



Dr Chris Ellis

Cardiologist, Auckland City Hospital

Interpreting ECGs - Concurrent Workshop Session

Saturday, 11 June 2011

Start 4:30pm

Duration: 60mins

Van Gogh

 **Rotorua GP CME 2011**
New Zealand Medical Association

General Practice Conference & Medical Exhibition



09-12 June 2011 | Energy Events Centre | Rotorua

Interpreting ECGs

Dr Chris Ellis

Cardiologist

Greenlane CVS Services

Auckland City Hospital

& Auckland Heart Group:

Mercy Hospital



NZMA GP CME Conference, Rotorua 9-12 June 2011

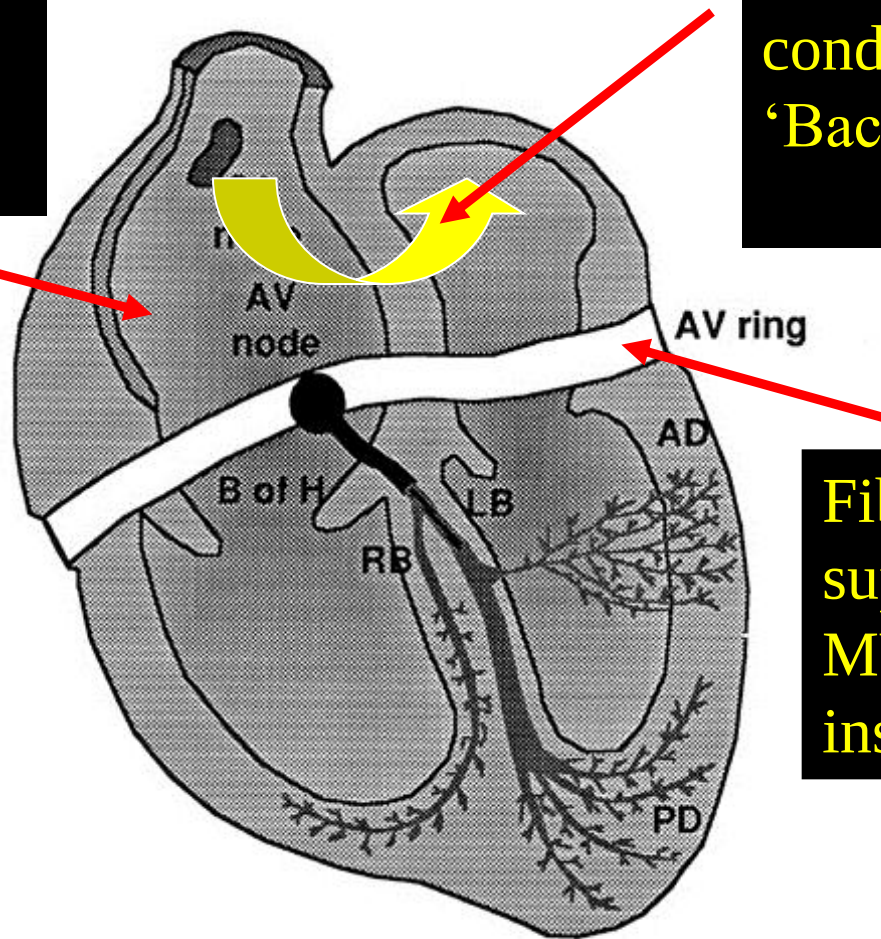
ECG Programme 11 June 2011



Diagram of the Cardiac Conducting System

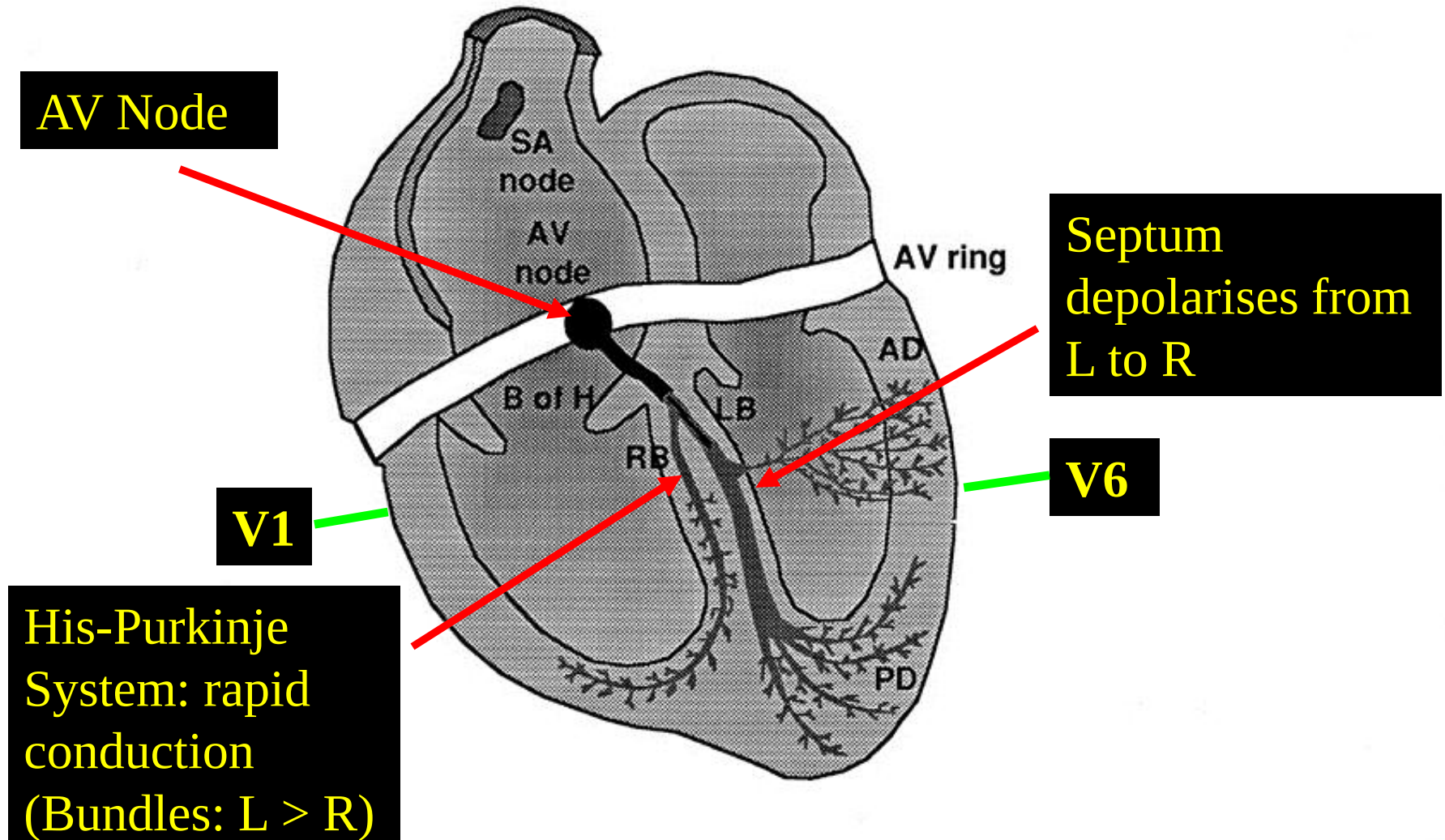
Cell to cell
conduction in
RA

RA to LA via
conduction tissue:
'Bachmann's bundle'



Fibrous ring
supporting TV &
MV is an electrical
insulator

Diagram of the Cardiac Conducting System

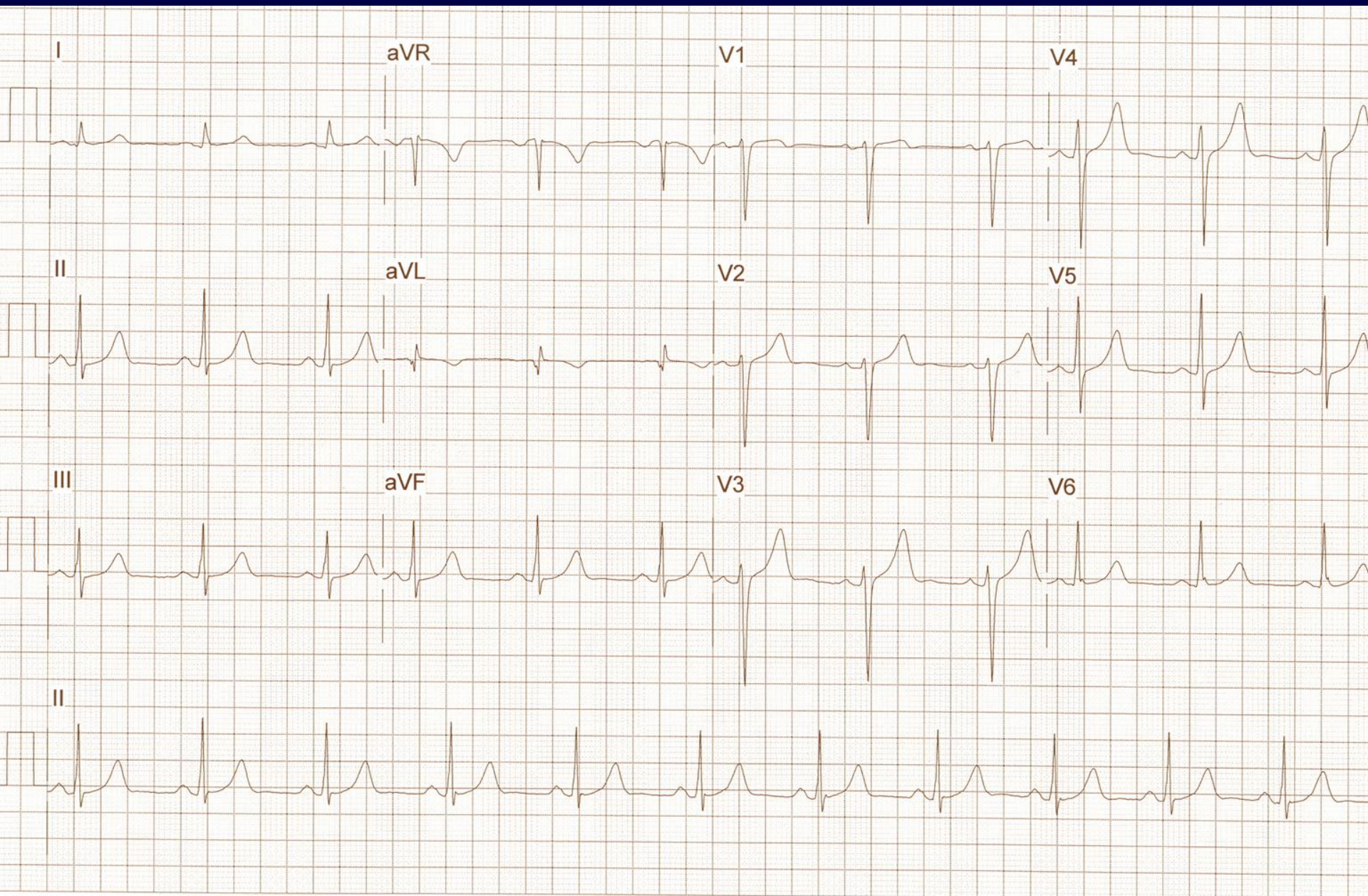


Normal ECG

- Leads 1, 2, 3, AVL, AVF, AVR are ‘standard’ or ‘vertical’ leads
- Chest leads: V1 to V6 are ‘horizontal’ leads
- The Normal Axis is -30 to +90 degrees

ECG Case 1

Normal



Reporting an ECG

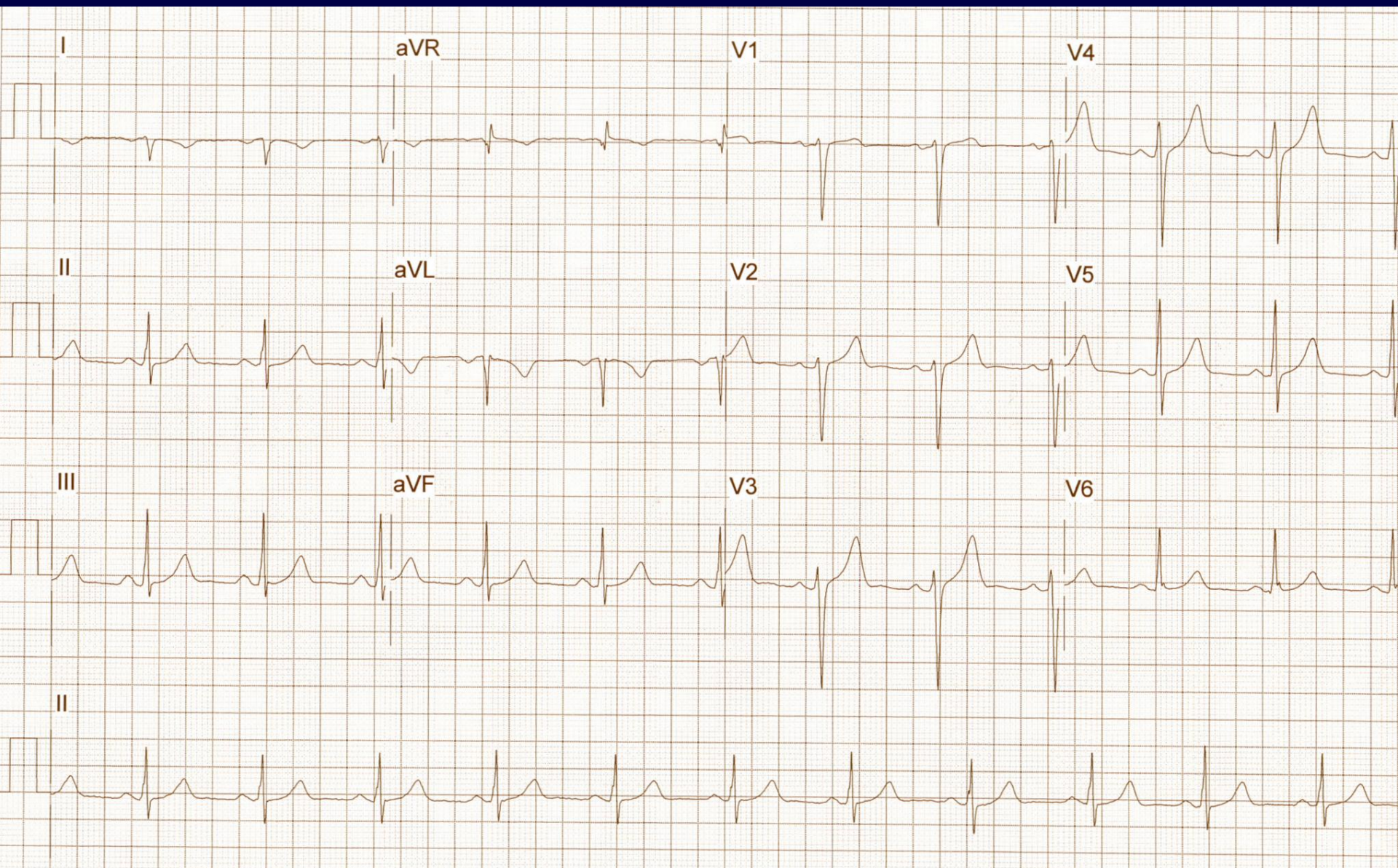
When reporting an ECG, the rhythm, rate and axis should be described. Remember:

- One square is 0.2 seconds in time [=200ms]
 - one 'little square' is 0.04 seconds
- A 'bradycardia' is a rate of < 60 beats/minute
 - (complexes > 5 squares apart)
- A 'tachycardia' is a rate of > 100 beats/minute
 - (complexes < 3 squares apart)
- A 'normal axis' (-30 to $+90$ degrees) exists if leads 1 and 2 are 'positive'. If either is negative, the axis is abnormal
- The normal PR interval is ≥ 0.12 seconds and ≤ 0.20 seconds
- The normal QRS complex is ≤ 0.08 second

ECG Case 2



ECG Case 2

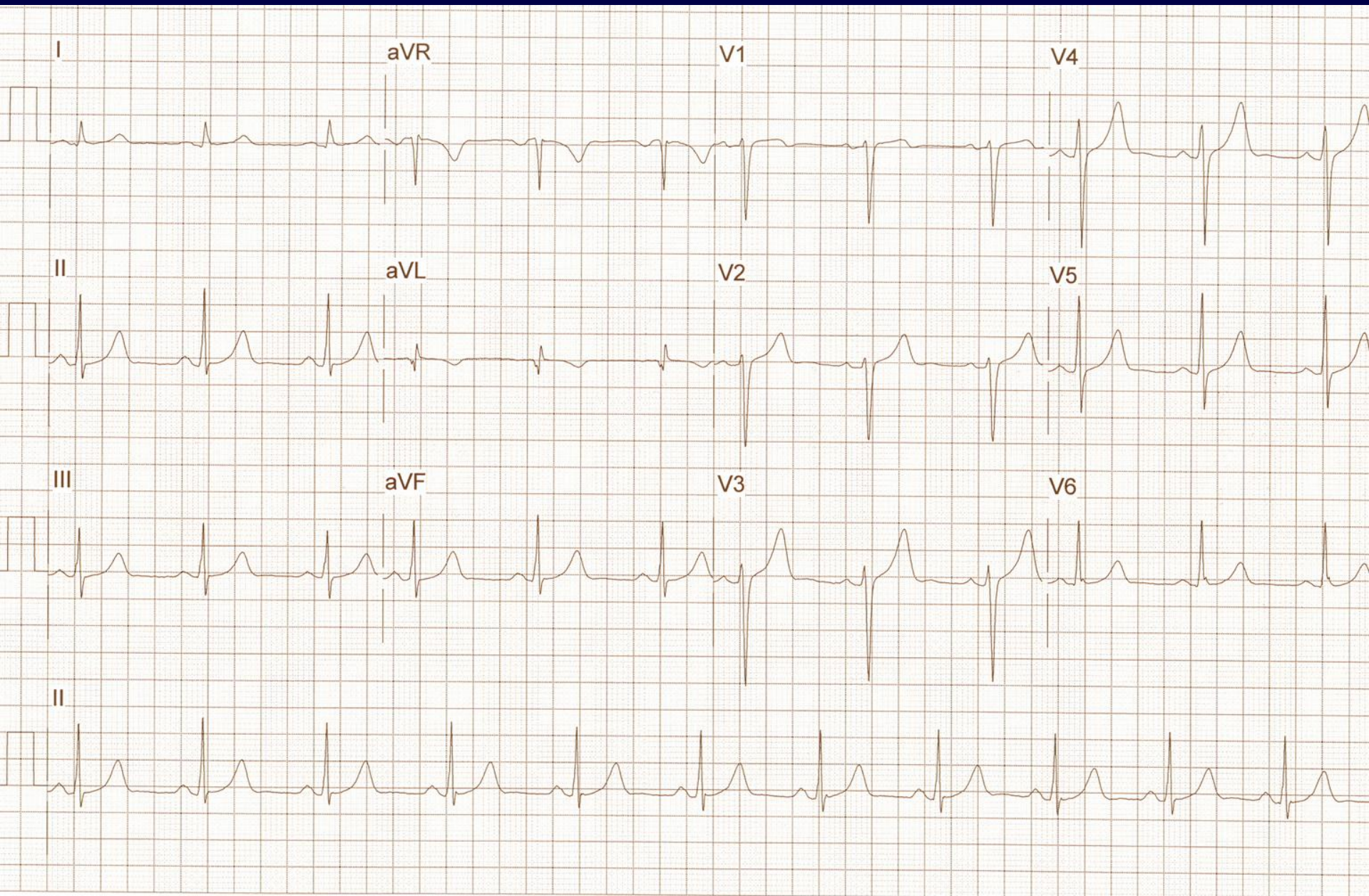


ECG 2: Crossed Arm Leads!

- 1 is upside down
- 2 & 3 transposed
- AVR & AVL transposed
- AVF & Chest leads unchanged



Normal ECG



Classification of Arrhythmias

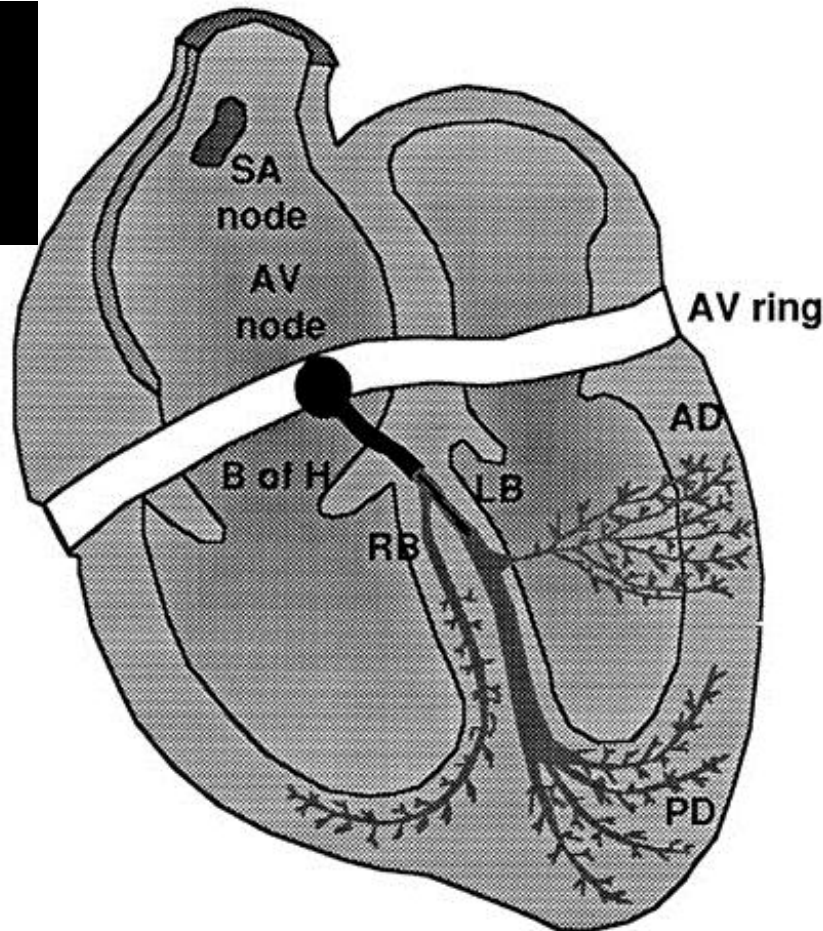
1. Rate: Tachycardia or Bradycardia
 - < 60 or > 100 / minute
2. Anatomical: 'Supraventricular' or 'Ventricular'
 - 'Ventricular' if totally within the ventricle(s)

Mechanisms of Arrhythmias

1. Disorder of Impulse formation
 - Extra 'spark'
 - [abnormal automaticity or triggered conduction]
2. Disorder of Impulse conduction
 - Abnormal 'Circuit'
 - [Re-entry]

Diagram of the Cardiac Conducting System

Anatomical
Sites

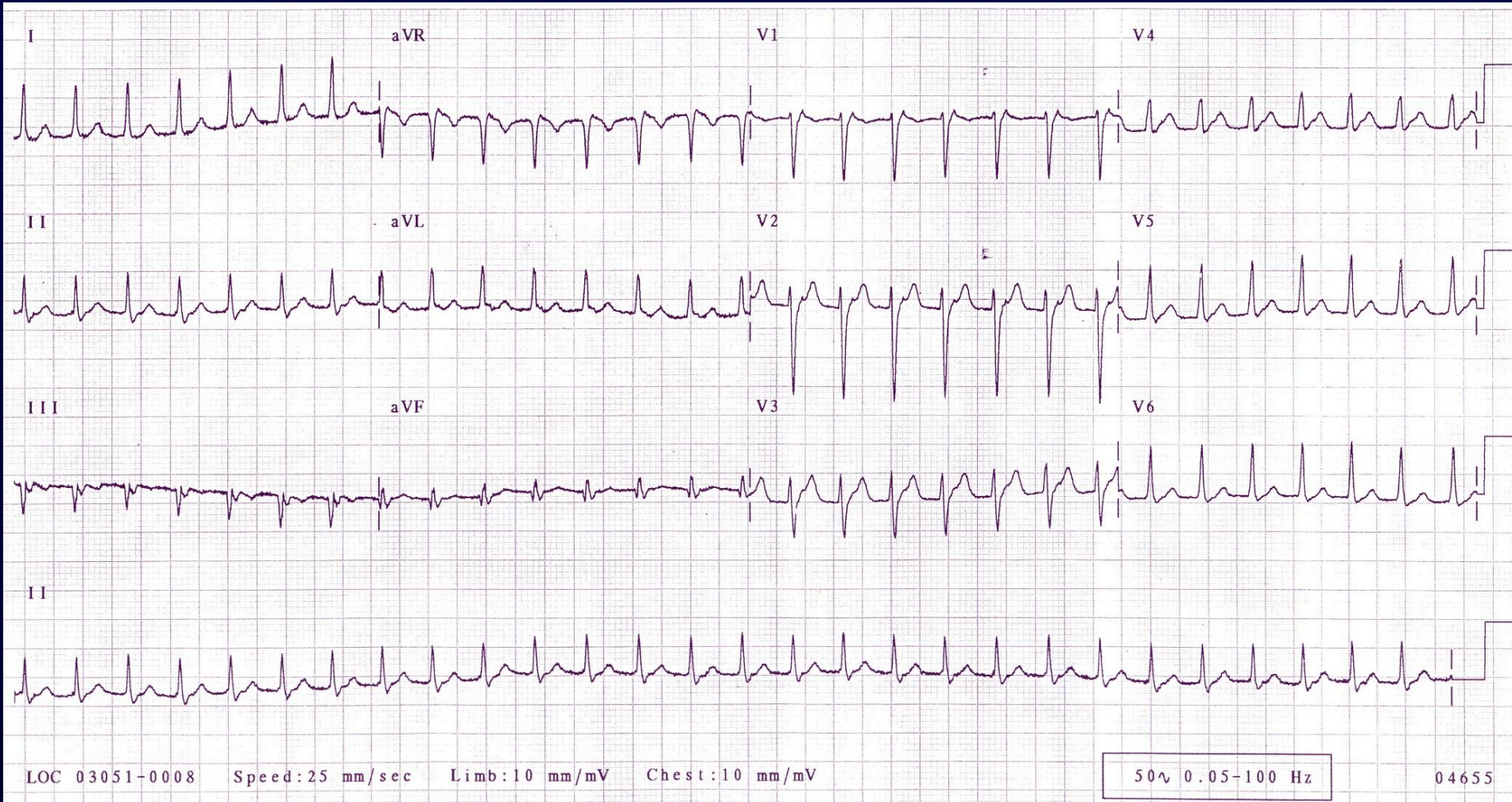


‘Spark’

