Dr Chris Ellis

Consultant Cardiologist

Auckland

ECG interpretation in General Practice - Concurrent Workshop Repeated

Saturday, 22 June 2013	Start 8:30am	Duration: 55mins	Picasso
	Start 9:35am	Duration: 55mins	Picasso

ECG Interpretation in General Practice

Dr Chris Ellis

Cardiologist

Greenlane CVS Services, Cardiology Department,

Auckland City Hospital

& Auckland Heart Group:

Mercy Hospital

NZMA GP CME Conference, Rotorua 22 June 2013

ECG Interpretation

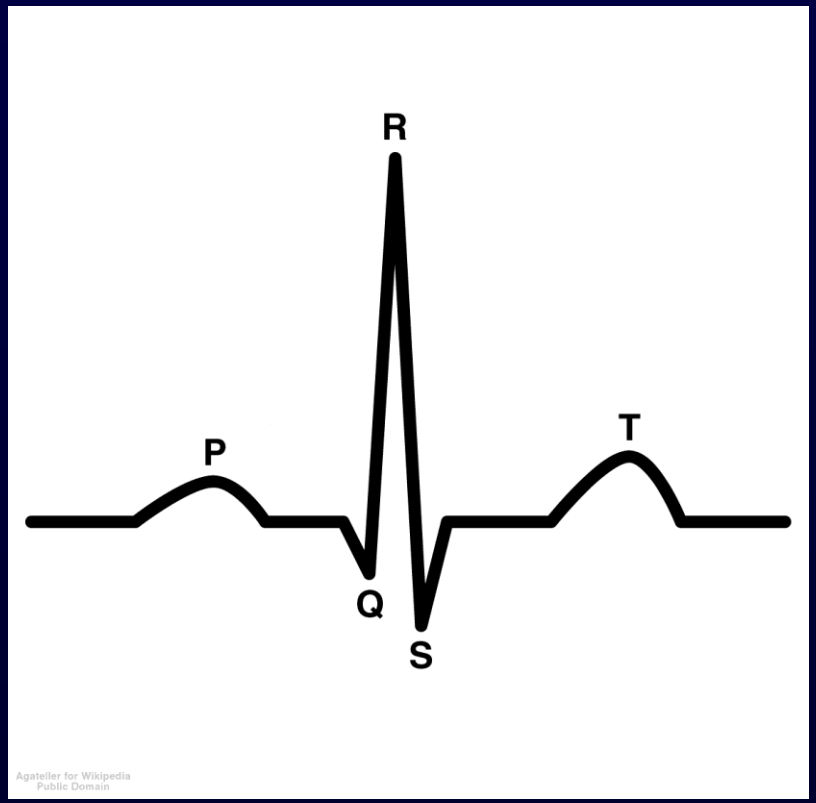
Heart Disease: The Central Role of the ECG

Community Assessment:

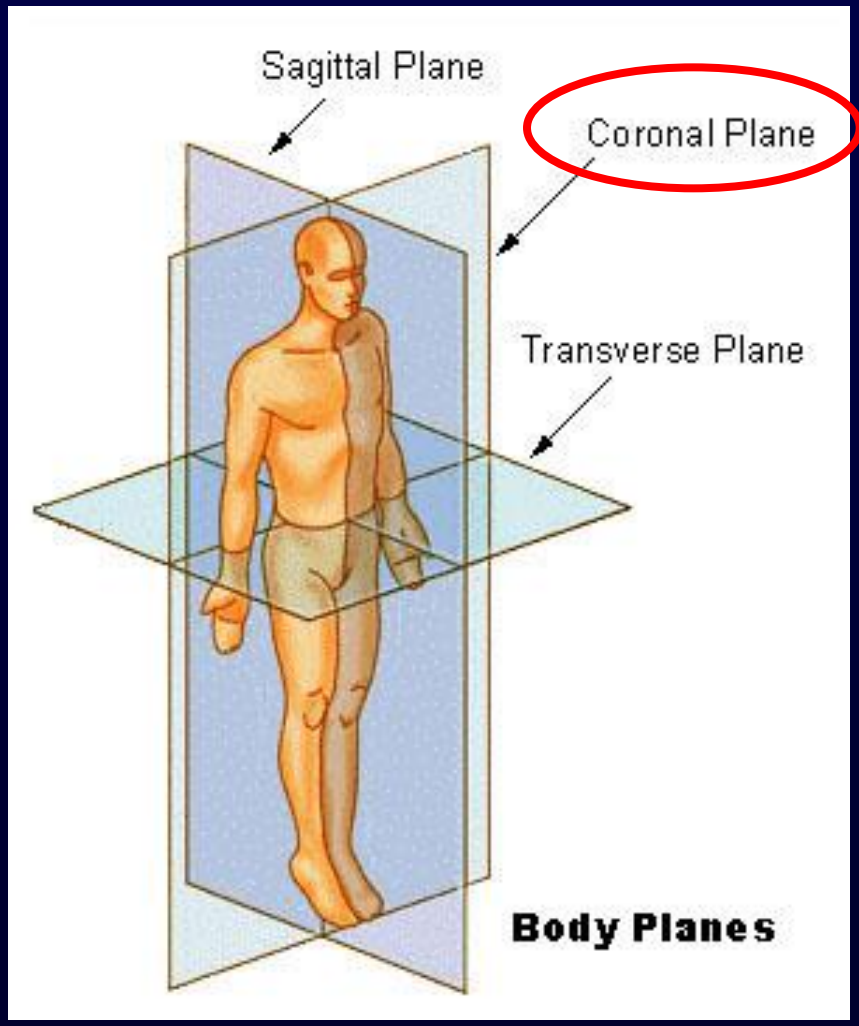
- History, Examination
- ECG
- Blood tests, Chest X-Ray

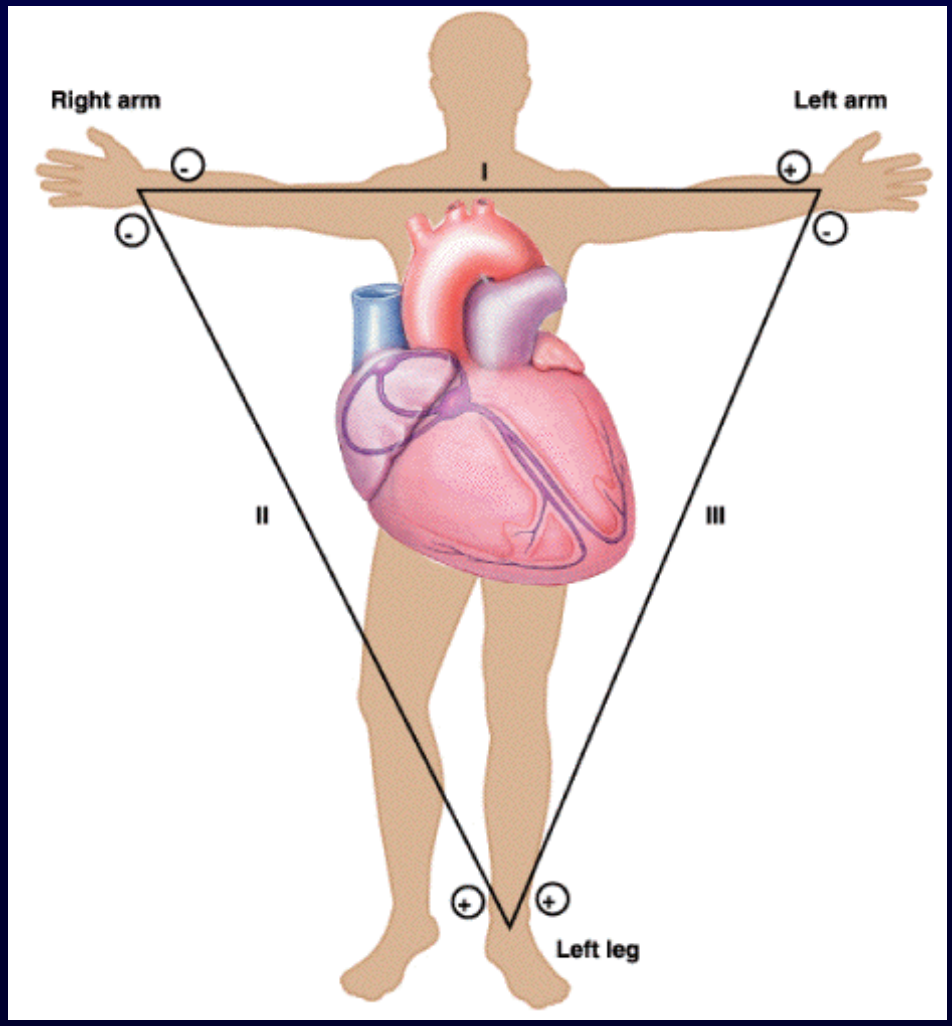
Hospital Assessment:

- Treadmill test
- Echocardiogram
- Stress echo
- Calcium score test
- Full CT cardiac angiogram
- Cardiac MRI
- Invasive cardiac angiogram
- Nuclear cardiac tests

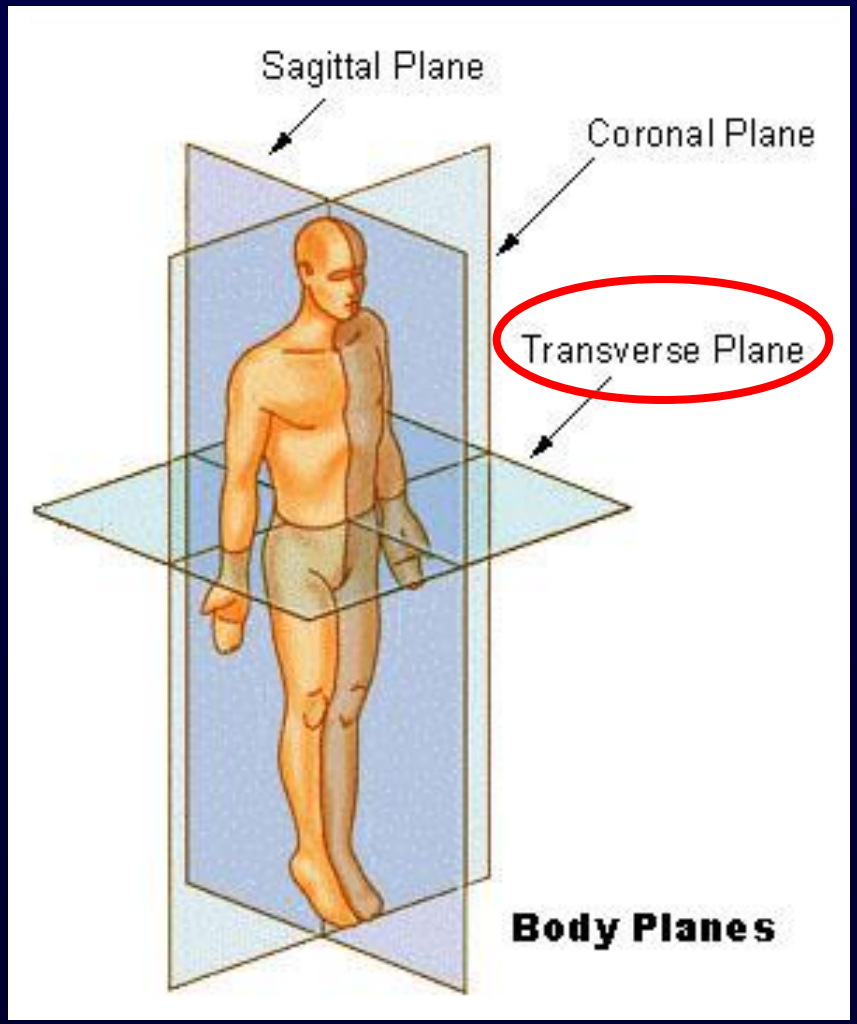


ECG: Standard Leads in Coronal Plane





ECG: Chest Leads in Transverse Plane



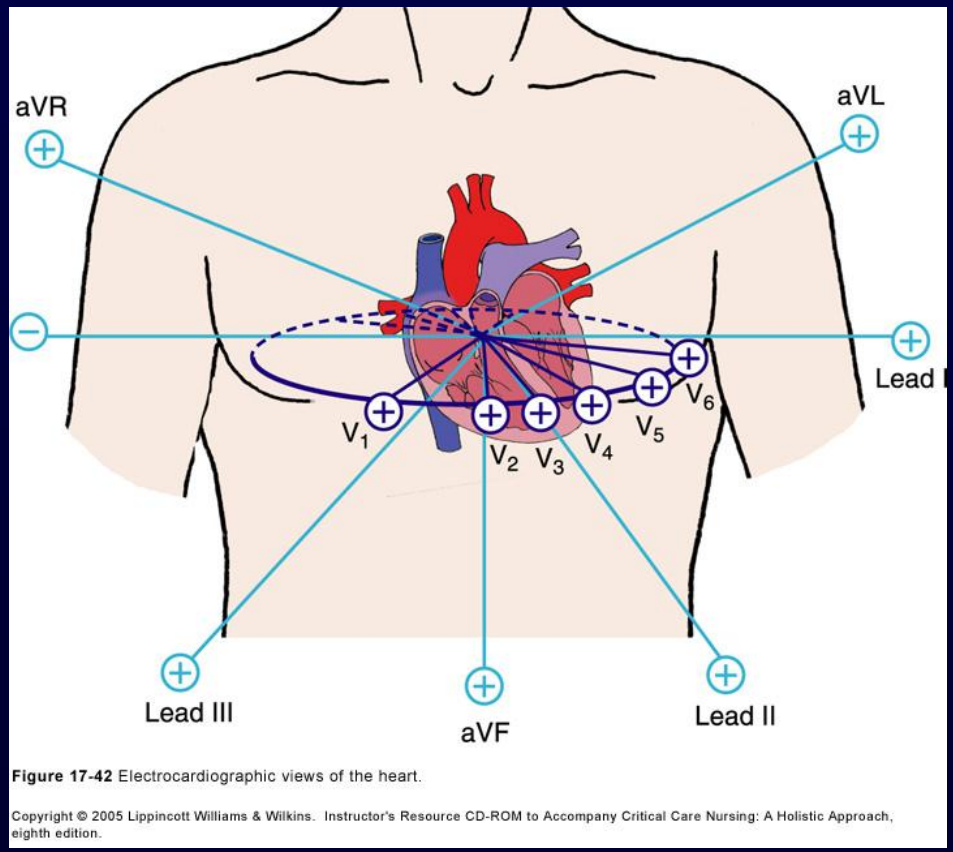
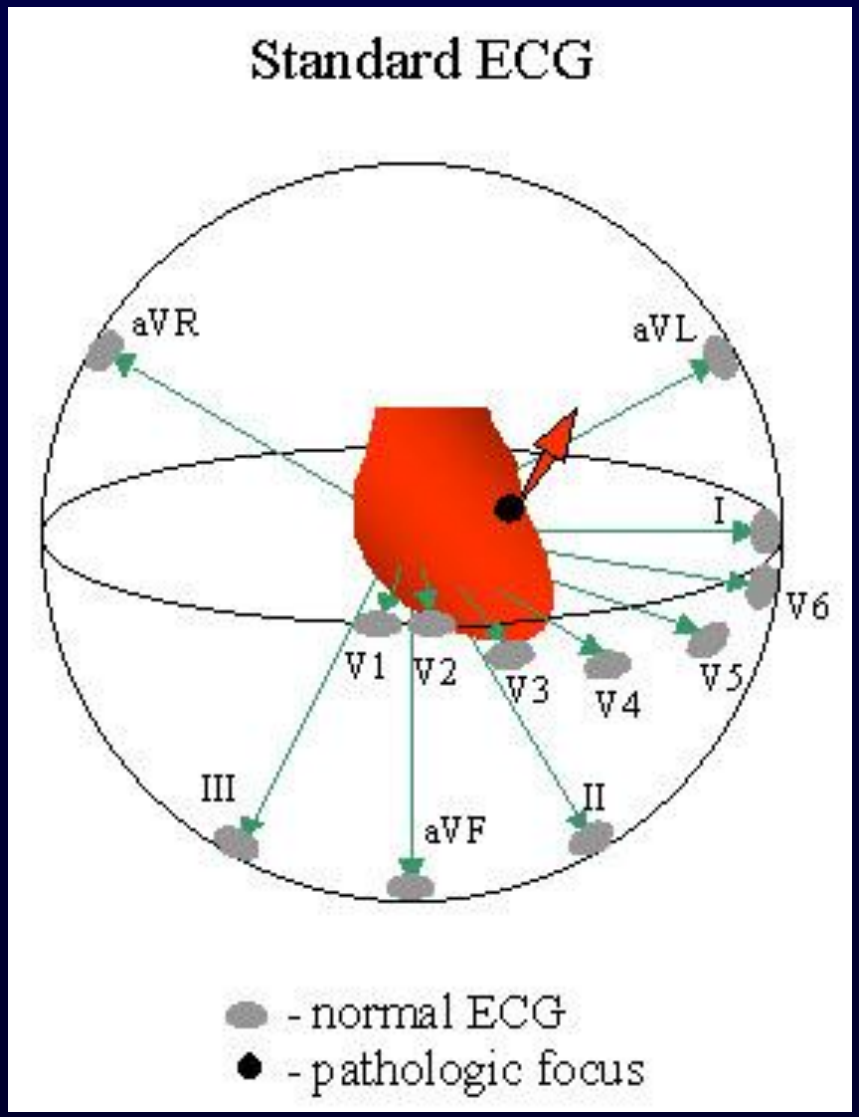
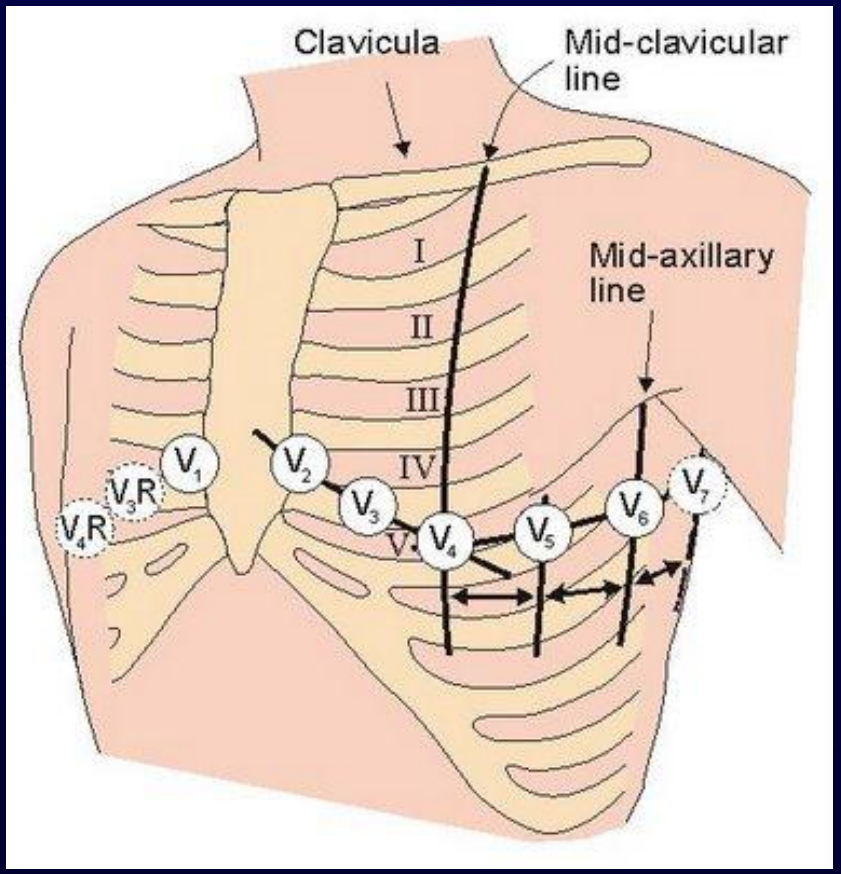


Figure 17-42 Electrocardiographic views of the heart.

