



# ECG- recognition of cardiac arrhythmias in primary care

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# Outline of presentation

- **Refresher of basics in ECG interpretation**
- **Common ECG abnormalities seen in primary care**
- **ECG interpretation of arrhythmias and initial management**
- **Case studies**

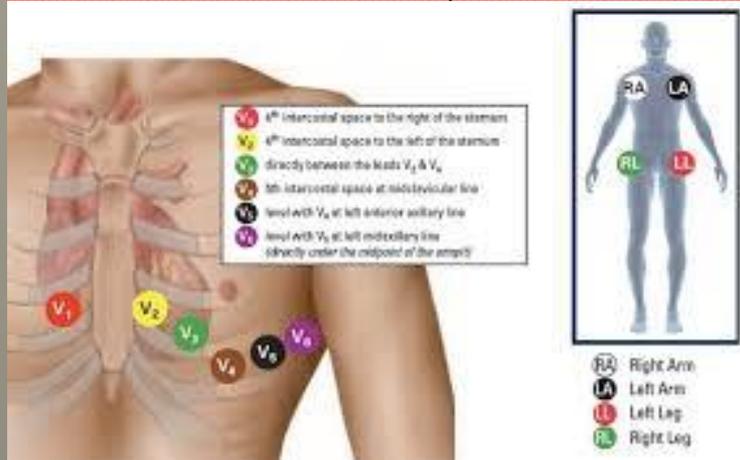
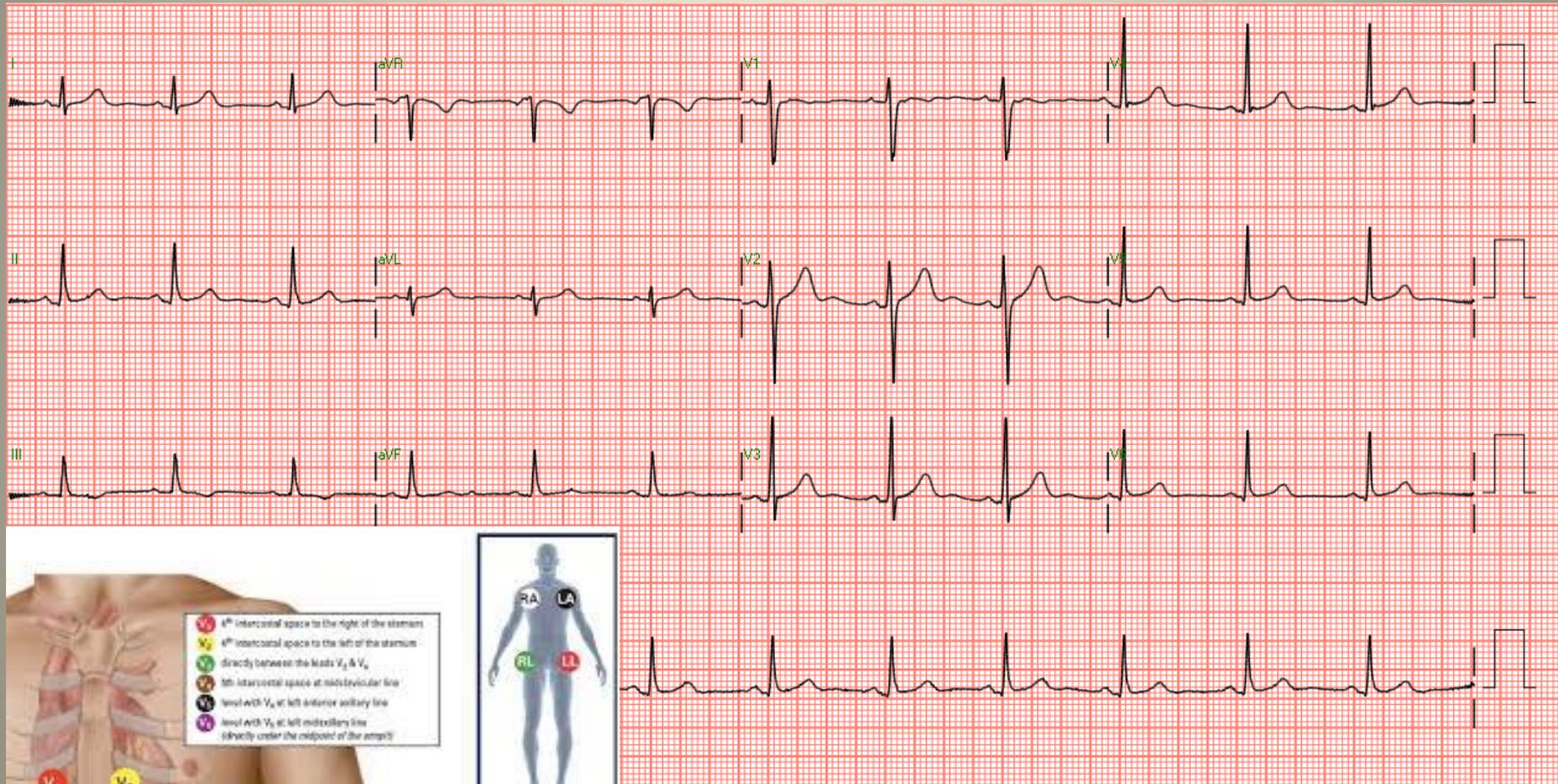


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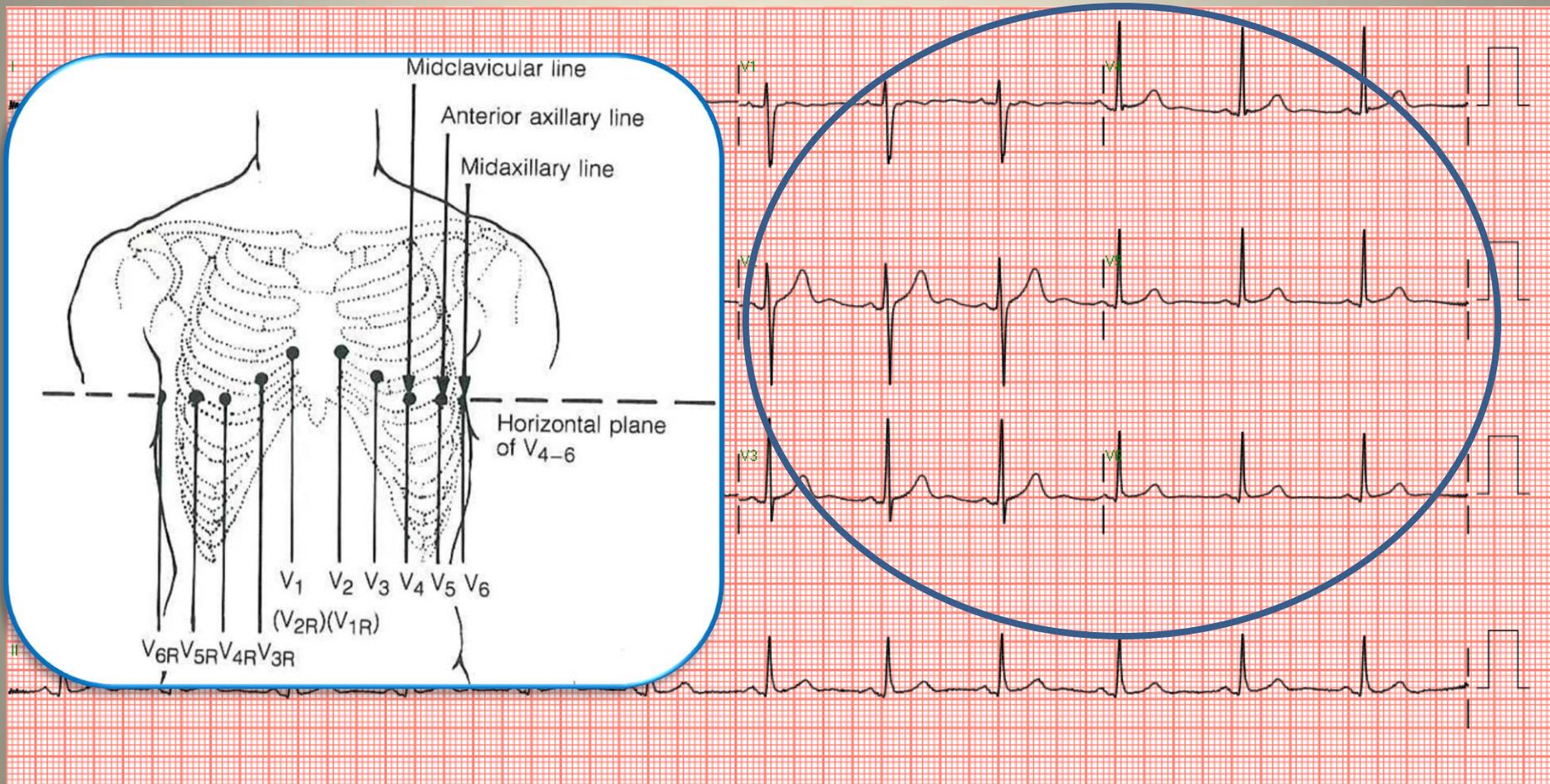
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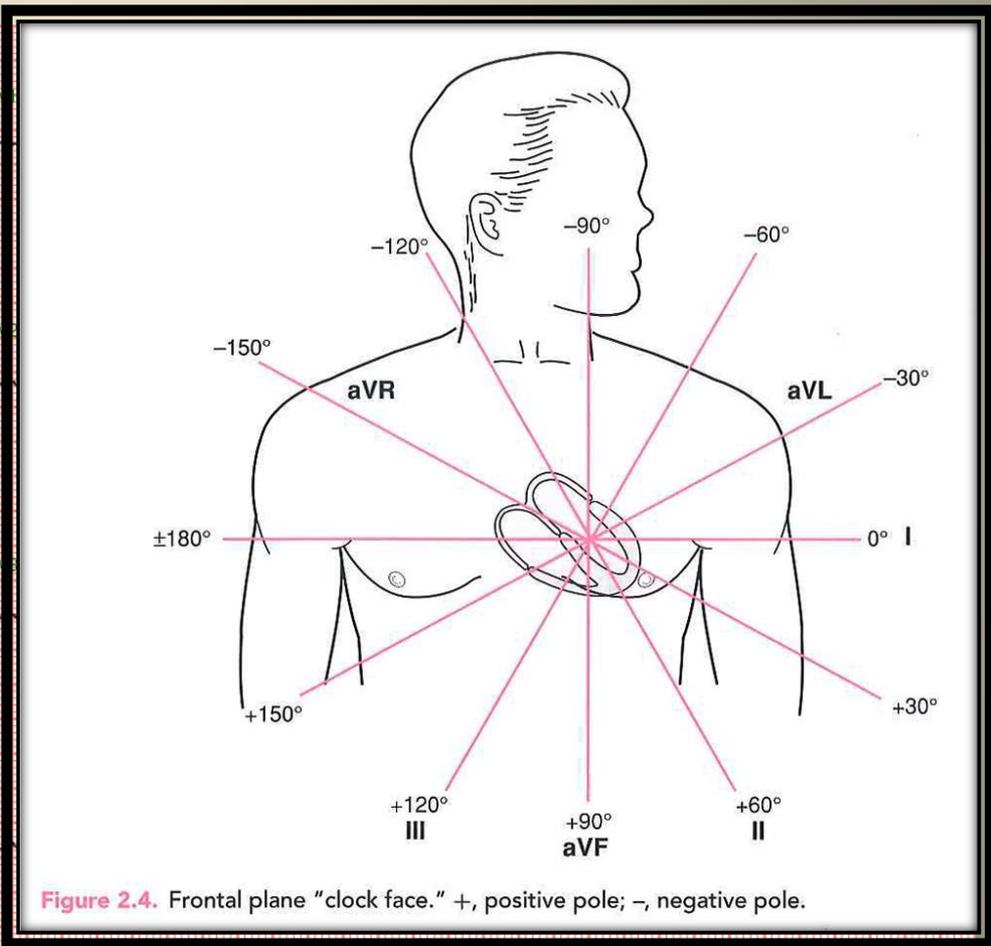
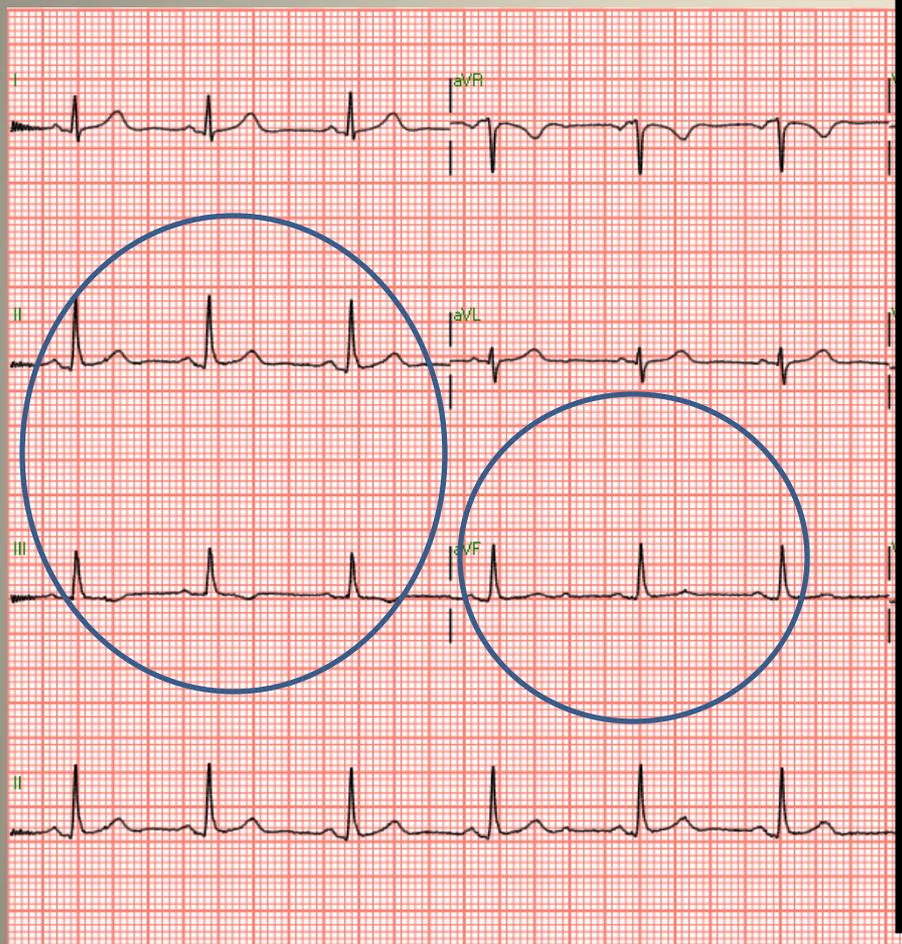
# The Standard 12-lead ECG



# “Anterior+Lateral Leads”

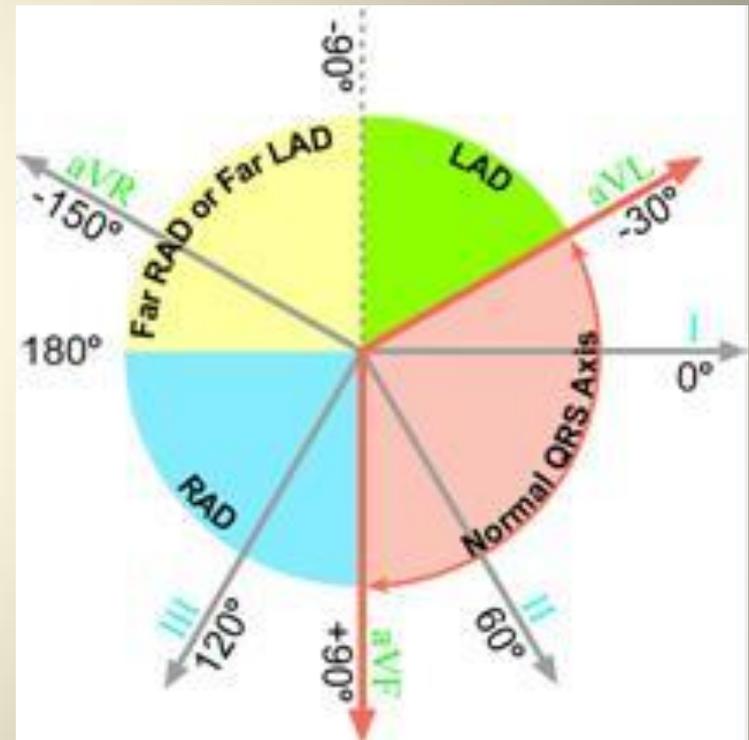
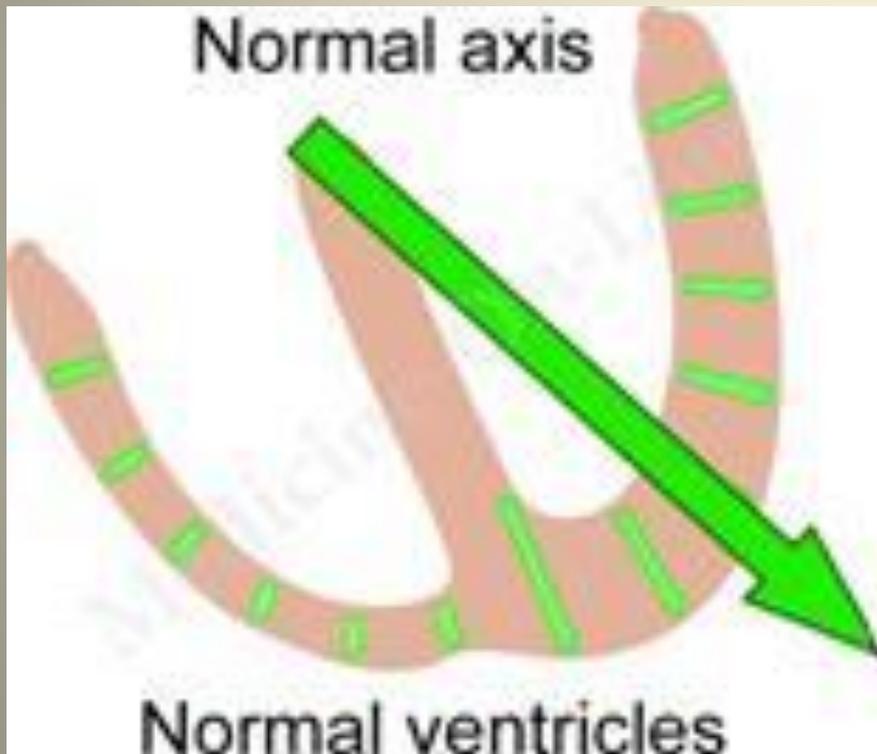