‘Circuit’

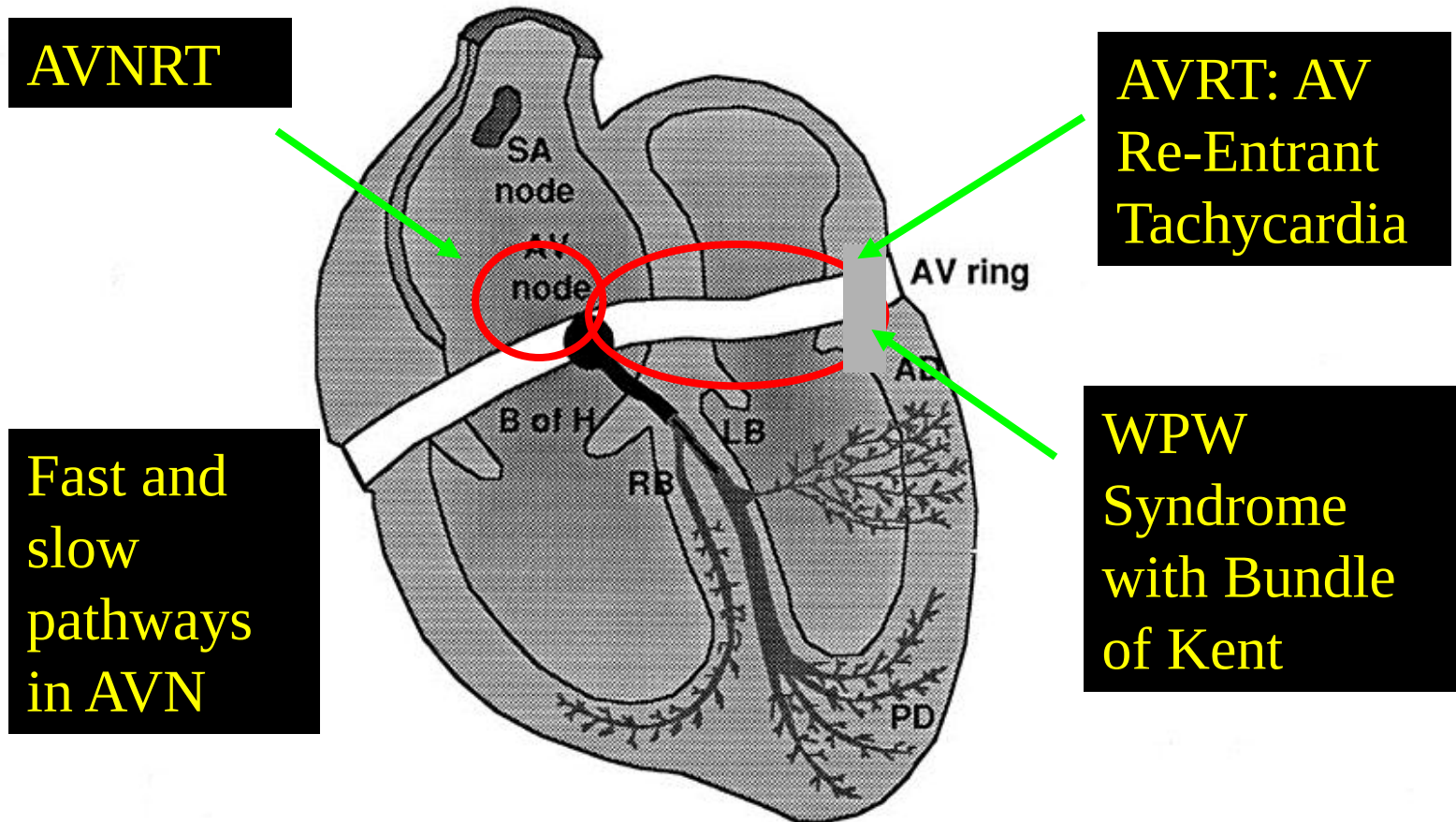
[‘Fibrillation’]

ECG Case 3



ECG Case 3: 'Circuit SVT' of AV Node

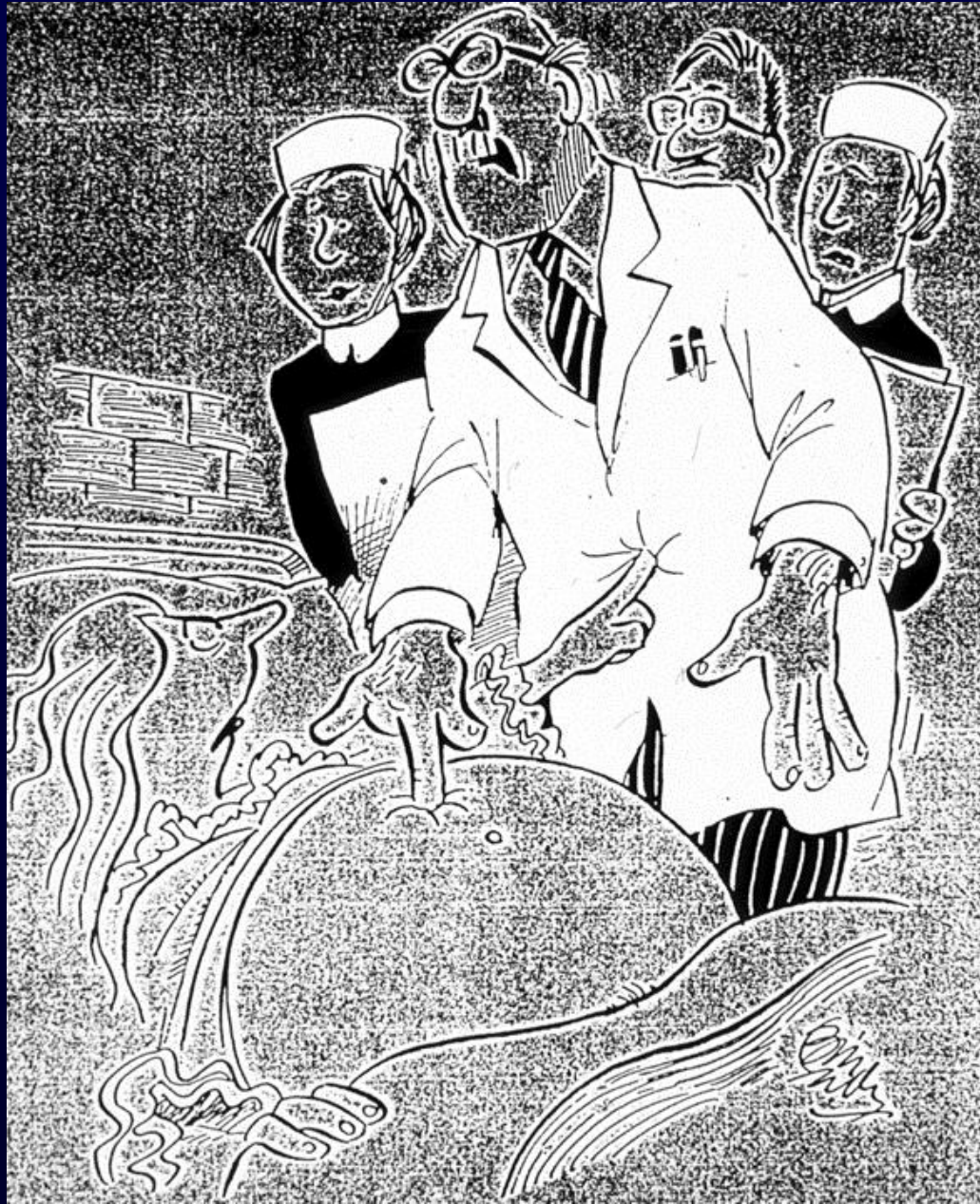
Diagram of the Cardiac Conducting System



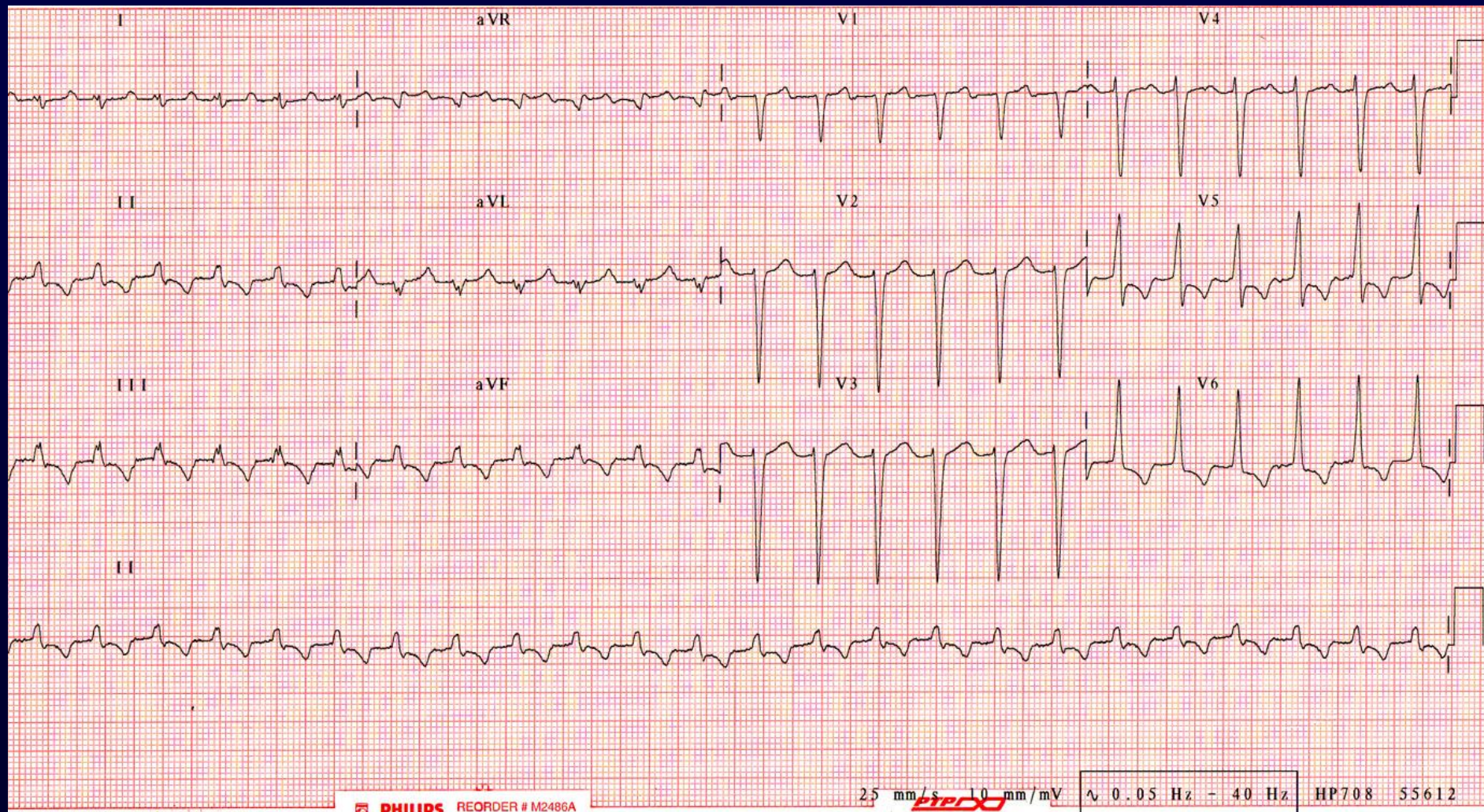
Another Example: Adenosine for SVT



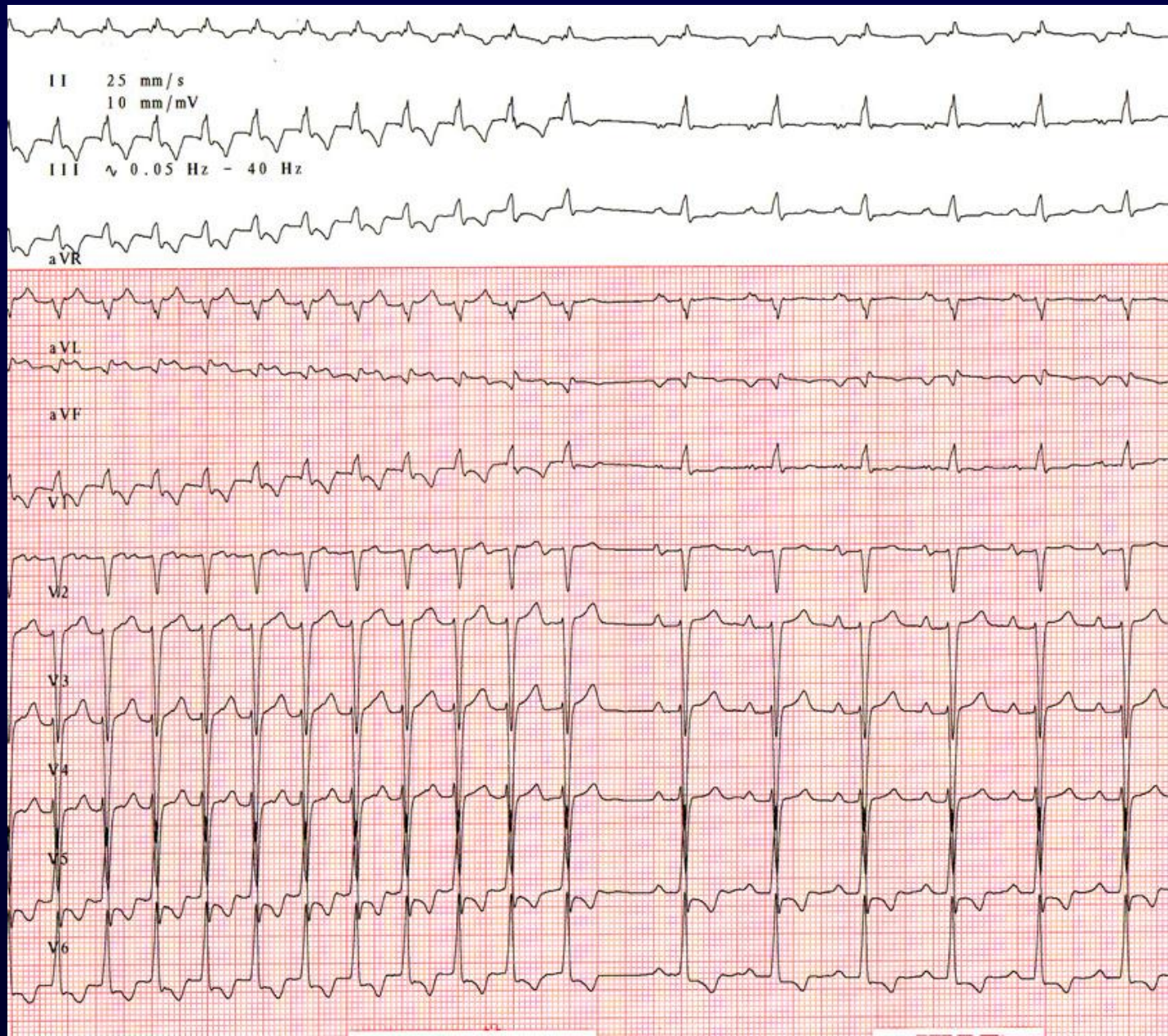
ECG Case 4



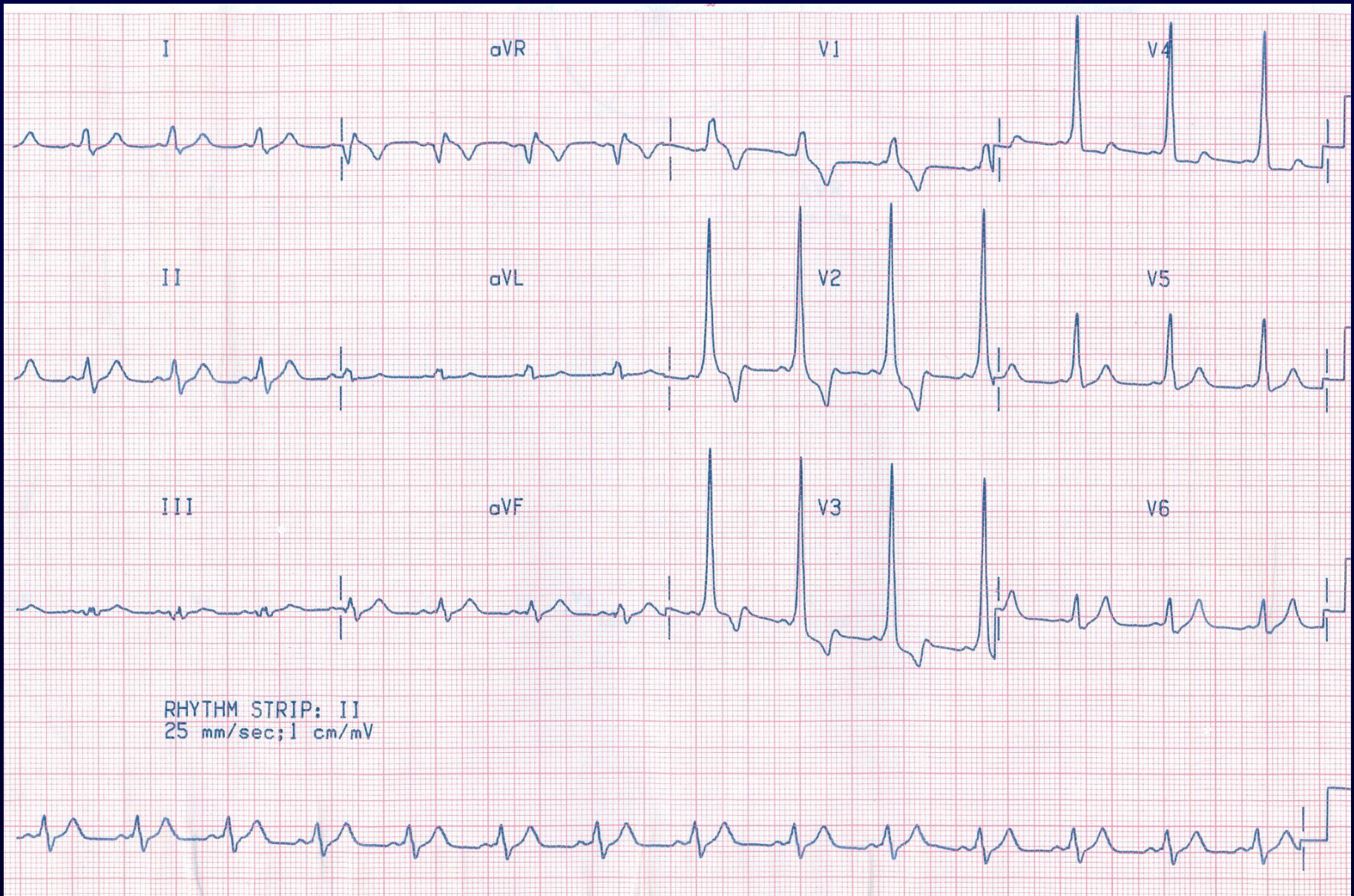
ECG Case 4



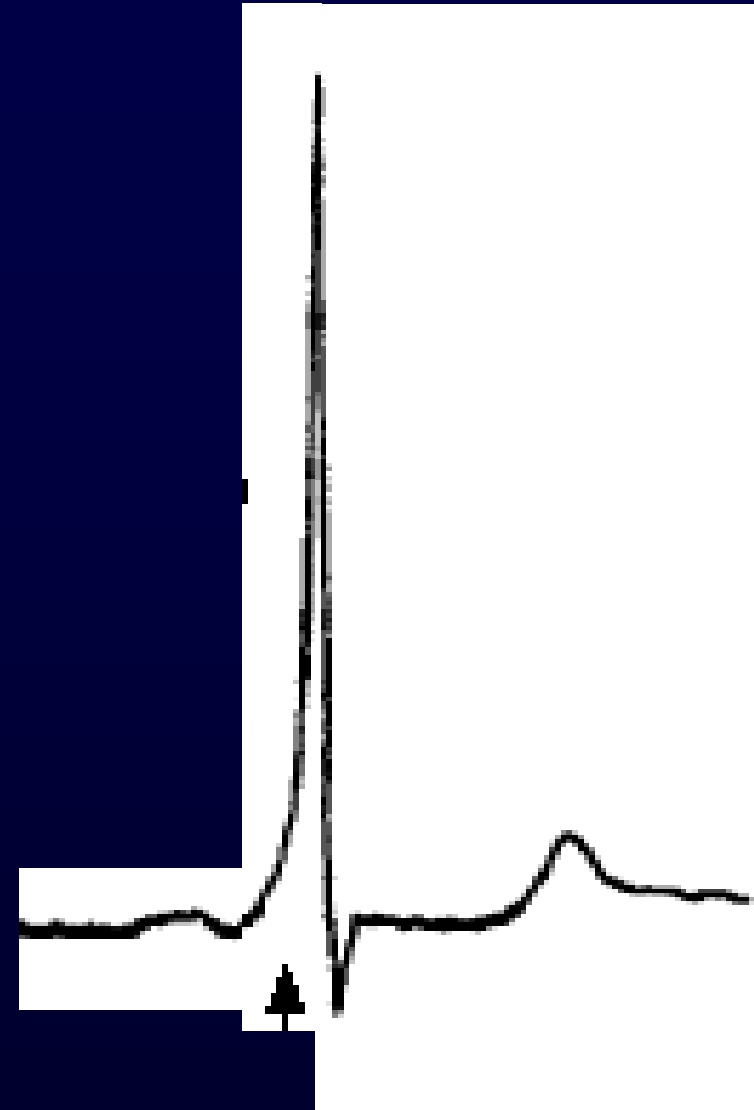
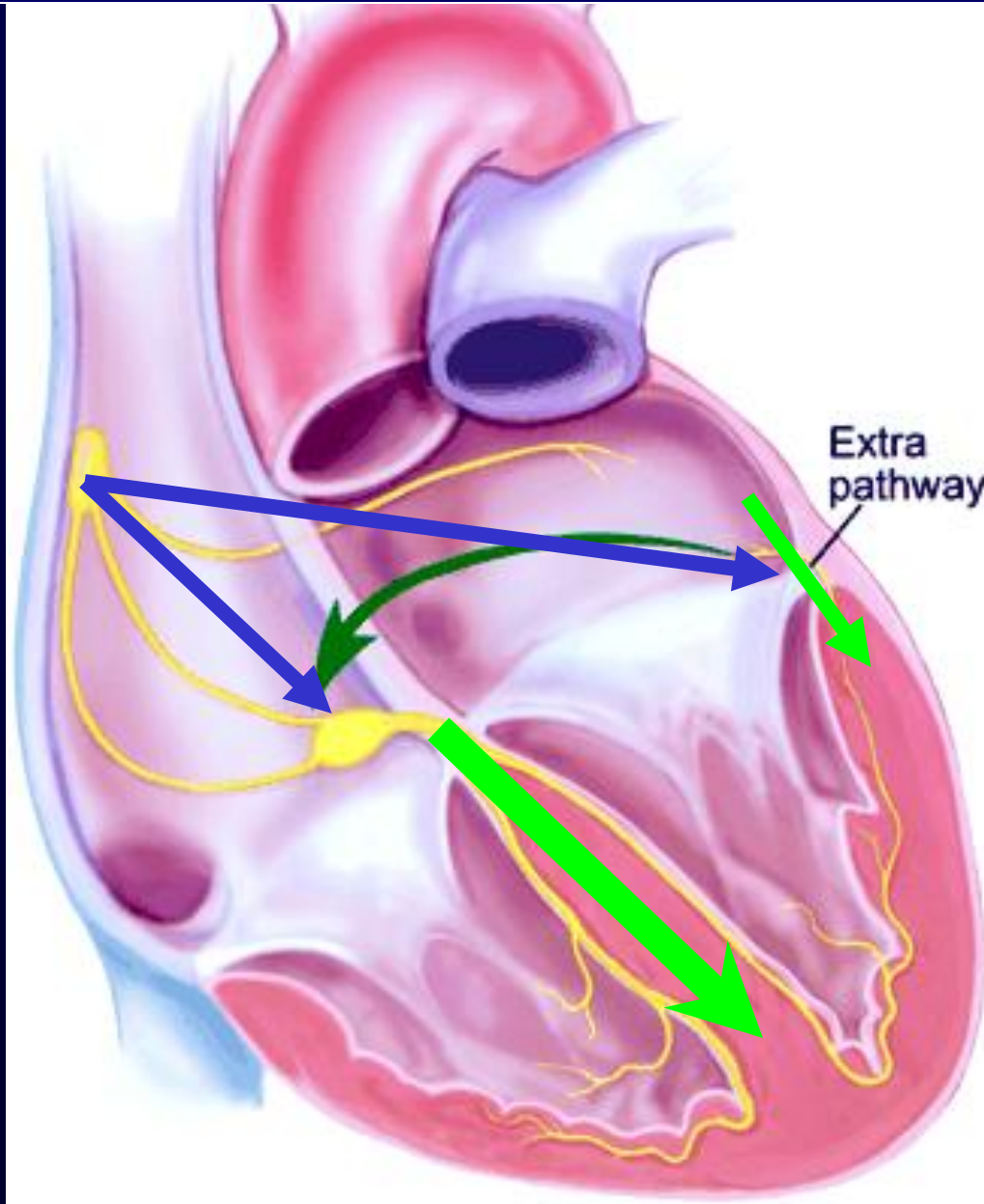
ECG Case 4: Adenosine Treatment



ECG Case 5



ECG 5: WPW Syndrome



ECG Case 7



“Quick nurse – the blindfold!”