ECG: Leads in Coronal & Transverse Planes





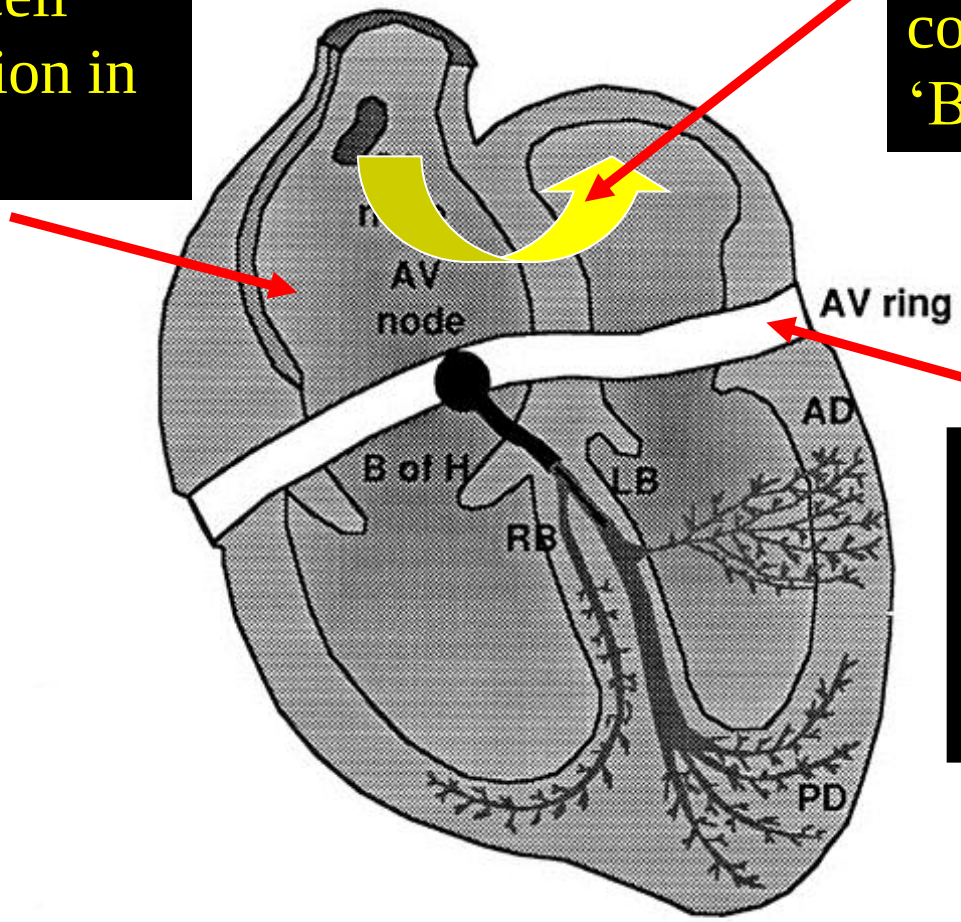
ECG: The Basics

- Electrical ‘depolarisation’ precedes muscle contraction
- Skin electrodes can detect this electrical activity
- Atrial muscle mass is small
  - Electrical current is small
  - P wave is small
- Left ventricular muscle mass is more than RV muscle mass
  - The QRS complex is dominated by the LV current
- T wave records ‘repolarisation’ of muscle mass

Diagram of the Cardiac Conducting System

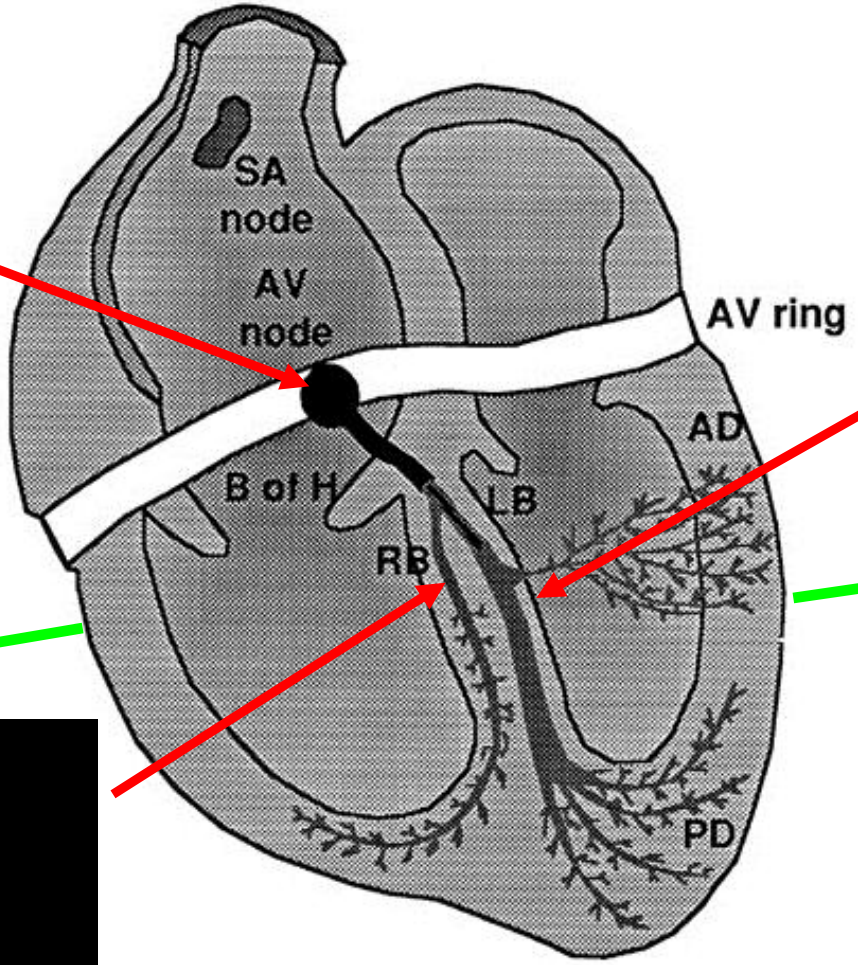
Cell to cell conduction in RA

RA to LA via conduction tissue: ‘Bachmann’s bundle’



Fibrous ring supporting TV & MV is an electrical insulator

Diagram of the Cardiac Conducting System



AV Node

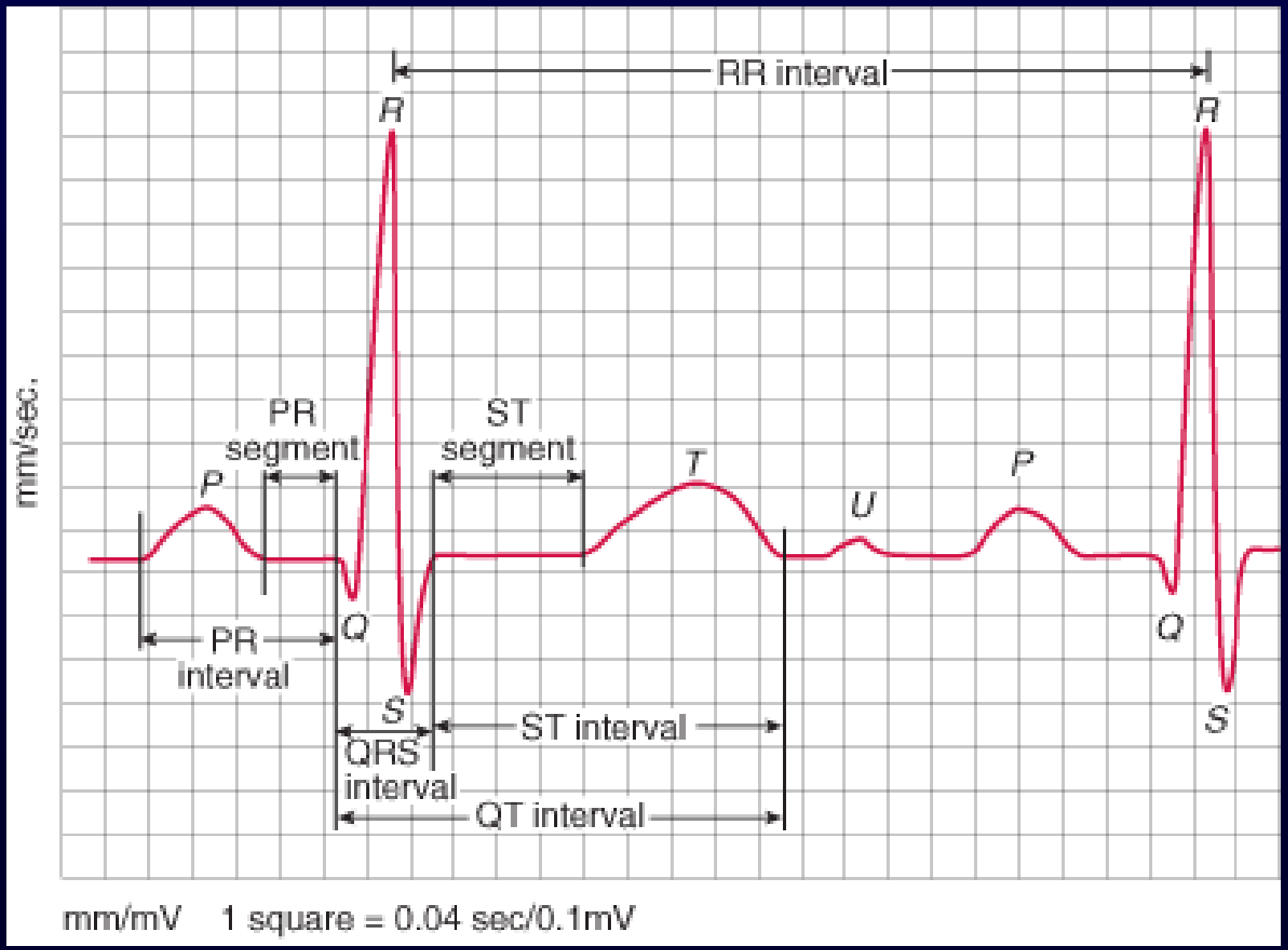
Septum depolarises from L to R

V6

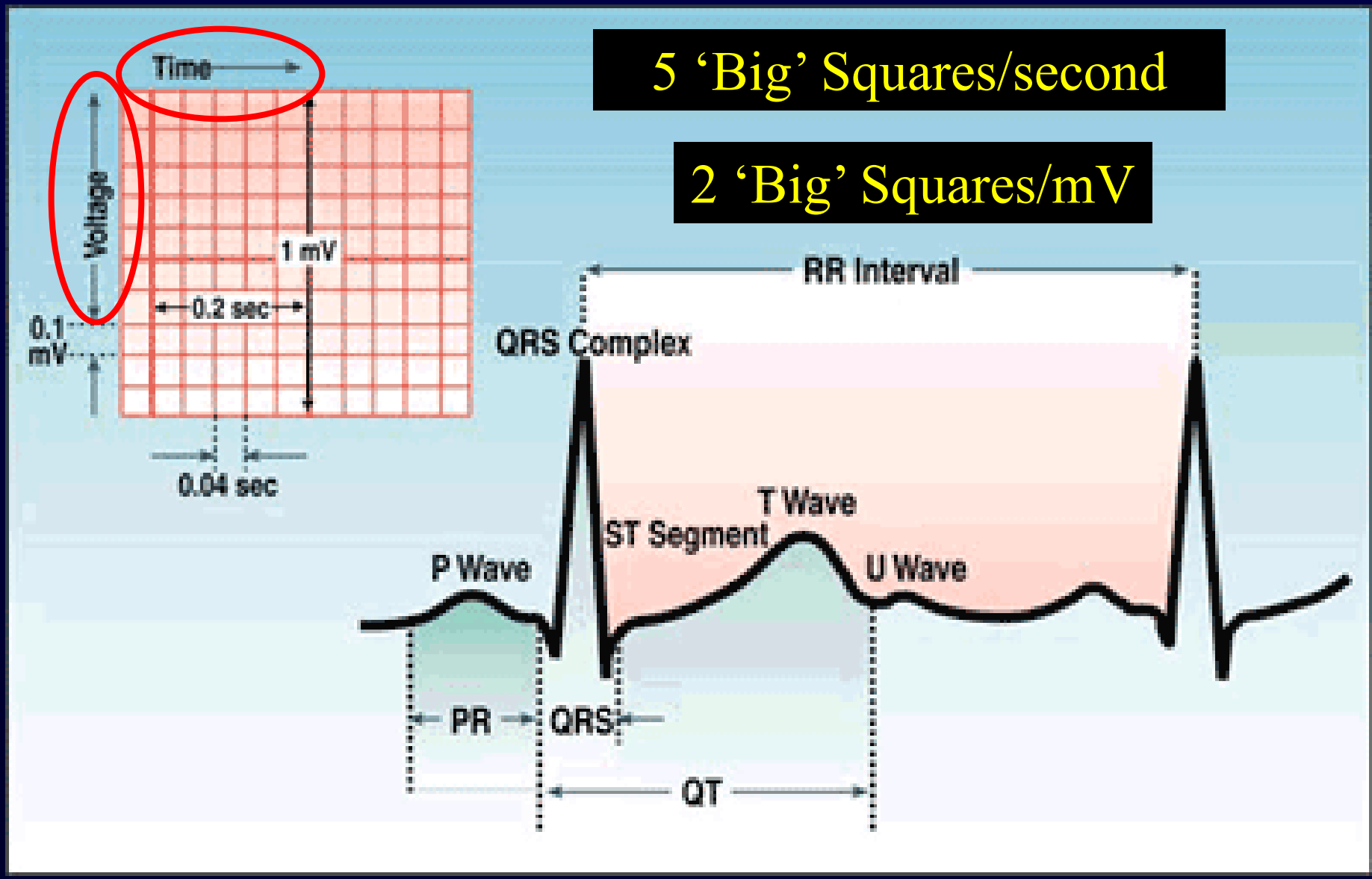
V1

His-Purkinje System: rapid conduction (Bundles: L > R)

