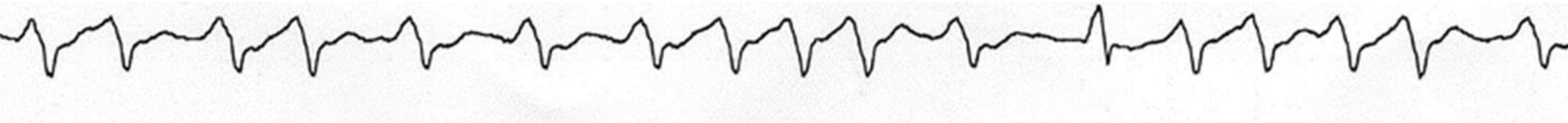


ECG workshop “practical electrocardiography for the GP”

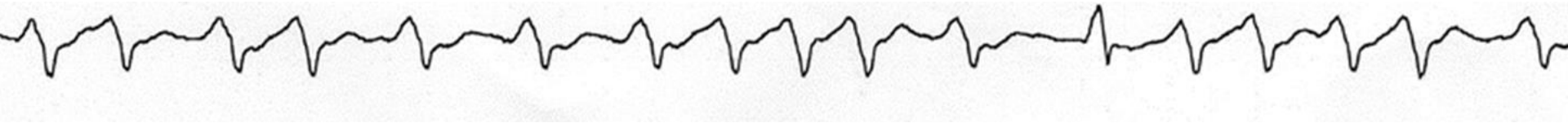


Community Cardiac Network Dec 1, 2020

Jonathan Lipton, Cardiologist & Electrophysiologist
Director Arrhythmia Service Royal Hobart Hospital



ECG workshop “~~practical electrocardiography for the GP~~” “how to make sense of those squiggly lines”



Community Cardiac Network Dec 1, 2020

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Director Arrhythmia Service Royal Hobart Hospital

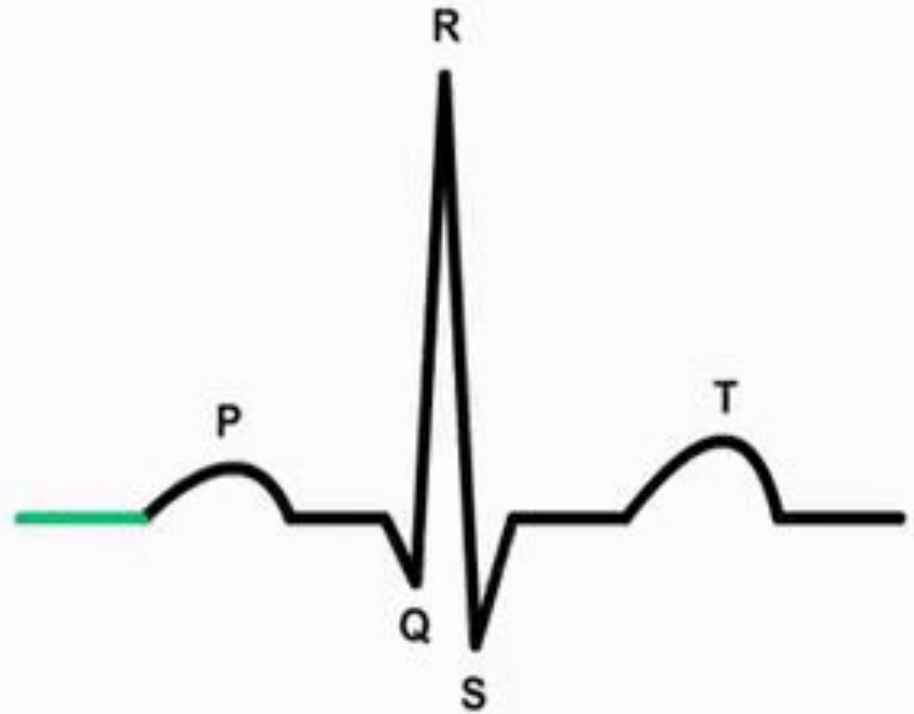


Aims

- Systematic approach
- Making the complex simple
- ECGs in clinical context for common and important cardiac conditions



ECG basics



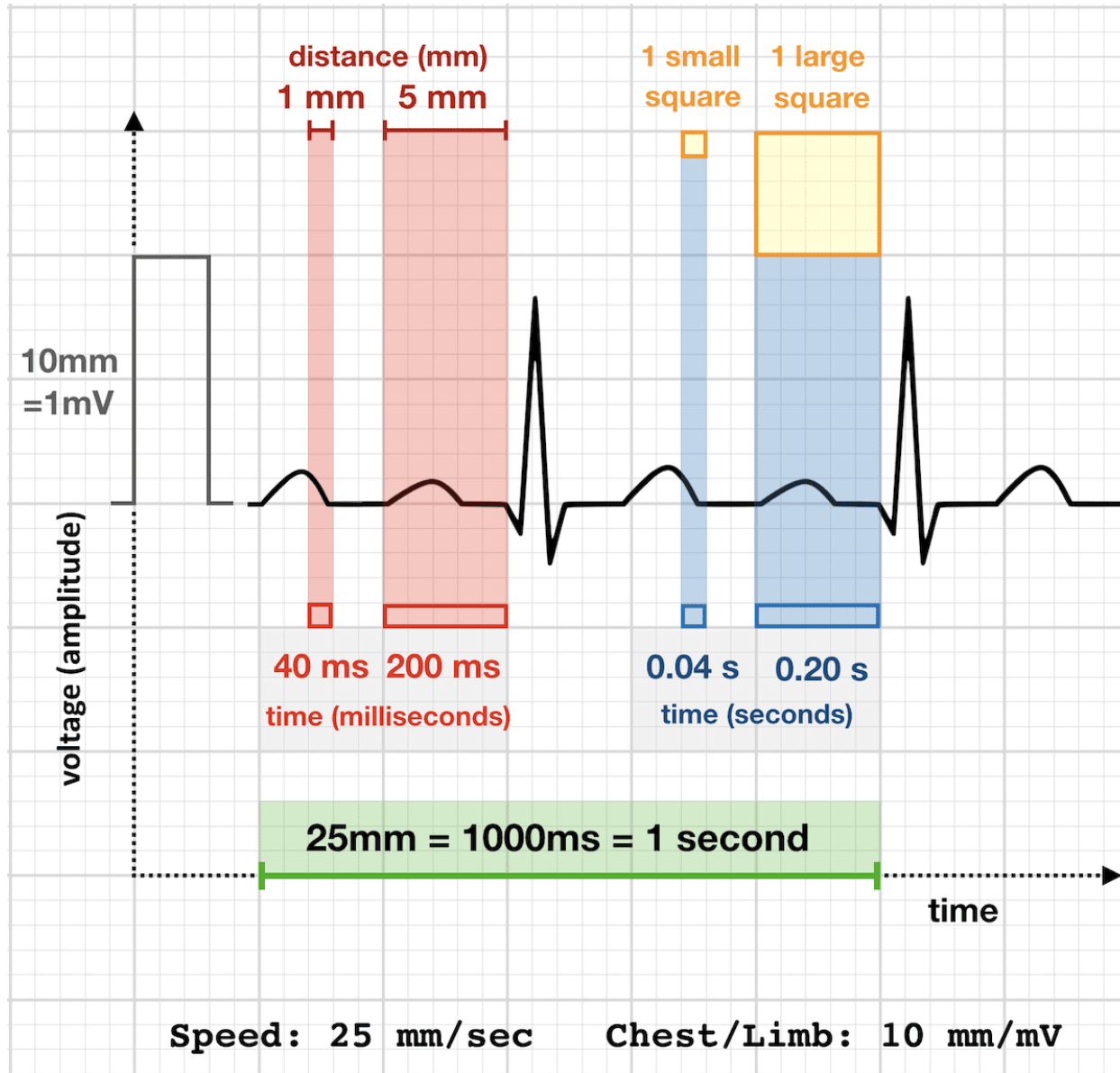
Systematic approach

1. Rate
2. Regularity
3. QRS width
4. P waves
 - Relationship P wave to QRS (atno-ventricular relationship)
5. ST segment
 - Elevation/Depression
 - QT
6. Other
 - QRS axis/P wave morphology/specific patterns

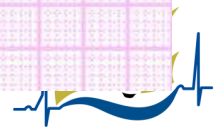
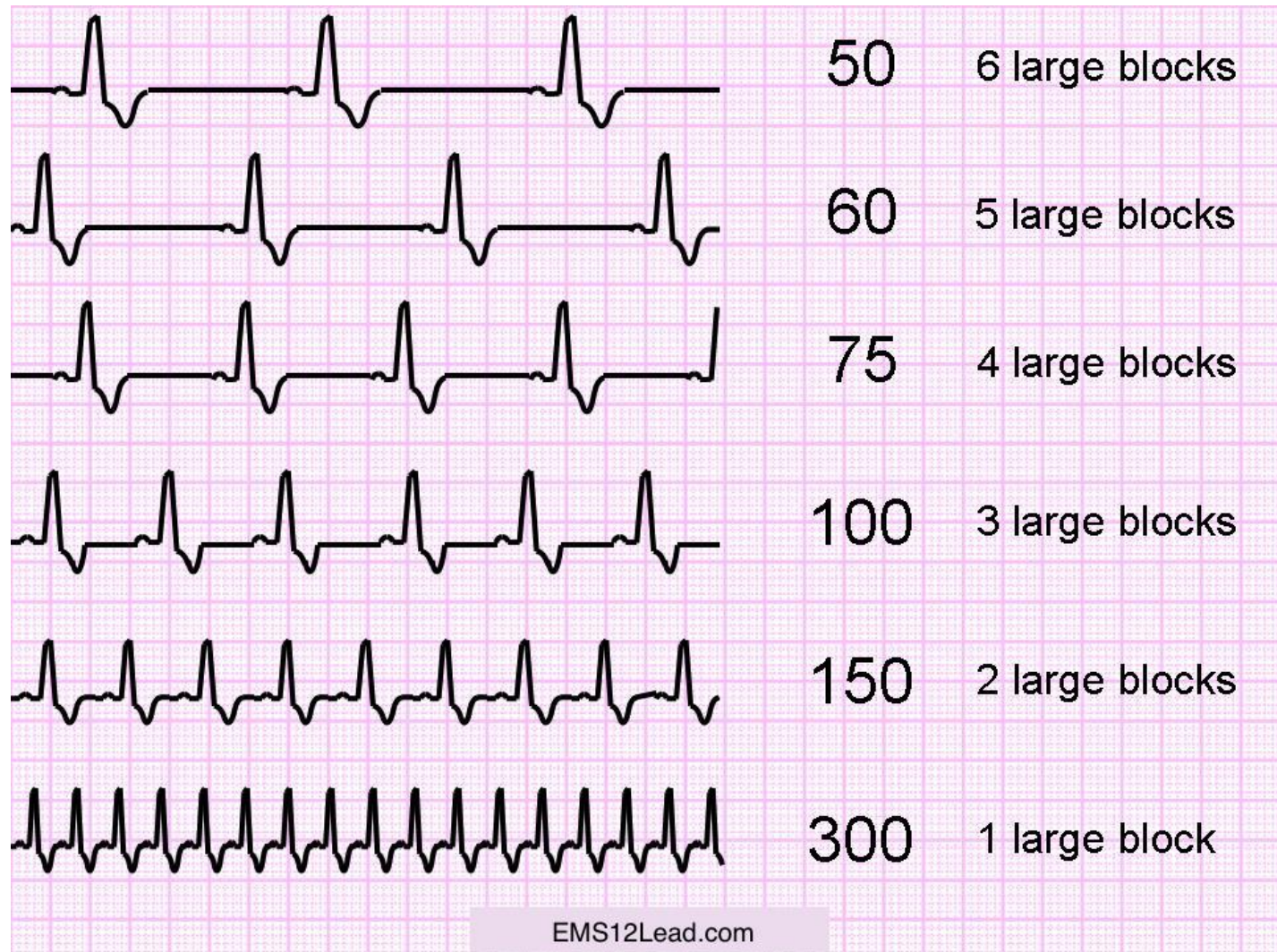
Choose and use your system of choice, but be consistent!



Rate



Rate



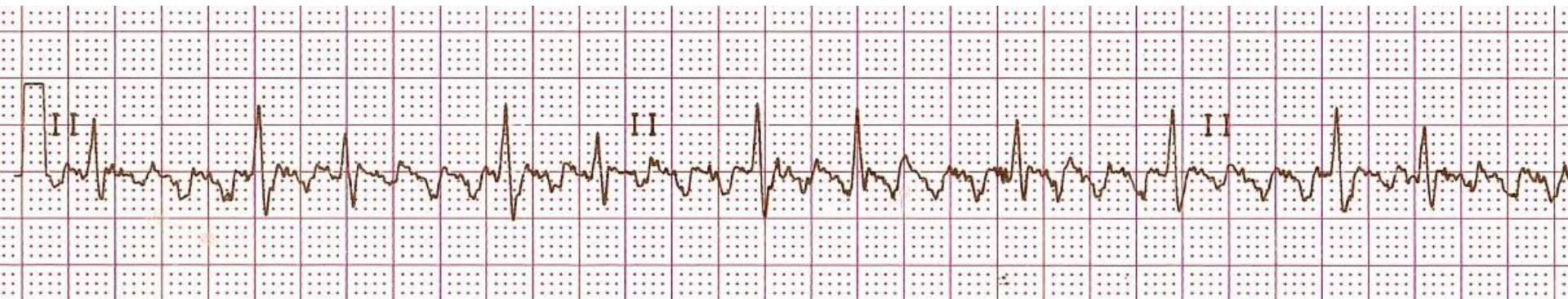
Regularity



Regularity



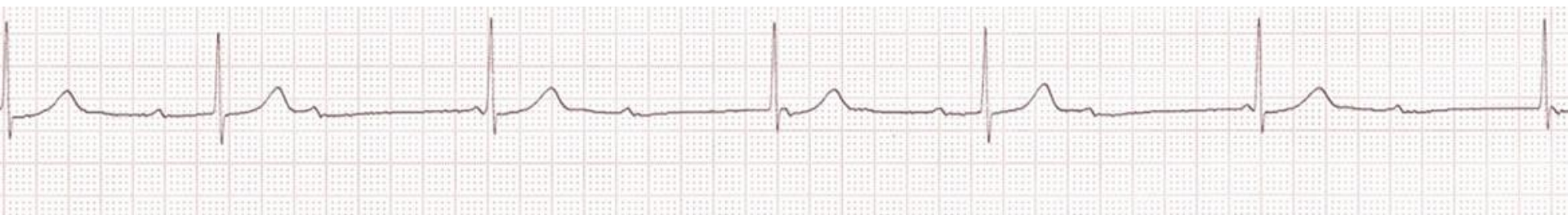
Regularity



Regularity



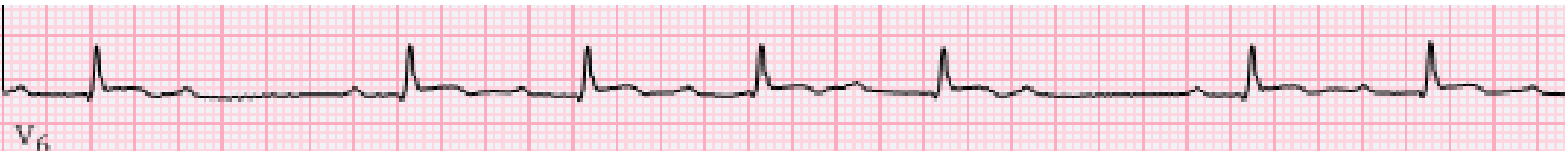
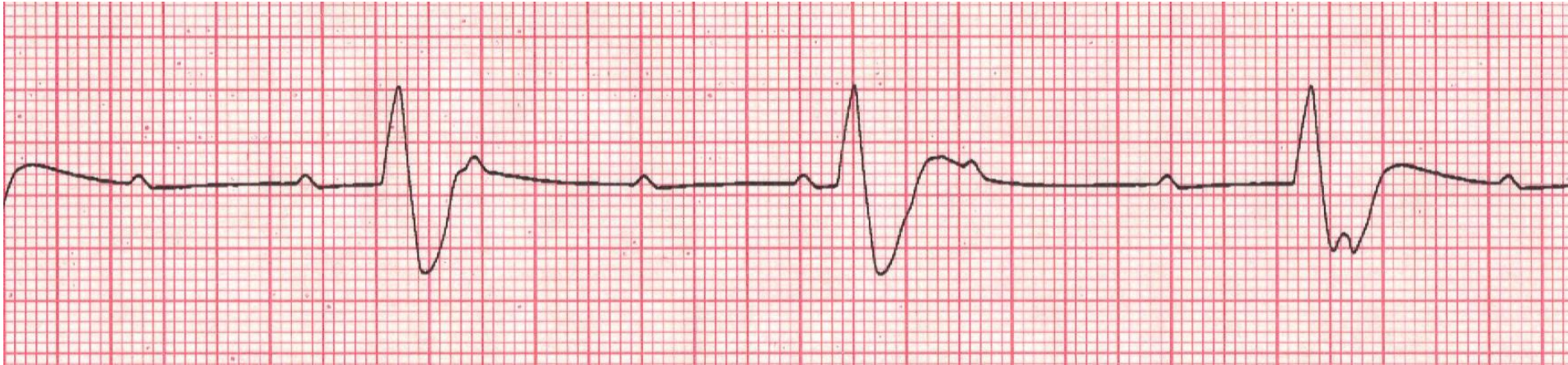
QRS width