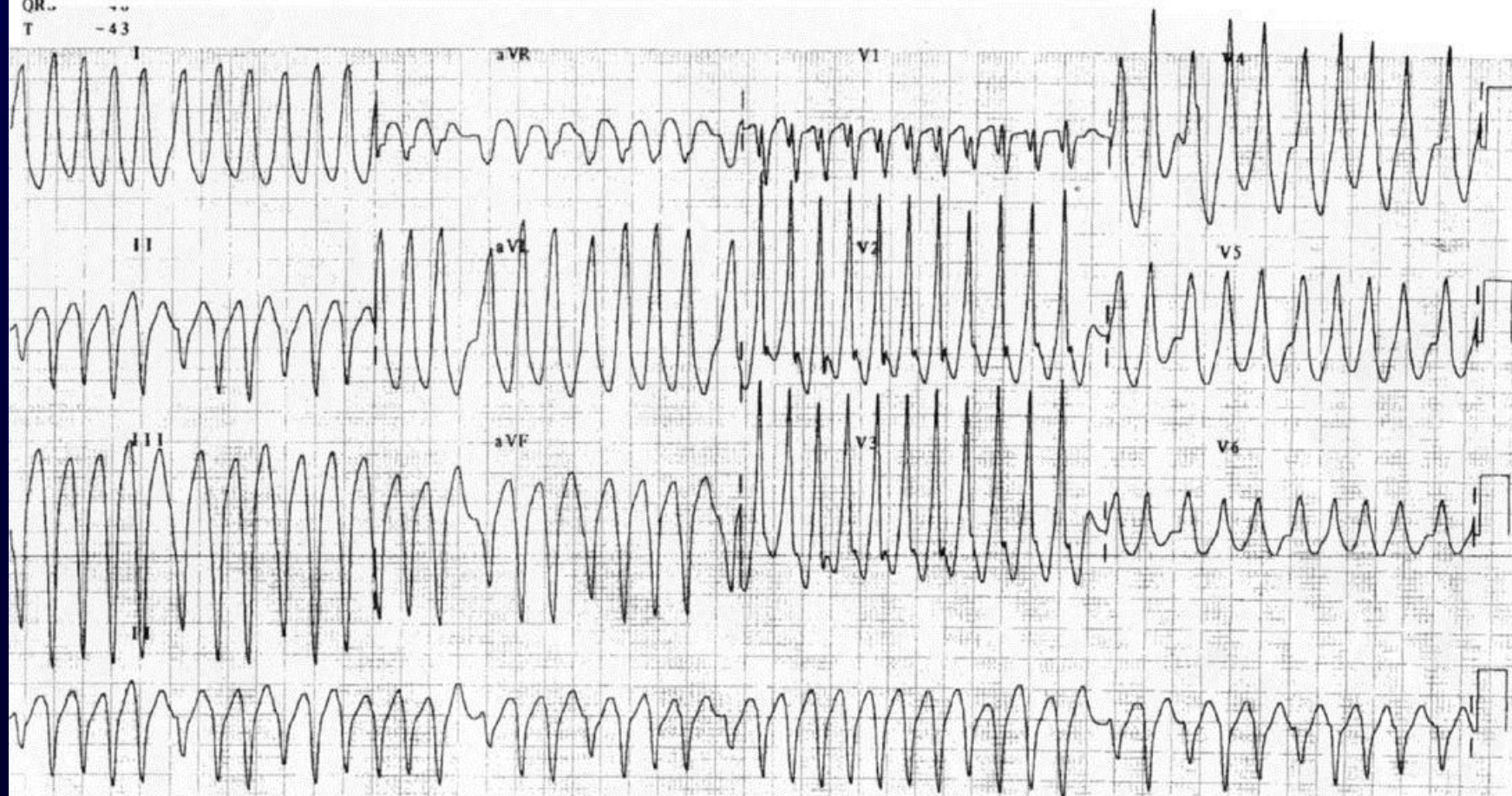
ECG Case 7

Rate 176
PR 136
QRSD 172
QT 346
QTc 592

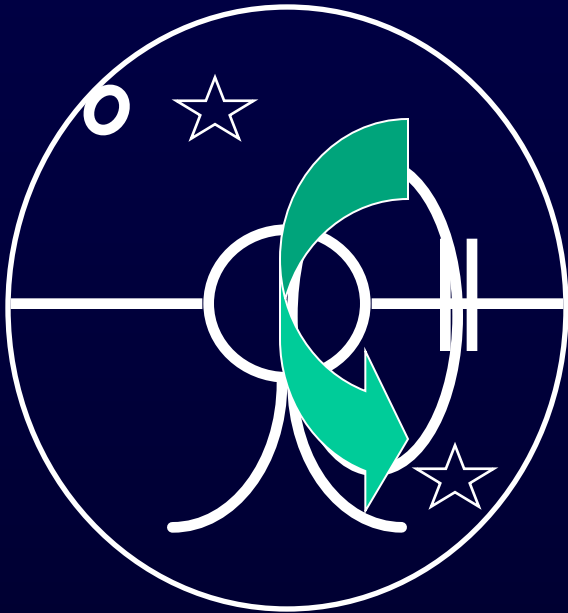
(2)

Palpitations

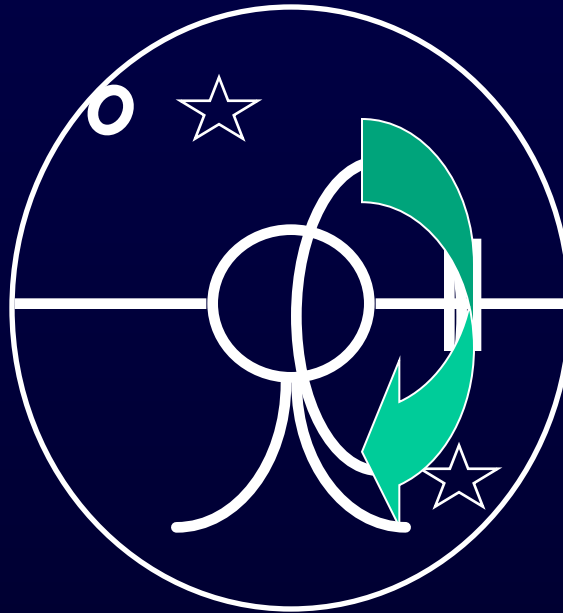
QR...
T -43



Tachycardias in WPW



Usual SVT
Antegrade
AVN

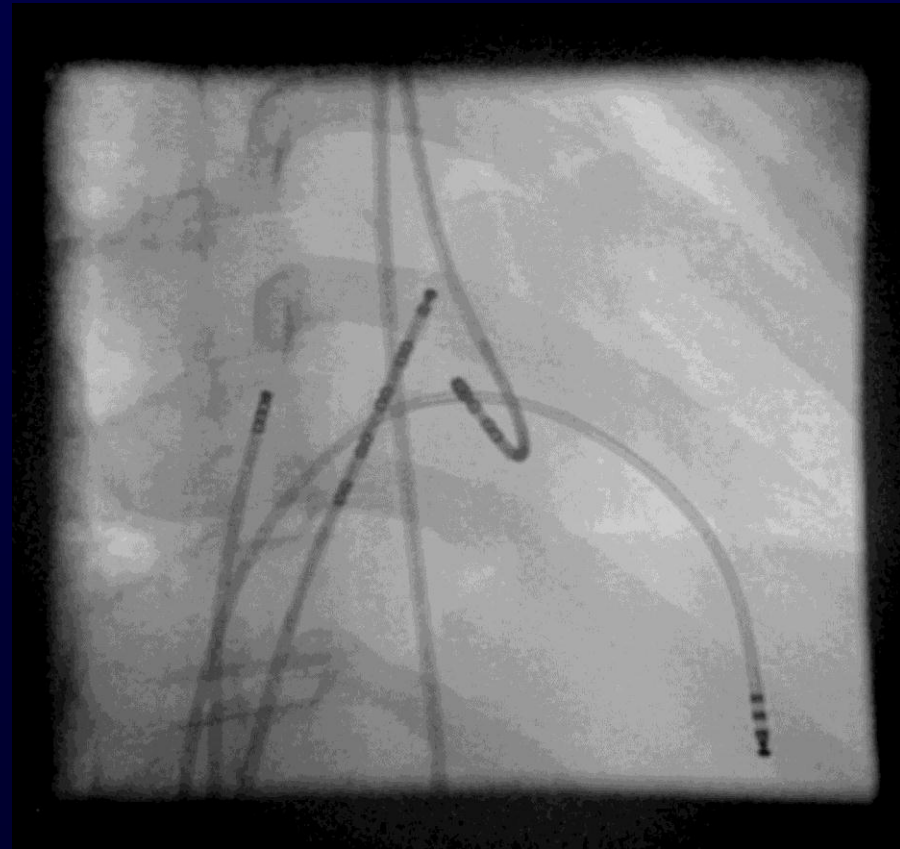
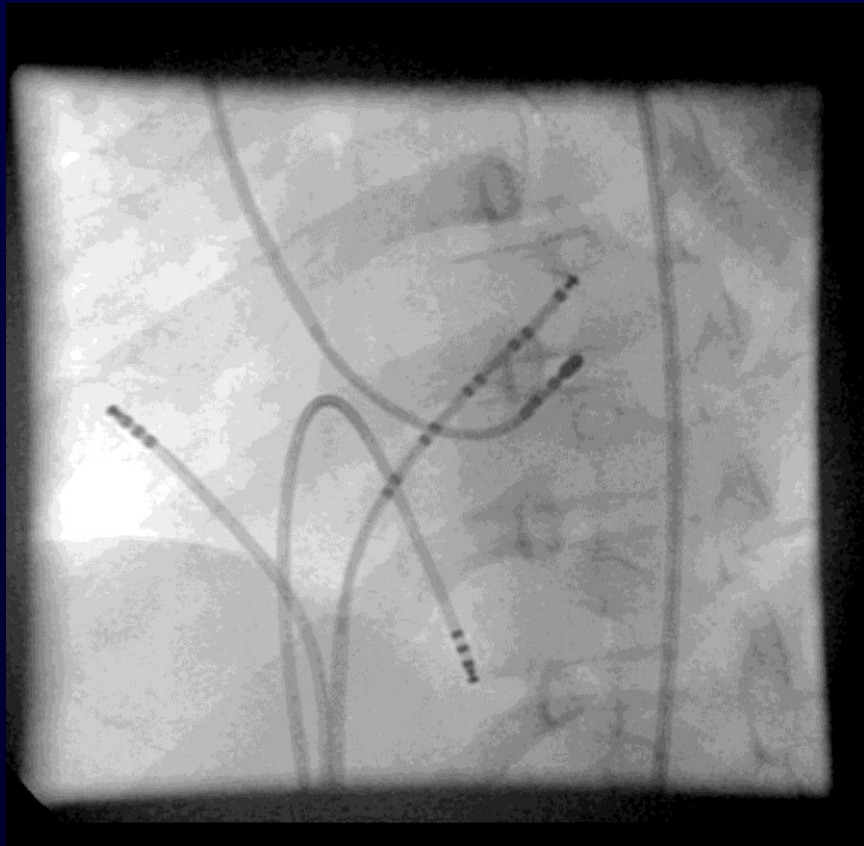


Unusual SVT
Retrograde
AVN

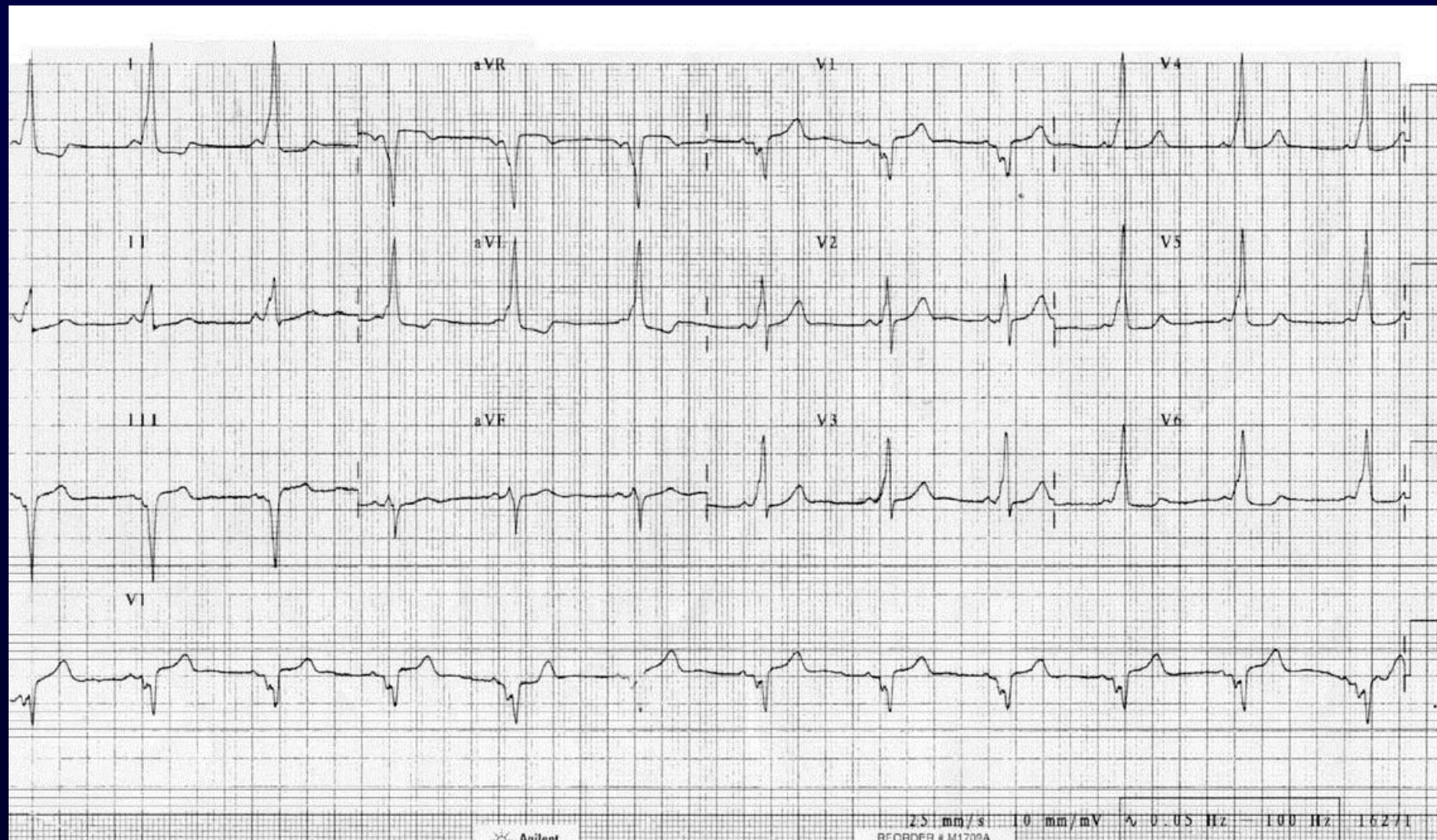


Rare, dangerous
Atrial Fibrillation
with no AVN
conduction

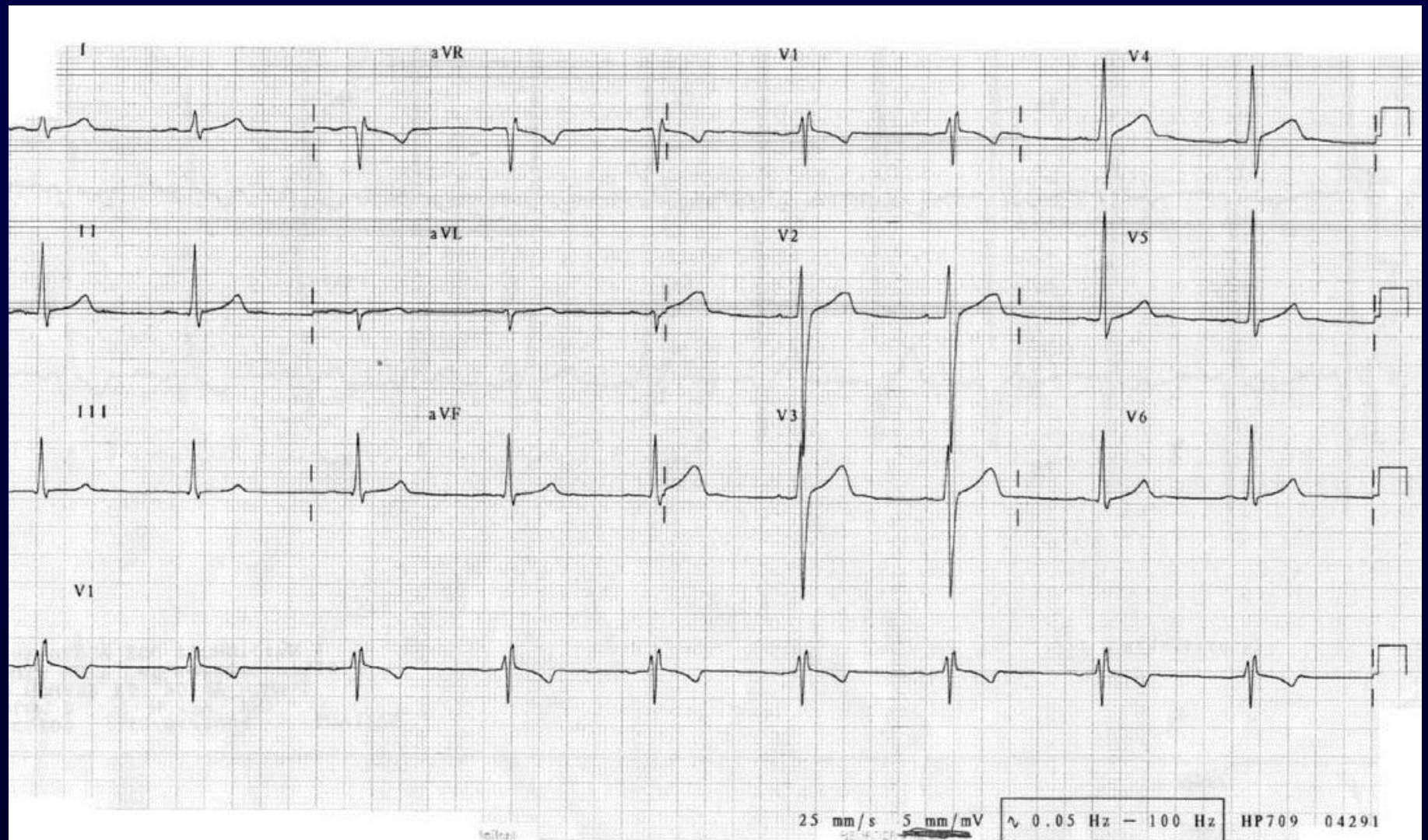
ECG Case 7: EP Study & Ablation of Bundle of Kent (Accessory Pathway)



ECG Case 8



ECG Case 8: Post EP Ablation



ECG Case 9



"How's he feeling? I badly need a pair of kidneys."