# “Inferior Leads”



# QRS Axis (Electrical Axis)

Average of all the instantaneous mean electrical vectors occurring sequentially during vent. depolarisation



# Heart Rate

**Reciprocal of time interval between two successive heart beats**

- Standard paper speed is 25 mm/s
- Therefore 25 small squares (25mm) or 5 big squares = 1 second
- No. of big squares in 1 min is  $5 \times 60 = 300$
- Heart rate = number of heart beats (QRS complexes) per minute
- R-R interval = [No. of big squares/5] secs
- In 1 sec the no. heart beats = [5/No. of big squares]
- Therefore, no. of heart beats in 1 min, i.e. heart rate =  $[(60 \times 5) / \text{No. of big squares}]$

**Heart Rate =  
 $300 \div (\text{Number of big square between two R waves})$**



**Ventricular  
rate ~  $300 / 5$   
~ 60 bpm**

# WIDTH of the QRS complex

- Normally < 120 ms (3 small squares)
- Causes of prolonged QRS duration:
  - bundle branch block
  - ventricular ectopic beats
  - Presence of accessory pathway (abnormal atrioventricular connection)

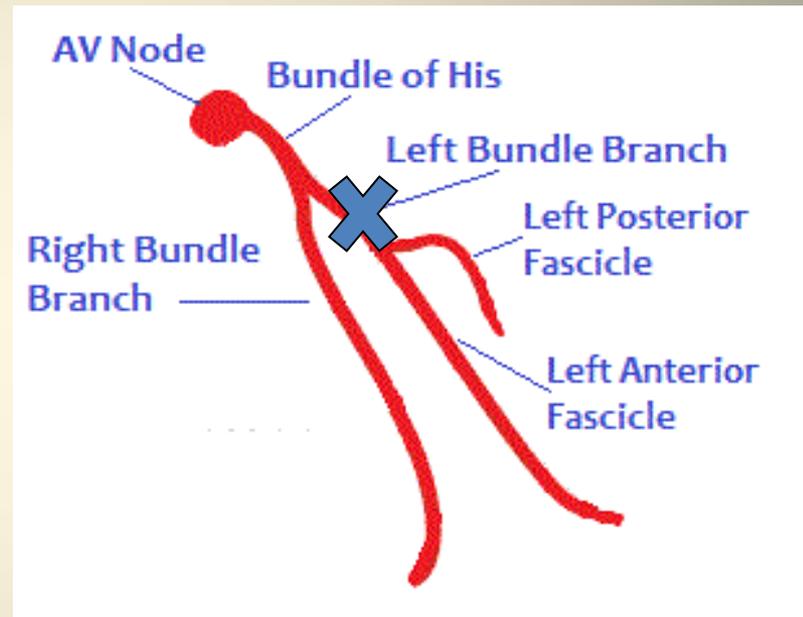
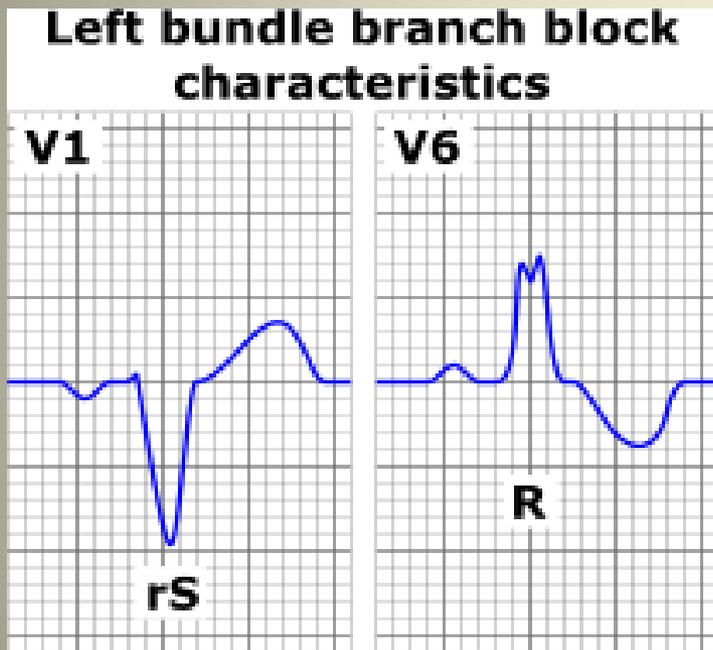


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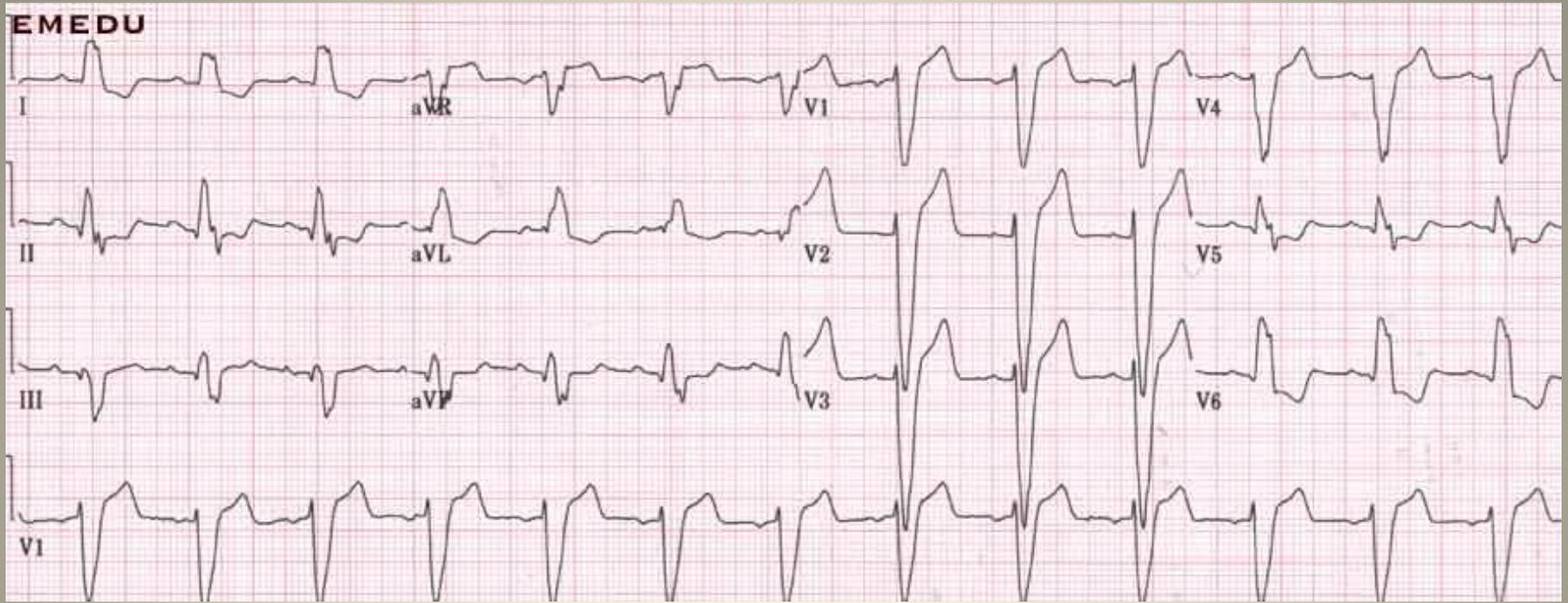


# Left bundle branch block (LBBB)



Easy way to remember – “WILLIAM”  
V1 looks like a W in LBBB and V6 looks like an M

# LBBB

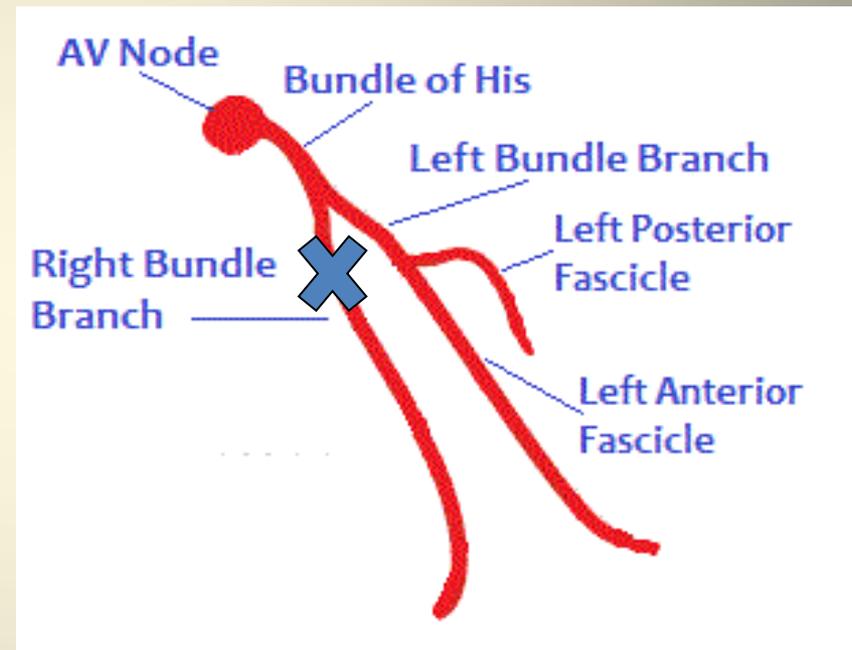
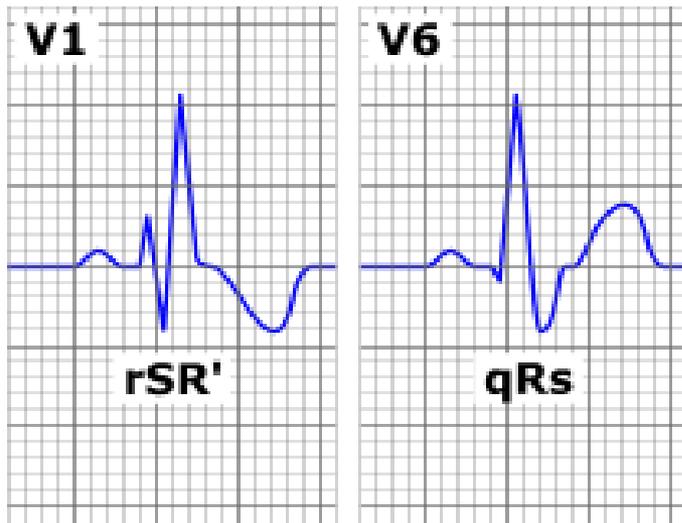


The ECG criteria for a left bundle branch block (LBBB) include:

1. QRS duration of  $> 120$  milliseconds.
2. Absence of Q wave in leads I, V5, and V6.
3. ST and T wave displacement opposite to the major deflection of the QRS complex.

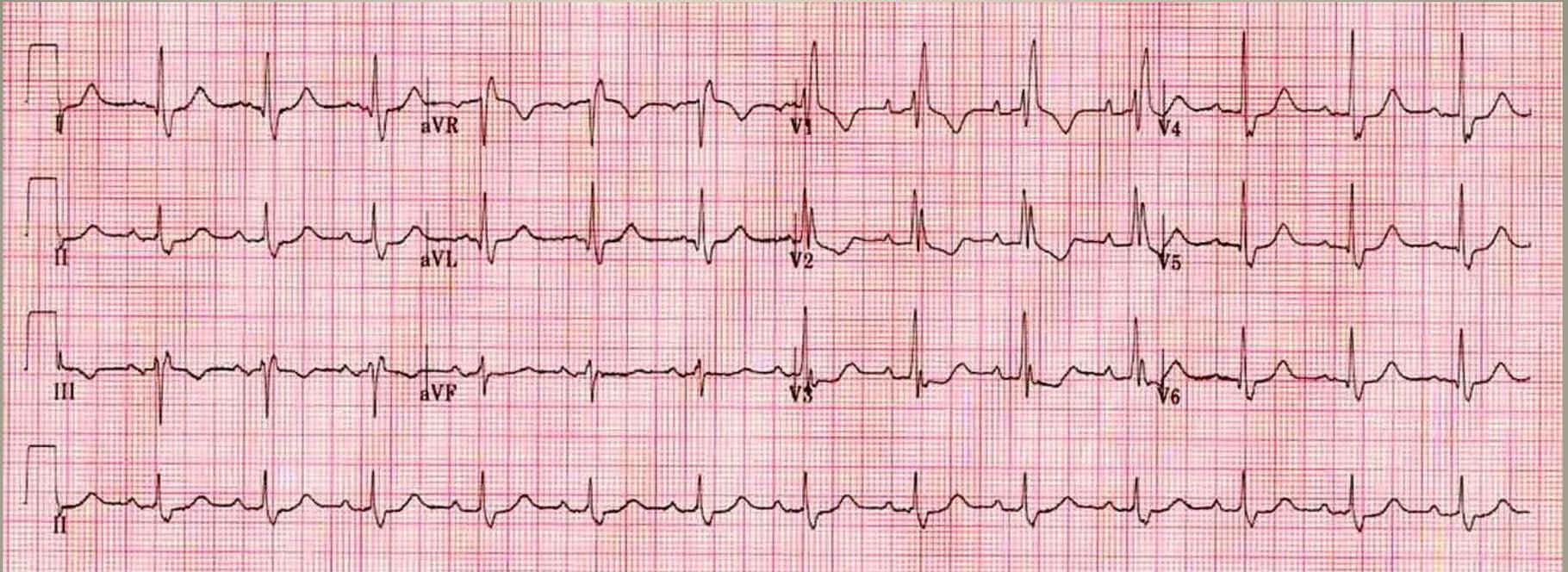
# Right bundle branch block (RBBB)

## Right bundle branch block characteristics



Easy way to remember – “MARROW”  
V1 looks like a M in RBBB and V6 looks like an W

# RBBB



The ECG criteria for a right bundle branch block include:

1. QRS duration of  $> 120$  milliseconds
2. rsR' "bunny ear" pattern in precordial leads
3. Slurred S waves in leads I, aVL and frequently V5 and V6.