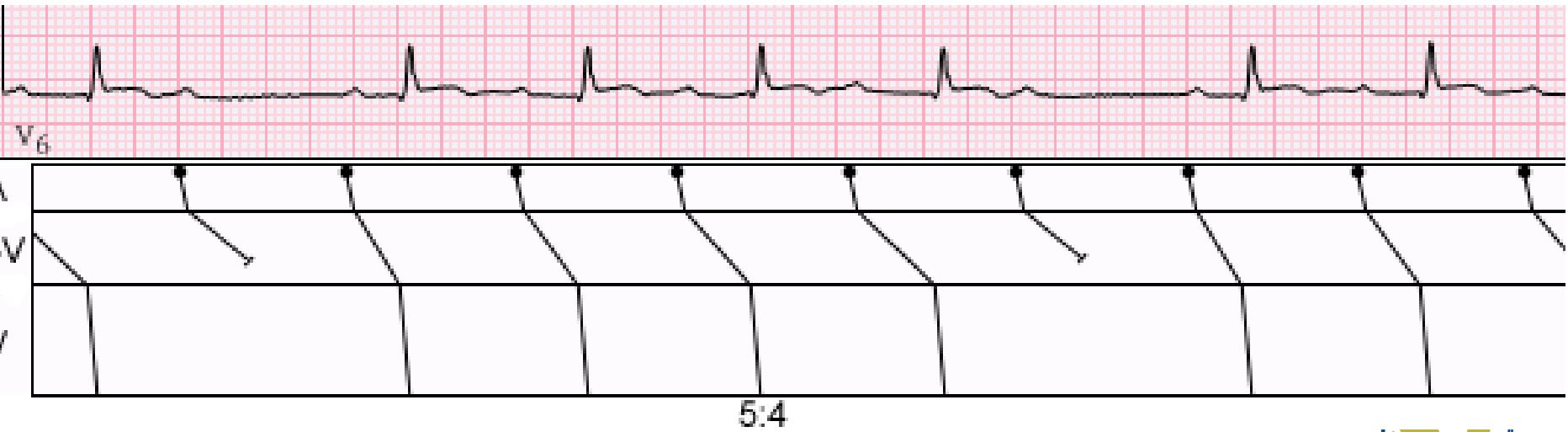
P waves present/absent



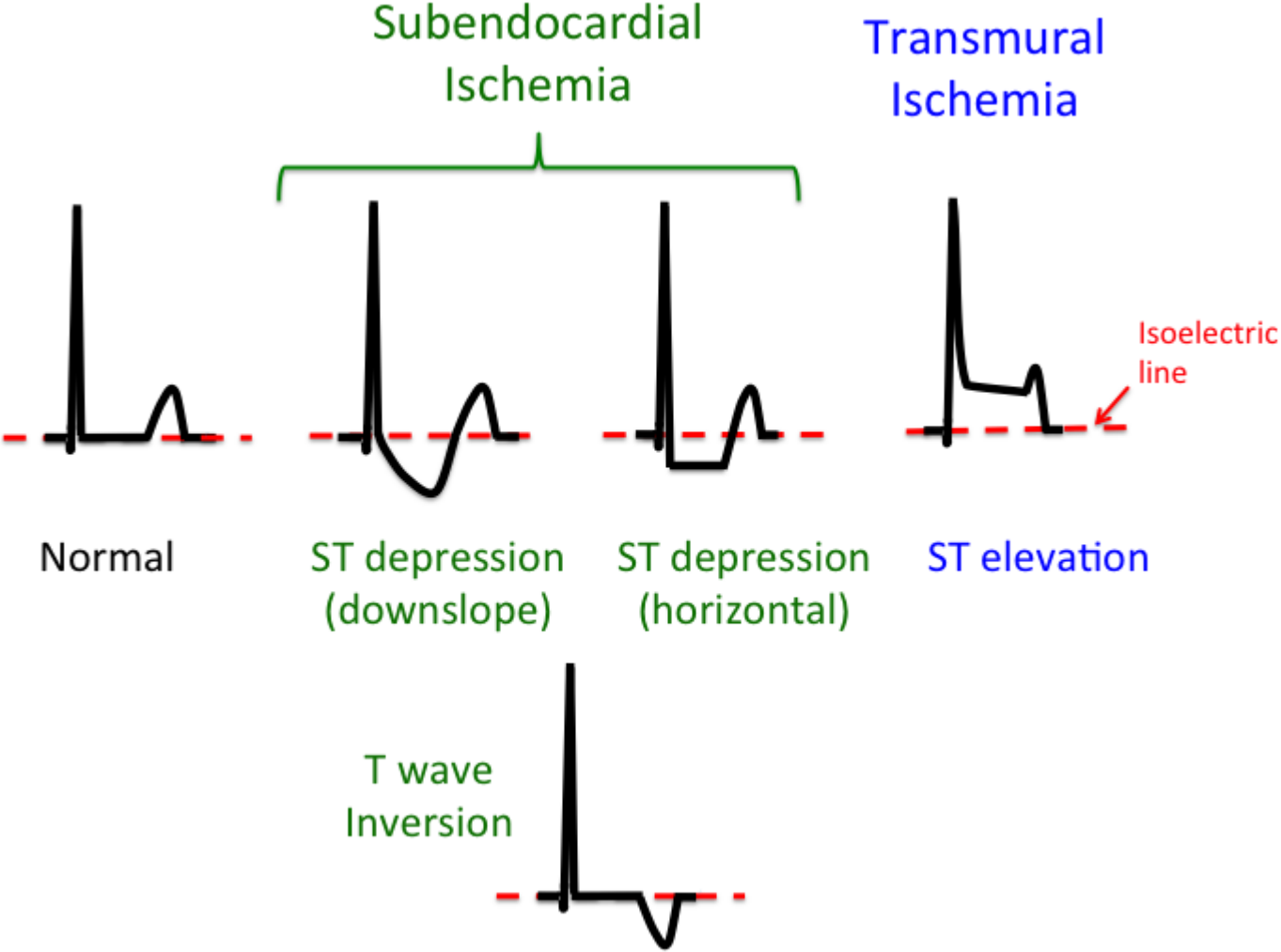
P wave relation to QRS



P wave relation to QRS



ST segment



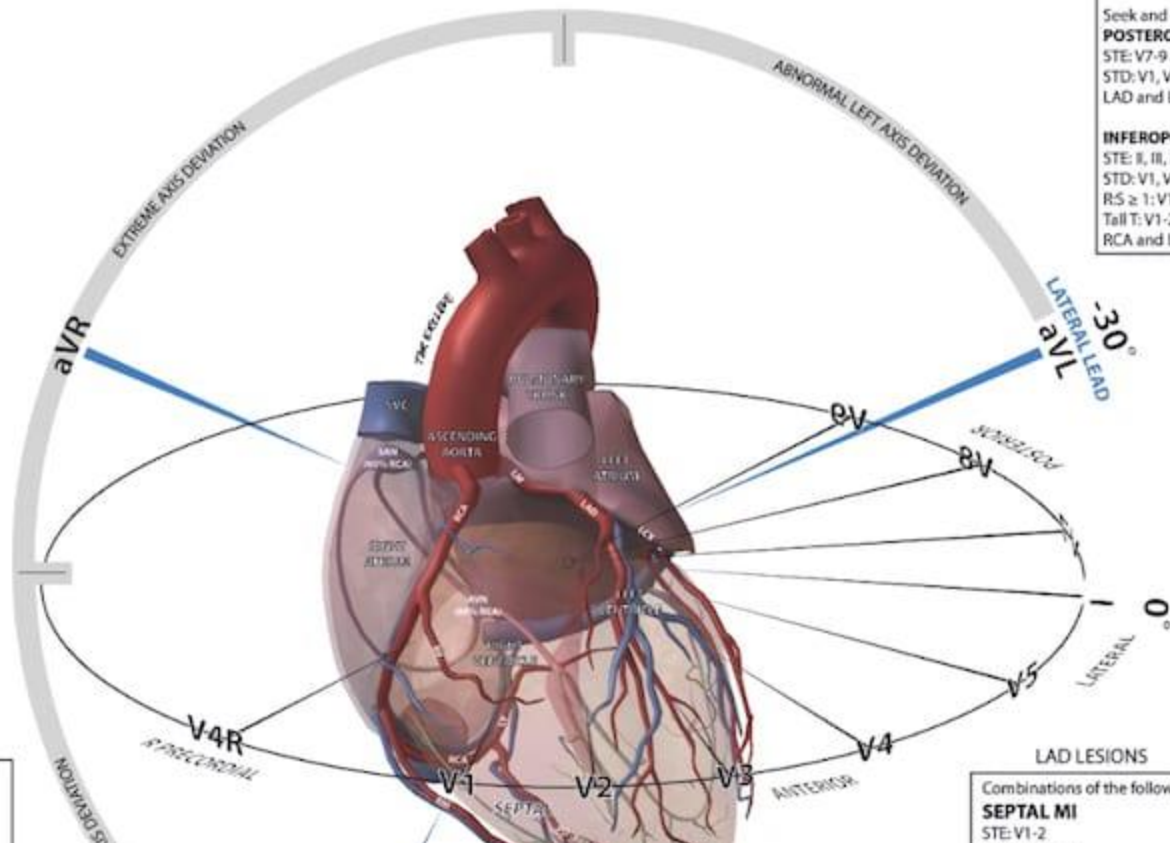
AMI ECG, ANATOMY AND PATHOLOGY

LCX LESIONS ±

POSTERIOR MI
 STE: V7-9
 STD: V1-2 (reciprocal STE)
 RS ≥ 1: V1-2
 Tall T: V1-2
 RCA and LCX occlusion

Seek and exclude
POSTEROLATERAL MI
 STE: V7-9 and I, aVL, V5-6
 STD: V1, V2
 LAD and LCX occlusion

INFEROPOSTERIOR MI
 STE: II, III, aVF and V7-9
 STD: V1, V2 (reciprocal STE)
 RS ≥ 1: V1-2
 Tall T: V1-2
 RCA and LCX occlusion



RCA 'TYPE' LESIONS ±

INFERIOR MI
 STE: II, III, aVF
 STD: aVL (reciprocal STE)
 RCA occlusion distal to RV

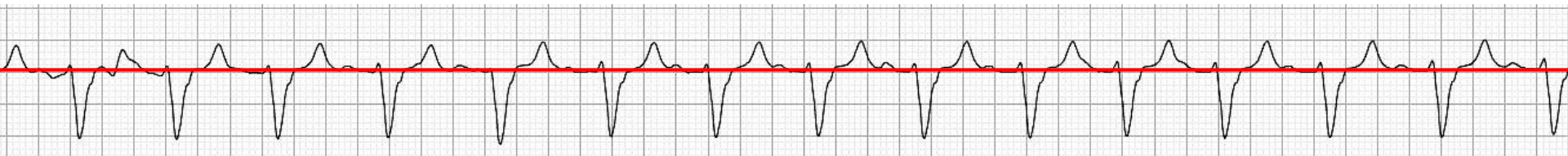
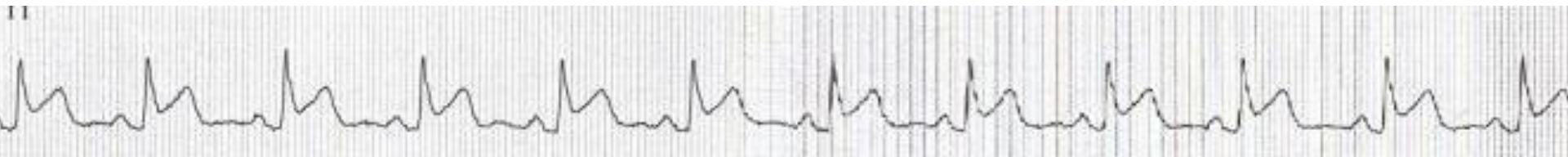
LAD LESIONS

Combinations of the following
SEPTAL MI
 STE: V1-2

| | | | |
|-----|-----|----|----|
| I | aVR | V1 | V4 |
| II | aVL | V2 | V5 |
| III | aVF | V3 | V6 |

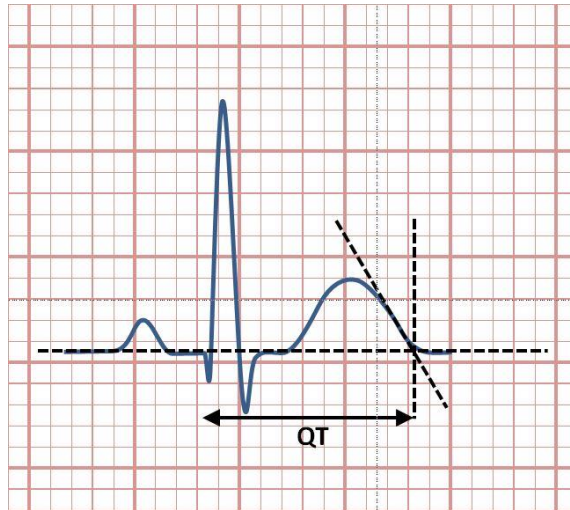
| |
|----------|
| Lateral |
| Inferior |
| Anterior |
| Septal |

ST elevation/depression



QTc calculation

- <https://www.covidqtc.com/qtc-calculator>



- Select lead with clear end of T wave (II, V5/V6))
- Identify start of QRS, end of T wave (Tangent method) and heart rate. 1 square = 40ms
- Enter values into calculator

QTc Calculator

Input data below to obtain the QTc.

Age (years)

Baseline Rhythm
 Normal Sinus
 Wide QRS >120 ms (Paced/BBB)
 Atrial Fibrillation

Gender
 Male
 Female

Heart Rate (bpm)

QT Interval Units

QTc (Bazett)
0 ms

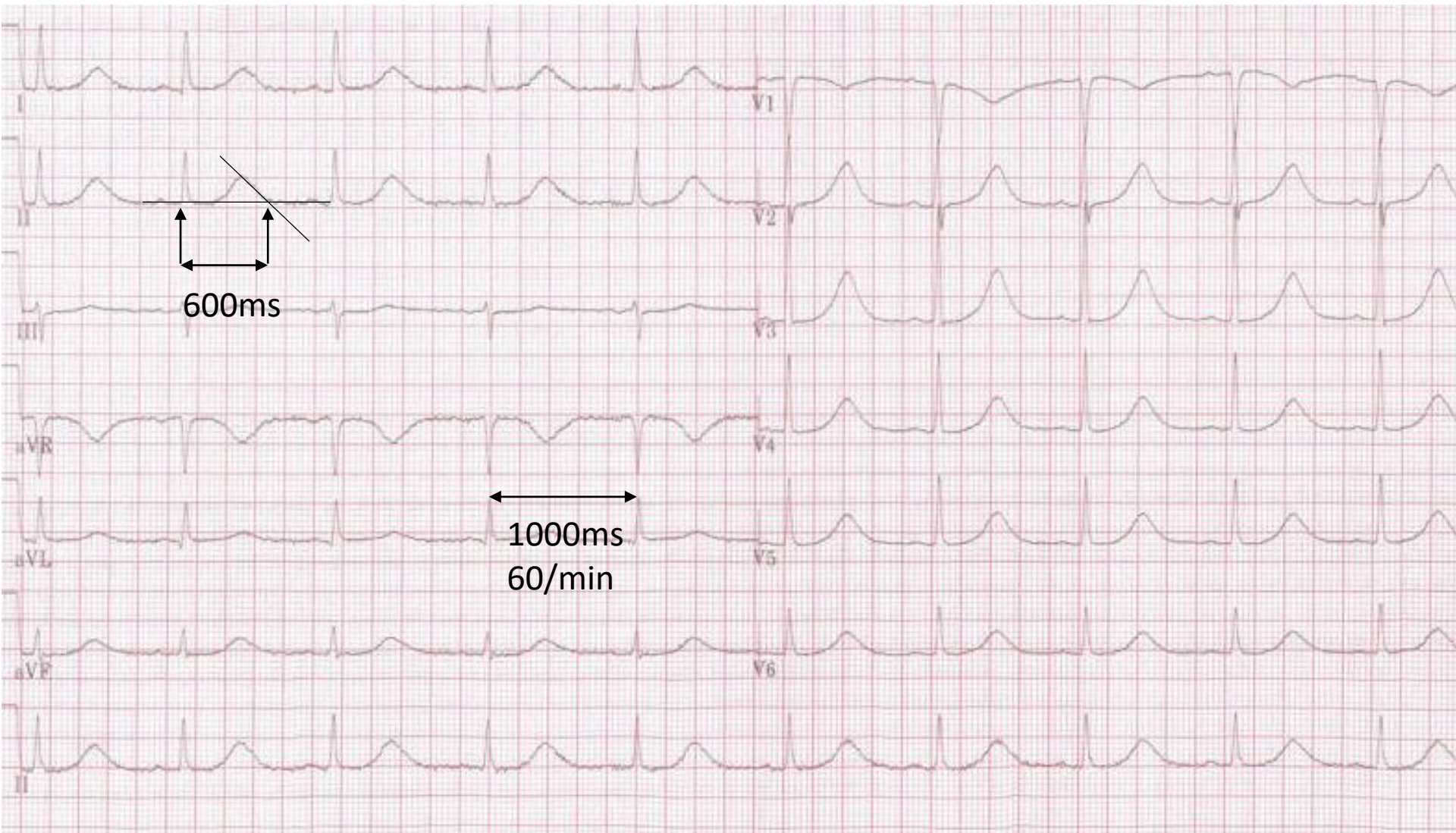
0 ms

QTc (Fridericia)
0 ms

QTc (Hodges)
0 ms

QTc (Framingham)
0 ms

QT segment



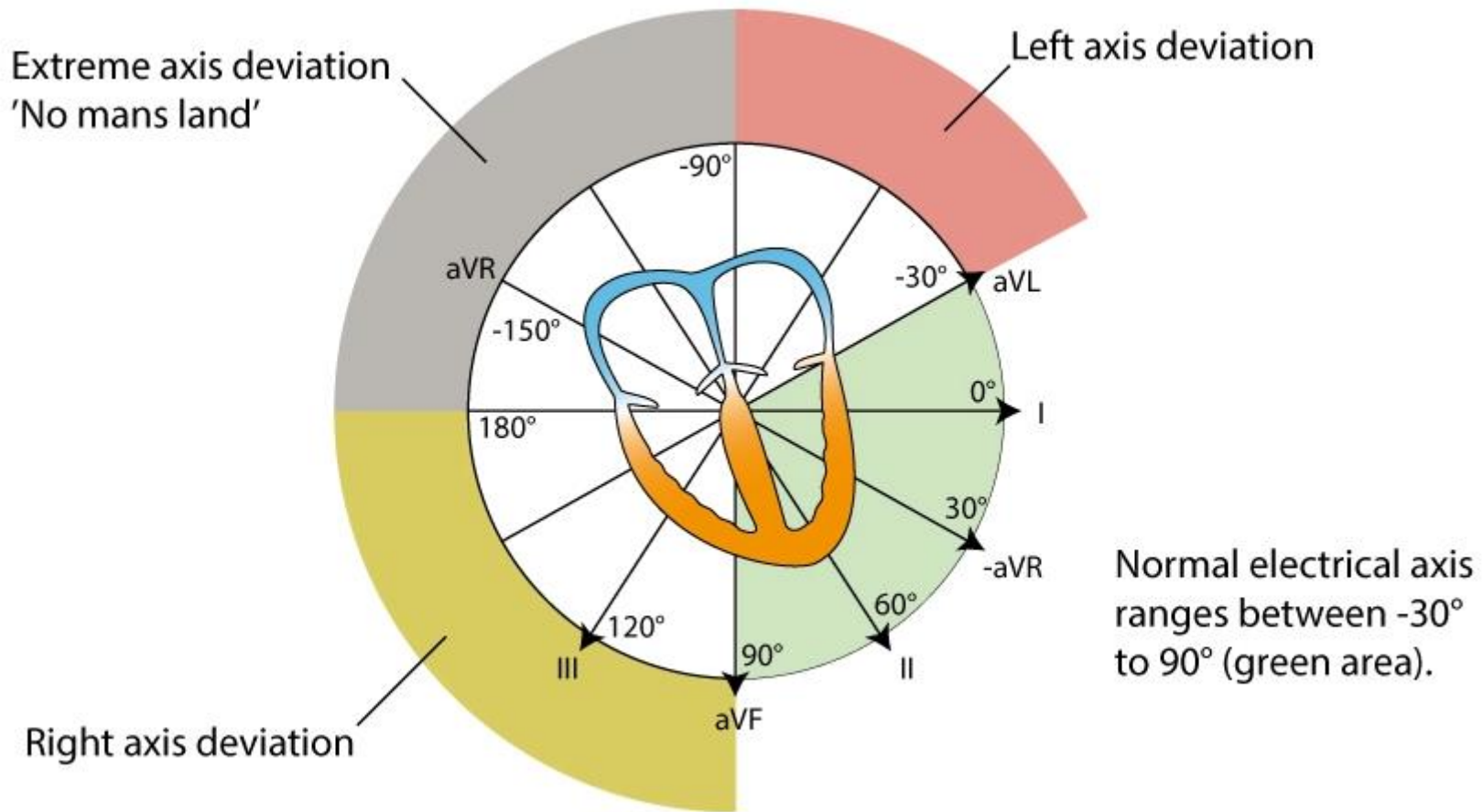
Other

- P wave morphology
 - Determines origin of atrial activation
 - Positive inferior leads: likely sinus
 - Negative in inferior leads: in retrograde conduction
 - 'Flutter waves'



