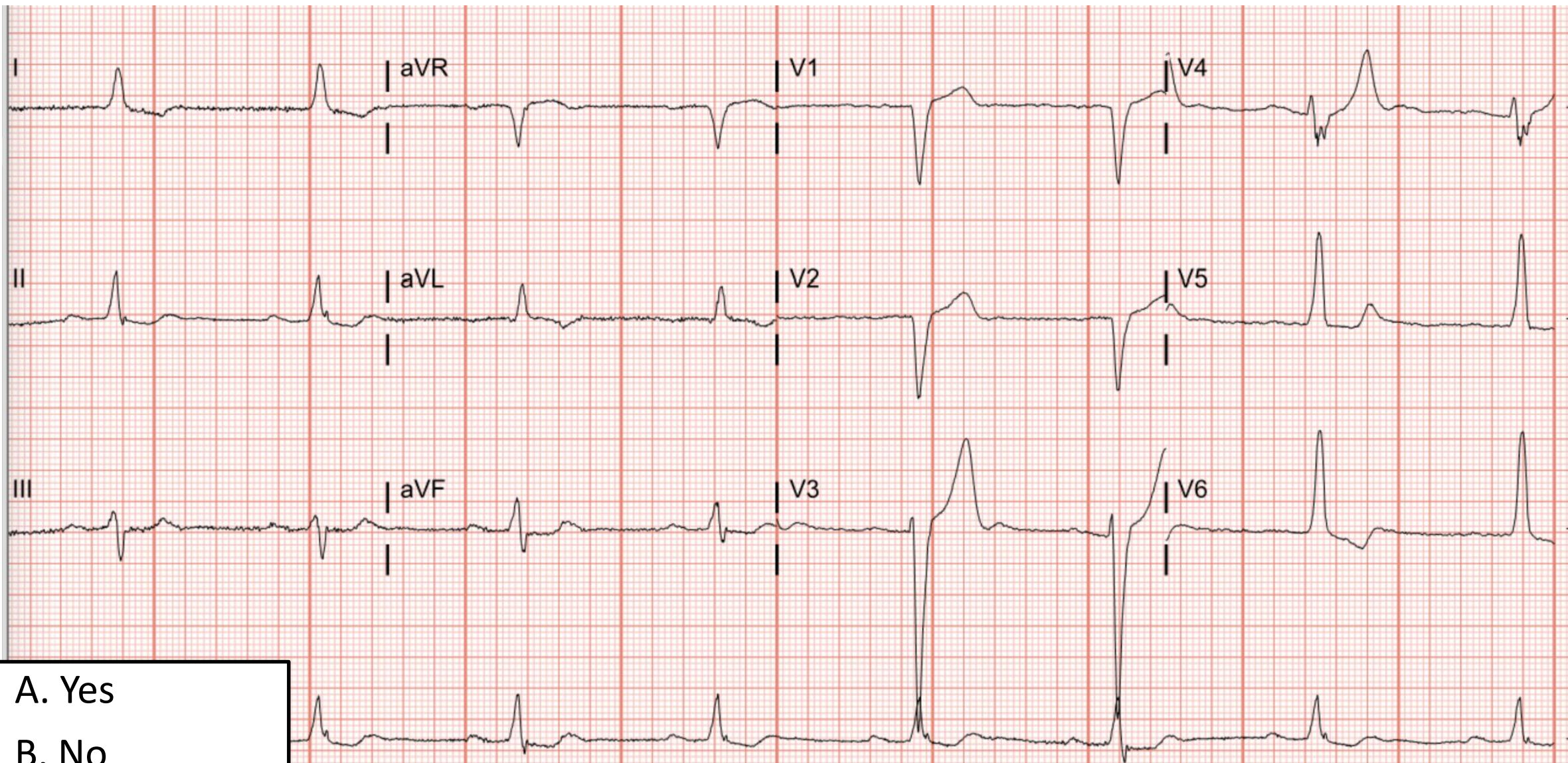




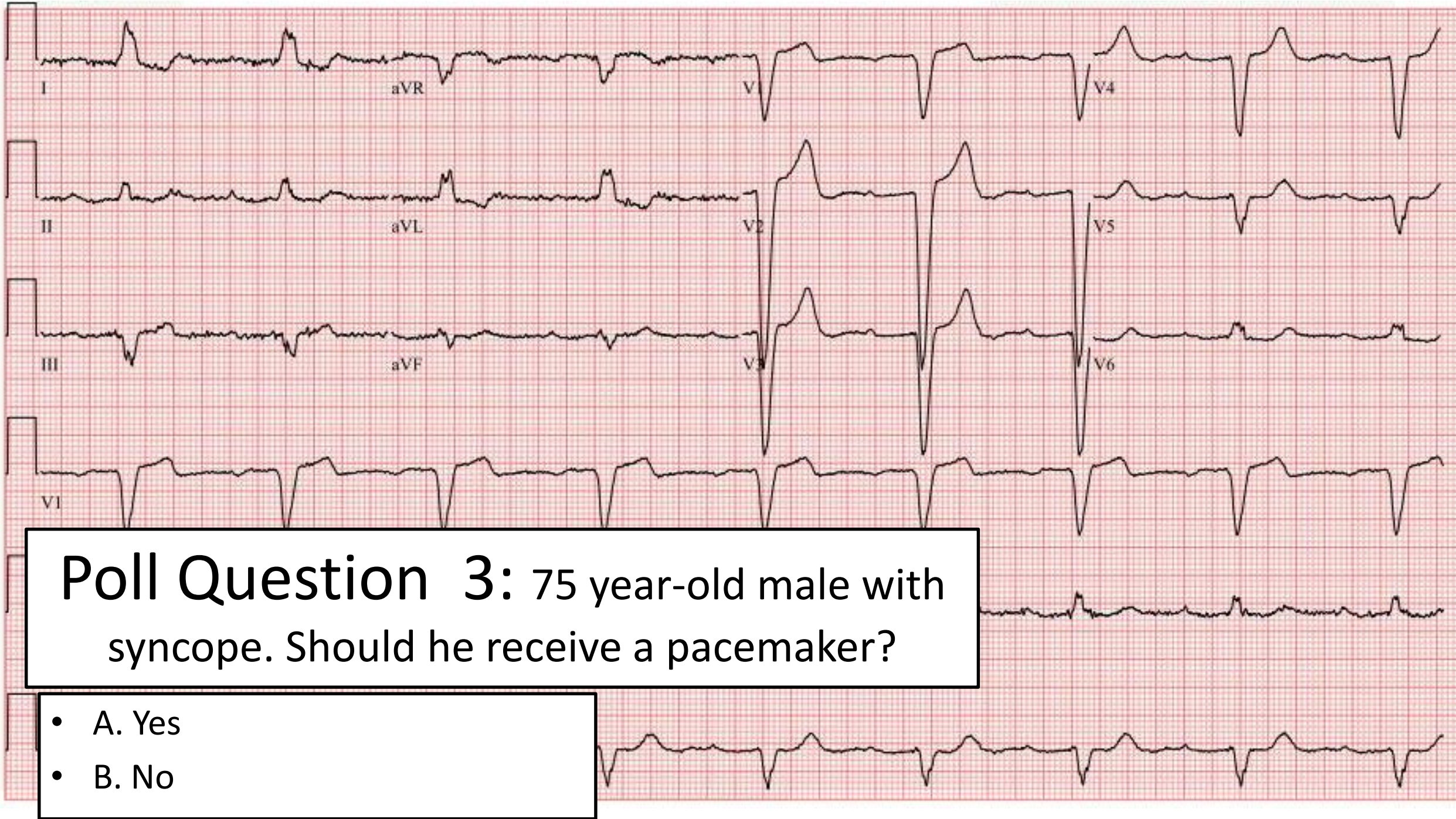


“Strauss Criteria” LBBB:
QRS \geq 130 in females or \geq 140ms in males
Mid-QRS notching or slurring in \geq 2 contiguous leads
Also long PR interval (more than 200ms/1 box)

POLL Question 2: Is this a true left bundle branch block? (ie. Does it meet Strauss criteria?)

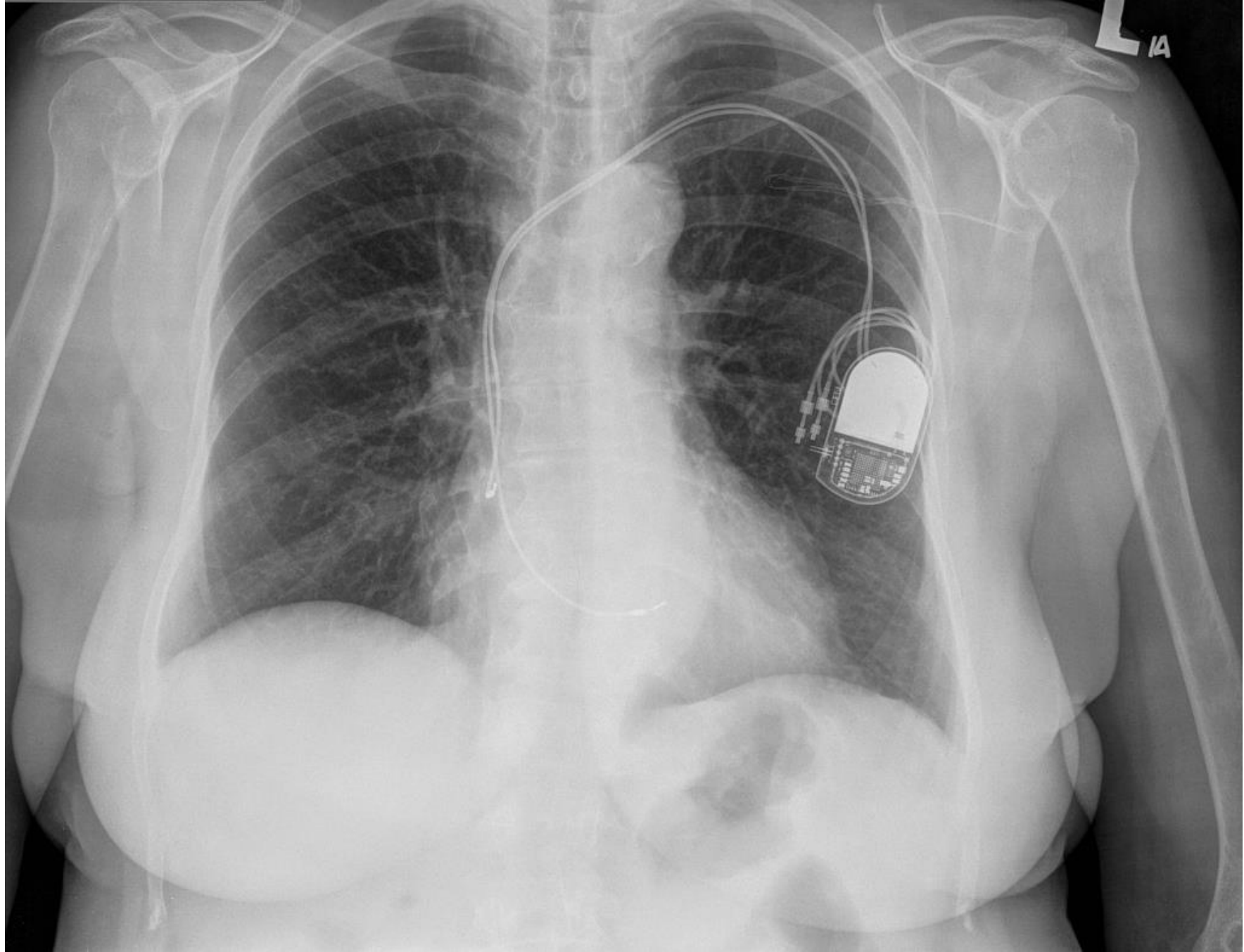


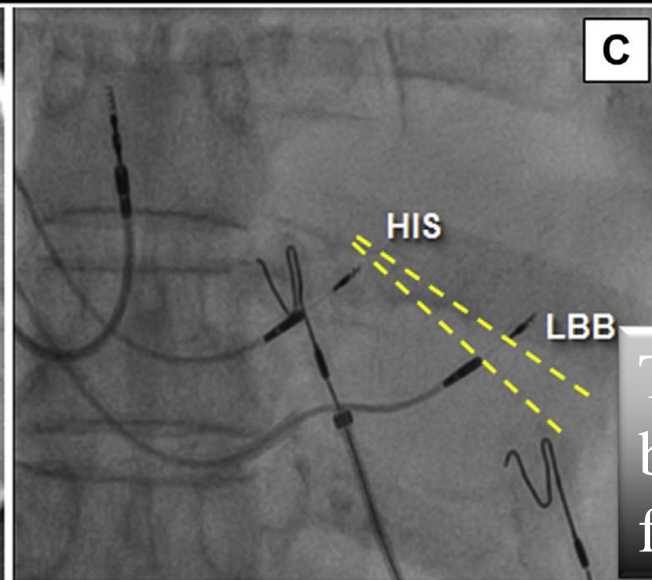
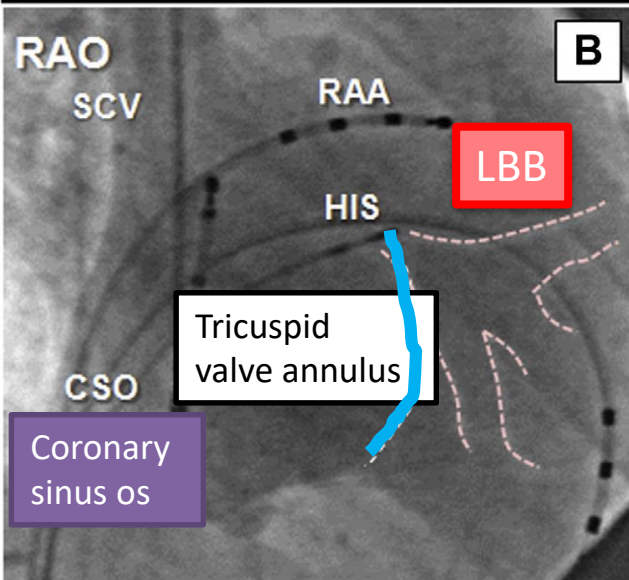
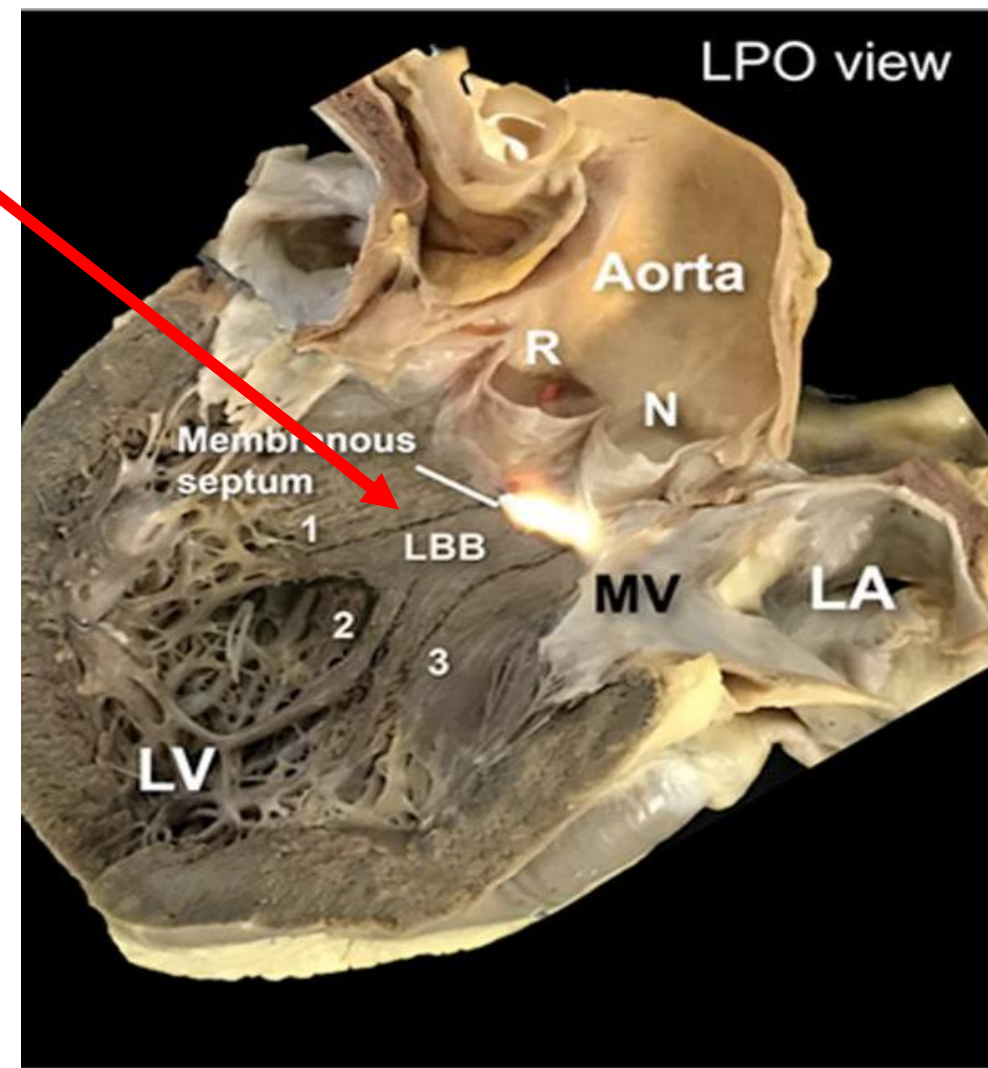
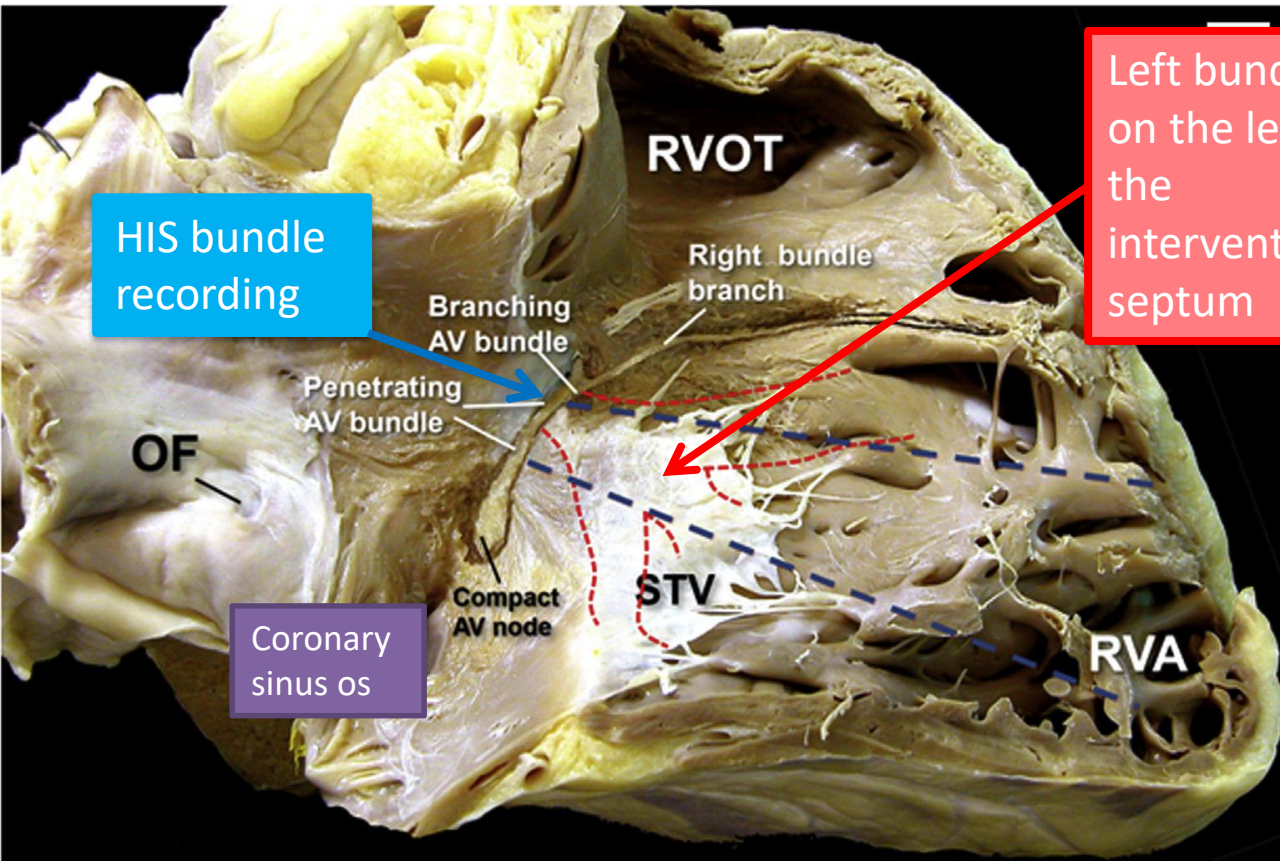
- A. Yes
- B. No



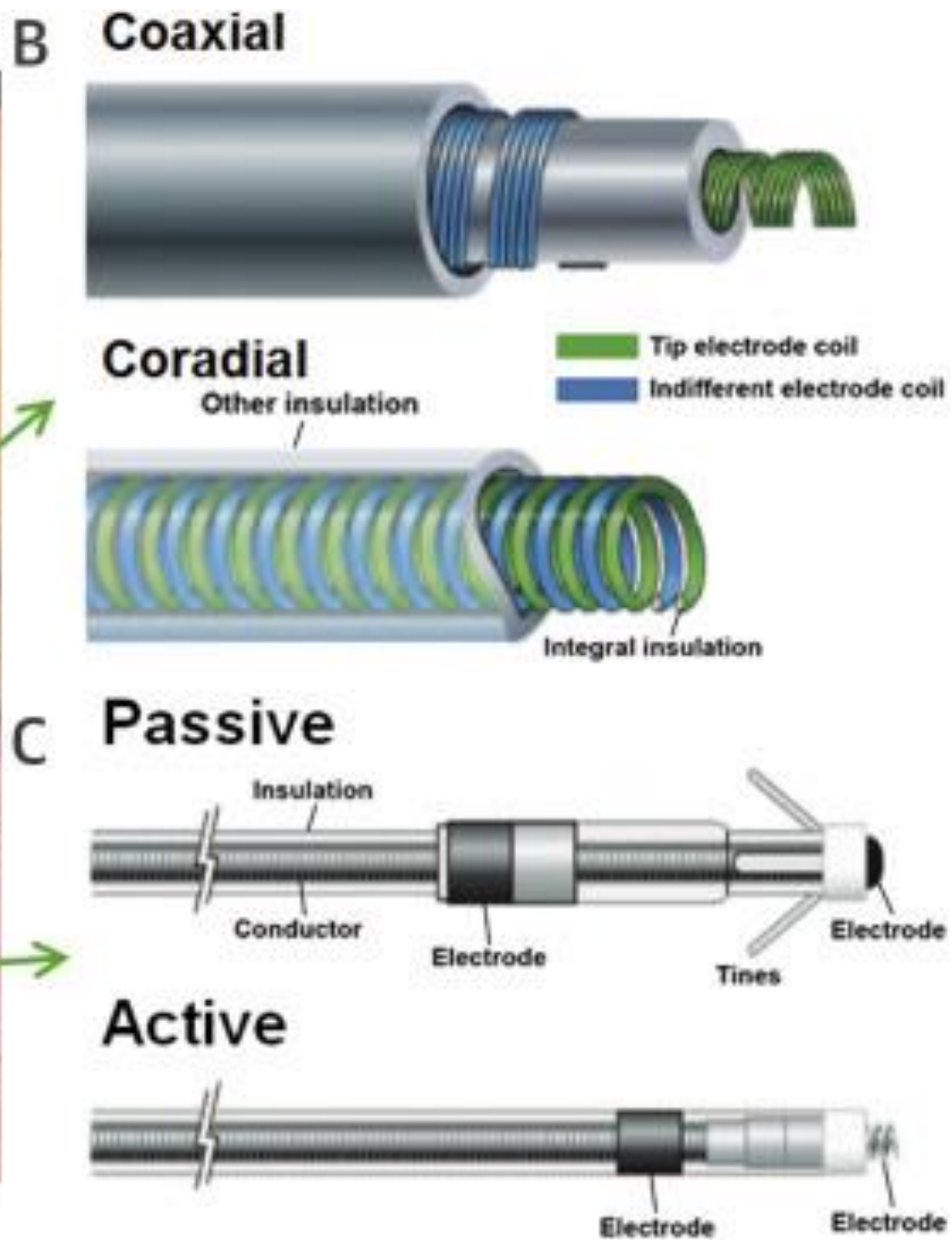
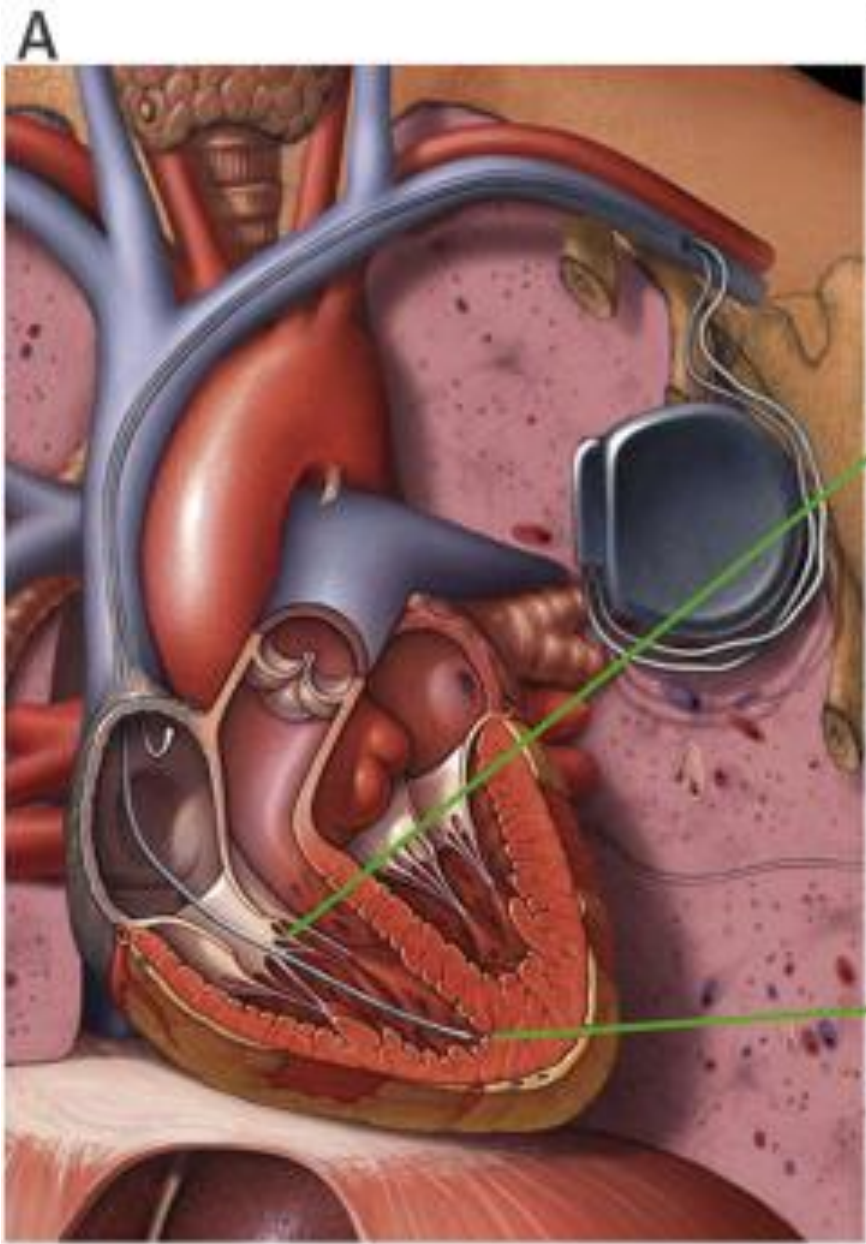
Poll Question 3: 75 year-old male with syncope. Should he receive a pacemaker?