ECG Case 9

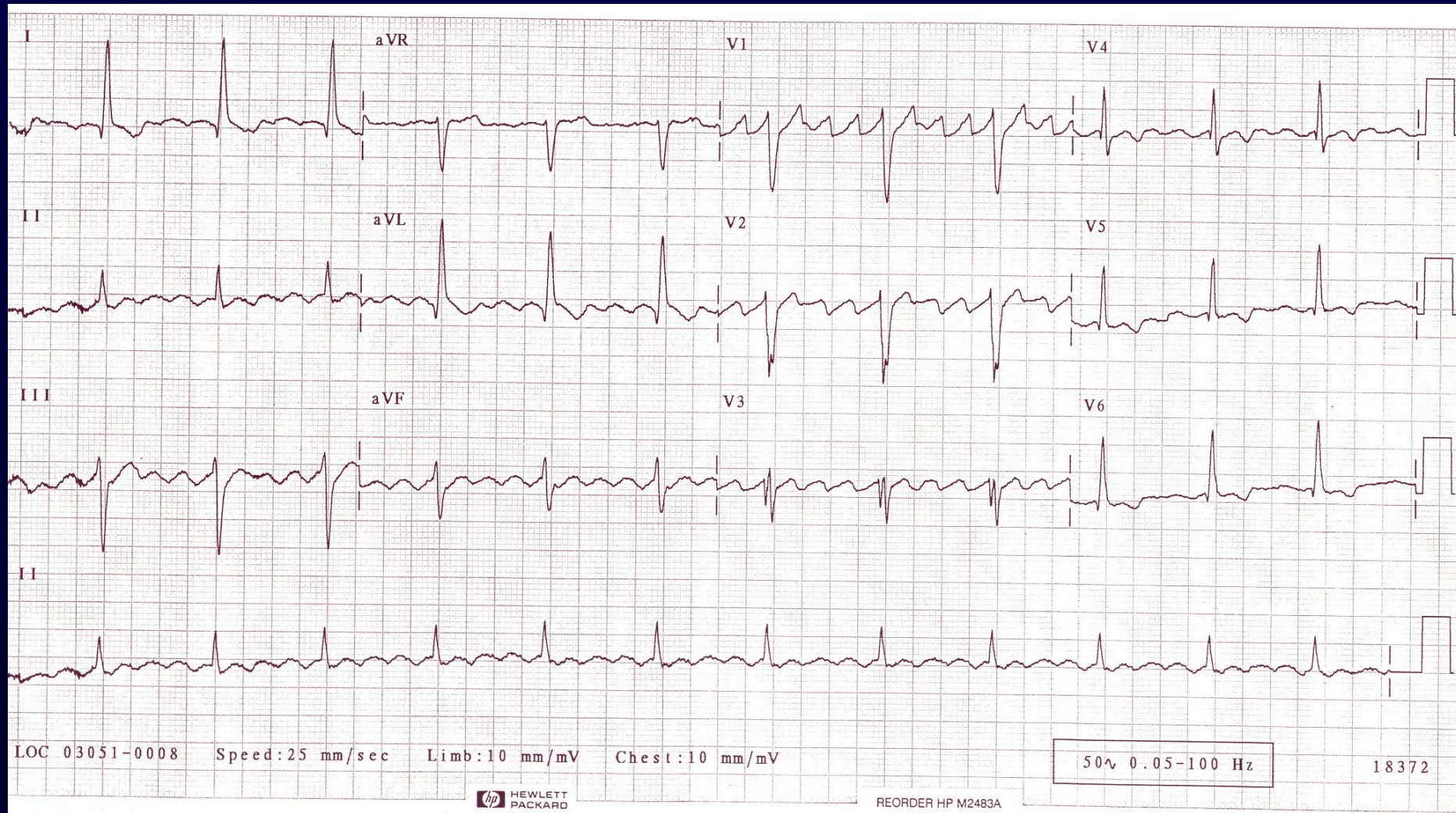
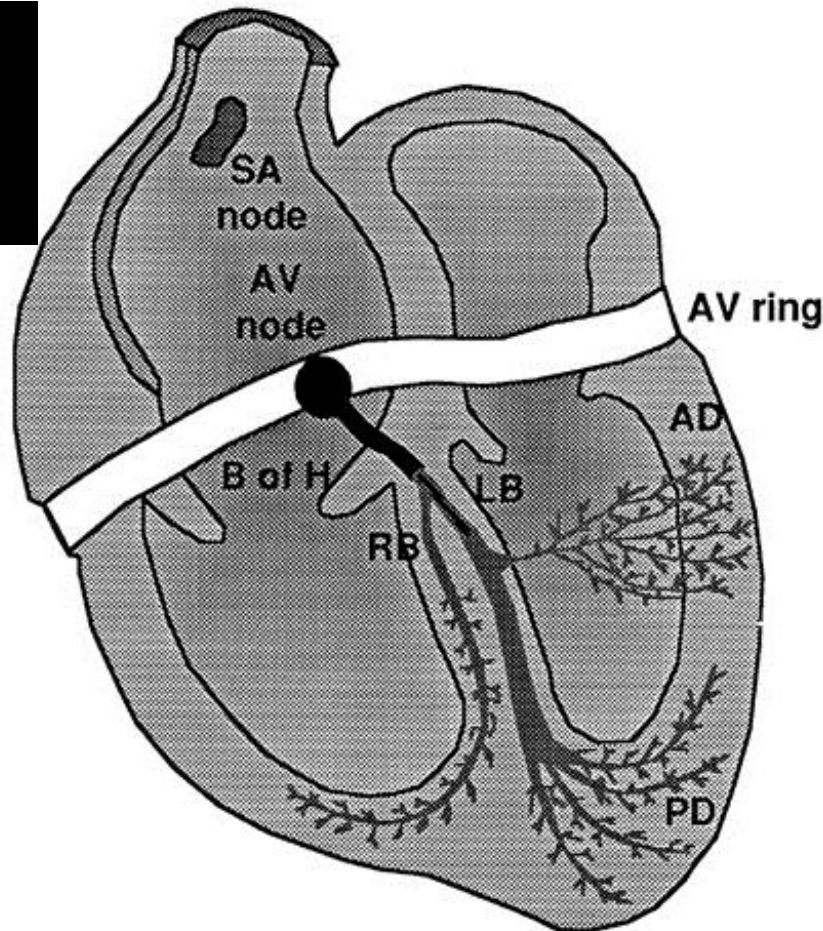


Diagram of the Cardiac Conducting System

Anatomical
Sites

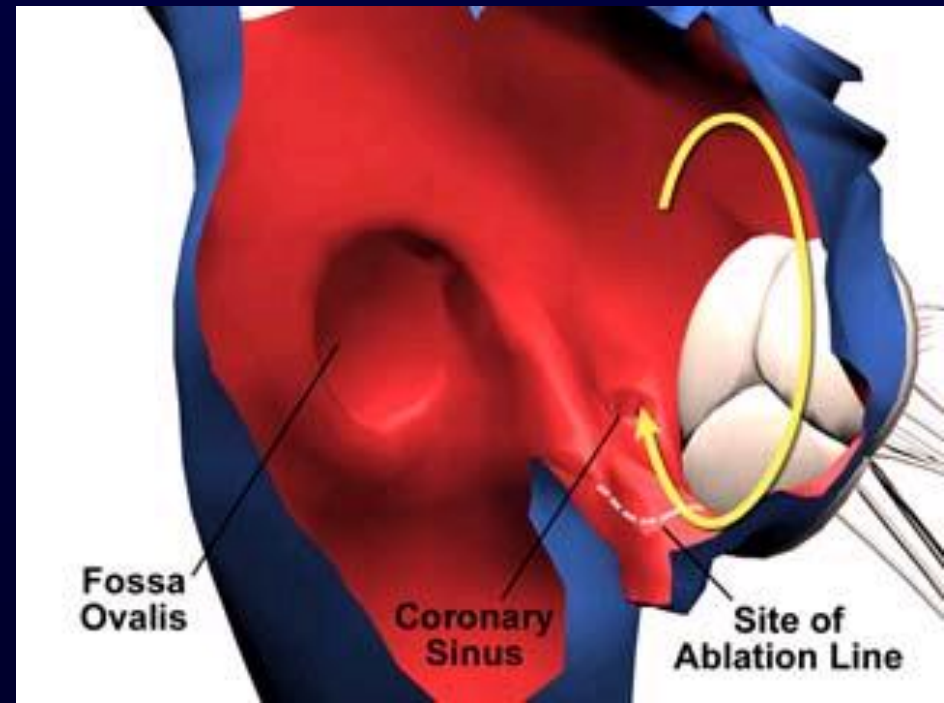
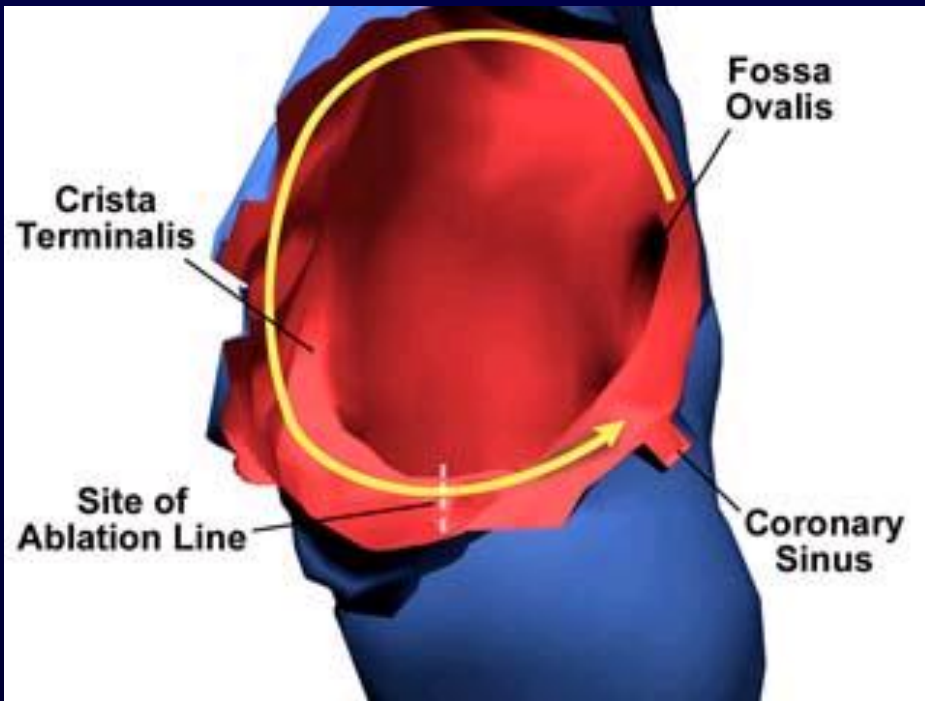


‘Spark’

‘Circuit’

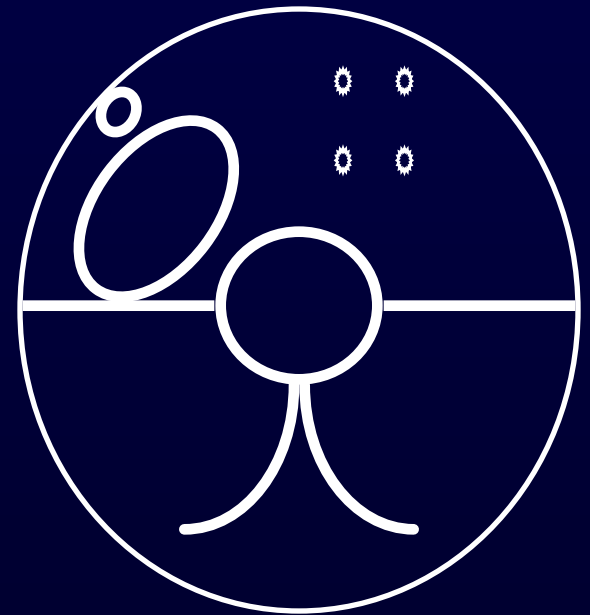
[‘Fibrillation’]

Typical Atrial Flutter Circuit in Right Atrium

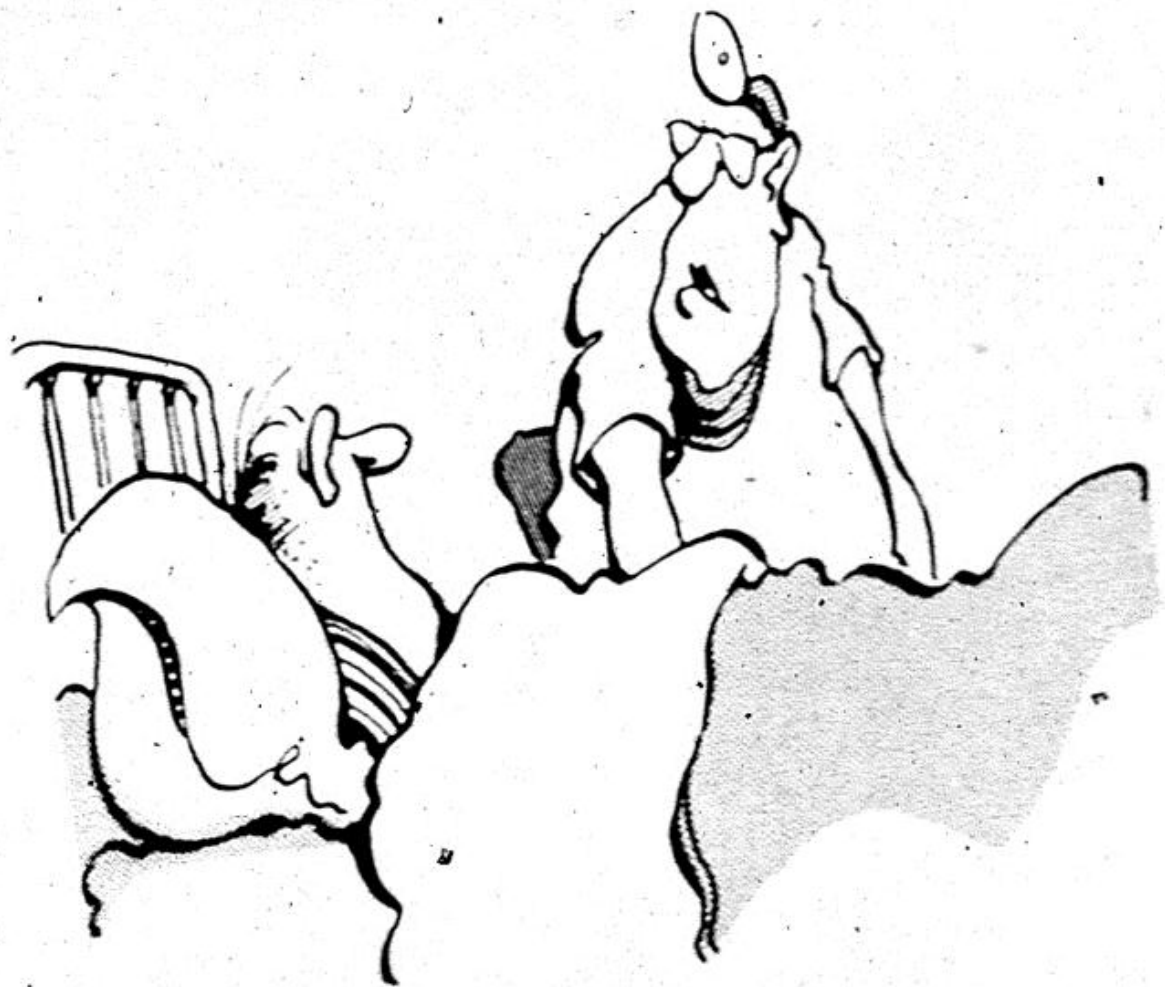


Atrial Flutter

- Typical A Flutter (RA)
- Medical therapy
- Ablation therapy
 - Isthmus Block
- Risks
 - Recurrence
 - Other Atrial Tachycardias
 - Atrial Fibrillation

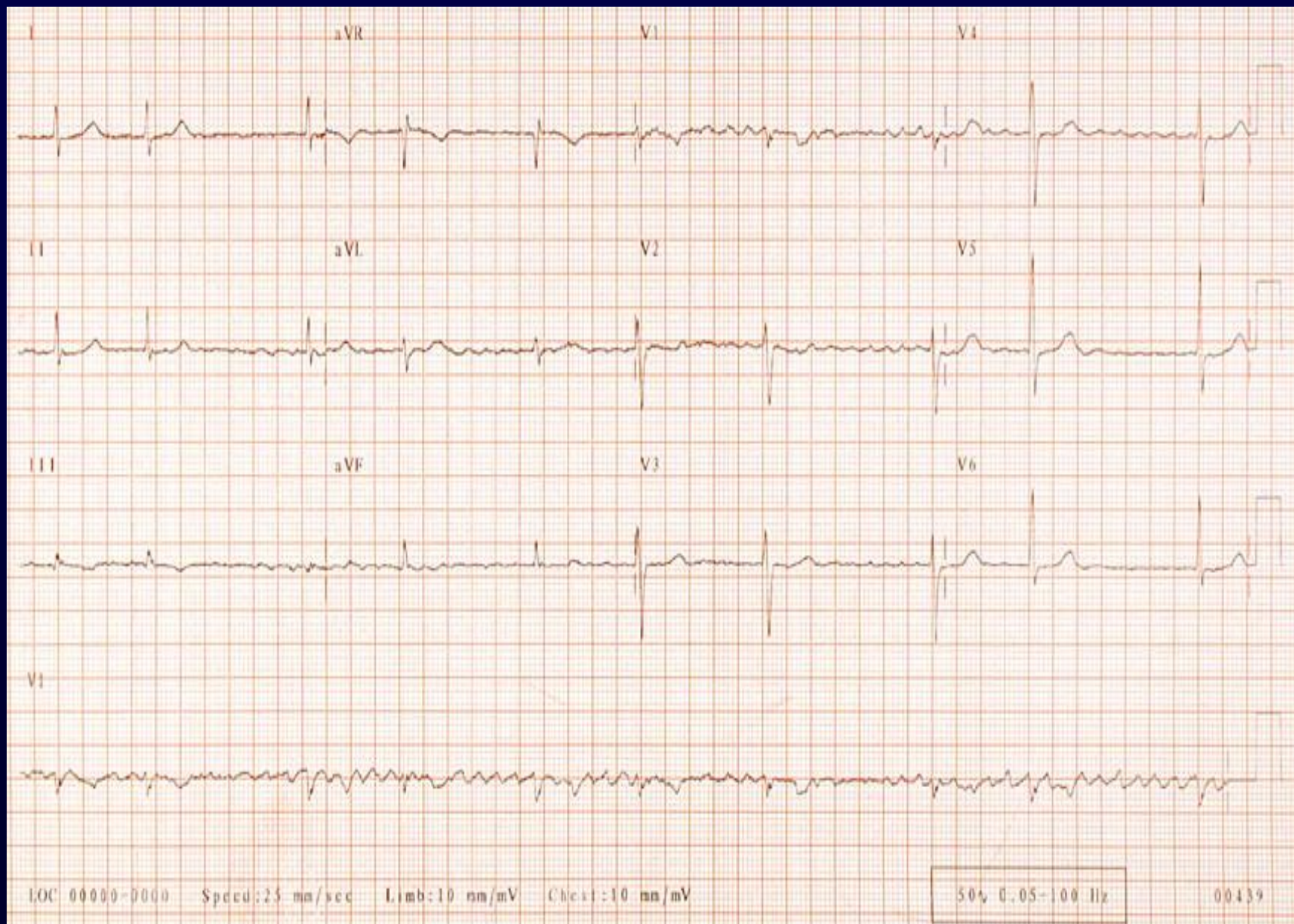


ECG Case 10

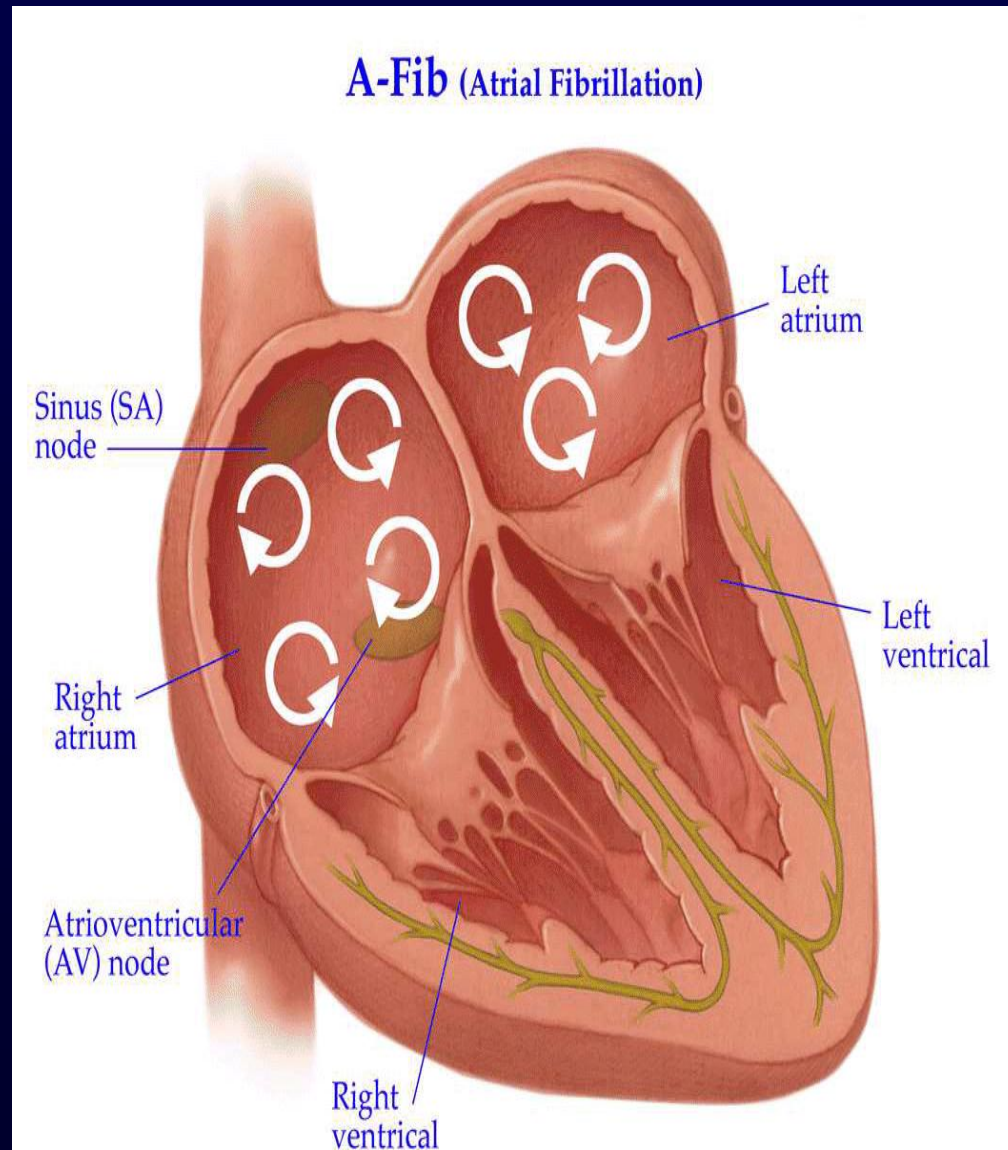


"With my luck lately, I'd say
your chances are about 50-50."

ECG Case 10



Atrial Fibrillation: Complex Re-Entry (Circuit) Mechanism



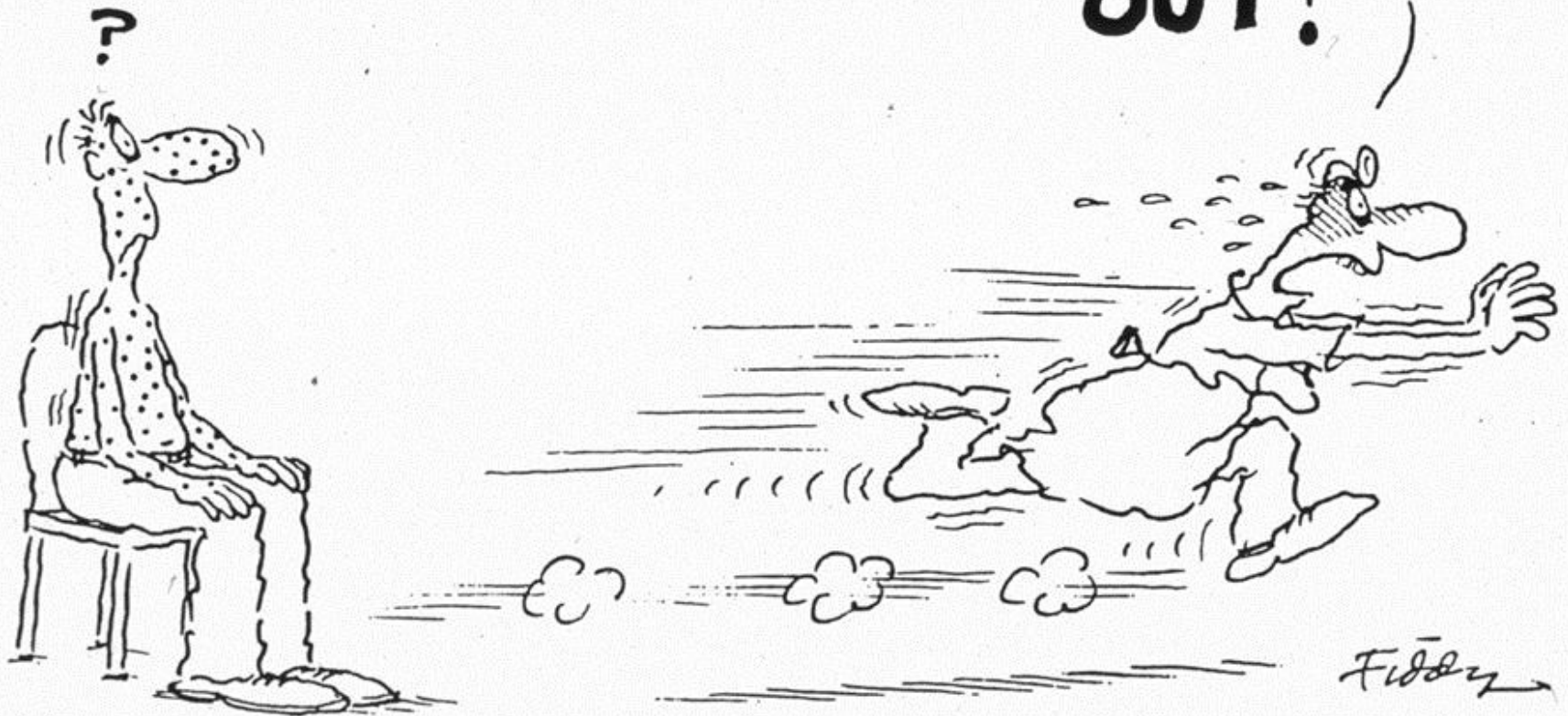
Atrial Fibrillation: Complex Re-Entry (Circuit) Mechanism; 3 Types

1. Paroxysmal: Usually recurrent, lasting < 7 days & self-terminating
 - LA junction/pulmonary vein triggers
 - Slivers of atrial tissue lying within the pulmonary veins
 - Localised autonomic ganglia releasing neurotransmitters
 - ALSO Some Af is RA triggered e.g. with pulmonary disease

Atrial Fibrillation: Complex Re-Entry (Circuit) Mechanism; 3 Types

2. Persistent: Lasting longer than 7 days & requiring intervention for termination
3. Permanent: Medical decision is made not to attempt termination
 - Additional changes occur in the atria with time [Persistent & Permanent]: fibrosis, changes in refractory period & conduction which encourage multiple small ‘circuits’ to form