# ECG criteria for left ventricular hypertrophy (LVH)

## The Sokolow-Lyon index:

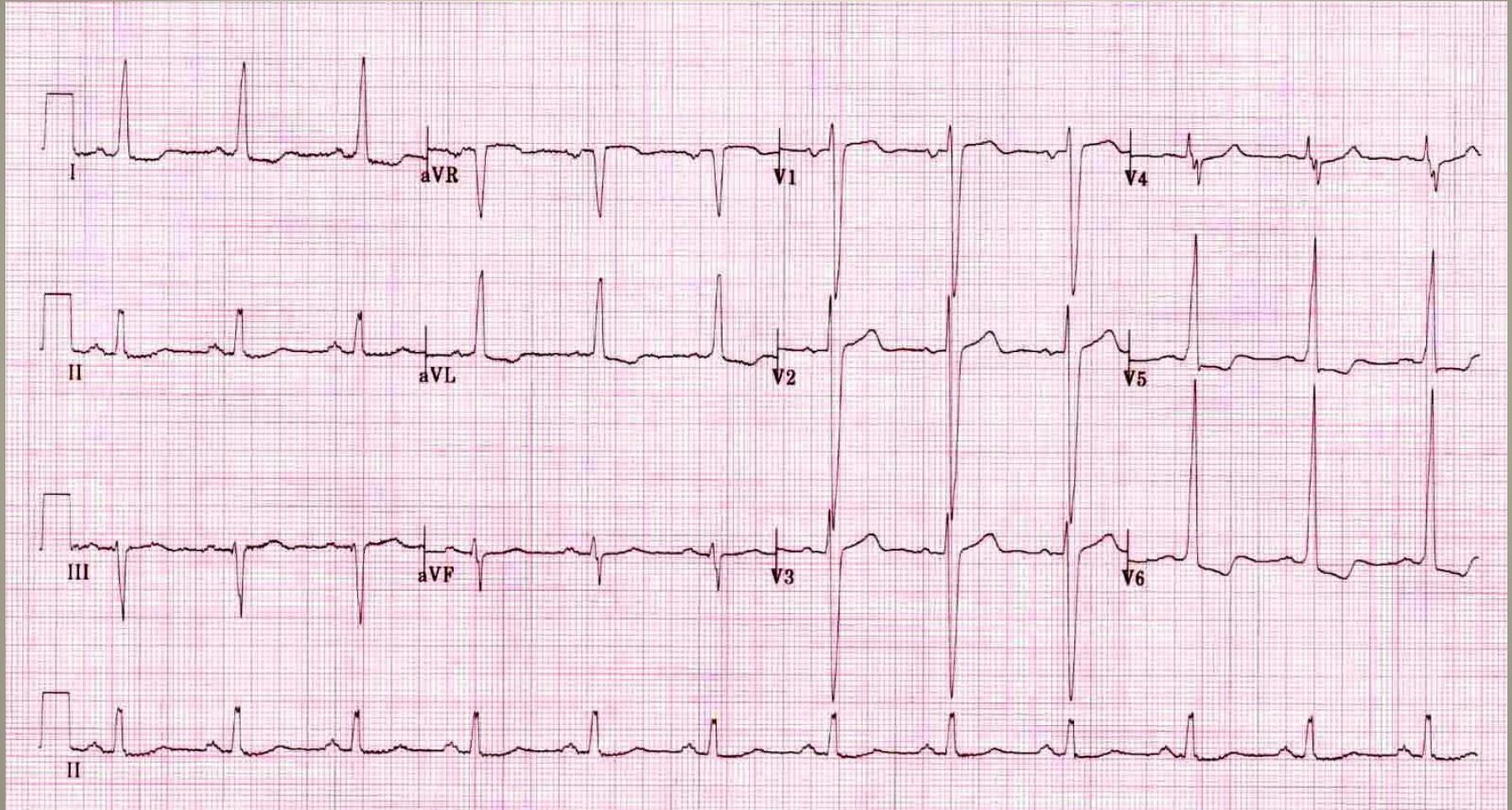
- $S$  in  $V_1$  +  $R$  in  $V_5$  or  $V_6$  (whichever is larger)  $\geq$  35 mm ( $\geq$  7 large squares)
- $R$  in  $aVL$   $\geq$  11 mm

## The Cornell voltage criteria:

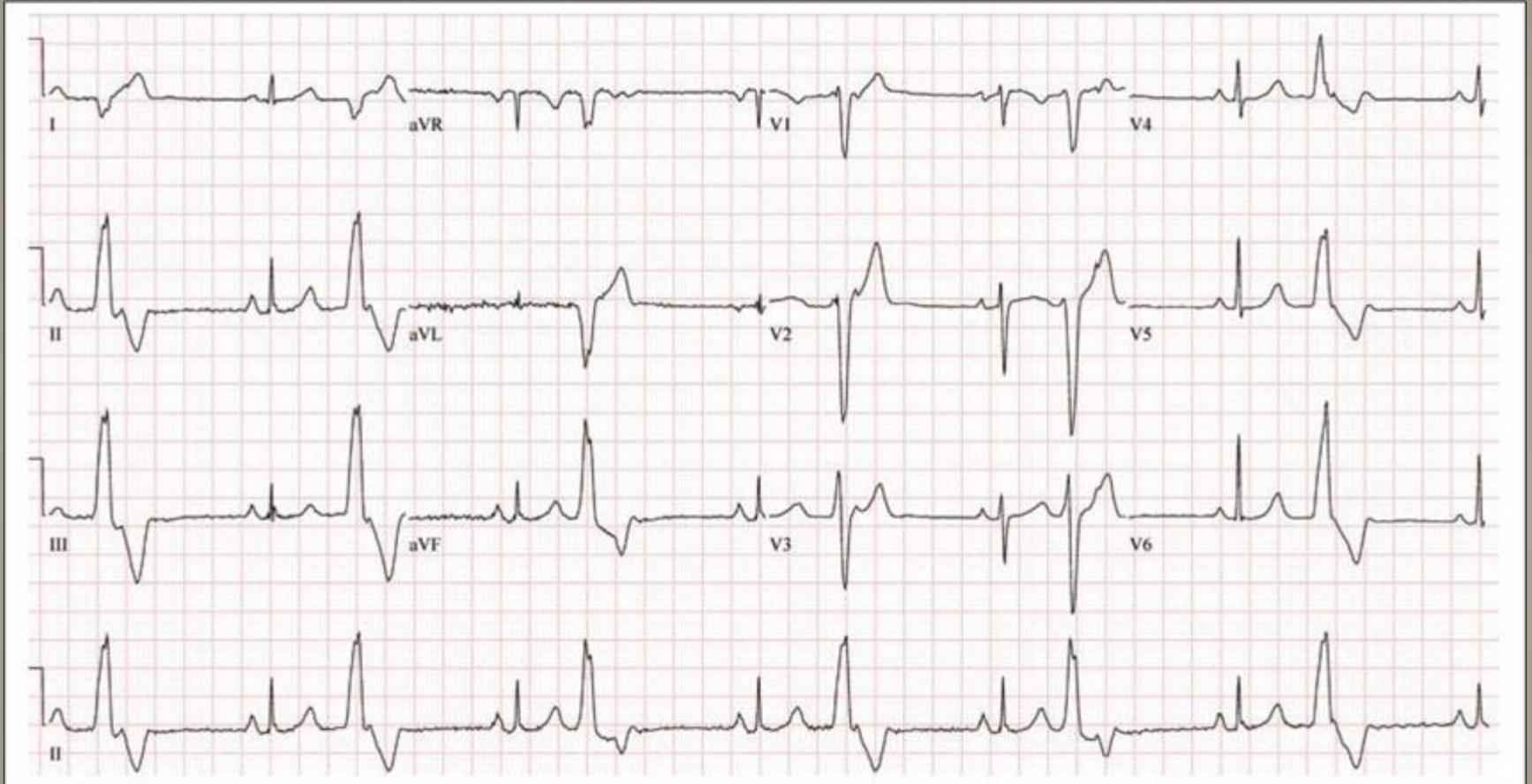
- Involves measurement of the sum of the R wave in lead  $aVL$  and the S wave in lead  $V_3$
- $S$  in  $V_3$  +  $R$  in  $aVL$   $>$  28 mm (men)
- $S$  in  $V_3$  +  $R$  in  $aVL$   $>$  20 mm (women)



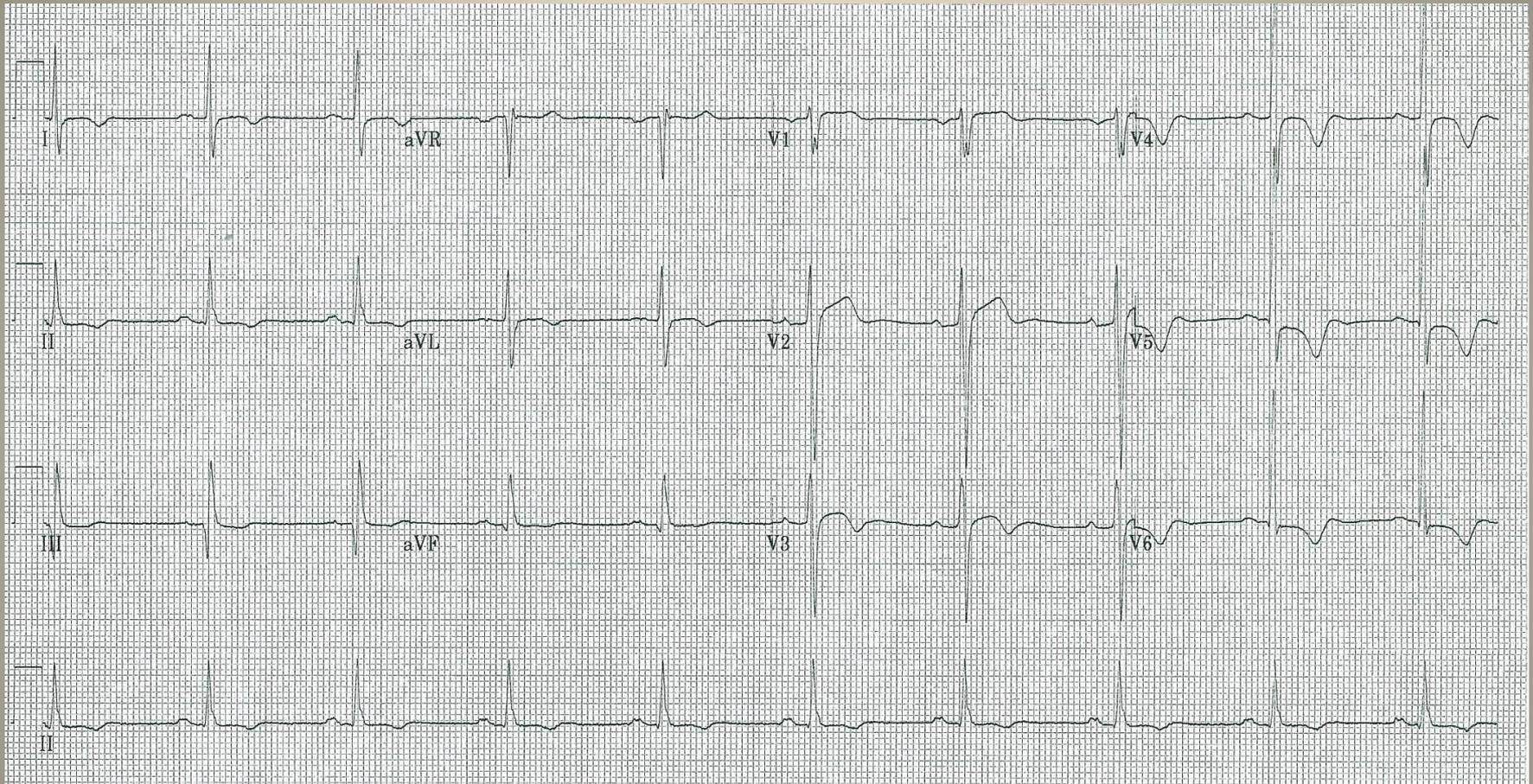
# LVH on ECG



# RVOT ectopics



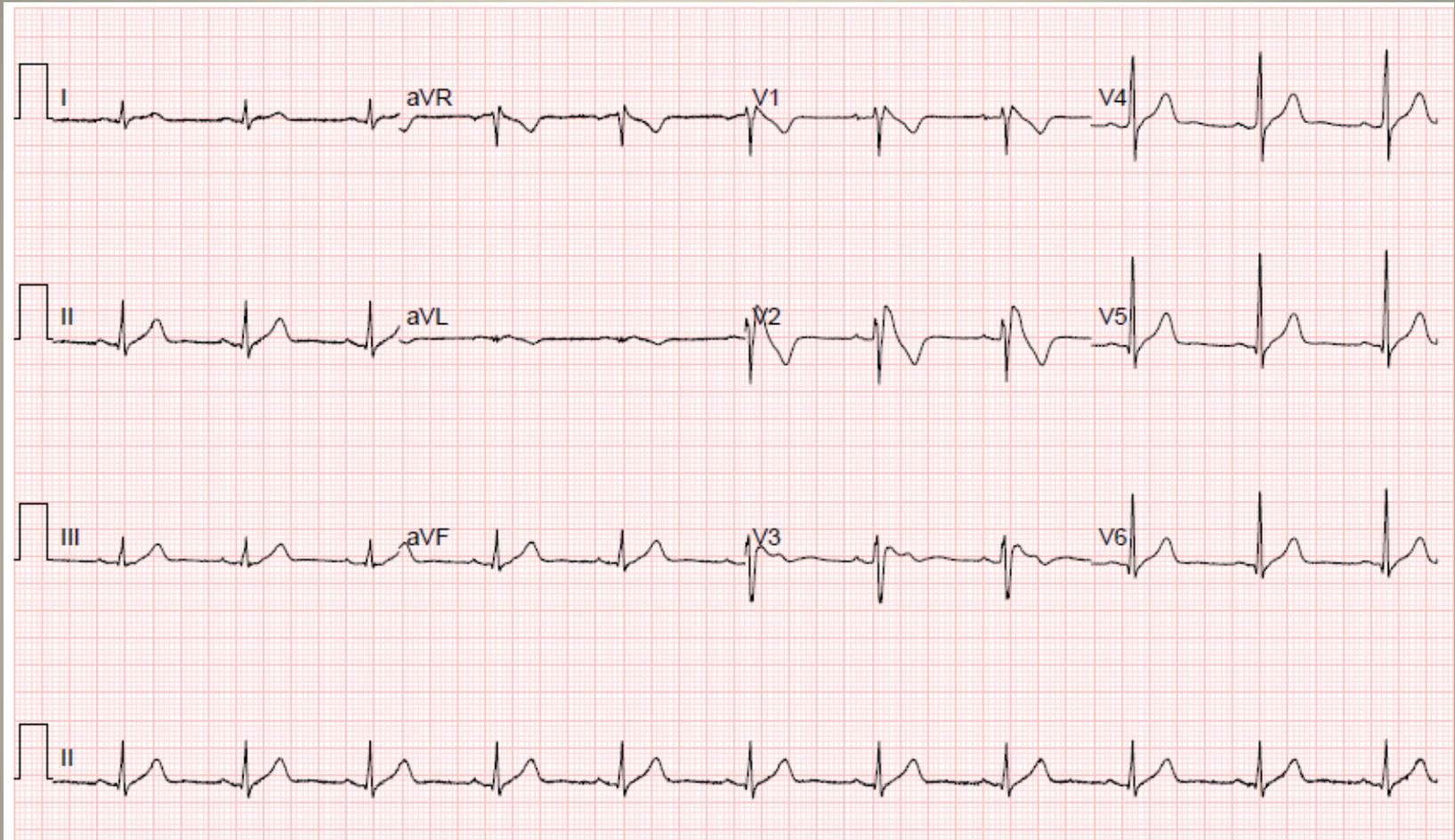
# Abnormal ventricular repolarization



- 51 year old man- routine ECG pre-cataract surgery
- No symptoms or cardiac history; not hypertensive
- Father died suddenly in his 40s

Likely diagnosis:  
Hypertrophic cardiomyopathy

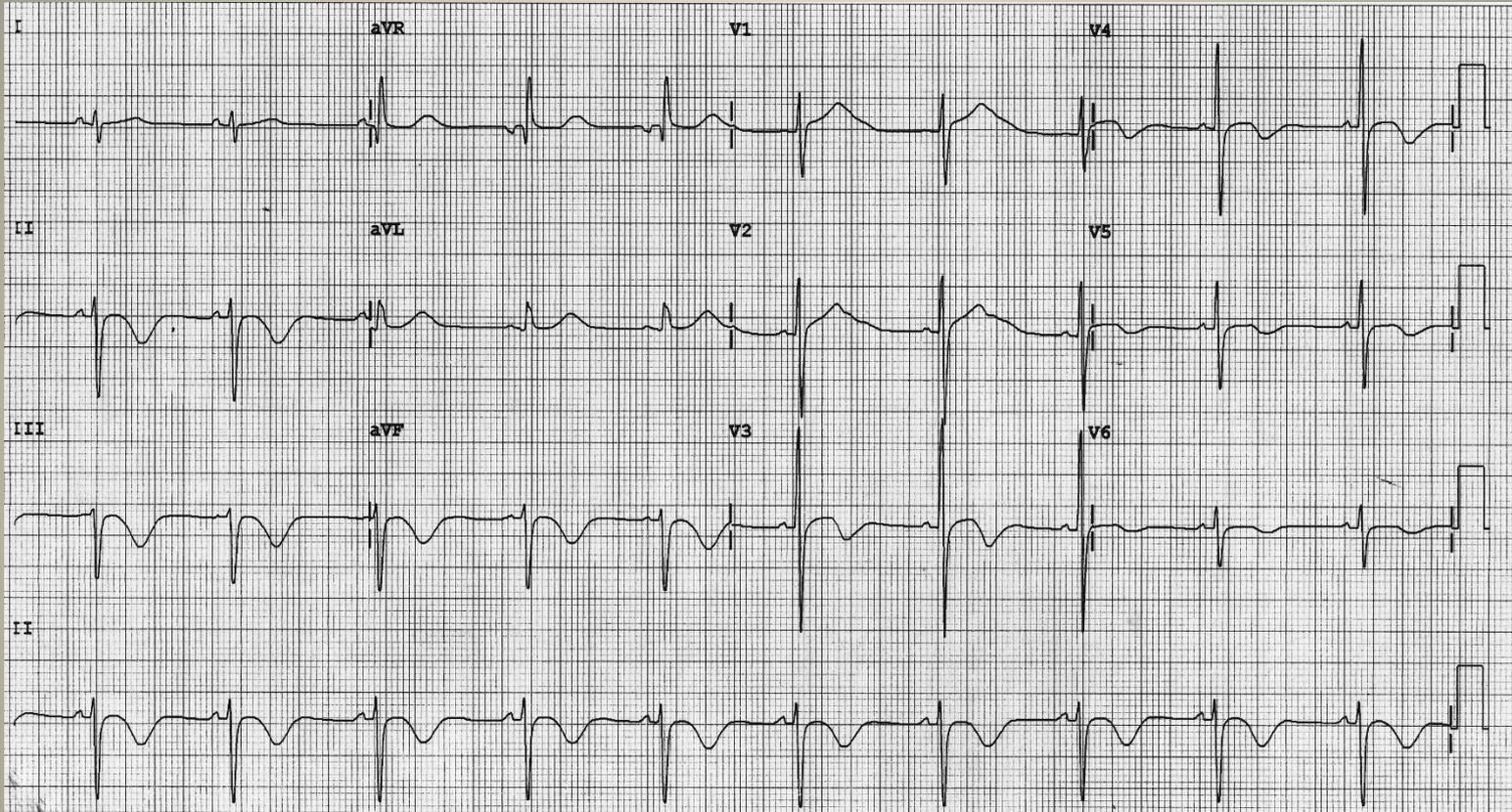
# Brugada syndrome



- Asymptomatic 44 year old man; routine ECG
- Uncle and father died suddenly in 40s