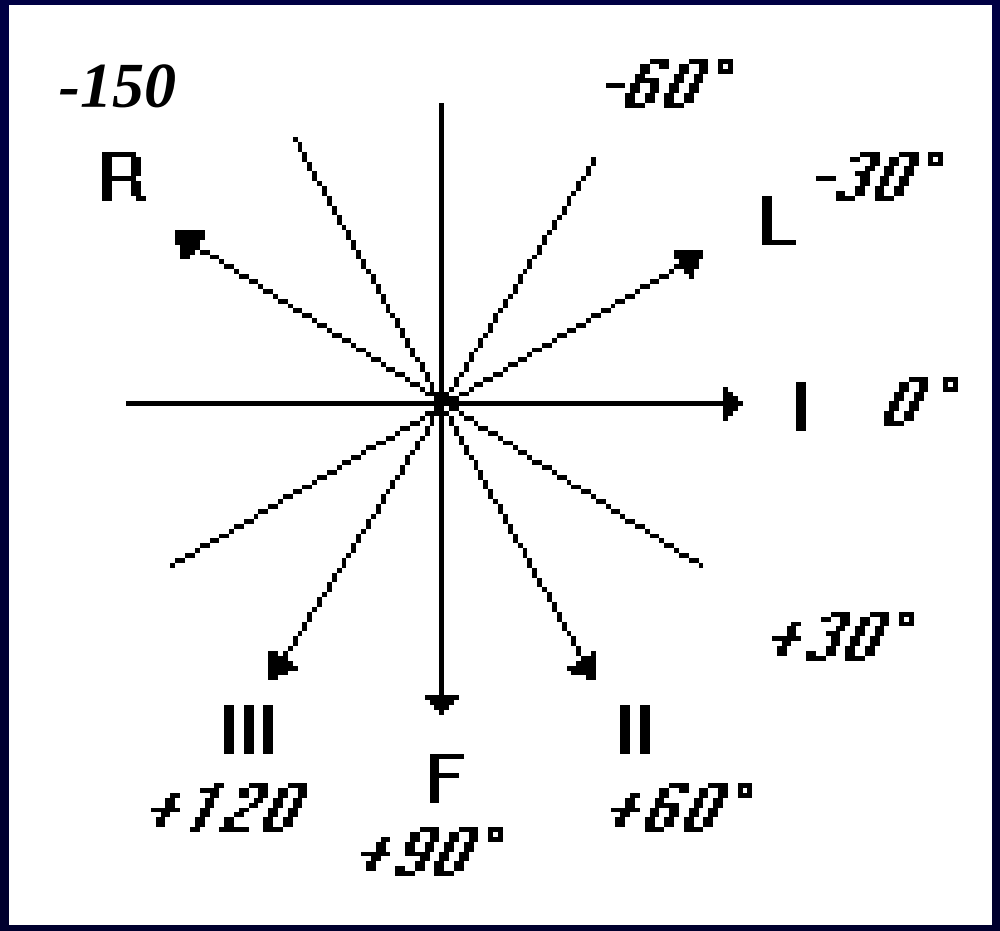
ECG: Standard Nomenclature



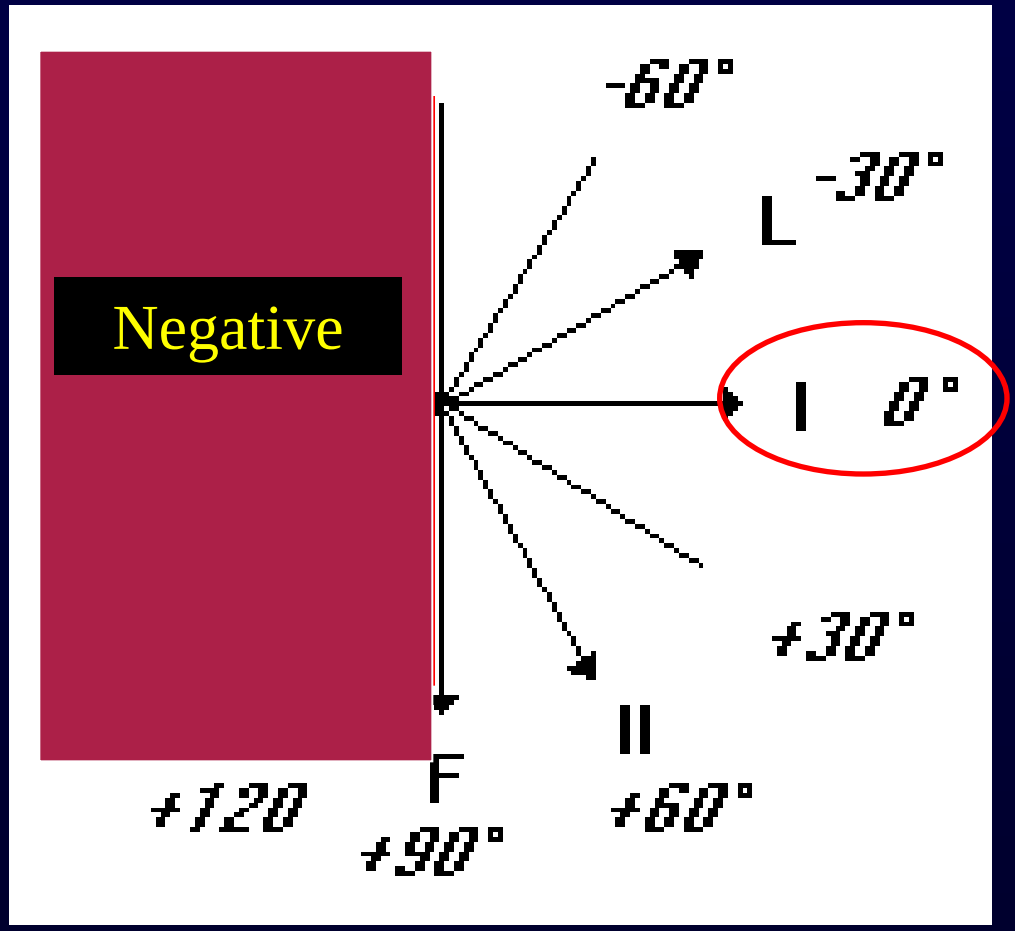
ECG: Time & Voltage



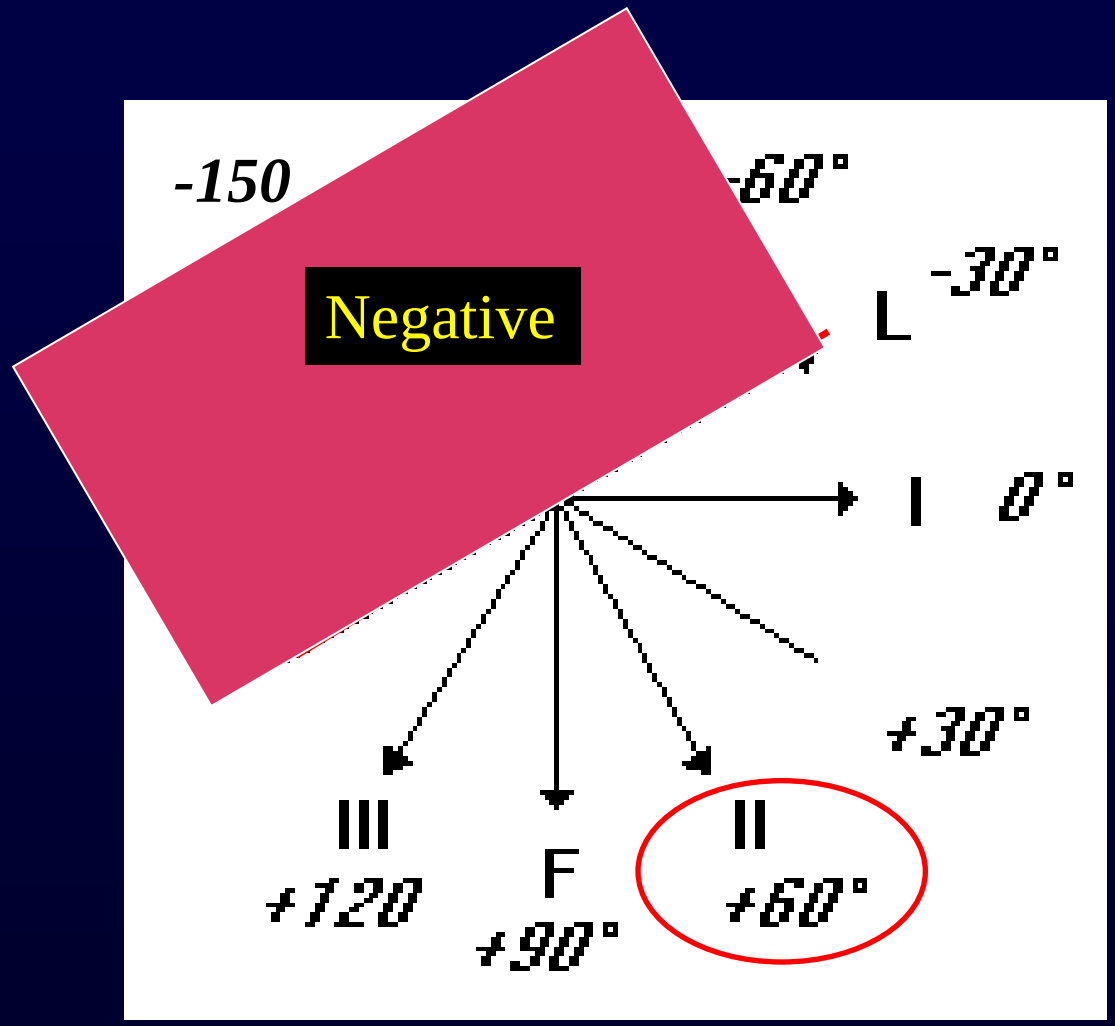
ECG: The Normal Axis



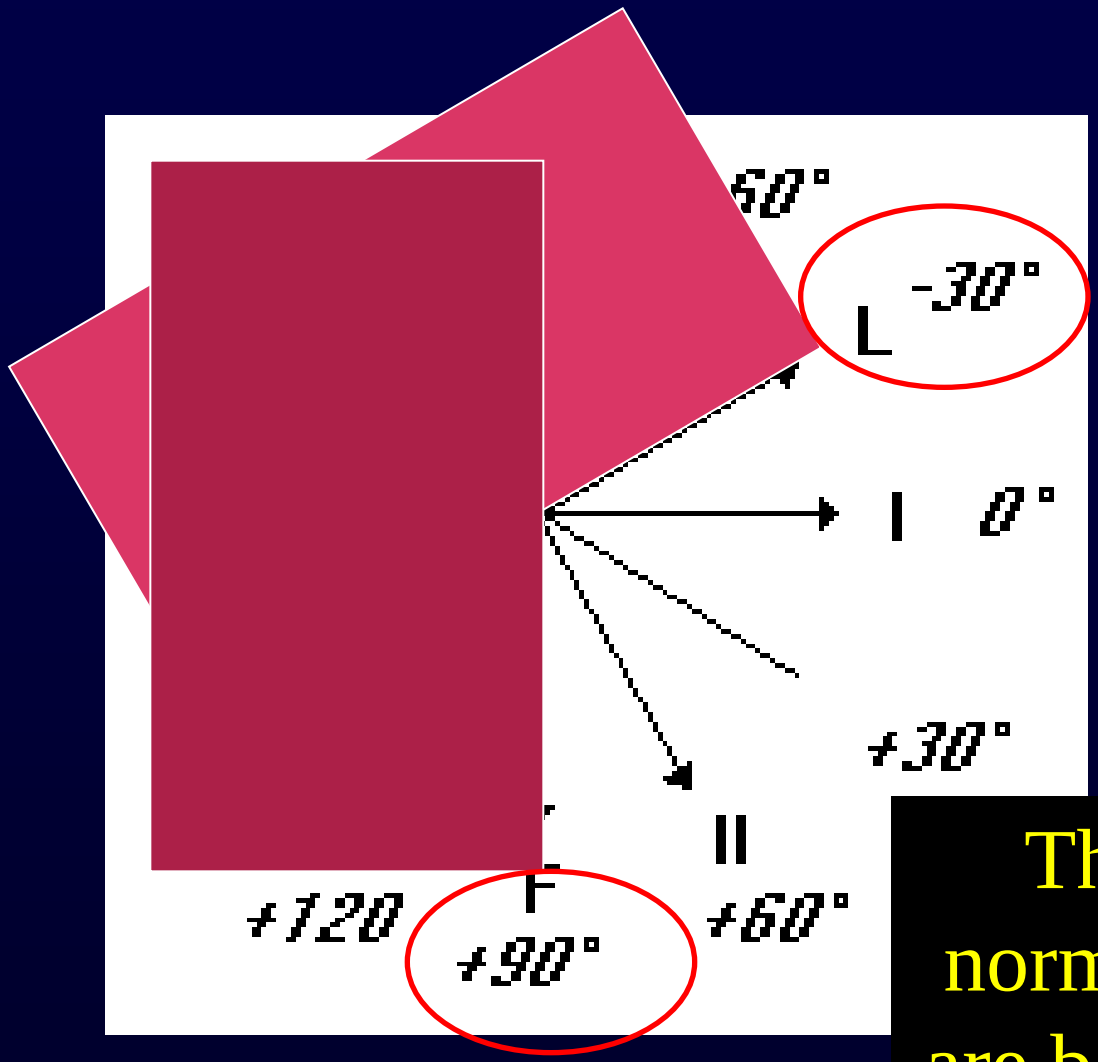
ECG: The Normal Axis (-30 to + 90)



ECG: The Normal Axis (-30 to + 90)

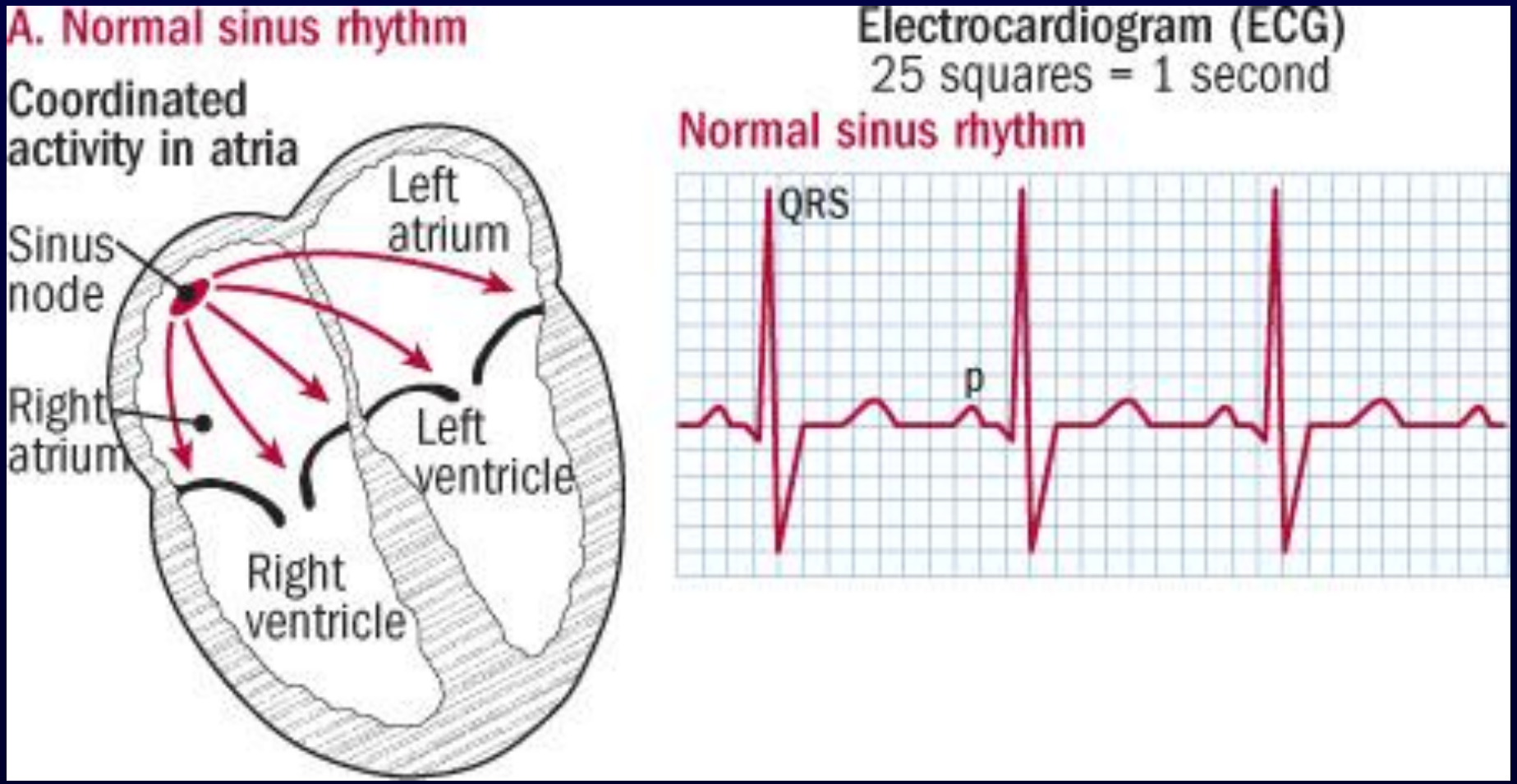


ECG: The Normal Axis (-30 to + 90)

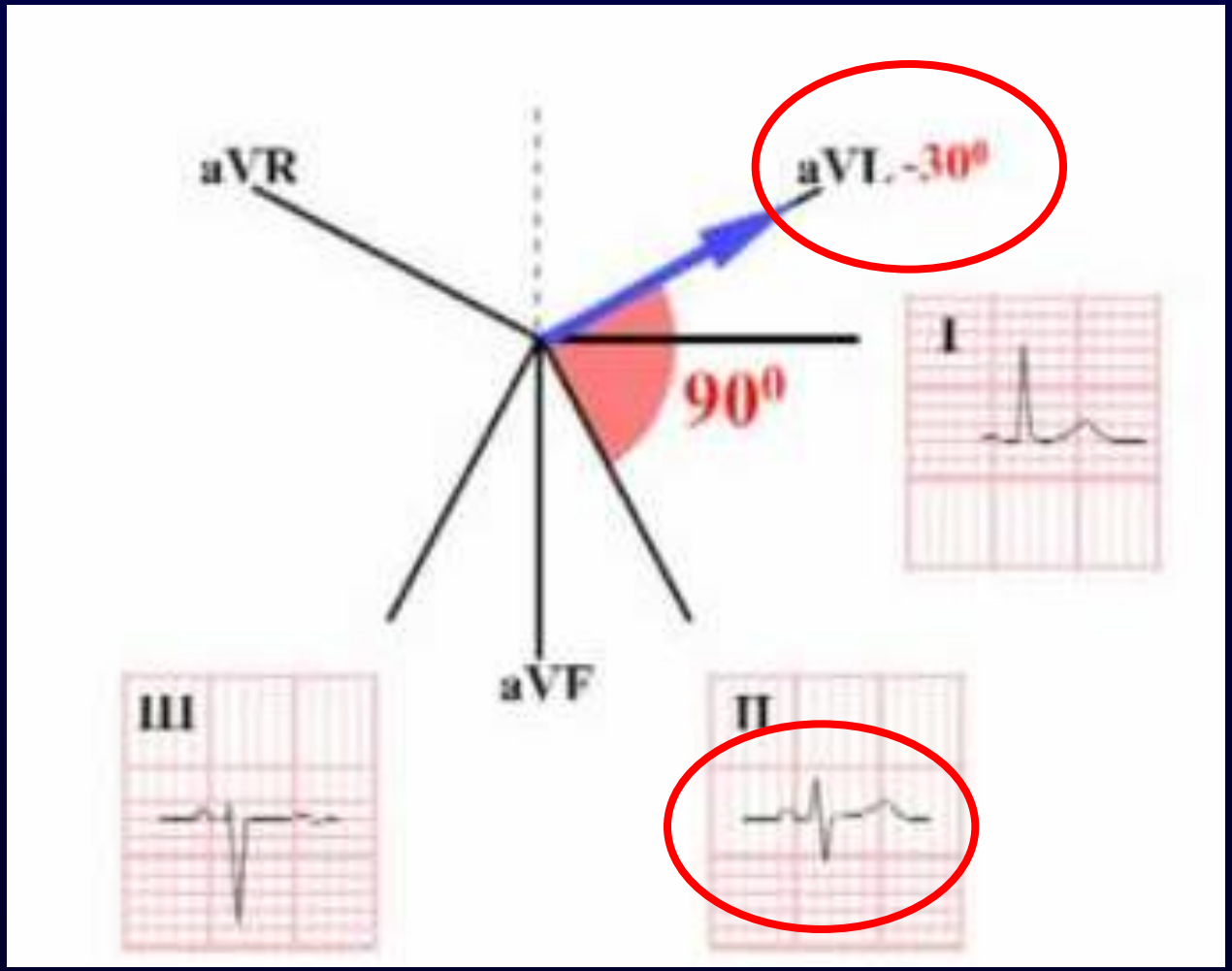


The axis is normal if 1 & 2 are both positive

ECG: Depolarisation



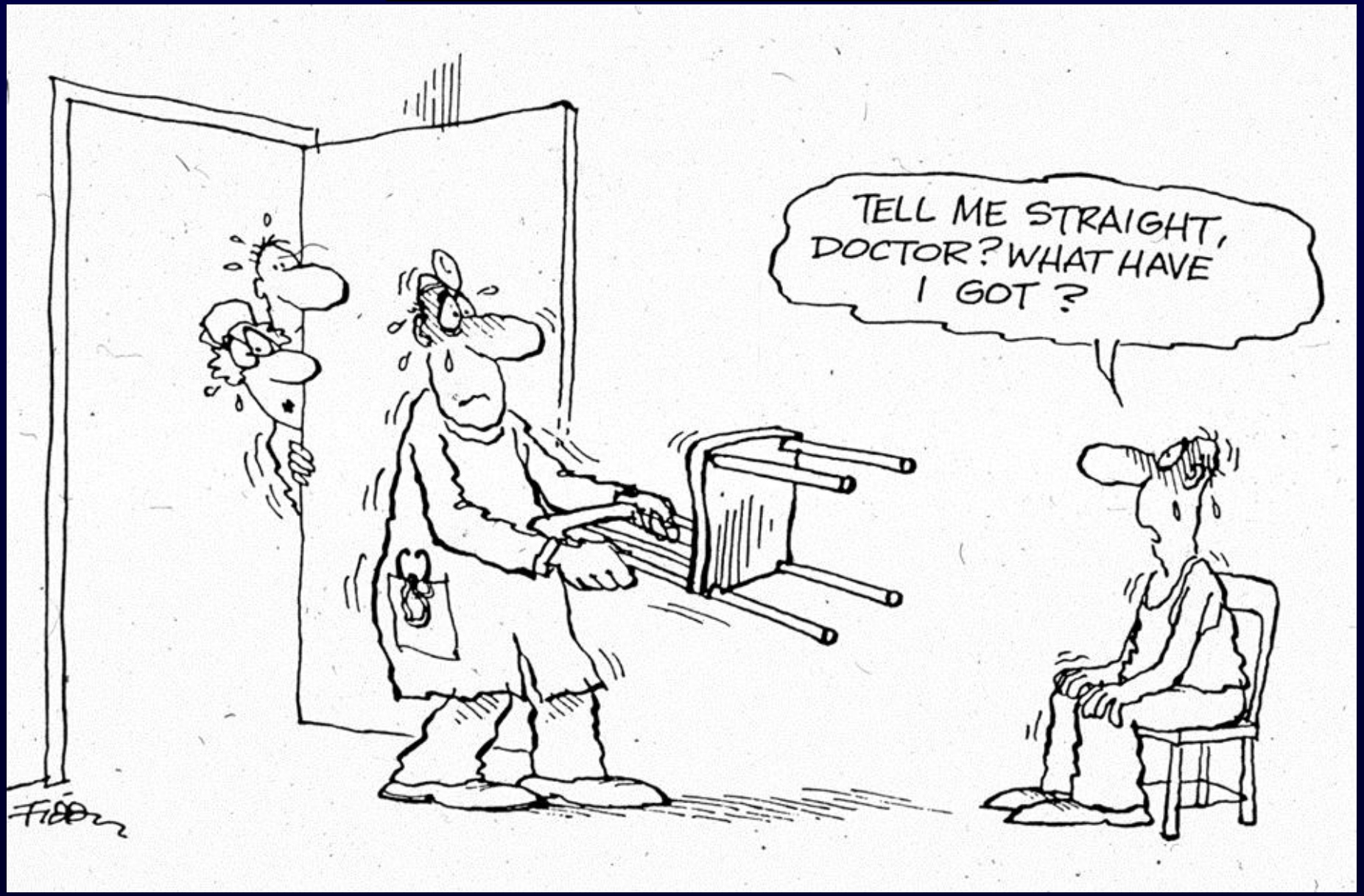
ECG: Depolarisation seen from Different Electrodes