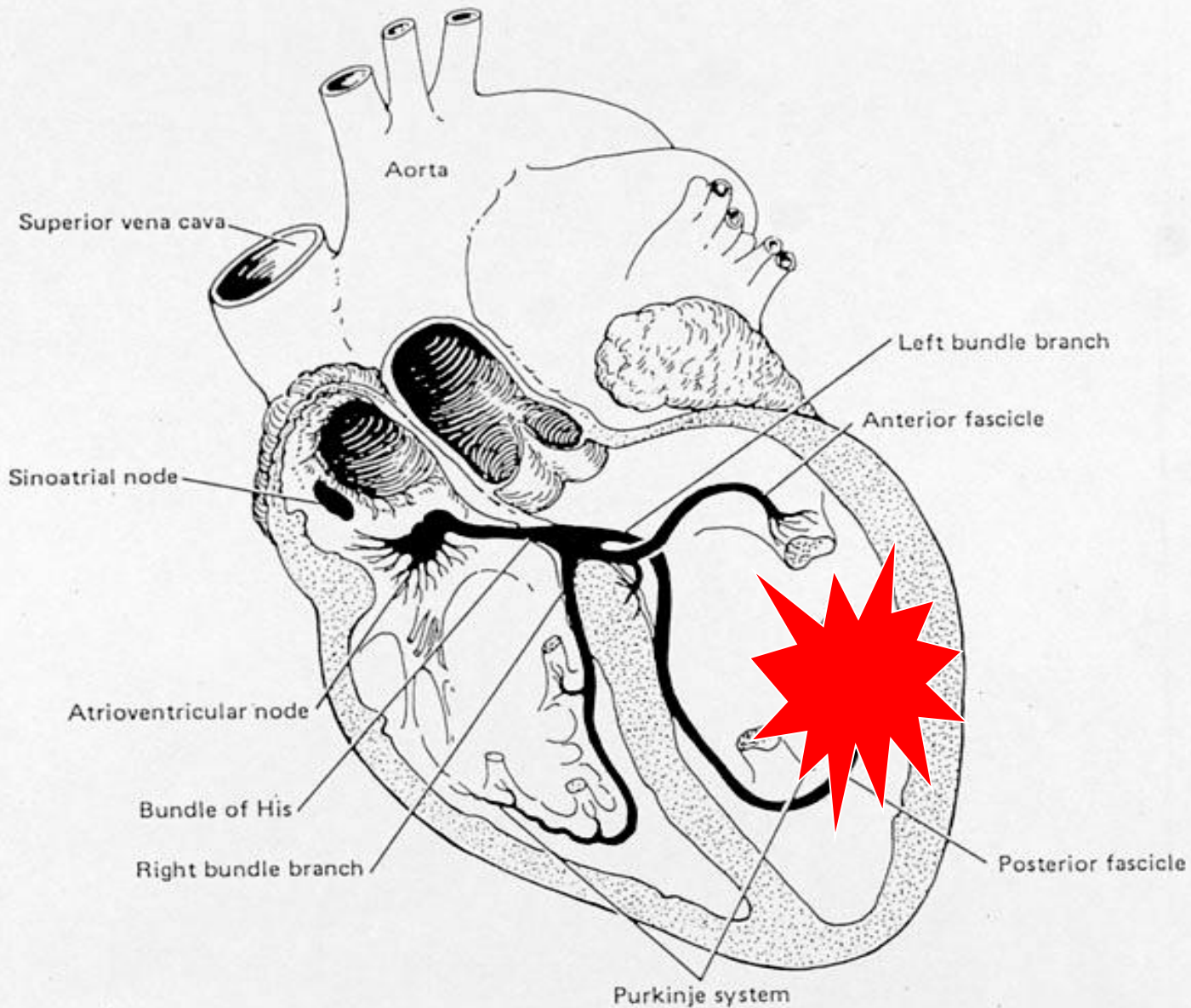
Quick-Fire ECGs

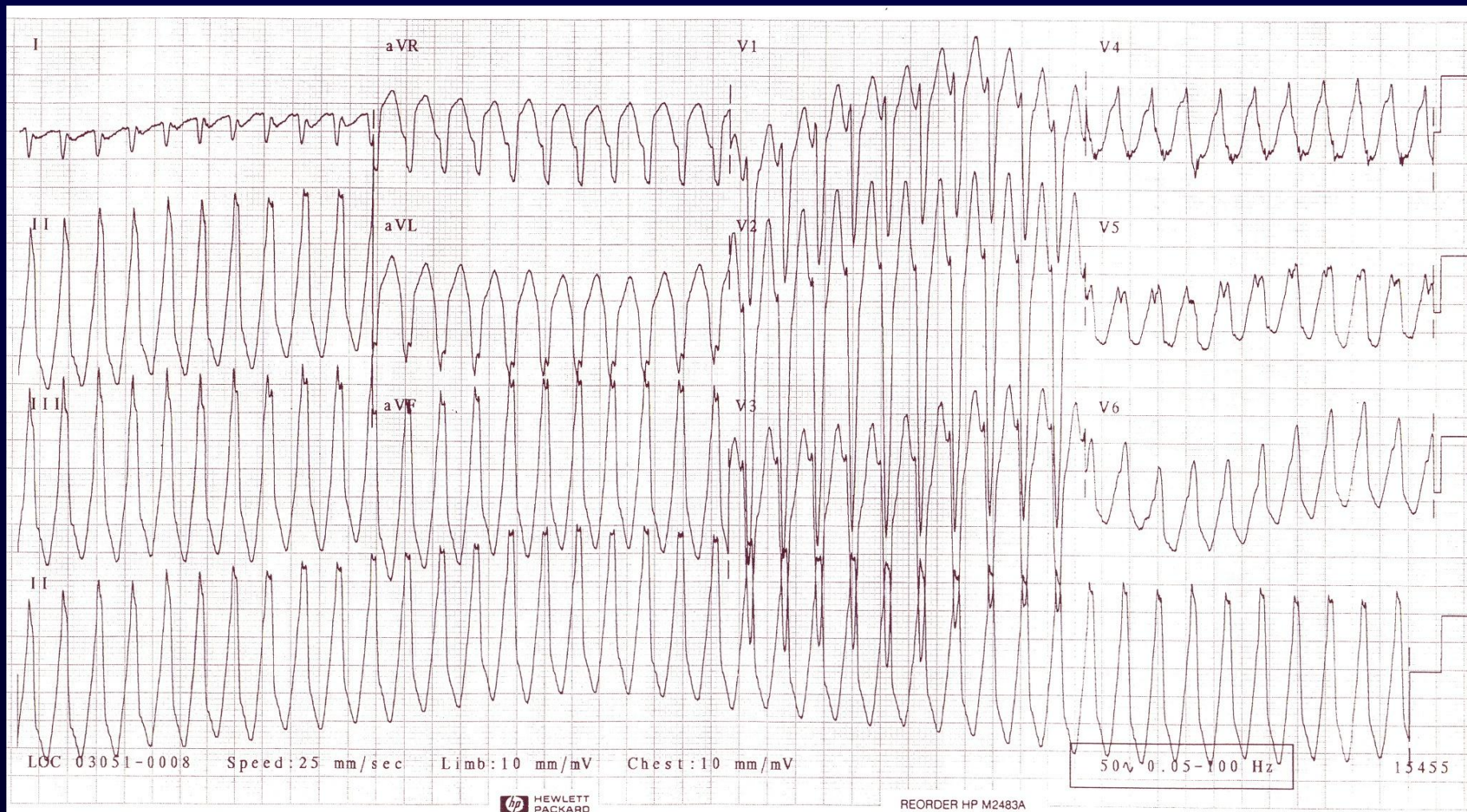


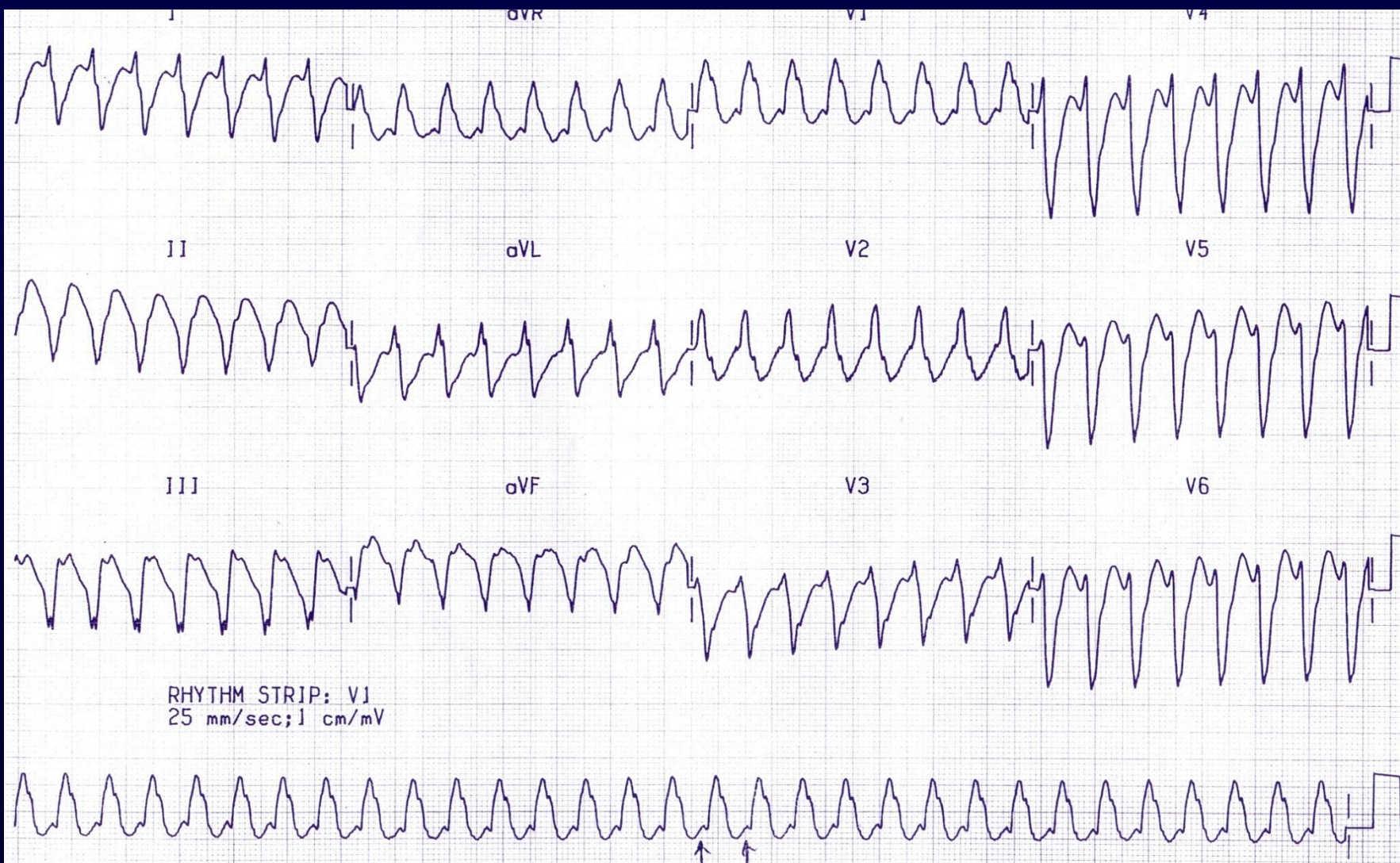


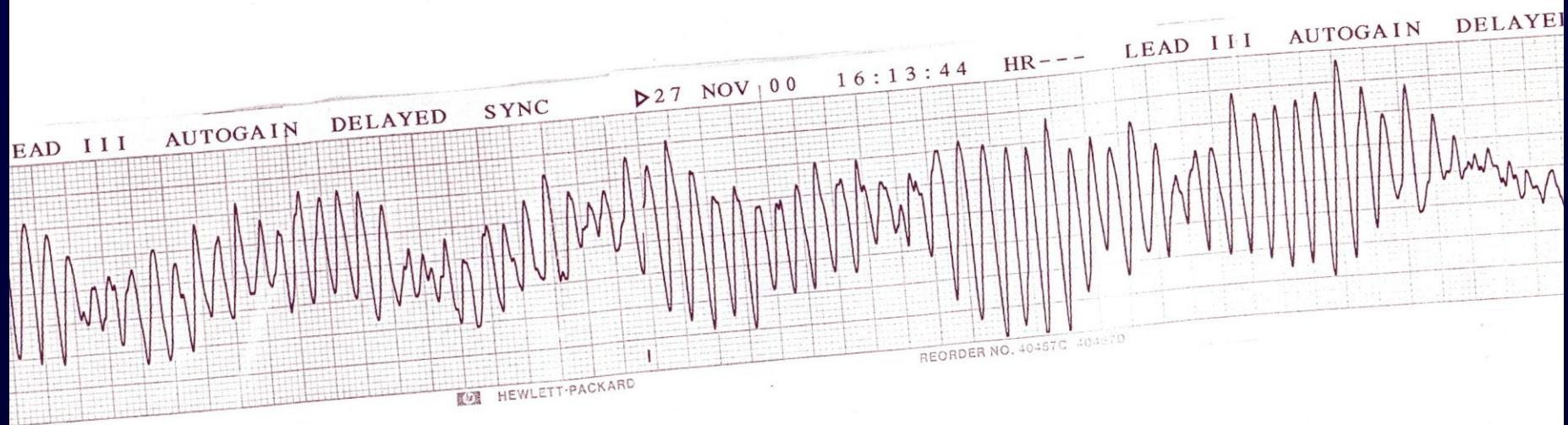


VF = Defibrillate asap!











"I can't even pronounce what you've got!"

II

aVL

V2

V5

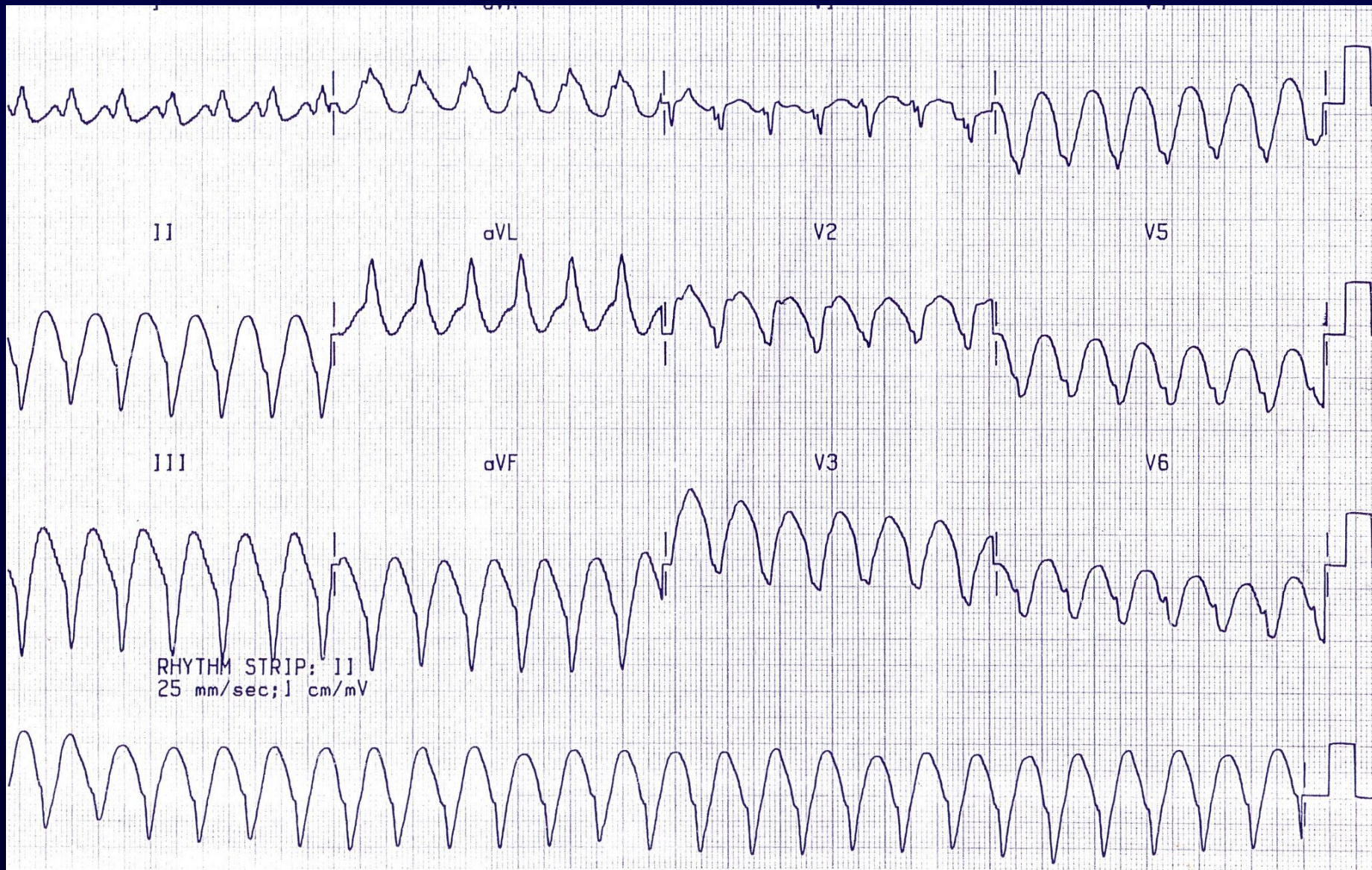
III

aVF

V3

V6

RHYTHM STRIP: II
25 mm/sec; 1 cm/mV



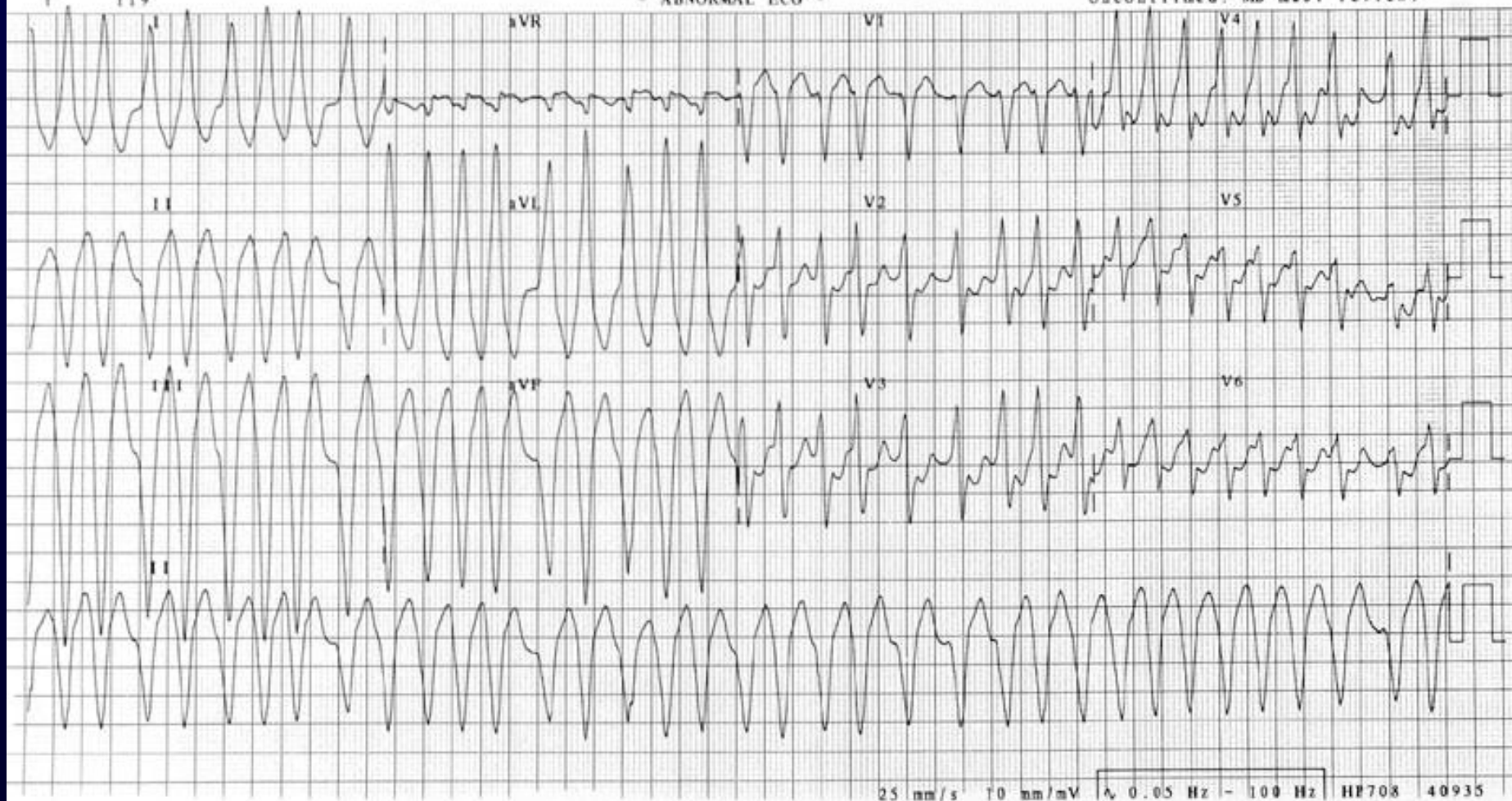
Rate 213 . VENTRICULAR TACHYCARDIA, rate = 213V-rate > 150, QRSD > 150 mS
PR 0 No further analysis will be attempted
QRSD 154
QT 281
QTc 529

--Axis--

P
QRS -61
T 119

- ABNORMAL ECG -

Unconfirmed. MD must review.