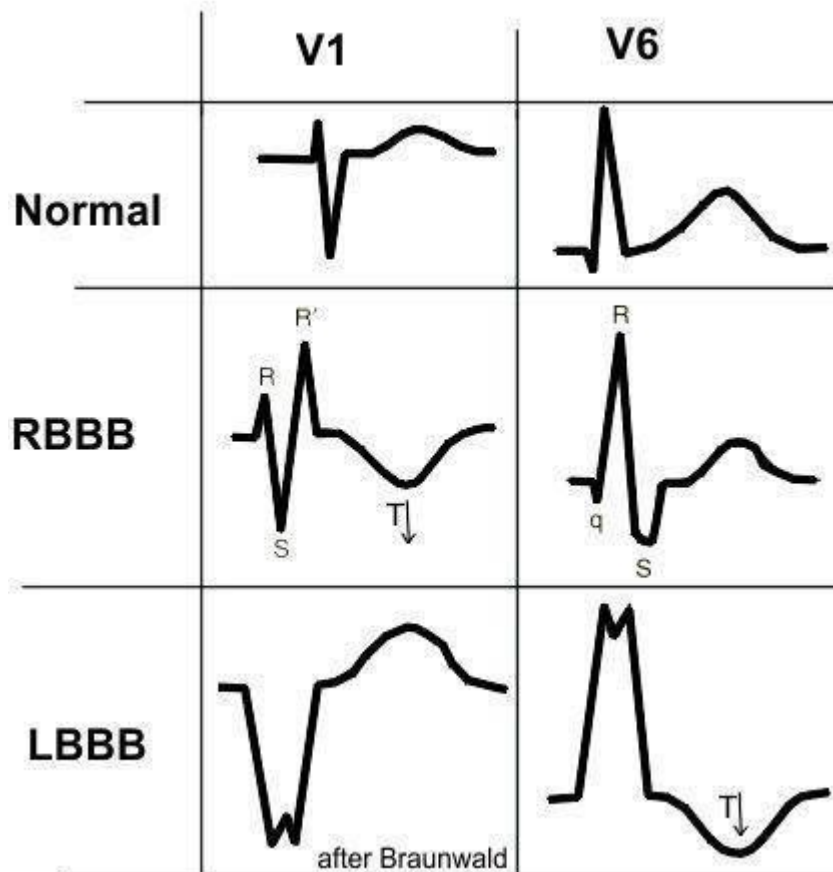
Determination of axis

Leads in which QRS deflection is positive



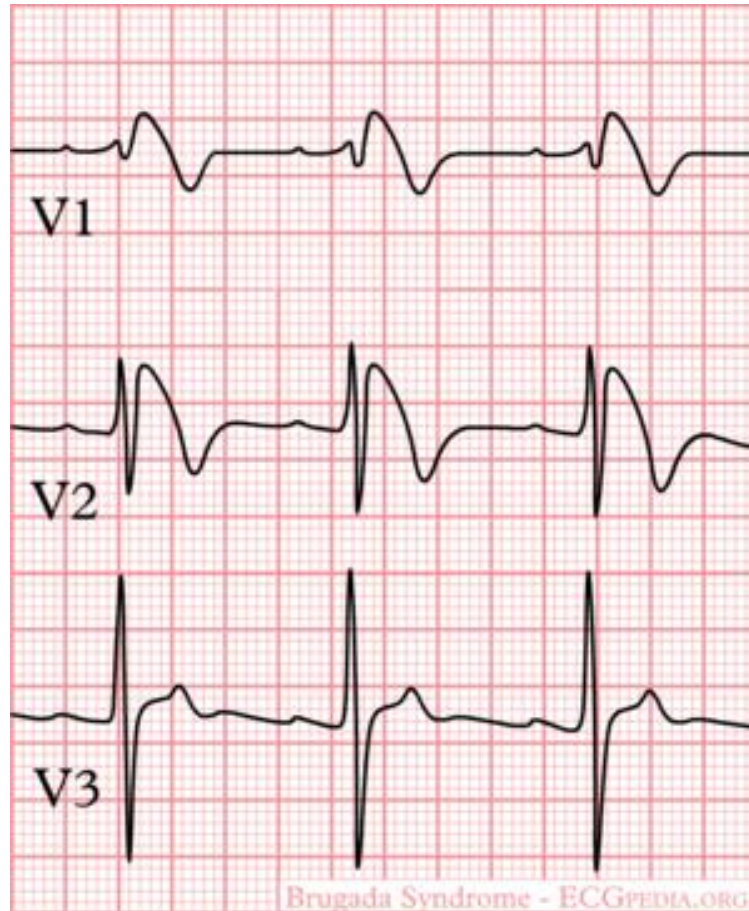
Axis/intraventricular conduction

- Indication how ventricles are activated
- Bundle Branch block patterns

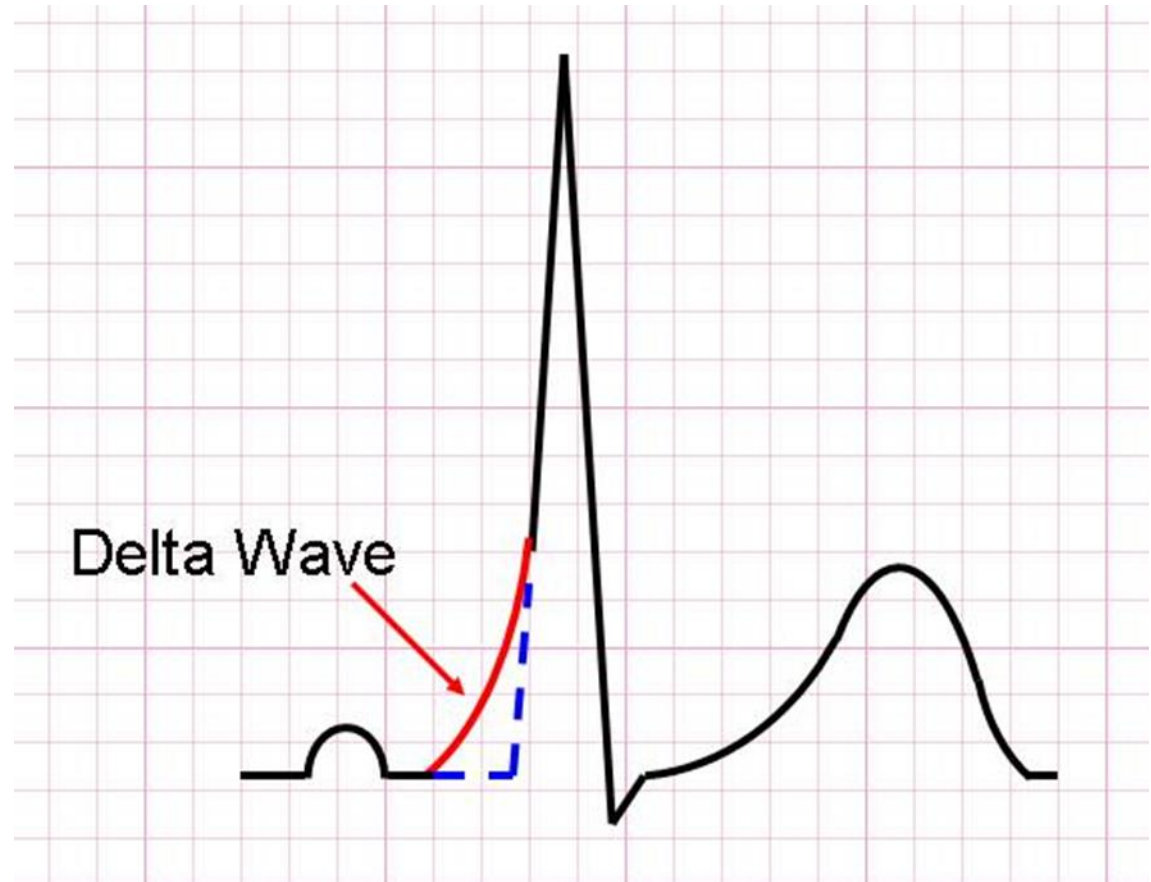
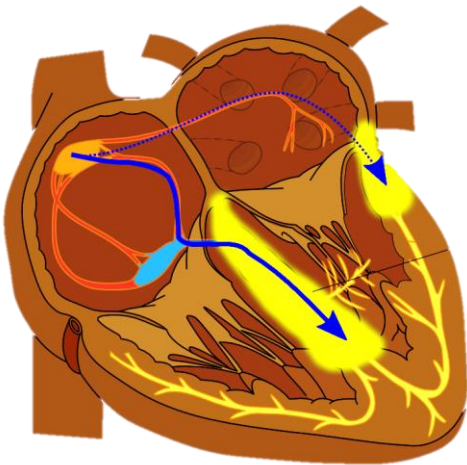


Specific patterns

- Brugada




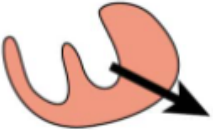


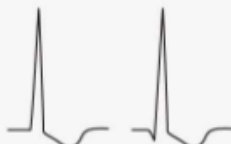






Preexcitation “delta wave” due to accessory pathway



Ventricular hypertrophy

Use leads V1, V2, V5 and V6 to spot ventricular hypertrophy.
These leads show characteristic QRS changes in hypertrophy.

| | V1/V2 | V5/V6 |
|--|---|--|
| <p>Normal</p>  |  |  |
| <p>Left ventricular hypertrophy</p>  |  |  <p>Typically convex ST segment, with or without the septal q-wave.</p>  <p>Less typical is this straight ST segment, with or without septal q-wave.</p> |
| <p>Right ventricular hypertrophy</p>  |  <p>RS complex qR complex</p>  <p>rSR' pattern, similar to right bundle branch block R complex</p> |  |

- Different criteria
- QRS voltage not reliable indicator (due to body habitus)
- Axis deviation / 'strain' pattern



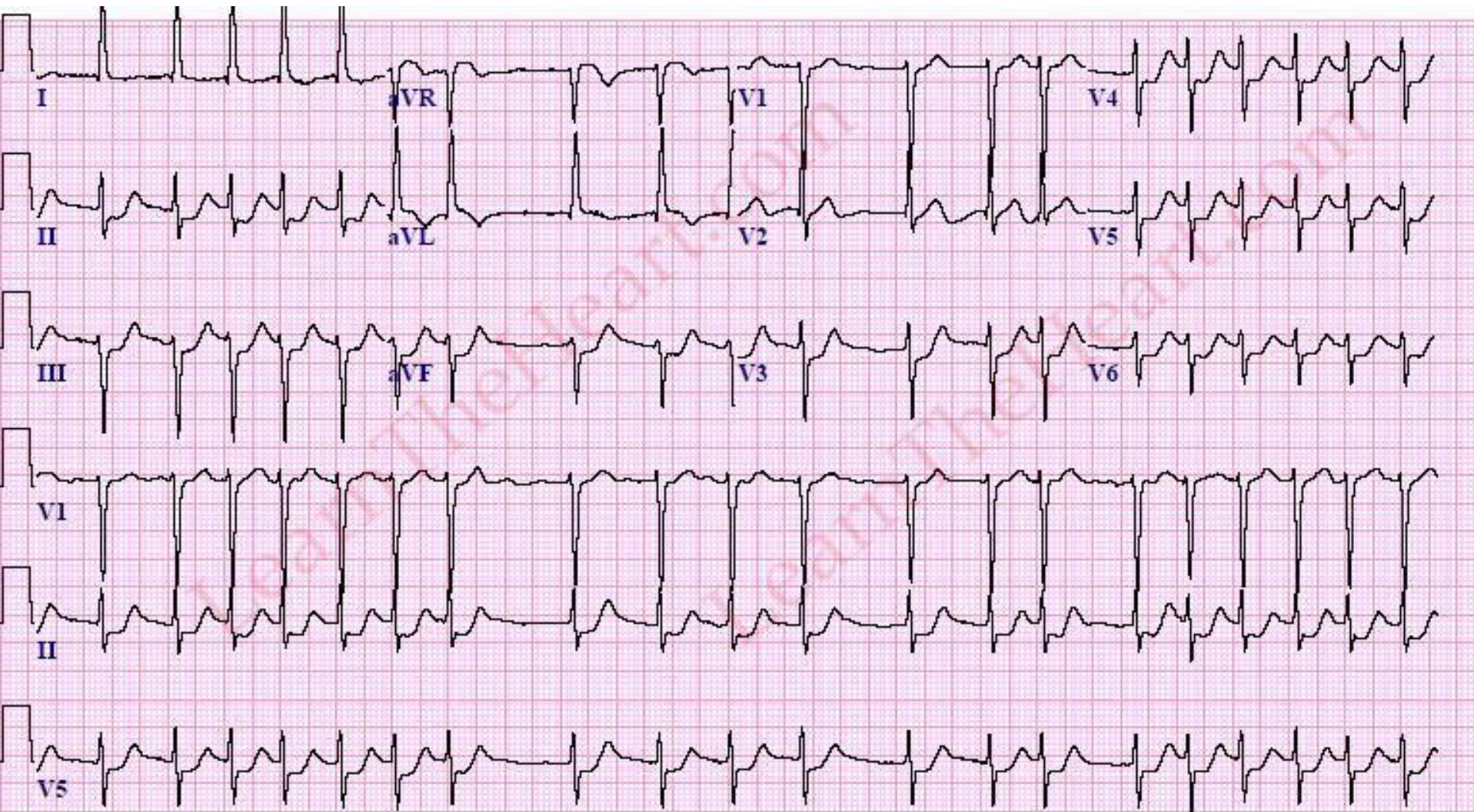
Theory to practice



Case 1

- 78 year old male with HTN, Diabetes presents vomiting and watery stools past 3 days. For the past several days he has had palpitations and chest discomfort
- BP 100/70, Sats 95%





25mm/s 10mm/mV 40Hz 005C 12SL 254 CID: 26

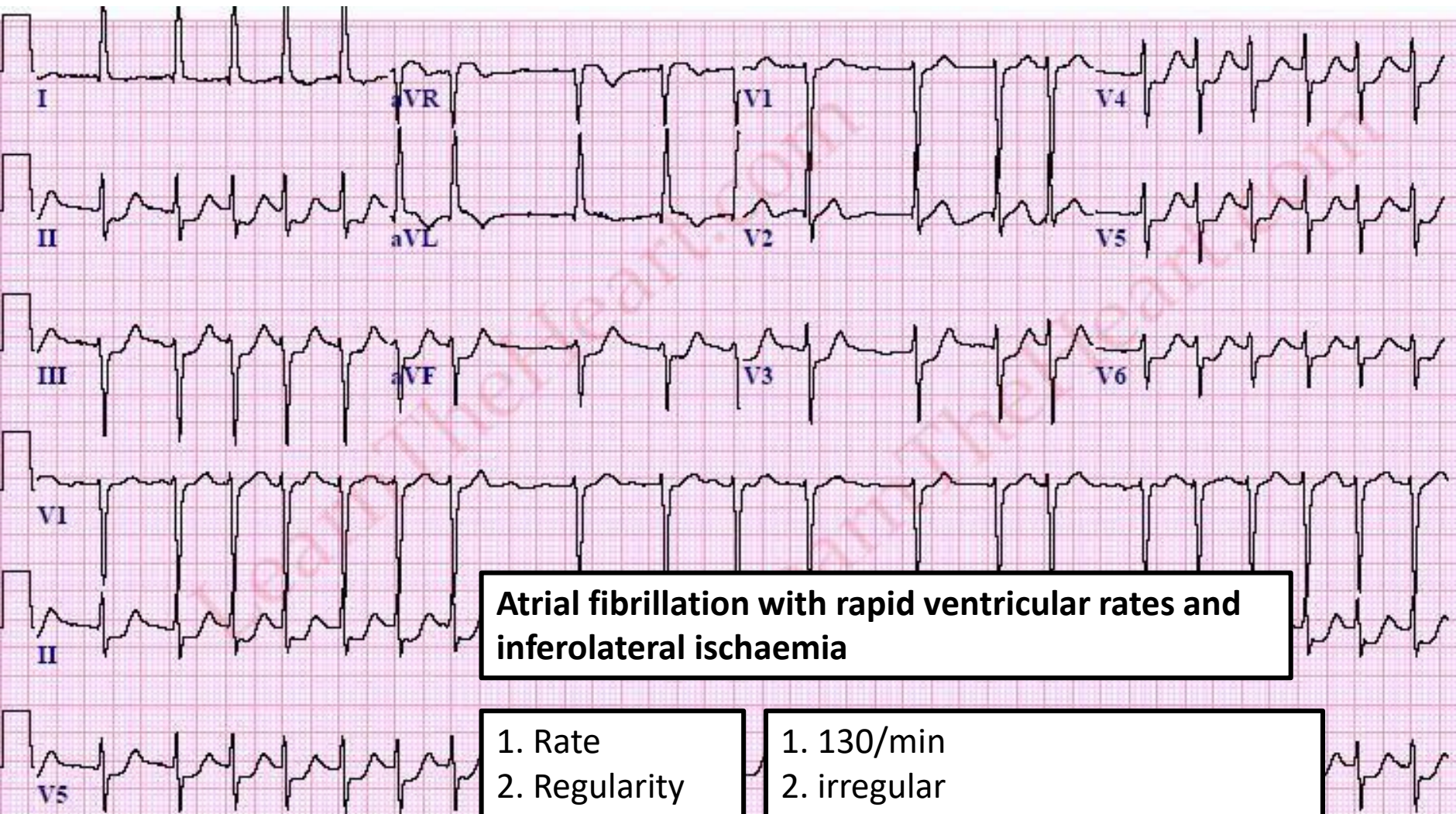
EID:602 EDT: 21:39 20-JUN-2005 ORDER:



What Next?

- 1. Urgent Cardioversion
- 2. Rate Control and anticoagulation
- 3. Anticoagulation/transoesophageal echo/cardioversion
- 4. Cath Lab





Atrial fibrillation with rapid ventricular rates and inferolateral ischaemia

1. Rate
2. Regularity
3. QRS width
4. P waves
5. ST segment
6. Other

1. 130/min
2. irregular
3. narrow
4. no
5. Depression inferolateral leads



What Next?

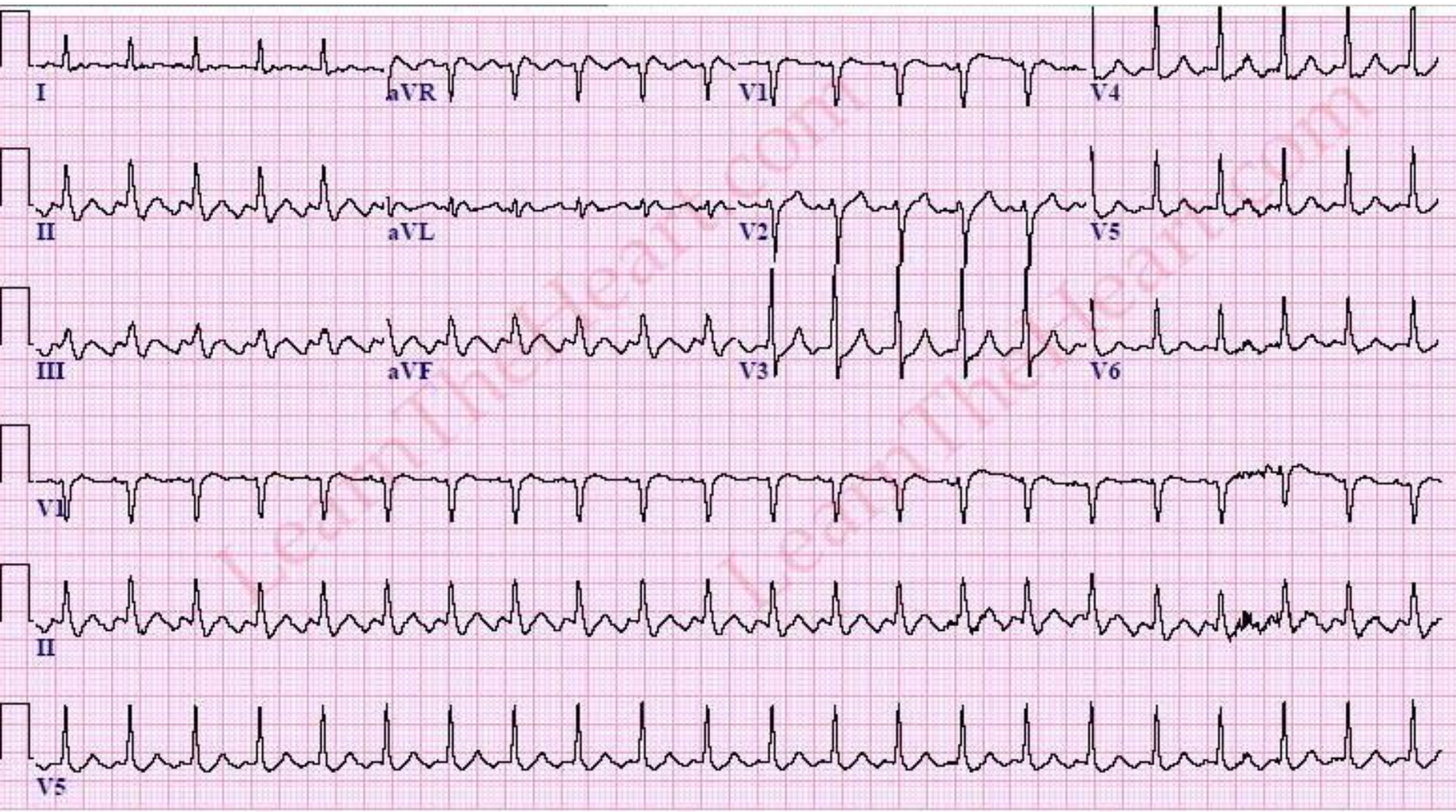
- 1. Urgent Cardioversion
- **2. Rate Control and anticoagulation**
- 3. Anticoagulation/TEE/DCCV
- 4. Cath Lab



Case 2

- 75 year old female with hypertension, presents with palpitations





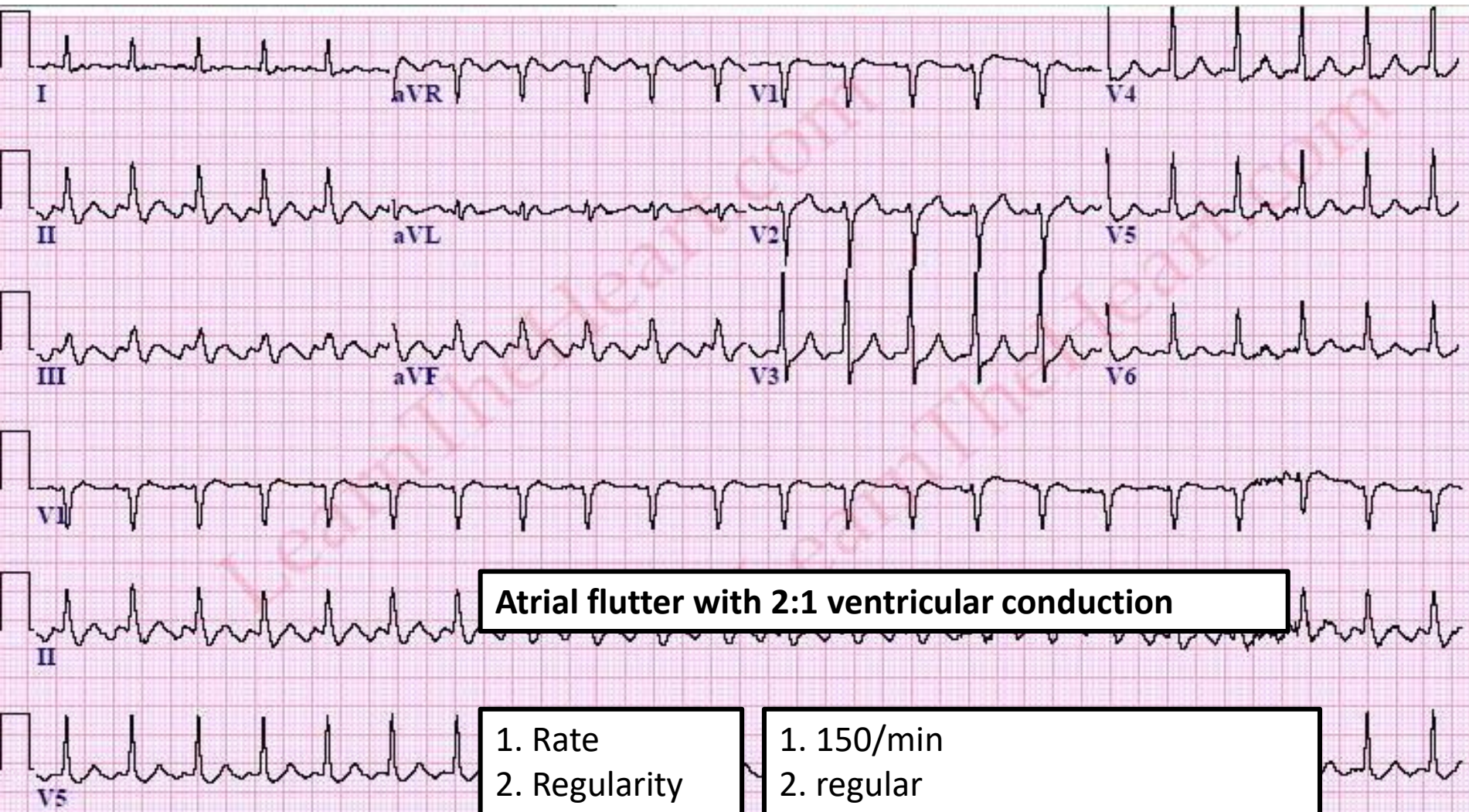
25mm/s 10mm/mV 40Hz 005C 12SL 254 CID: 27

EID:610 EDT: 16:43 15-MAY-2005 ORDER:

What is this rhythm?