Normal ECG

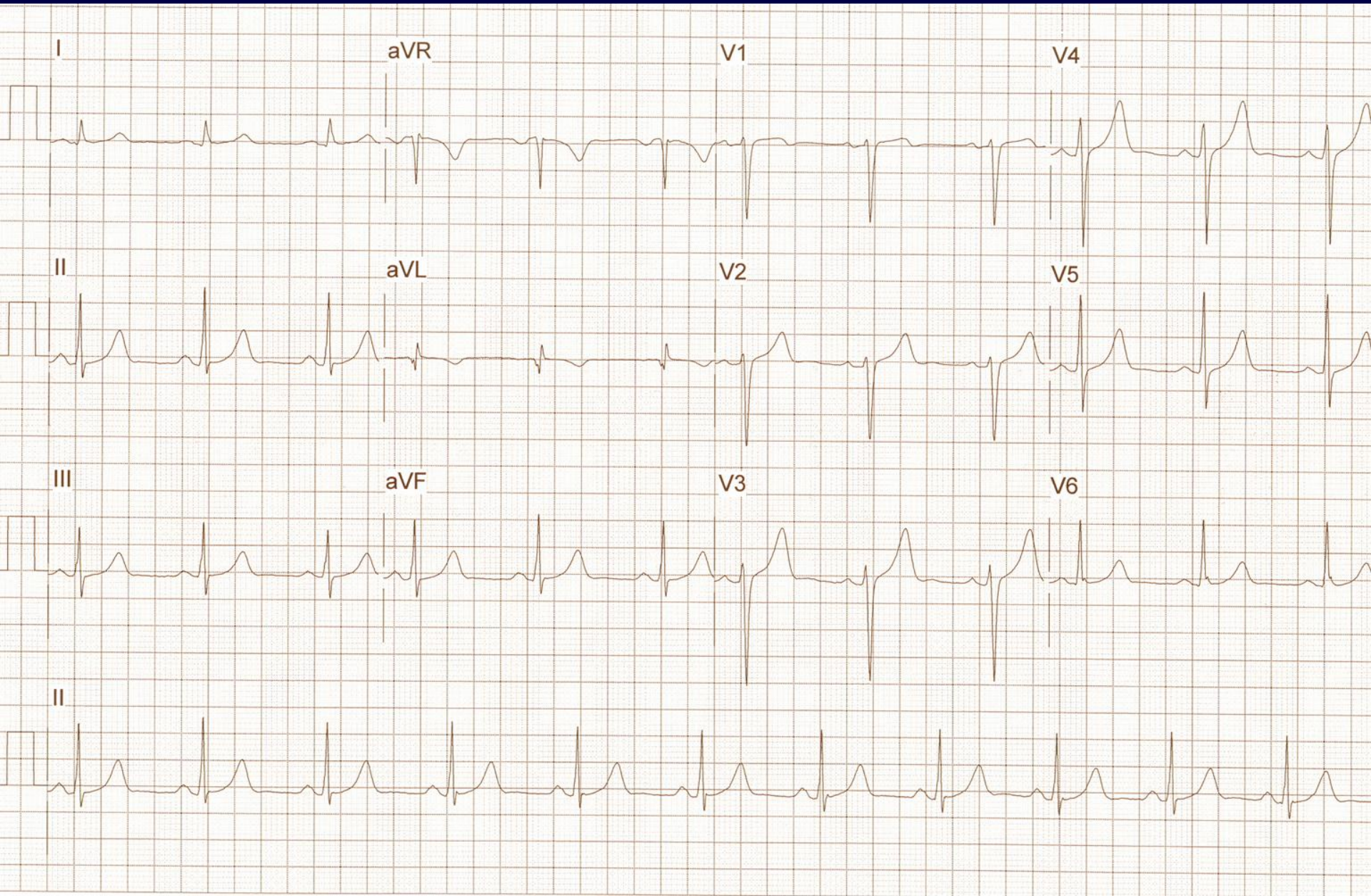
- Leads 1, 2, 3, AVL, AVF, AVR are ‘standard’ or ‘vertical’ or ‘coronal’ leads
- Chest leads: V1 to V6 are ‘horizontal’ or ‘transverse’ leads
- The Normal Axis is -30 to +90 degrees

ECG Case 1



ECG Case 1

Normal



Reporting an ECG

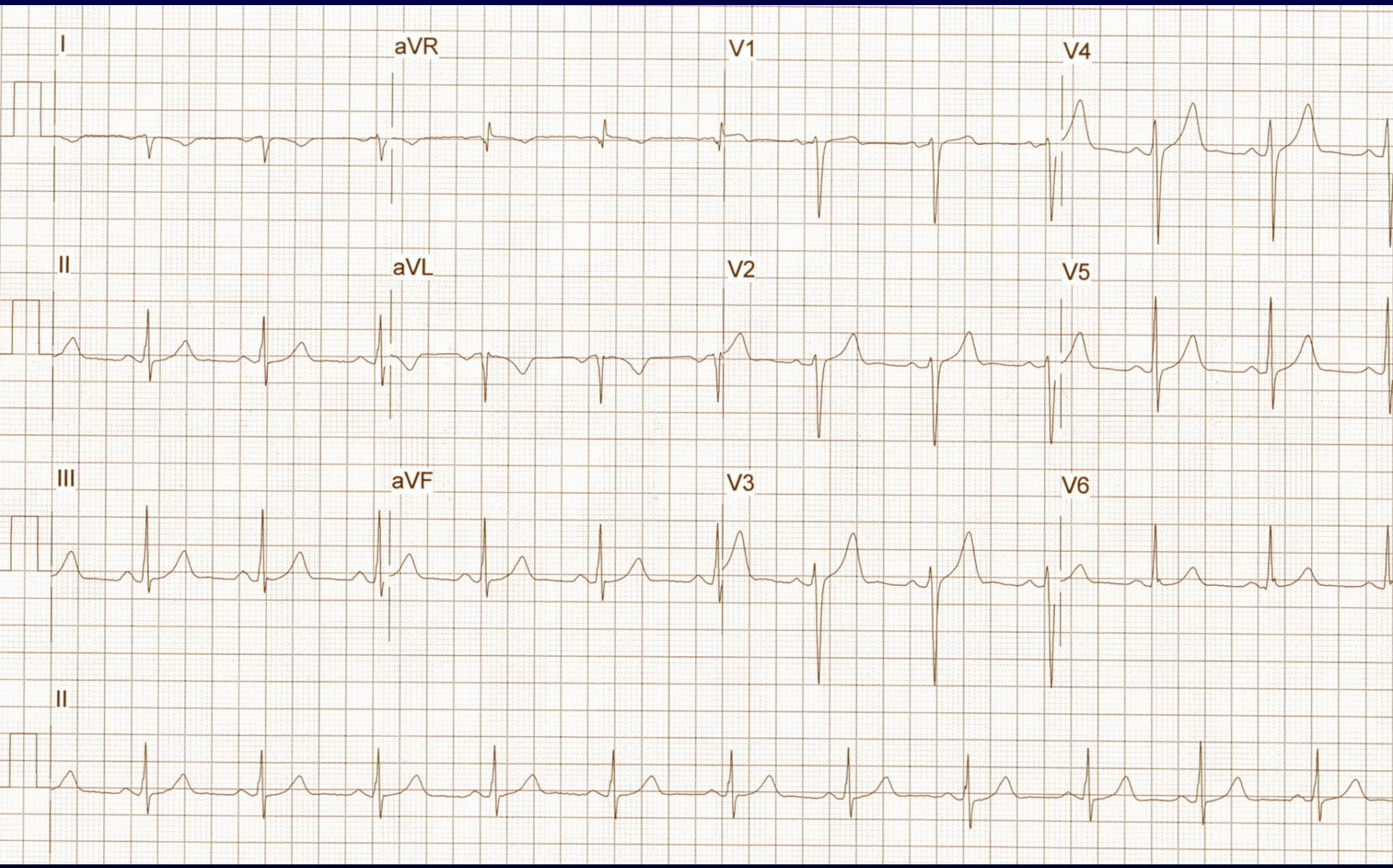
When reporting an ECG, the rate, rhythm and axis should be described. Remember:

- A ‘bradycardia’: a rate of < 60 beats/minute
  - (complexes > 5 ‘little’ squares apart)
- A ‘tachycardia’: a rate of > 100 beats/minute
  - (complexes < 3 ‘little’ squares apart)
- A ‘normal axis’ (– 30 to + 90): if leads 1 and 2 are ‘positive’
  - If either is negative, the axis is abnormal
- The normal PR interval: $\geq$ 0.12 secs & $\leq$ 0.20 secs
- The normal QRS complex: $\leq$ 0.08 secs
  - ‘Intra-ventricular conduction delay’ is > 0.08 & $\leq$ 0.12 secs
  - BBB pattern/’prolonged QRS’: > 0.12 secs

ECG Case 2

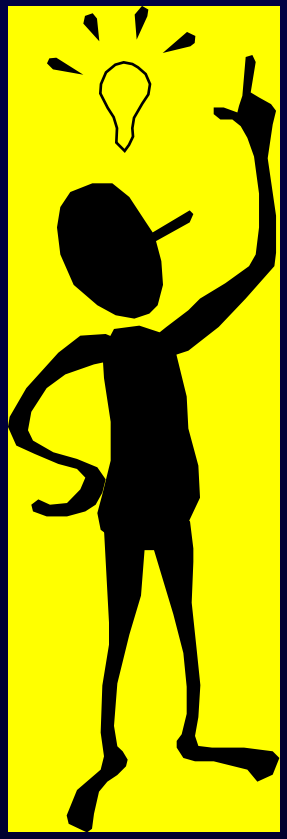

"You have a rare condition called 'good health'.
Frankly, I'm not sure how to treat it."

ECG Case 2

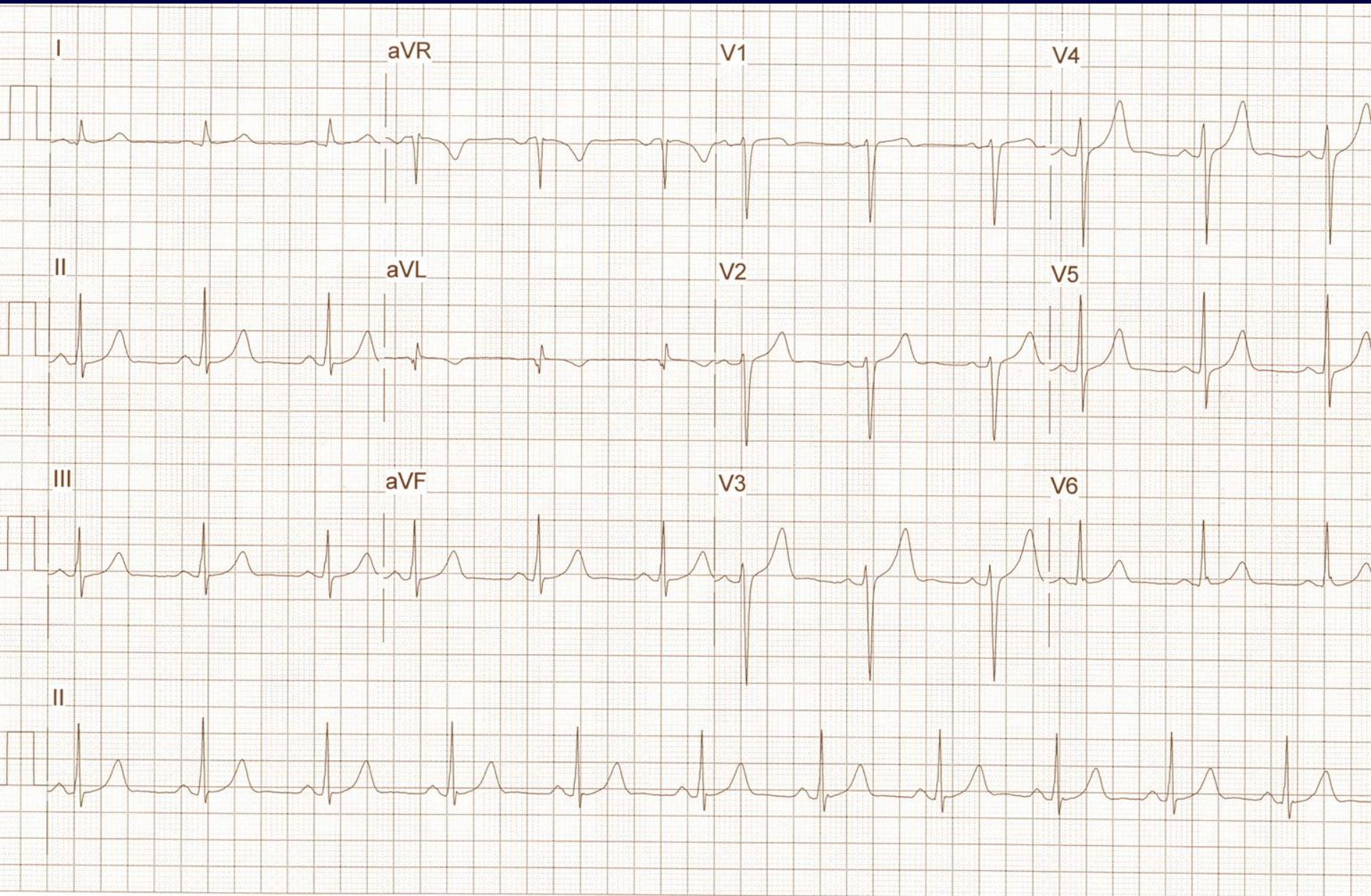


ECG 2: Crossed Arm Leads!

- 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)

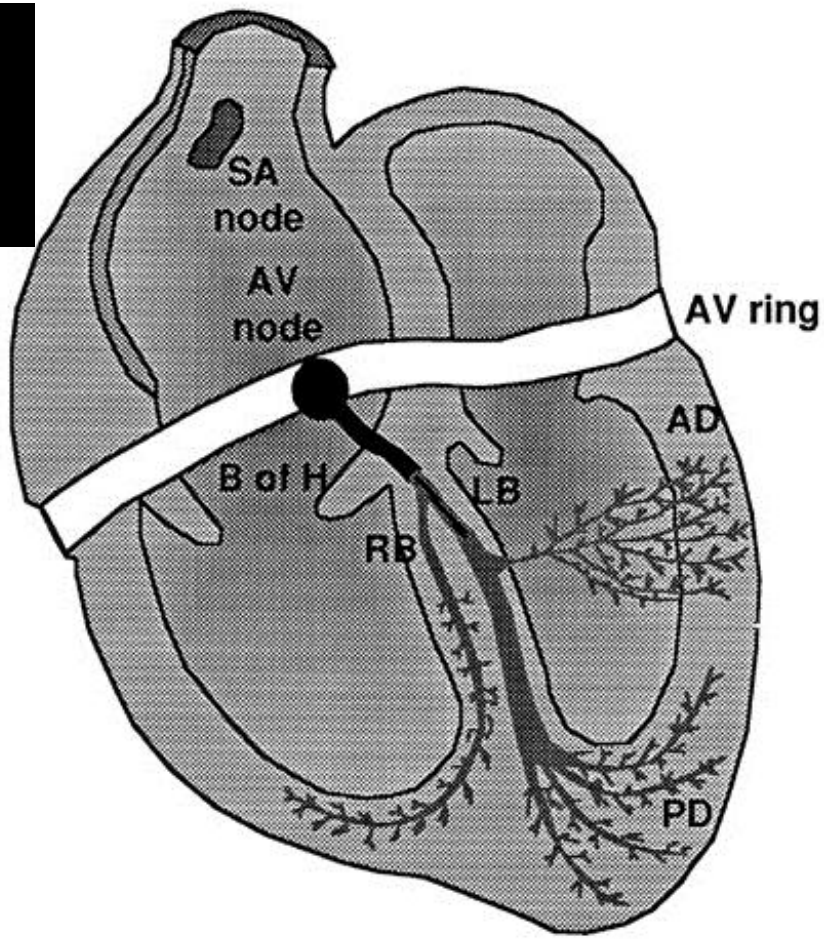
Mechanisms of Arrhythmias

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

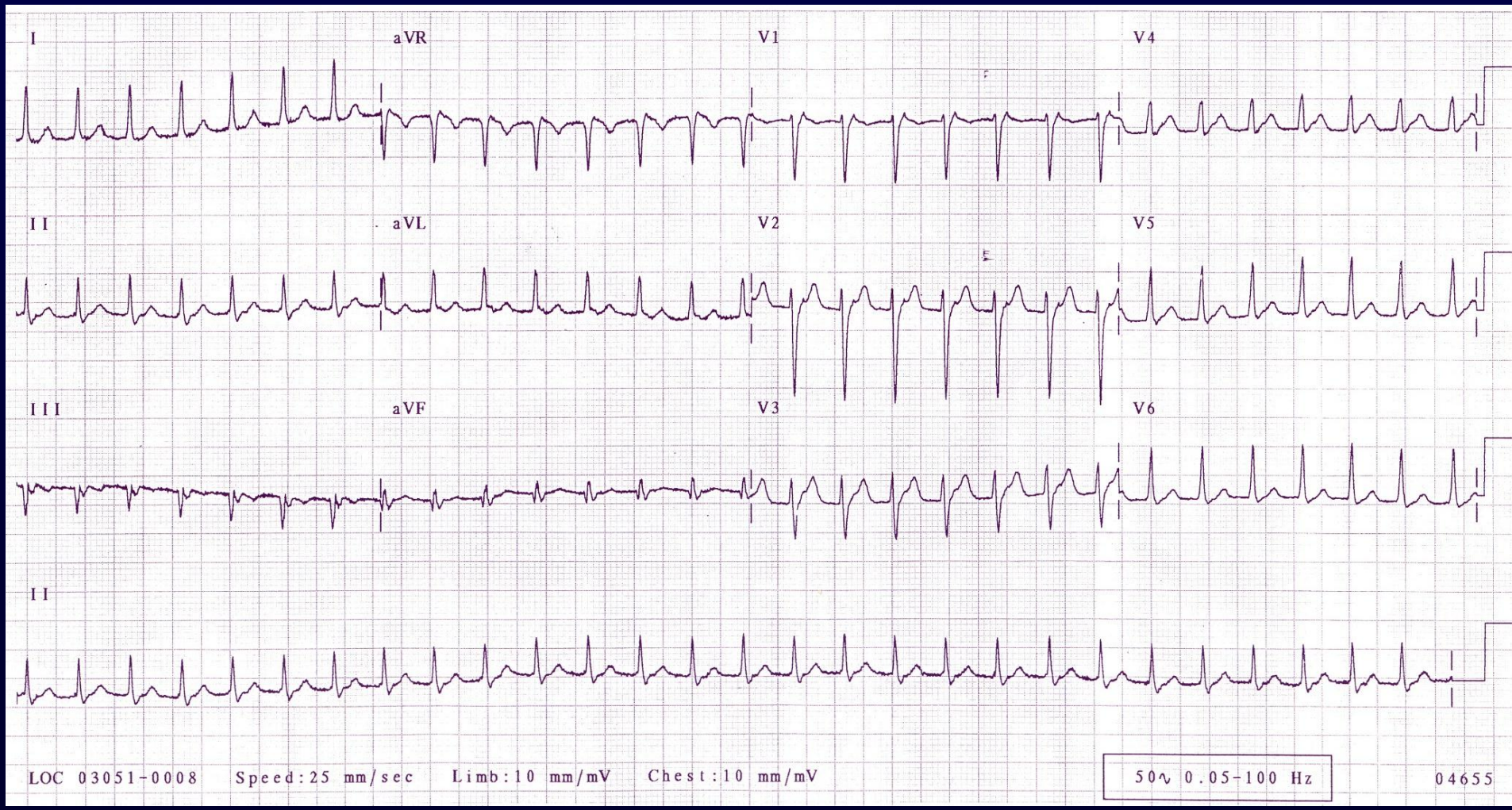


‘Spark’

‘Circuit’

[‘Fibrillation’]