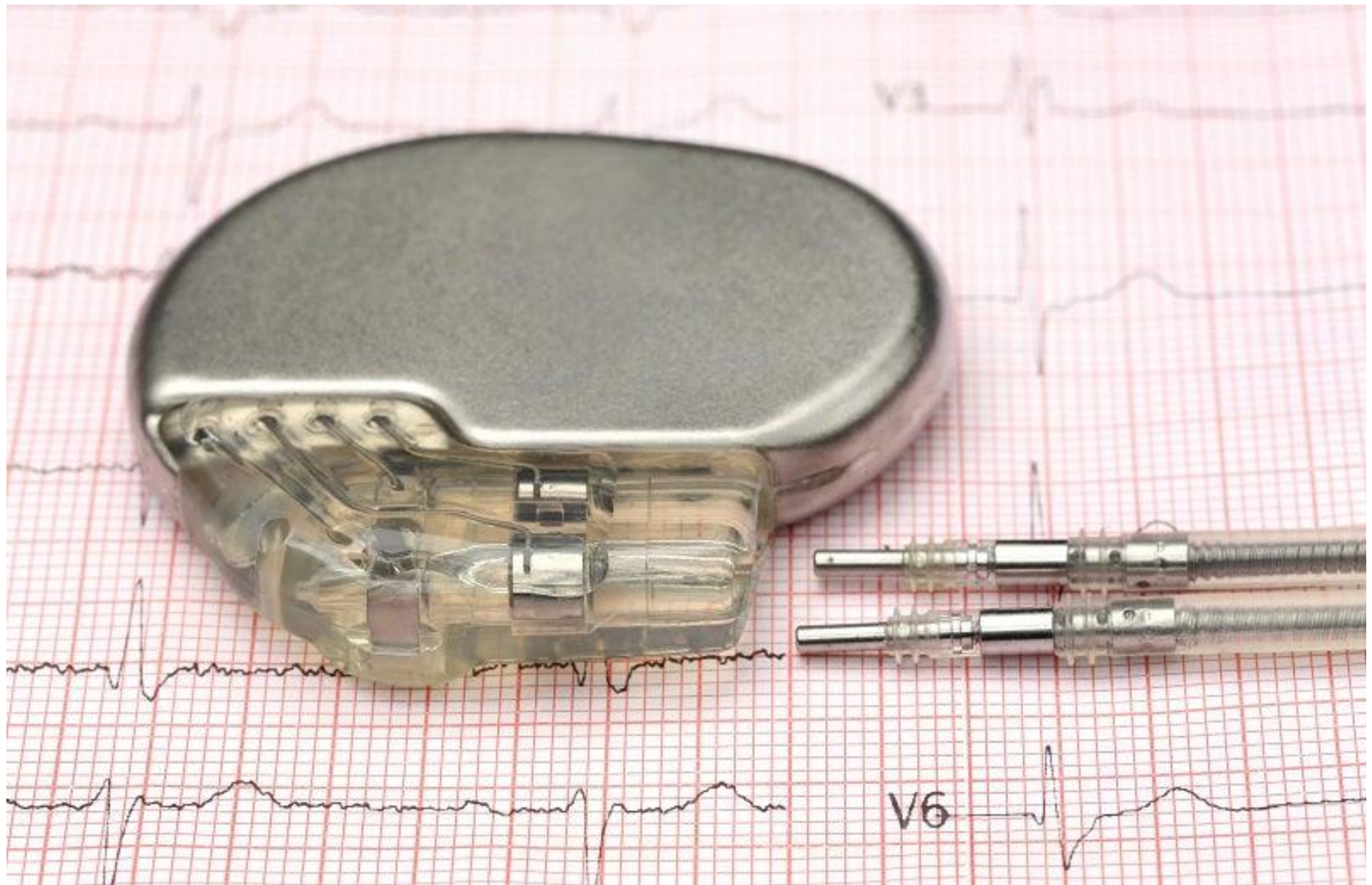
- A. Yes
- B. No



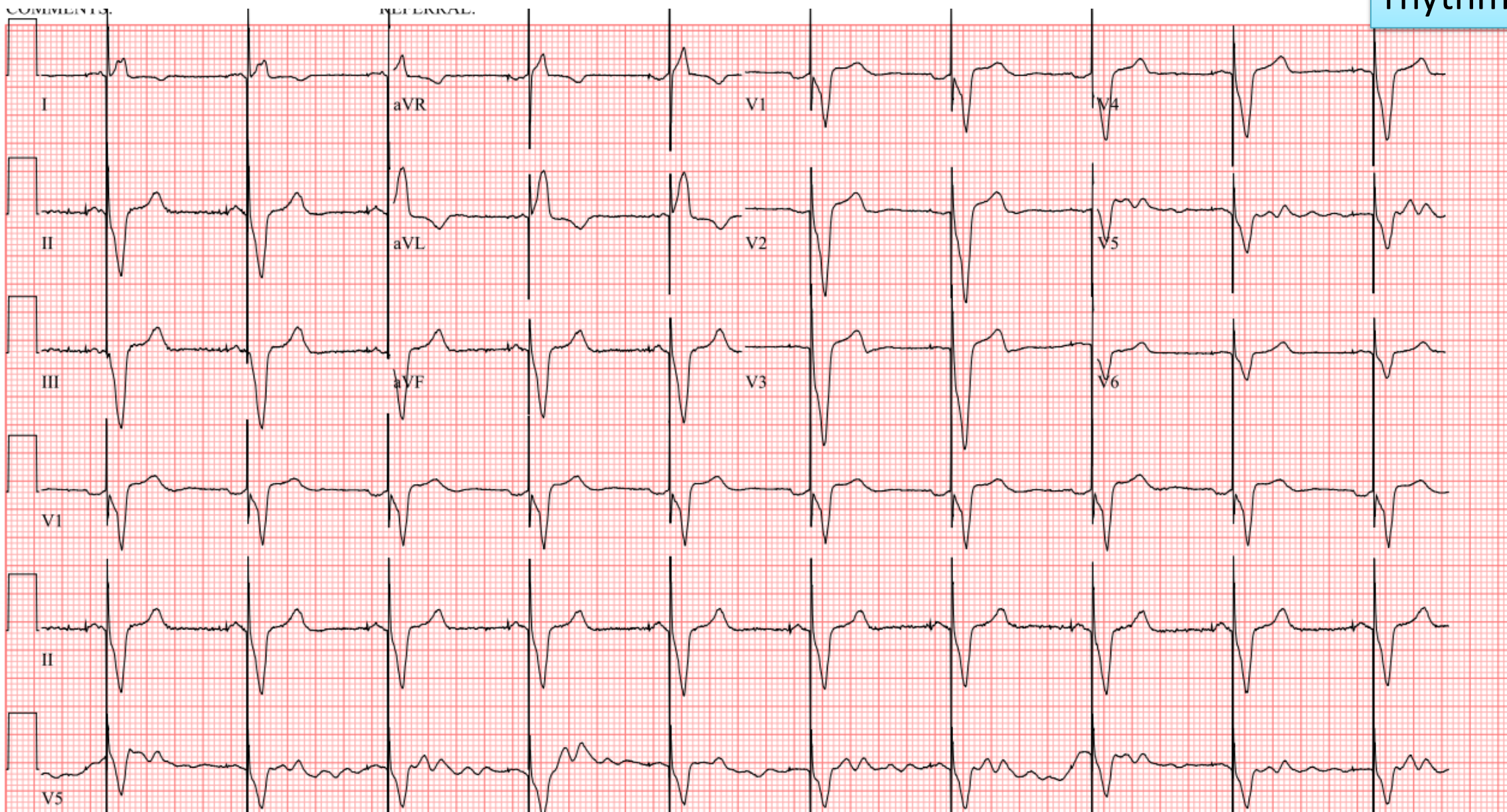


The relationship with a His pacing lead: Left bundle pacing lead is typically 1-1.5mm further distally along the septum

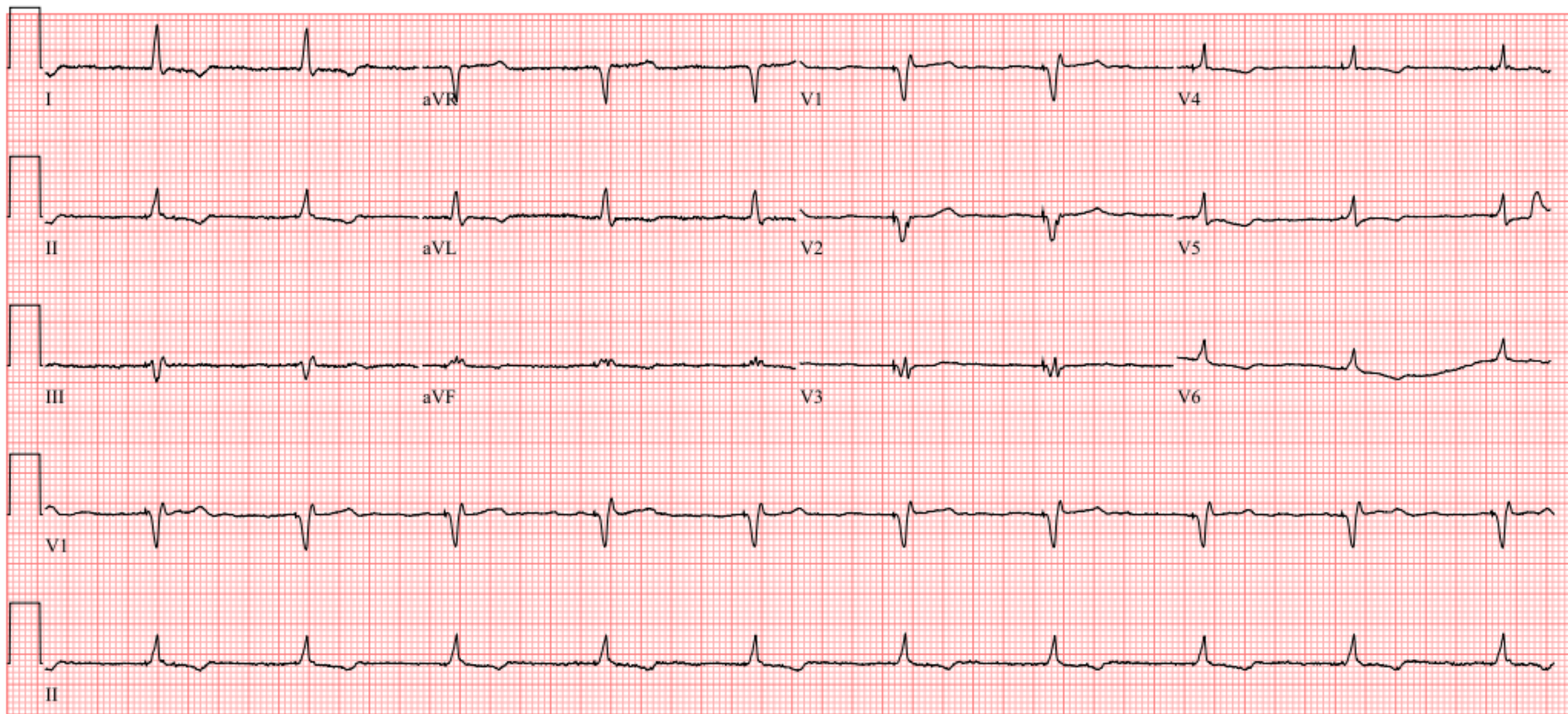




What is the rhythm?

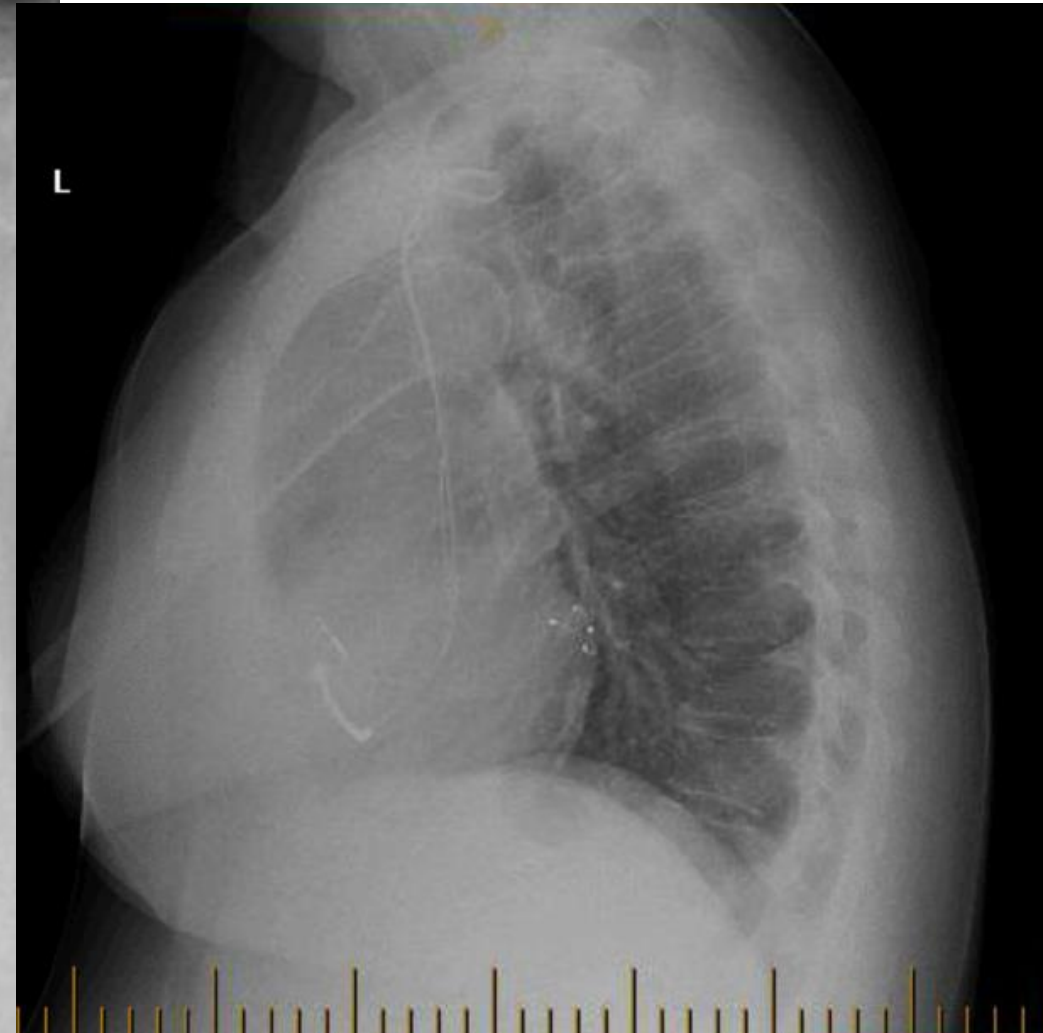
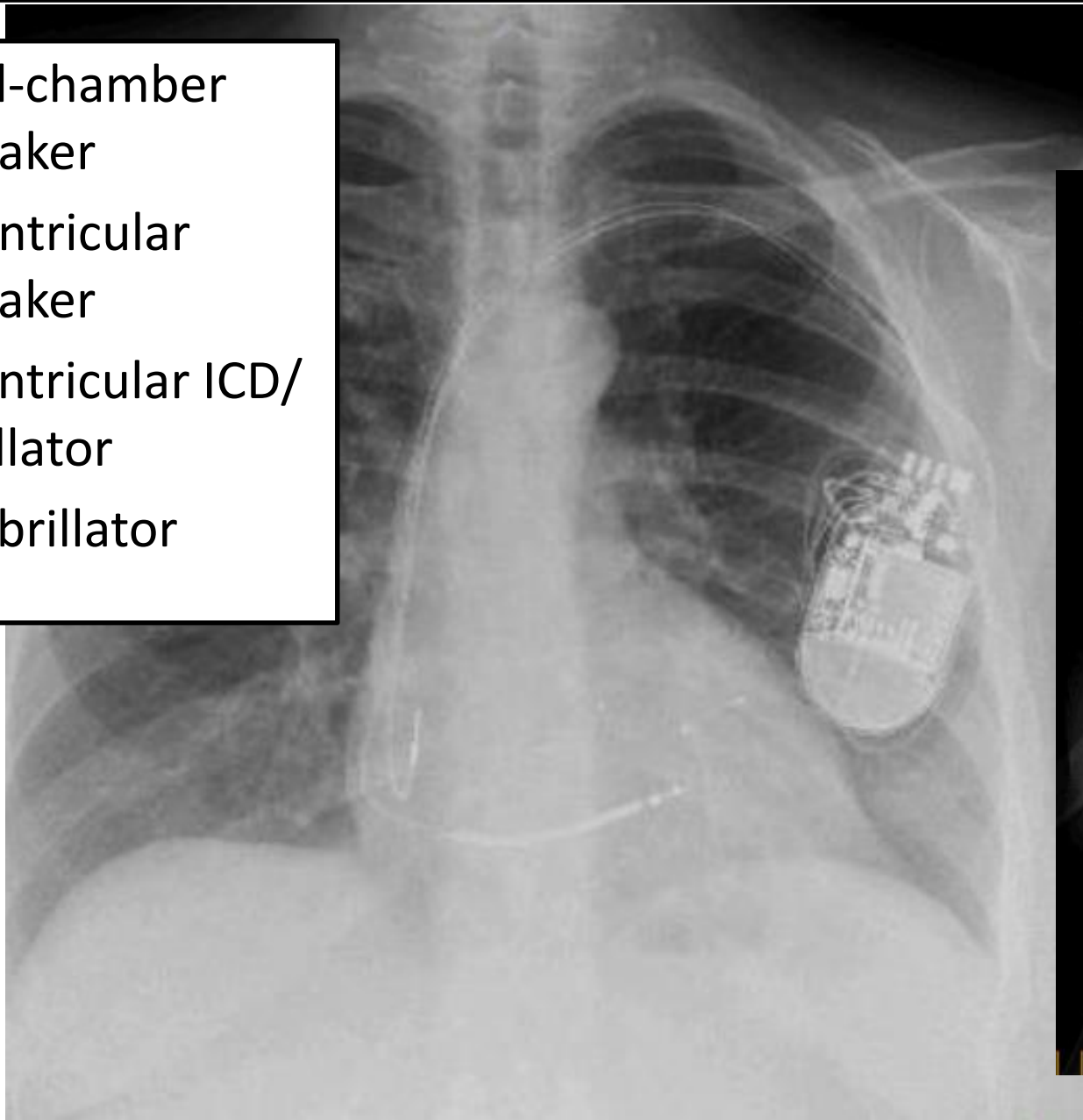


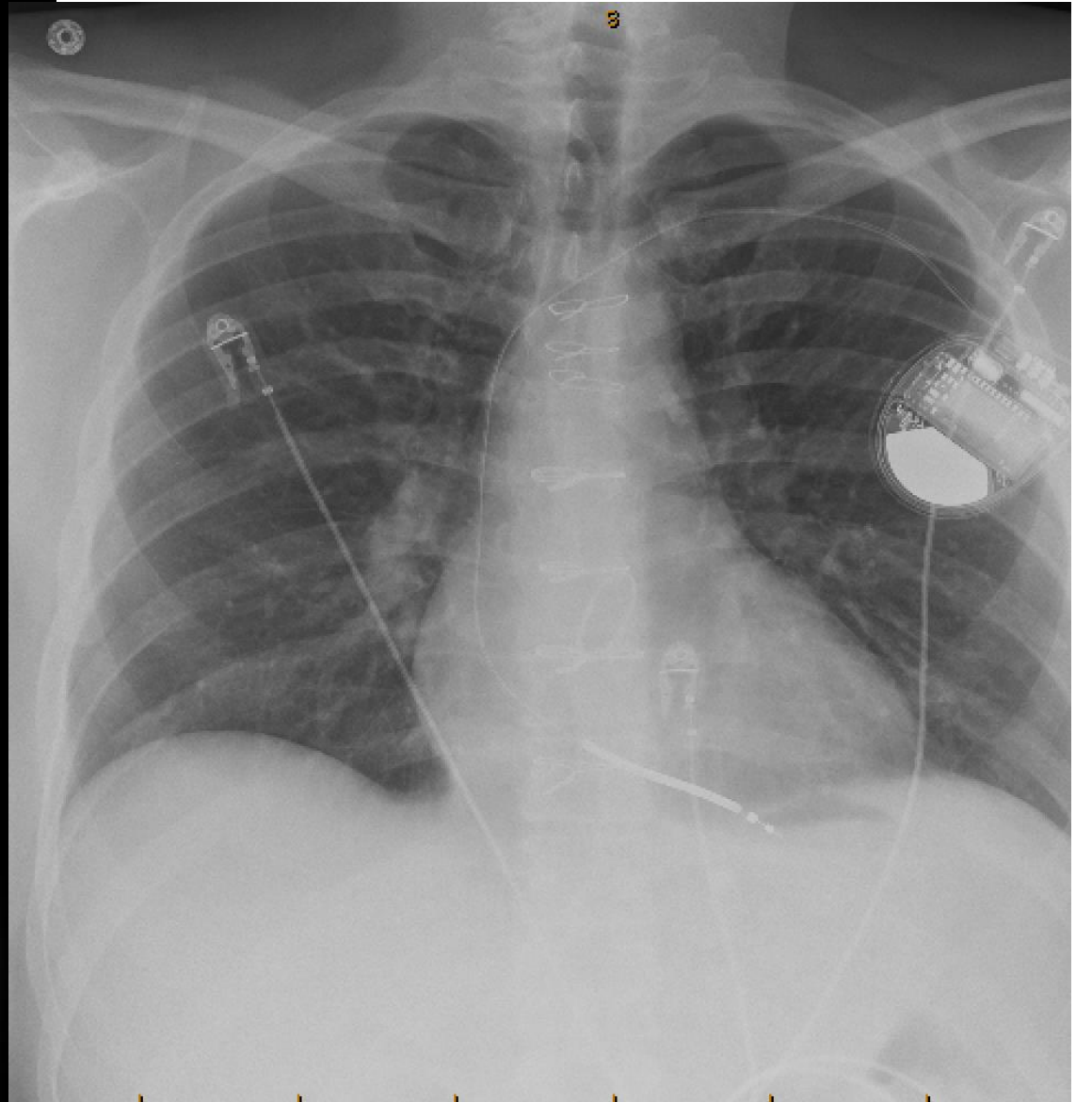
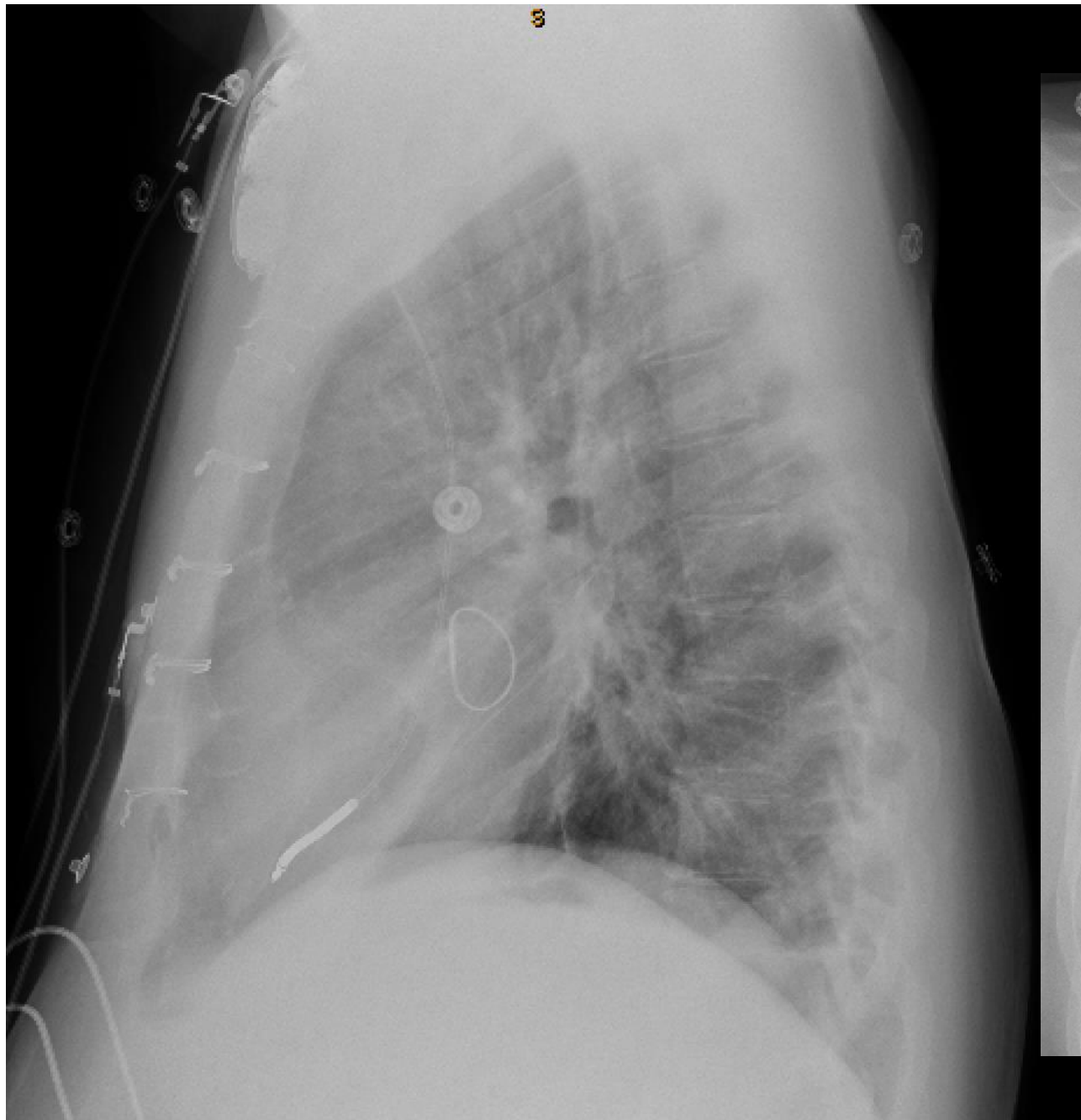
What is the rhythm? Is this patient paced?



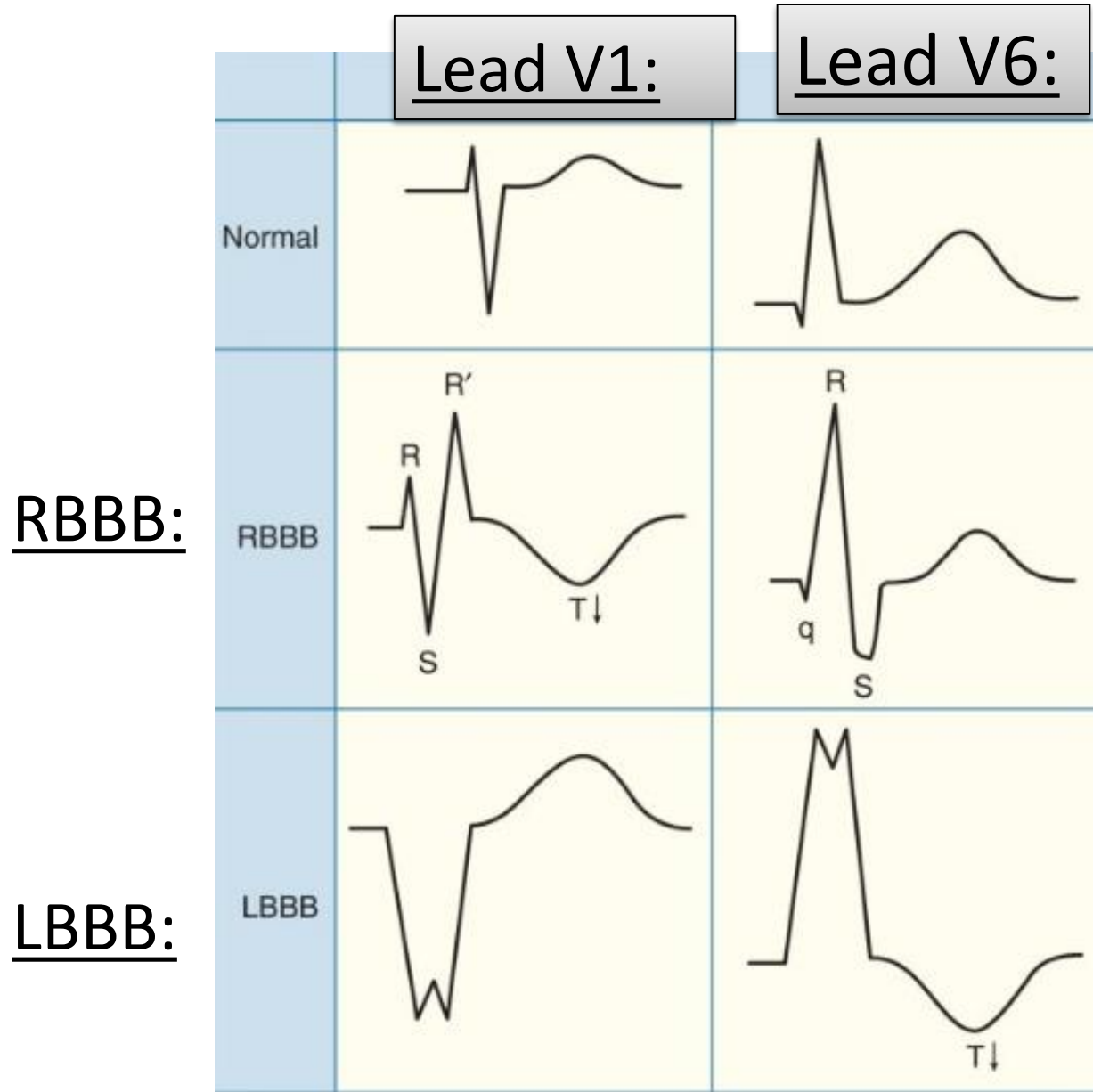
Poll Question 4: What type of device is this?