- 1. Atrial Fibrillation
- 2. Supraventricular Tachycardia
- 3. Atrial Flutter
- 4. Multifocal Atrial Tachycardia





Atrial flutter with 2:1 ventricular conduction

1. Rate
2. Regularity
3. QRS width
4. P waves
5. ST segment
6. Other

1. 150/min
2. regular
3. narrow
4. ?
5. ?
6. Flutter waves

25mm/s 10mm/mV 40Hz 005C 12SL 254 CID: 2

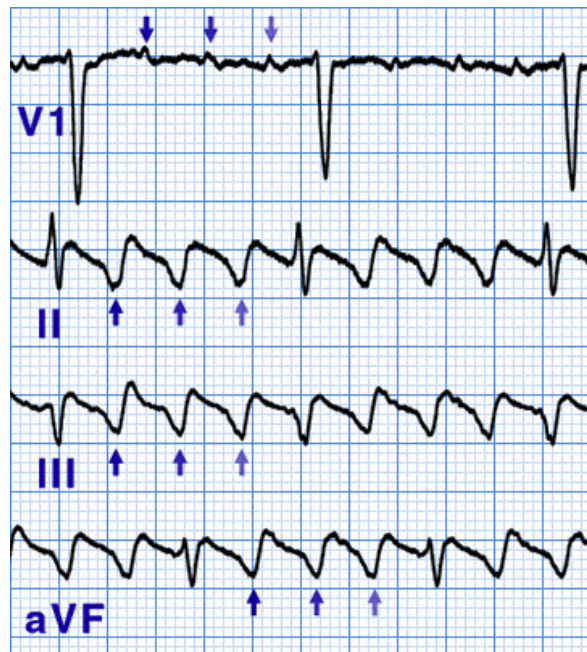
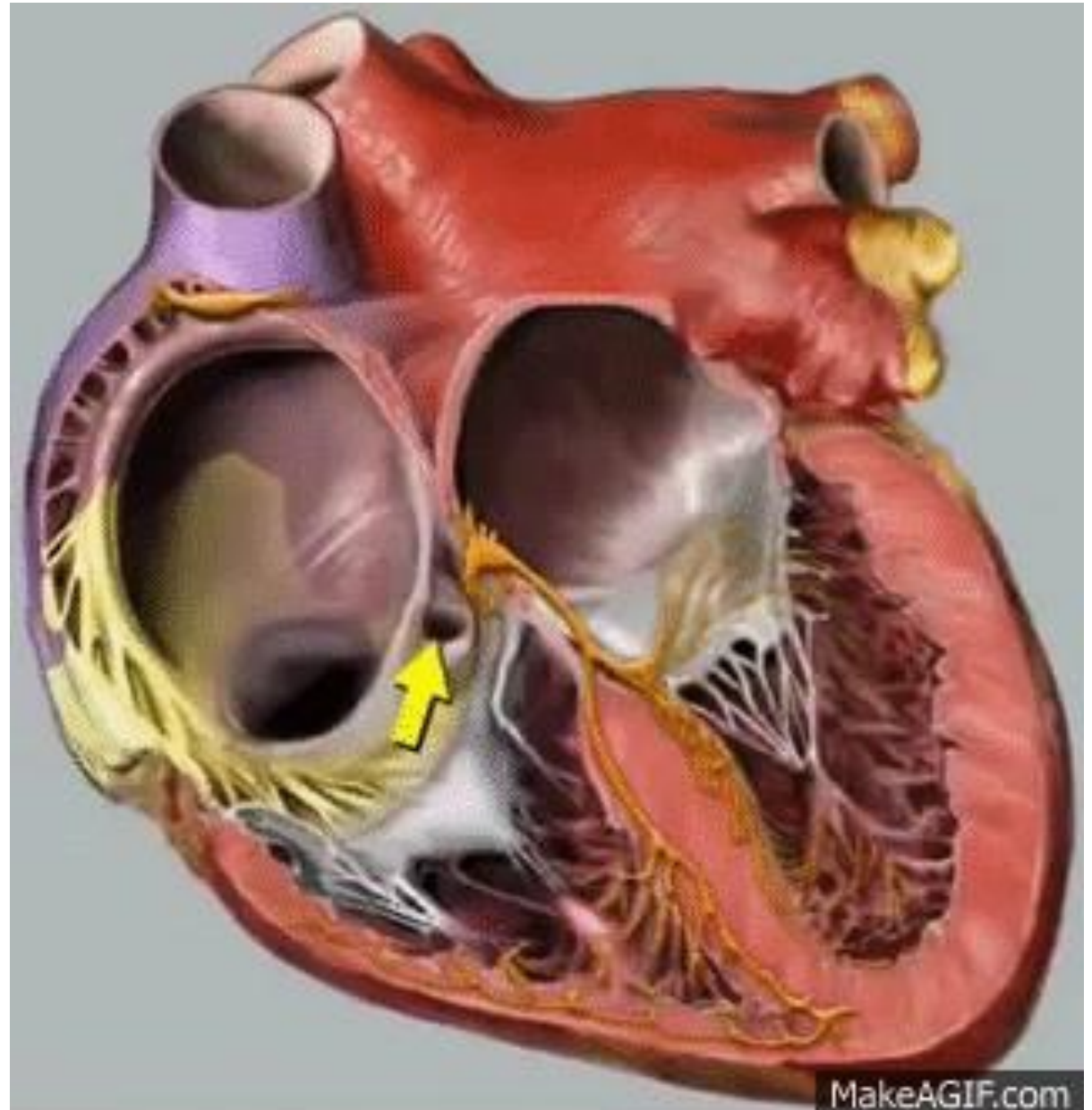
MAY-2005 ORDER:

What is this rhythm?

- 1. Atrial Fibrillation
- 2. Supraventricular Tachycardia
- **3. Atrial Flutter**
- 4. Multifocal Atrial Tachycardia



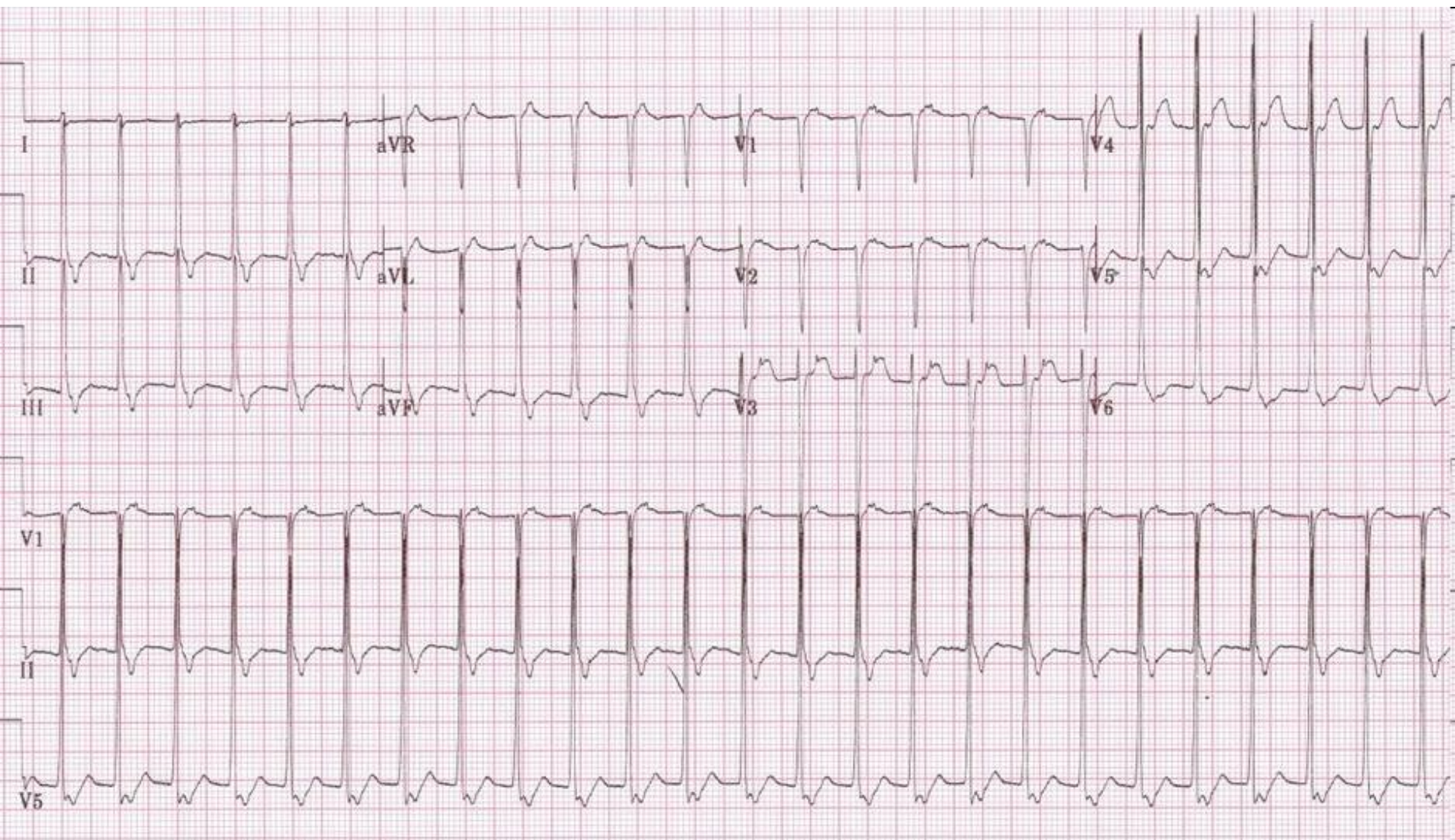
Counter-clockwise, “typical” Atrial flutter



Case 3

- 22 year old with no prior history, was sitting in an ECG lecture and had the sudden onset of palpitations.

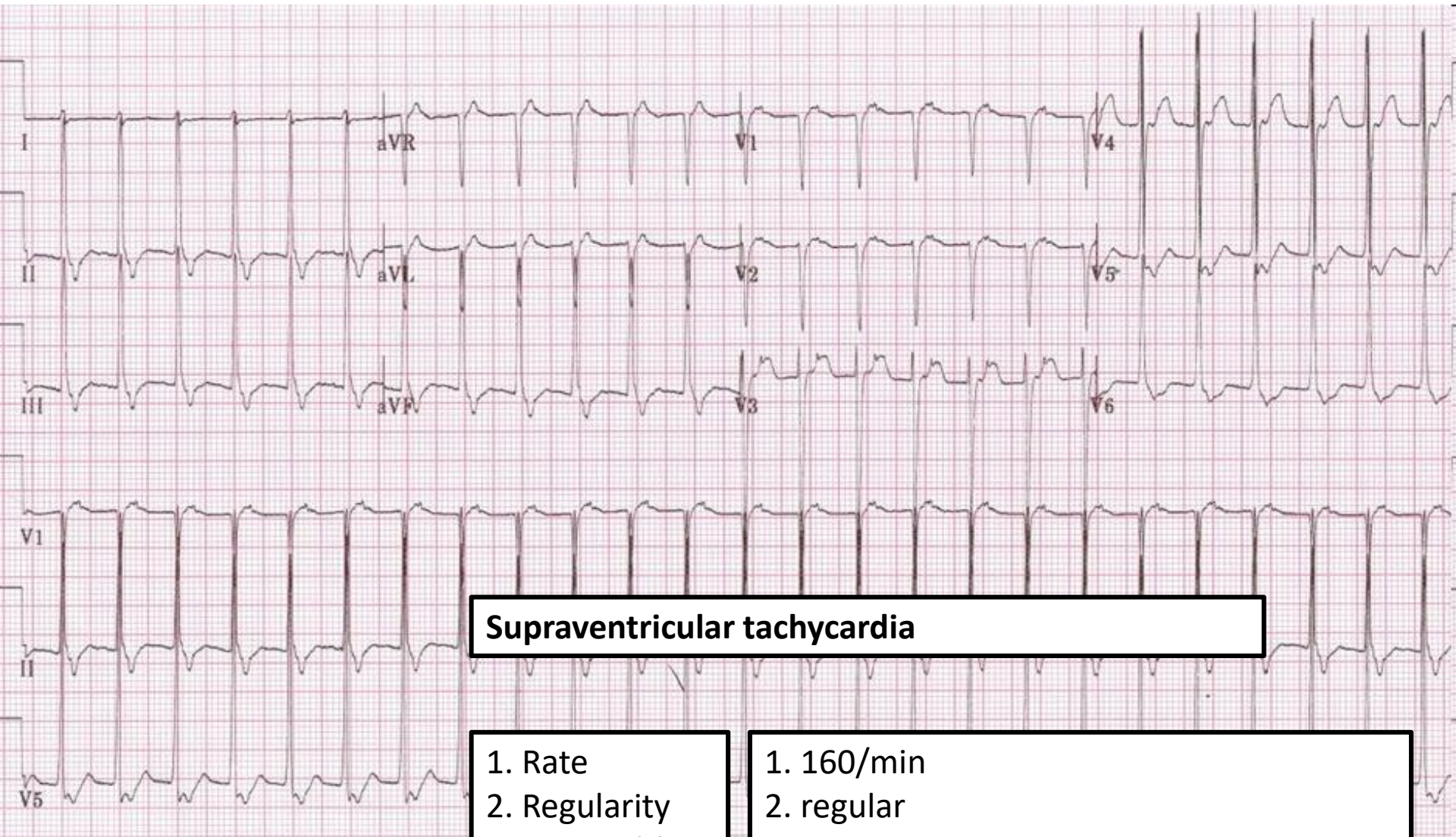




What is this rhythm?

- 1. Atrial Fibrillation
- 2. Supraventricular Tachycardia
- 3. Atrial Flutter
- 4. Multifocal Atrial Tachycardia





Supraventricular tachycardia

- 1. Rate
- 2. Regularity
- 3. QRS width
- 4. P waves
- 5. ST segment
- 6. Other

- 1. 160/min
- 2. regular
- 3. narrow
- 4. no
- 5. ?
- 6. Negative deflection after QRS: P wave

What is this rhythm?

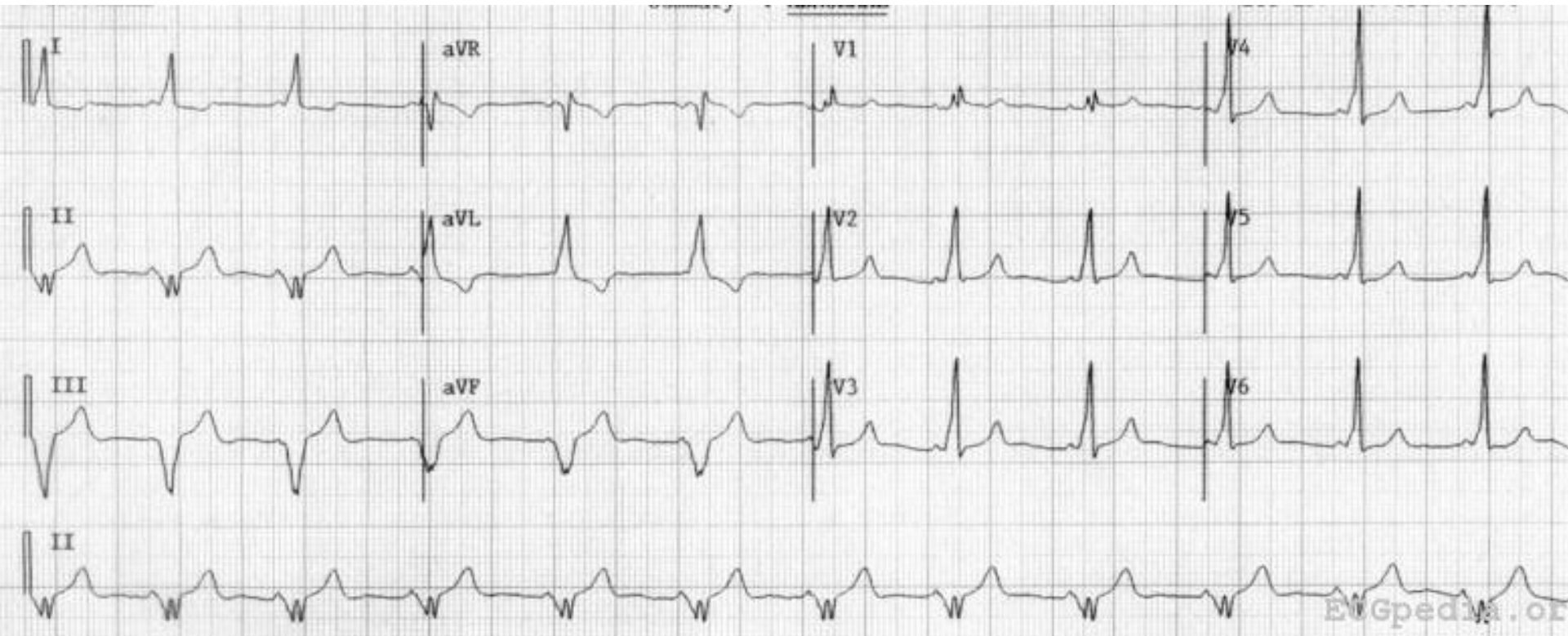
- 1. Atrial Fibrillation
- **2. Supraventricular Tachycardia**
- 3. Atrial Flutter
- 4. Multifocal Atrial Tachycardia



Case 3 - continues

- The patient is given 6 mg of intravenous adenosine and the rhythm terminates to sinus rhythm.
- This is the ECG after SVT termination

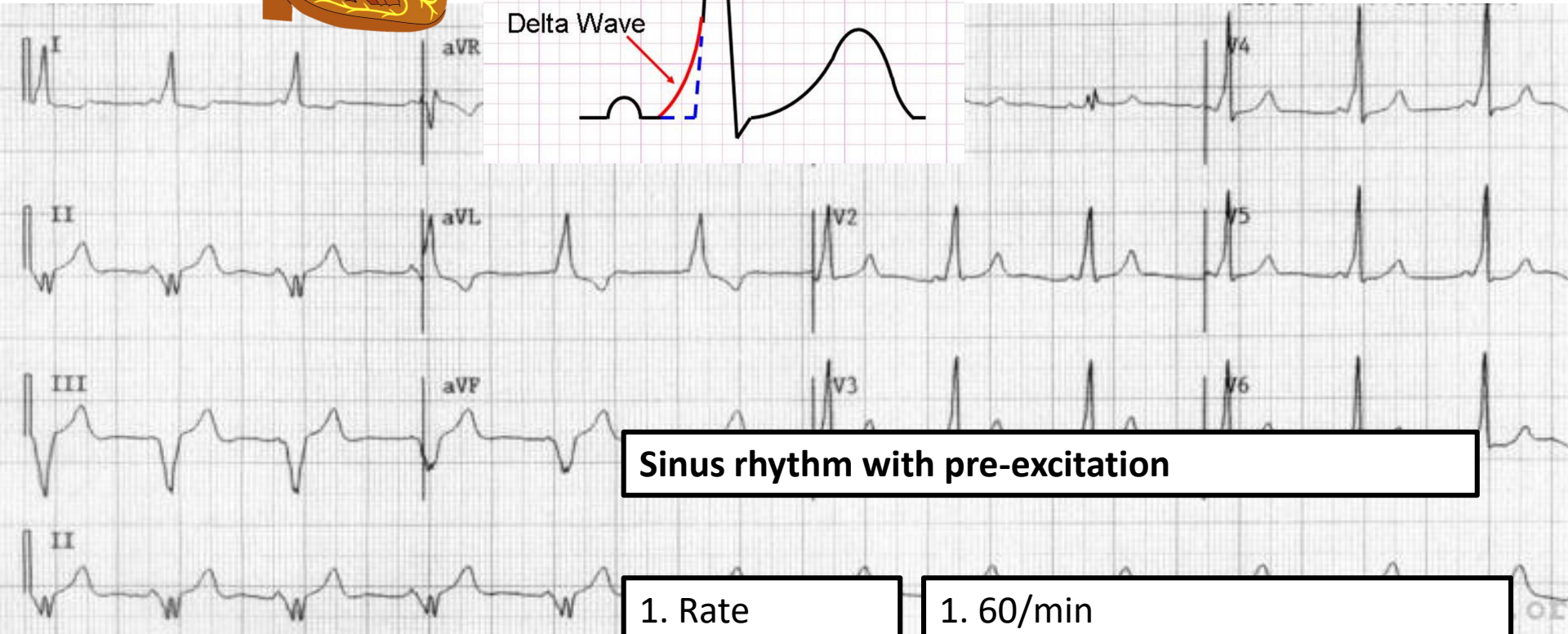
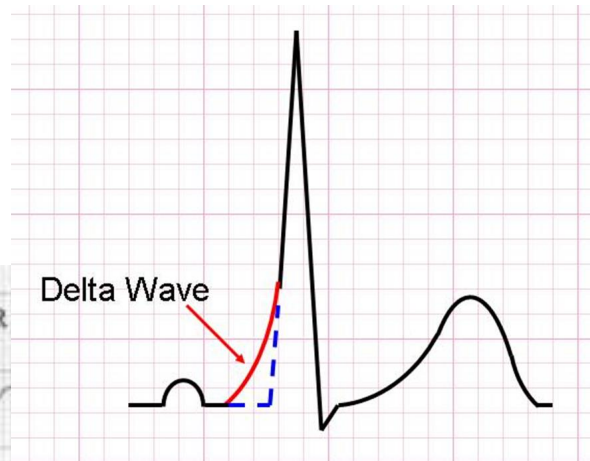
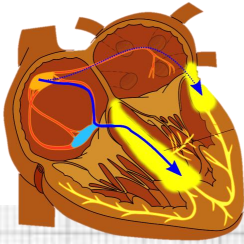




What does this ECG show?

- Wolf – Parkinson – White Pattern
- Idioventricular rhythm
- Sinus rhythm with Left Bundle Branch Block
- Sinus Rhythm with old inferior wall Myocardial Infarction





Sinus rhythm with pre-excitation

1. Rate
2. Regularity
3. QRS width
4. P waves
5. ST segment
6. Other

1. 60/min
2. regular
3. wide
4. yes
5. normal
6. Short PR, delta-wave

What does this ECG show?