ECG Case 3

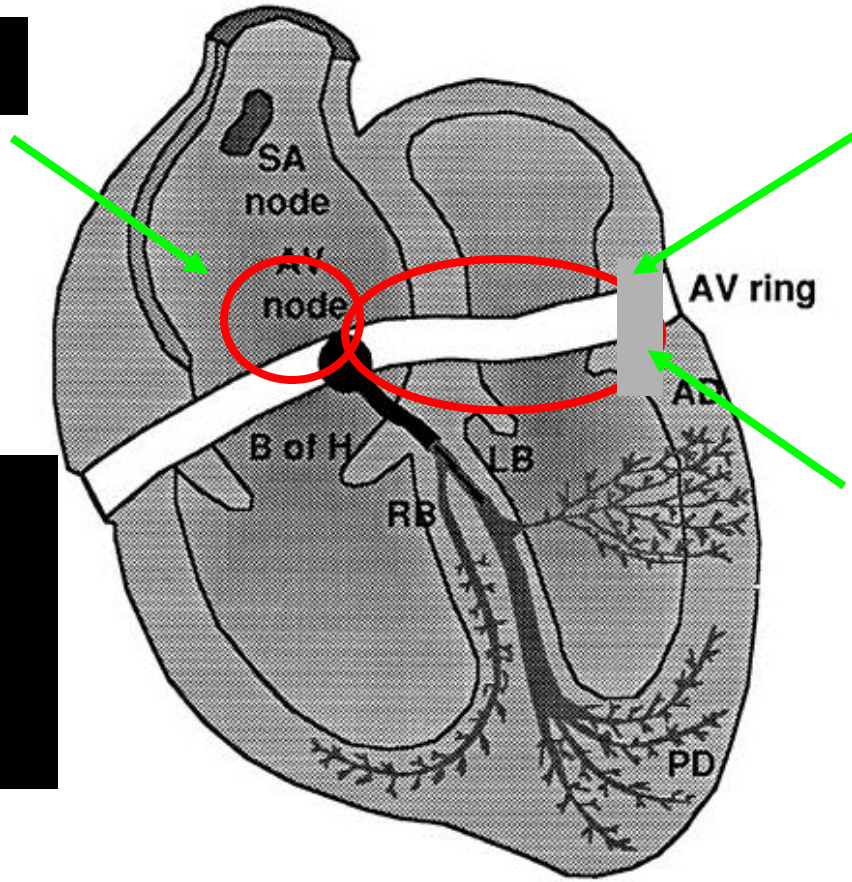

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
LOC 03051-0008
Speed:25 mm/sec
Limb:10 mm/mV
Chest:10 mm/mV
50∿ 0.05-100 Hz
04655

ECG Case 3: ‘Circuit SVT’ of AV Node

Diagram of the Cardiac Conducting System

AVNRT

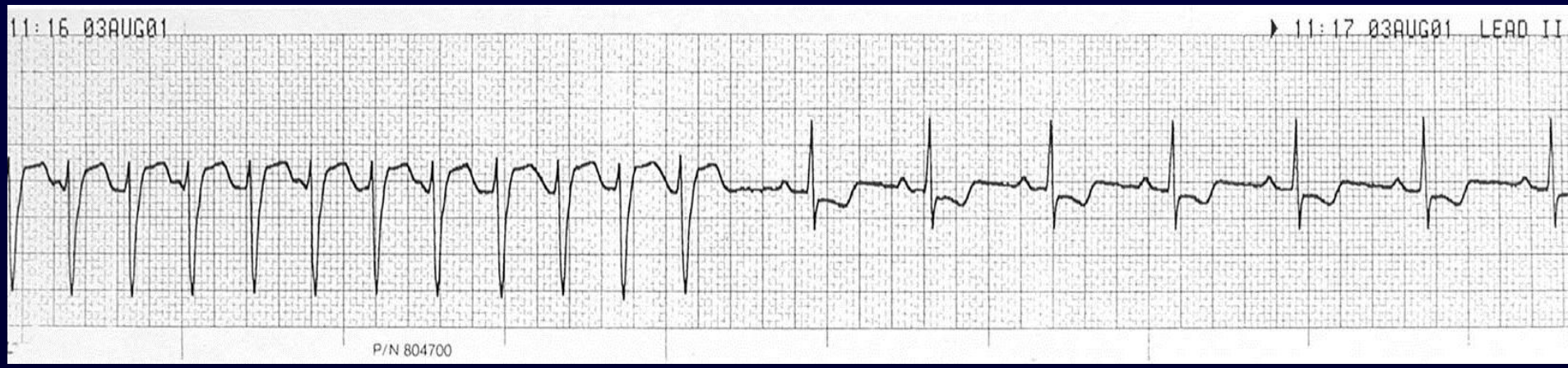
Fast and slow pathways in AVN



AVRT: AV Re-Entrant Tachycardia

WPW Syndrome with Bundle of Kent

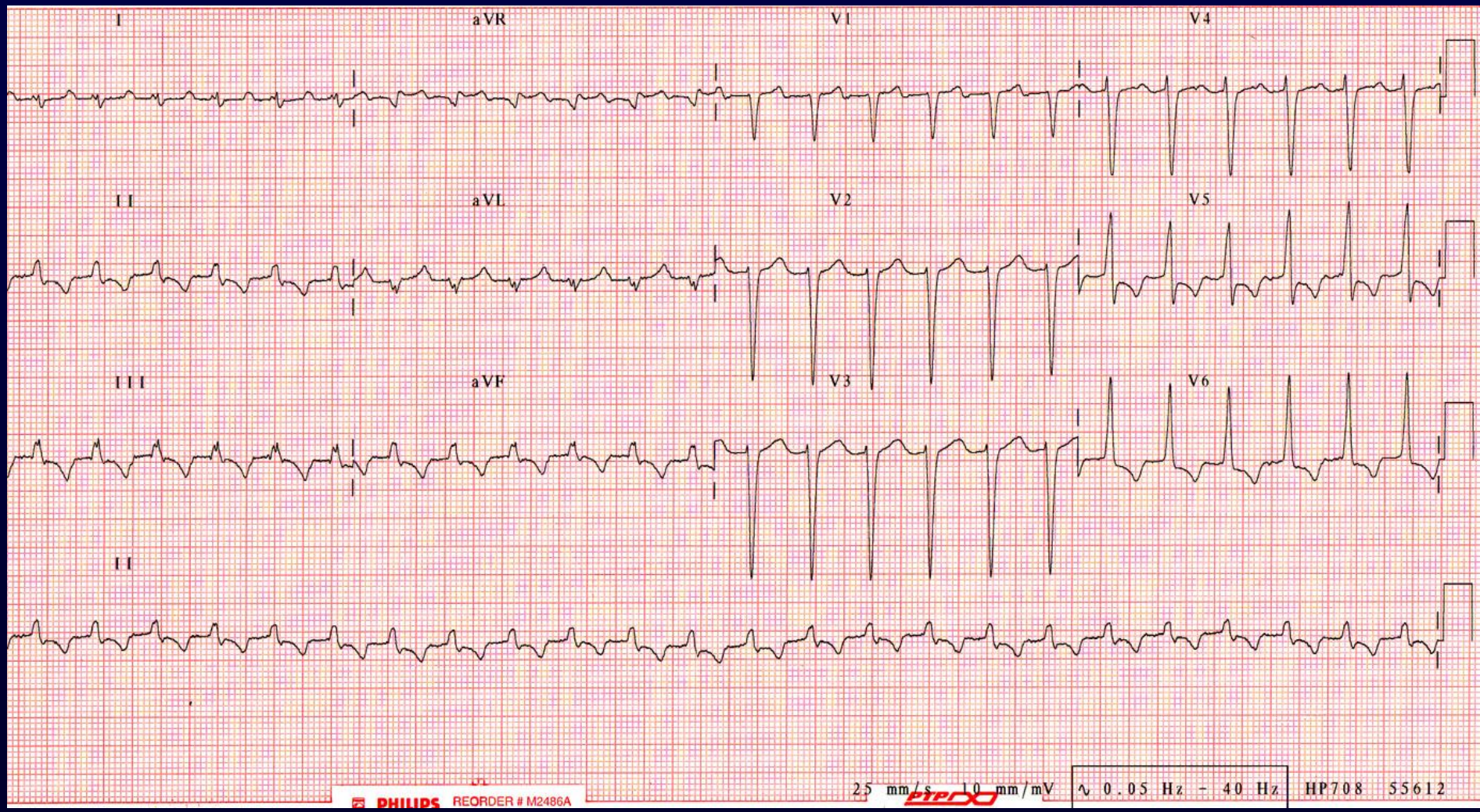
Different SVT Case: Adenosine for SVT



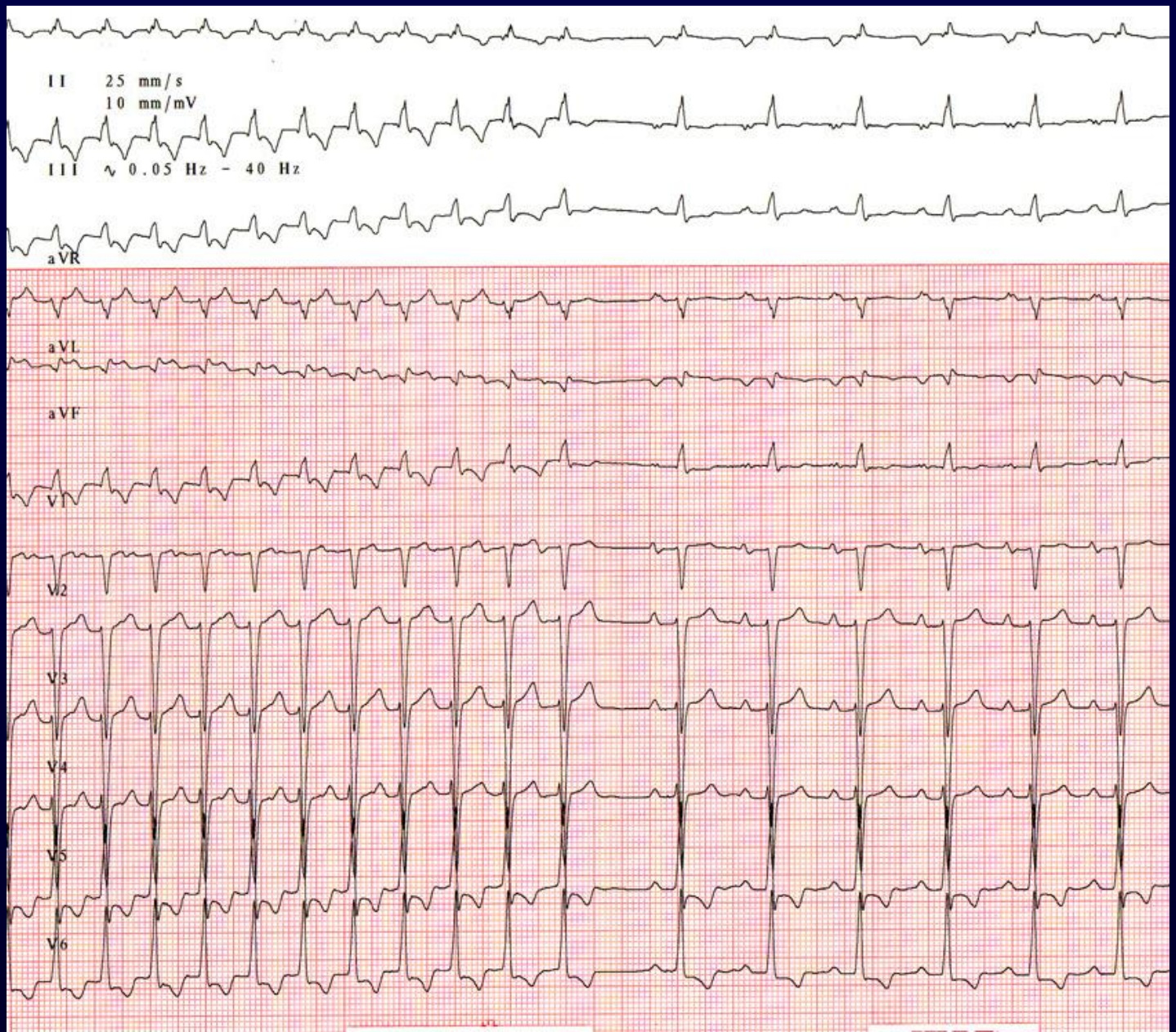
ECG Case 4

"I want to look like Cindy Crawford."

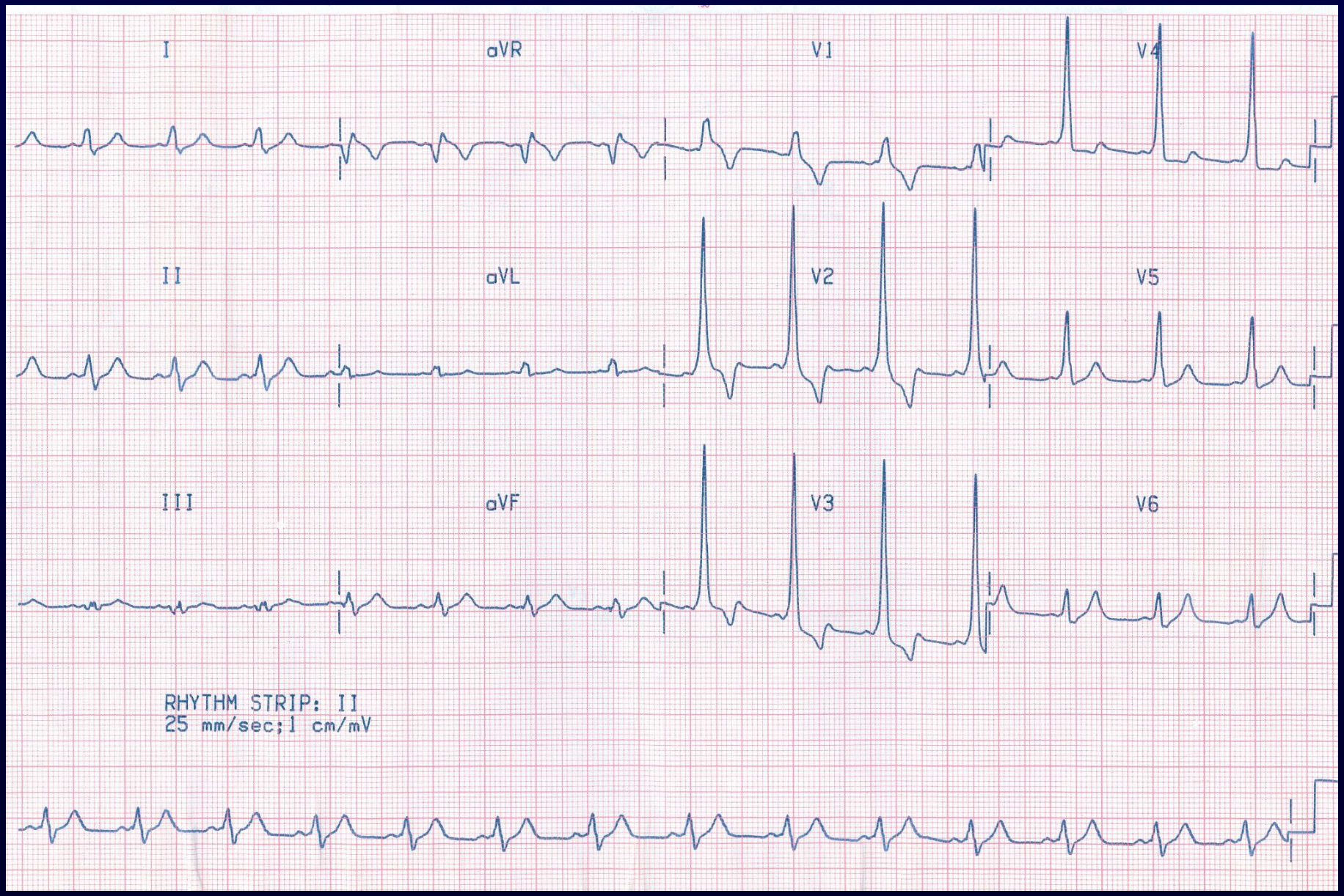
ECG Case 4


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
PHILIPS REORDER # M2486A
25 mm/s 10 mm/mV
0.05 Hz - 40 Hz
HP708 55612