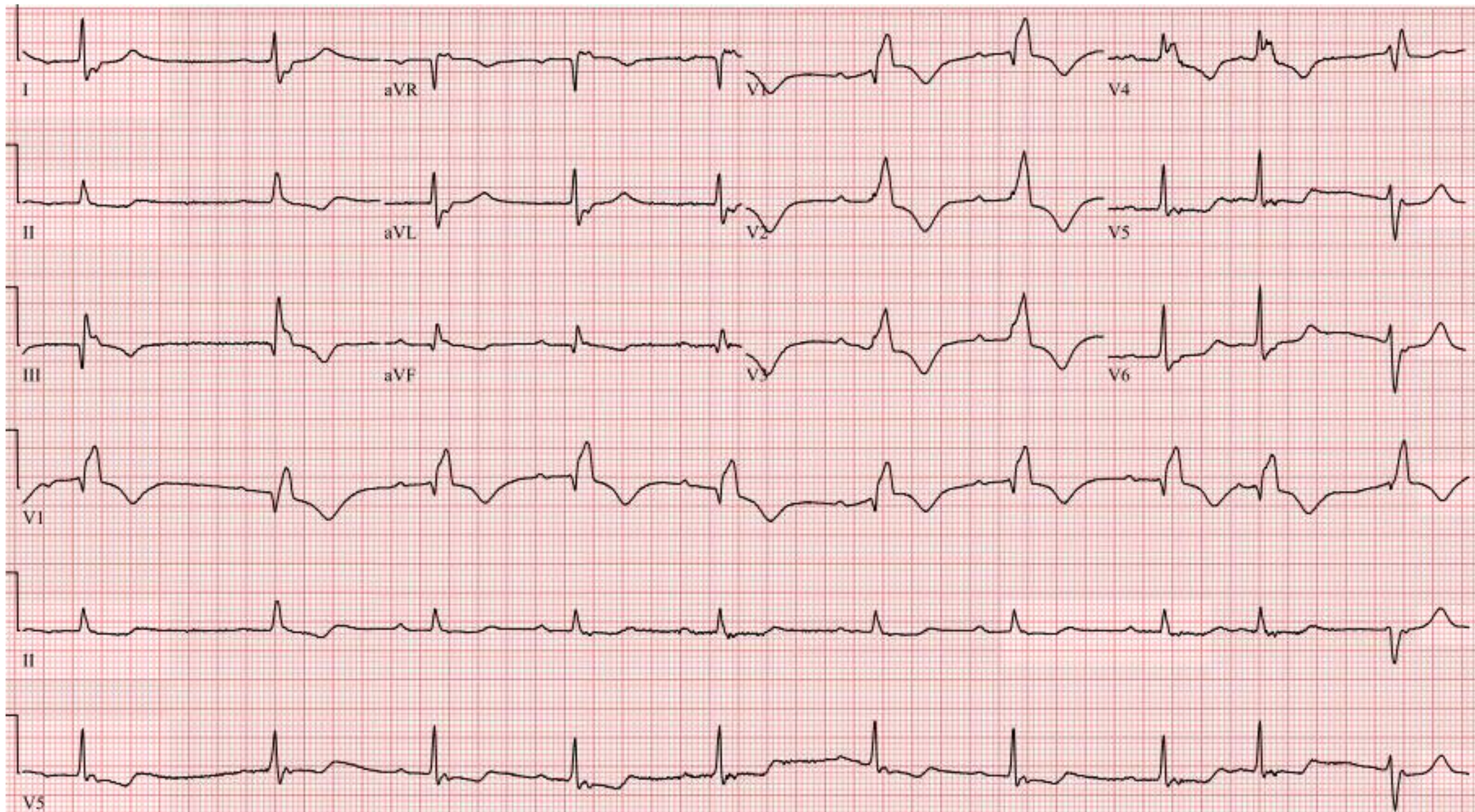
- A. Dual-chamber pacemaker
- B. Biventricular pacemaker
- C. Biventricular ICD/defibrillator
- D. Defibrillator



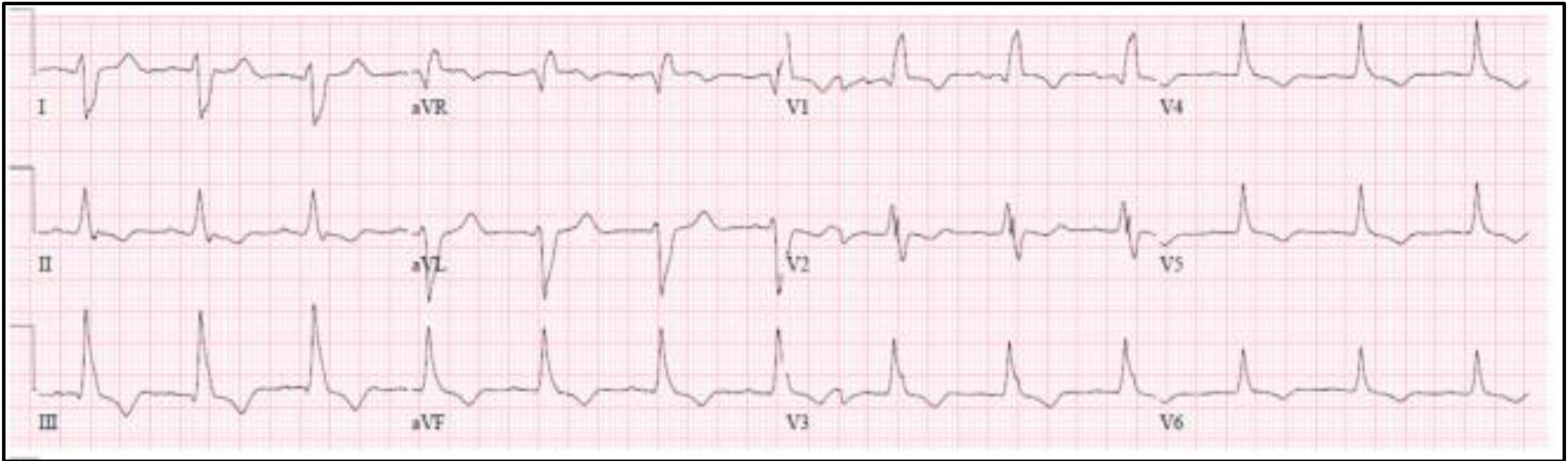


Draw a typical RBB; typical LBBB



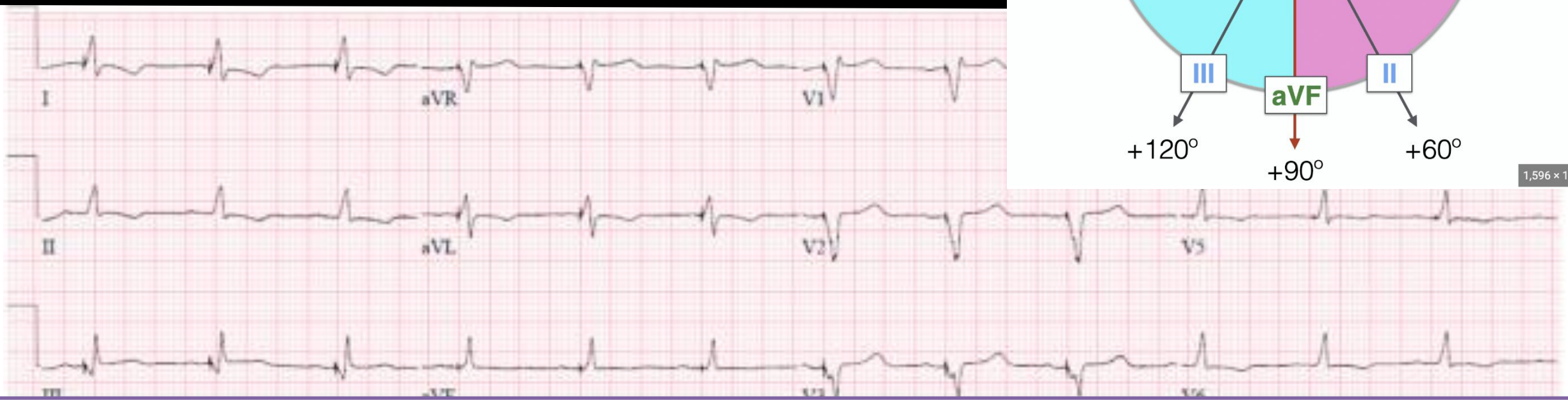
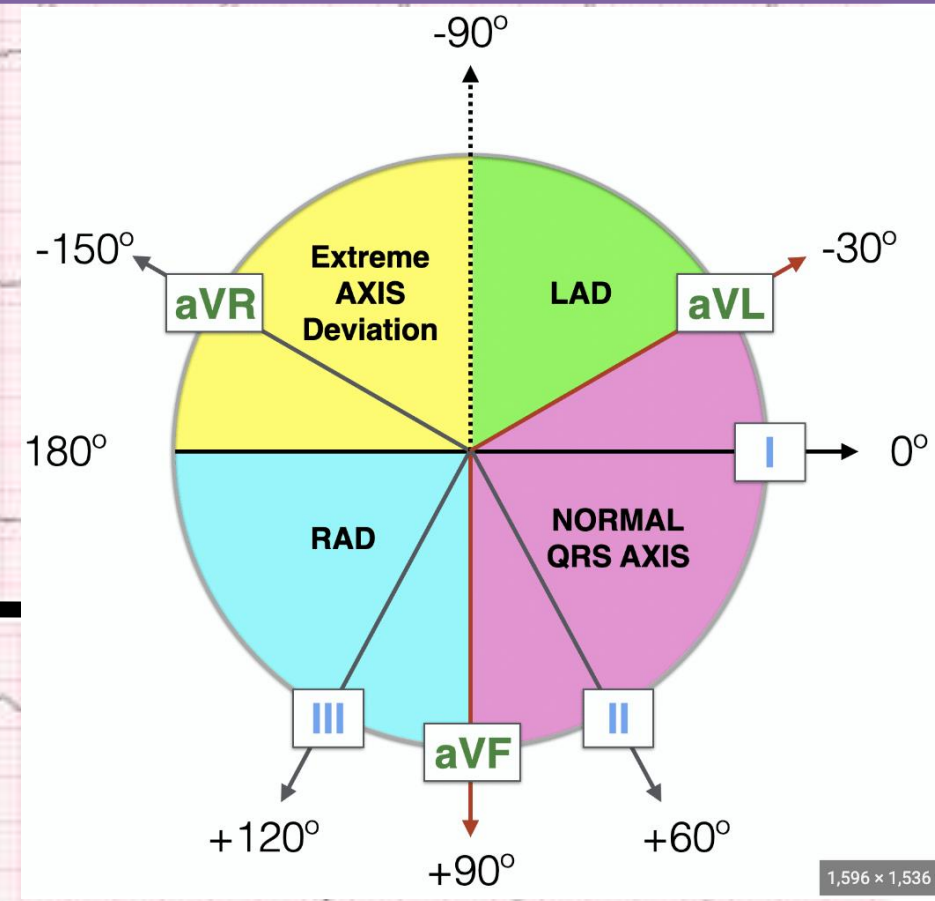


Poll Question 5: 80 year-old female with dyspnea



- A. Normal ECG
- B. Left bundle branch block
- C. RBBB + left anterior fascicular block (left axis)
- D. RBBB + left posterior fascicular block (right axis)

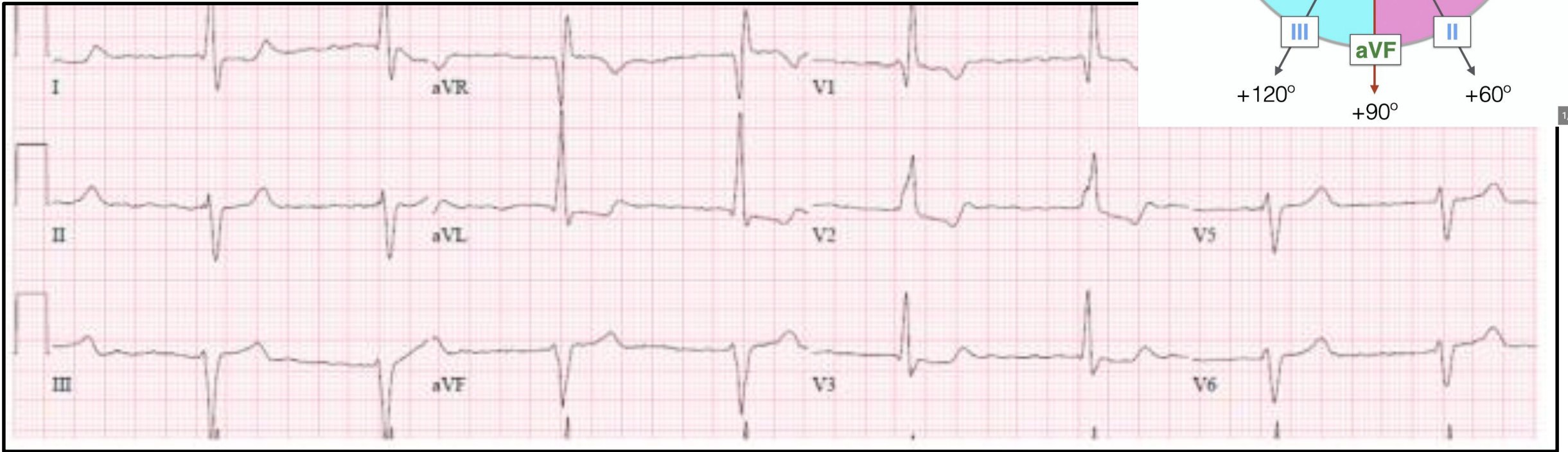
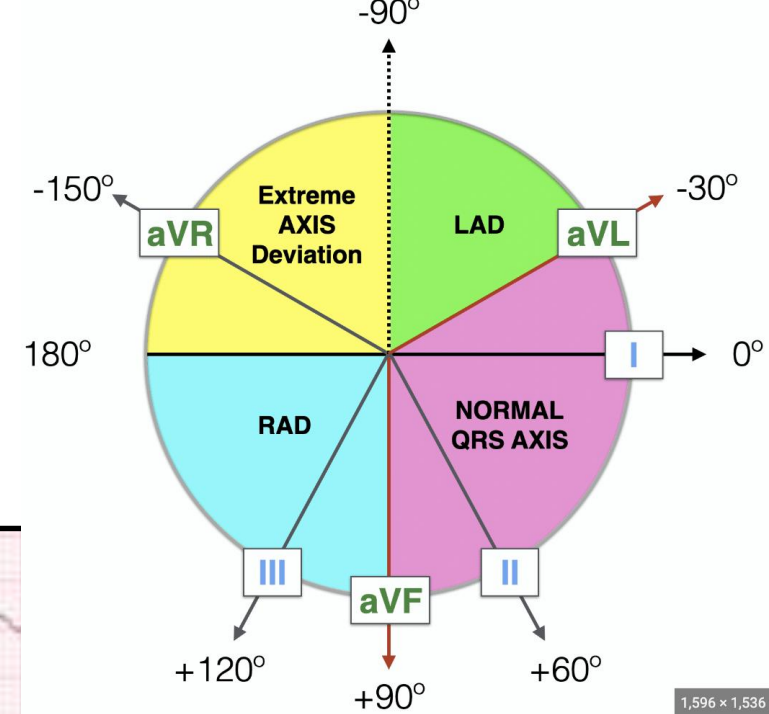
Baseline ECG with RBBB + left posterior fascicular block (right axis)



1,596 x 1,536

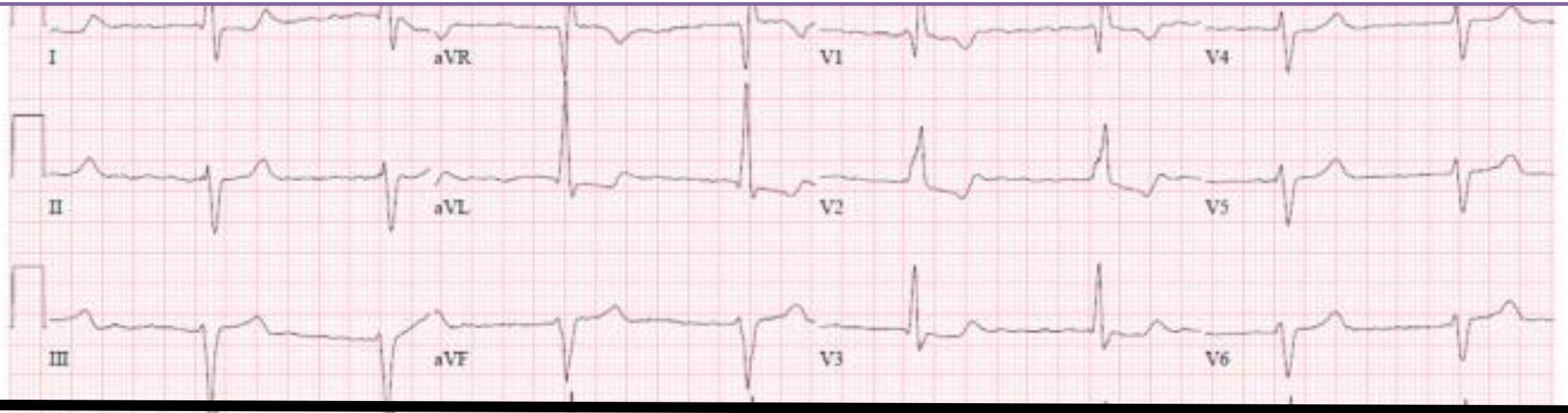
ECG with 'conduction system' pacing: correction of the RBBB and right axis

Poll Question 6: 78 year-old male with exertional dyspnea



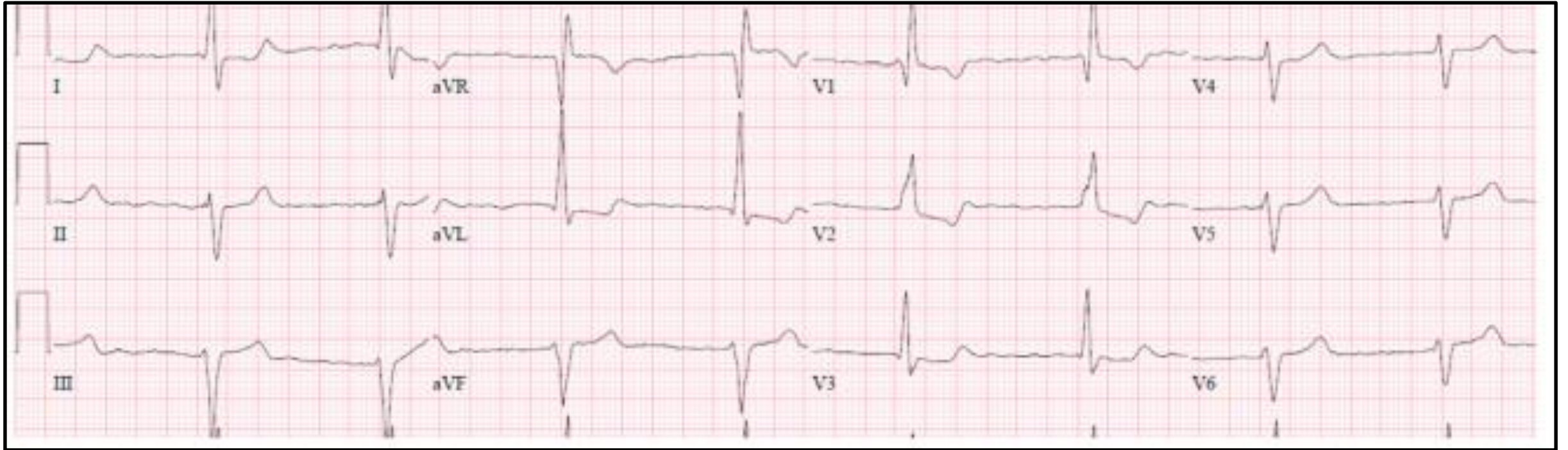
- A. Normal ECG
- B. Left bundle branch block
- C. RBBB + left anterior fascicular block (left axis)
- D. RBBB + left posterior fascicular block (right axis)

Baseline ECG with RBBB + left anterior fascicular block (left axis)

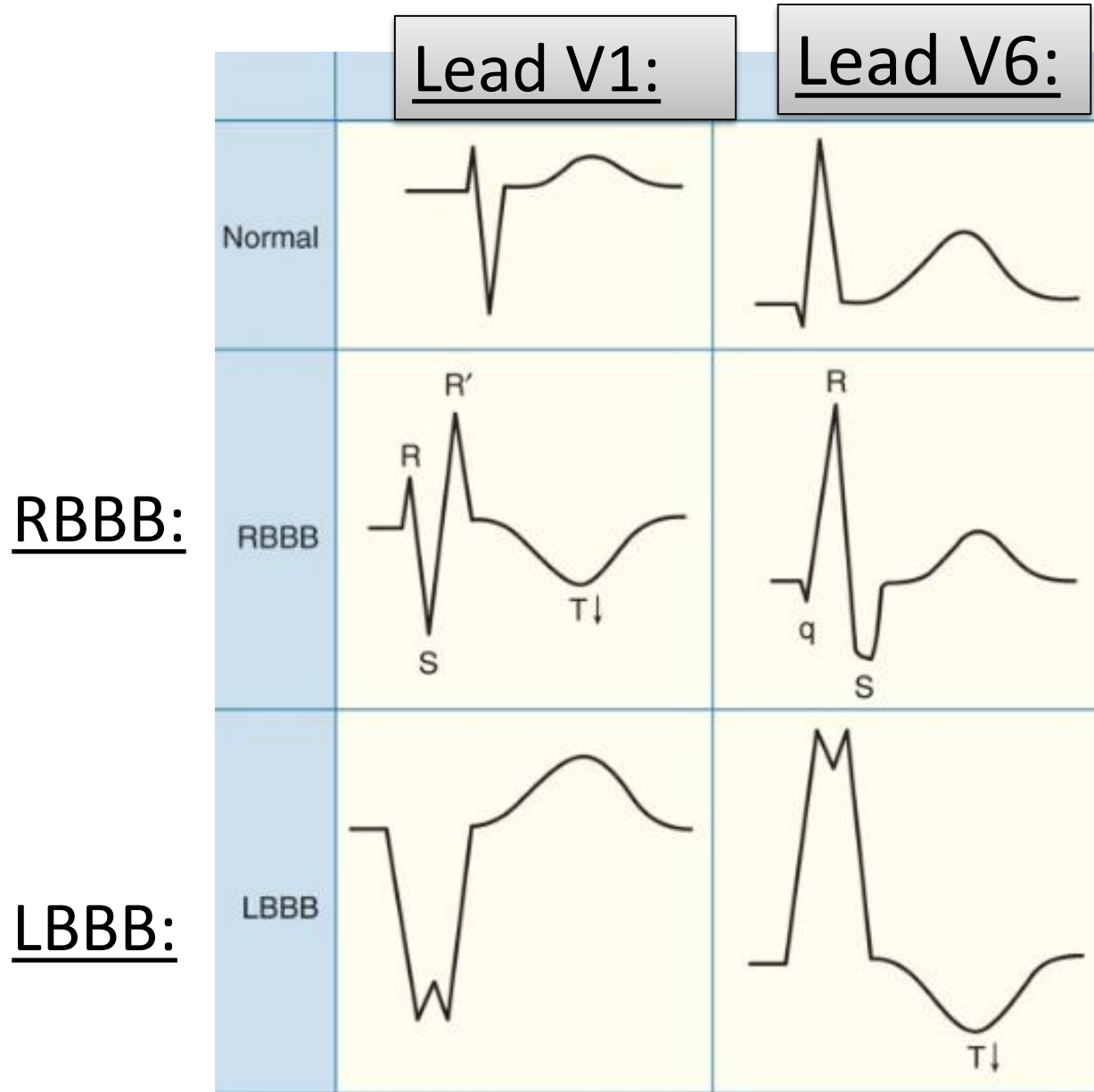


ECG with 'conduction system' pacing: correction of the RBBB and left axis

What else do you notice about this ECG?

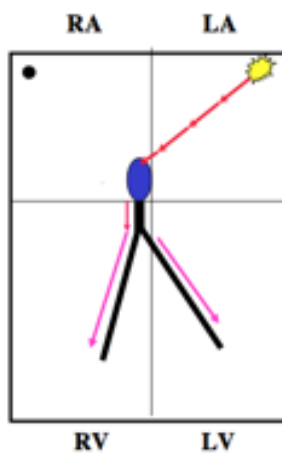


Draw a typical RBB; typical LBBB

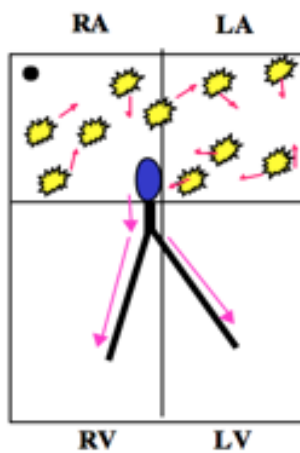


SVT

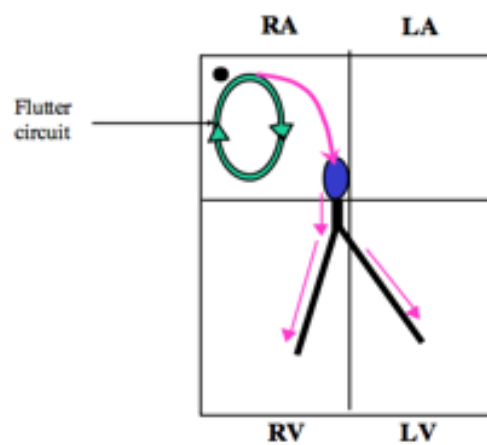
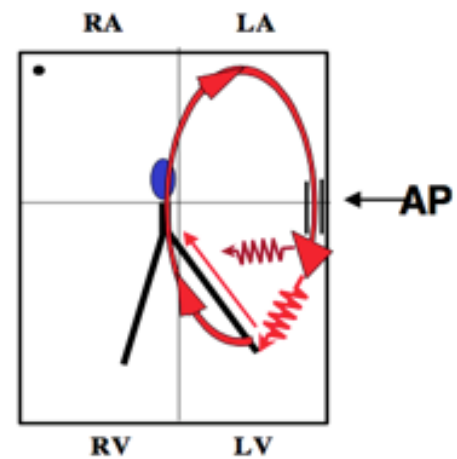
A Tach