Will require further risk stratification for VF

# Long QT interval



- 15 year old boy with history of nocturnal “seizures”
- QTc prolonged (580ms; normal is 360 - 440ms)

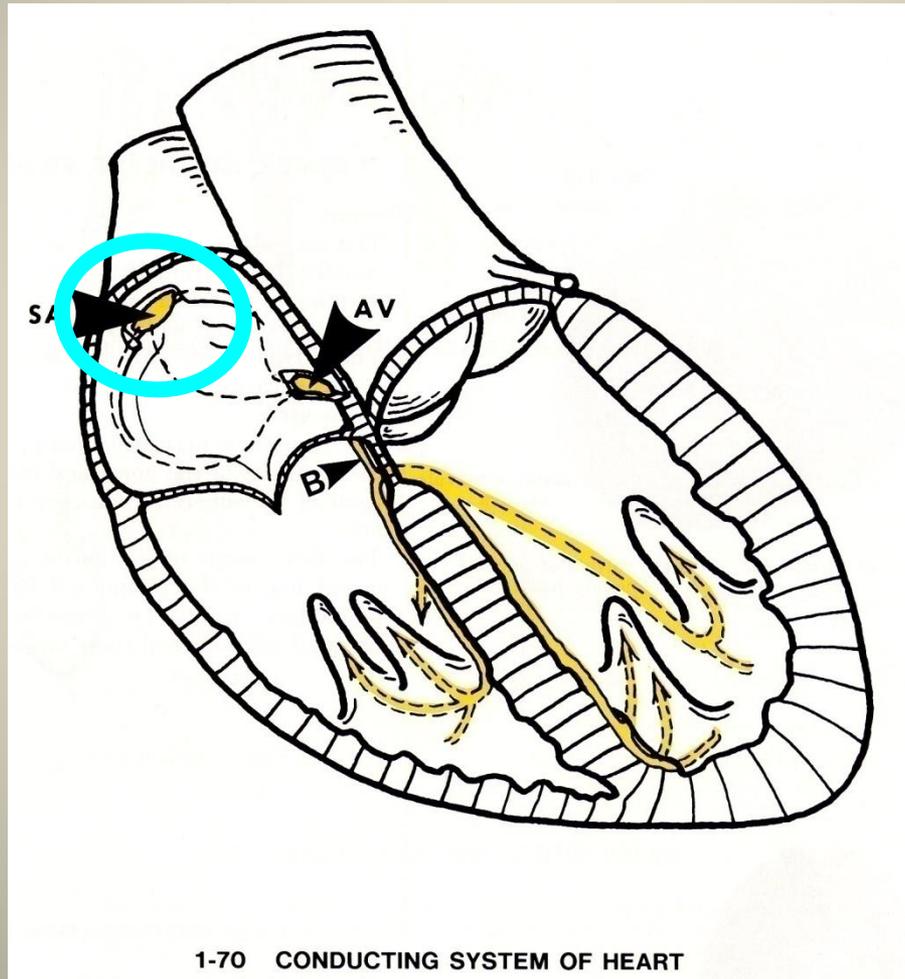
**Diagnosis:**  
Congenital Long QT  
syndrome

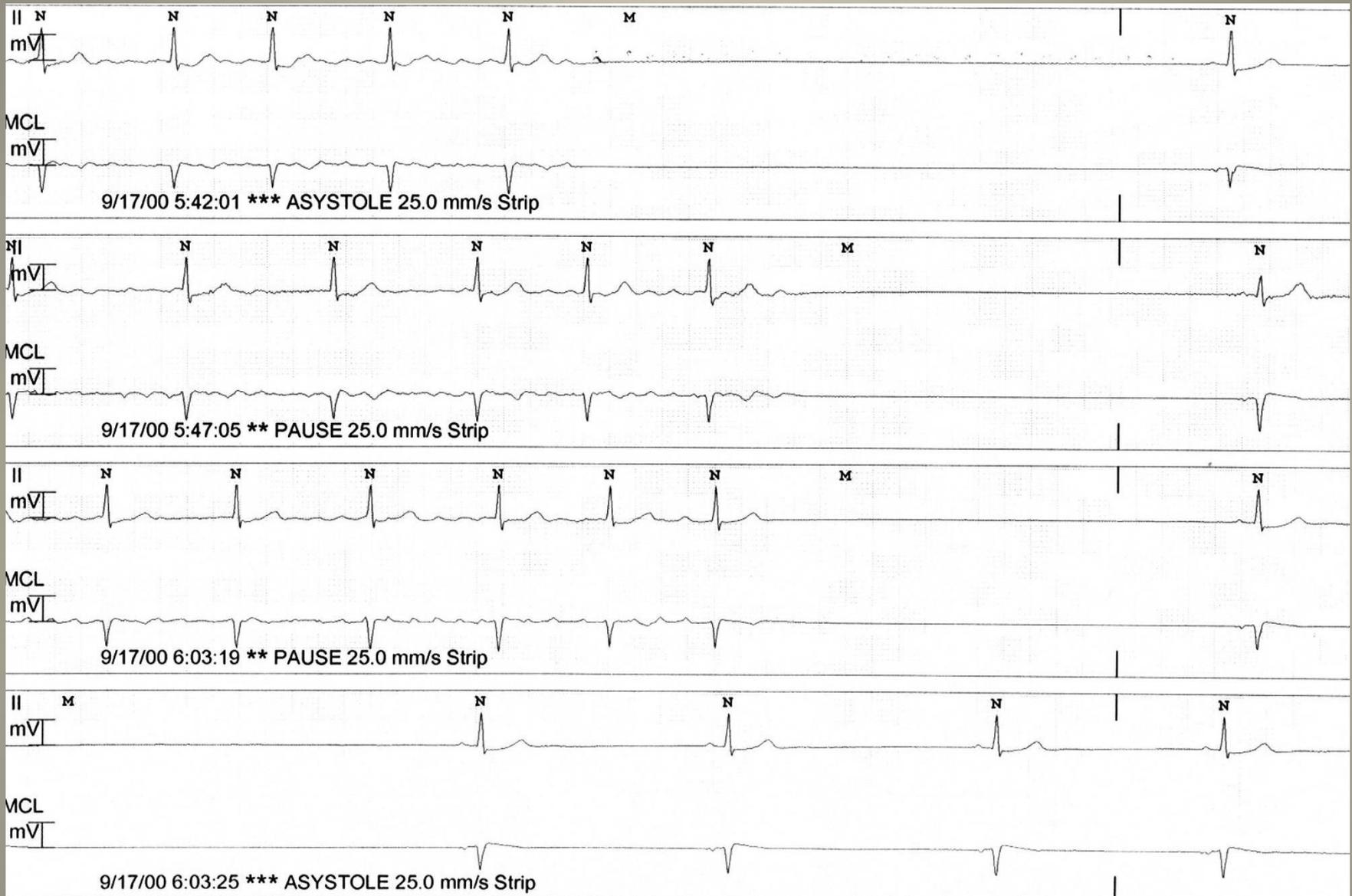
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# Sick Sinus Syndrome



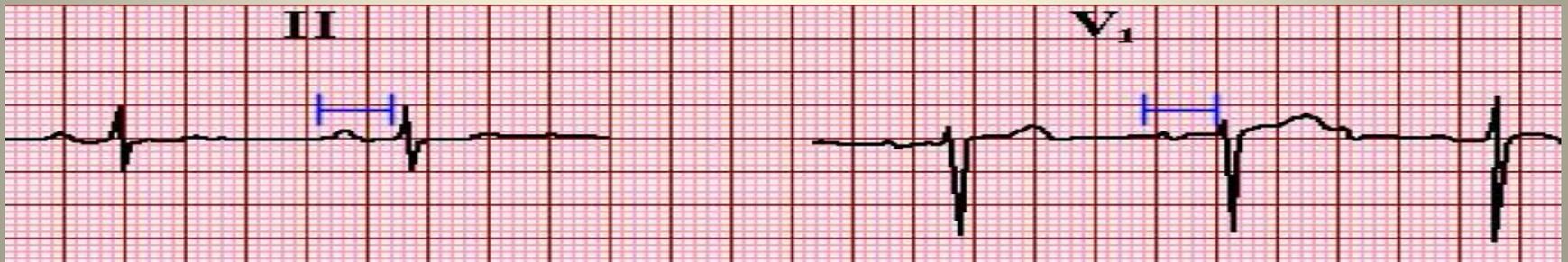


80 year old woman with recurrent syncope- admitted for cardiac investigations; telemetry showed frequent 4-5 second pauses

Diagnosis- sick sinus syndrome; treatment- insertion of permanent pacemaker

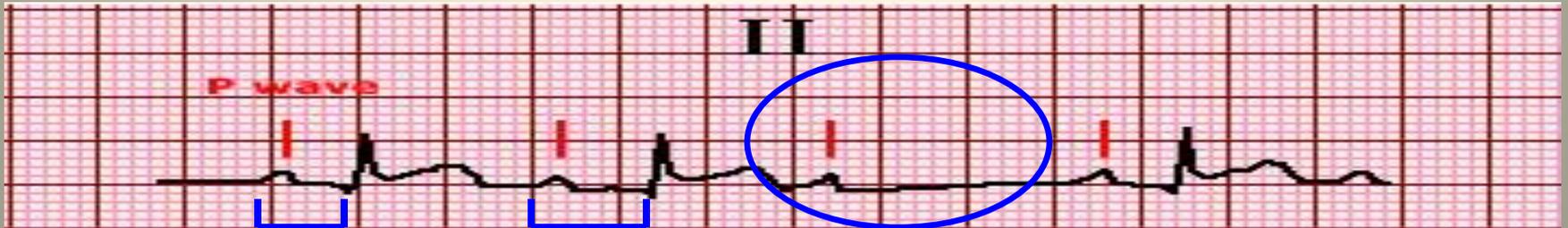
# First Degree AV Block

- **First degree block: Occurs when there is prolongation or delay in impulse conduction through the AV node.**
- **PR interval fixed**
- **Prolonged PR interval [ $>0.20$  secs] or 5 small squares**



# Second Degree AV Block – Mobitz Type I

- Mobitz type I: Result of an intermittent block of the impulse within the AV node, with subsequent failure to conduct an atrial impulse from the atria to the ventricles
- PR interval gradually lengthened, then drop QRS



Can be normal in young people or athletes due to increased vagal tone

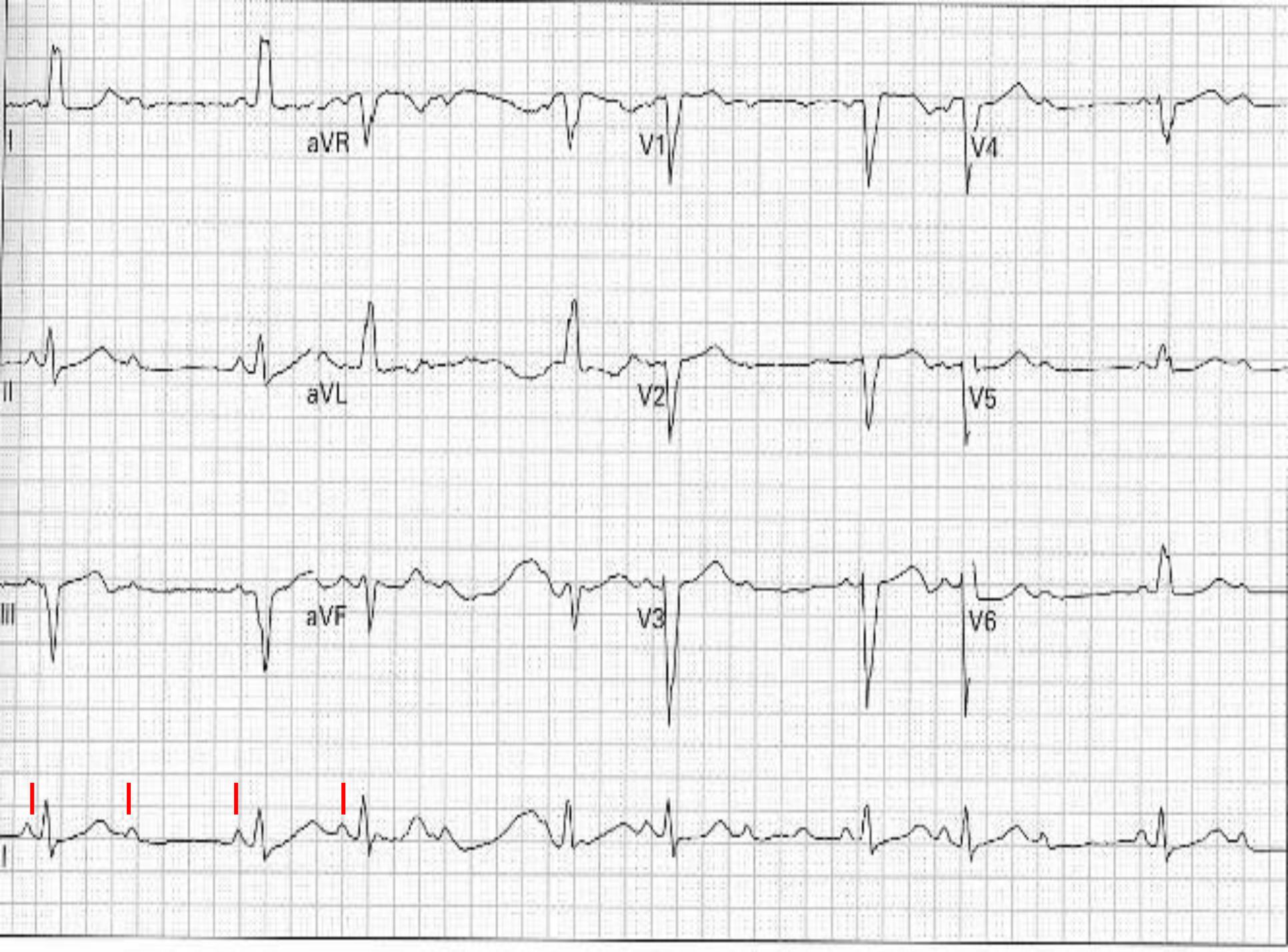
# Second Degree AV Block – Mobitz Type II

- Mobitz type II: Characterized by episodic and unpredictable failure of the node to conduct the impulse from the atria to the ventricles
- PR interval fixed, then drops QRS randomly
- May be > one successive non-conducted P wave, resulting in several P waves in a row without QRS complexes



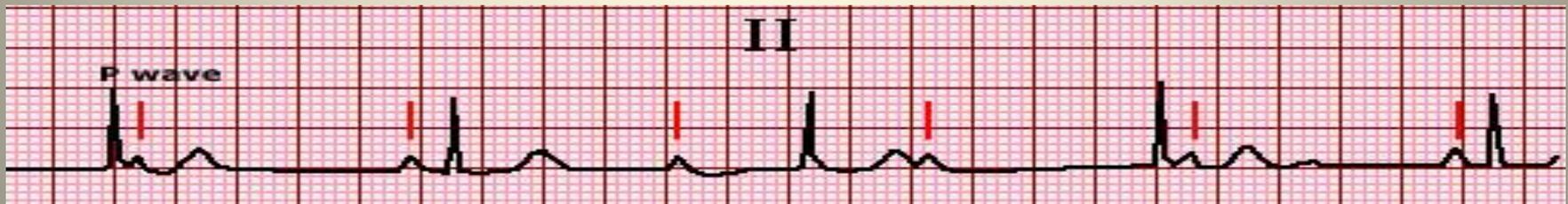
Usually pathological and represents conducting tissue disease.