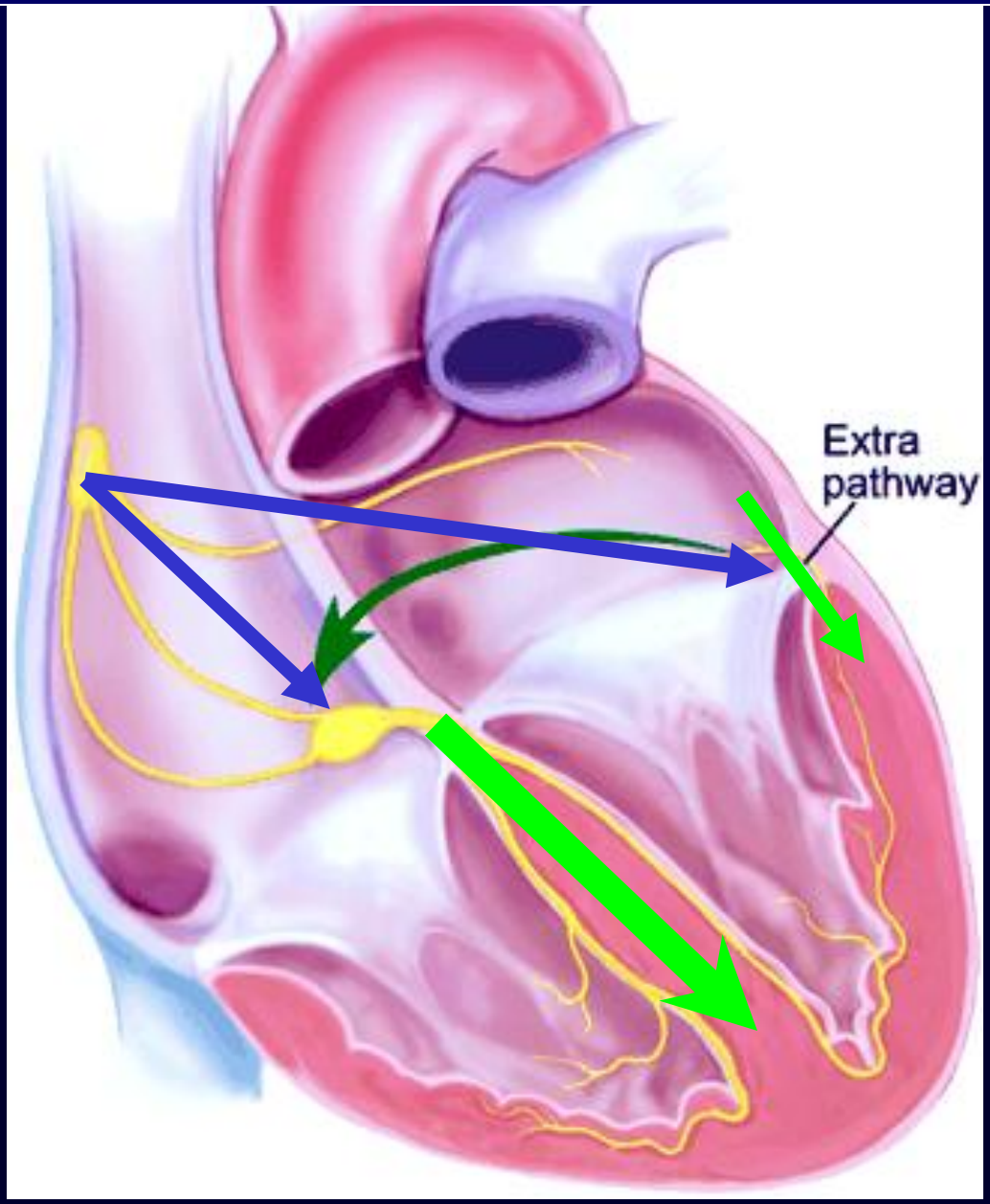
ECG Case 4: Adenosine Treatment

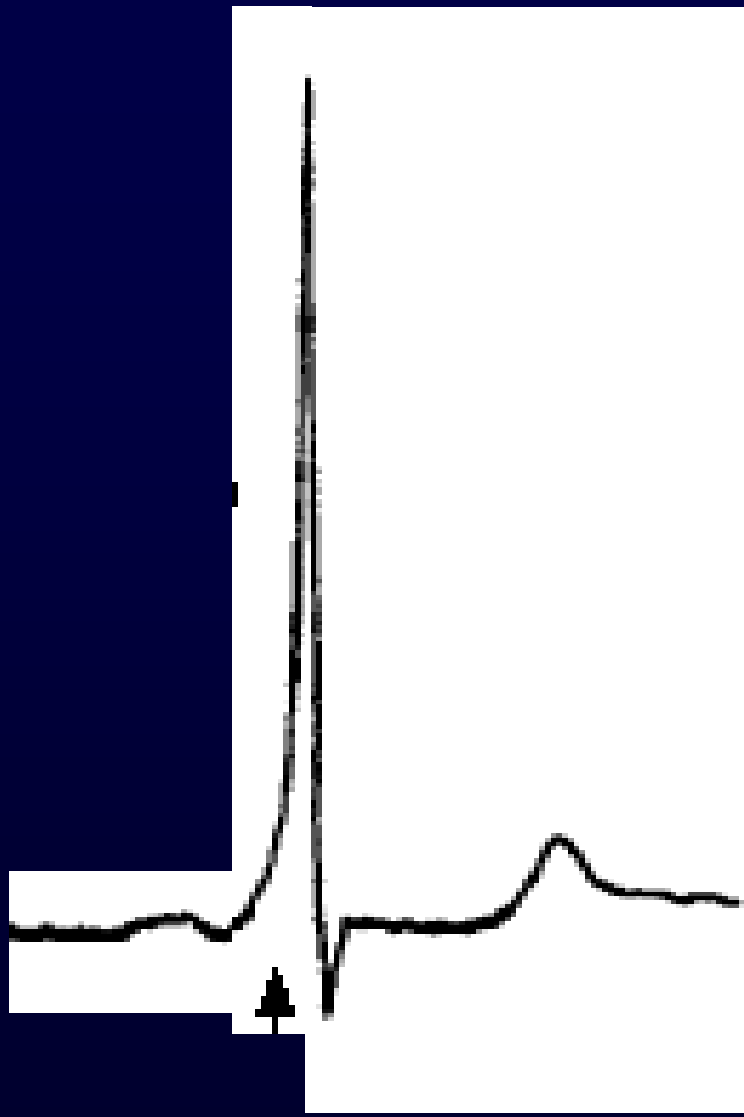


ECG Case 5

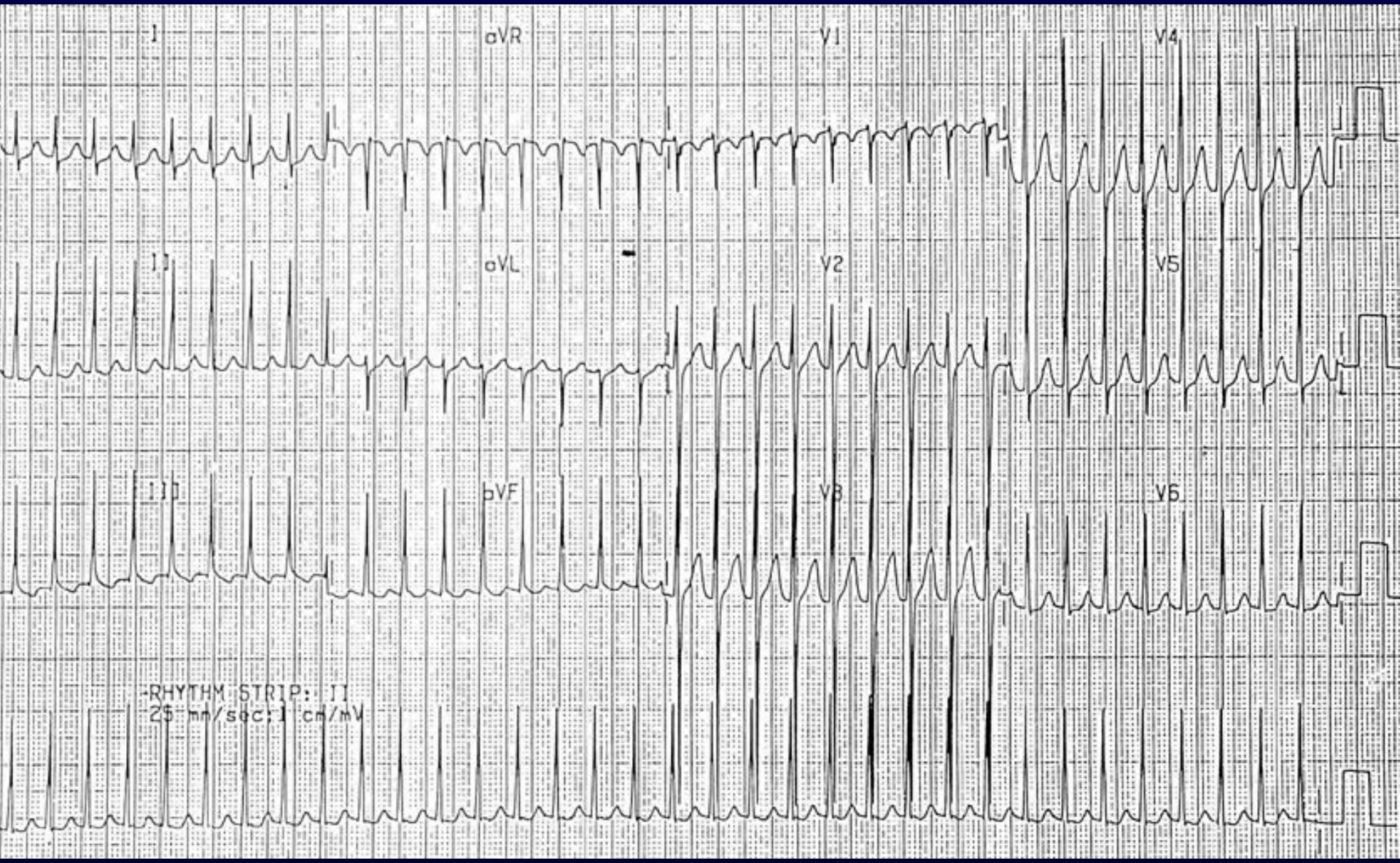

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
RHYTHM STRIP: II
25 mm/sec; 1 cm/mV

ECG 5: WPW Syndrome

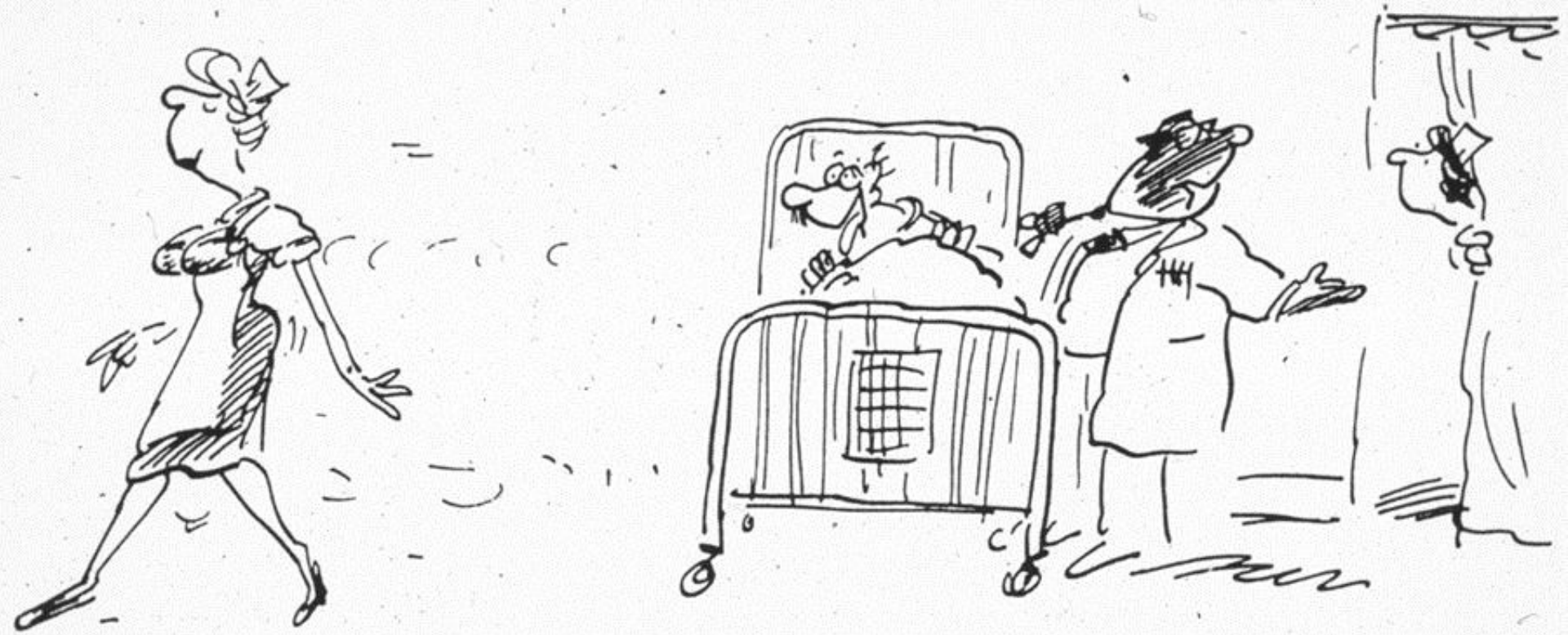




ECG 6

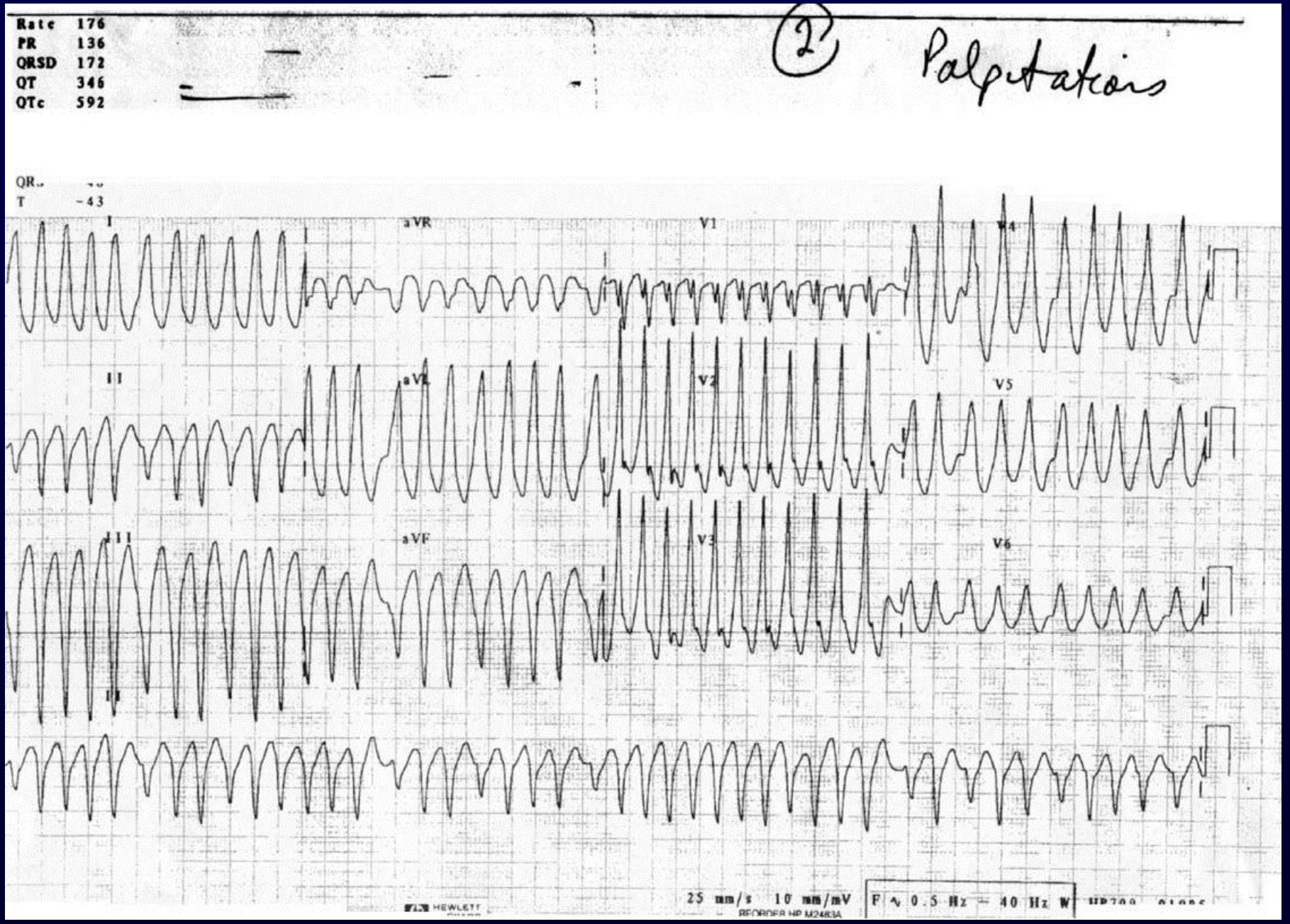

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
RHYTHM STRIP: II
25 mm/sec; 1 cm/mV

ECG Case 7

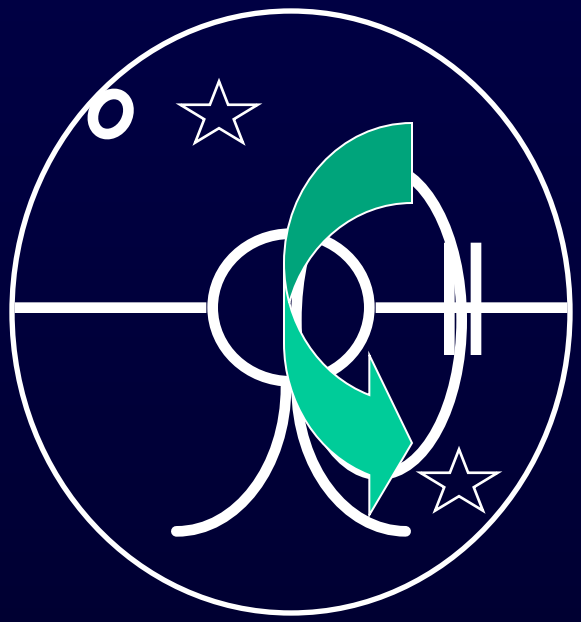


"Quick nurse – the blindfold!"

ECG Case 7


Rate 176
PR 136
QRSD 172
QT 346
QTc 592
(2)
Palpitations
T -43
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
25 mm/s 10 mm/mV
F ∿ 0.5 Hz – 40 Hz W