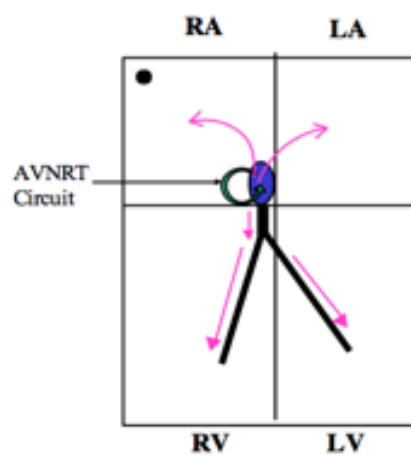
A Fib



ART

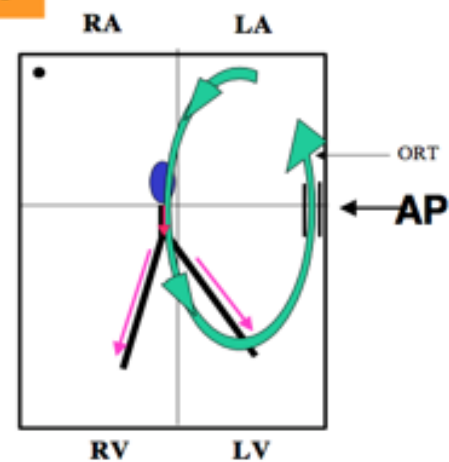


A Flutter

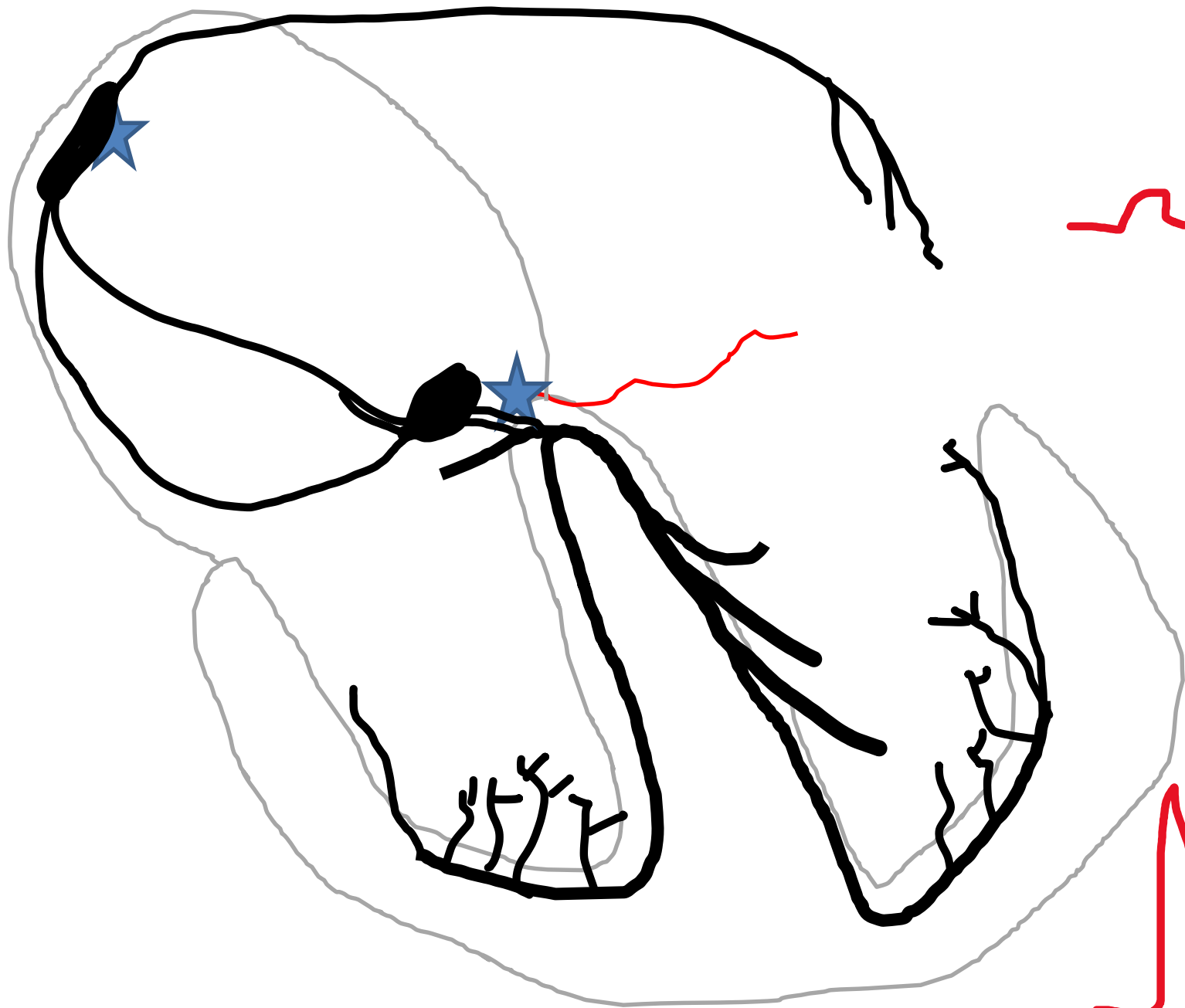


AVNRT

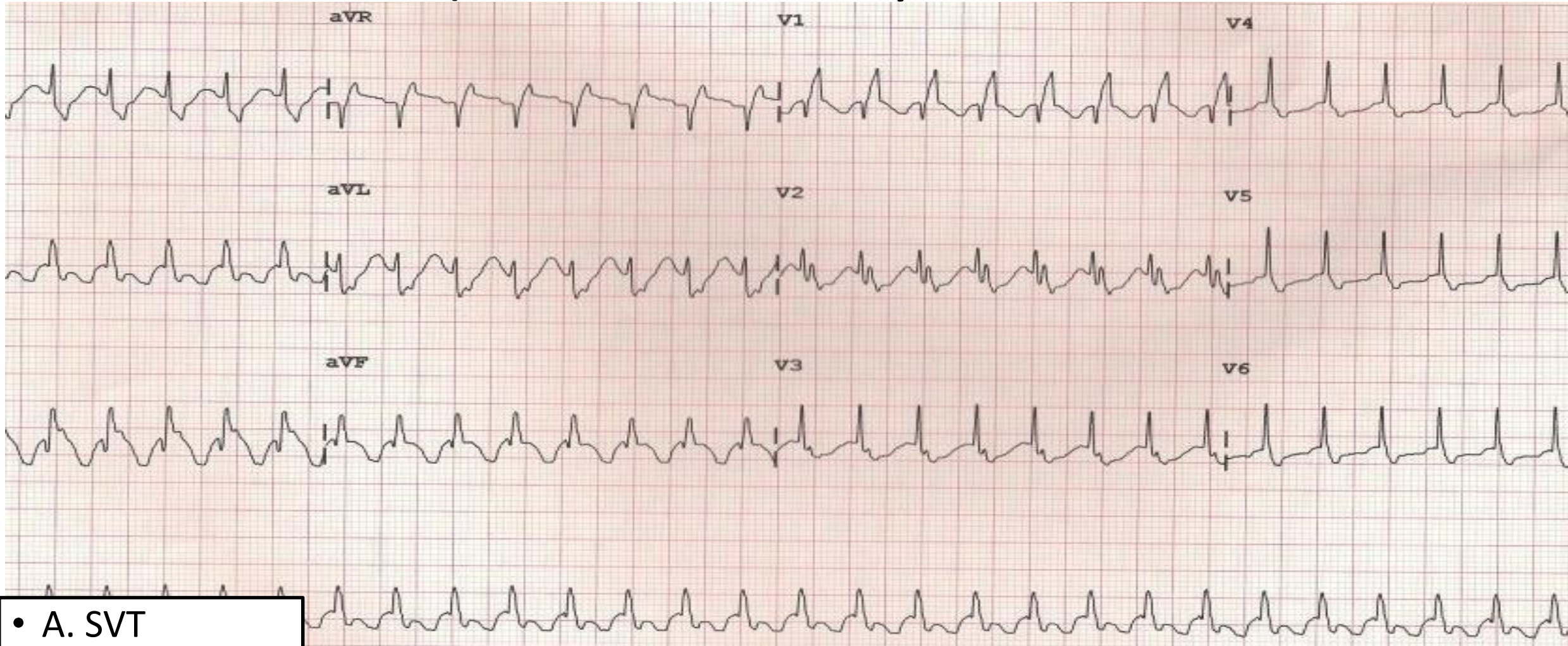
AVRT



AVRT

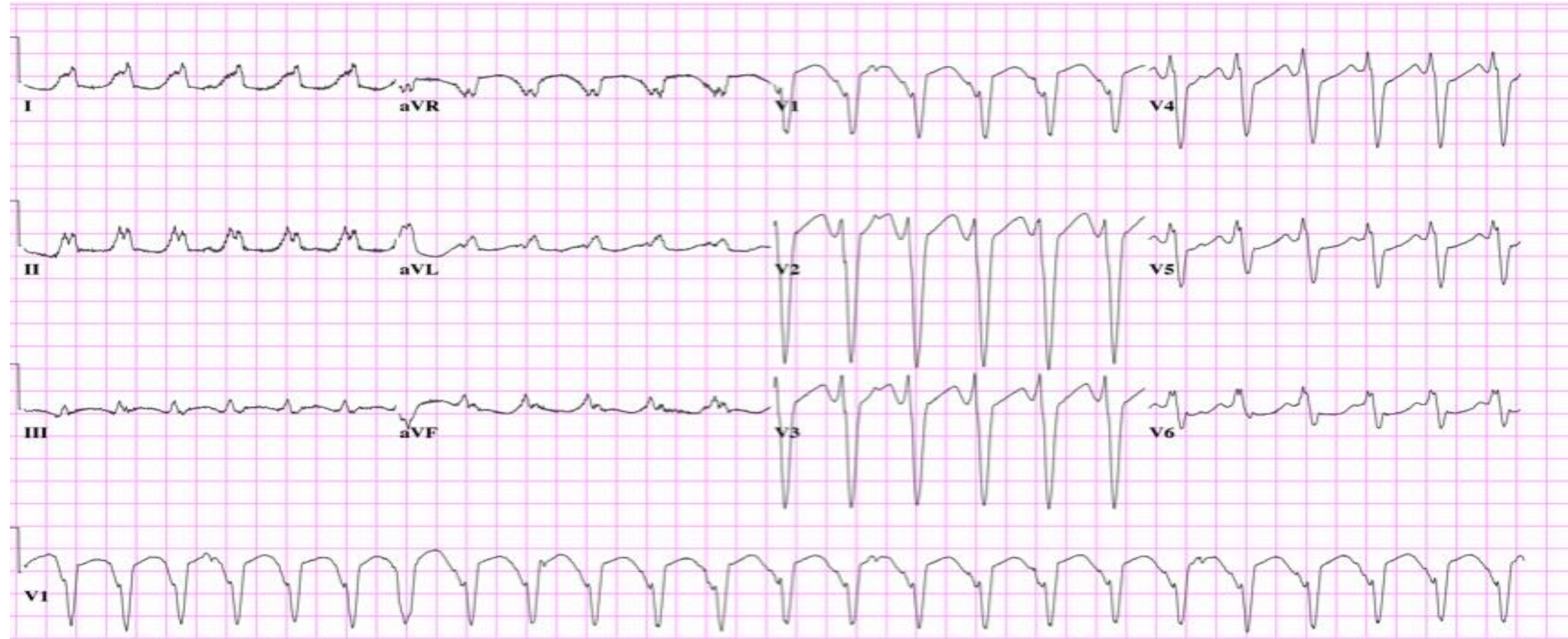


Poll 7: SVT (supraventricular tachycardia) or VT (ventricular tachycardia?)

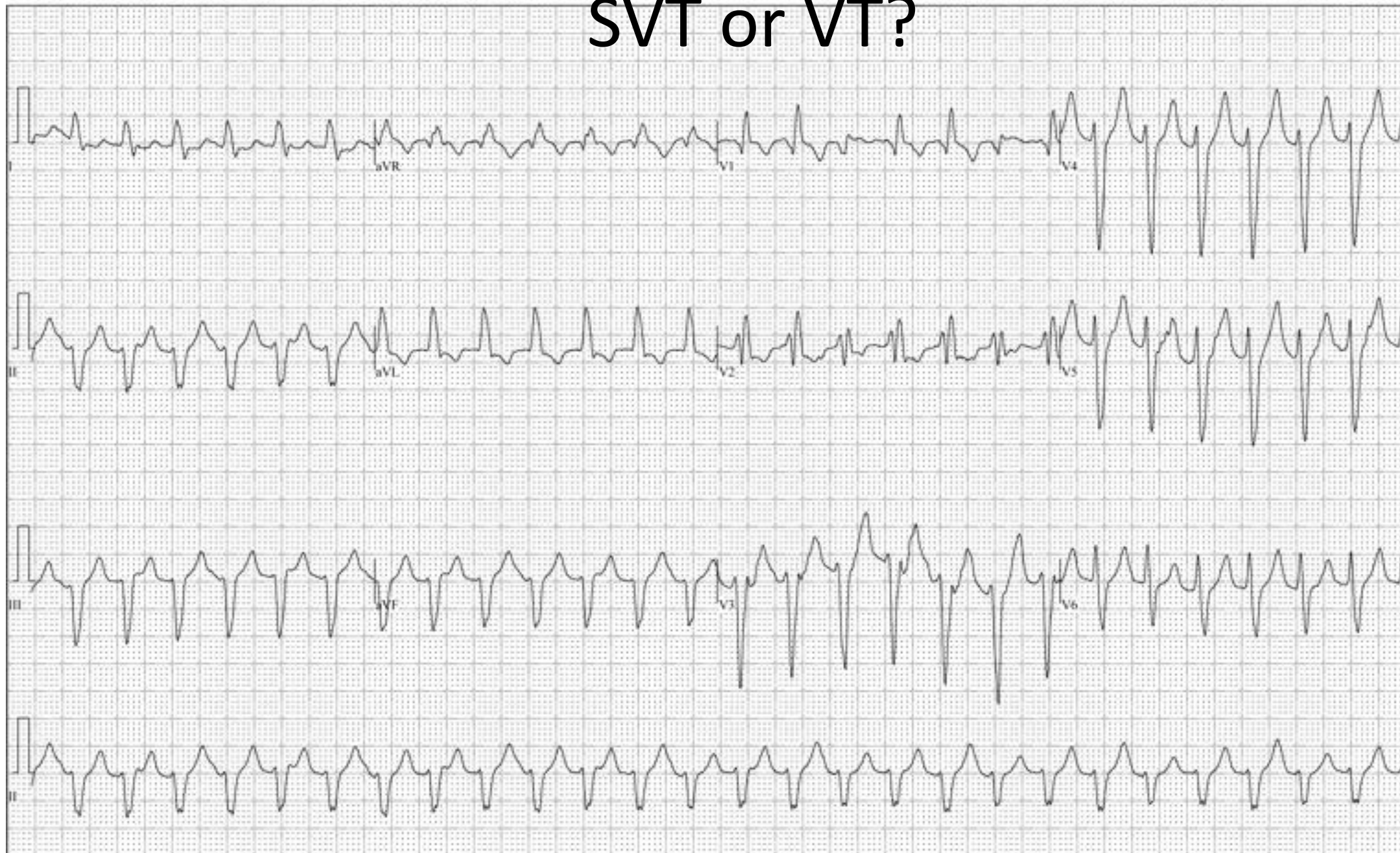


- A. SVT
- B. VT

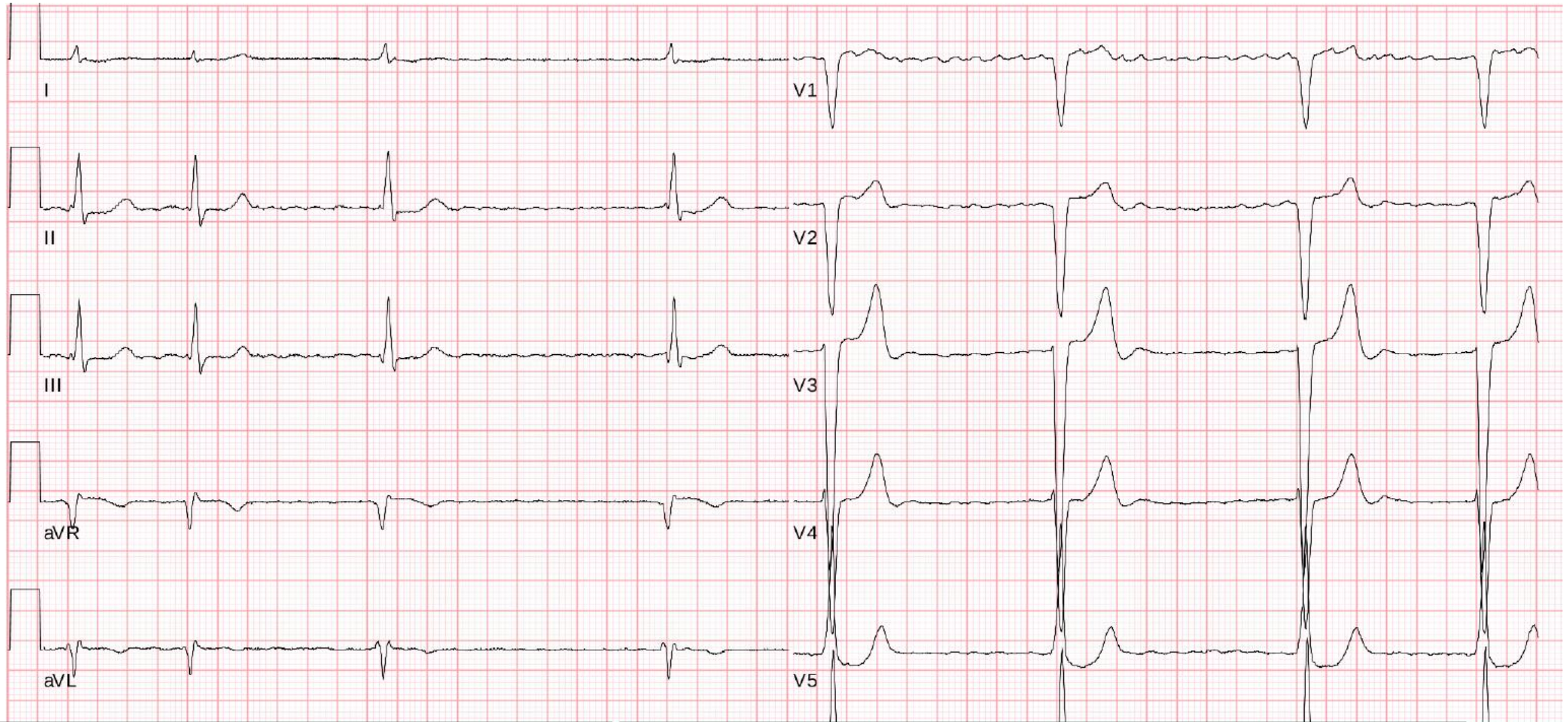
SVT or VT?



SVT or VT?



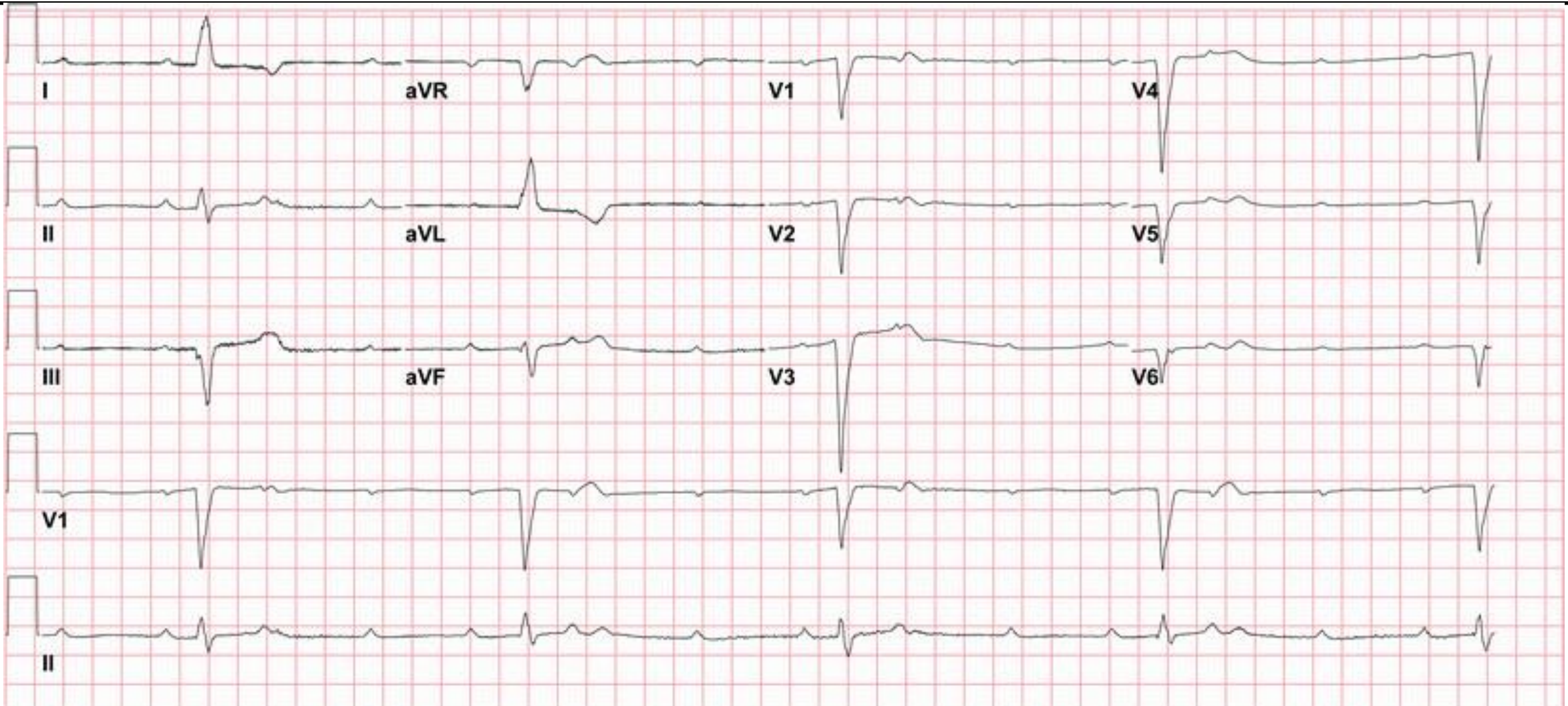
Poll Question 8: What is the underlying rhythm?



- A. Normal ECG
- B. atrial fibrillation

- C. atrial flutter
- D. sinus rhythm with complete heart block

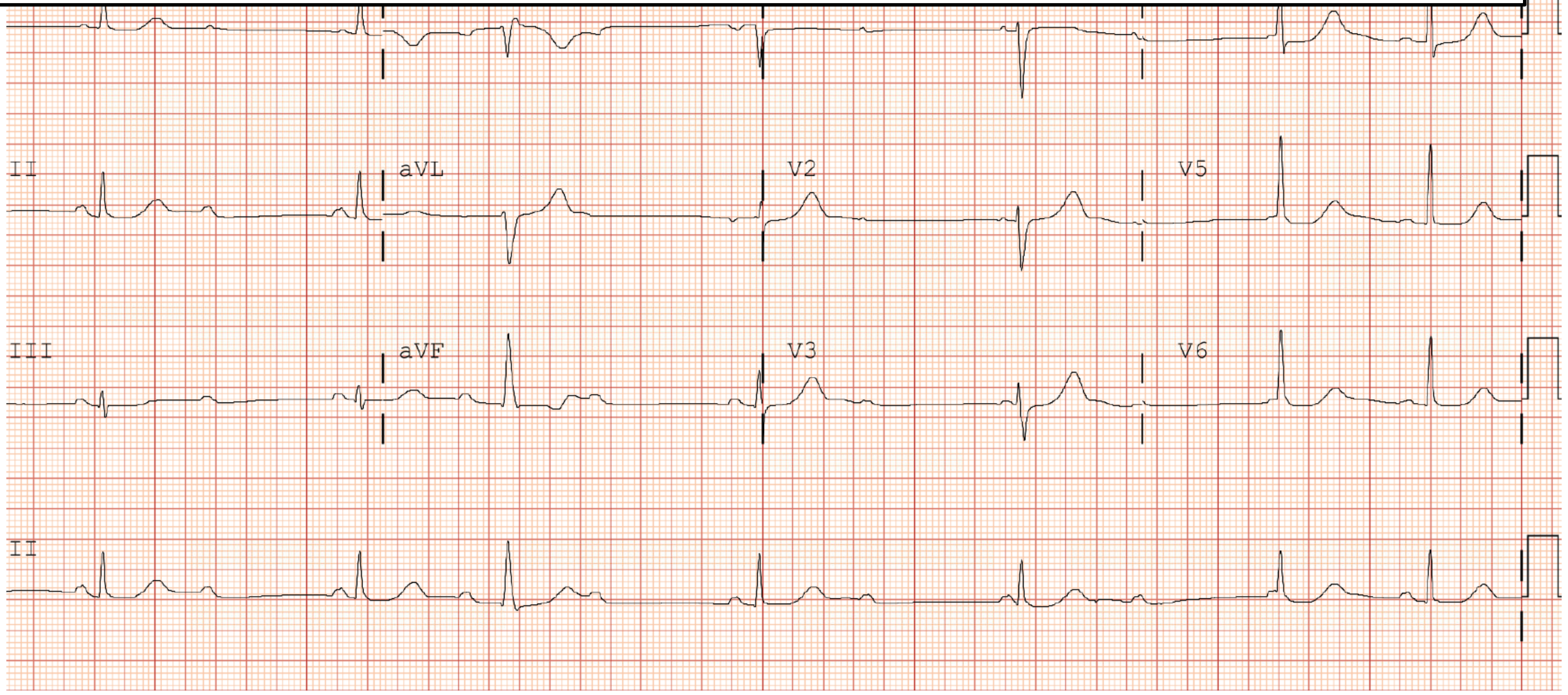
Poll 9: 70M with LVEF 60%. What type of device should you implant if any?



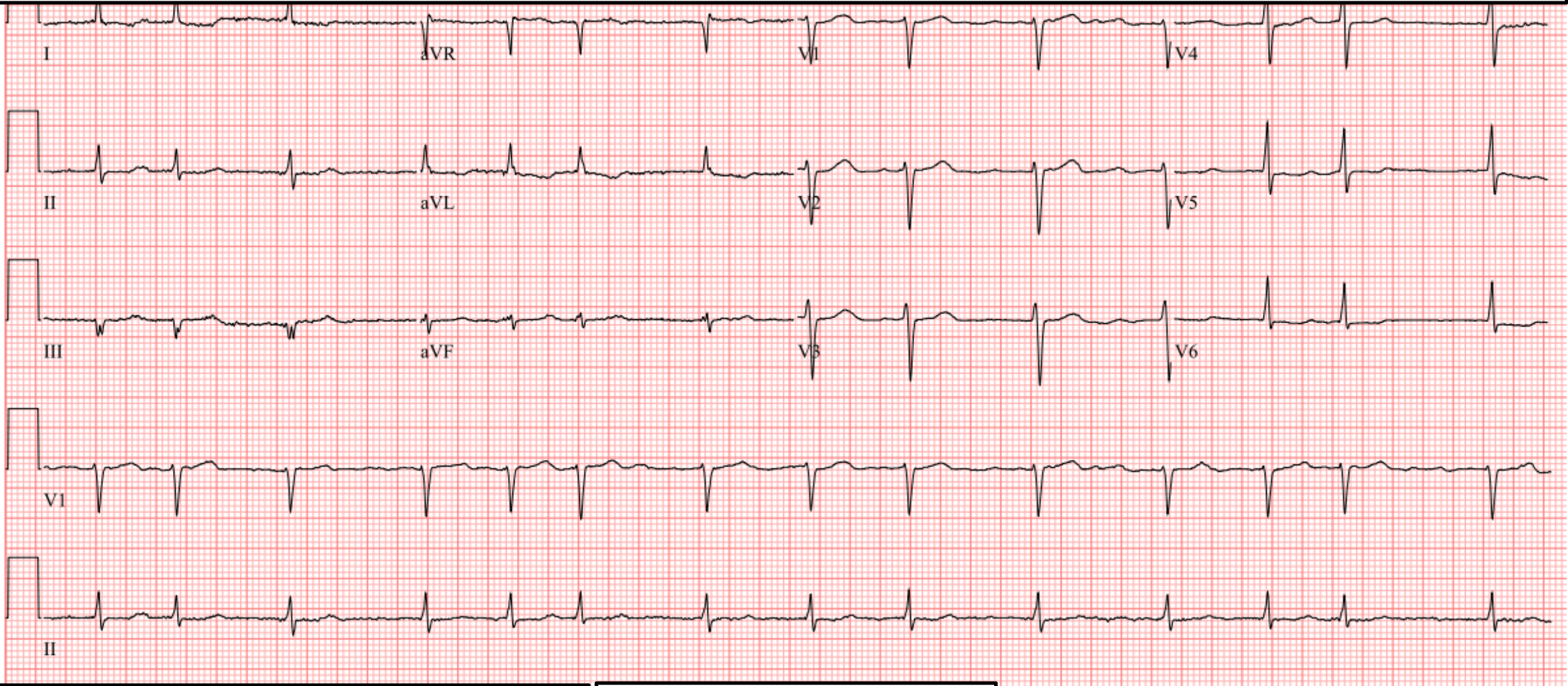
- A. No pacemaker
- B. Single-chamber pacemaker

- C. dual-chamber pacemaker
- D. defibrillator

What is the underlying rhythm?



Poll Question 10: 83F with fatigue

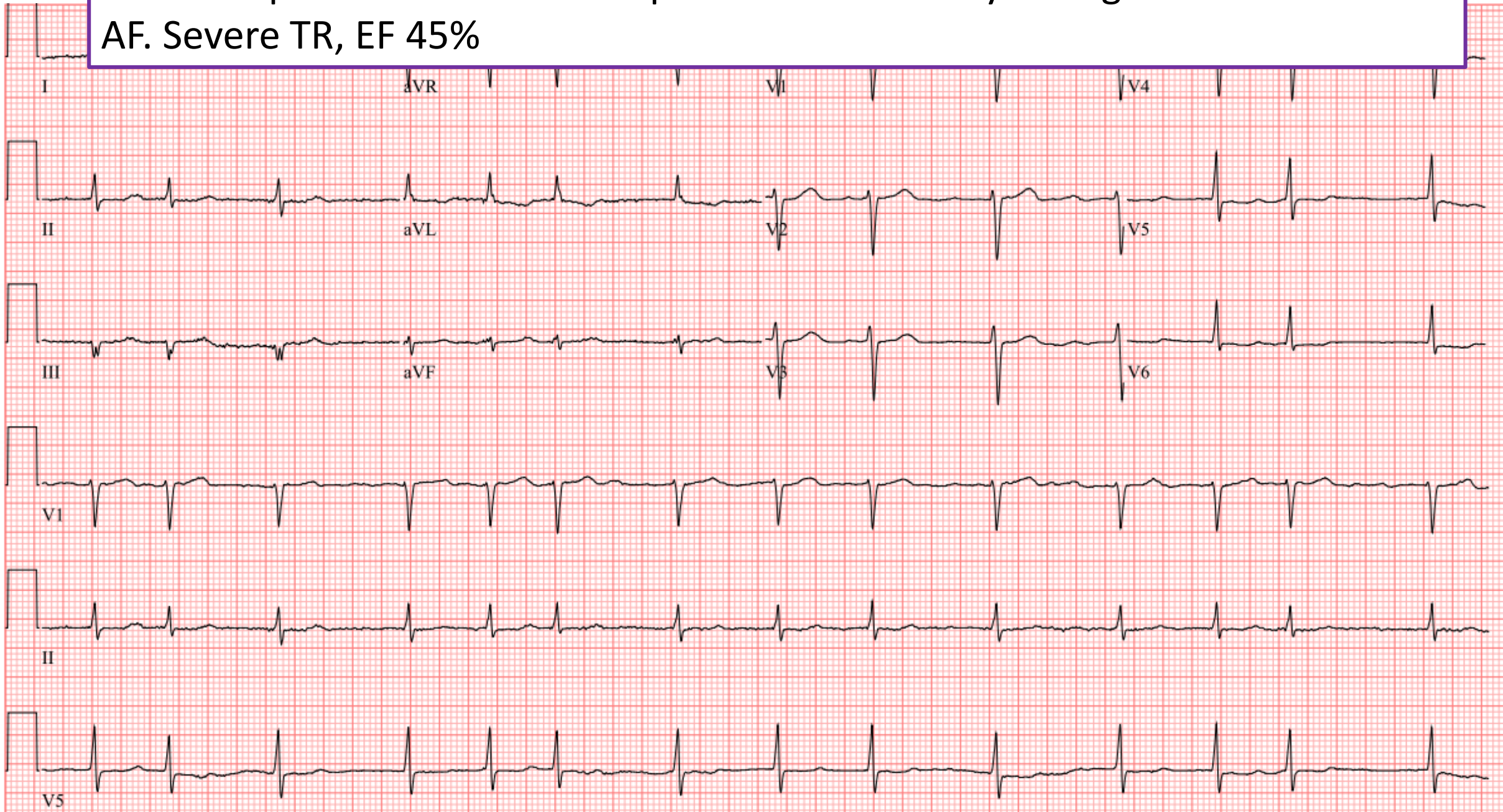


- A. Normal ECG
- B. Left bundle branch block

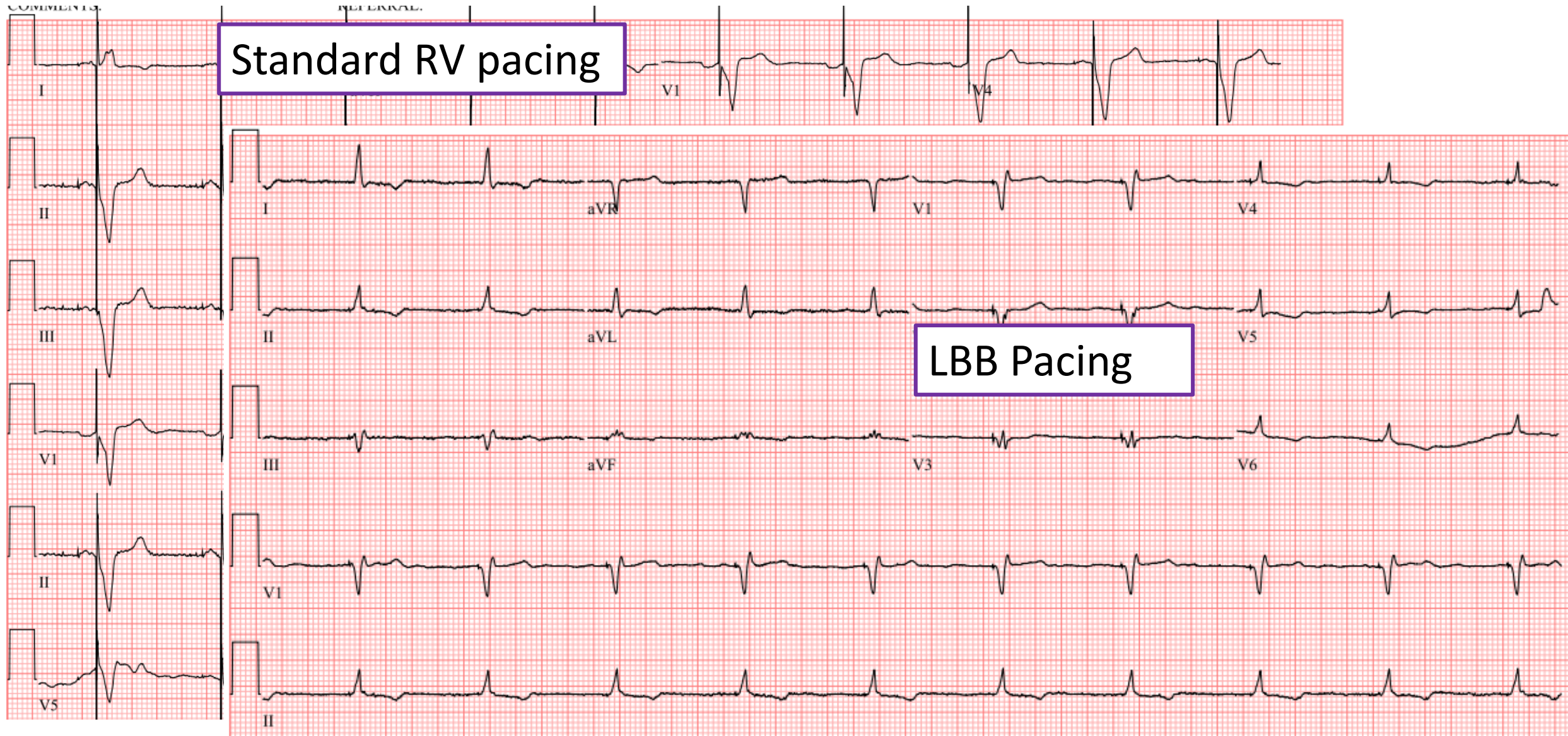
- C. Atrial flutter
- D. Atrial fibrillation