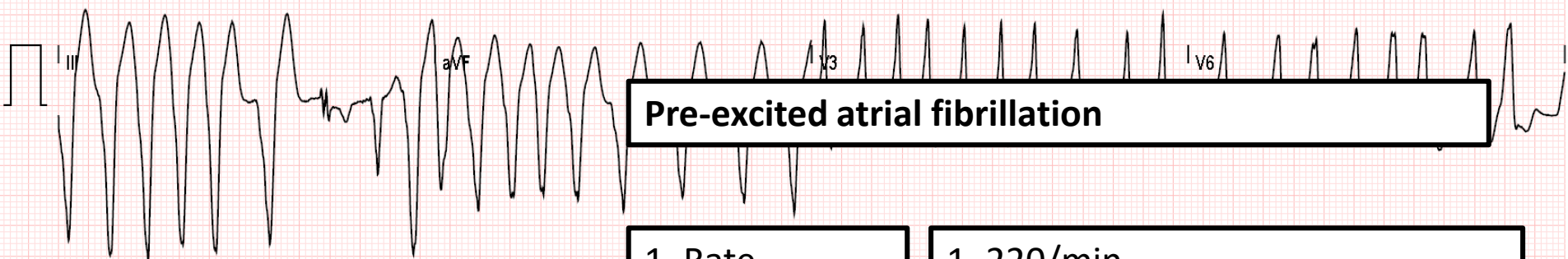
- **1. Wolf – Parkinson – White Pattern**
- 2. Idioventricular rhythm
- 3. Sinus rhythm with Left Bundle Branch Block
- 4. Sinus Rhythm with old inferior wall Myocardial Infarction



Case 3 - continues

- Patient presents 3 weeks later after a syncope on morning after a night with some beverages.
- During ECG in ED palpitations





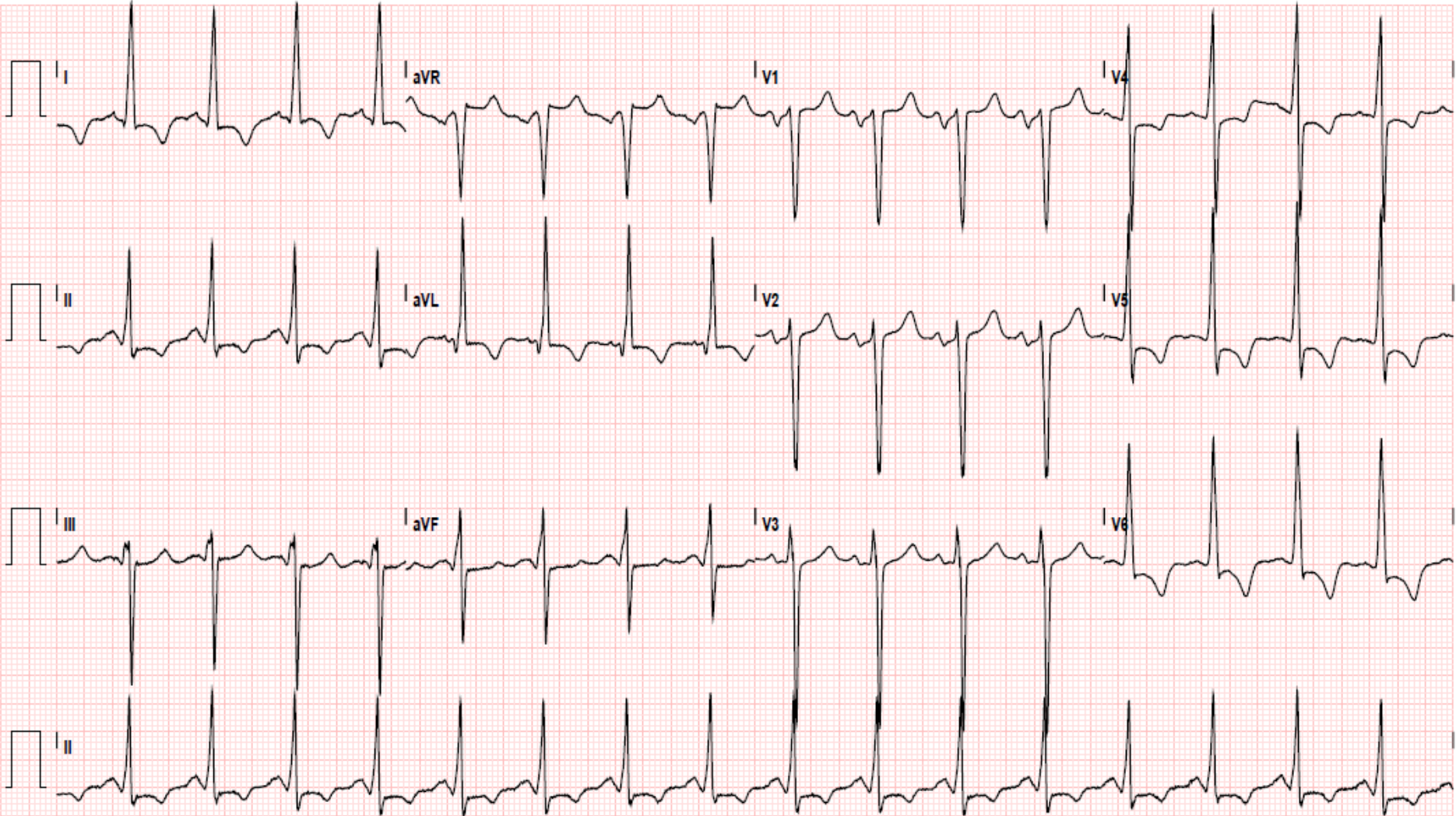
Pre-excited atrial fibrillation



- 1. Rate
- 2. Regularity
- 3. QRS width
- 4. P waves
- 5. ST segment
- 6. Other

- 1. 220/min
- 2. irregular
- 3. Wide (variable)
- 4. no
- 5. ?
- 6.

Case 4. 48 year old male, admitted with appendicitis, preop ECG.

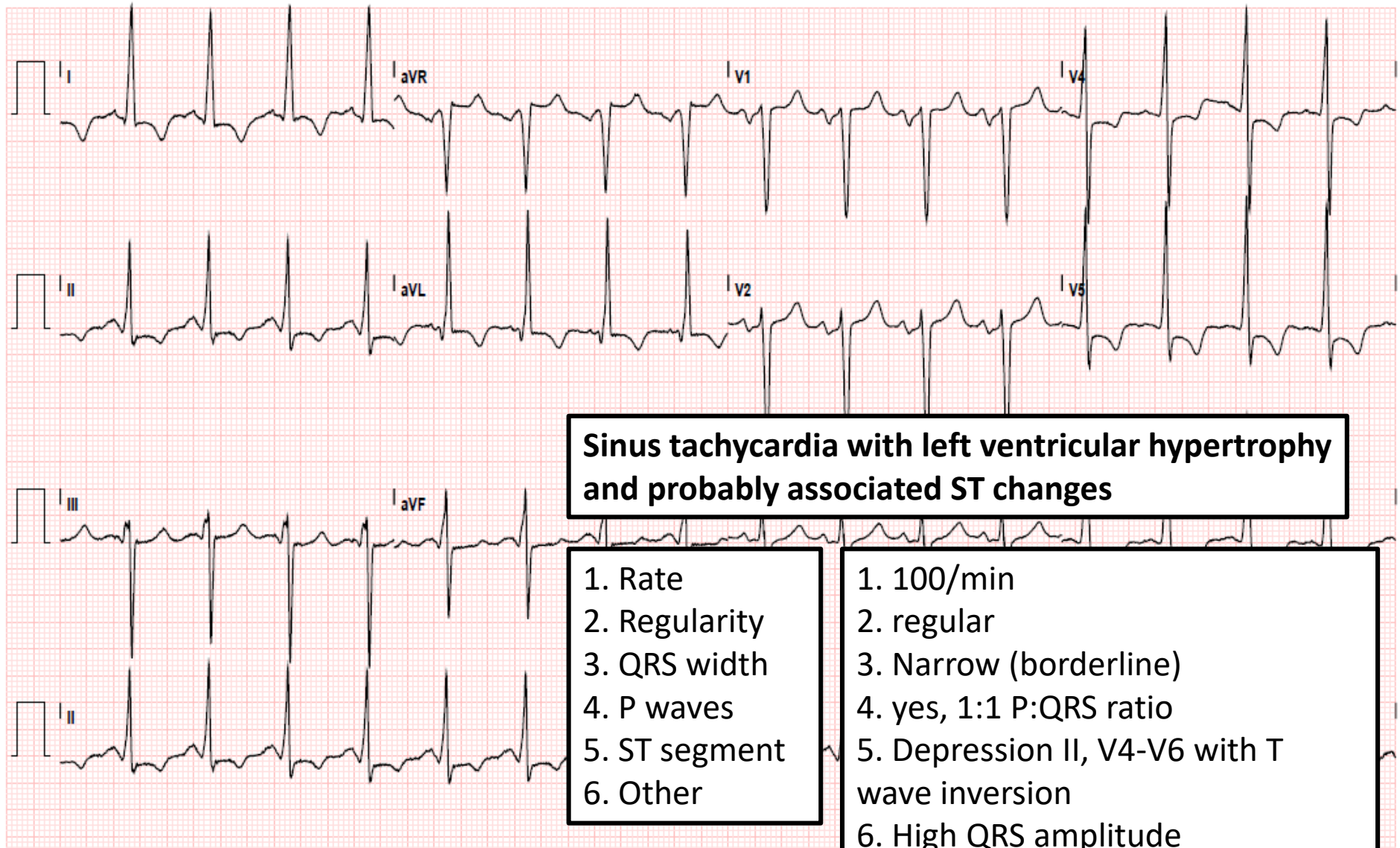


What does this ECG show?

- 1. Atrial flutter
- 2. normal sinus rhythm
- 3. Left ventricular hypertrophy
- 4. Inferolateral ischaemia



48 year old male, admitted with appendicitis, preop ECG.



What does this ECG show?

- 1. Atrial flutter
- 2. normal sinus rhythm
- **3. Left ventricular hypertrophy**
- 4. Inferolateral ischaemia

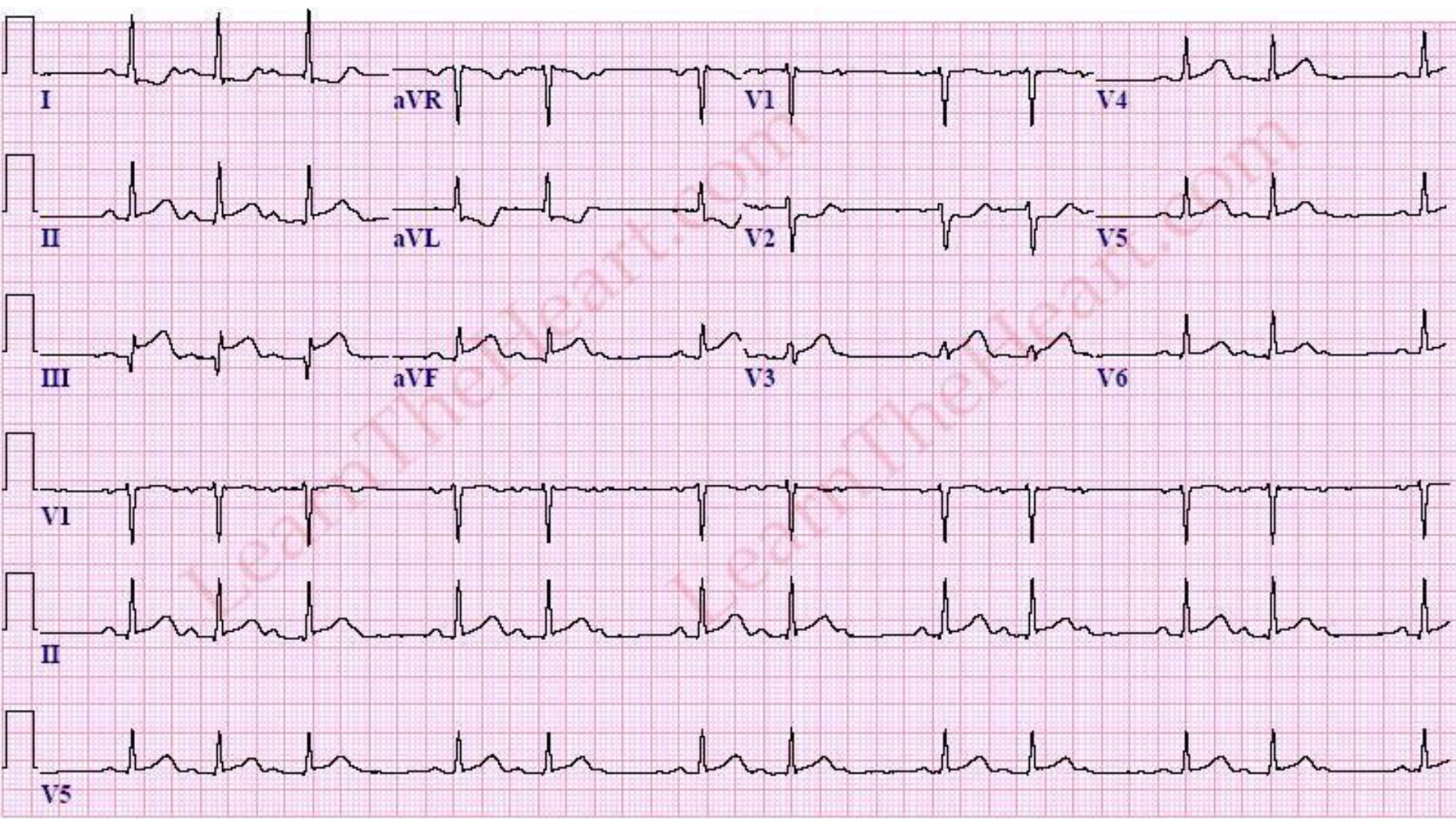


Case 5

- 55 year old male, intermittent chest discomfort and syncope



Case 5

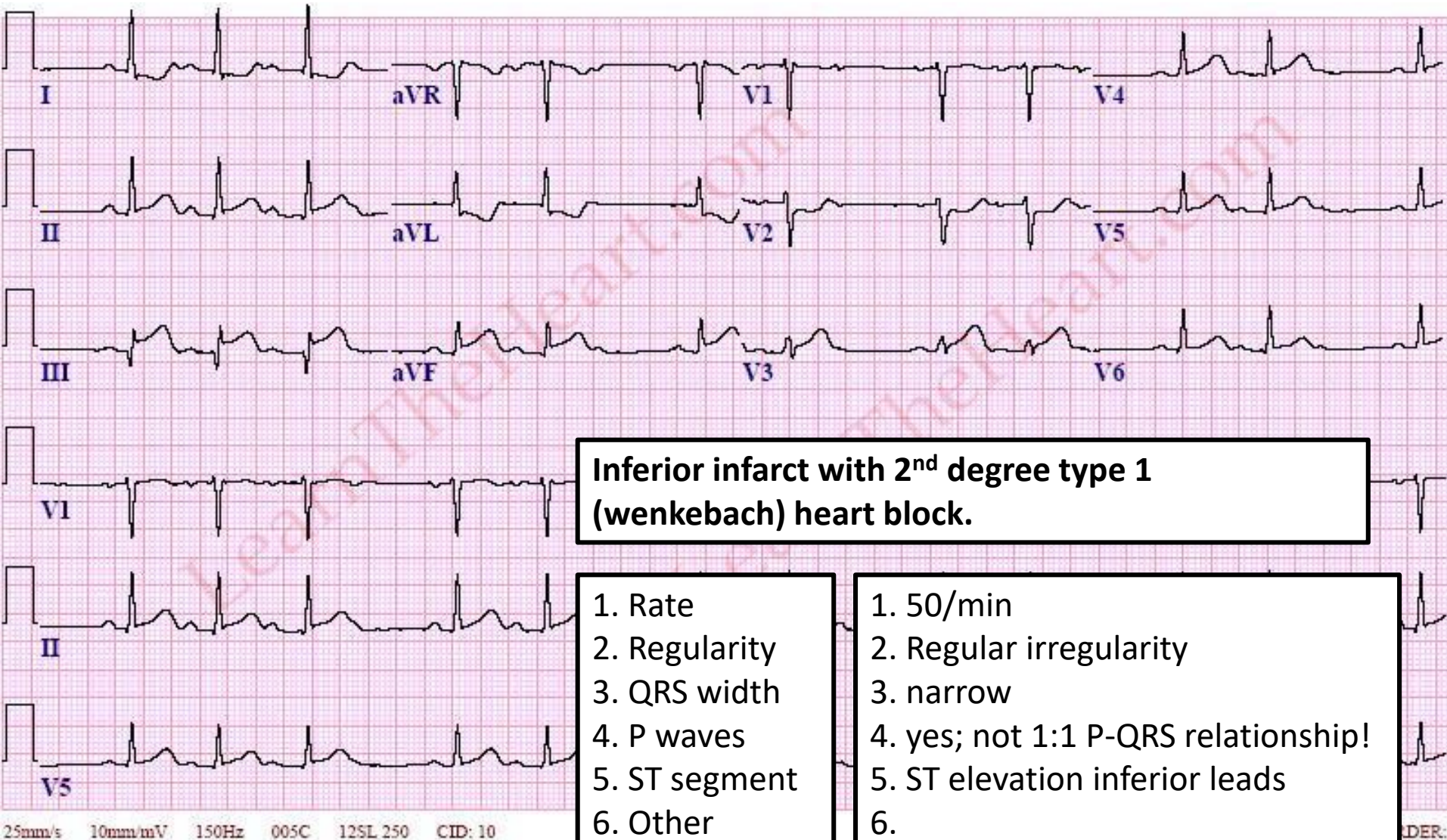


What rhythm does this ECG show?

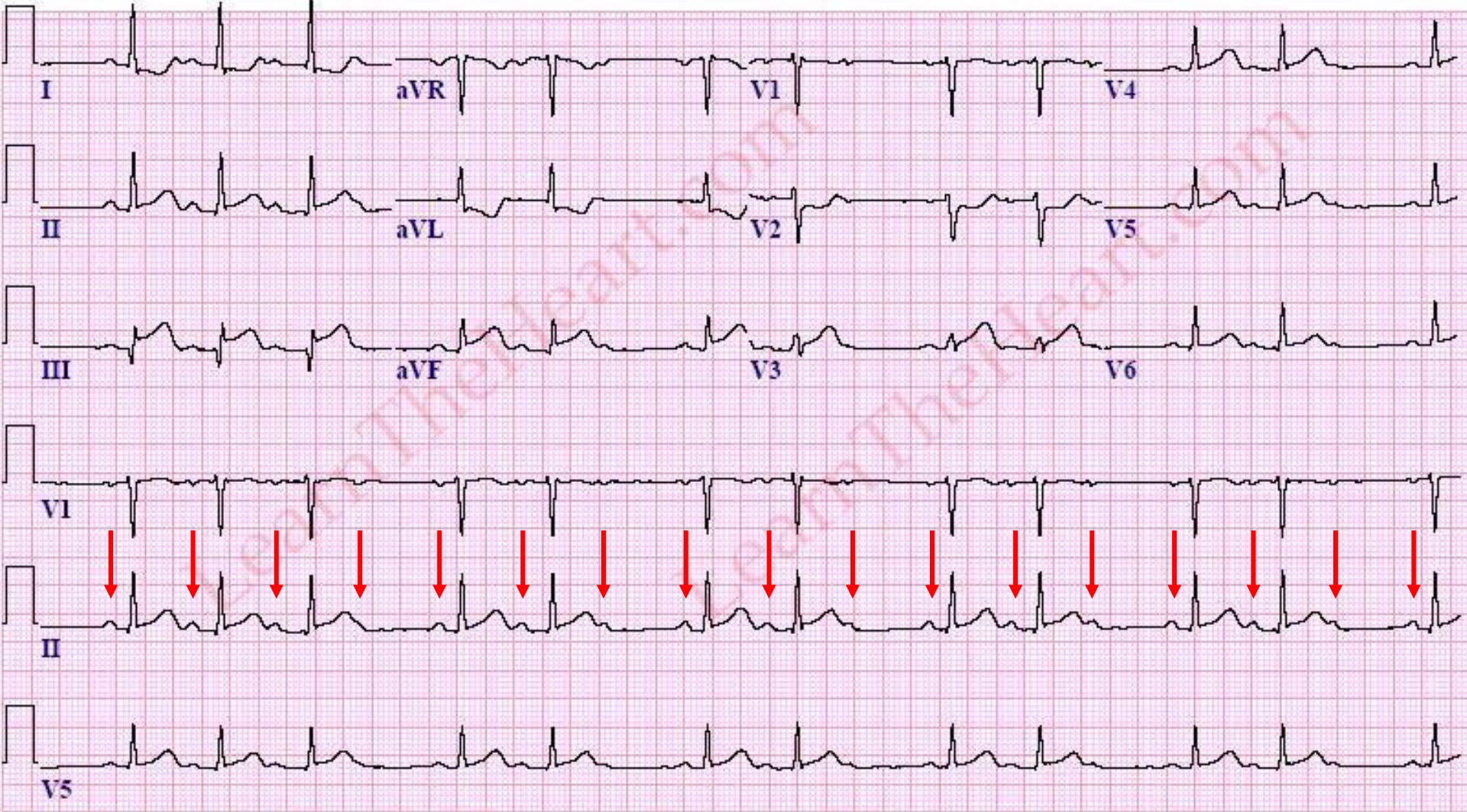
- 1. Sinus rhythm with 1st degree AV Block
- 2. Sinus rhythm with Type 1 Second degree AV block
- 3. Sinus rhythm with Type 2 Second Degree AV block
- 4. Sinus rhythm with complete heart block



Case 5



Case 5



What rhythm does this ECG show?