Tachycardias in WPW



Usual SVT

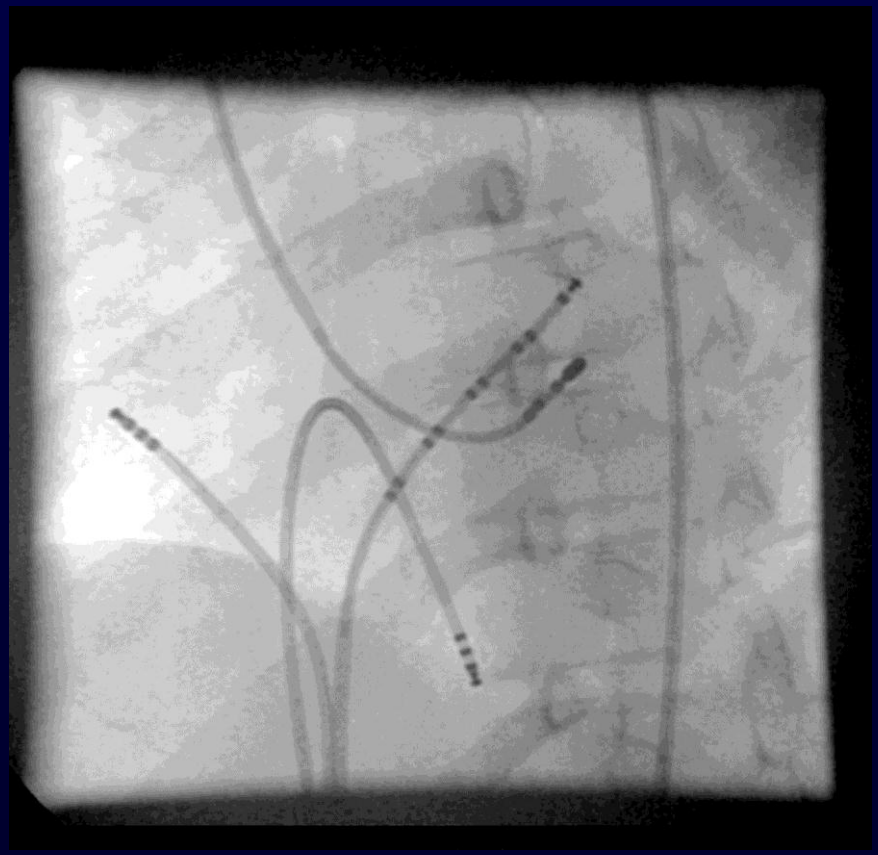
Antegrade

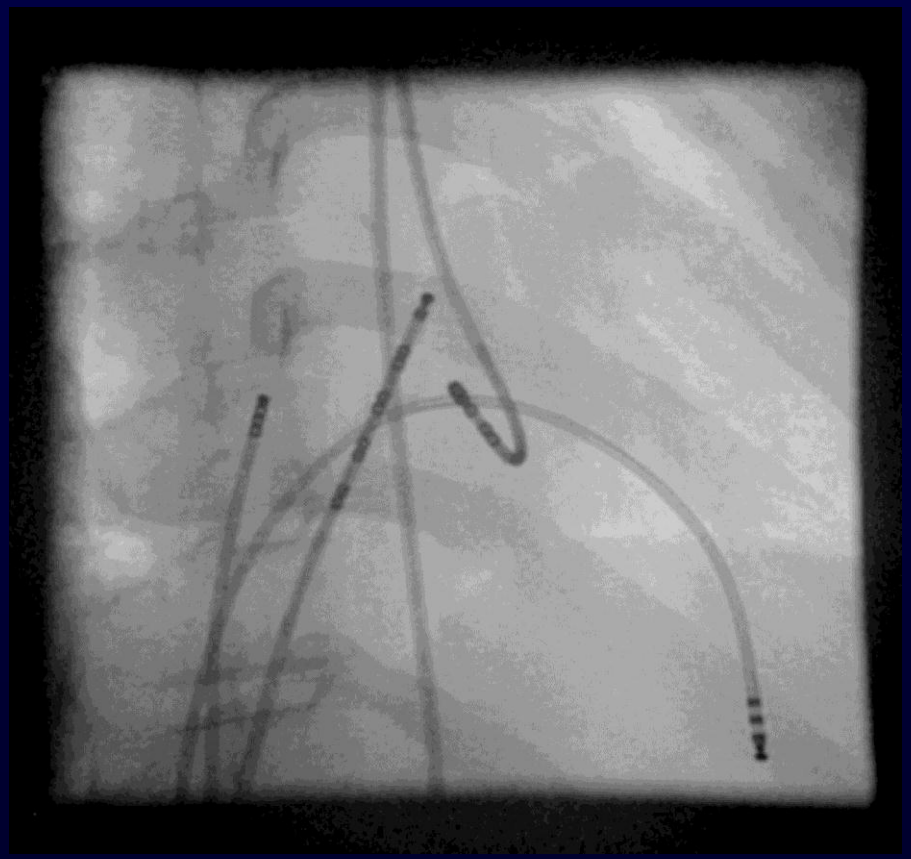
AVN

Unusual SVT
Retrograde
AVN

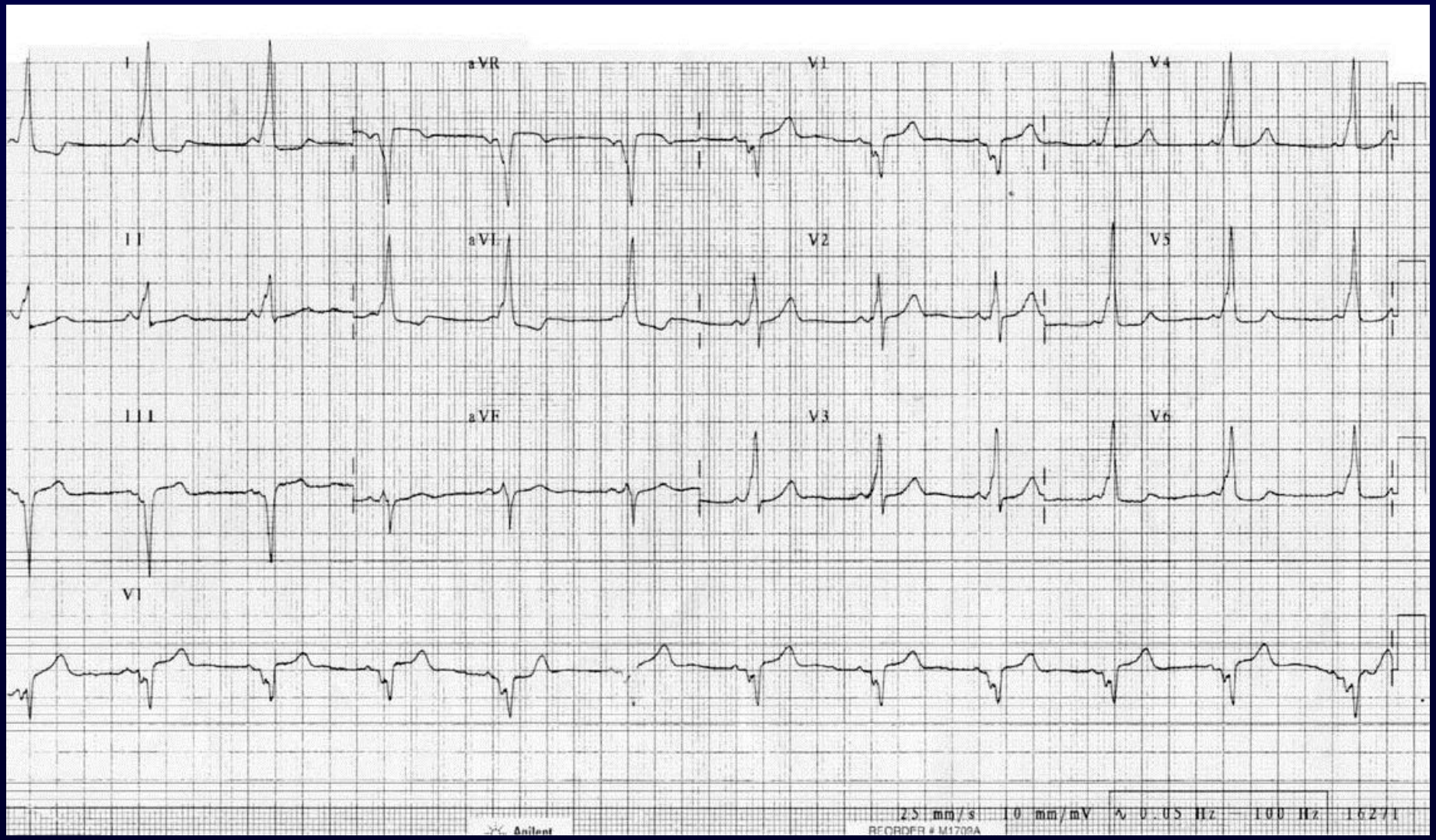
Rare, dangerous
Atrial Fibrillation
with no AVN
conduction

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

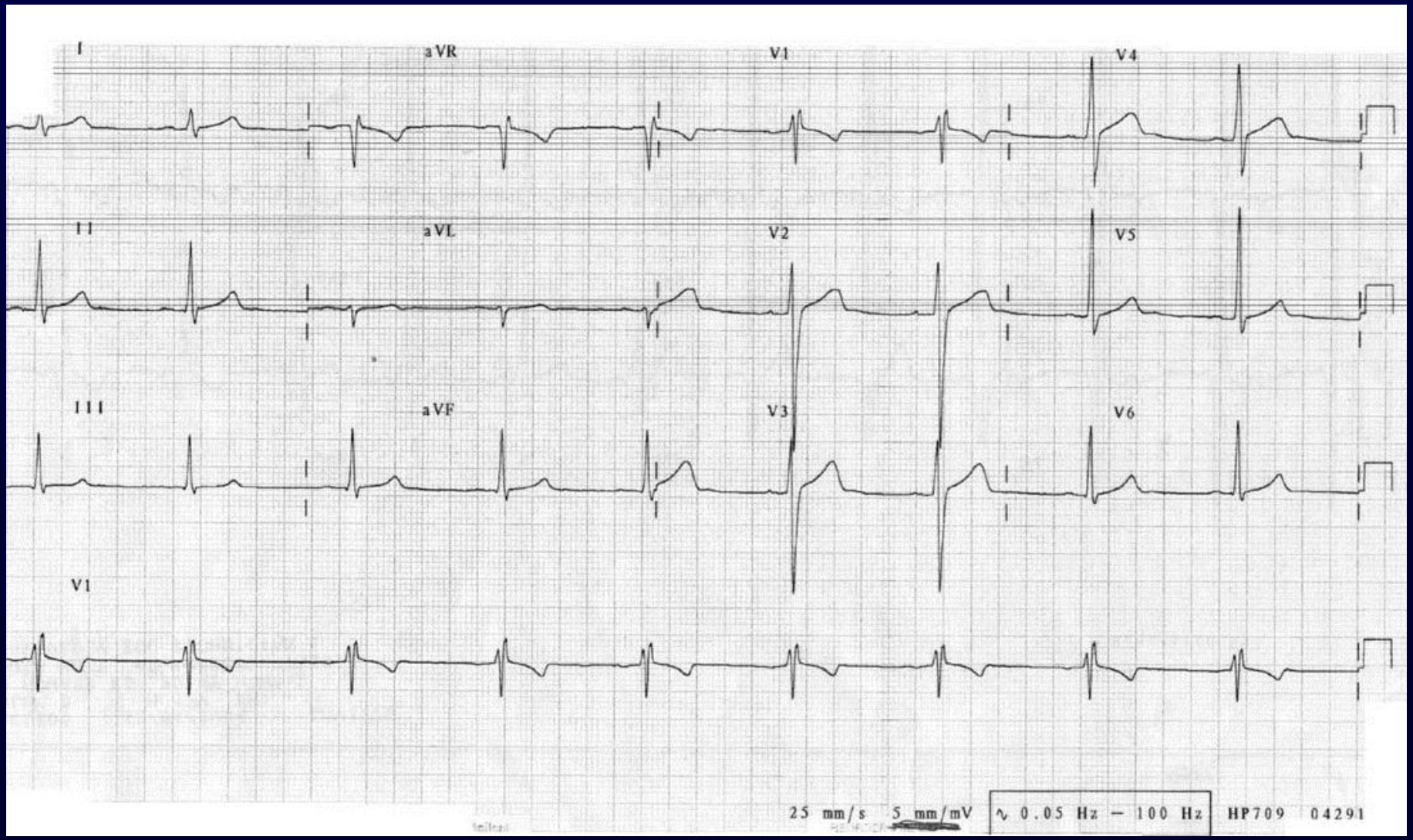




ECG Case 8


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
25 mm/s
10 mm/mV
0.05 Hz
100 Hz
16271

ECG Case 8: Post EP Ablation



ECG Case 9

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

ECG Case 9

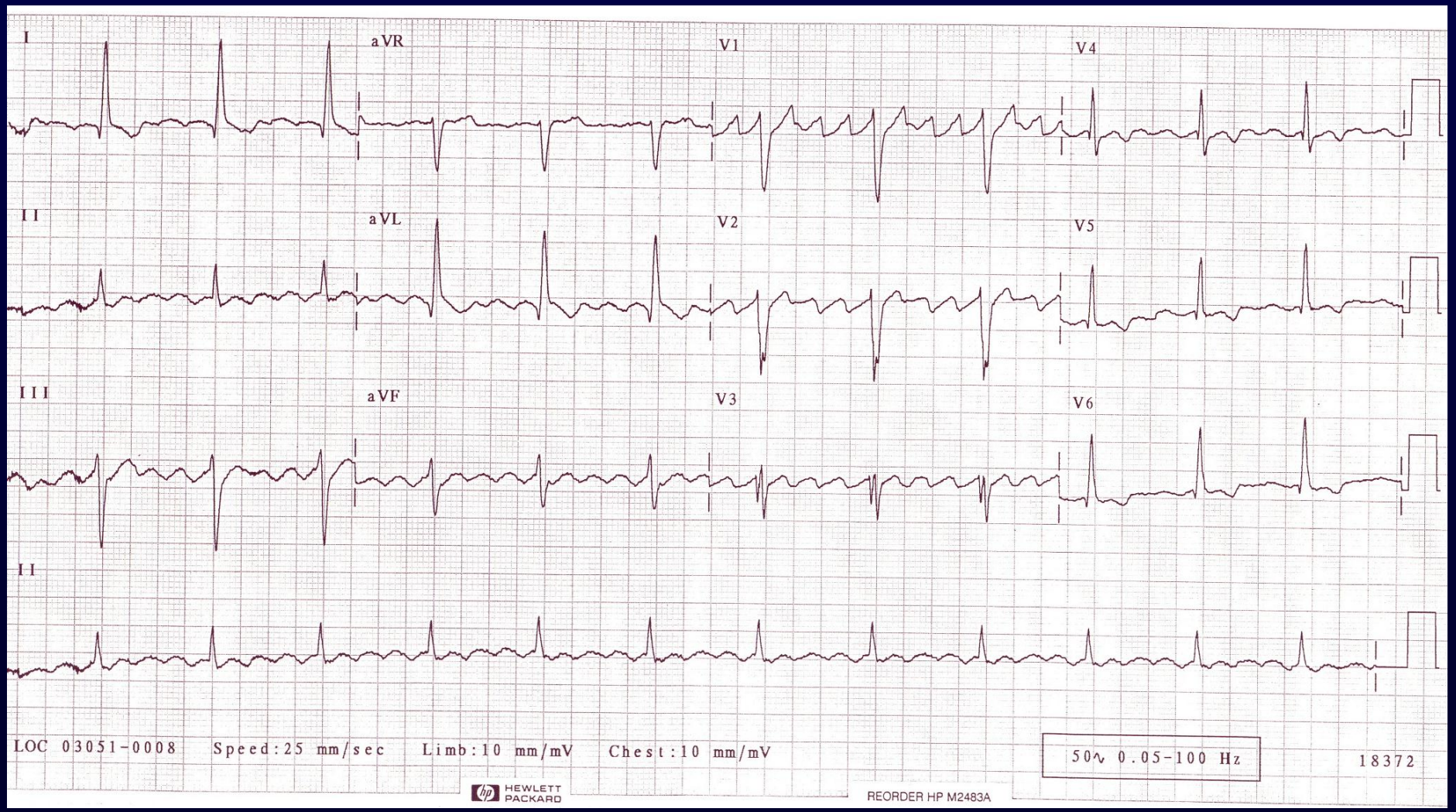
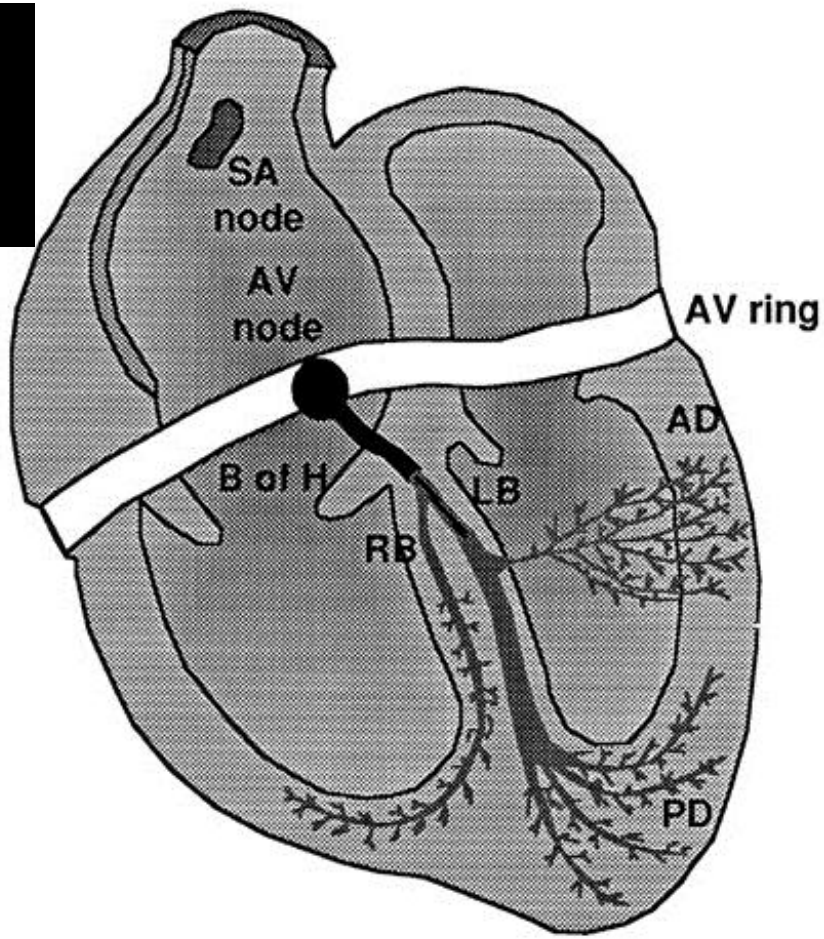

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
LOC 03051-0008
Speed:25 mm/sec
Limb:10 mm/mV
Chest:10 mm/mV
50∿ 0.05-100 Hz
18372
HEWLETT PACKARD
REORDER HP M2483A

Diagram of the Cardiac Conducting System

Anatomical

Sites

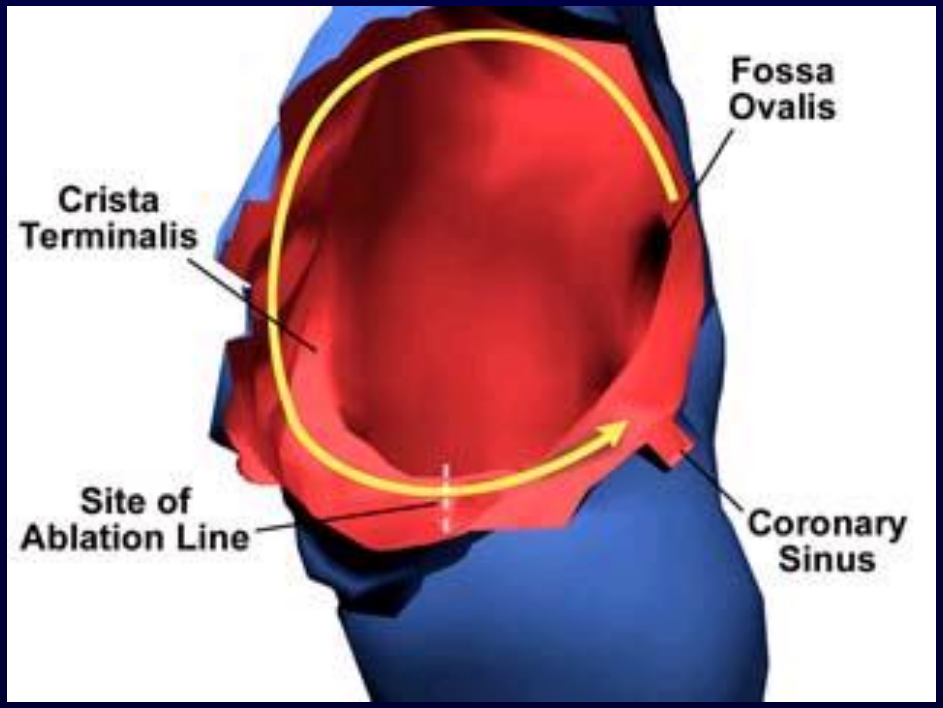


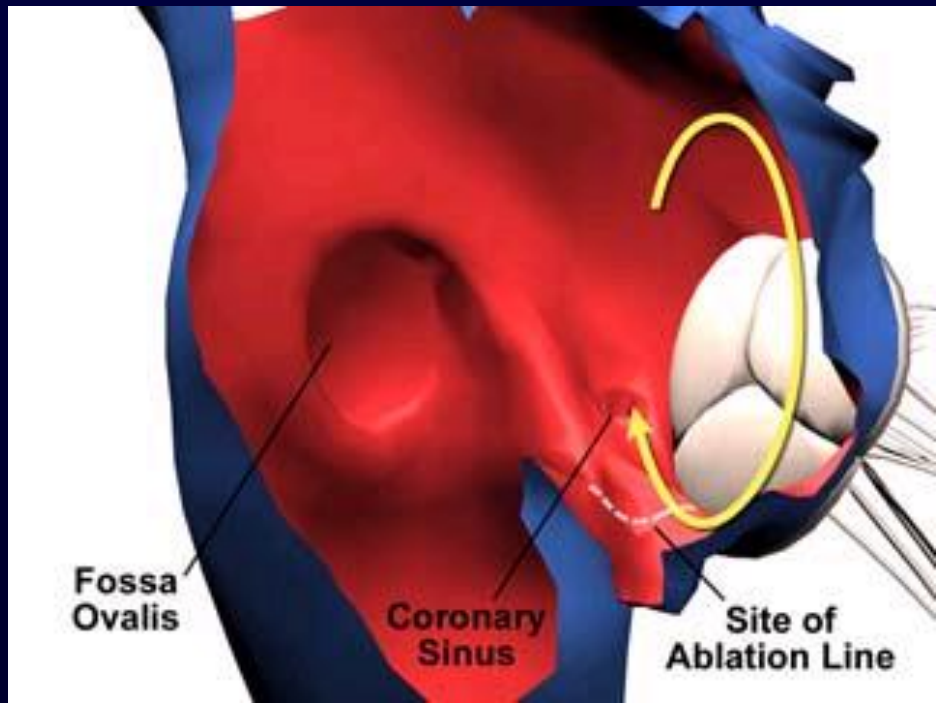
‘Spark’

‘Circuit’

[‘Fibrillation’]

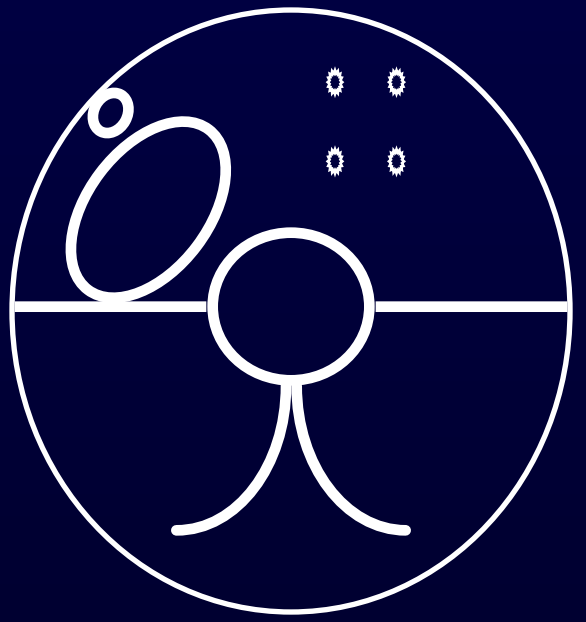
Typical Atrial Flutter Circuit in Right Atrium