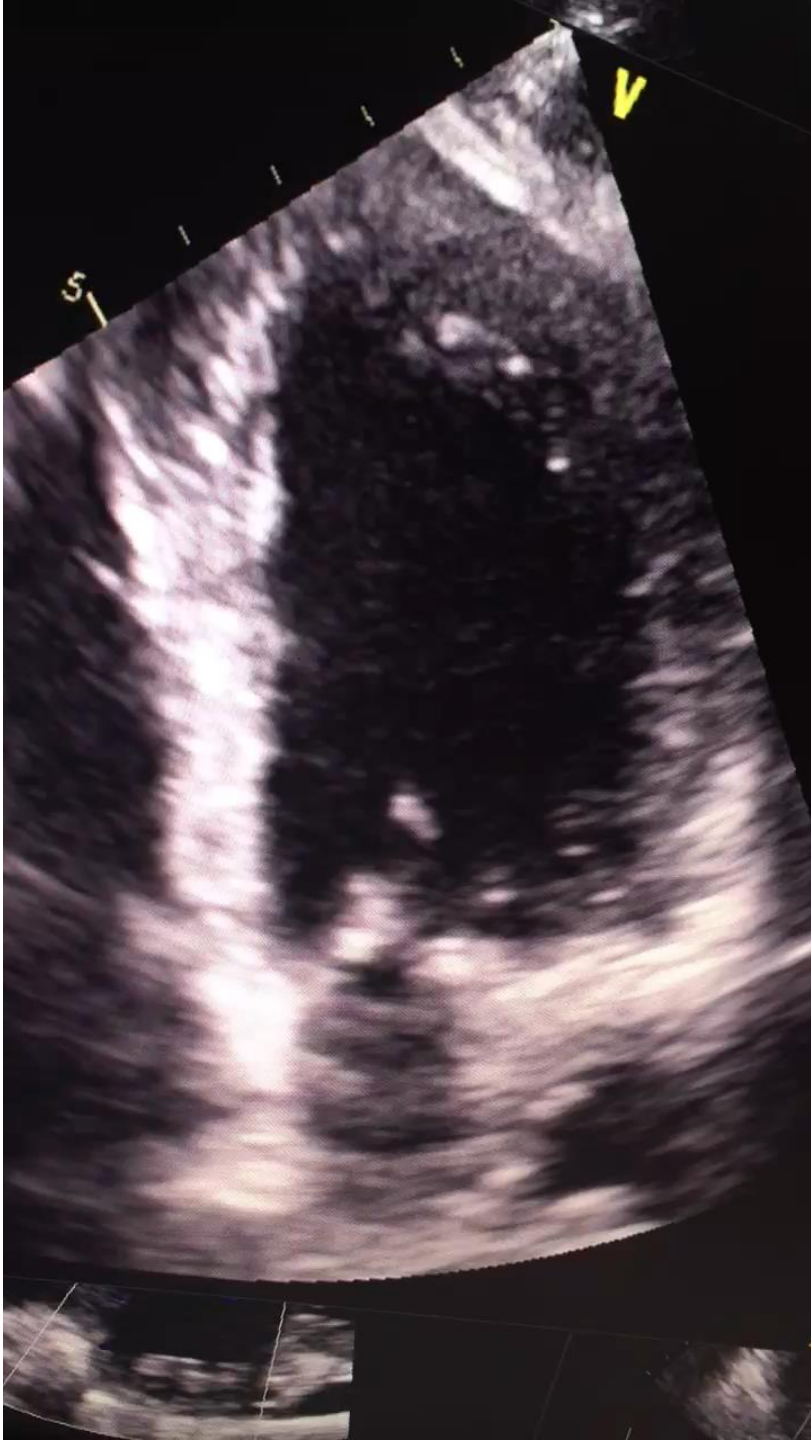


80F Pre-op trans-aortic valve replacement. Severely enlarged LA with chronic AF. Severe TR, EF 45%



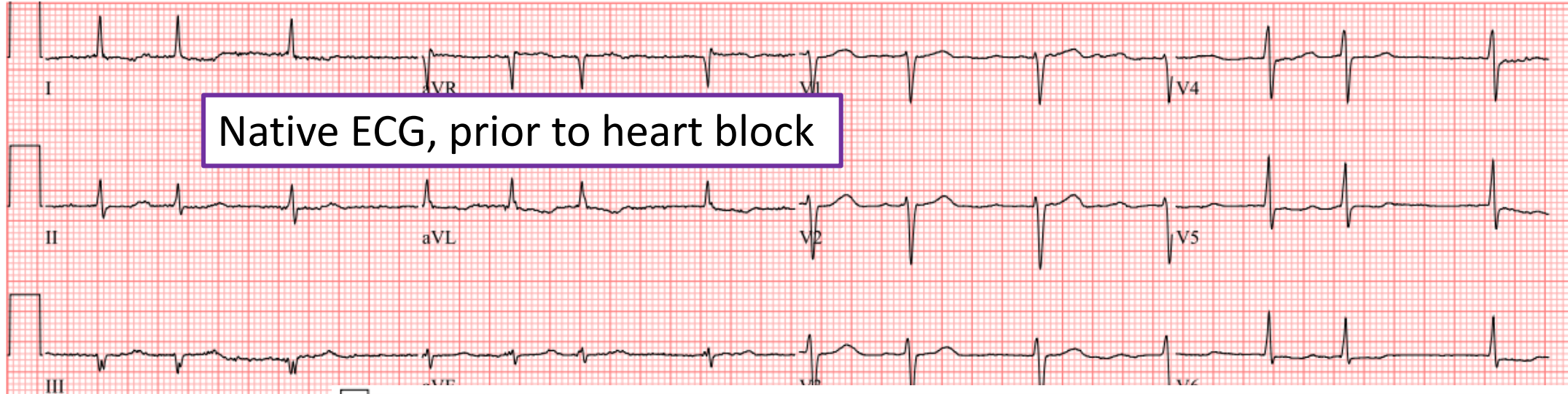
83F Post-op TAVI develops complete heart block, dependent on temporary pacing wire. What should we do now?



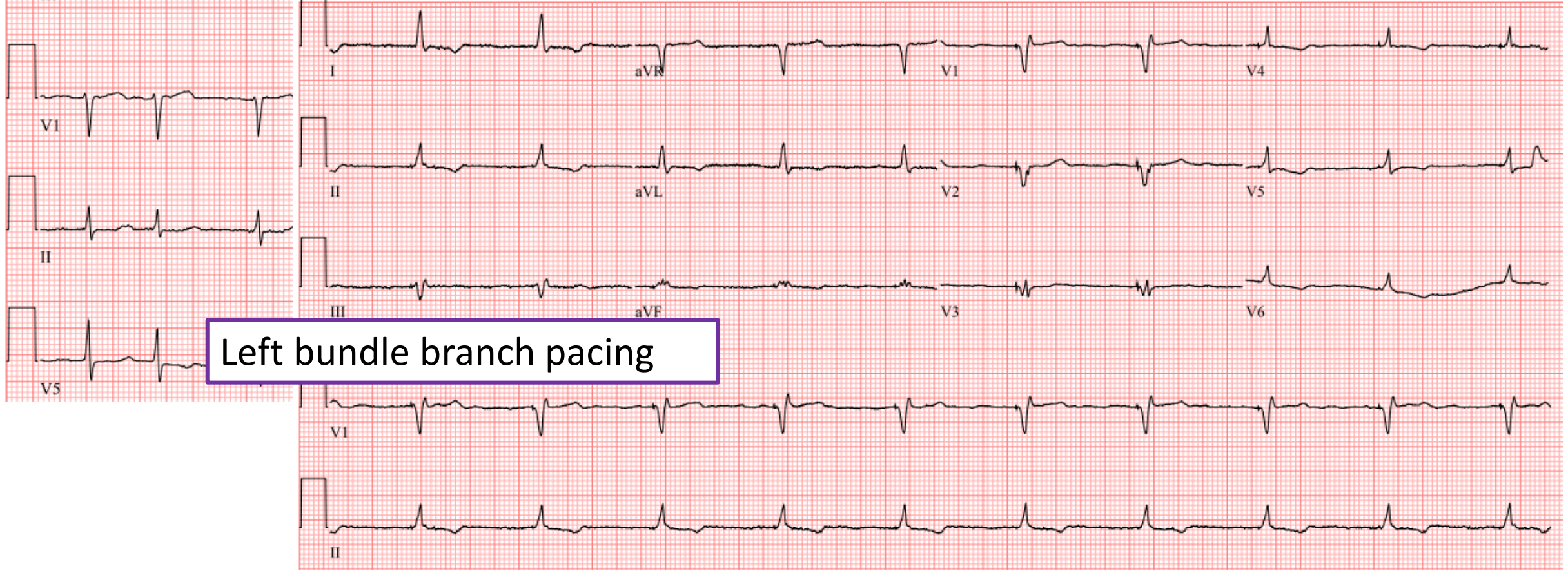


Stable
threshold,
sensing, and
impedance of
the lead

Native ECG, prior to heart block

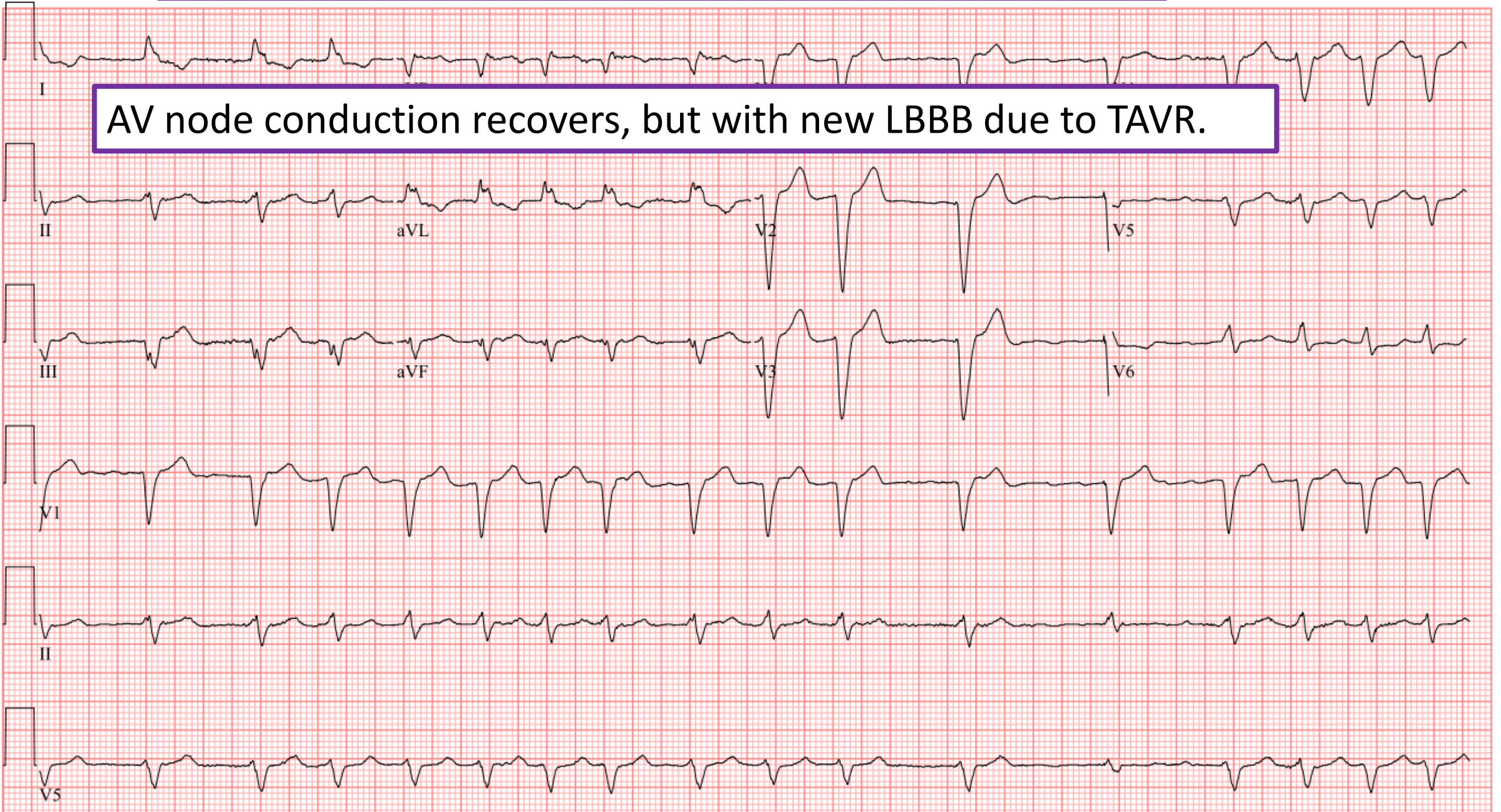


Left bundle branch pacing



1 week later, presents to ED with pulmonary edema.

AV node conduction recovers, but with new LBBB due to TAVR.



6/8/2020
3:01:03 PM
1 - 5/5

AXIOM
VC21C 16

R

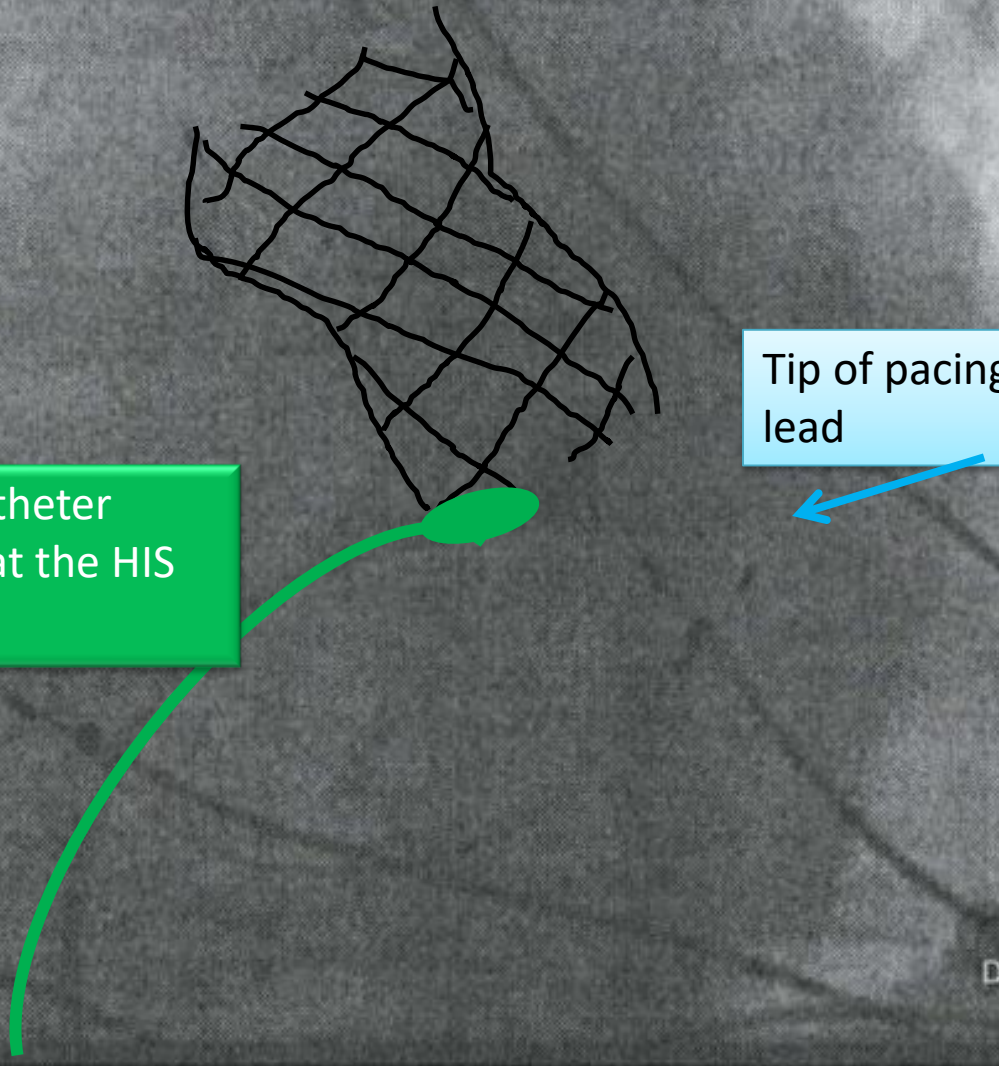
Ablation Catheter
positioned at the HIS
(av node)

Tip of pacing
lead

FL(-) LD
cm 25
A
D 18
LAO 16° / CAUD 1°

EE
DDO

WC
WW



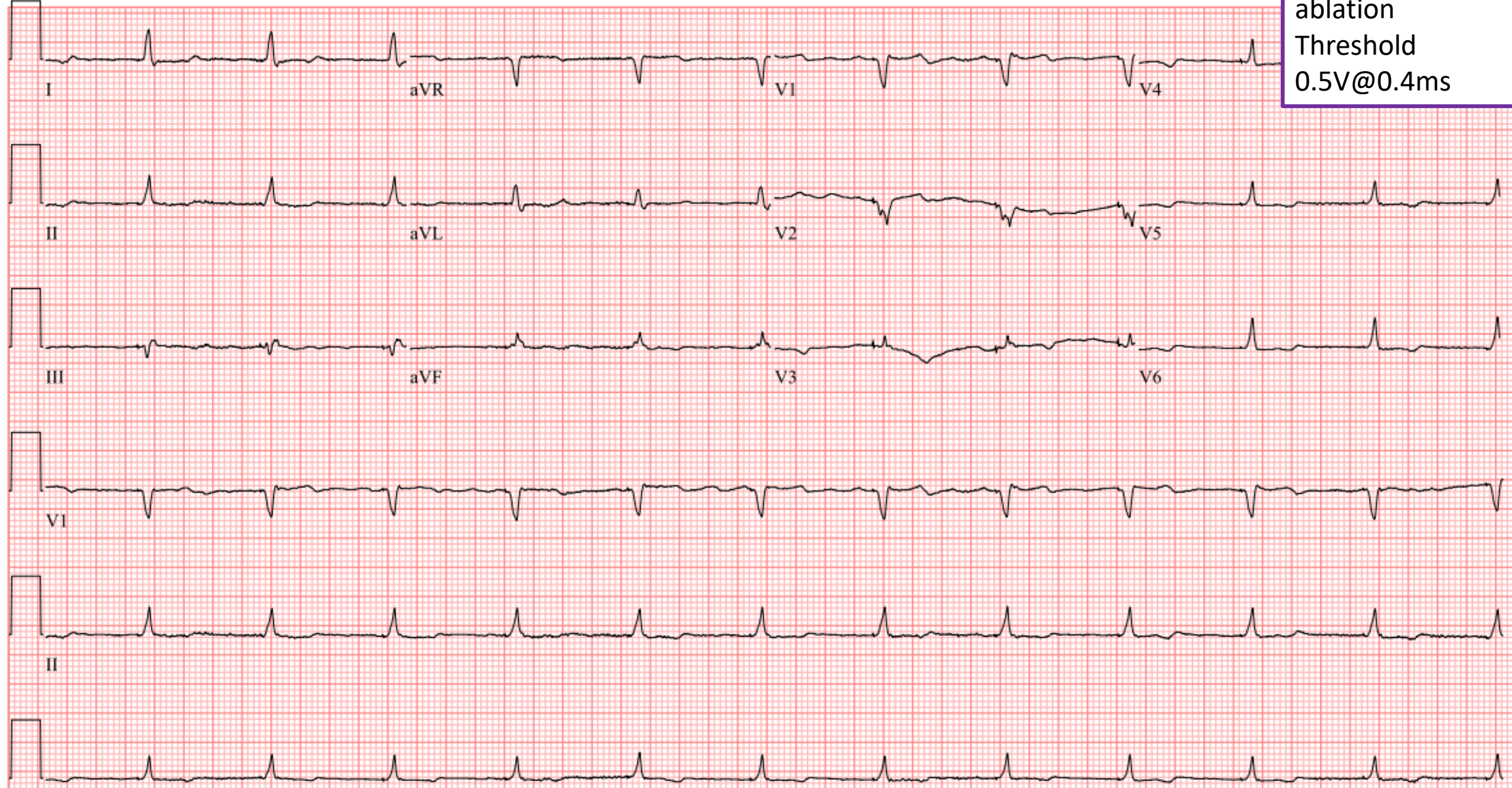
Technician: * Nurse
Test ind:

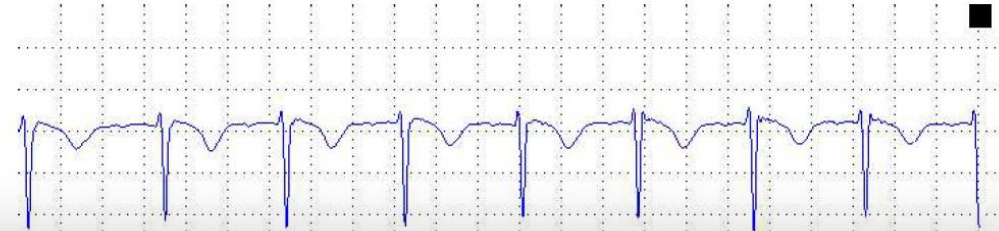
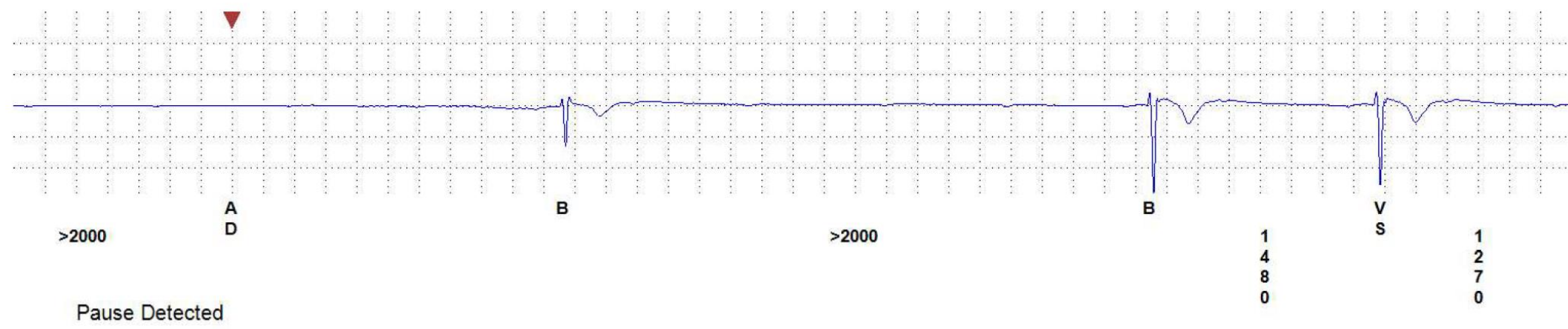
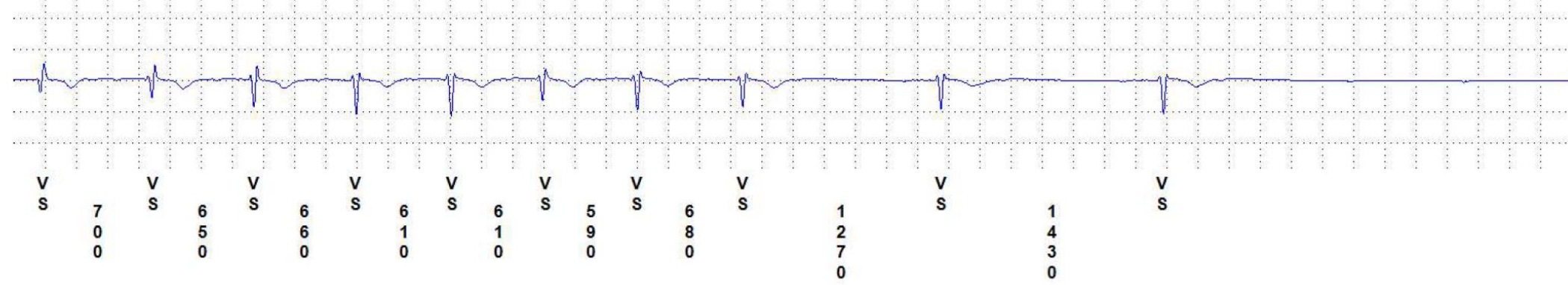
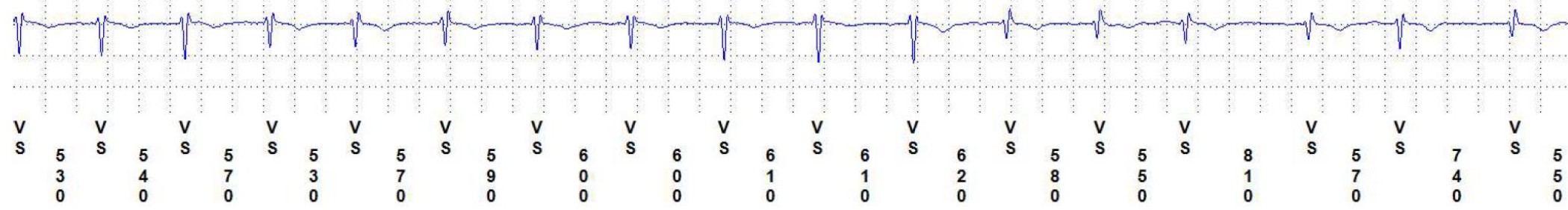
80F Post AV node ablation

Confirmed By: Derek

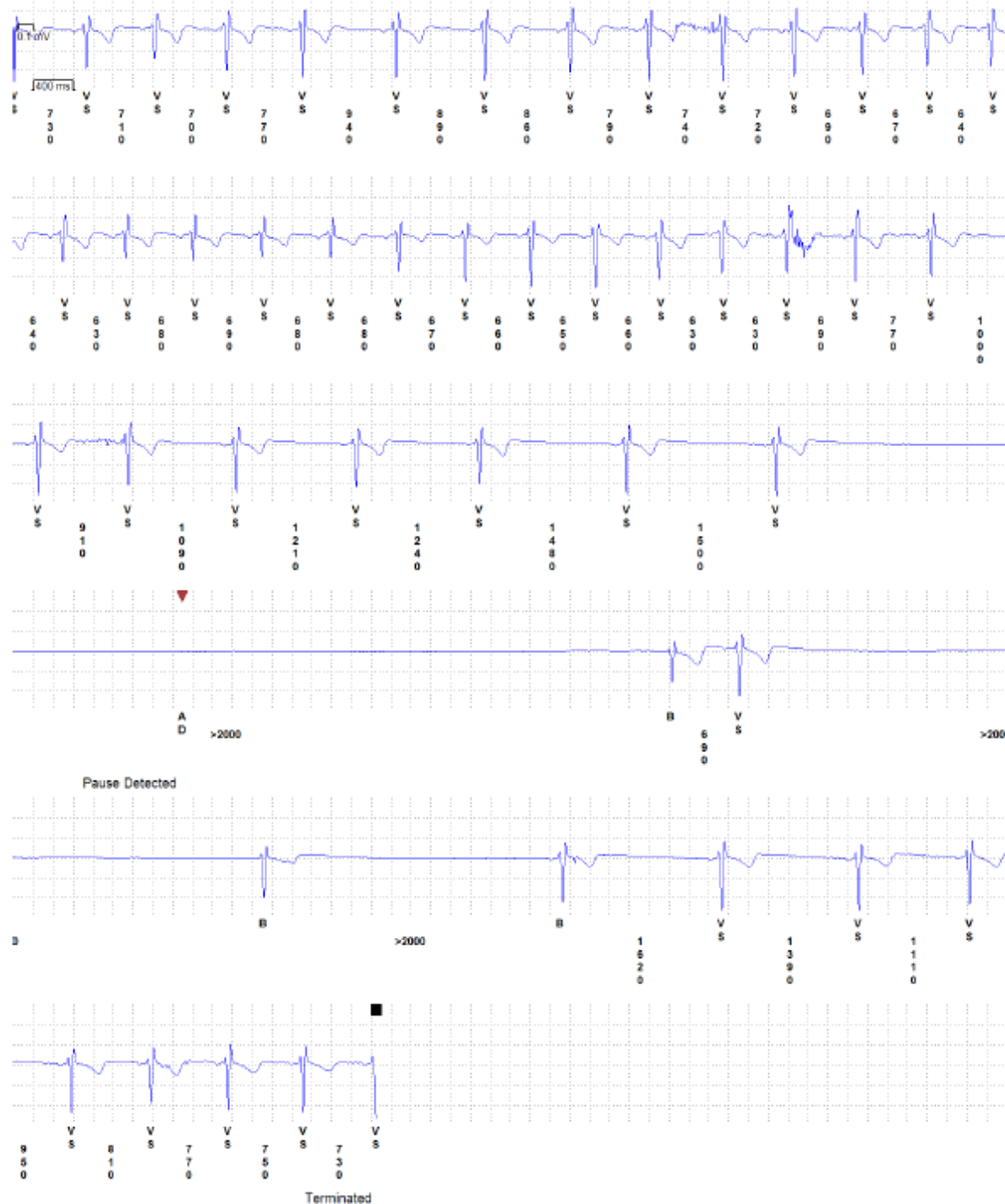
Post AV node
ablation
Threshold
0.5V@0.4ms

COMMENTS:





What is happening here?