Symptomatic patients require pacemaker insertion

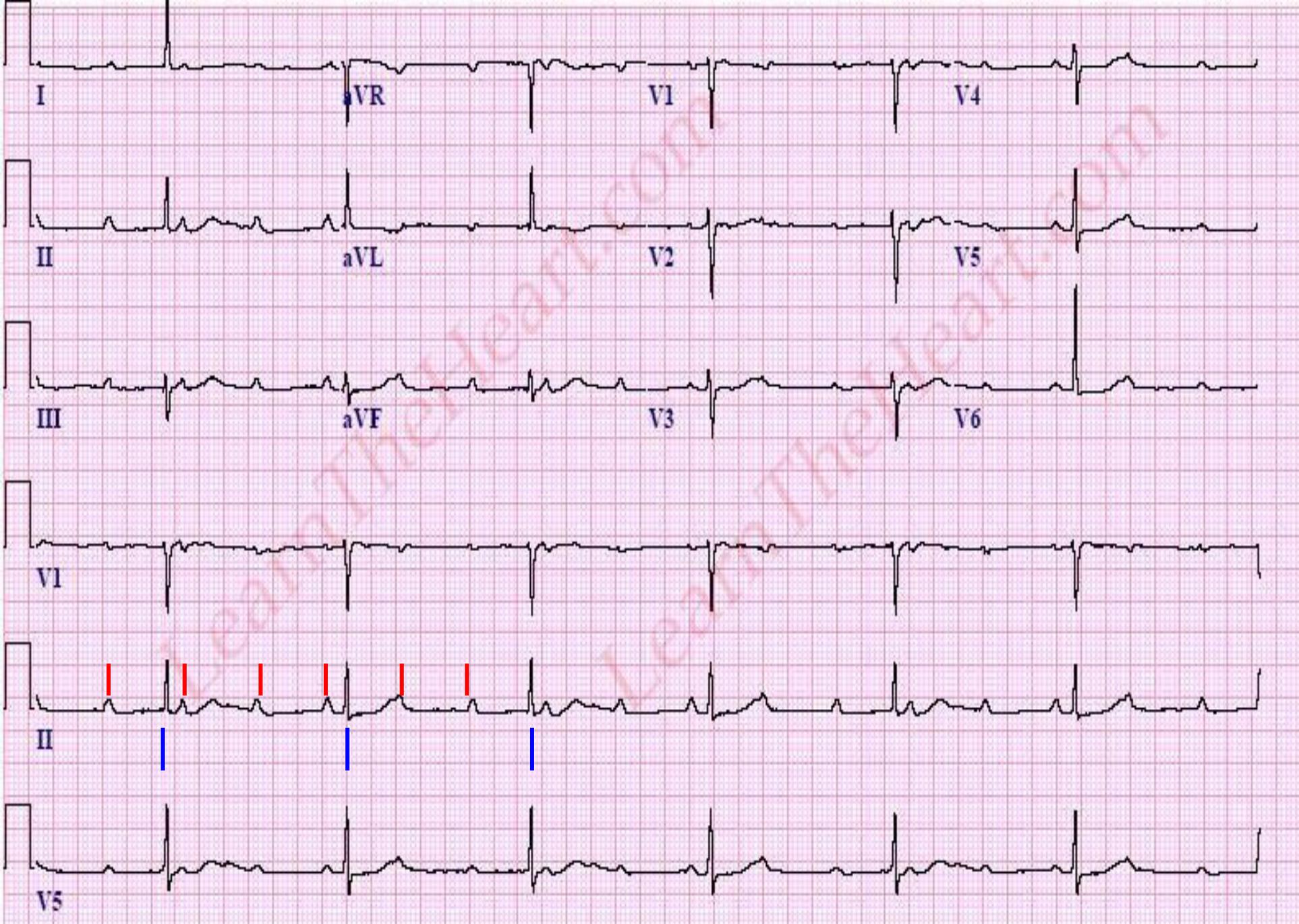


# Third Degree AV Block

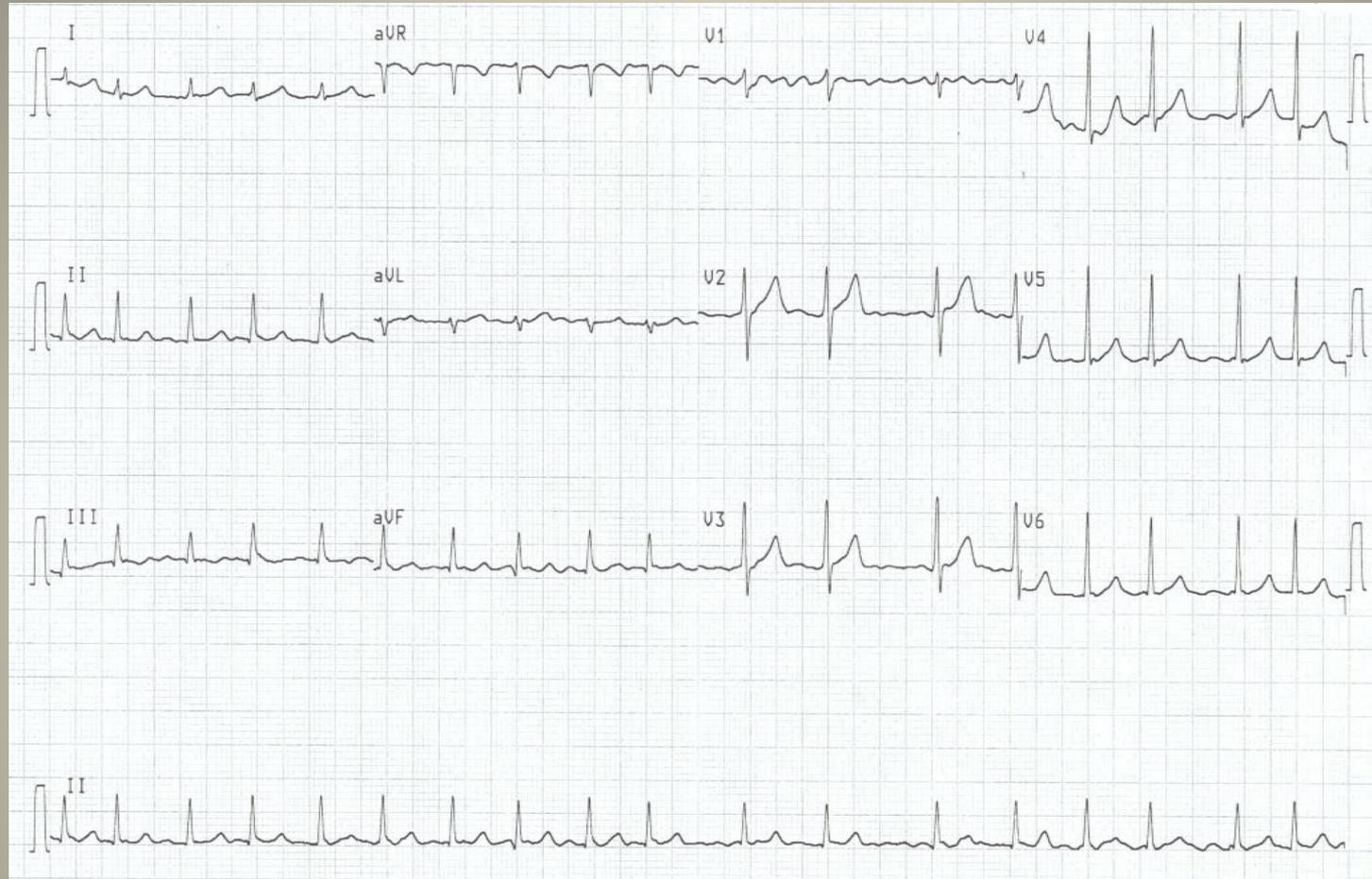
- **Third degree AV block: Occurs when there is complete failure of the AV node to conduct any impulses from the atria to the ventricles**
- **Irregularly variable PR intervals**
- **P waves completely dissociated from QRS complexes**



Always pathological and usually represents conducting tissue disease (may be transient in acute MI)  
Symptomatic patients require pacemaker insertion



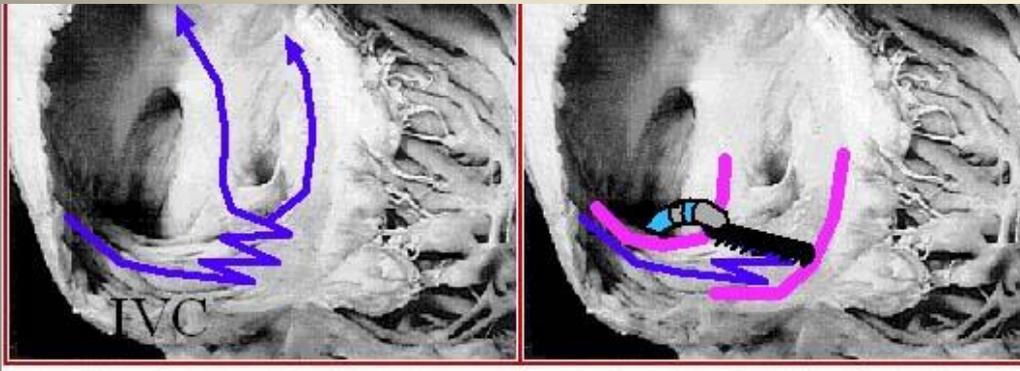
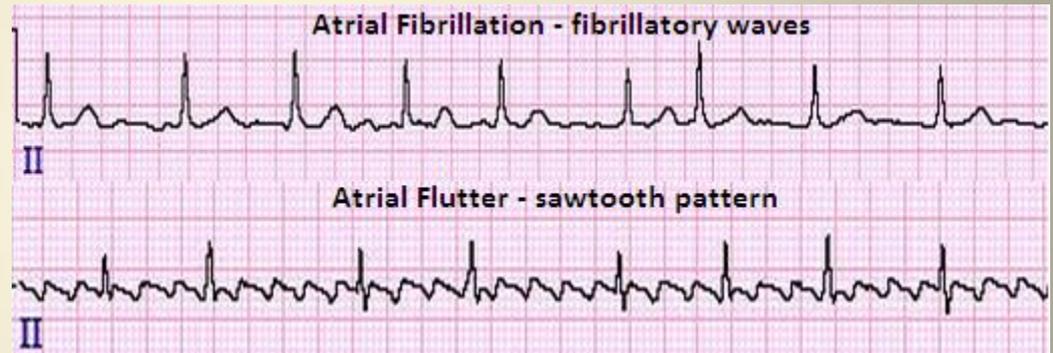
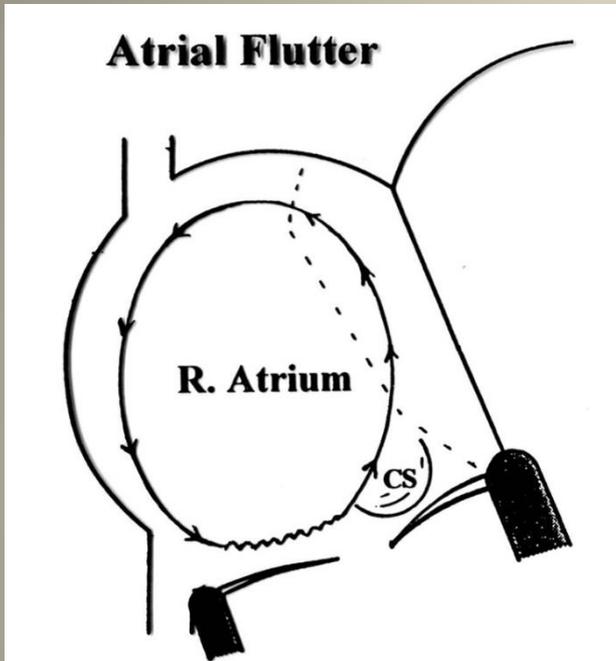
# Atrial Fibrillation



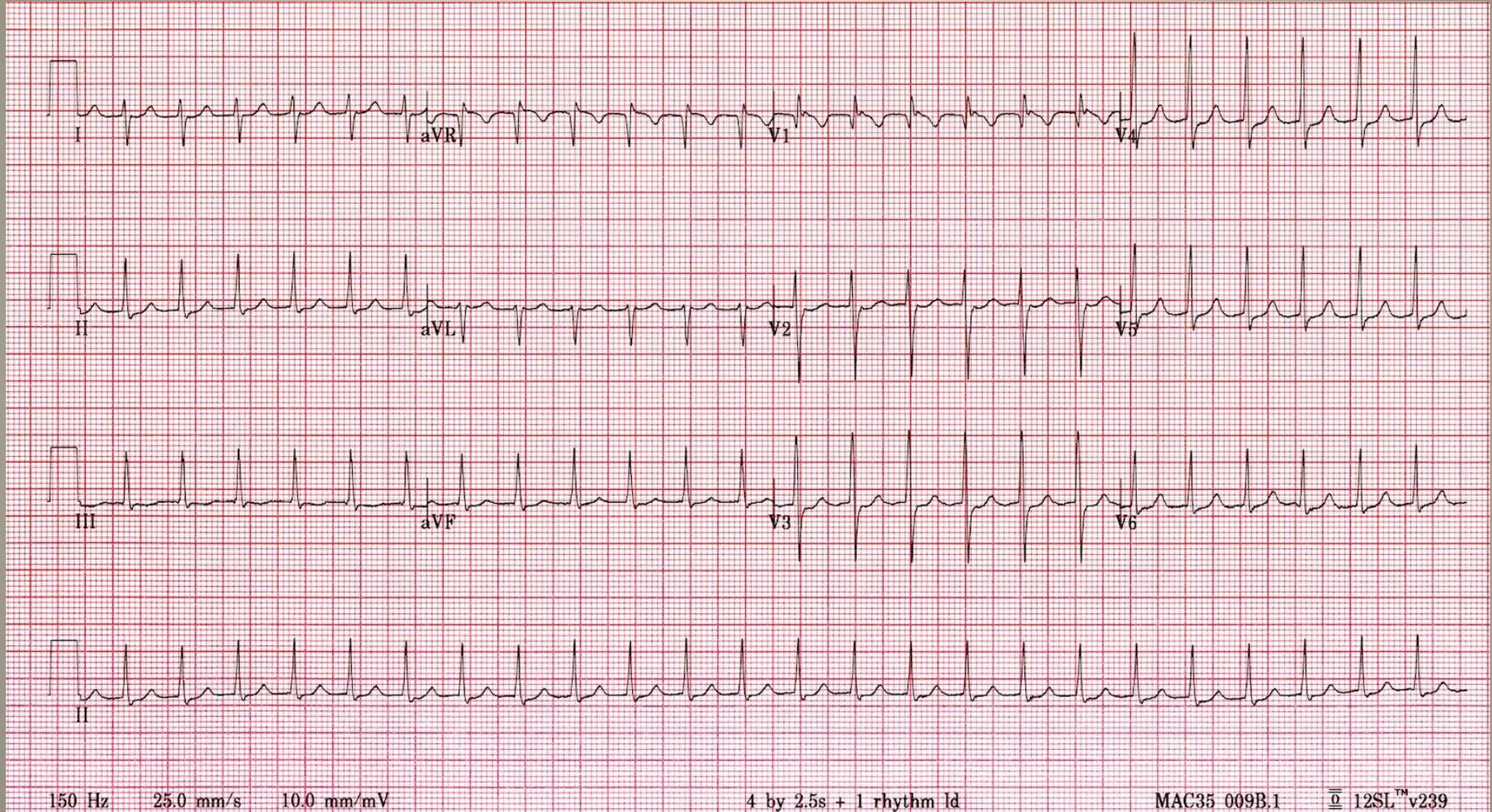
- Irregular, fast ventricular rate (> 100 bpm in this case)
- No distinct P wave is seen
- more common in the elderly
- high risk of thrombo-embolism when associated with mitral valve stenosis