Rate 133 . No further analysis attempted for this ECG - not enough leads could be measured
PR 132 * Lead(s) V1,V2,V3,V4,V5,V6 were not used for morphology analysis
QRSD 76
QT 230
QTc 342

--Axis--

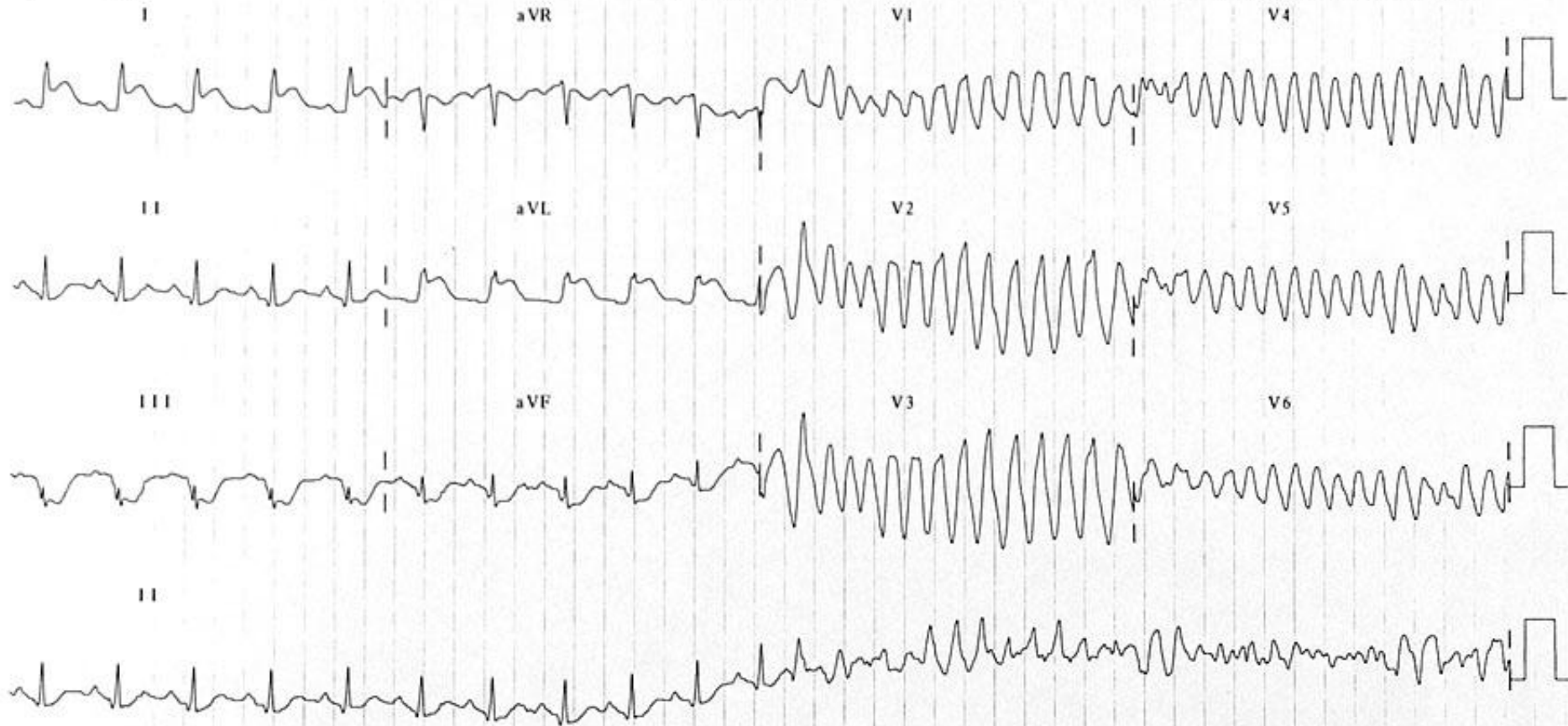
P 56

QRS -15

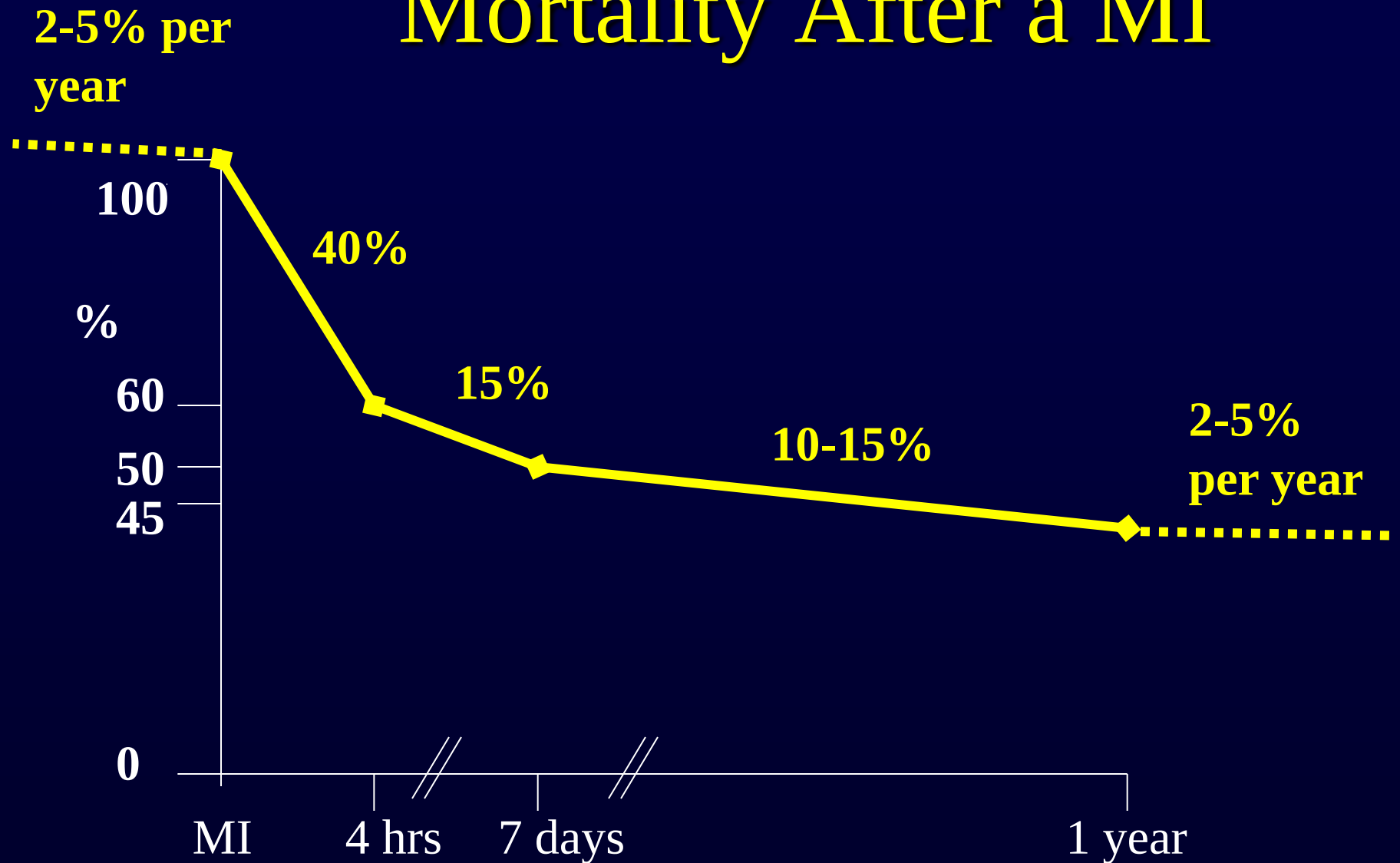
T -12

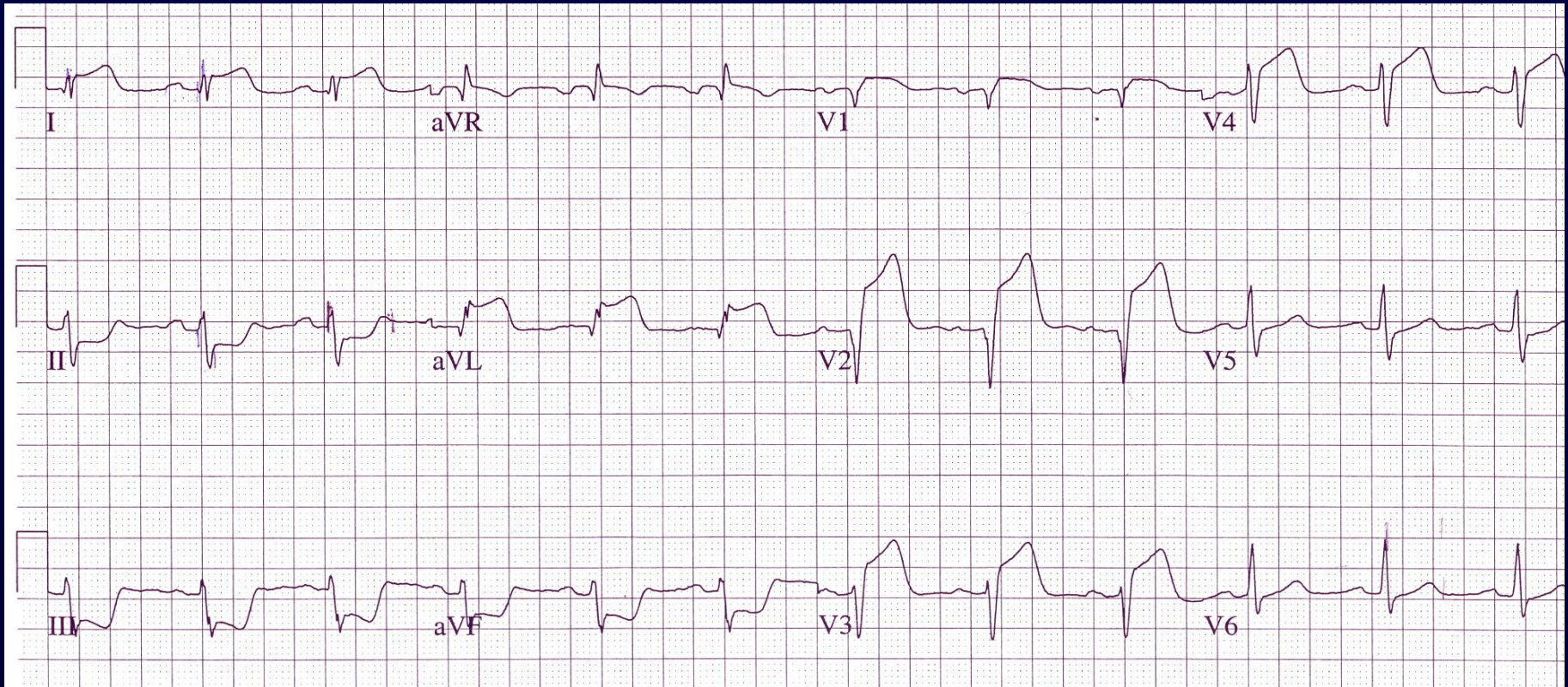
- DEFECTIVE ECG -

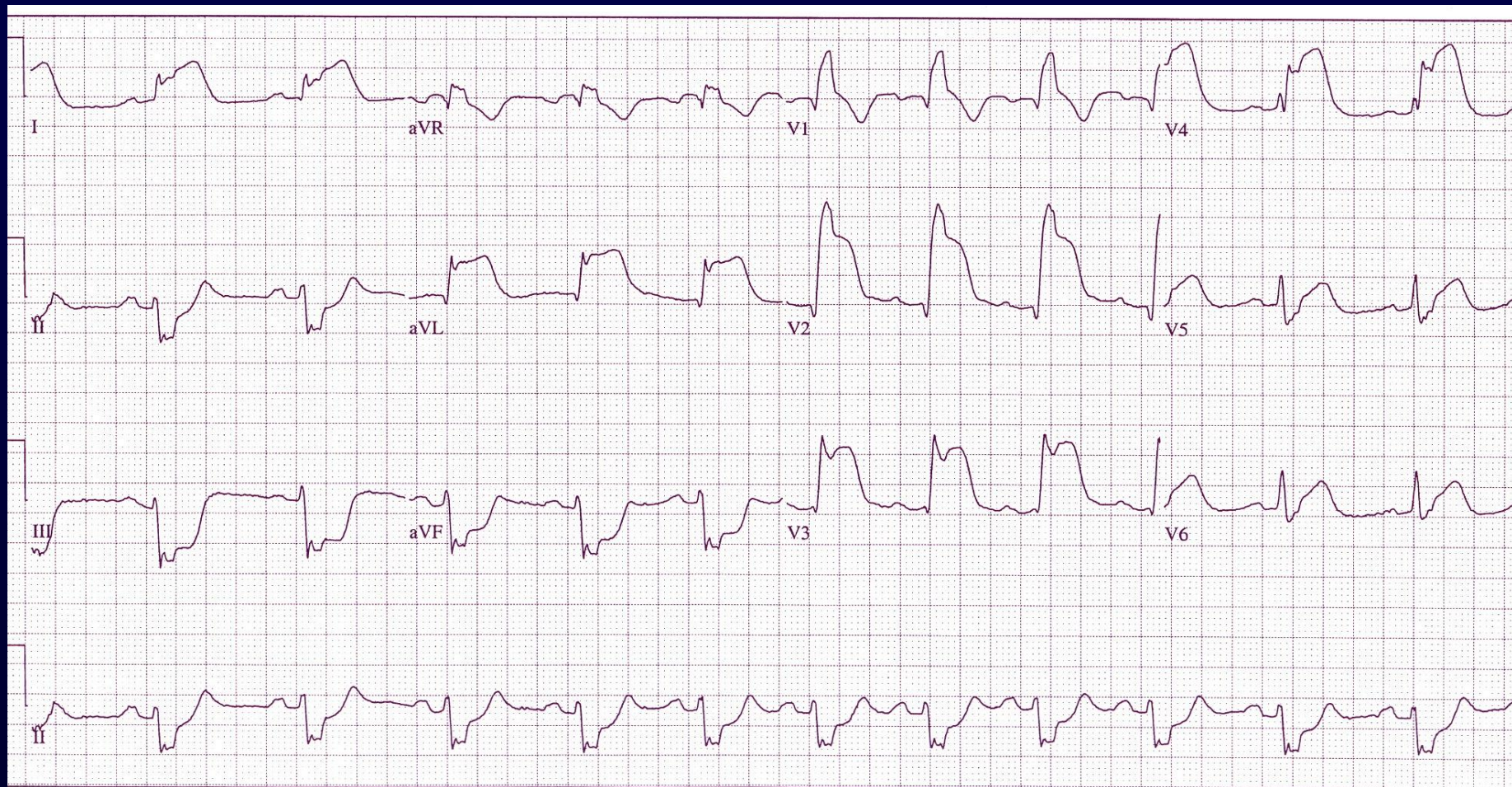
Unconfirmed. MD must review.