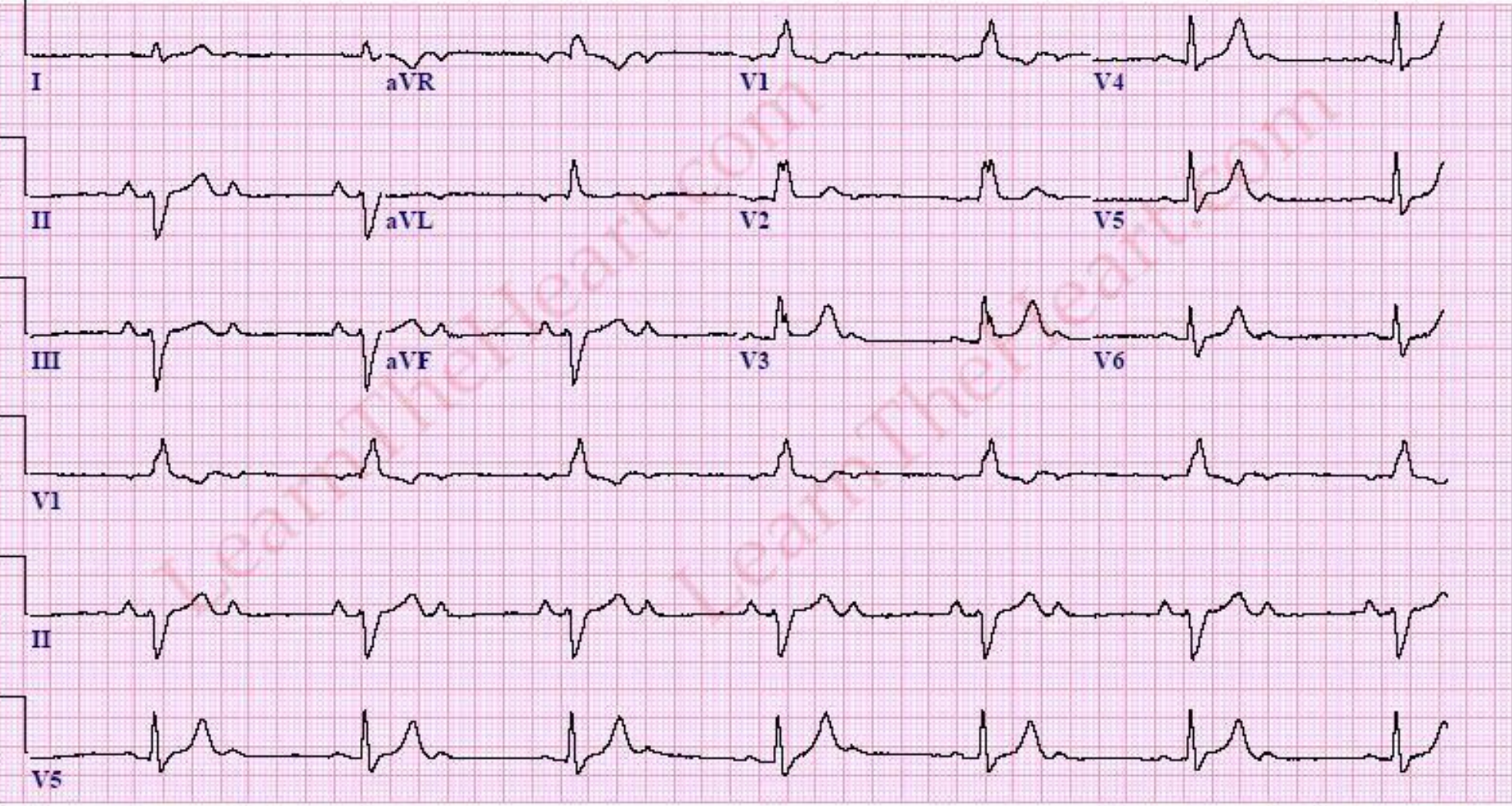
- 1. Sinus rhythm with 1st degree AV Block
- **2. Sinus rhythm with Type 1 Second degree AV block**
- 3. Sinus rhythm with Type 2 Second Degree AV block
- 4. Sinus rhythm with complete heart block



Bradycardia

- Sinus Node Dysfunction
 - Sinus Arrest
 - Sinoatrial Block
 - 'sick sinus syndrome'
 - Paroxysmal AF with post-reversion pauses
 - Medications
- AV Node Disease
 - AV Block
 - Type 1- prolonged PR
 - 2nd Degree Type 1- gradual PR prolongation before block "Wenkebach"
 - Can be physiological at rest
 - 2nd degree Type 2 – No PR change before block
 - Pathological, indication of distal conduction disease.
 - 3rd Degree – Independent P wave rate and QRS rate

Case 6

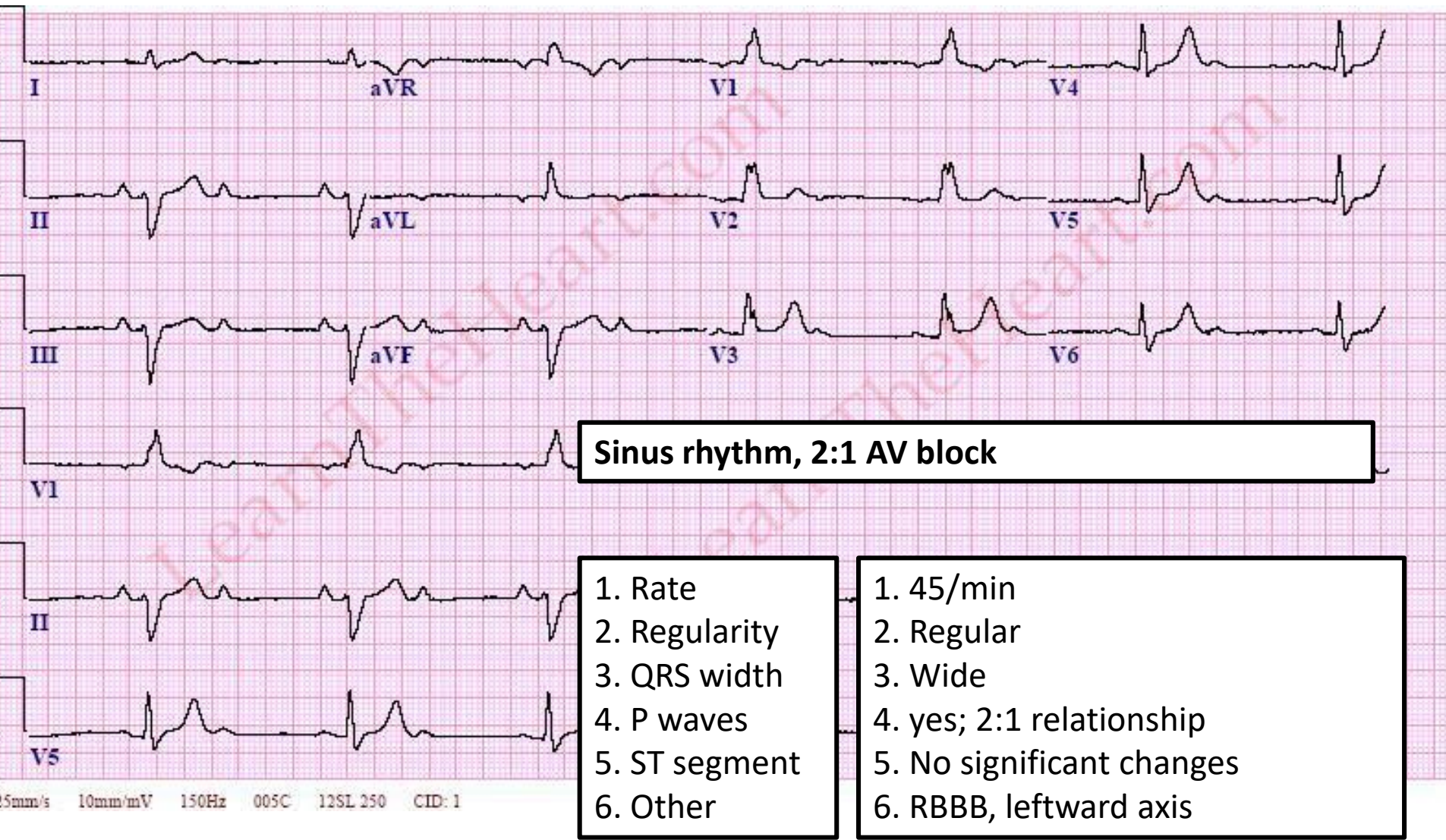


What rhythm does this ECG show?

- 1. Sinus rhythm with 1st degree AV Block
- 2. Sinus rhythm with 2:1 AV block
- 3. Sinus rhythm with complete heart block



Case 6



What rhythm does this ECG show?

- 1. Sinus rhythm with 1st degree AV Block
- **2. Sinus rhythm with 2:1 AV block**
- 3. Sinus rhythm with complete heart block



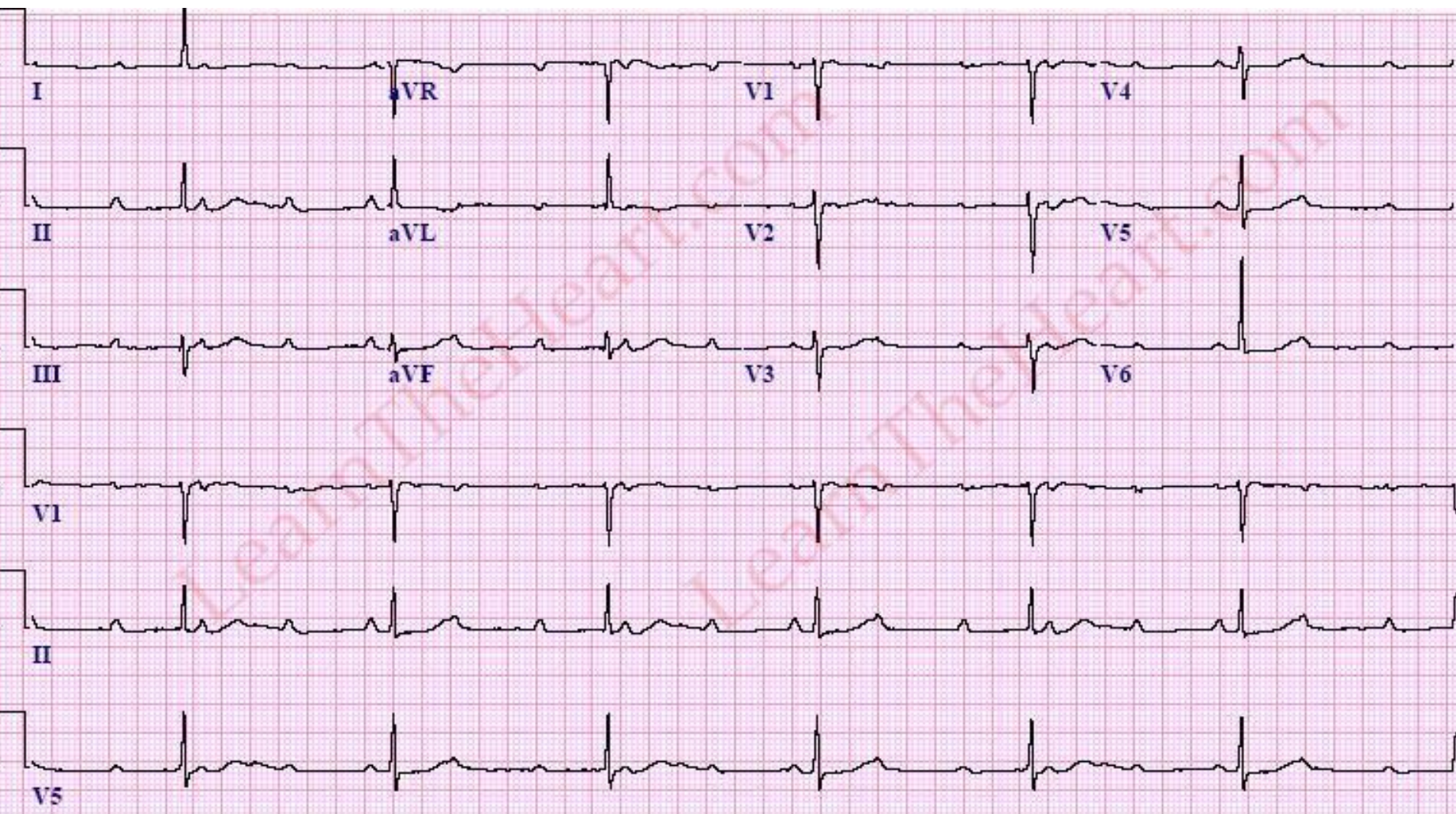
2:1 AV block

Is it Type 1 or Type 2 Second Degree AVB?

- Maneuvers
- If you increase sympathetic tone and AV nodal conduction improves → Type I 2nd degree AVB- benign
- If you increase vagal tone (CSM) and conduction improves → Type II second degree AVB- bad!
- Wide QRS- more likely Type II
 - Type I: can be physiological
 - Type II: implies distal conduction disease-→ pacemaker!



After walking patient in Case 6

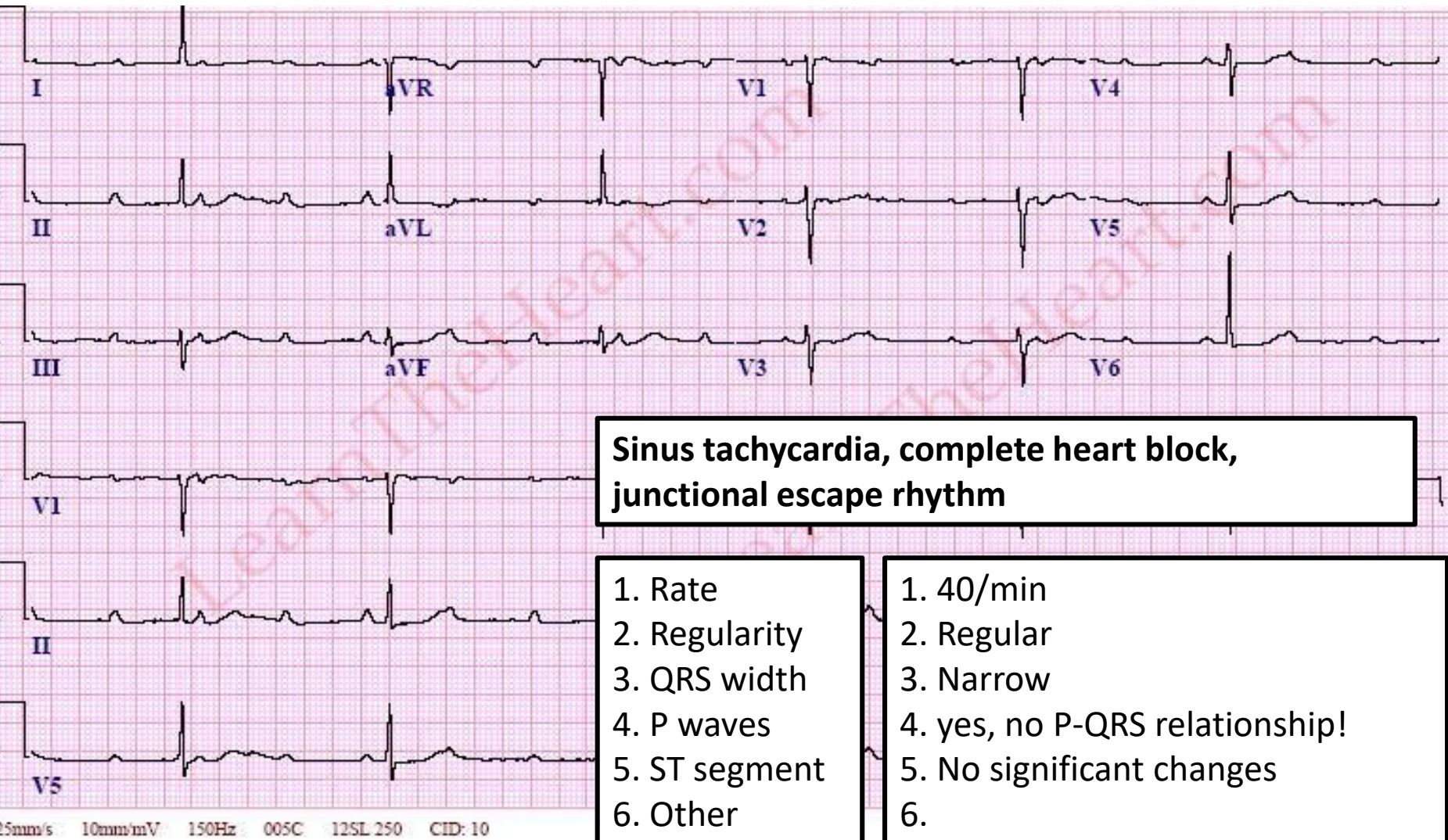


Did the AV block...

- 1. Get worse
- 2. Stay the same
- 3. Improve



After walking patient in Case 6



Did the AV block...

- **1. Get worse**
- 2. Stay the same
- 3. Improve

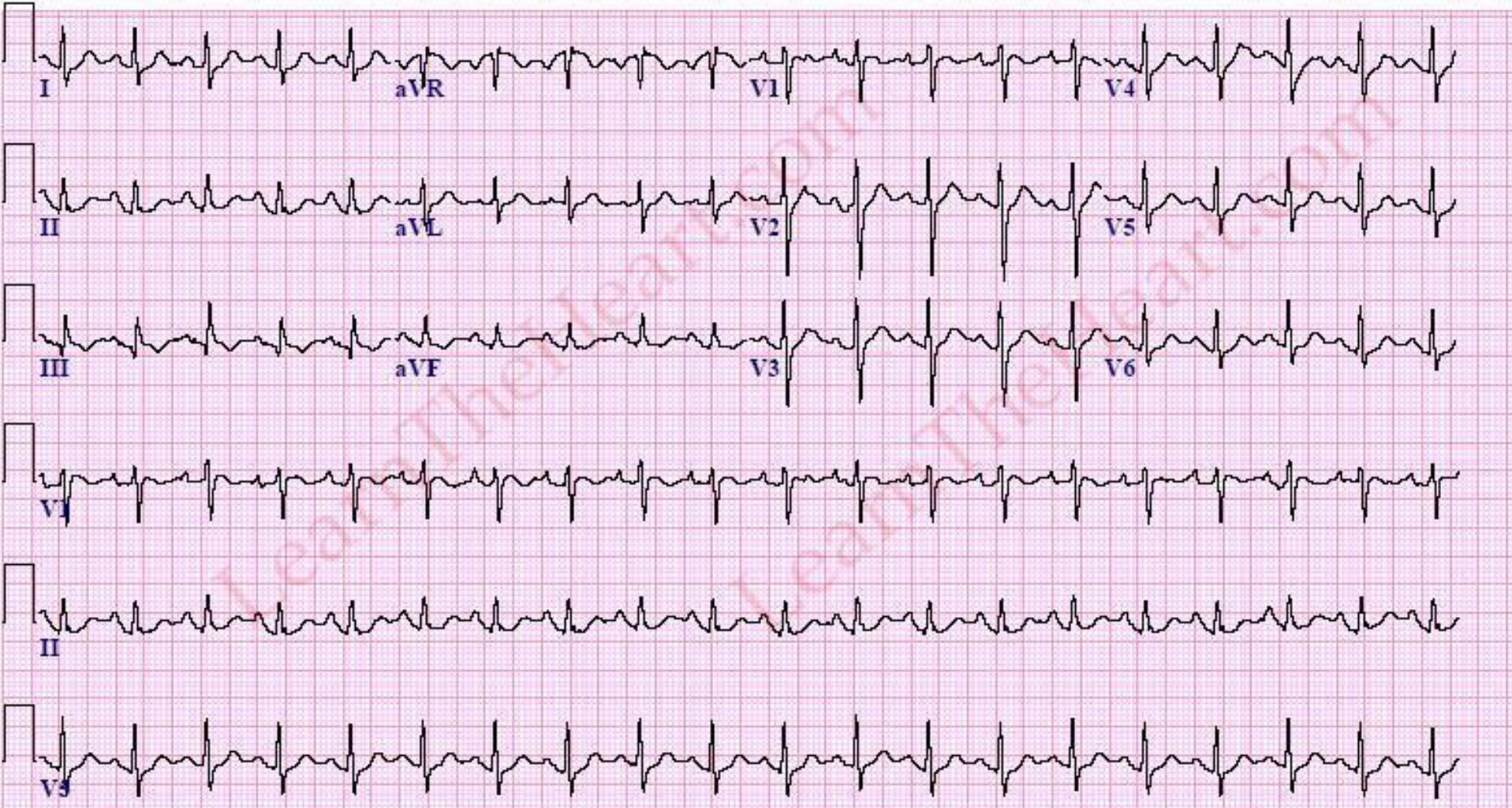


Case 7

- 75 year old recent fall and hip fracture.
- 1 week after discharge
- Shortness of breath with chest pain



Case 7

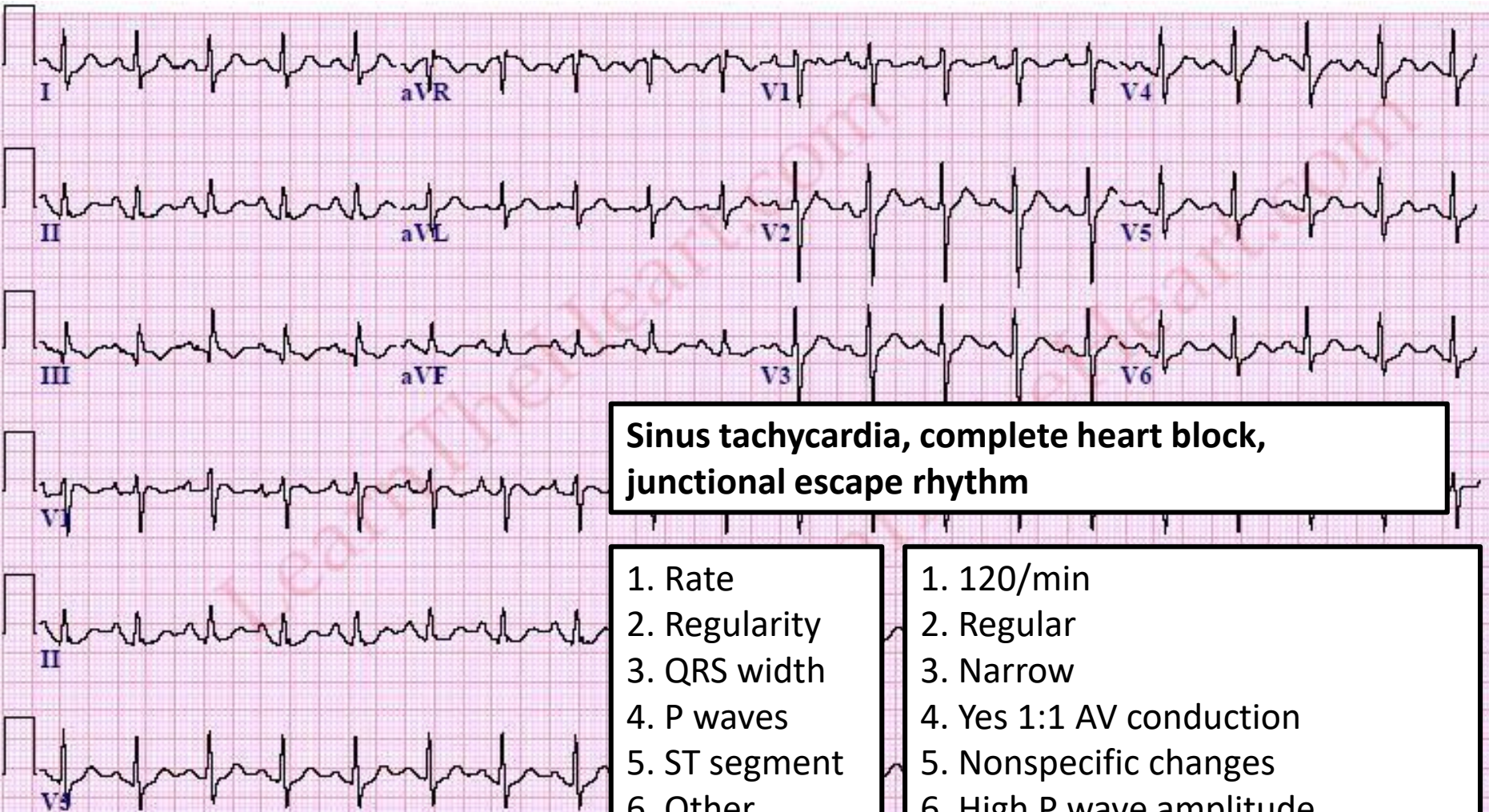


What is the most likely cause sudden deterioration?