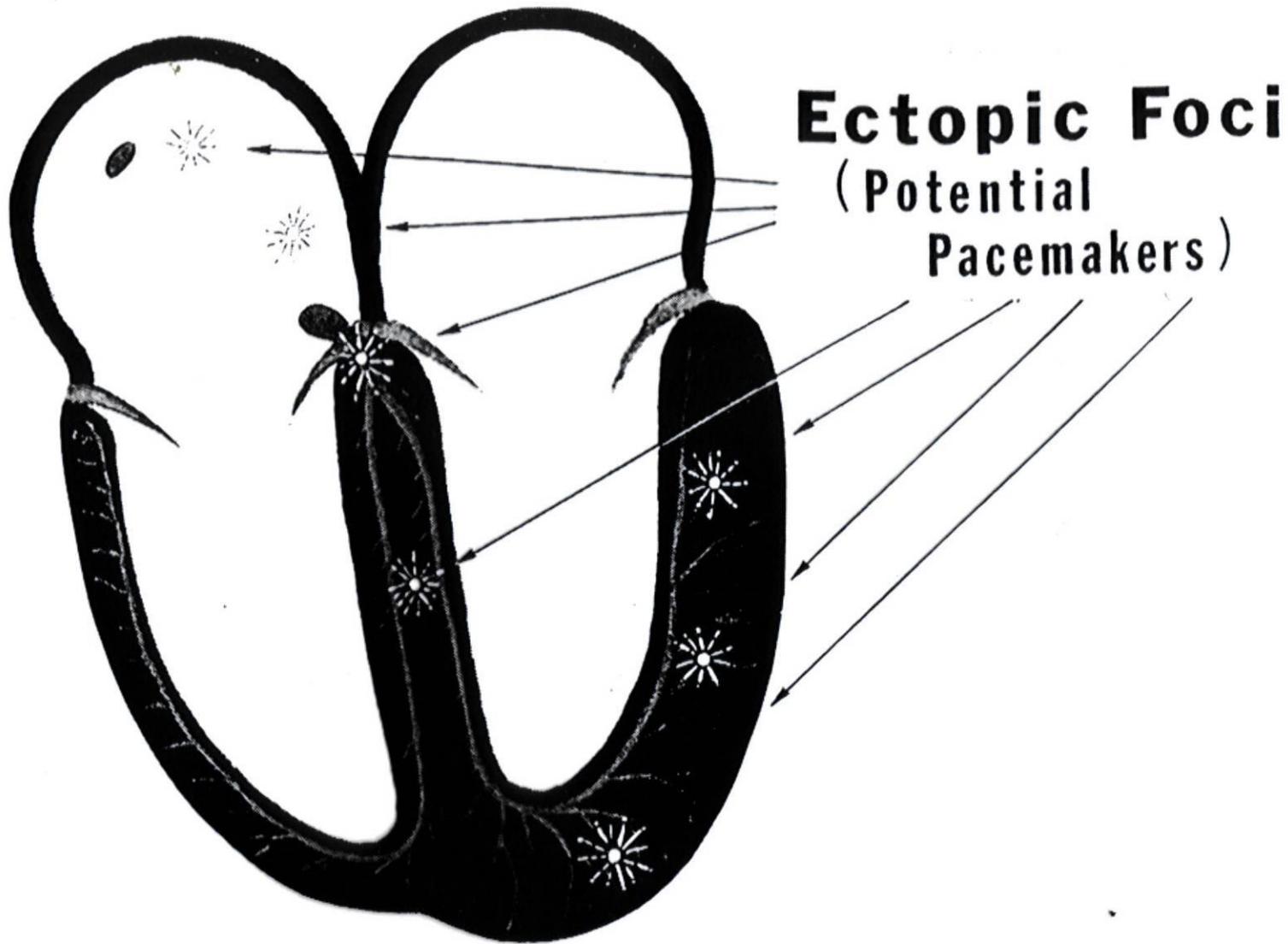
# Typical Atrial flutter

- Macro-reentrant rhythm in RA
- Anatomical and electrical circuit due to crista terminalis
- “Saw-tooth” waves seen on ECG



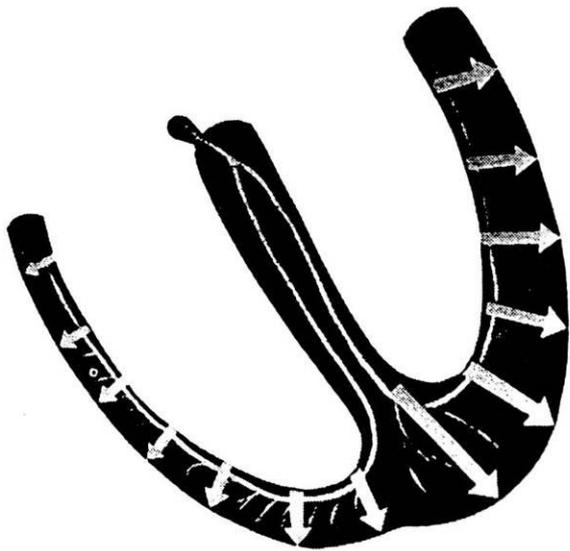
# Supraventricular tachycardia (SVT)



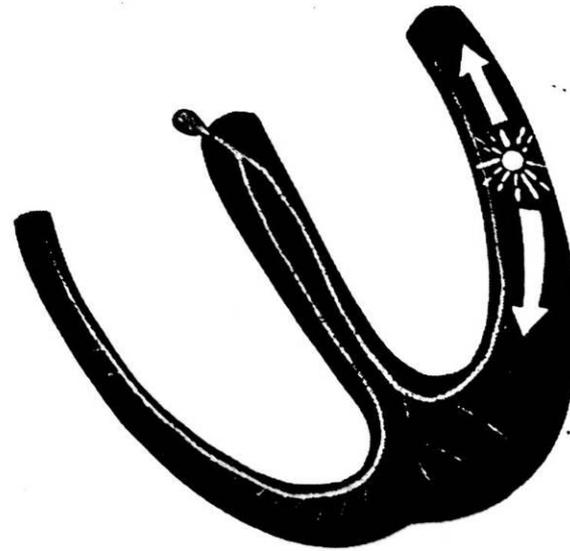


Other areas of the heart have the ability to pace if the normal (SA Node) pacemaking mechanism fails.





**Normal**

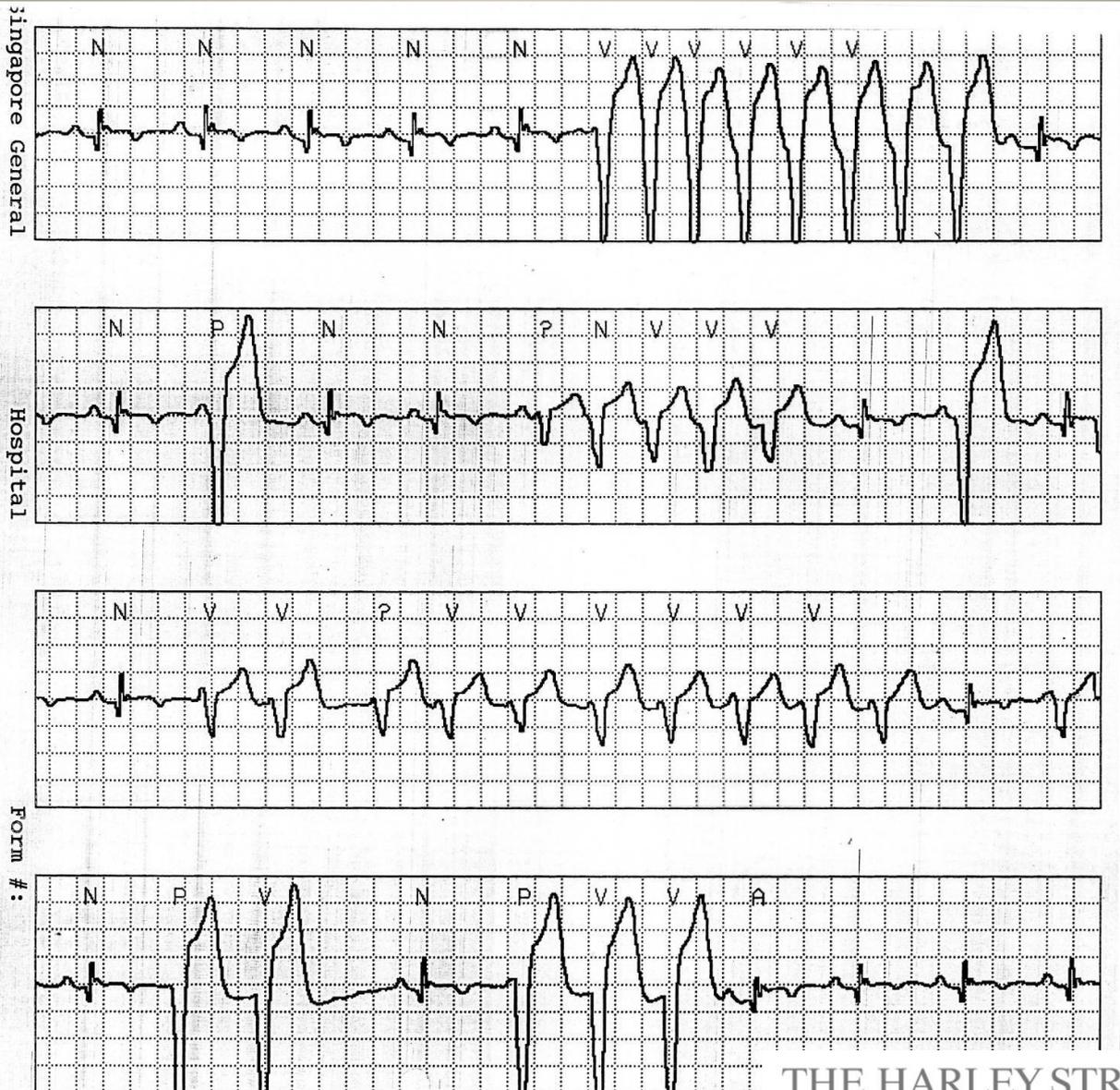


**P. V. C.**



Depolarization of the P.V.C. does not follow the usual ventricular conduction system pathway, therefore conduction is slow (very wide QRS).

# Ventricular Ectopics and non-sustained VT



**Any questions so far?**



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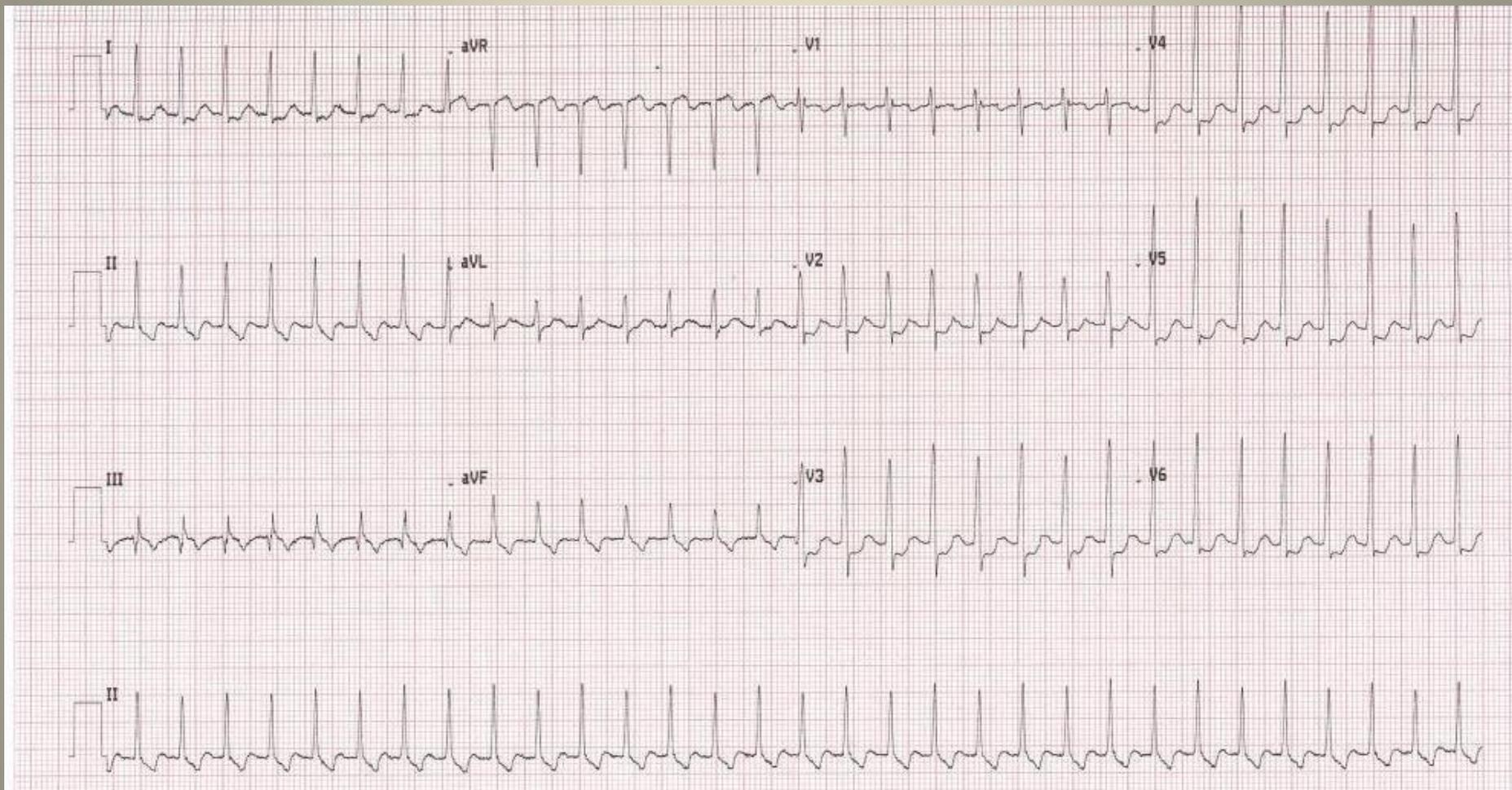


# Case 1

- **36 year old man with intermittent palpitations for a few years**
- **Increasing in frequency- few times a week**
- **No previously documented arrhythmia**
- **No cardiovascular risk factors**
- **Usually fit and well**
- **Presented to GP with palpitations**

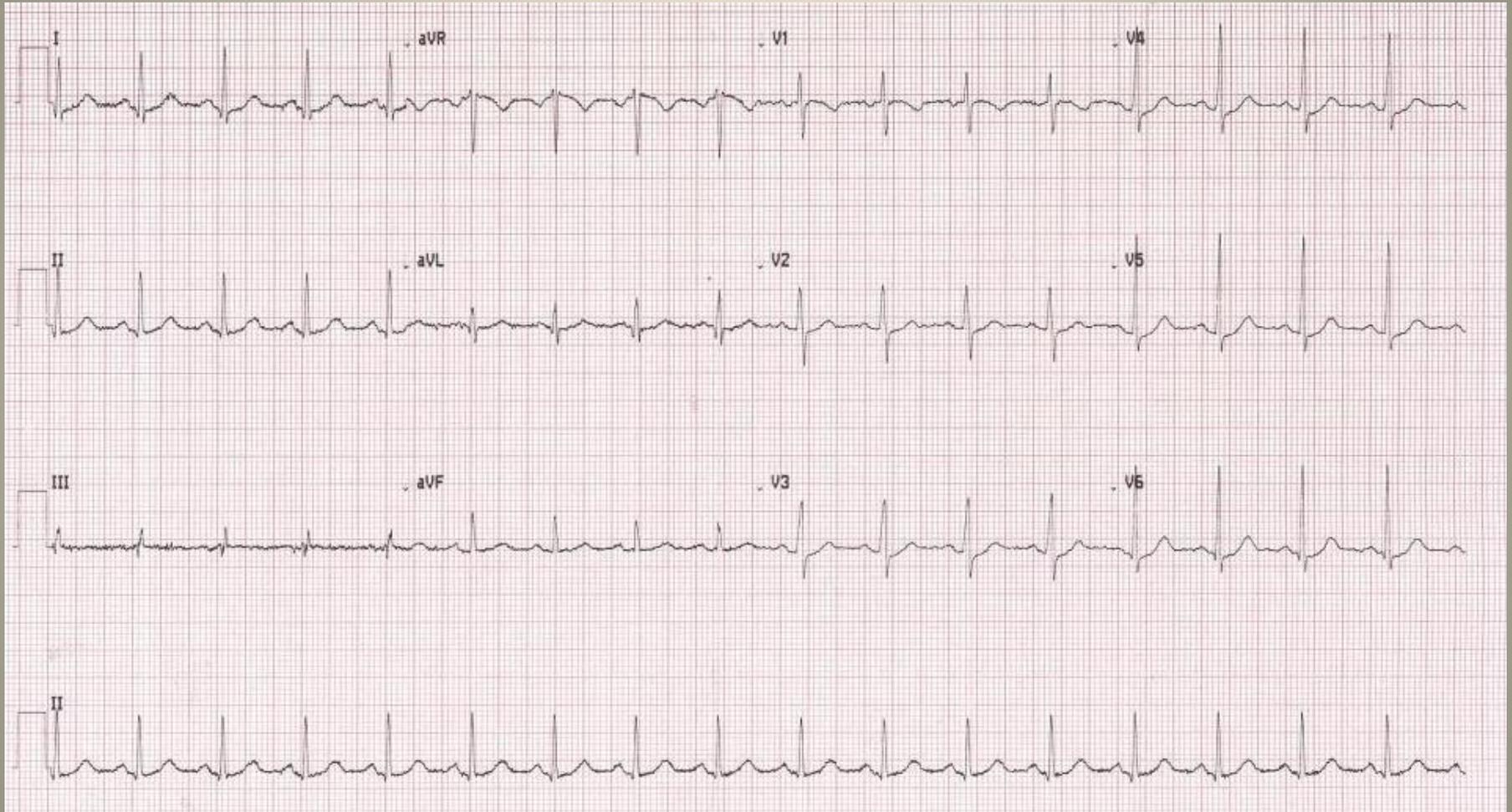


# Case 1- ECG during palpitations



**Diagnosis- supraventricular tachycardia (SVT)**

# Case 1- ECG after palpitations settled



# Case 1

- **Investigations:**
  - Blood tests (including renal and thyroid function)- normal
  - Echo normal
- **Trial of beta-blocker for 1 month**
- **Palpitations persisted**
- **Proceeded to EP study and catheter**
  - Successful ablation of slow pathway for AVNRT
- **Follow up- no further palpitations; off medication**