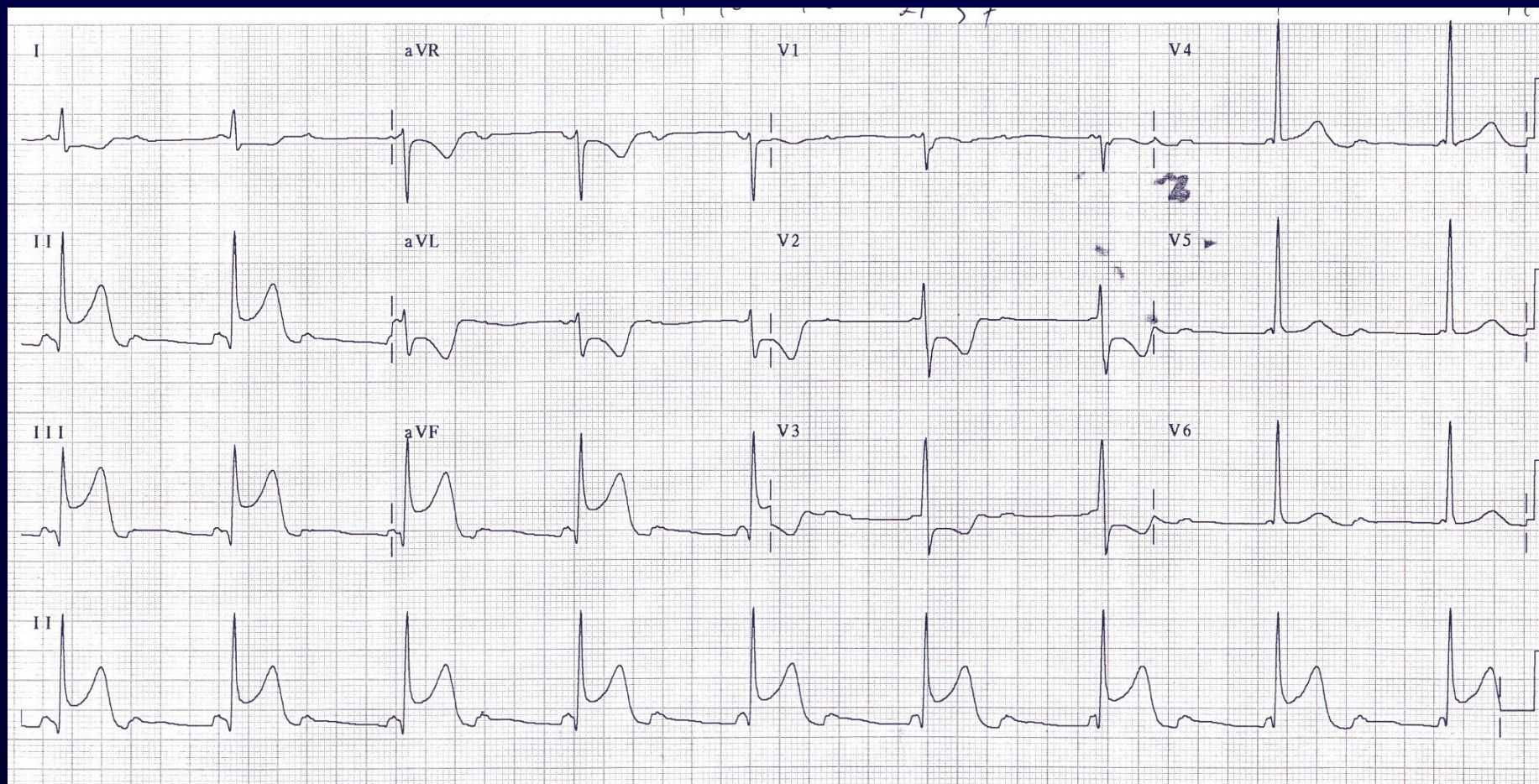
Mortality After a MI



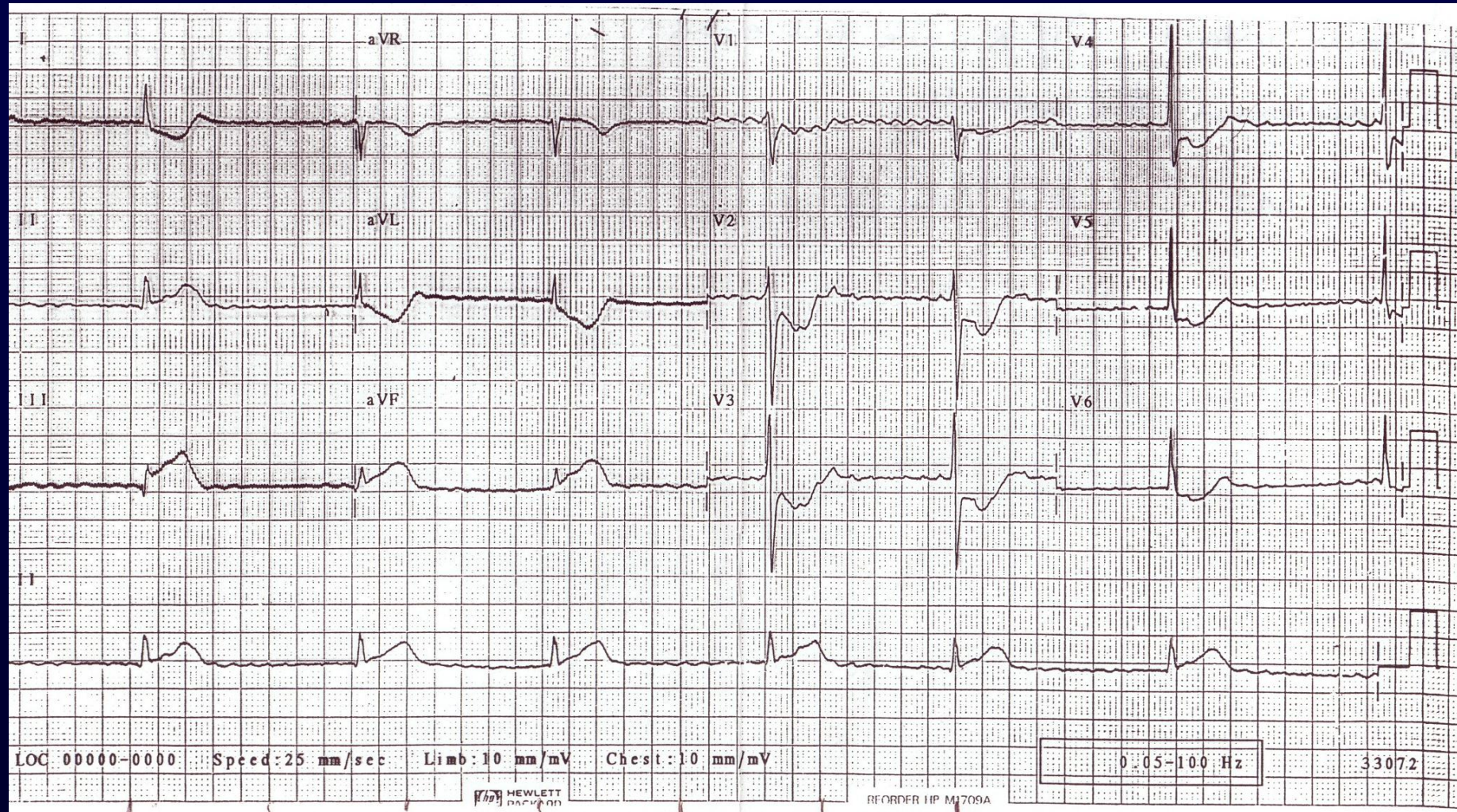


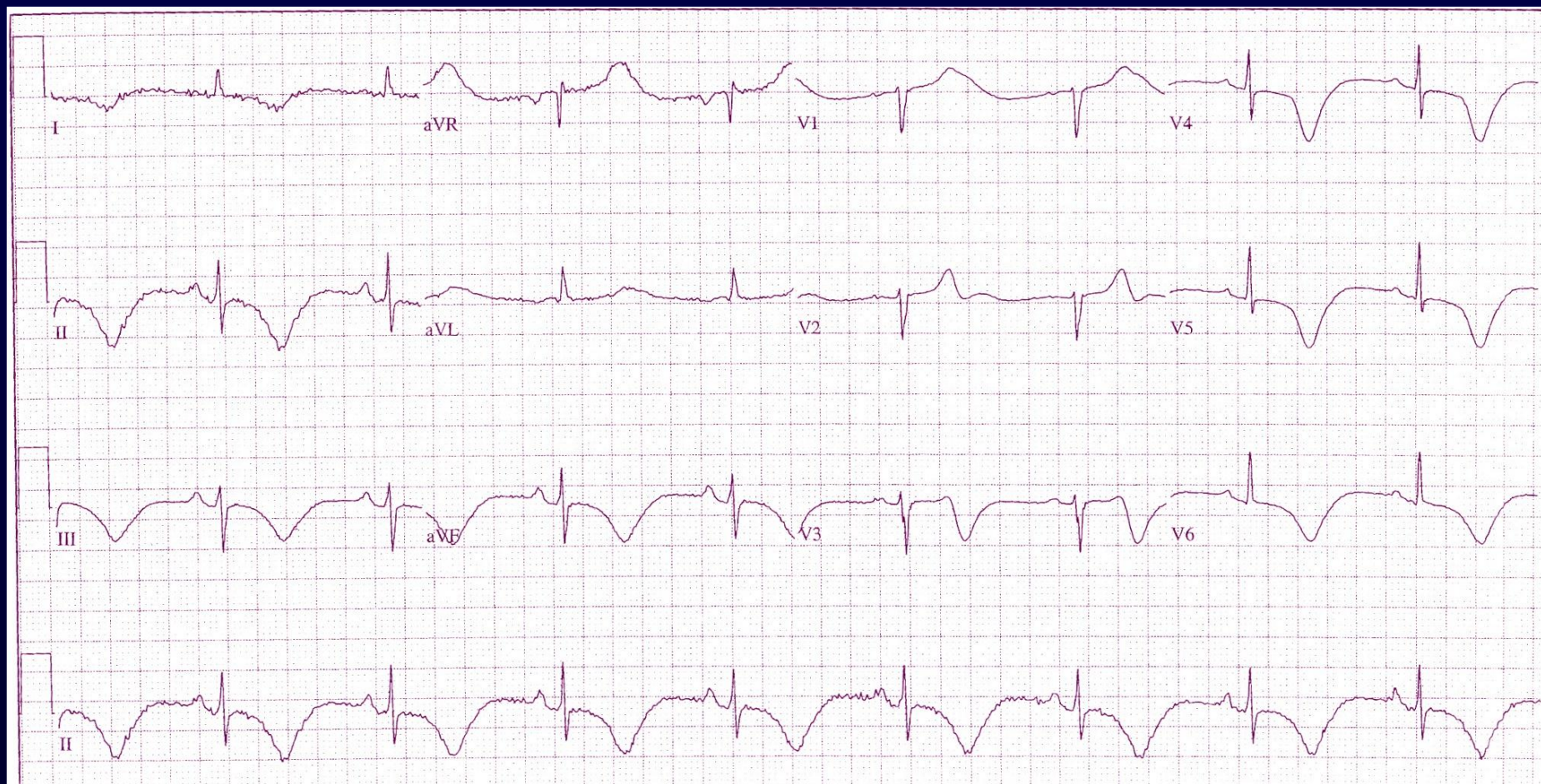


Inferior STEMI with CHB



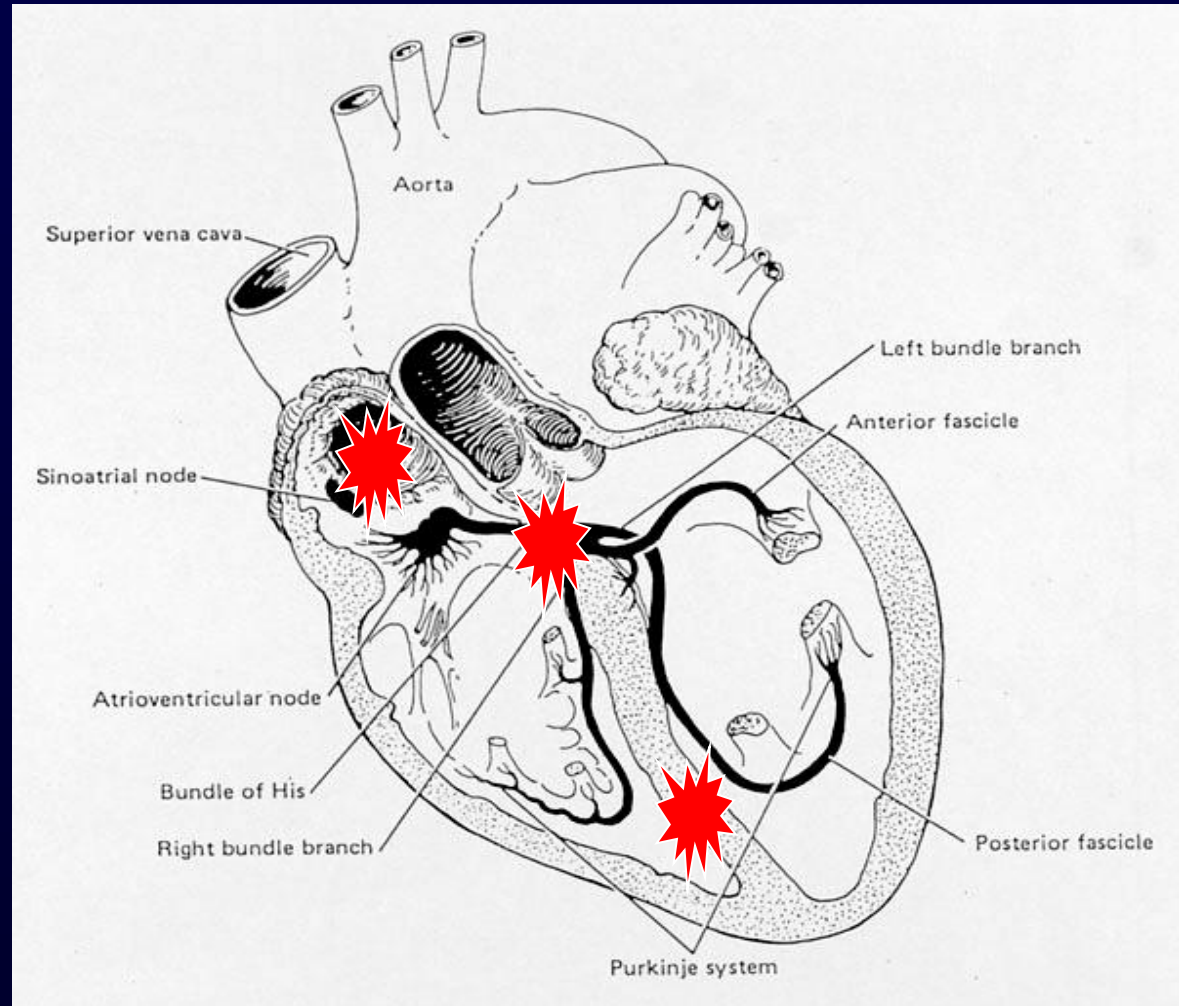
Inferior STEMI with Atrial Fibrillation



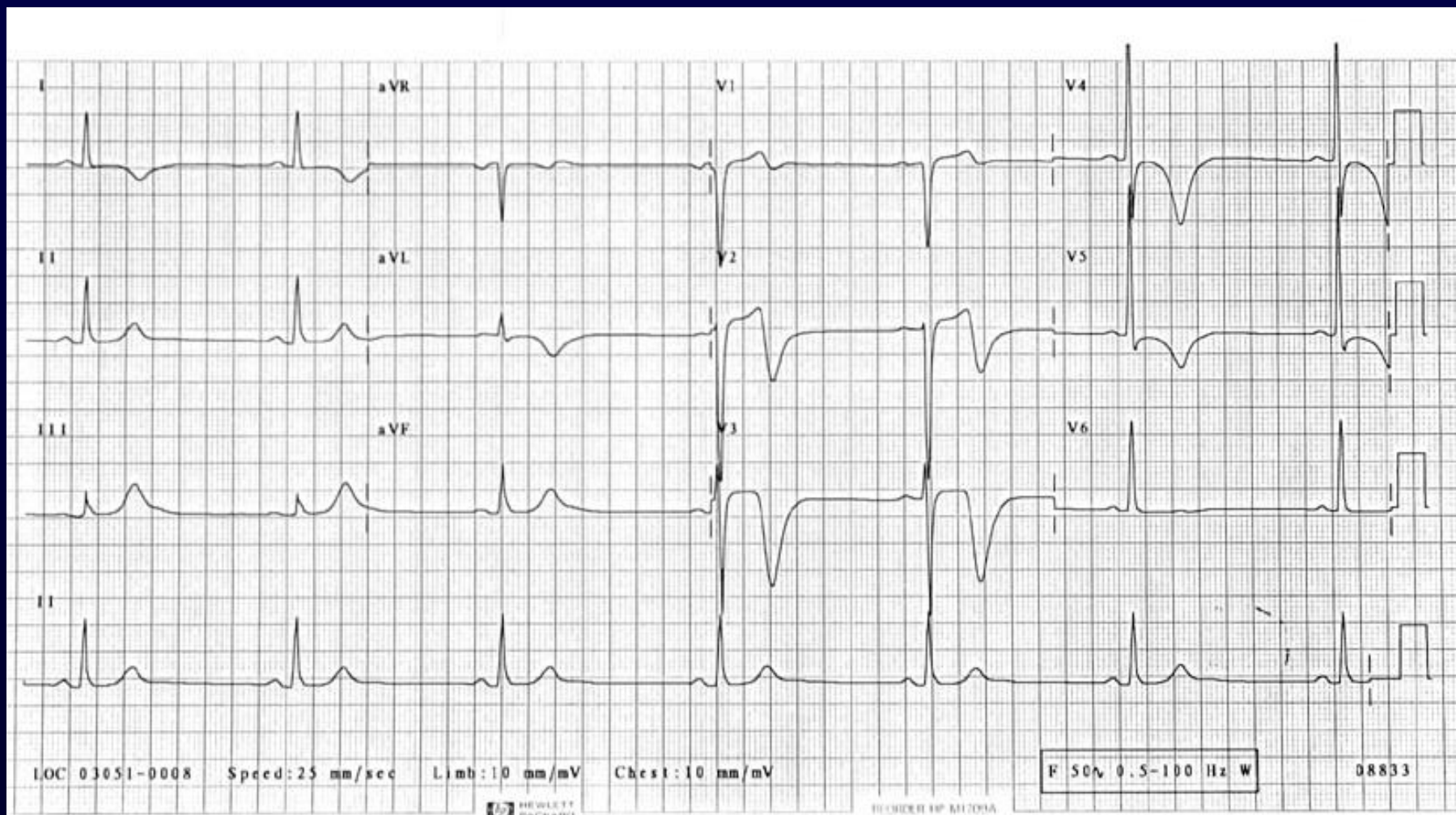


Intrinsic depolarisation rates

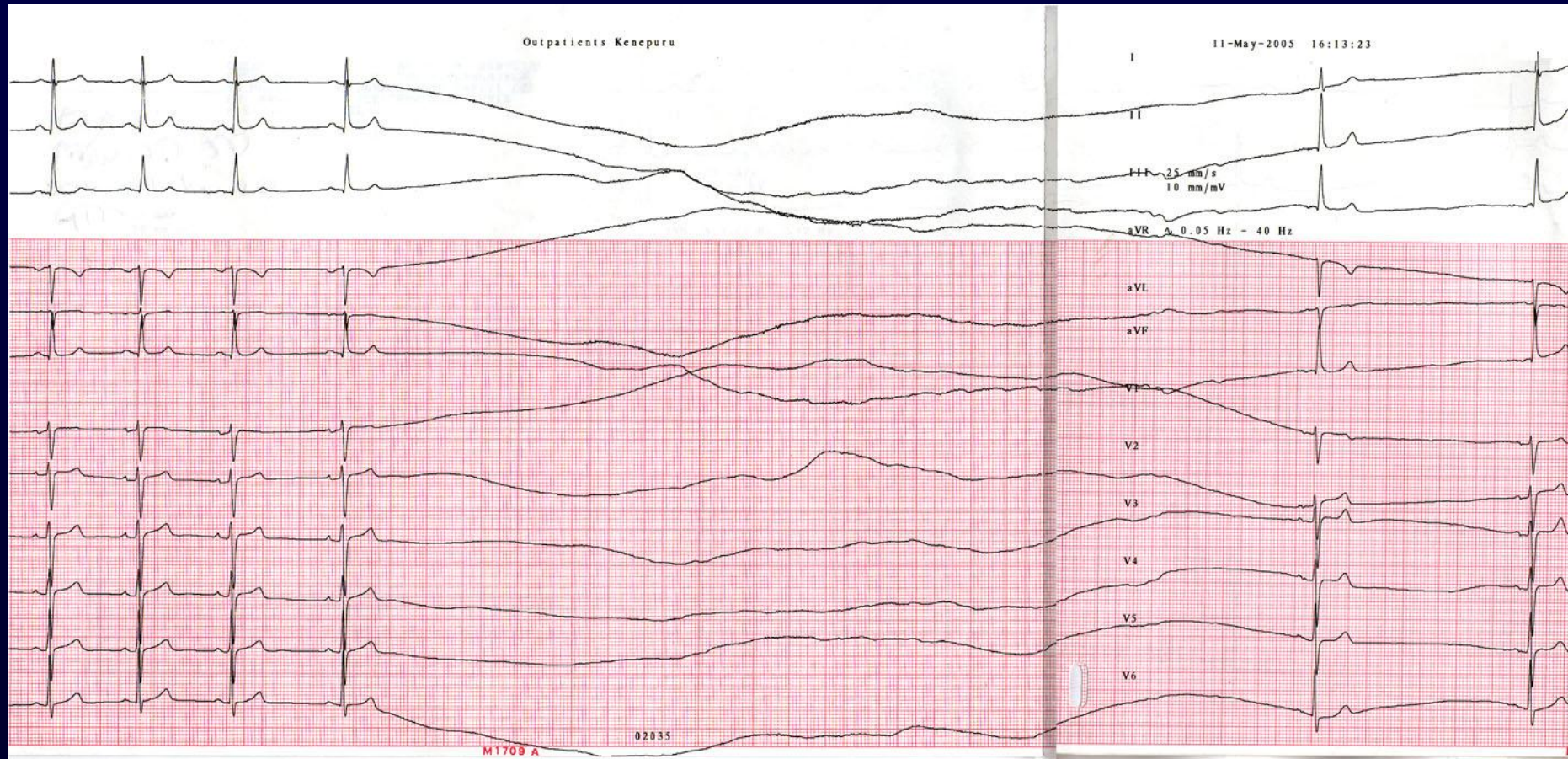
SA node	60-70/min
AV Jn	35-50/min
Ventricles	30-40/min

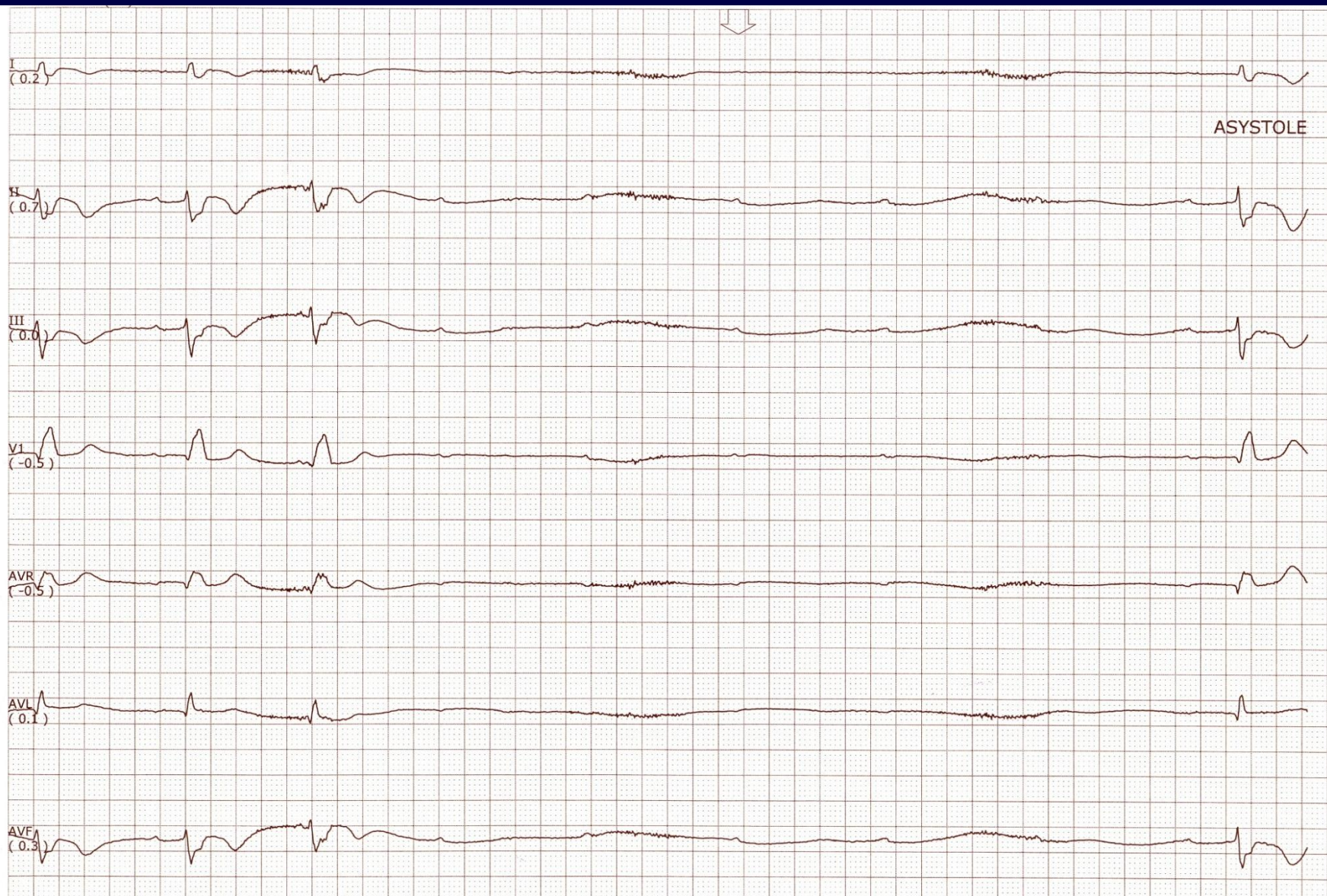


Sinus Bradycardia with Anterior ST/T Wave changes



Recurrent Syncope: Sinus Pauses





AV Block

First degree heart block (1°)

- prolonged PR interval, constant

Second degree heart block (2°)

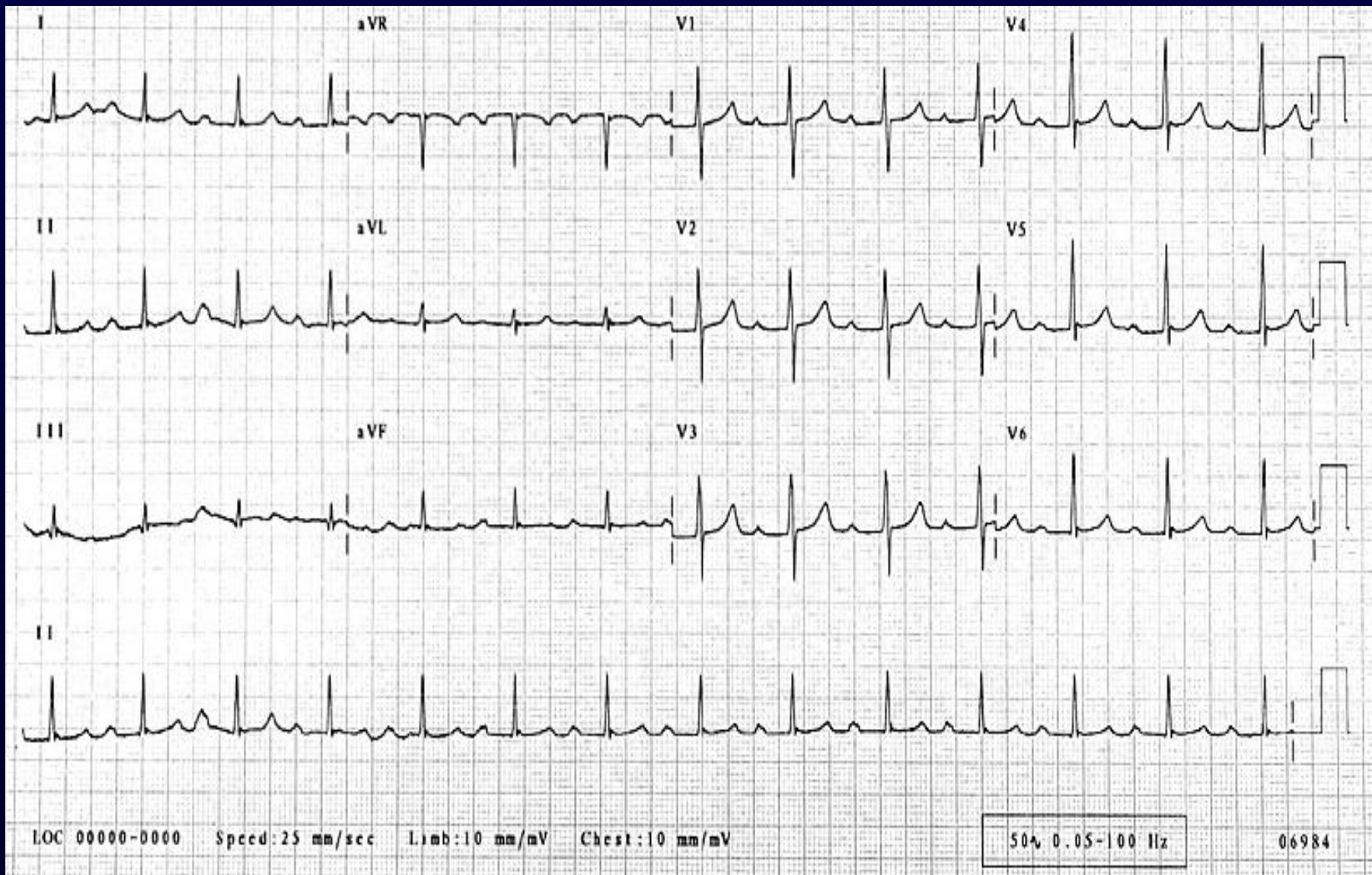
- *Mobitz Type I - Wenkebach*
- *Mobitz Type II*

Third degree heart block (CHB)

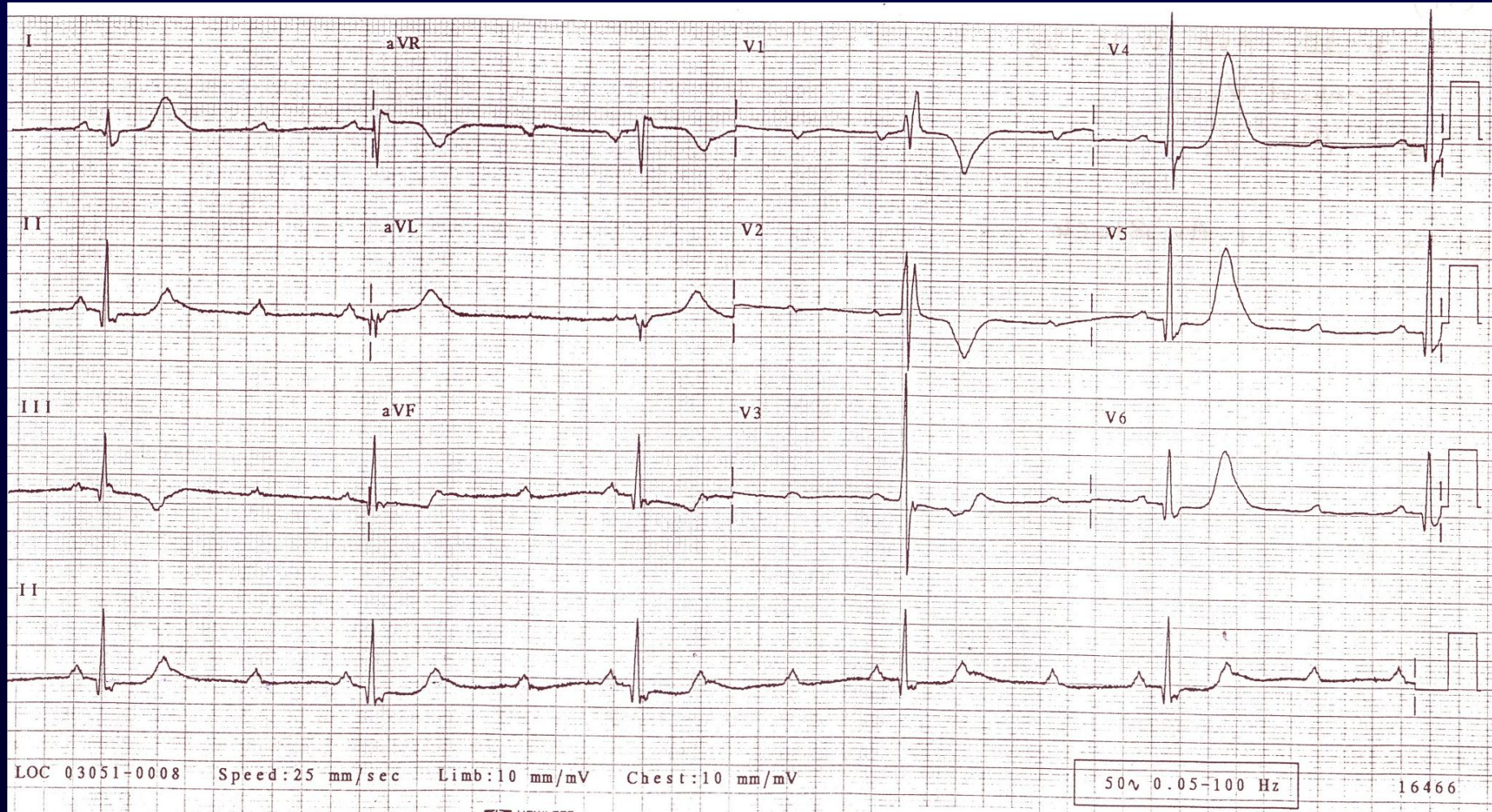
Aetiology of AV Block

- **Idiopathic / Degenerative**
- **Myocardial infarction**
- **Cardiac surgery**
- **Infiltrative & Inflammatory cardiac disease**
- **Drugs**
 - **digoxin, beta-blockers, calcium channel blockers**

First Degree Heart Block



Second Degree Heart Block: 3 to 1



Third Degree [Complete] Heart Block

Rate 34 . Sinus bradycardia, rate 34.....Normal P axis, rate < 50
 PR 307 . First degree AV block.....PR>220mS age 16-60 V-rate 1- 50
 QRS 118 . Incomplete right bundle branch block.....QRS 110 mS, terminal forces right
 QT 538 . Early transition.....QRS positive in V2
 QTc 404 * Lead(s) I,II,III were not used for morphology analysis