- 1. Acute Myocardial Infarction
- 2. Acute Pulmonary Embolism
- 3. Emphysema
- 4. Supraventricular Tachycardia



Case 7



**Sinus tachycardia, complete heart block,
junctional escape rhythm**

1. Rate
2. Regularity
3. QRS width
4. P waves
5. ST segment
6. Other

1. 120/min
2. Regular
3. Narrow
4. Yes 1:1 AV conduction
5. Nonspecific changes
6. High P wave amplitude

What is the most likely cause of patient in case 8's sudden deterioration

- 1. Acute Myocardial Infarction
- **2. Acute Pulmonary Embolism**
- 3. Emphysema
- 4. Supraventricular Tachycardia



Case 8. 40 year old male

- Palpitations and (near)syncope



3/09/2018 5:55:51 PM

SINUS TACHYCARDIA WITH FREQUENT VENTRICULAR PREMATURE COMPLEXES
ABNORMAL RHYTHM ECG

DOB 02/04/1963

AGE 55 yr

Vent rate: 117 BPM

PR int: 166 ms

QRS dur: 94 ms

QT/QTc: 403/472 ms

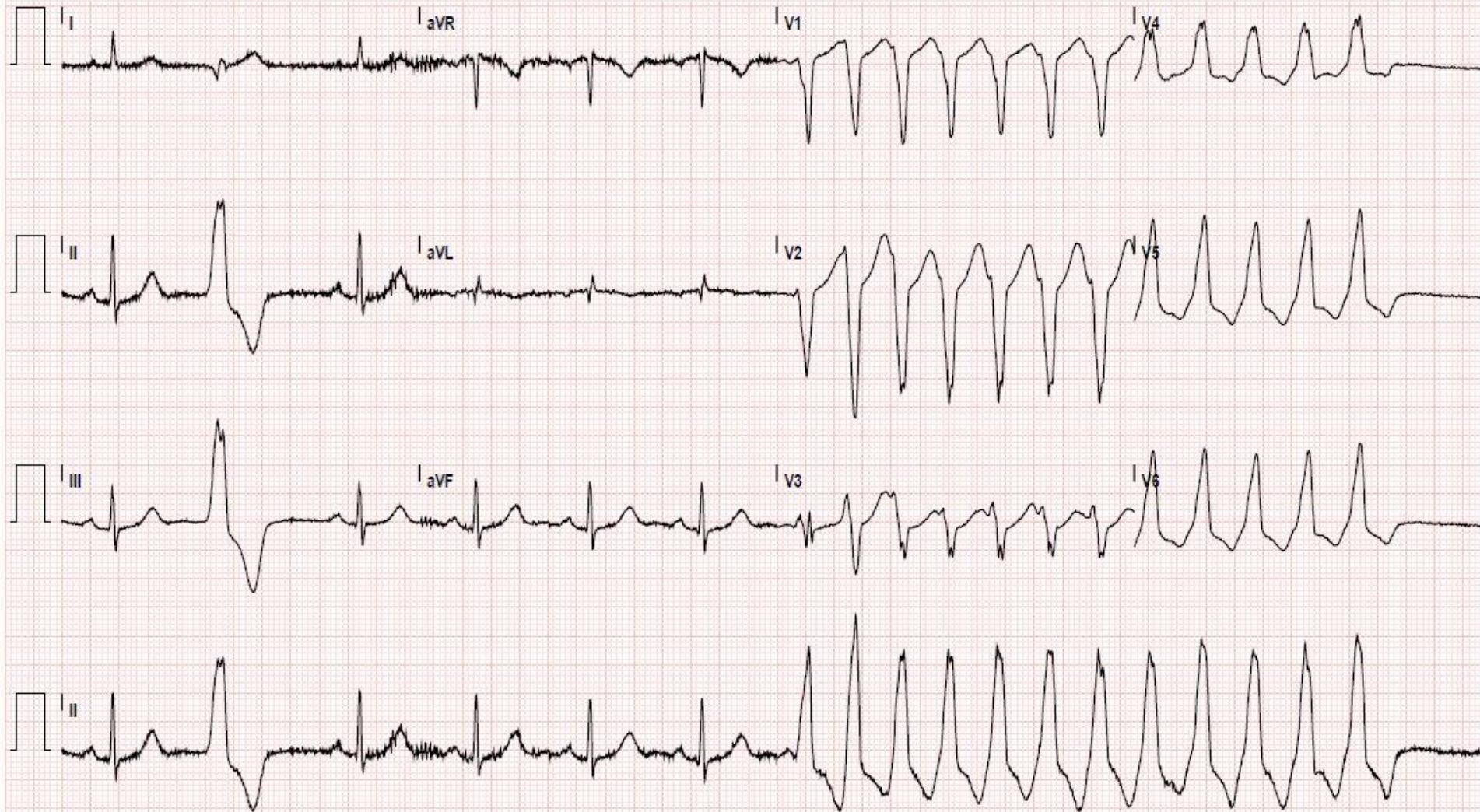
P-R-T axes: 73 49 75

UNCONFIRMED REPORT

LOC

WARD

COMMENT



3/09/2018 5:55:51 PM

SINUS TACHYCARDIA WITH FREQUENT VENTRICULAR PREMATURE COMPLEXES
ABNORMAL RHYTHM ECG

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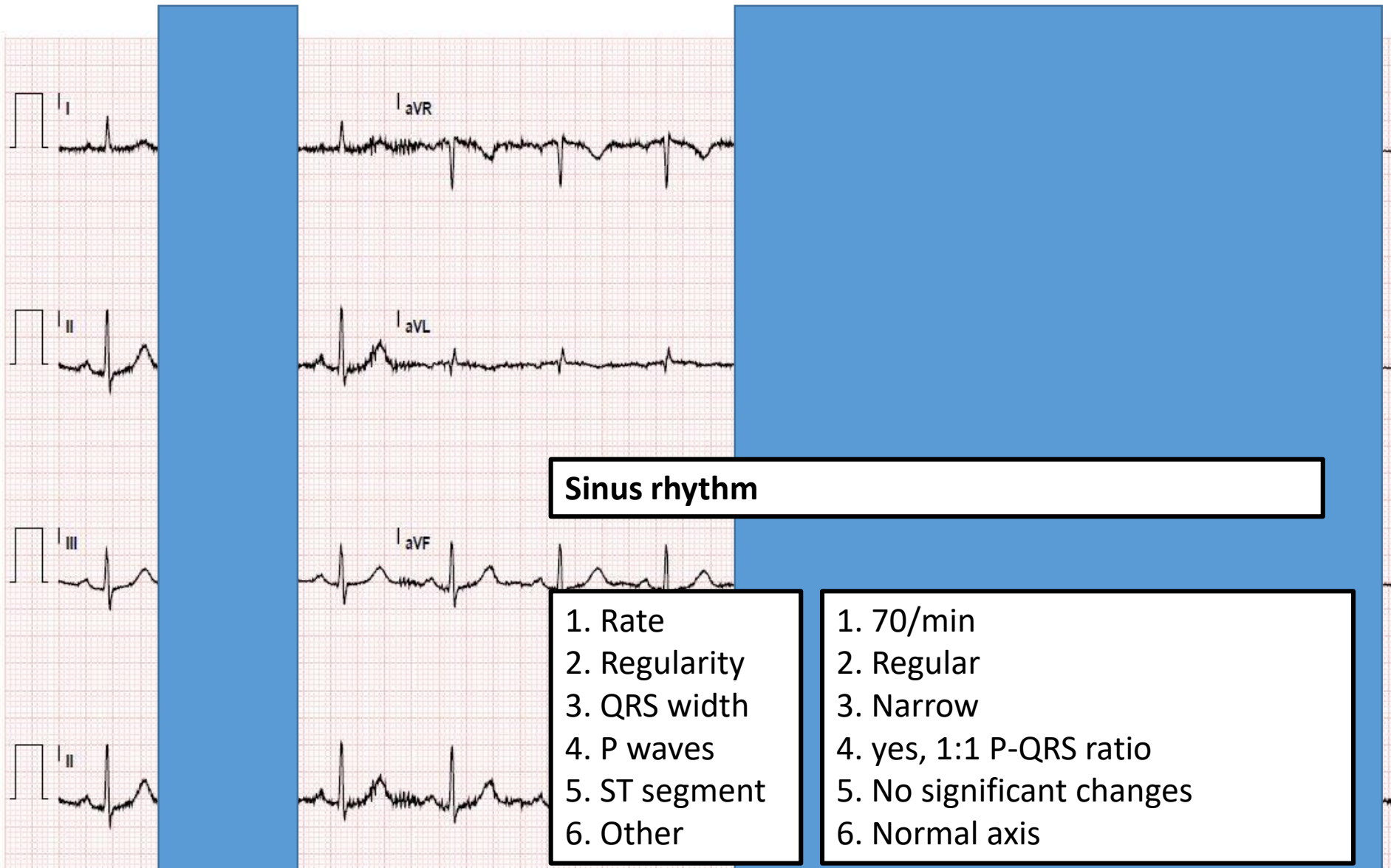
UNCONFIRMED REPORT

LOC

TECH

WARD

COMMENT



Sinus rhythm

1. Rate
2. Regularity
3. QRS width
4. P waves
5. ST segment
6. Other

1. 70/min
2. Regular
3. Narrow
4. yes, 1:1 P-QRS ratio
5. No significant changes
6. Normal axis