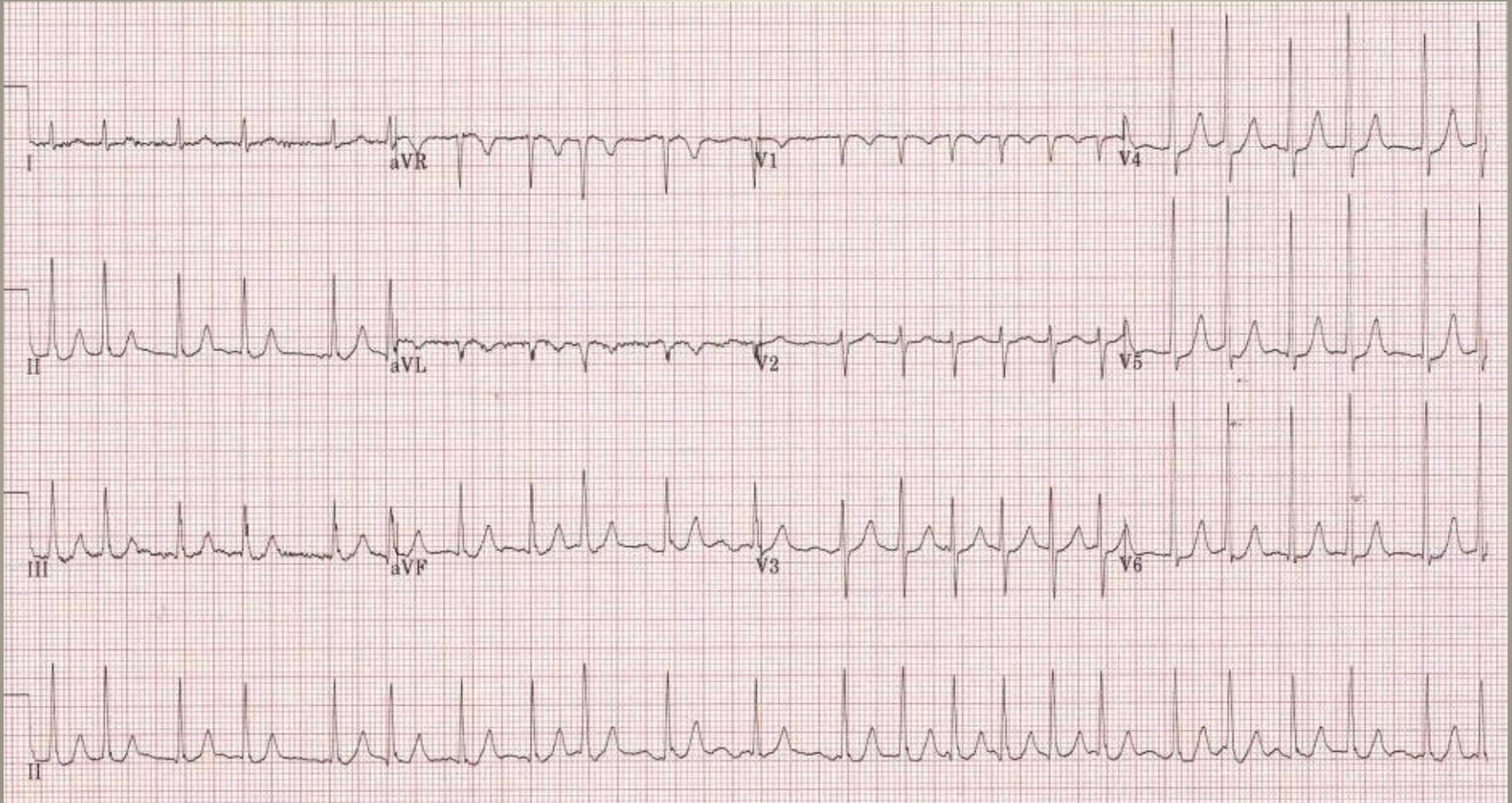


# Case 2

- 68 year old woman saw GP for a routine check-up
  - Asymptomatic
  - History of high blood pressure
  - Suffered a “mini-stroke” 2 years ago
- 
- GP noted increased BP (150/90mmHg) and felt heart rate was irregular

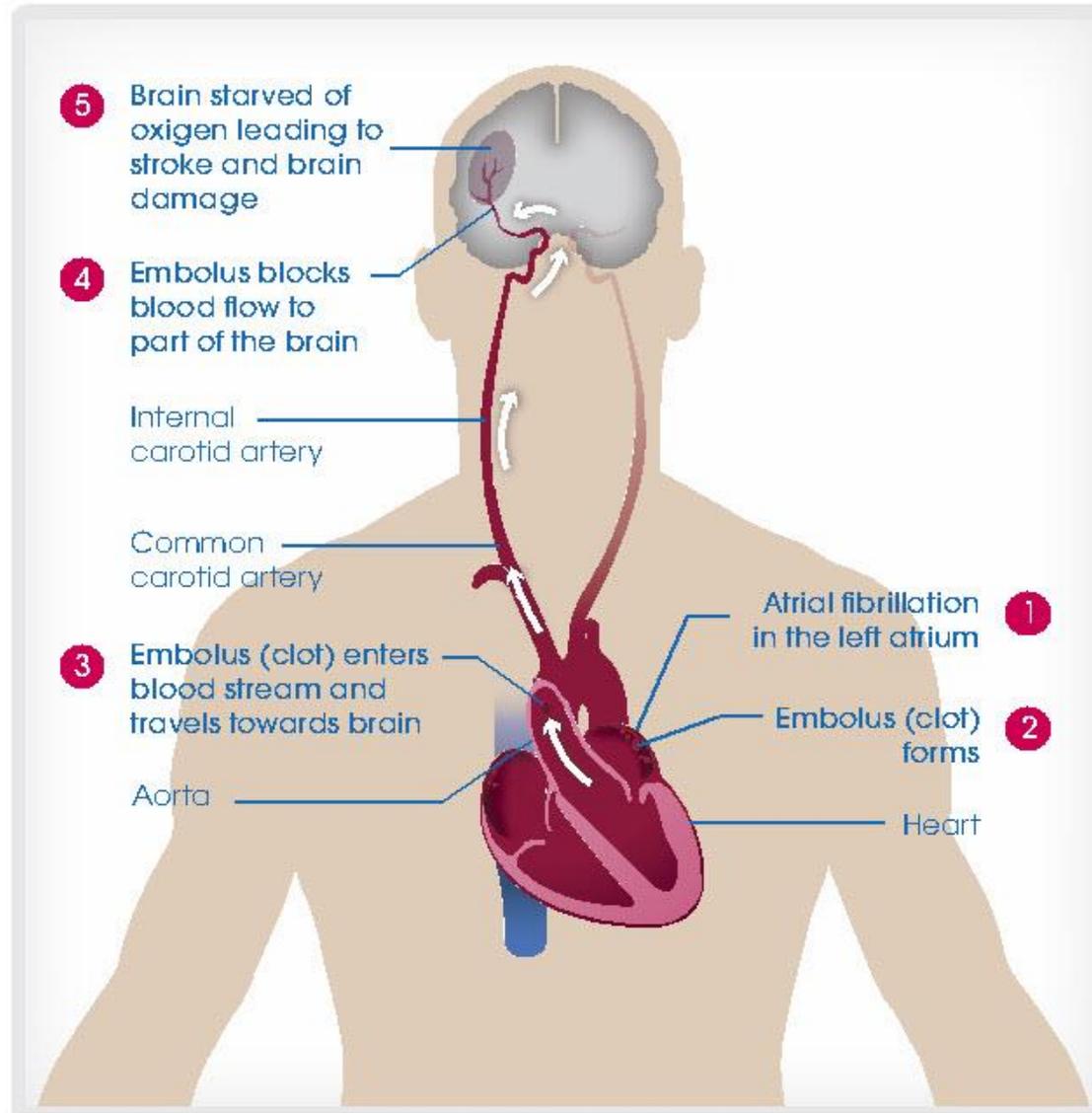


# Case 2- 12-lead ECG



**Diagnosis- AF with fast ventricular rate**

# How atrial fibrillation leads to stroke



# CHADS<sub>2</sub> and CHA<sub>2</sub>DS<sub>2</sub>-VASc

Risk factors	Points assigned	
	CHADS <sub>2</sub>	CHA <sub>2</sub> DS <sub>2</sub> -VASc
Age (years)		
65–74		+1
≥75		+2
>75	+1	
Congestive heart failure	+1	+1
Hypertension	+1	+1
Diabetes mellitus	+1	+1
Stroke/TIA	+2	+2
Vascular disease*		+1
Female gender		+1
	Cumulative score: 0–6	Cumulative score: 0–9

\*MI, peripheral artery disease or aortic plaque

Lip GY *et al*, 2010.



# ESC 2010 Guidelines: the role of CHA<sub>2</sub>DS<sub>2</sub>-VASc

Risk category	CHA <sub>2</sub> DS <sub>2</sub> -VASc score	Recommended antithrombotic therapy
1 'major' risk factor or ≥2 'clinically relevant non-major' risk factors	≥2	OAC
1 'clinically relevant non-major' risk factor	1	Either OAC or ASA 75–325 mg daily  Preferred: OAC rather than ASA
No risk factors	0	Either ASA 75–325 mg daily or no antithrombotic therapy  Preferred: no antithrombotic therapy rather than ASA

Camm AJ *et al*, 2010.



# Case 2 – investigations



## Blood tests

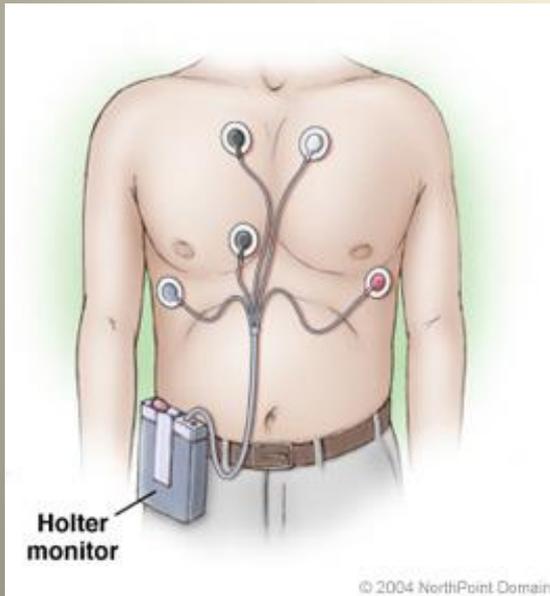
- Checked kidney function, thyroid function, full blood count

## 24 hour Holter monitor

- To detect whether AF is persistent or paroxysmal
- Assess heart rate range and control

## Echocardiogram

- Slightly dilated LA
- Normal LV function and valves

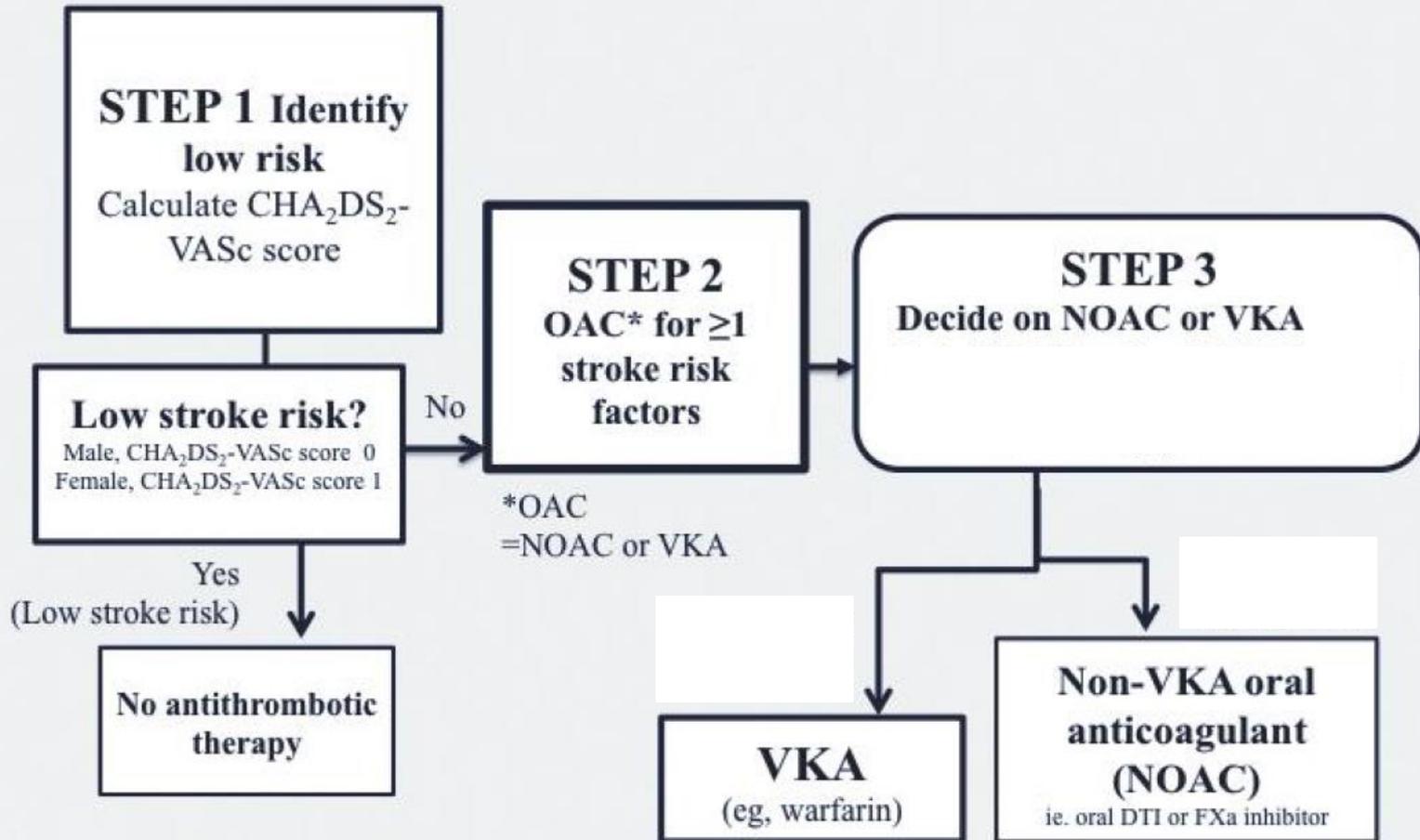


# Case 2 - treatment

- **CHA<sub>2</sub>DS<sub>2</sub>VASc score- 5 (Age, Female, HT, TIA-2)**
  - Very high risk of stroke
- **Started on appropriate medical treatment**
  - BP and AF rate control ( ACEIn and beta-blocker)
  - Oral anticoagulation with novel anticoagulant (eliquis 5mg bd)
  - Regular follow up to monitor BP and AF progression