--Axis--

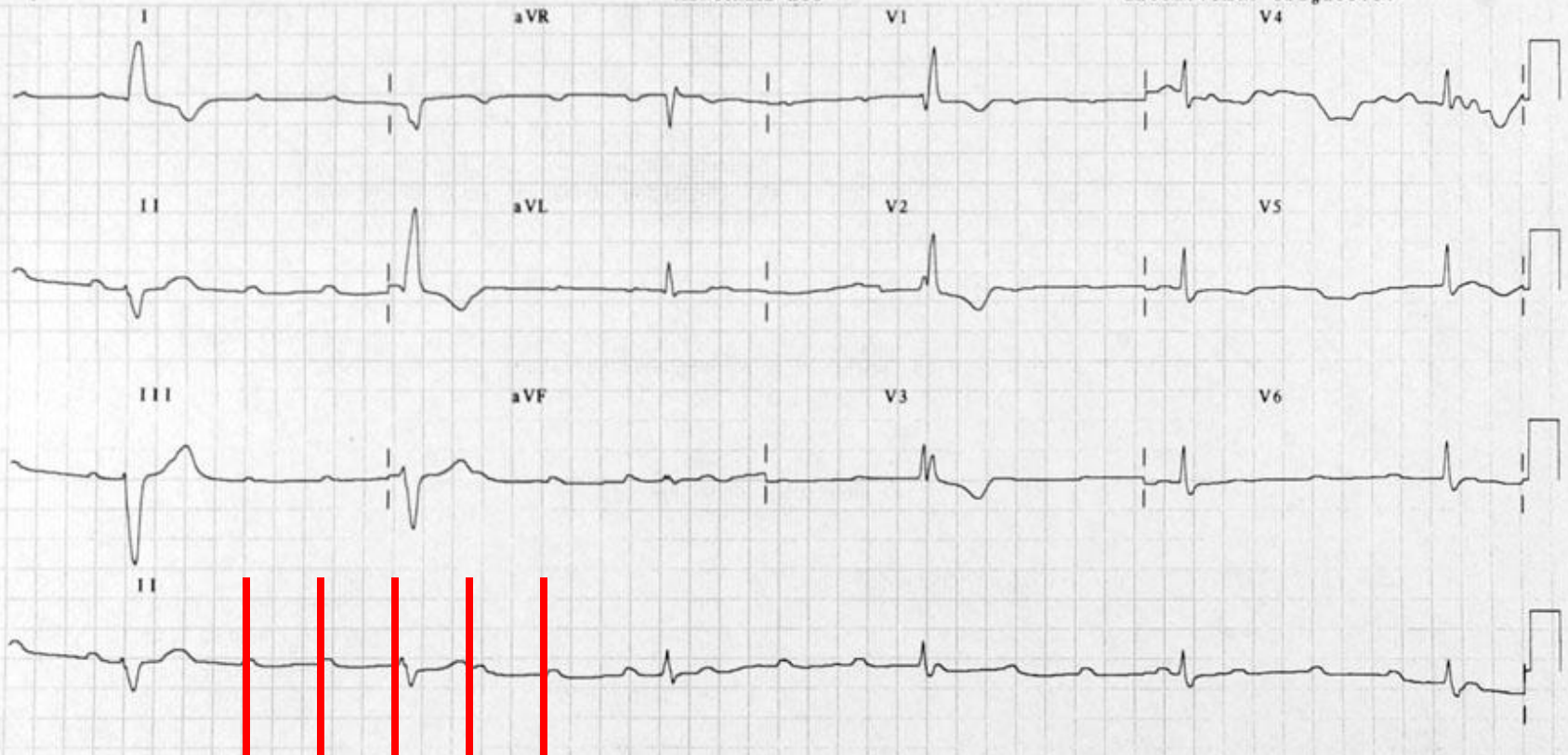
P 54

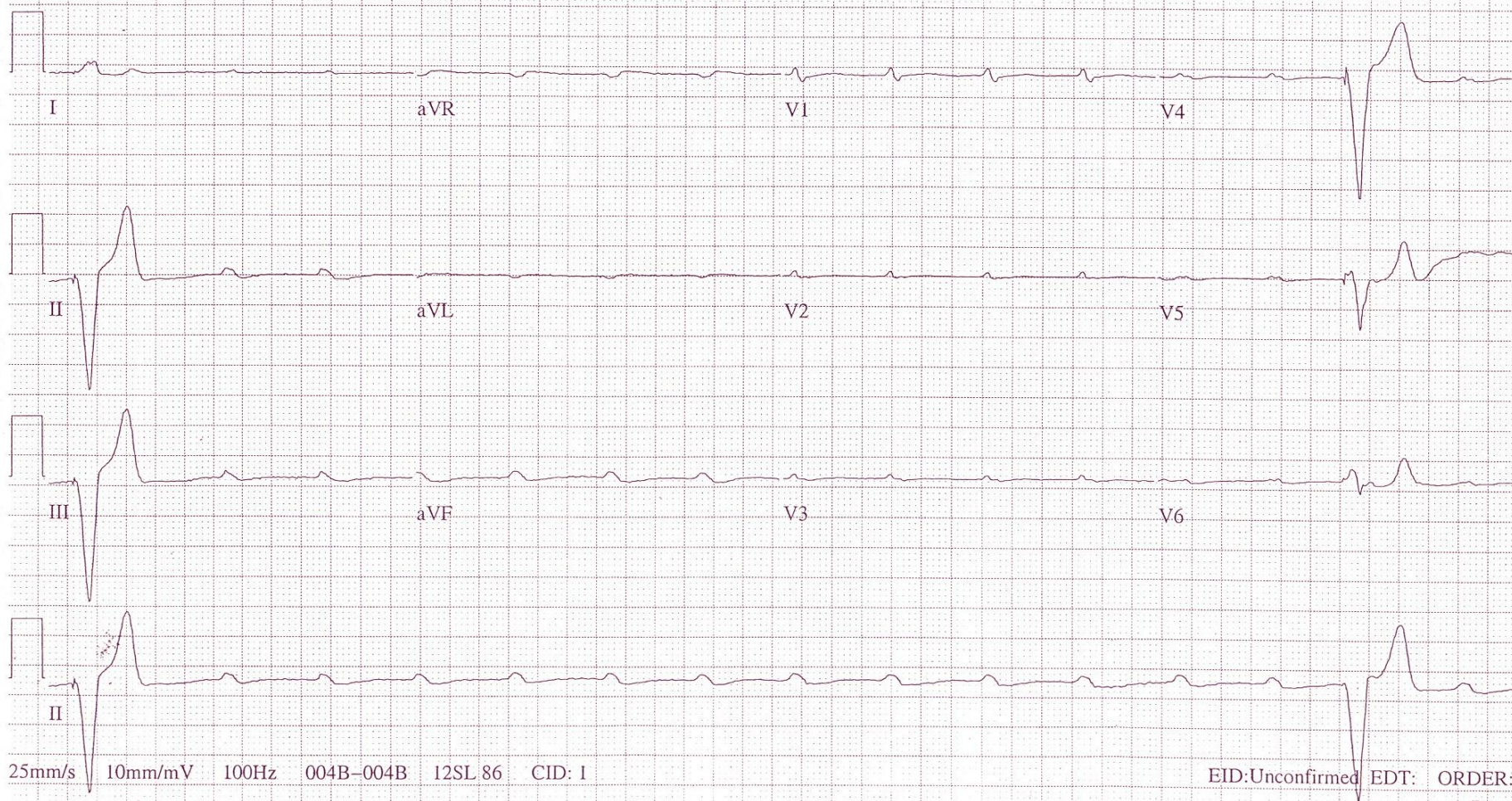
QRS 6

T

- ABNORMAL ECG -

Unconfirmed diagnosis.

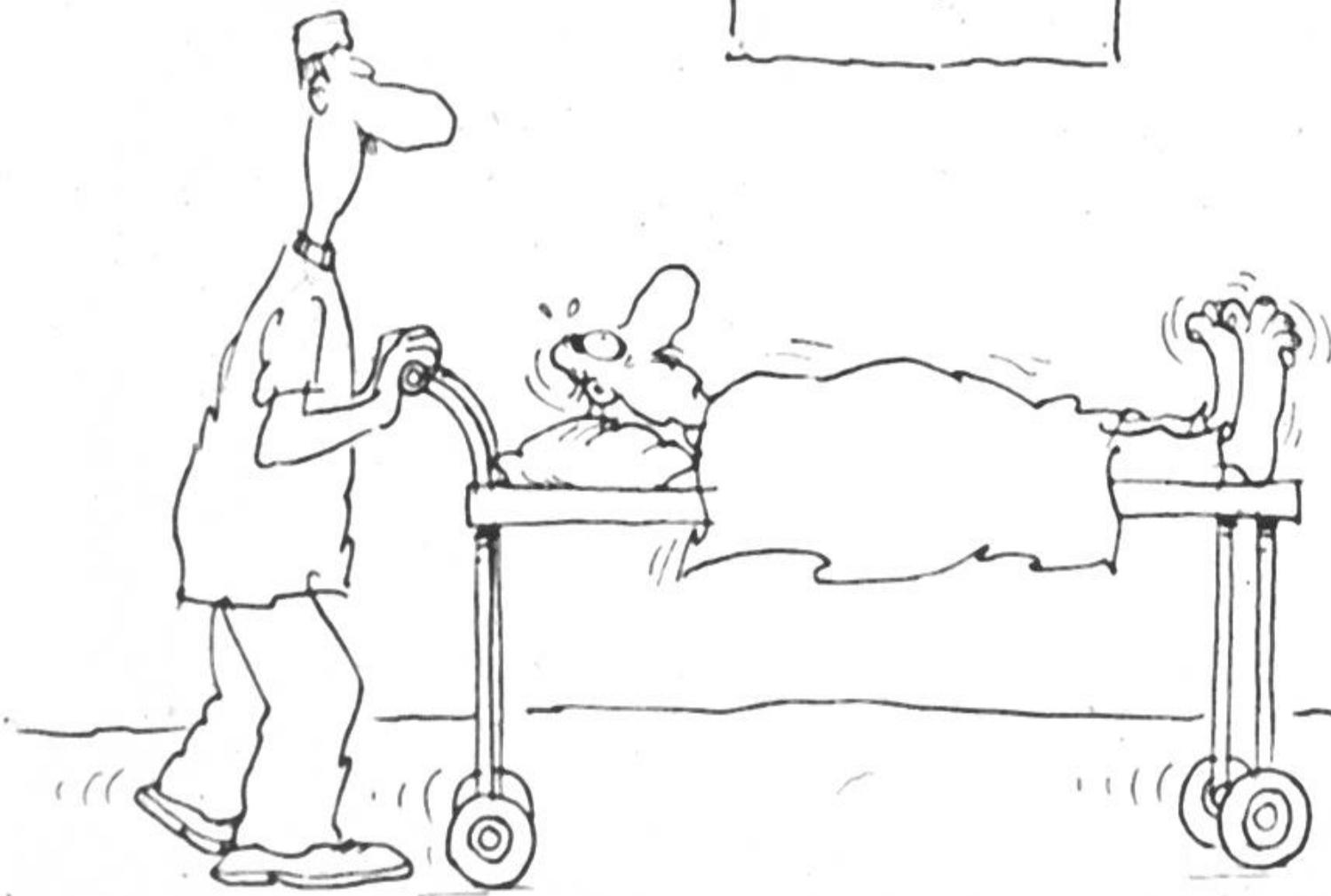




25mm/s 10mm/mV 100Hz 004B-004B 12SL 86 CID: I

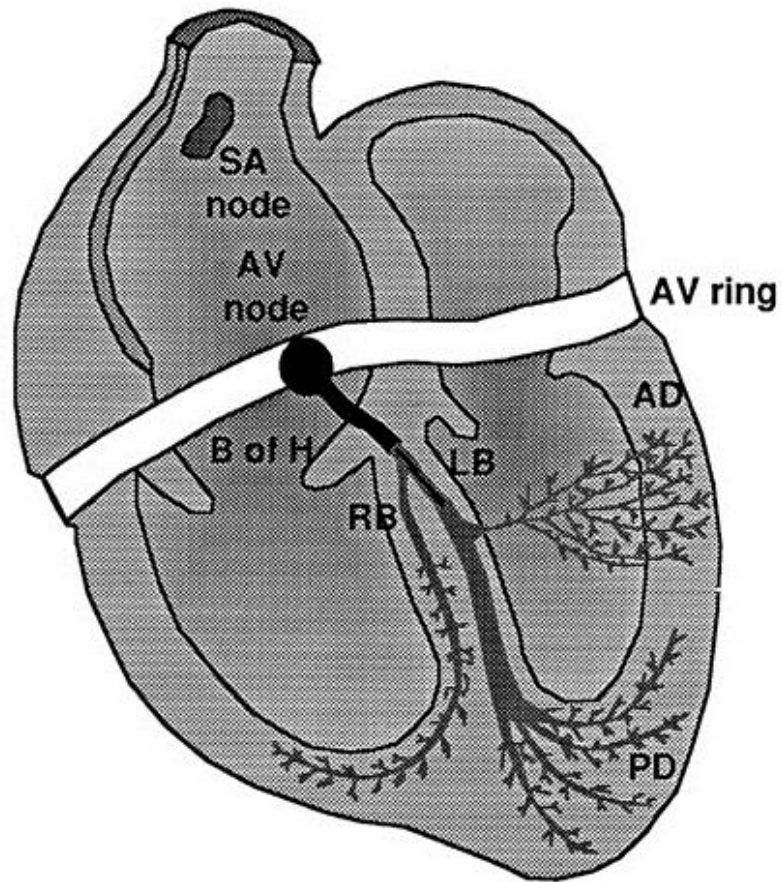
EID:Unconfirmed EDT: ORDER:

The End
➔

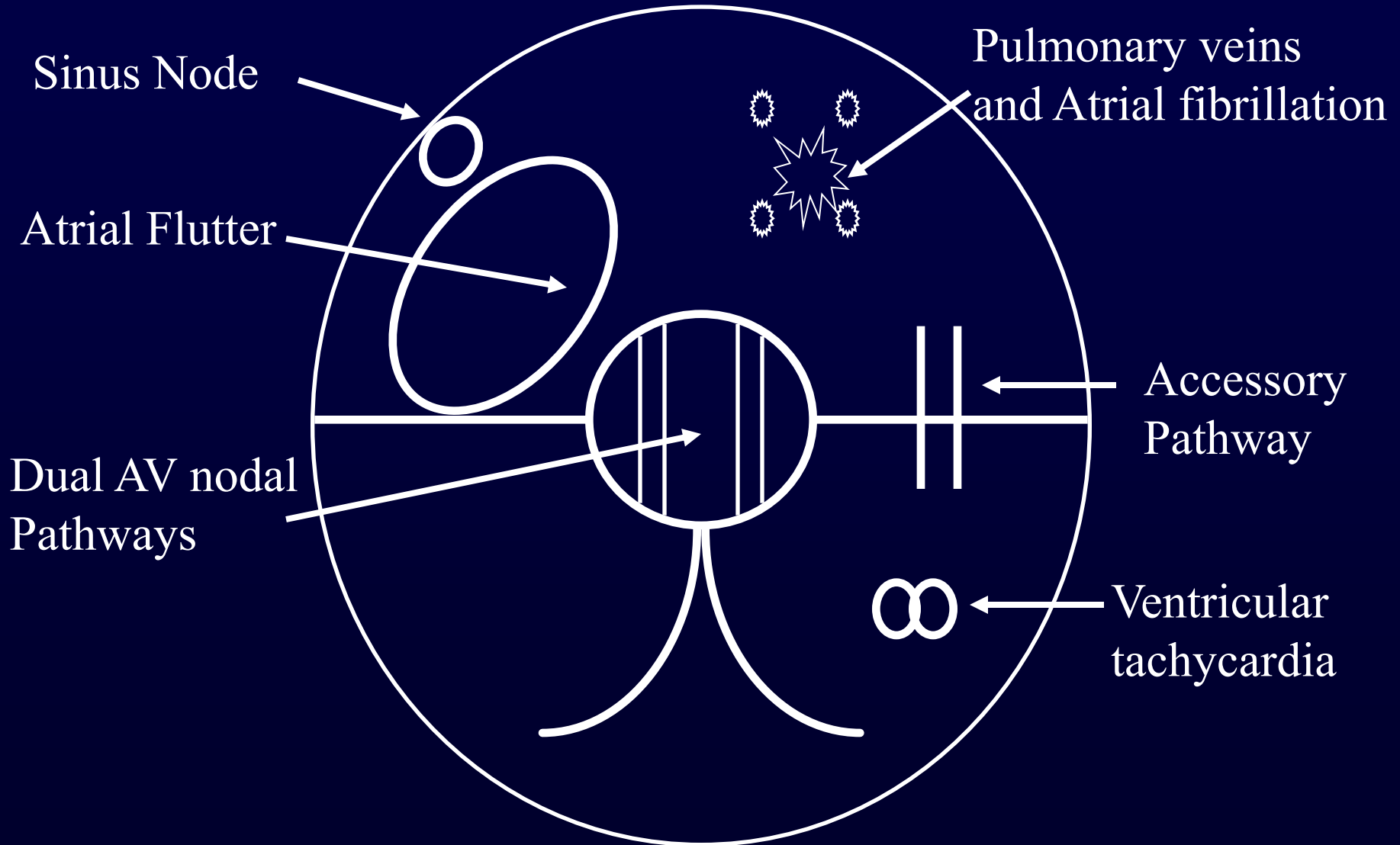


Eden

Diagram of the Cardiac Conducting System



Tachycardia Mechanisms



Atrial Fibrillation

Atrial Fibrillation

- Disorganised atrial electrical activity
 - Multiple small ‘circuits’
- No effective atrial emptying
 - Stasis/thrombus formation
 - Loss of diastolic ventricular filling
- Variable ventricular rates
 - Preexisting AV conduction disease
 - Drug treatment

Atrial Fibrillation

- **Types**
 - **Paroxysmal**
 - **Persistent**
 - **Permanent**
- **Common Symptoms**
 - **Asymptomatic**
 - **Rate**
 - **Complications**
- **Causes**
 - **Cardiac**
 - **Non Cardiac**

Causes of Atrial Flutter/Fibrillation Include:

- Hypertension
- Ischaemic heart disease
- Heart valve problems, especially mitral regurgitation or stenosis
- Alcohol excess (especially a 'binge')
- Cardiomyopathy: hypertrophic or dilated with LV impairment
- Thyrotoxicosis
- Respiratory conditions eg COPD or lung fibrosis
- Endurance athletes
- Atrial septal defect
- Infiltrative cardiac states eg Amyloid, sarcoid
- Pulmonary emboli
- Familial
- Others (including 'idiopathic' ie we don't know!)

AF Management

- Assessment
 - Symptomatic state
 - Aetiology
- Treat underlying causes
- Treat rate vs Rhythm
 - AV nodal slowing agents
 - Anti-arrhythmic therapies
- Treat to prevent complications
 - Embolic events
 - Rate related cardiomyopathies

Assessment

- Clinical examination
 - Vitals
 - Structural heart disease
- ECG
- Blood Tests
- CXR
- Echo
- Other tests e.g.. ETT

Medical Rx AF

- Rhythm agents
 - Rate control
 - Beta blockers/Ca antagonists/(Digoxin)
 - Rhythm control
 - Class I Flecainide/propafenone
 - Class III Sotalol/Amiodarone
- Antithrombotic agents
 - Aspirin/Clopidogrel
 - LMWH
 - Warfarin
 - Dabigatran

Anticoagulation in AF

- Age < 65 and no other risk factors
 - Annual stroke rate 1%, bleeding risk with warfarin >1%
 - Managed with aspirin
- Age 65 – 75 and no other risk factors
 - Annual stroke rate about 2%
- Age > 75
 - Consider warfarin (target INR 2.0 – 3.0)
- AF with risk factors (see CHAD Score)
 - Consider warfarin (target INR 2.0 – 3.0)

CHADS Score: Calculation

<u>Medical Condition</u>	<u>Points</u>
• Prior Stroke	2
• CHF	1
• High BP	1
• Diabetes	1
• Age $\geq$ 75 years	<u>1</u>
	6

CHADS Score developed from 1733 Medicare beneficiaries aged 65 to 95 years of age, USA

CHADS Score: Outcome

<u>CHADS Score</u>	<u>Yearly Risk of Stroke</u>	
0	1.9%	[Aspirin]
1	2.8%	[Consider Warfarin]
2	4.0%	
3	5.9%	
4	8.5%	
5	12.5%	
6	18.2%	

NB: Warfarin reduces stroke by 2/3 [66%]

Aspirin reduces stroke by 1/4 [25%]

Warfarin causes a major bleed: 1-2% / annum

ECG Case 5



"I want to look like Cindy Crawford."

ECG Case 3



"I'd say it's your gallbladder, but if you insist on a second opinion, I'll say kidneys."

1

2

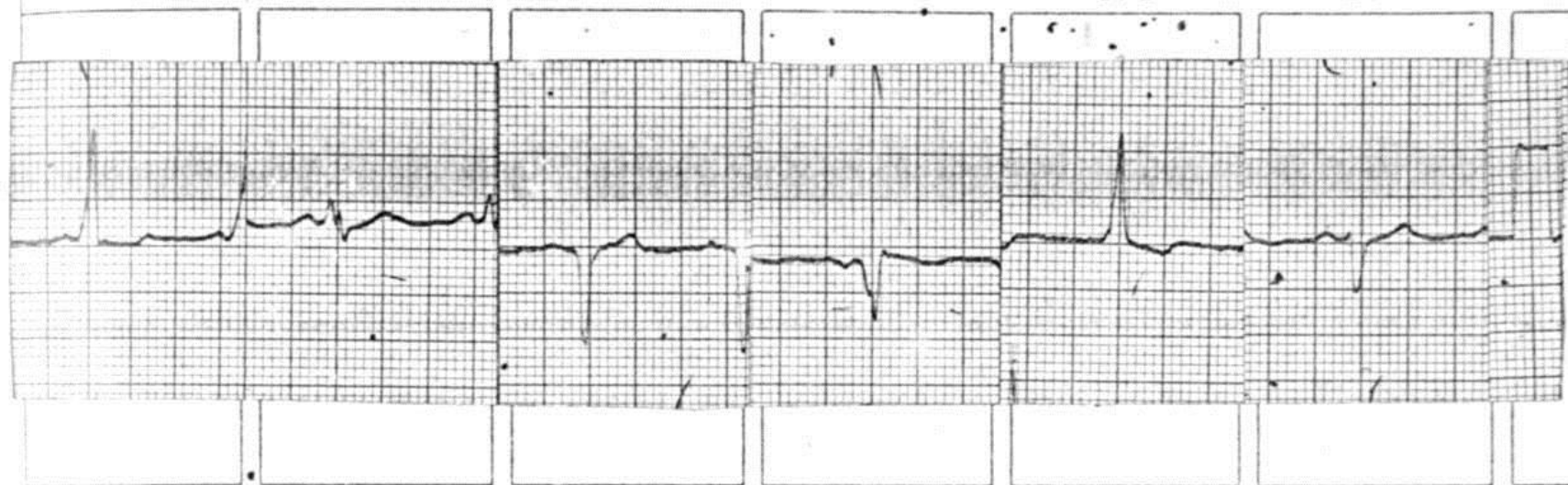
3

aVR

aVL

aVF

RES



V1

V2

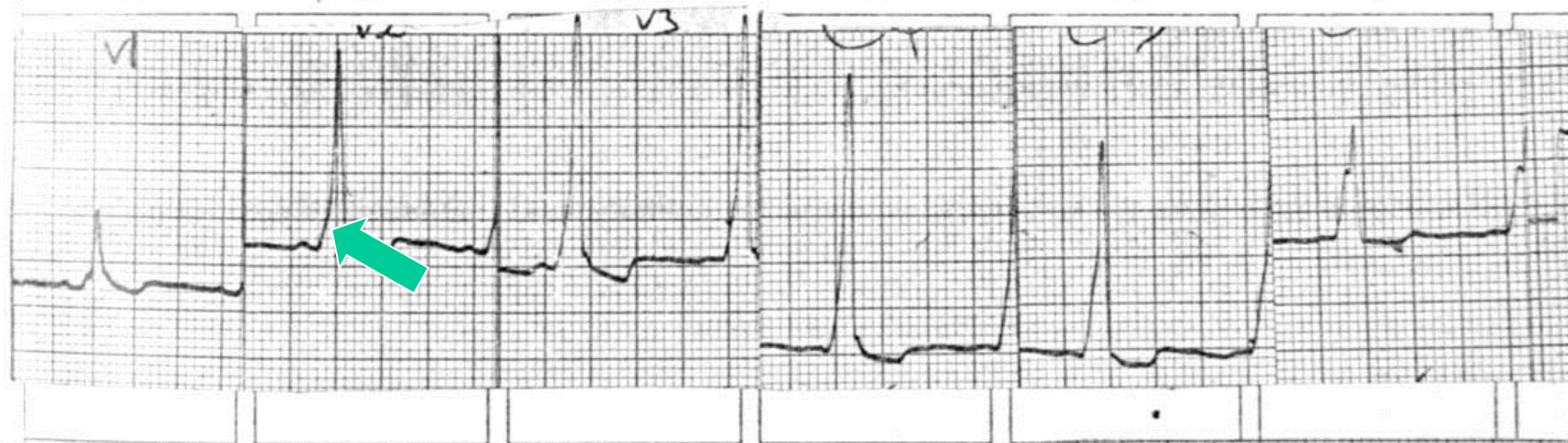
V3

V4

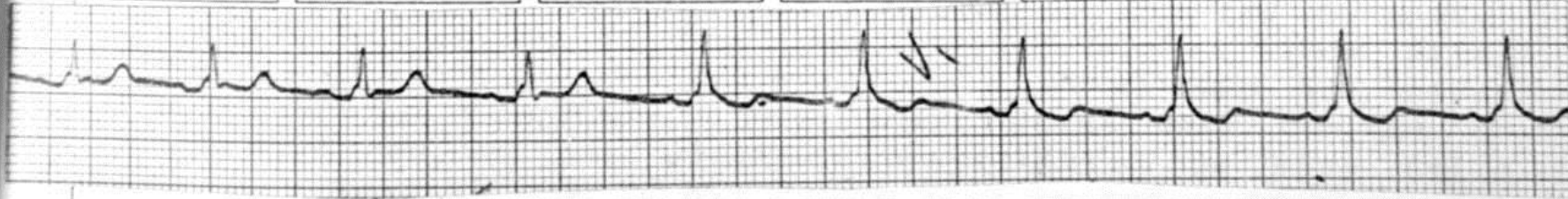
V5

V6

V7

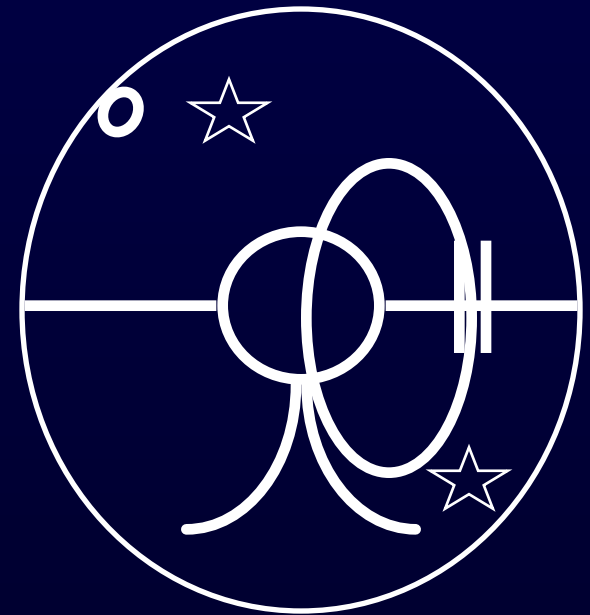


V6



WPW: AV Re-entrant Tachycardia

- Orthodromic regular SVT
 - Retrograde [V to A] through Kent Bundle
 - Narrow QRS (95% of cases)
- Antidromic regular SVT
 - Antegrade [A to V] through Kent Bundle
 - Wide QRS (5% of cases)



ECG 6