3/09/2018 5:55:51 PM

SINUS TACHYCARDIA WITH FREQUENT VENTRICULAR PREMATURE COMPLEXES
ABNORMAL RHYTHM ECG

DOB 02/04/1963

AGE 55 yr

Vent rate: 117 BPM

PR int: 166 ms

QRS dur: 94 ms

QT/QTc: 403/472 ms

P-R-T axes: 73 49 75

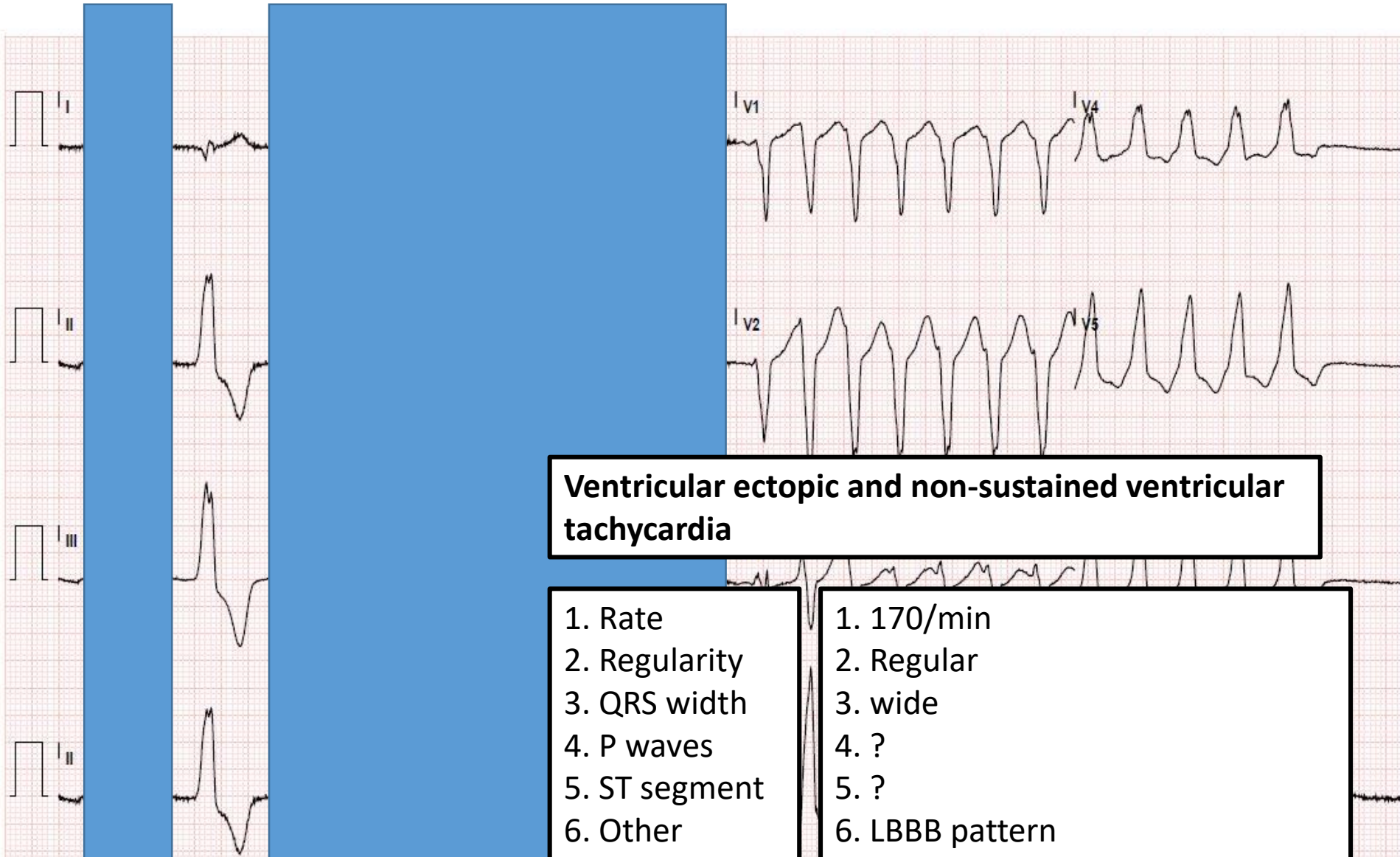
UNCONFIRMED REPORT

LOC

TECH

WARD

COMMENT



Ventricular ectopic and non-sustained ventricular tachycardia

- 1. Rate
- 2. Regularity
- 3. QRS width
- 4. P waves
- 5. ST segment
- 6. Other

- 1. 170/min
- 2. Regular
- 3. wide
- 4. ?
- 5. ?
- 6. LBBB pattern

3/09/2018 5:55:51 PM

SINUS TACHYCARDIA WITH FREQUENT VENTRICULAR PREMATURE COMPLEXES
ABNORMAL RHYTHM ECG

DOB 02/04/1963

AGE 55 yr

Vent rate: 117 BPM

PR int: 166 ms

QRS dur: 94 ms

QT/QTc: 403/472 ms

P-R-T axes: 73 49 75

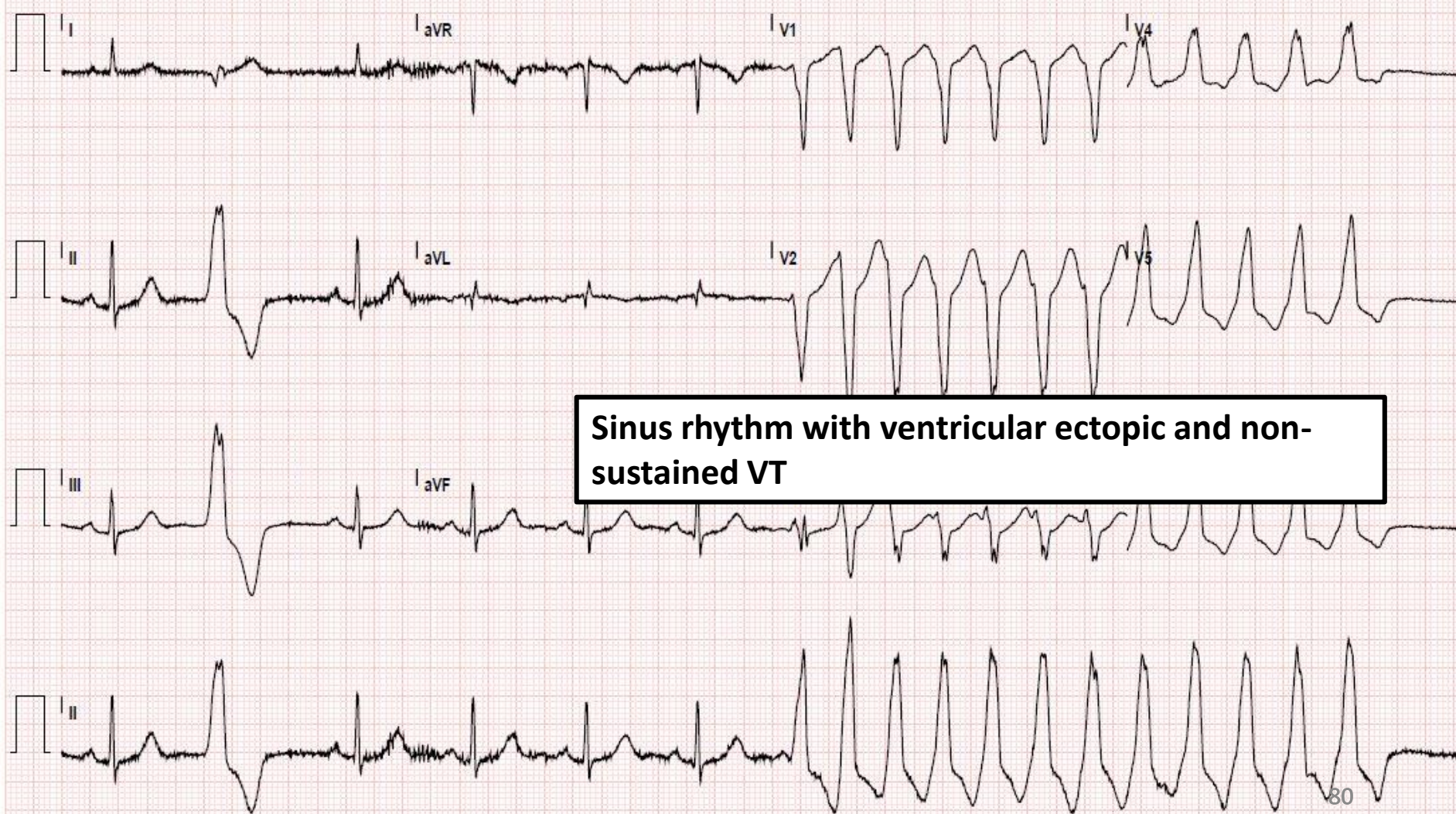
UNCONFIRMED REPORT

LOC

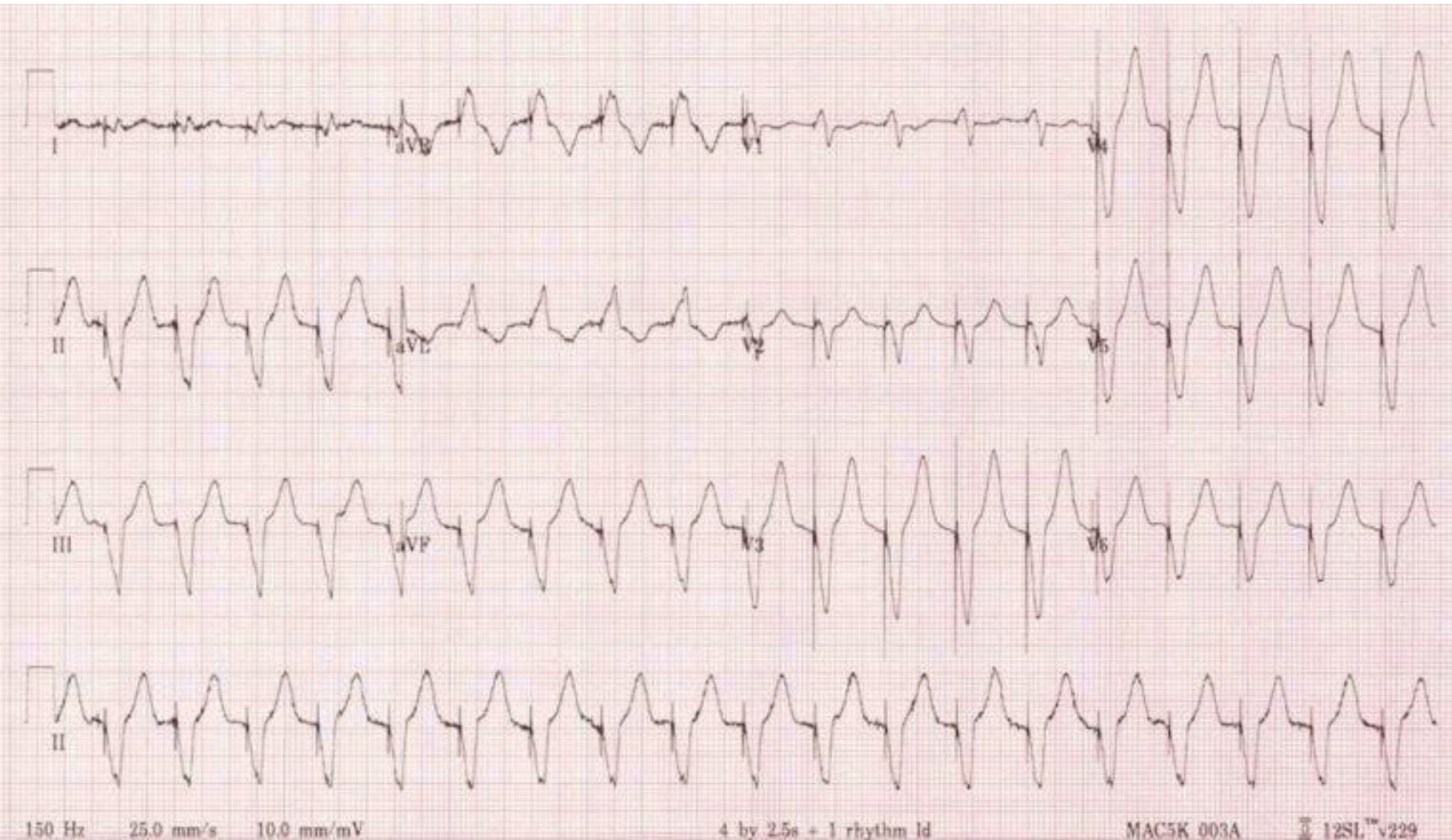
TECH

WARD

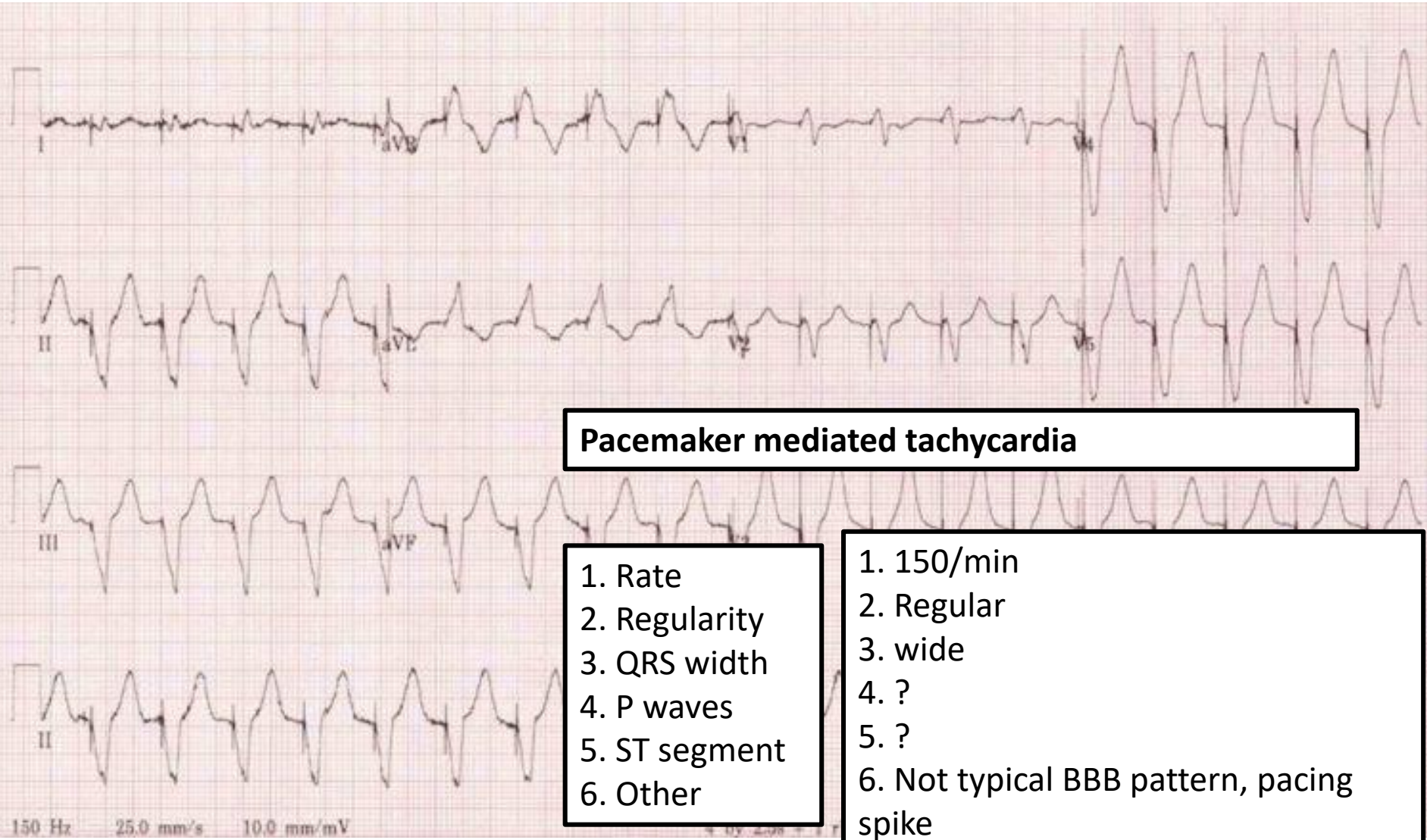
COMMENT



Case 9. 84 year old female visiting family from interstate. Palpitations



Case 9. 84 year old female visiting family from interstate. Palpitations



Pacemaker mediated tachycardia

1. Rate
2. Regularity
3. QRS width
4. P waves
5. ST segment
6. Other

1. 150/min
2. Regular
3. wide
4. ?
5. ?
6. Not typical BBB pattern, pacing spike

“wide complex tachycardia”

- Ventricular tachycardia (unless proven otherwise!)
- Supraventricular tachycardia with bundle branch block
- Supraventricular tachycardia with pre-excitation
- Paced rhythm

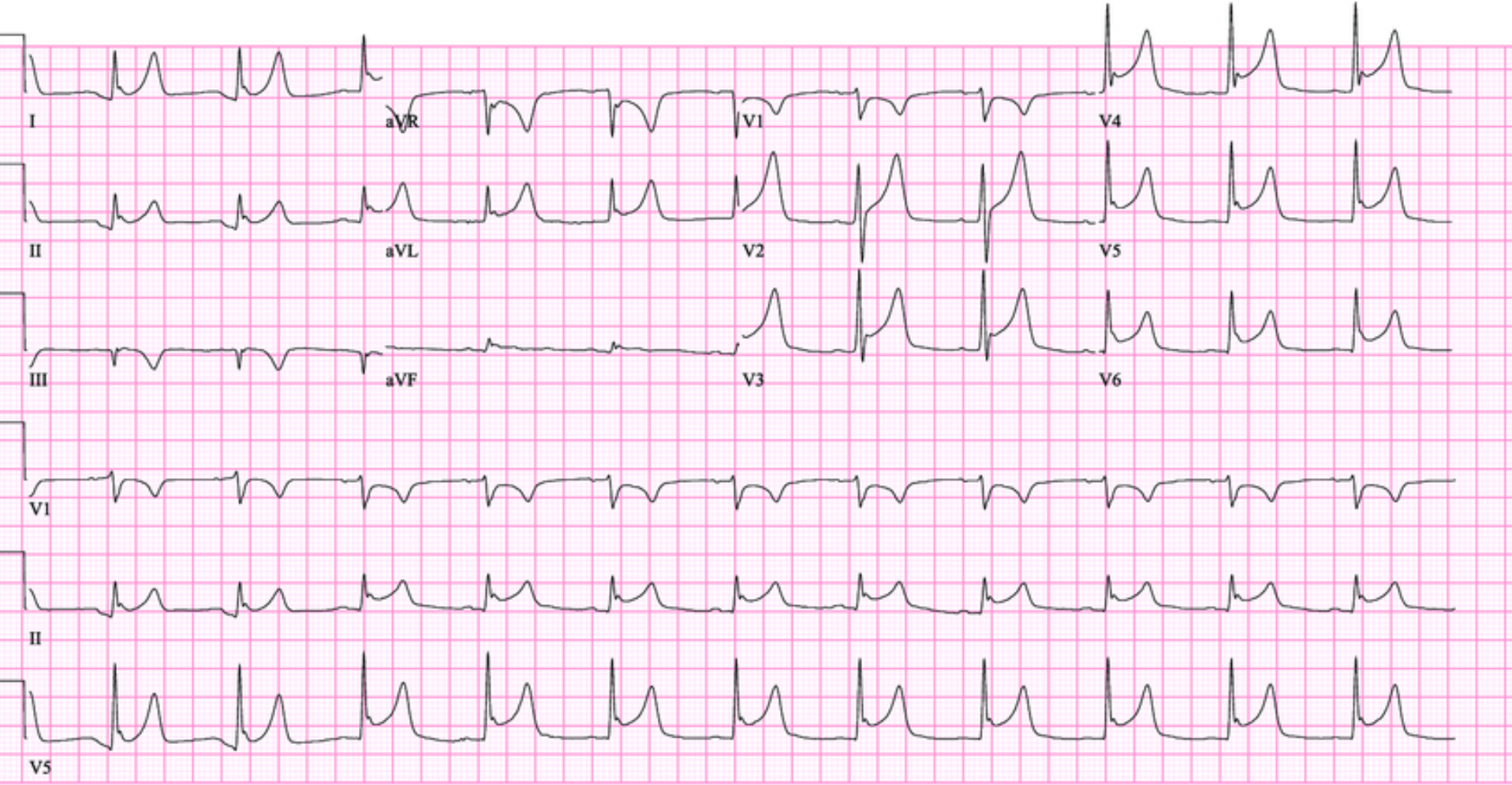


Wide complex tachycardia: VT or not VT?

- VT more likely
 - Structural cardiac abnormalities
 - Wide QRS ($>160\text{ms}$)
 - Not typical bundle branch pattern/'extreme' axis
- Various criteria/algorithms present
 - None 100% accurate
- Treat as VT until proven otherwise!



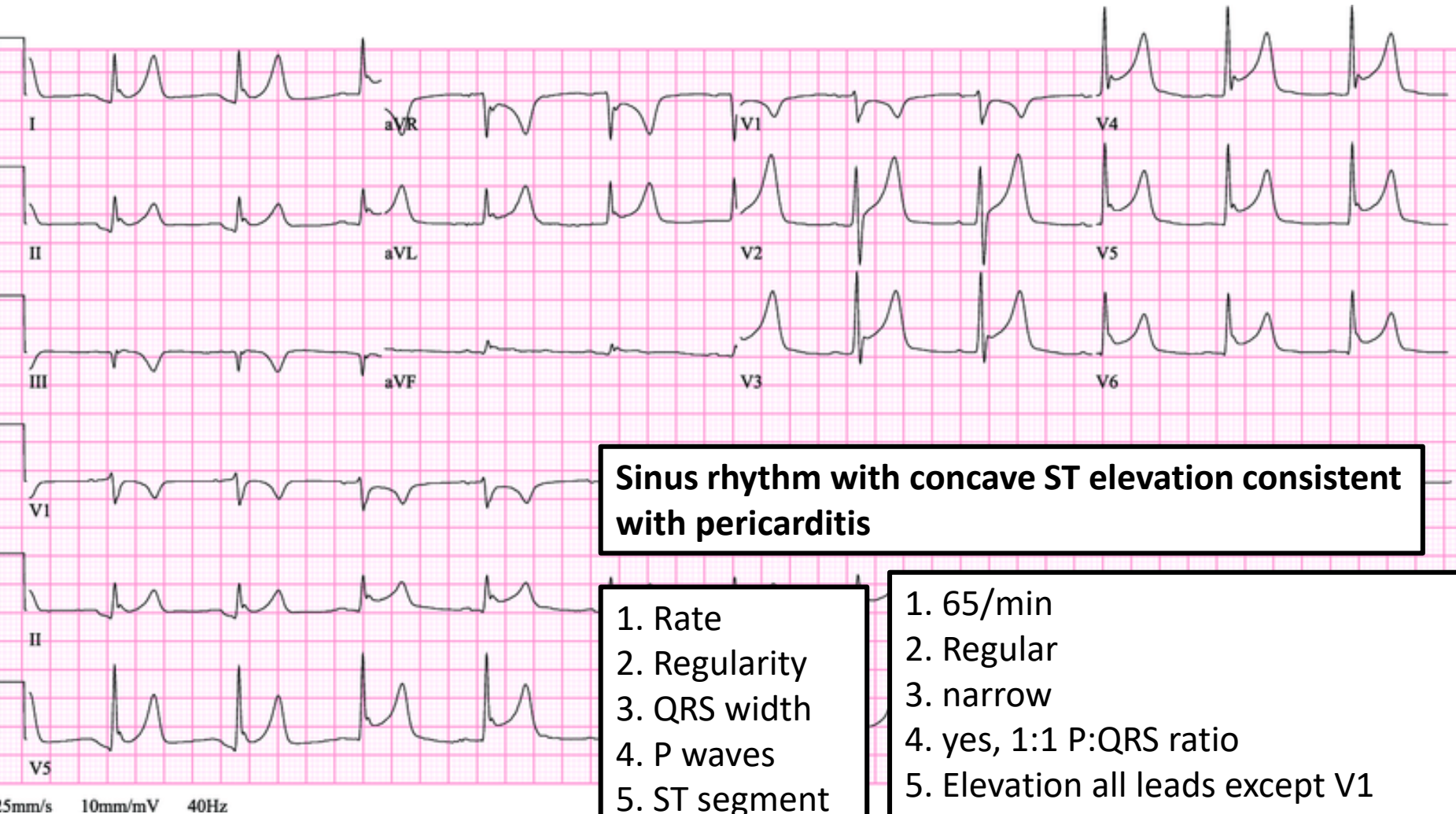
Case 10. 53 year old female, recovering from respiratory infection, continuous chest discomfort, related to breathing/position



15mm/s 10mm/mV 40Hz



Case 10. 53 year old female, recovering from respiratory infection, continuous chest discomfort, related to breathing/position

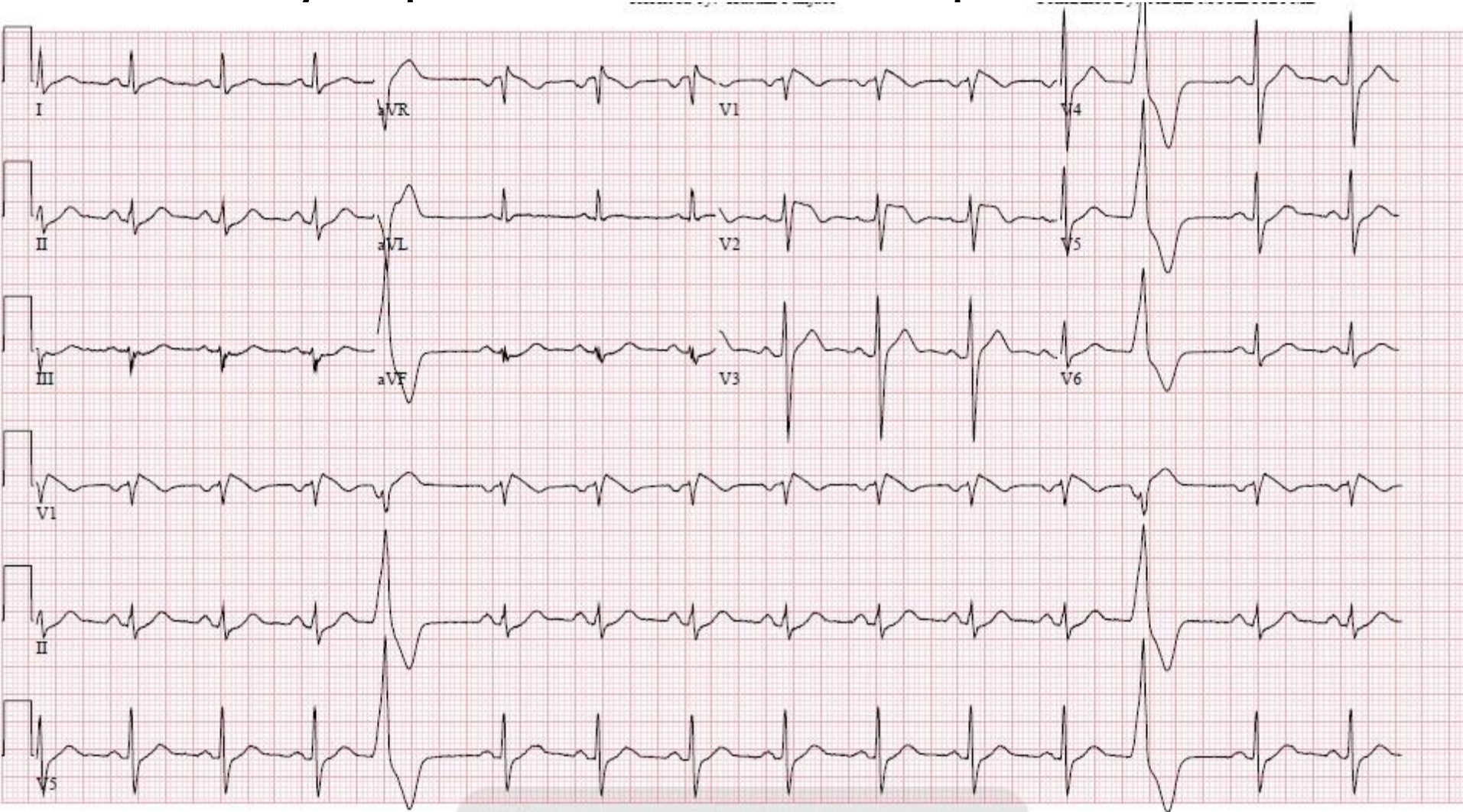


Sinus rhythm with concave ST elevation consistent with pericarditis

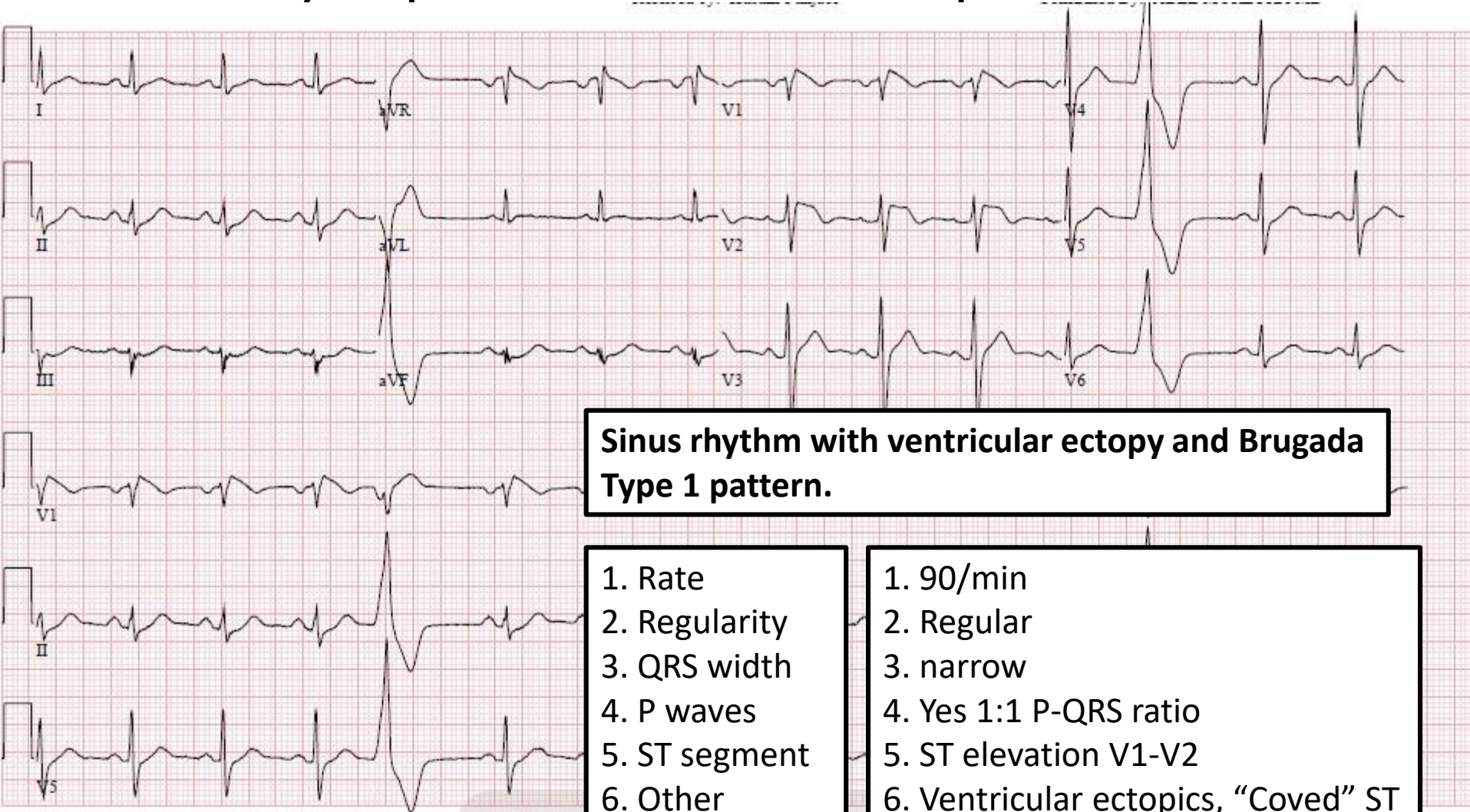
1. Rate
2. Regularity
3. QRS width
4. P waves
5. ST segment
6. Other

1. 65/min
2. Regular
3. narrow
4. yes, 1:1 P:QRS ratio
5. Elevation all leads except V1
6. PR depression in II

Case 11. 23 year old male with flu like symptoms and temp 40 C



Case 11. 23 year old male with flu like symptoms and temp 40 C



Sinus rhythm with ventricular ectopy and Brugada Type 1 pattern.

1. Rate
2. Regularity
3. QRS width
4. P waves
5. ST segment
6. Other

1. 90/min
2. Regular
3. narrow
4. Yes 1:1 P-QRS ratio
5. ST elevation V1-V2
6. Ventricular ectopics, "Coved" ST elevation