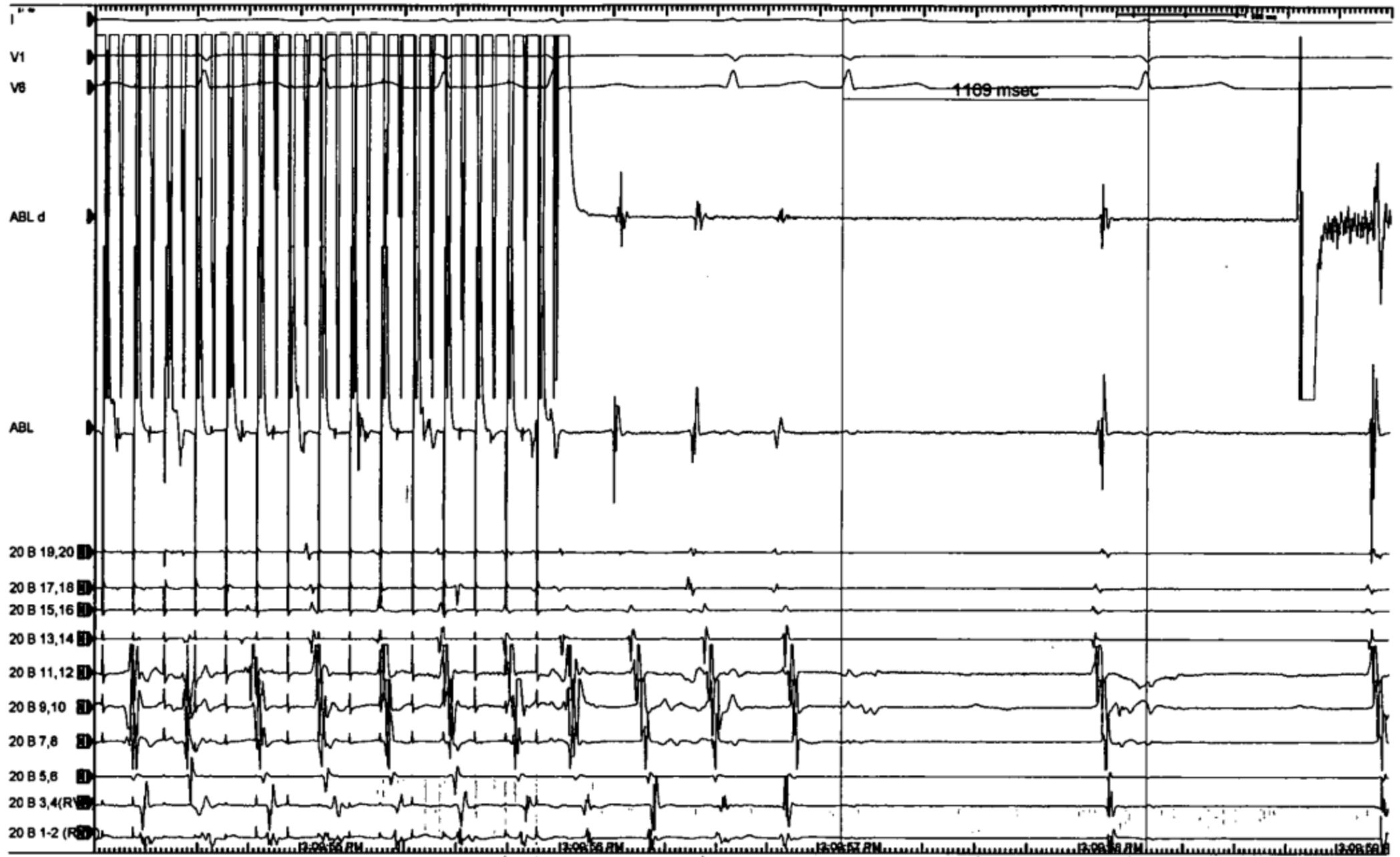
23M, recurrent syncope 2x per month x 8 months

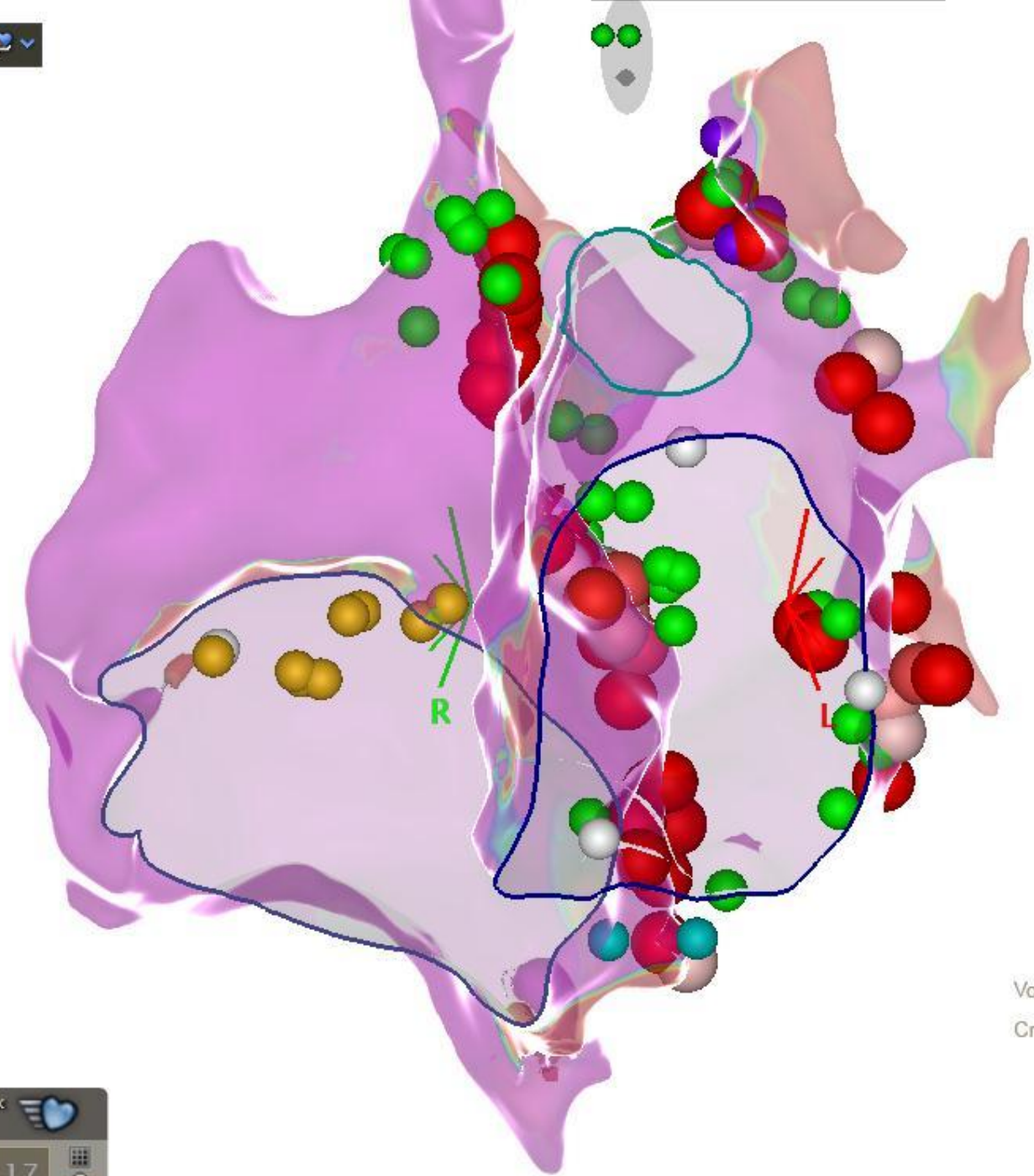
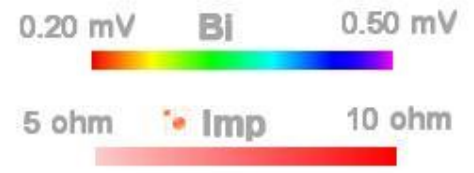
Short prodrome

EP study negative

so loop monitor implanted

High frequency stimulation posteromedial GP





1.15

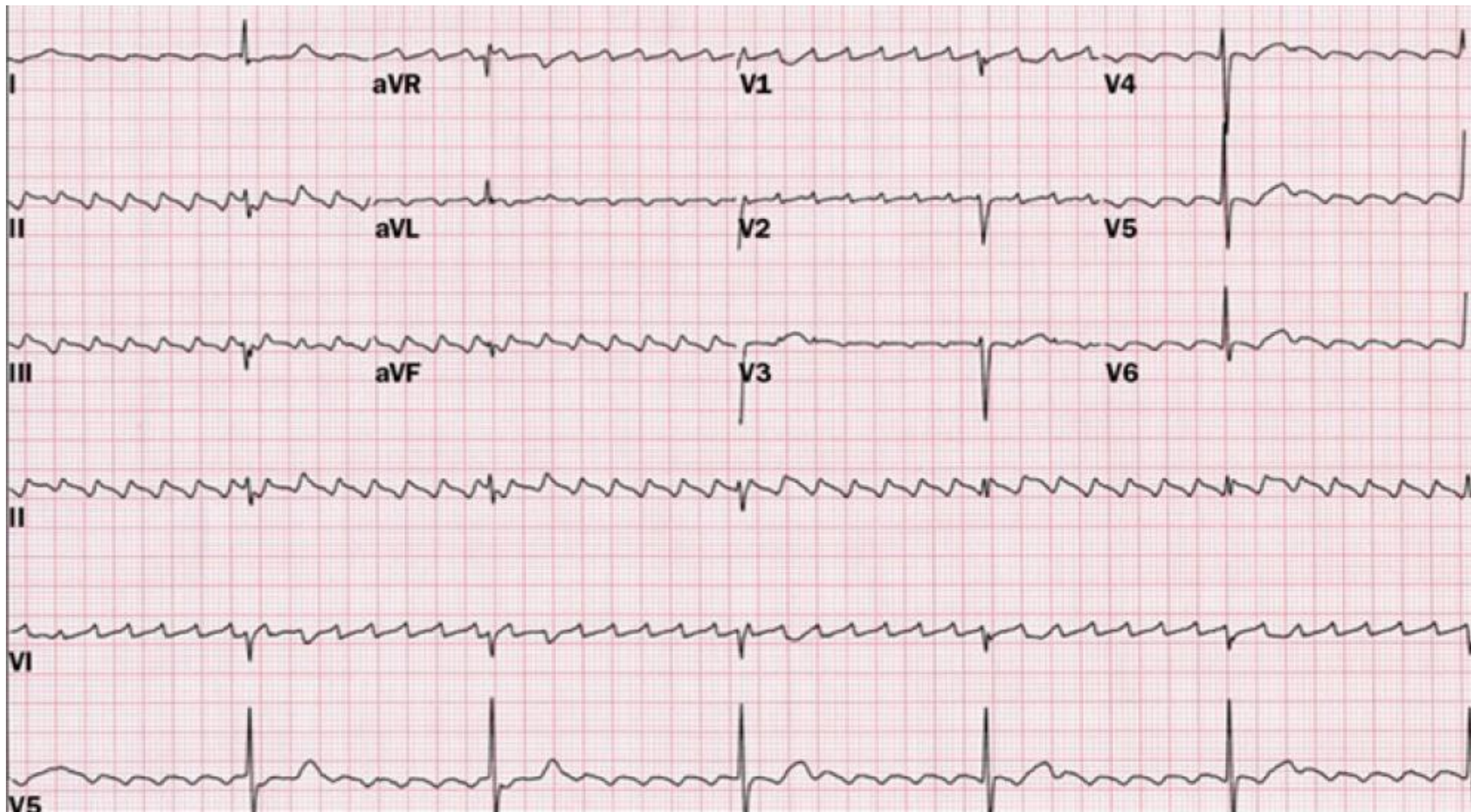
Volume: 105.59 LAO: 64°
Cranial: 0° Swivel: 0°

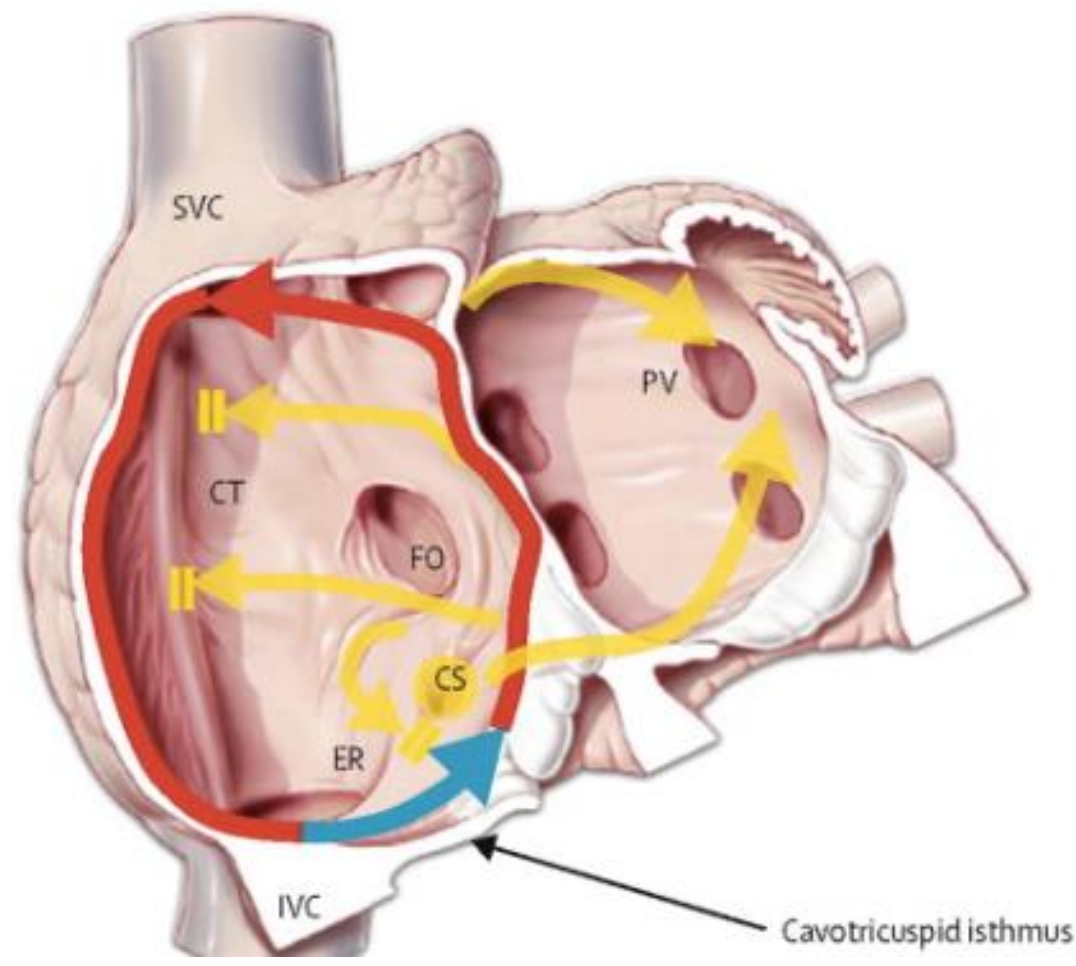
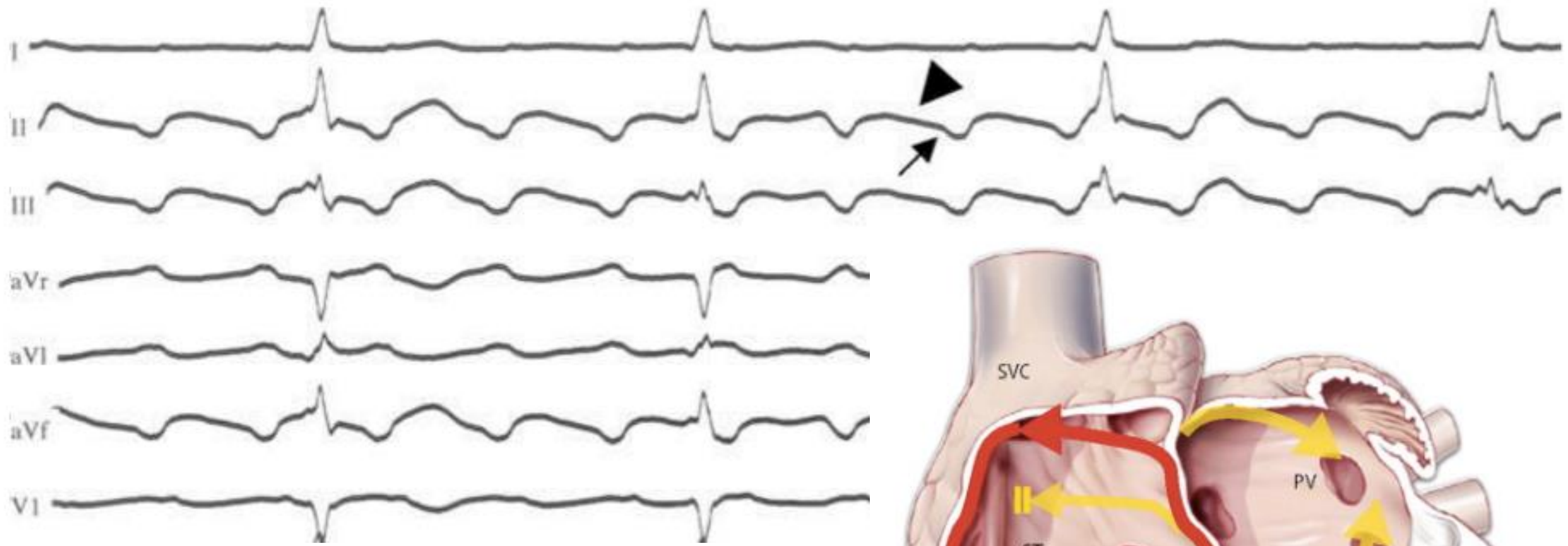
70%

AP PA LAO RAO LL RL INF SUP

17

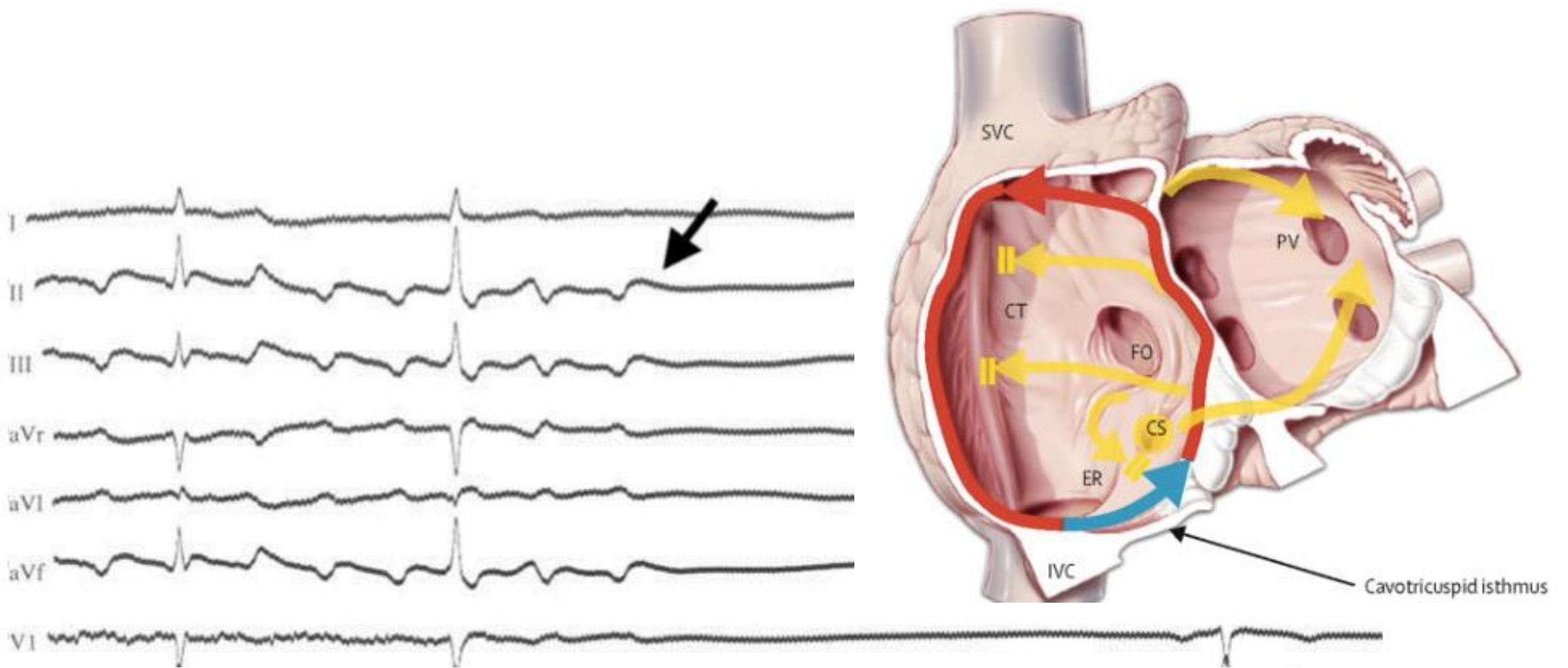
What is the underlying Rhythm?





Arrowhead represents initial slow descent
 Arrow represents later sharper rapid descent

Cavotricuspid isthmus



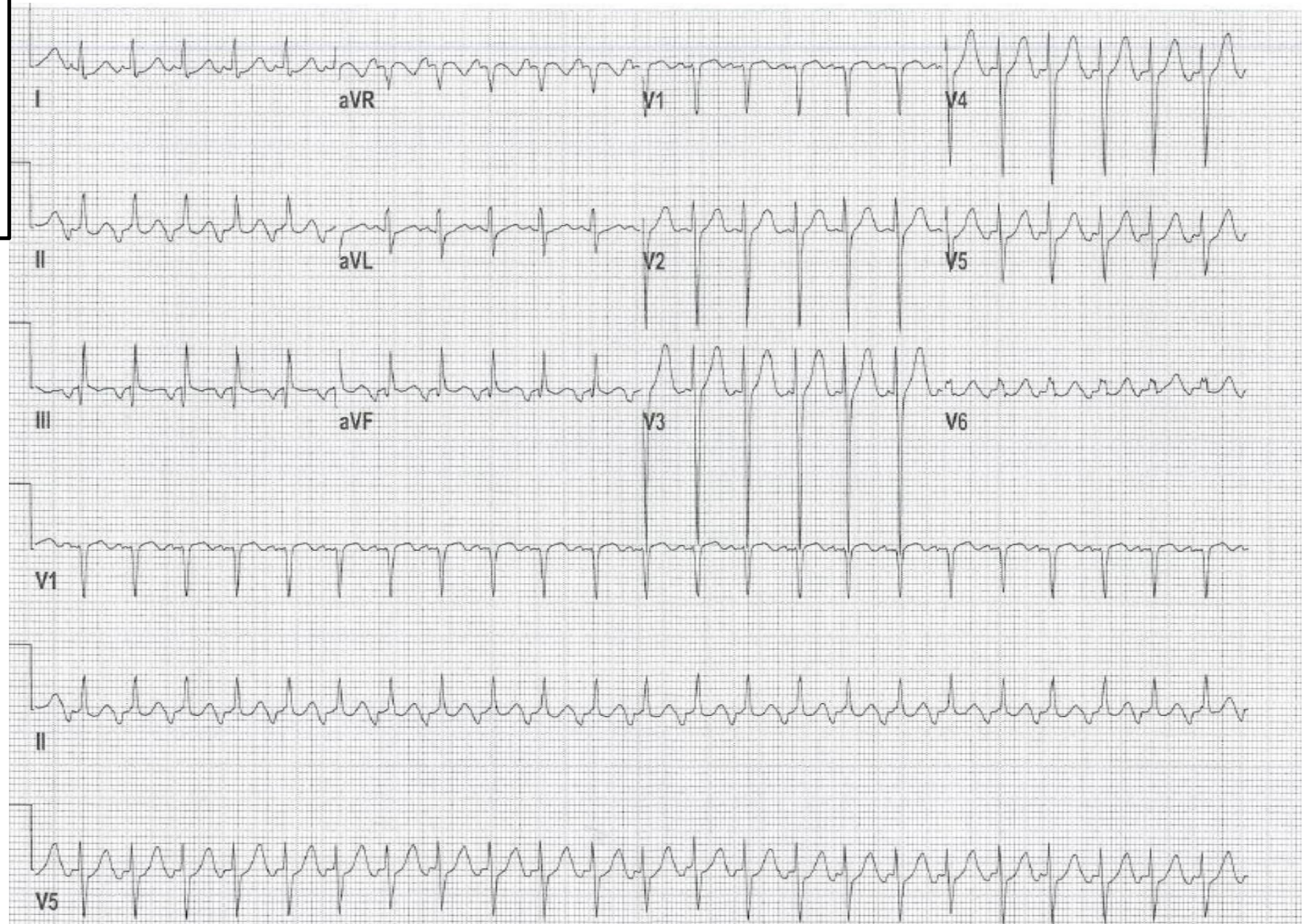
-During cavo-tricuspid isthmus ablation, the tachycardia terminates during the initial gradual downslope of the p wave.