# AF anticoagulation management pathway

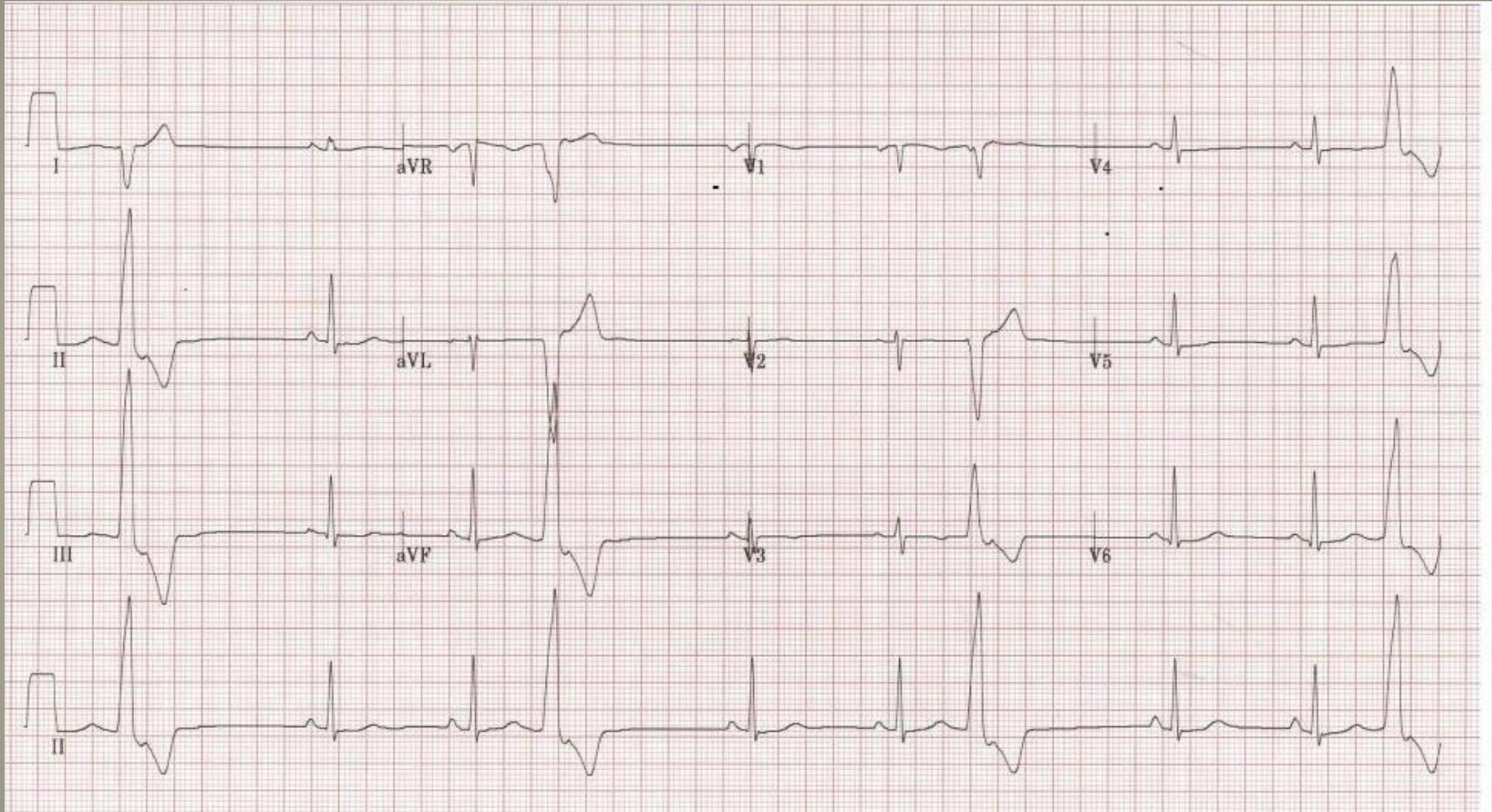


## Case 3

- 38 y.o. woman found to have abnormal ECG at routine medical check-up
- Completely asymptomatic
- History of hyperthyroidism (medically treated)
- Smoker- no other cardiac risk factors or PMH



# Case 3 ECG



Sinus rhythm with PVCs (ventricular trigeminy)

# Case 3- Holter recording

## General

**98446** QRS complexes  
**35122** Ventricular beats (36%)  
**0** Supraventricular beats (< 1%)  
**1** BB beats (< 1%)  
**2** % of total time classified as noise

## Ventriculars (V, F, E, I)

**35092** Isolated  
**0** Couplets  
**23079** Bigeminal cycles  
**10** Runs totaling 30 beats  
**3** Beats longest run 101 bpm 10:18:54 13-Jan  
**3** Beats fastest run 101 bpm 10:18:54 13-Jan

## Heart Rates

**45** Minimum at 06:16:12 14-Jan  
**68** Average  
**100** Maximum at 19:05:06 13-Jan  
**10** Beats in tachycardia ( $\geq 100$  bpm), < 1% total  
**3395** Beats in bradycardia ( $\leq 60$  bpm), 3% total  
**1.72** Seconds Max R-R at 07:38:24 14-Jan

## Supraventriculars (S, J, A)

**0** Isolated  
**0** Couplets  
**0** Bigeminal cycles  
**0** Runs totaling 0 beats

## Interpretation

Frequent monomorphic PVC's (36% PVC burden; >35,000 PVC's over recording period).  
Episodes of ventricular bigeminy and trigeminy; no NSVT detected.

**24hr Holter > 35,000 ventricular ectopics**

# Case 3- management

- Initial echo- normal LV function (LVEF 55-60%)
- Started on a beta-blocker
- 4 month follow-up
  - Still asymptomatic but EF reduced to 30-35%
  - Still had very frequent ectopics (40%) on Holter monitor
  - Therefore recommended for EP study and catheter ablation
- Successful ablation of RVOT ectopics
  - EF returned to normal 3 months post ablation

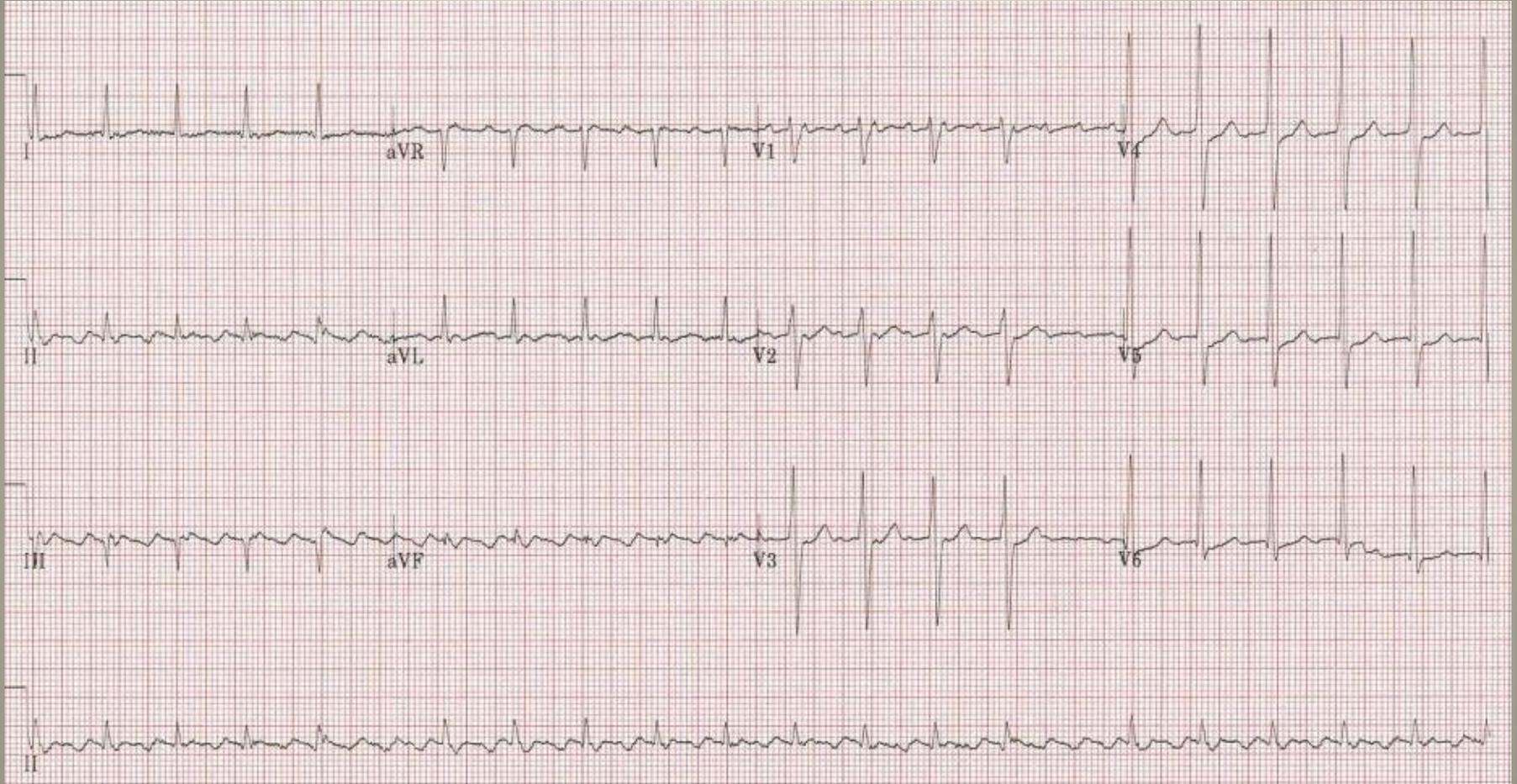


# Case 4

- 80 y.o. with increasingly breathlessness
- History of:
  - Hypertension
  - Type II diabetes
  - Heart failure
- Medication:
  - plavix, amaryl, glucophage, irbesartan, lasix
- Examination-
  - BP 140/90mmHg, HR 80-90bpm, signs of heart failure



# Case 4- ECG



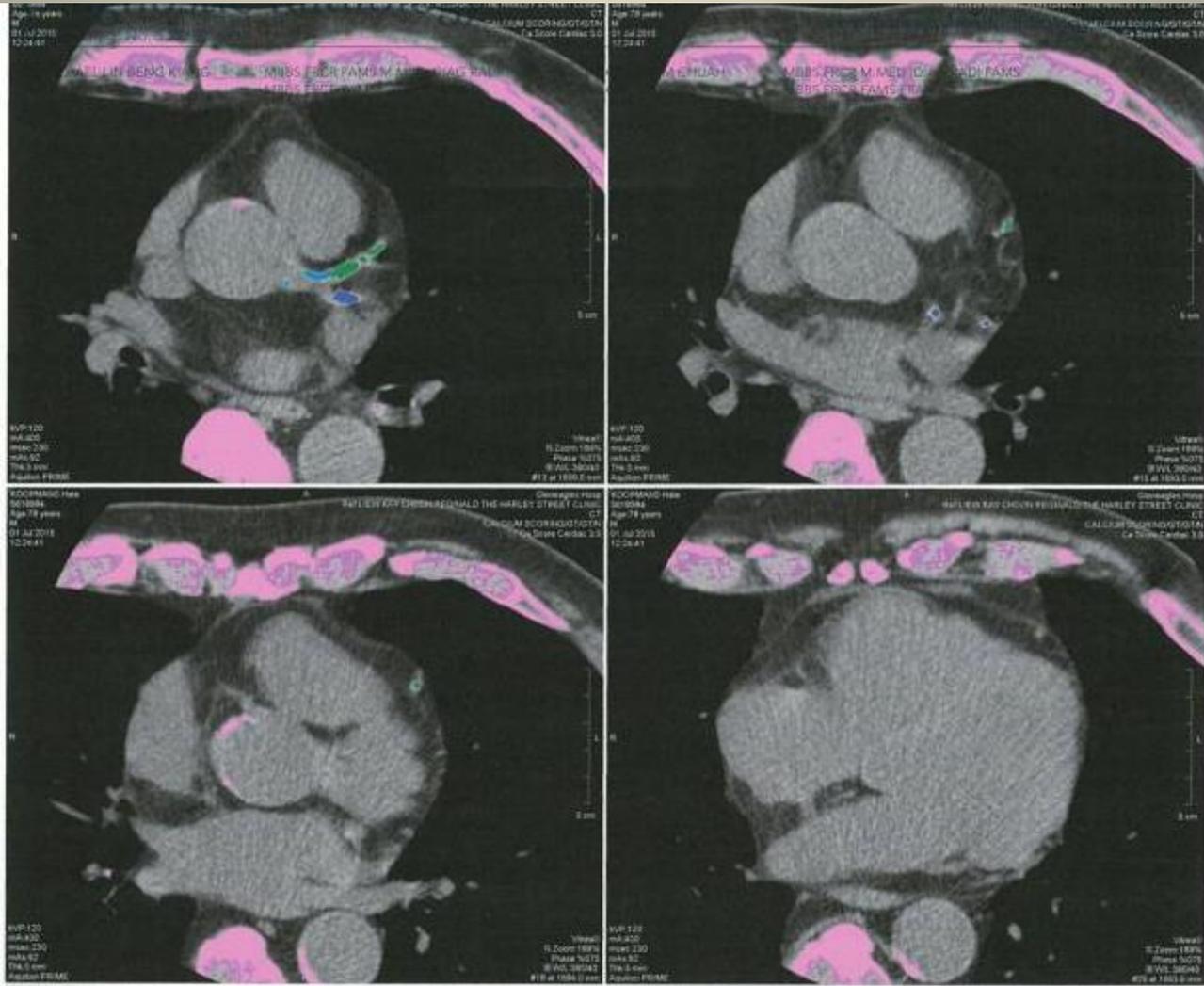
Diagnosis- typical atrial flutter

# Case 4- investigations

- **Investigations**
  - **Bloods-**
    - normal renal function and FBC, normal TFTs
    - ProBNP 375pg/mL, HbA1c 7.1%
  - **Echo-** LVEF 40-45% , mildly dilated LA, anterior hypokinesia
  - **24 hour Holter monitor-** atrial flutter throughout
- **Issues to consider**
  - Anticoagulation
  - Assess for coronary artery disease
  - Management of atrial flutter



# Case 4- CT calcium score



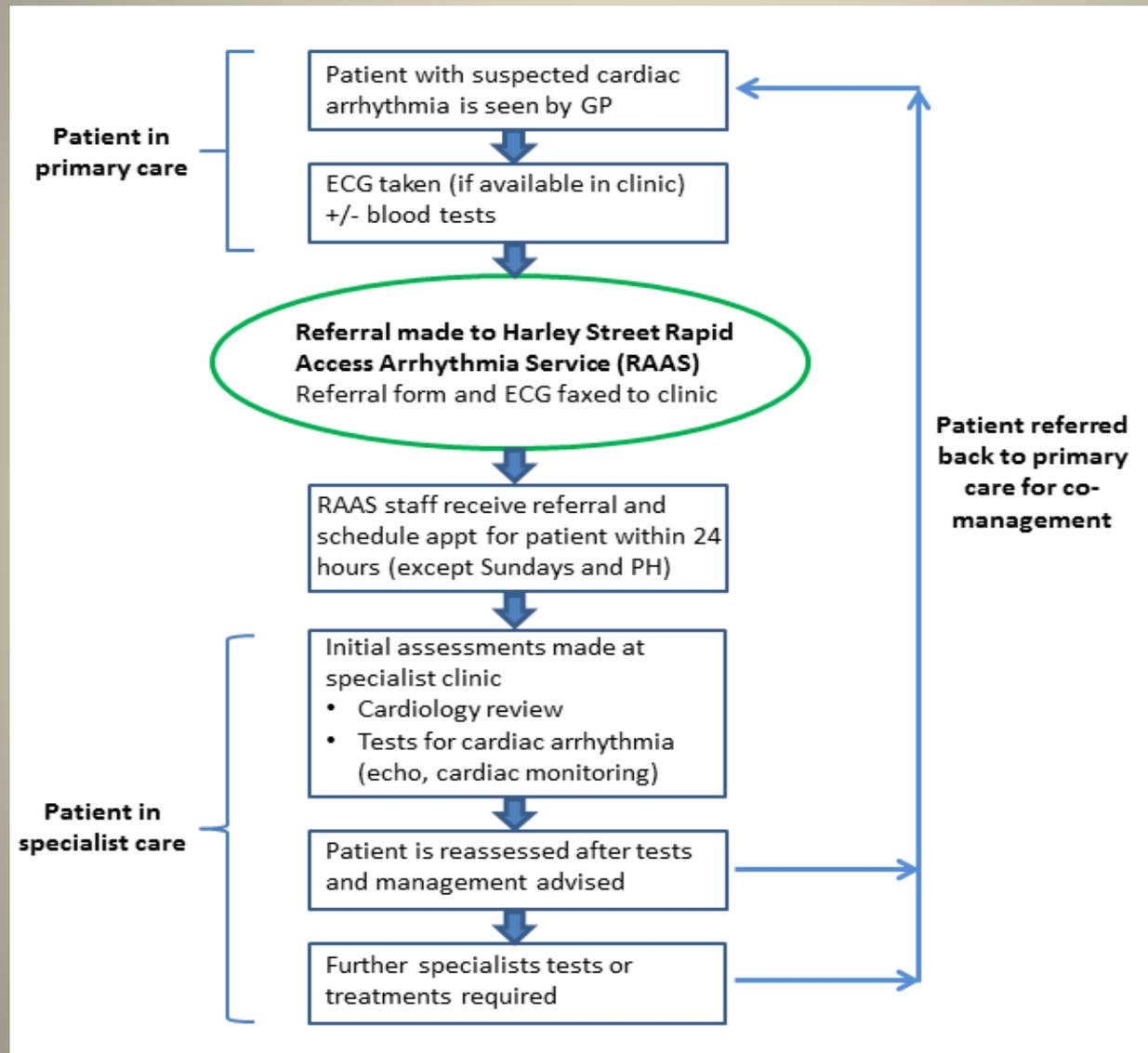
- CT calcium score 893 (mainly in LAD and Cx)

# Case 4- management

- Coronary angiogram-
  - 90% proximal LAD lesion; 50% Cx lesion
  - LAD lesion successfully treated with PCI
- EP study and catheter ablation of typical atrial flutter
- CHA<sub>2</sub>DS<sub>2</sub>VASc score- 5 (Age, HT, DM, CCF)
- High risk of stroke-
  - started on NOAC (Eliquis 2.5mg bd)
  - Other meds started- concor 2.5mg od, aspirin (DAPT for 6 months post PCI), statin
- 3 month follow up:
  - LVEF normalized (55-60%)
  - ECG sinus rhythm
  - Patient asymptomatic and back to normal activity



# Rapid access arrhythmia service



# THE HARLEY STREET HEART & CANCER CENTRE



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