-The slow initial descent represents conduction through the isthmus

-The sharp second descent represents penetration of the wavefront through the coronary sinus and interatrial septum, with passive depolarization of the LA

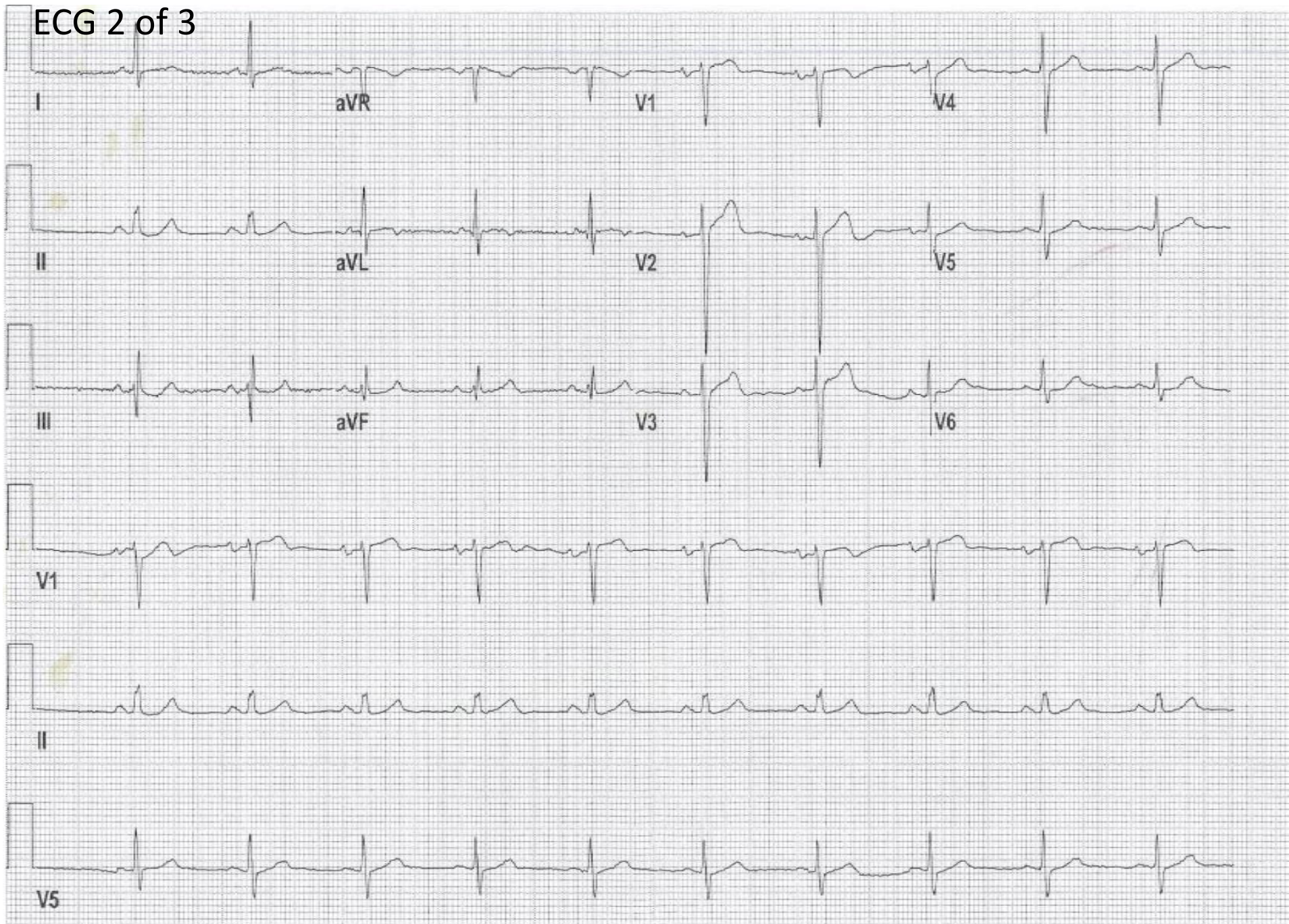
Poll Question

11: What is the rhythm?

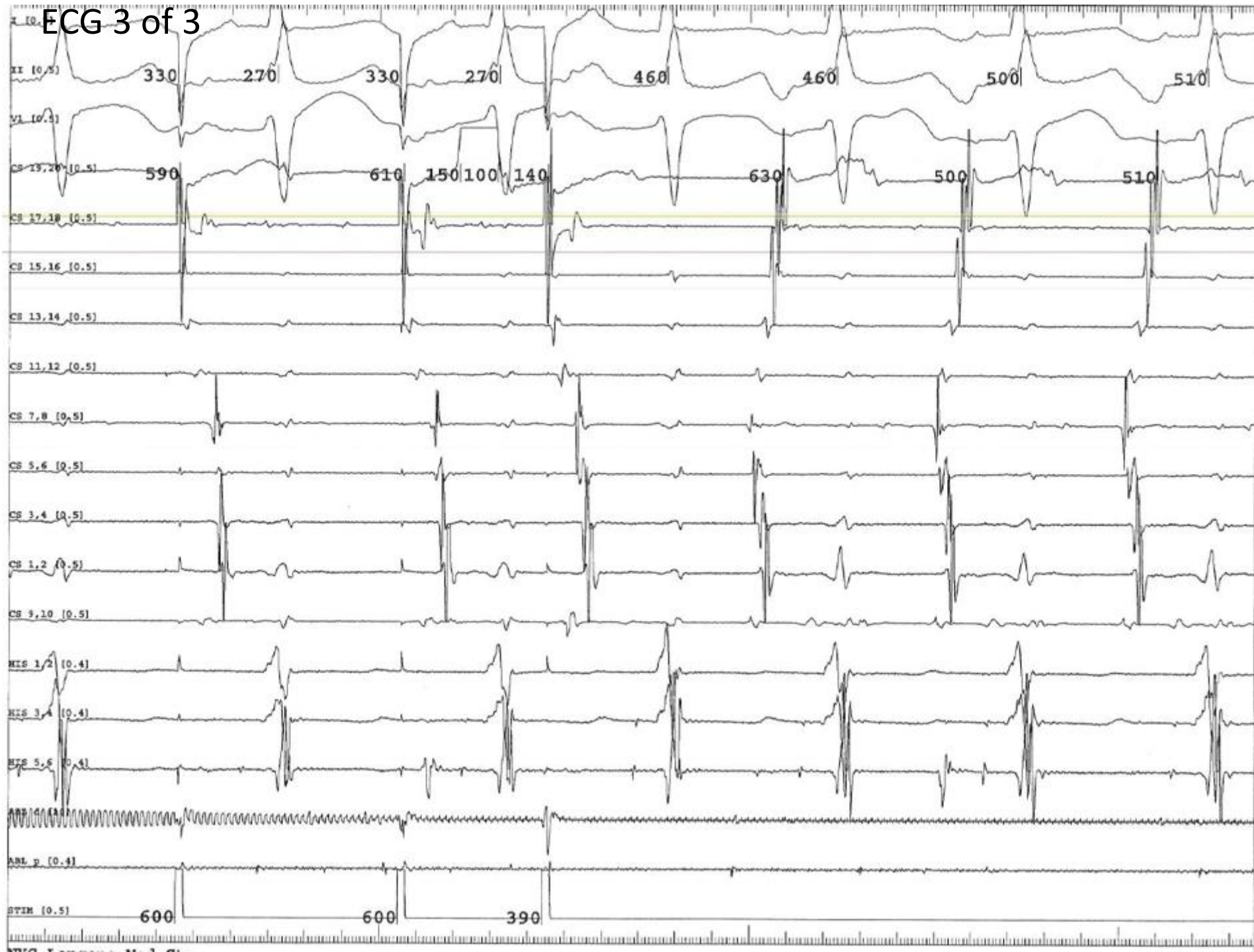


- A. Normal rhythm
- B. SVT
- C. Atrial flutter
- D. Atrial fibrillation

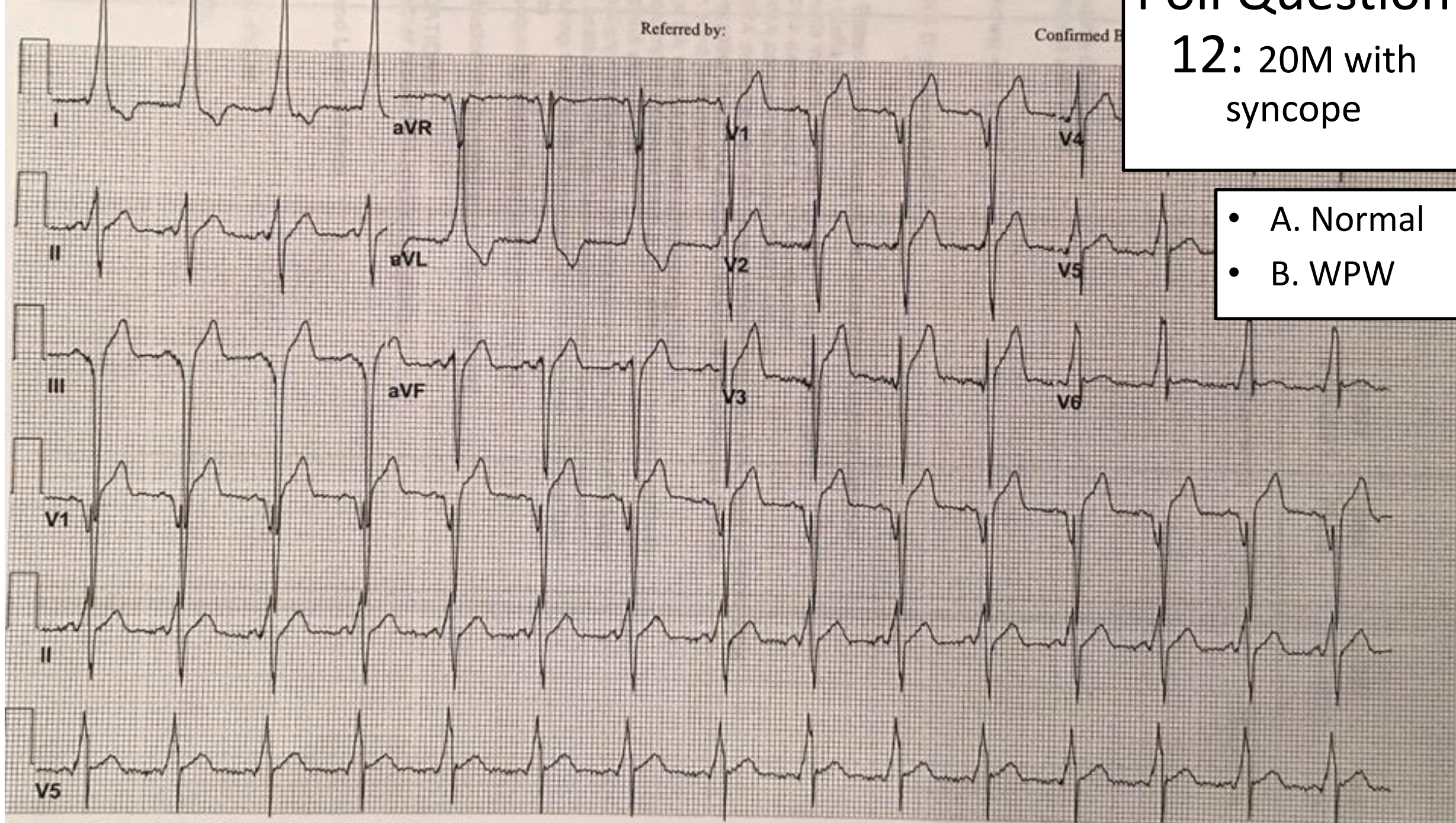
ECG 2 of 3



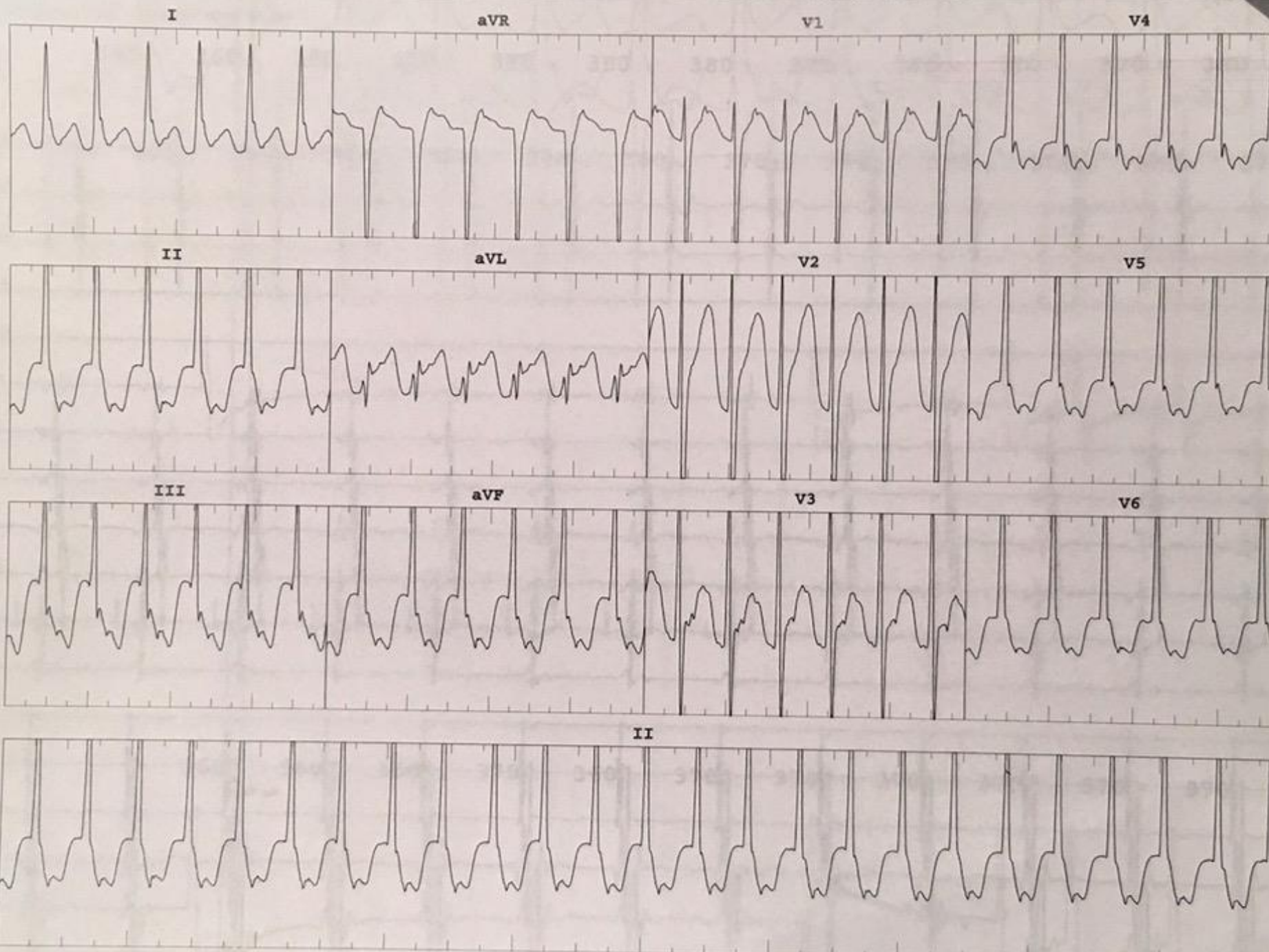
ECG 3 of 3



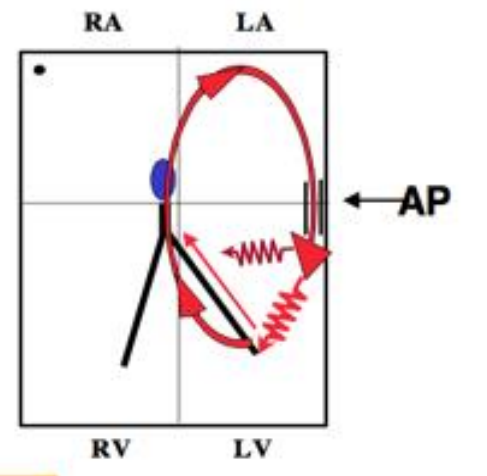
From Question 12: 20M with syncope



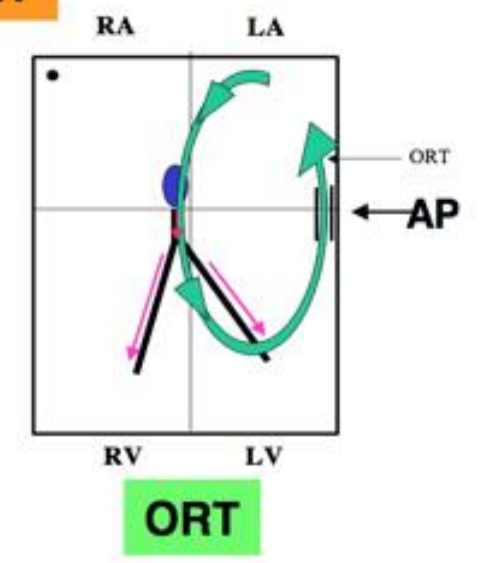
- A. Normal
- B. WPW



ART



AVRT

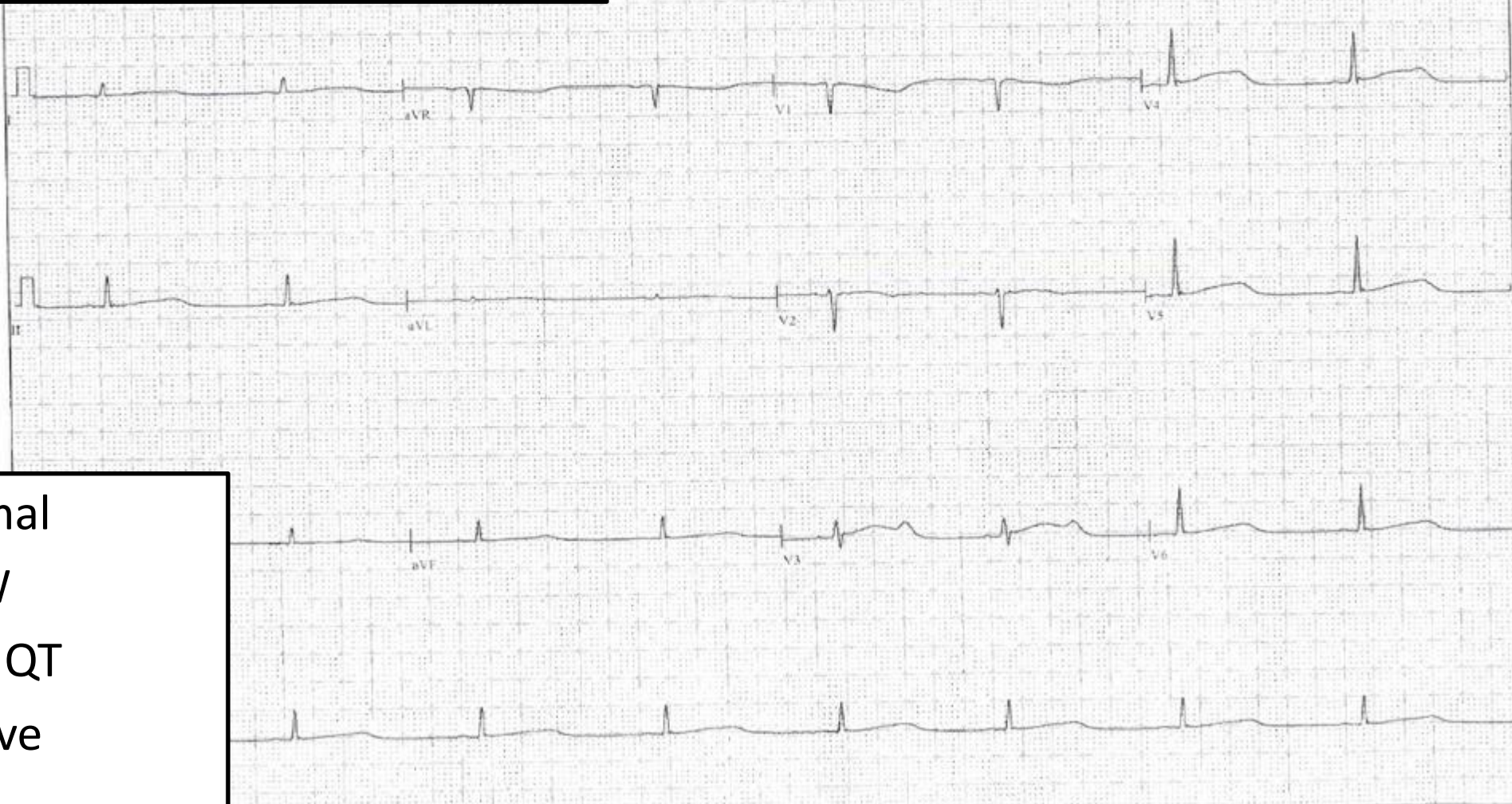


Poll Question 13:

What does the notch represent seen best on V3?

KaBC:	47	msec	Marked sinus Bradycardia
PR:	131	msec	- Diffuse nonspecific T-abnormality.
QT:	364	msec	
QRSD:	81	msec	ABNORMAL
P-QRS-T:	-1/55/-	degree	

2020



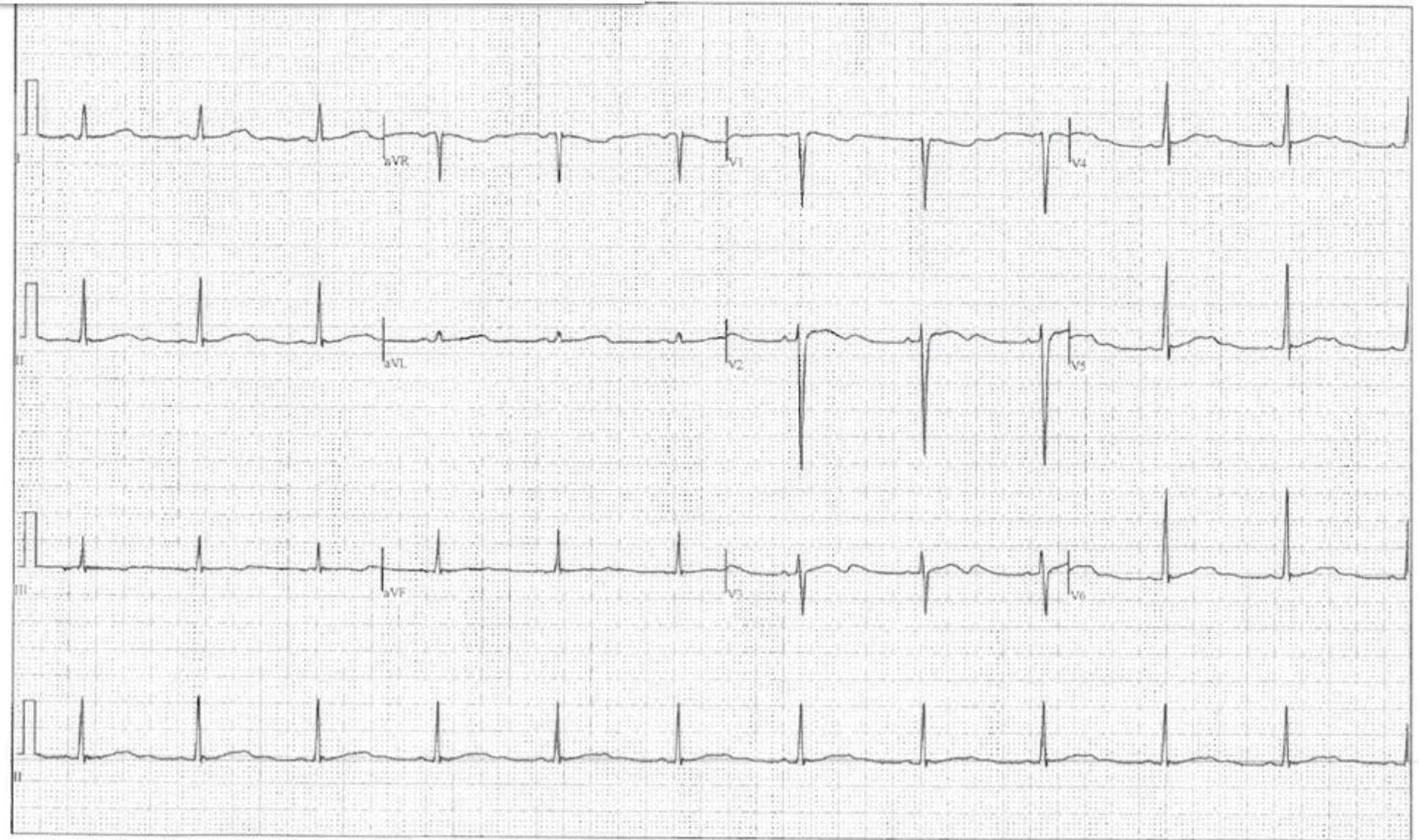
- A. Normal
- B. WPW
- C. Long QT
- D. u wave

Rate:	68	BPM	Interpretation:
PR:	118	msec	Sinus Rhythm -Short PR syndrome
QT:	426	msec	PRi = 118
QTcH:	440	msec	- Negative precordial T-waves.
QRSD:	86	msec	
P-QRS-T:	27/49/-1	degree	BORDERLINE RHYTHM



2013

2018



Case: 42F

- Diagnosis: presumed long QT type 2

Plan:

1. Exercise treadmill testing
2. Send blood for genetic testing
3. Start nadolol 20mg po qd; goal 1-2mg/kg/day
4. Eventual cascade screening pending genetic results
5. Consider LINQ (Reveal monitor)
6. Avoidance of drugs prolonging QT interval
7. Lifestyle changes: reduction of exposure to sudden noises, **abstention from competitive exercise**, adequate hydration

Long QT Syndrome (LQTS)

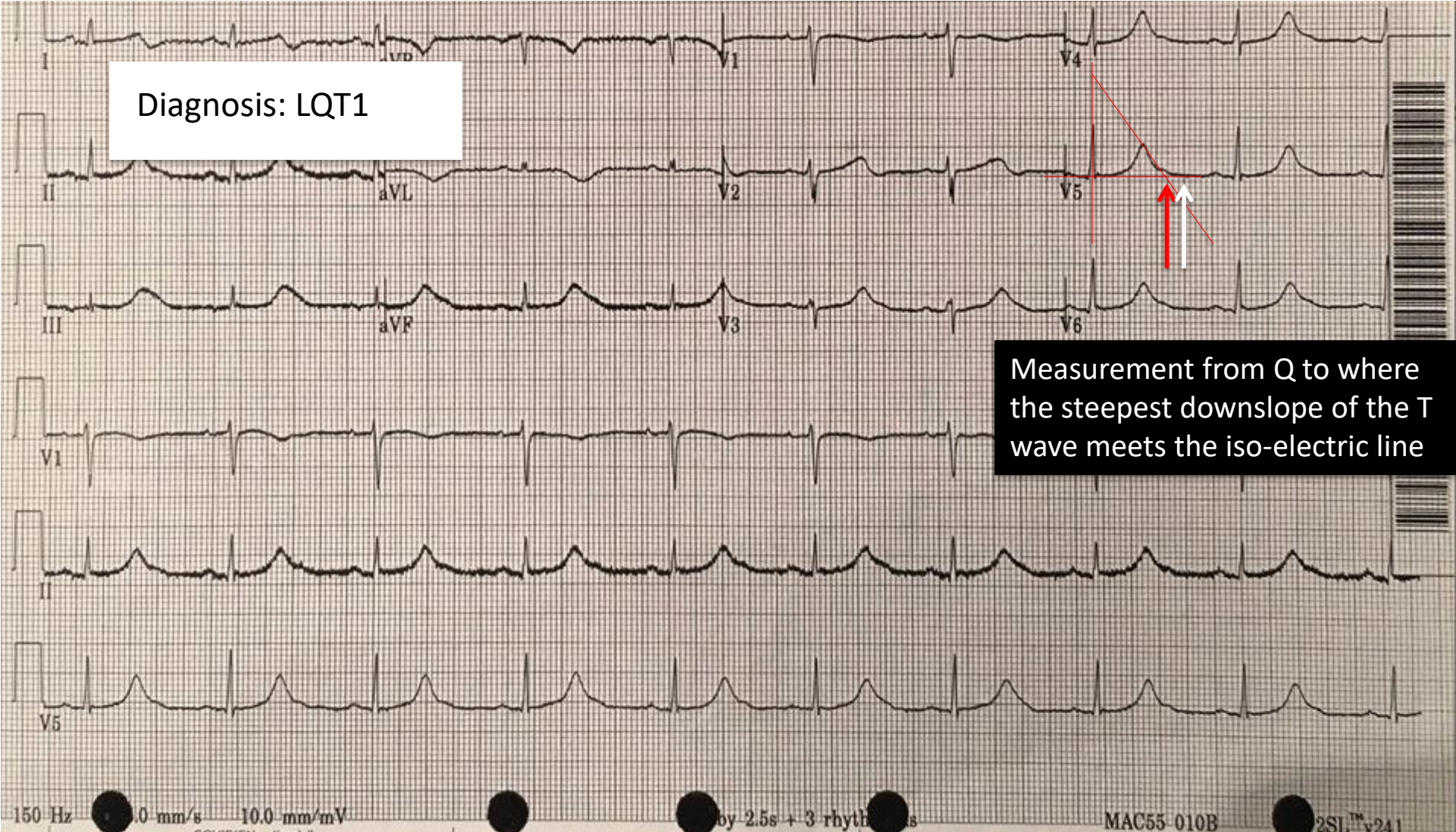
- Prevalence: 1 in 2000.
- QT similar between young boys and girls, where differences appear during puberty.
- In congenital LQTS, women have longer QT than men, therefore women are more often clinically diagnosed despite equal genotype sex-distribution
- The probability of a first cardiac event is higher in females by age 15, but decreases after puberty; the first cardiac event tends to be more often fatal in males than females
- The longer the QT interval, the increasing risk for malignant arrhythmias

Long QT Syndrome (LQTS)

- Although prolonged ventricular repolarization is the hallmark of LQTS, up to one third of carriers of a pathogenic LQTS mutation exhibit normal QTc values
 - These clinically 'silent' mutation carriers have a higher risk of syncope or cardiac arrest than the general population

Long QT syndrome (LQTS): measurement of the QT interval

48F several days after resuscitated cardiac arrest



Diagnosis of LQTS: Scoring system

≤1.0 point = low probability of LQTS

1.5-3.0 points = intermediate probability of LQTS

≥3.5 points = high probability of LQTS

Overall: QTc ≥ 460 (Bazett's)

99%: (>450 males; > 470 females)

Findings		Points	
ECG ¹	QTc ²	≥480 ms	3
		460-479 ms	2
		450-459 ms (in males)	1
		≥480 ms during 4 th minute of recovery from exercise stress test	1
	<i>Torsade de pointes</i> ³		2
	T wave alternans		1
	Notched T wave in 3 leads		1
Low heart rate for age ⁴		0.5	
Clinical history	Syncope ³	With stress	2
		Without stress	1
Family history	Family member(s) with definite LQTS ⁵		1
	Unexplained sudden cardiac death before age 30 years among immediate family ⁵		0.5
Total score			

Gene	Affected Channel	Disease	% of LQTS attributed to mutation of this gene
KCNQ1 (LOF)	Delayed rectifier I _{ks}	LQTS type 1	30-35%
KCNH2 (LOF)	Delayed rectifier I _{Kr}	LQTS type 2	25-30%
SCN5A (gain)	Nav1.5	LQTS type 3	5-10%

Almost all drugs causing torsades are I_{Kr} blockers

- LQTS 1,2, and 3 account for over 95% of genotype-positive cases. The yield of genetic testing in pts with a clinical diagnosis of LQTS is approx 75-80%.

Gene	Disease	% of LQTS
ANK2	LQTS4	<1%
KCNE1	LQTS5	<1%
KCNE2	LQTS6	<1%
KCNJ2	LQTS7	<1%
CACNA1c	LQTS8	<1%
CAV3	LQTS9	<1%

Gene	Disease	% of LQTS
SCN4B	LQTS10	Rare (2 cases)
AKAP9	LQTS11	Rare (1 case)
SNTA1	LQTS12	Rare (3 cases)
KCNJ5	LQTS13	Rare (2 cases)
CALM1	LQTS14	< 1%
CALM2	LQTS15	< 1%

Case: 42F judge with presyncope

RESULTS

KCNH2

Pathogenic Mutation: c.307_307+1delGGinsTT

SUMMARY

POSITIVE: Pathogenic Mutation Detected

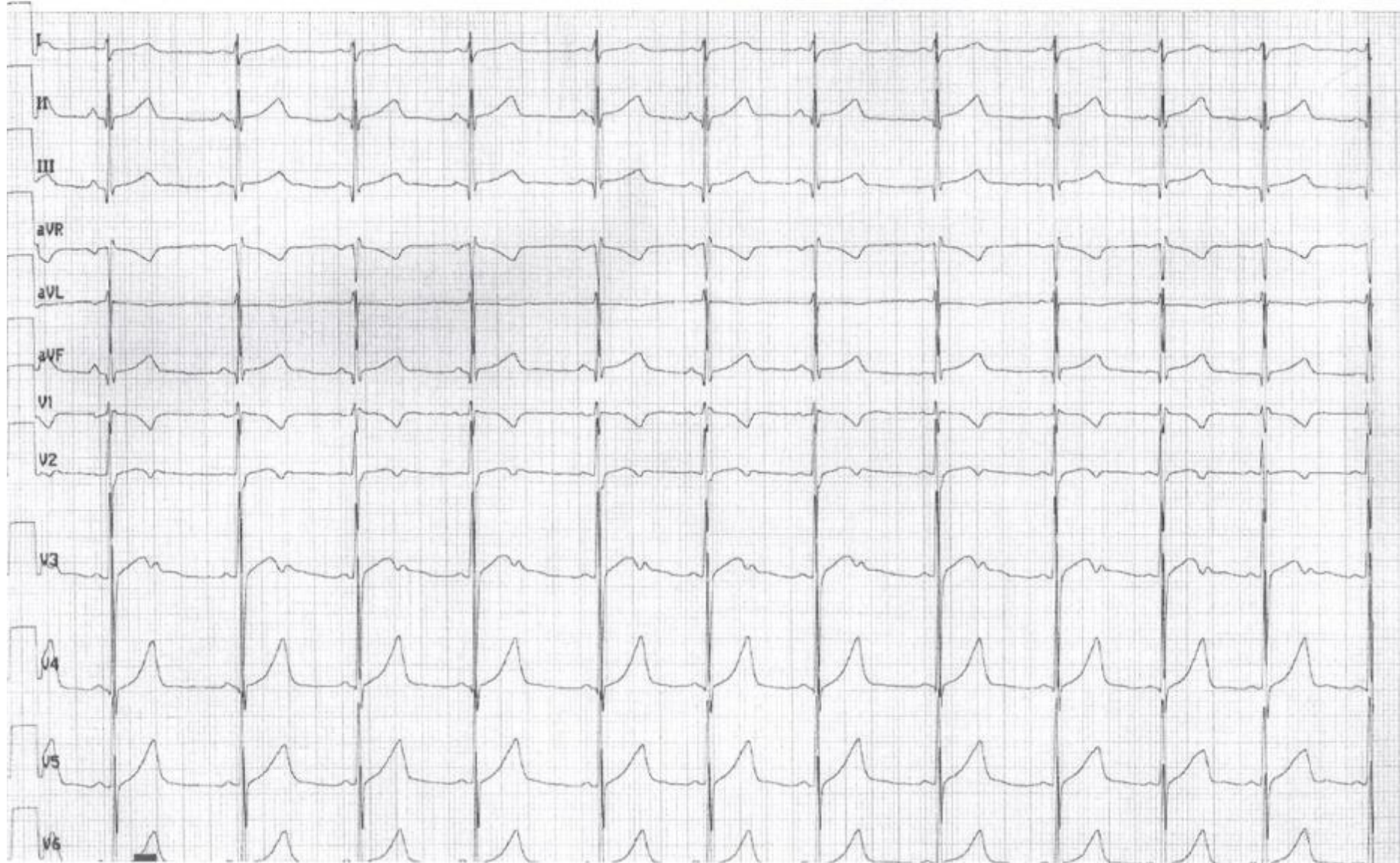
INTERPRETATION

- This individual is heterozygous for the **c.307_307+1delGGinsTT** pathogenic mutation in the *KCNH2* gene.
 - This result is consistent with a diagnosis of long QT syndrome.
 - The expression and severity of disease for this individual cannot be predicted.
 - Genetic testing for pathogenic mutations in family members can be helpful in identifying at-risk individuals.
 - Genetic counseling is a recommended option for all individuals undergoing genetic testing.
-

8 yr-old son *Age 8*

QRS dur: 81 ms
QT/QTc: 422/446 ms
P-R-T axes: 64 91 70
Avg RR: 829 ms
QTcB: 463 ms

BURDENLIFE ECG
INTERPRETATION BASED ON A DEFAULT AGE OF 40 YEARS
UNCONFIRMED REPORT

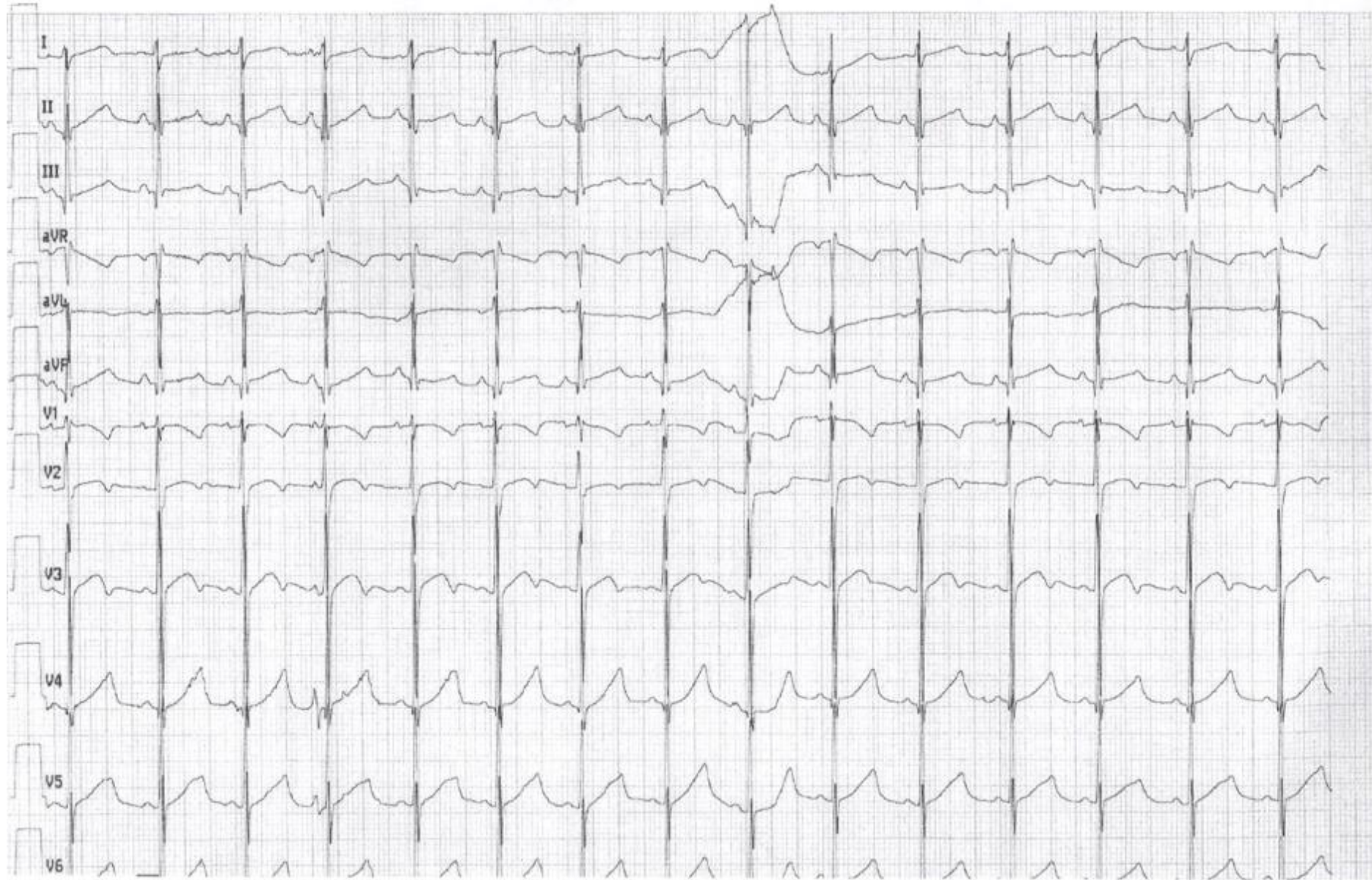


8 yr-old son

QRS dur: 83 ms
QT/QTc: 417/463 ms
P-R-T axes: 75 90 67
Avg RR: 673 ms
QTcB: 508 ms

INTERPRETATION BASED ON A DEFAULT RATE OF 40 BEATS
UNCONFIRMED REPORT

Hyperentail Af abn



8 yr-old son

Specific Site Analysis of KCNH2

RESULTS

KCNH2 SPECIFIC SITE c.307_307+1delGGinsTT Pathogenic Mutation: Detected

INTERPRETATION

This individual is heterozygous for the c.307_307+1delGGinsTT pathogenic mutation in the *KCNH2* gene, which was previously identified in this individual's relative(s). This result is consistent with a diagnosis of long QT syndrome; however, the expression and severity for this individual cannot be predicted.

The only *KCNH2* alteration analyzed for this individual was c.307_307+1delGGinsTT.

Genetic counseling is a recommended option for all individuals undergoing genetic testing.

Plan: Start nadolol

Implant LINQ (Reveal monitor) (long QT > 500ms)

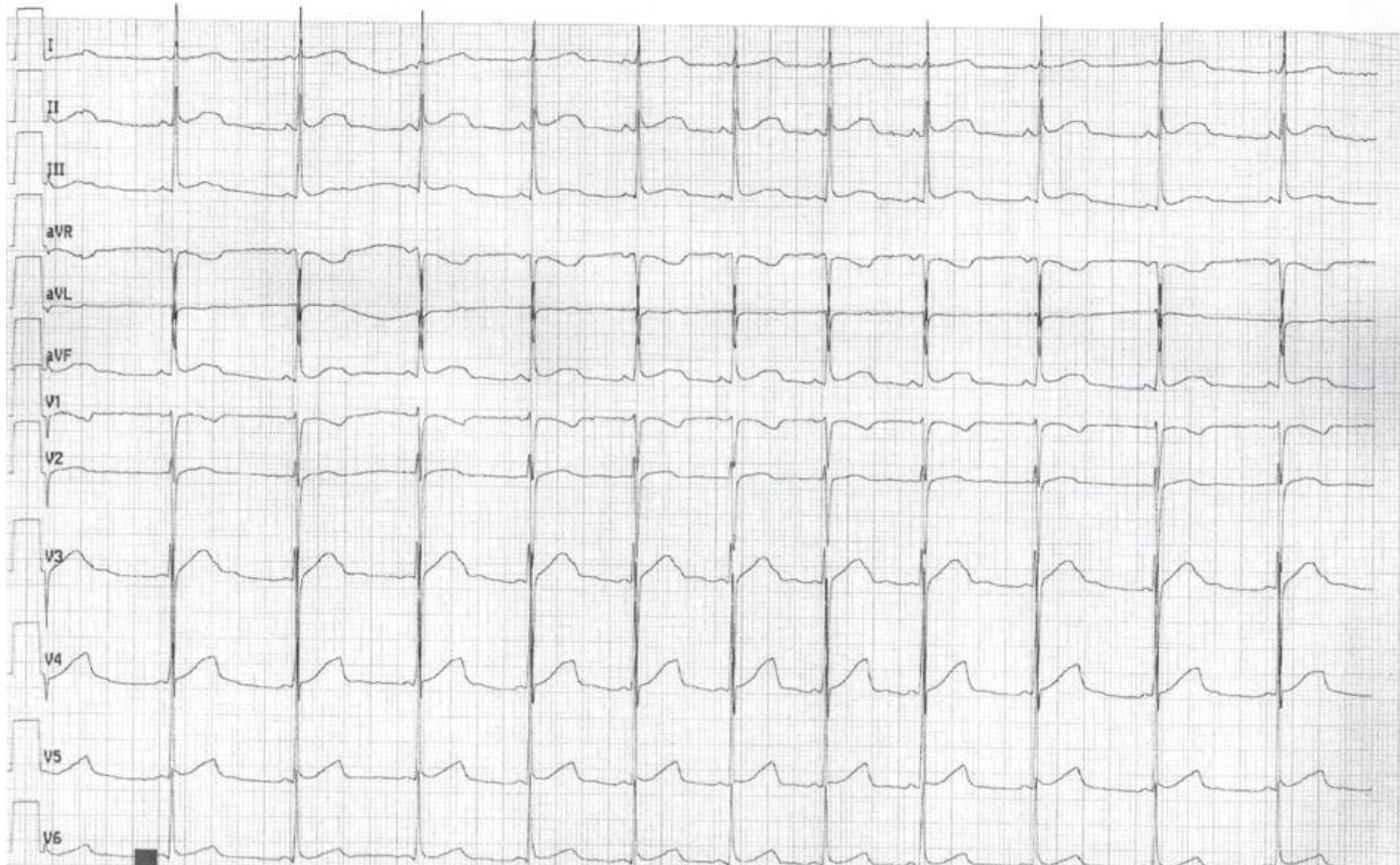
Age U

11 year-old daughter

UNCS dur: 71 ms
QT/QTc: 417/440 ms
P-R-T axes: 66 81 63
Avg RR: 834 ms
QTcB: 456 ms

ABNORMAL ECG
INTERPRETATION BASED ON A DEFAULT AGE OF 40 YEARS

UNCONFIRMED REPORT



109440028592

NYU HEART RHYTHM CENTER

Site # 56 Cart # 3

Version 1.34.03

Sequence #06140

25mm/s 10mm/mV 0.05-40 Hz

REORDER # 1.3.0.8

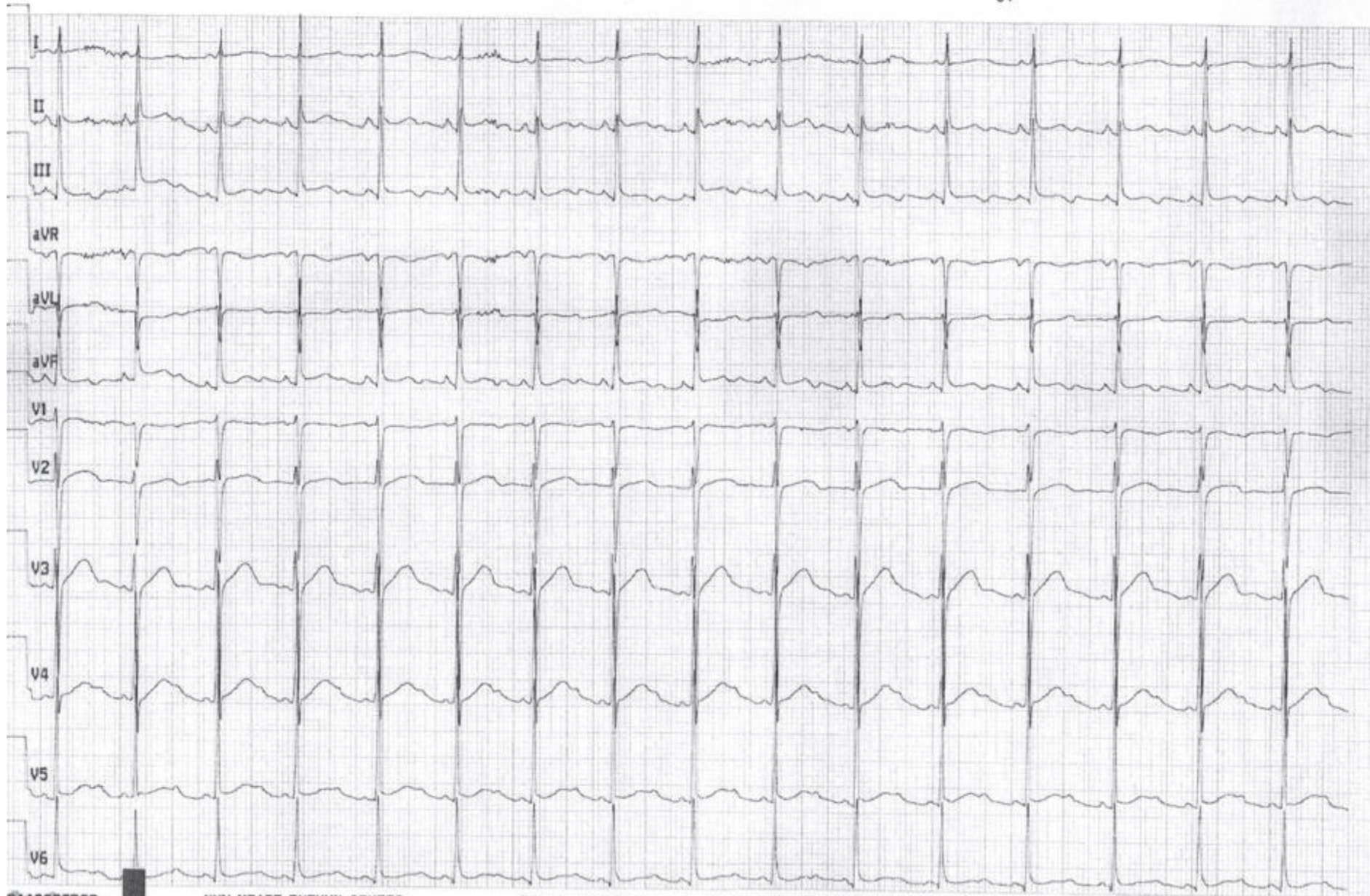
11 year-old daughter

QRS dur: 70 ms
QT/QTc: 347/401 ms
P-R-T axes: 68 79 59
Avg RR: 622 ms
QTcB: 439 ms

NONSPECIFIC ST & T-WAVE ABNORMALITY
ABNORMAL ECG
INTERPRETATION BASED ON A DEFAULT AGE OF 40 YEARS

UNCONFIRMED REPORT

Hypersensitivity



RESULTS

KCNH2 SPECIFIC SITE c.307_307+1delGGinsTT Pathogenic Mutation: Detected

INTERPRETATION

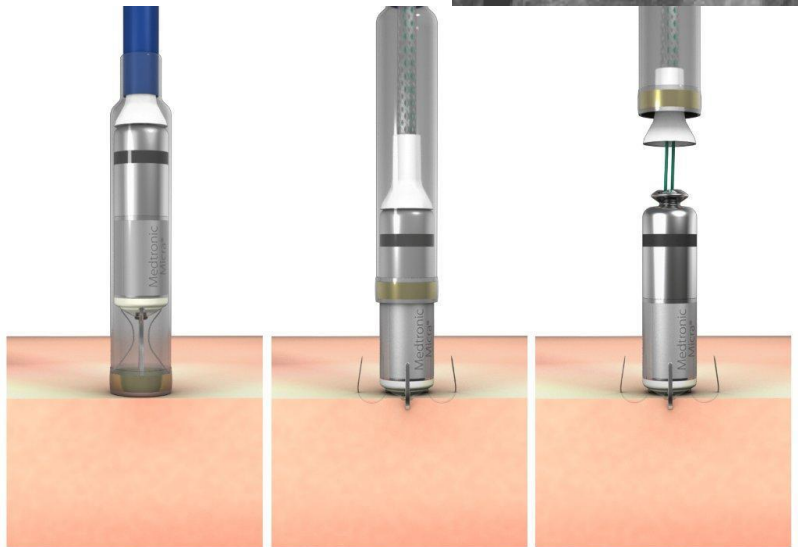
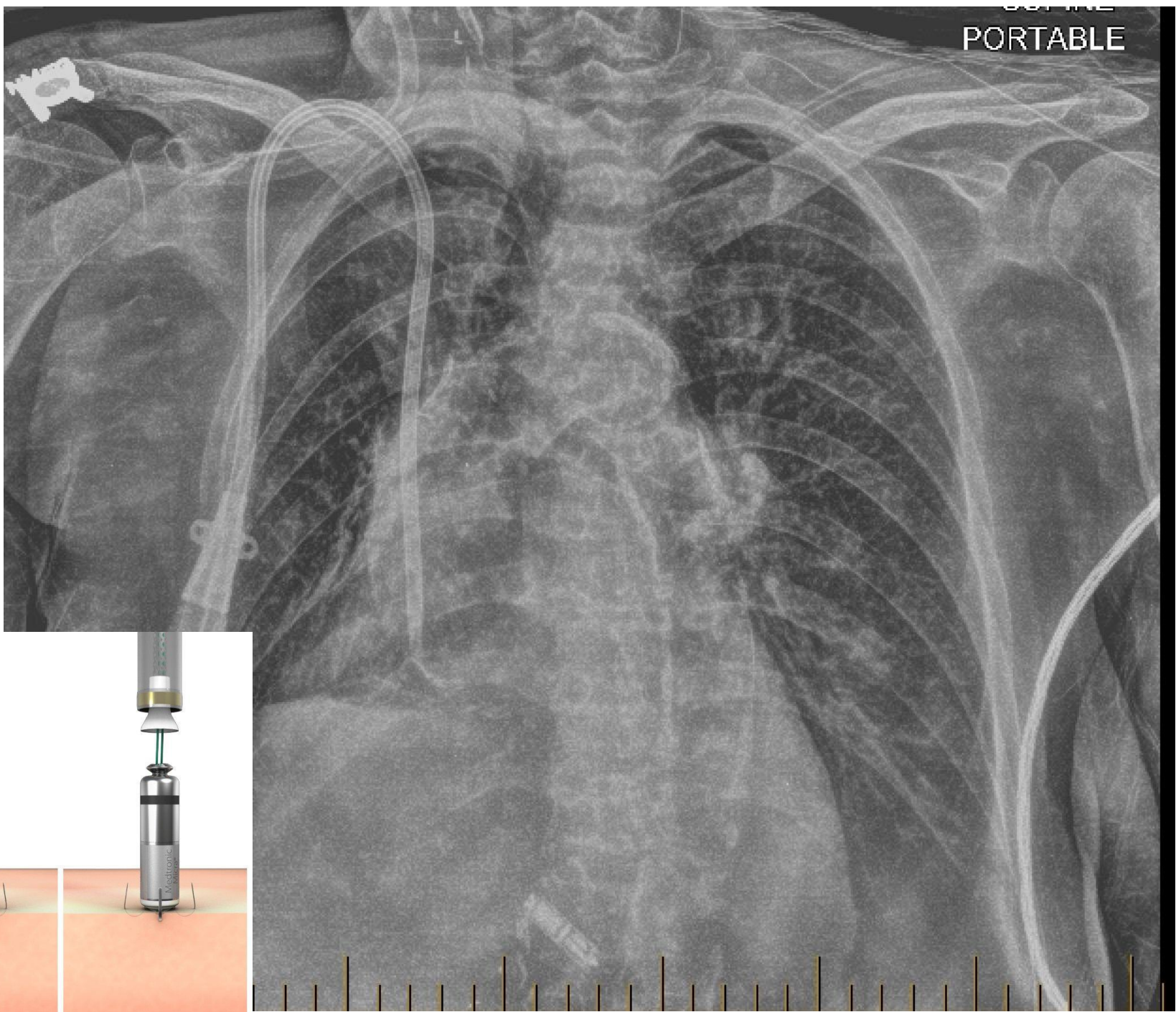
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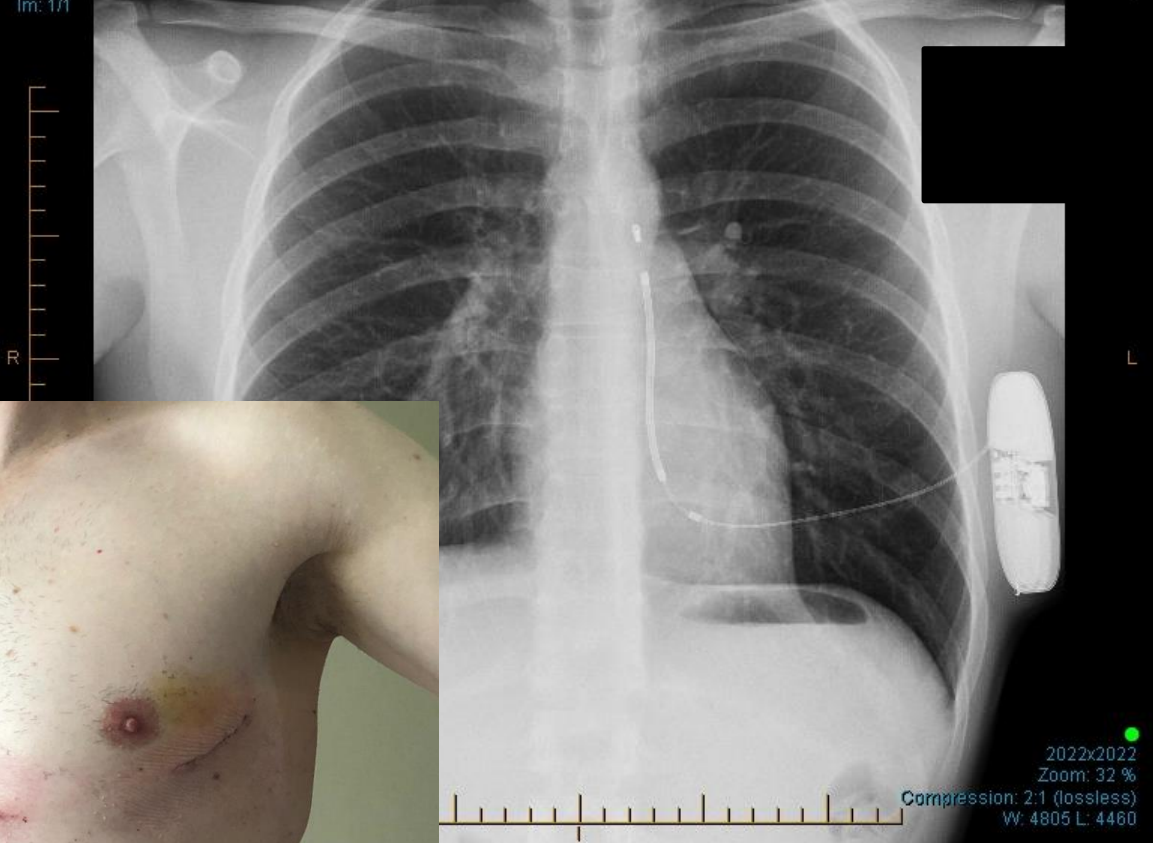
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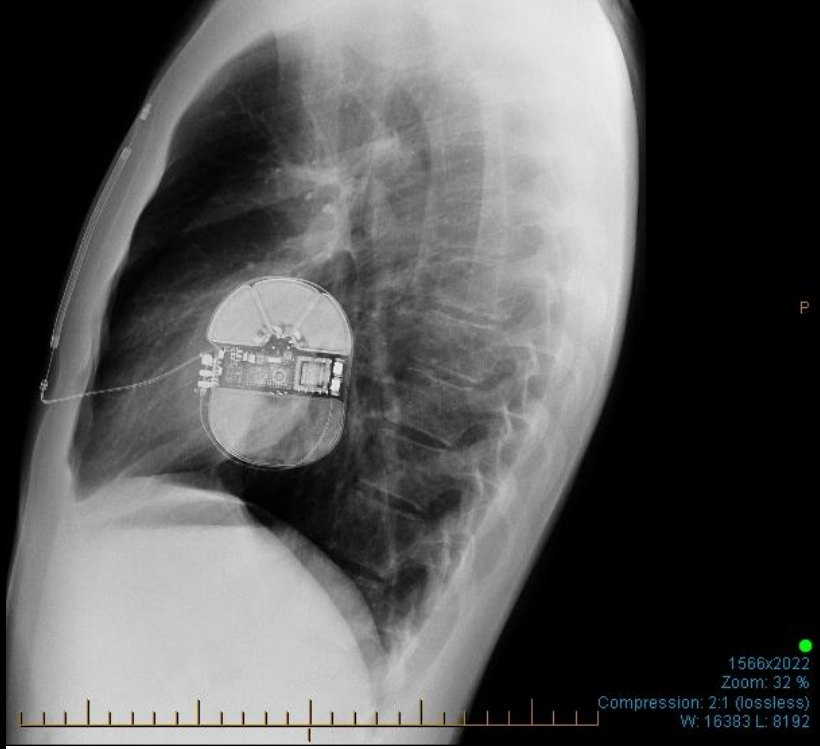


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Conclusions

General review of ECGs, pacing, QT measurements etc.