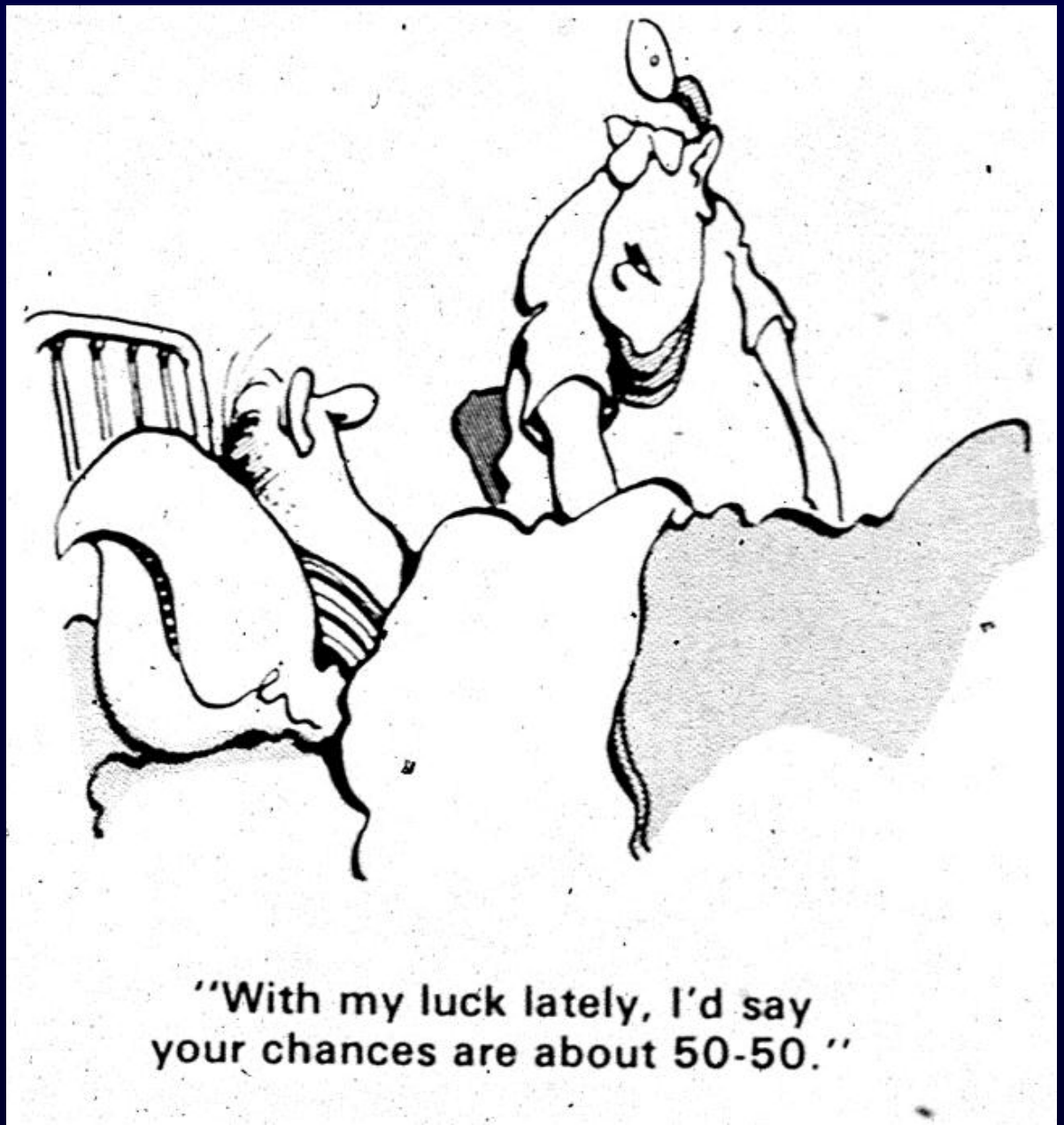


Atrial Flutter

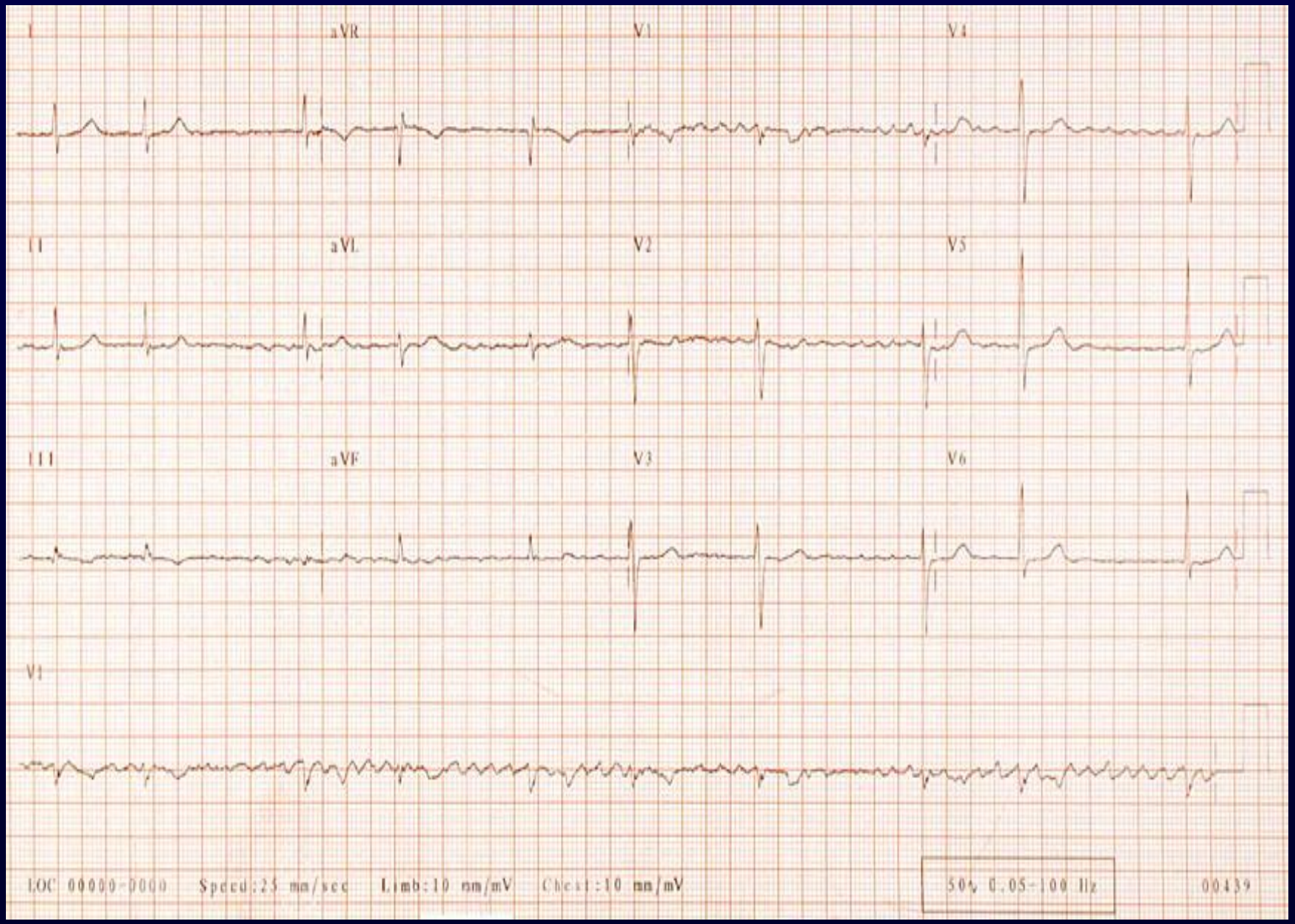
- Typical A Flutter (RA)
- Medical therapy
- Ablation therapy
  - Isthmus Block
- Risks
  - Recurrence
  - Other Atrial Tachycardias
  - Atrial Fibrillation



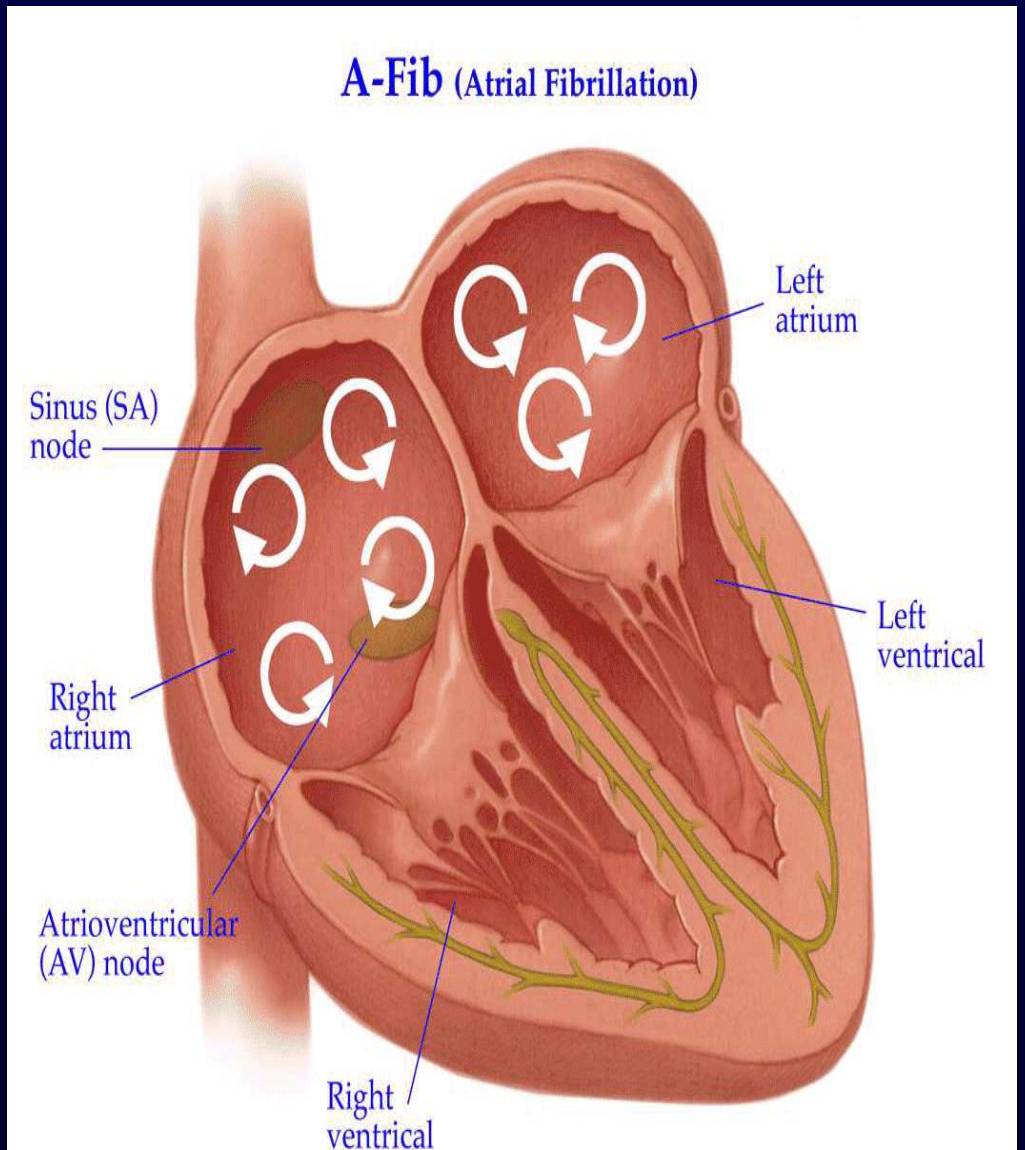
ECG Case 10



ECG Case 10


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
LOC 00000-0000
Speed:25 mm/sec
Limb:10 mm/mV
Chest:10 mm/mV
50% 0.05-100 Hz
00439

Atrial Fibrillation: Complex Re-Entry (Circuit) Mechanism

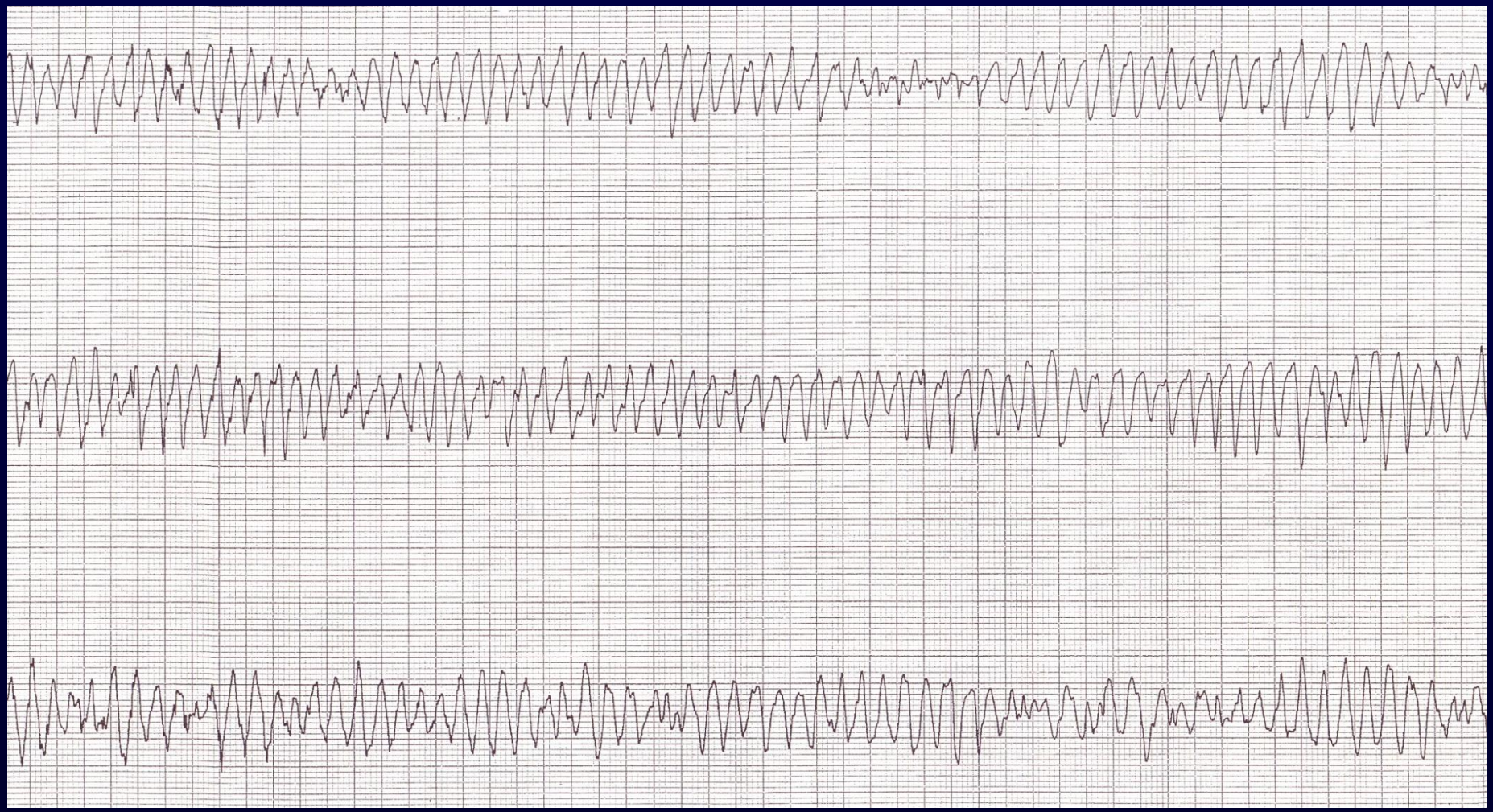


Atrial Fibrillation: Complex Re-Entry (Circuit) Mechanism; 3 Types

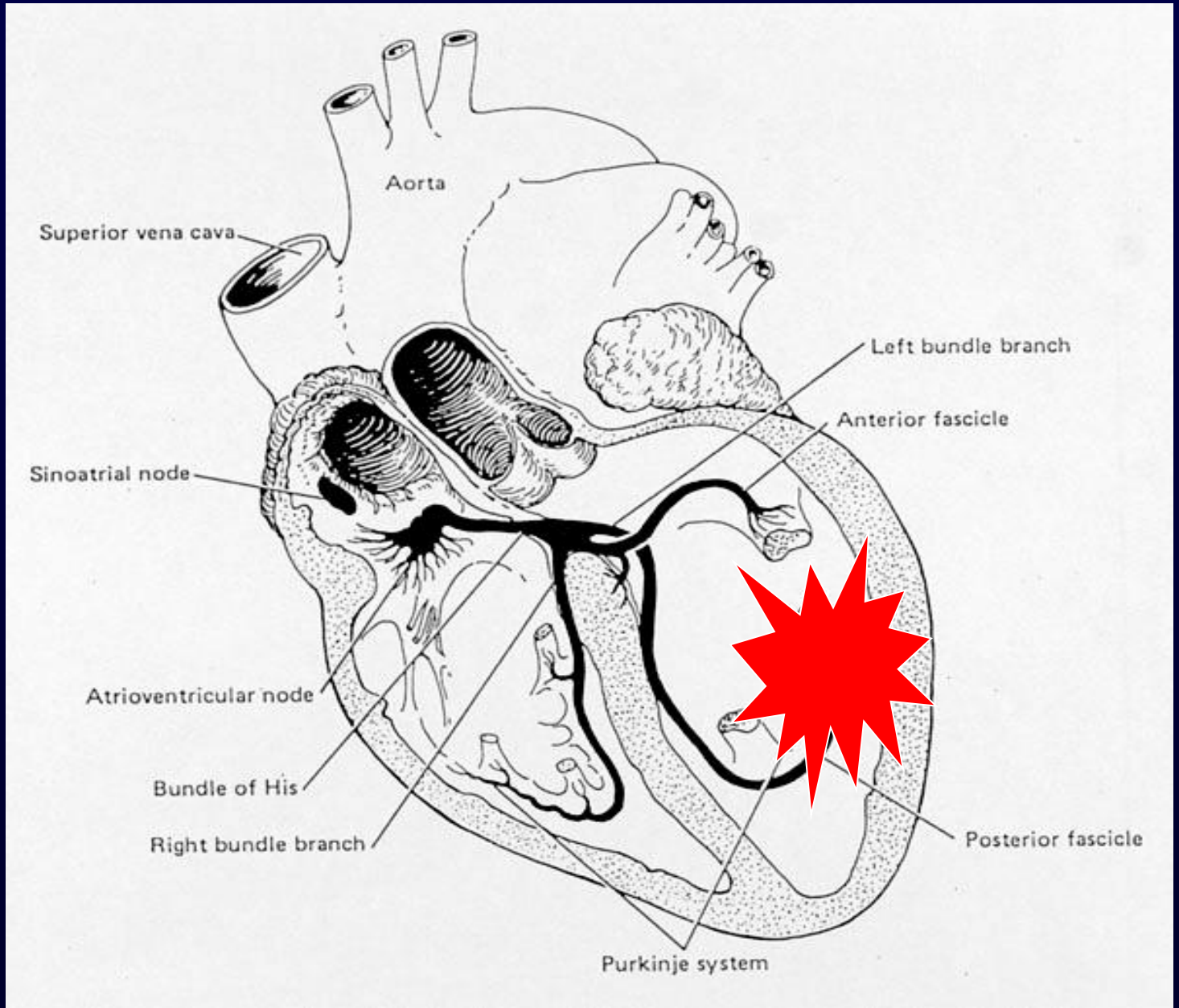
1. Paroxsysmal: Usually recurrent, lasting < 7 days & self-terminating
2. Persistent: Lasting longer than 7 days & requiring intervention for termination
3. Permanent: Medical decision is made not to attempt termination

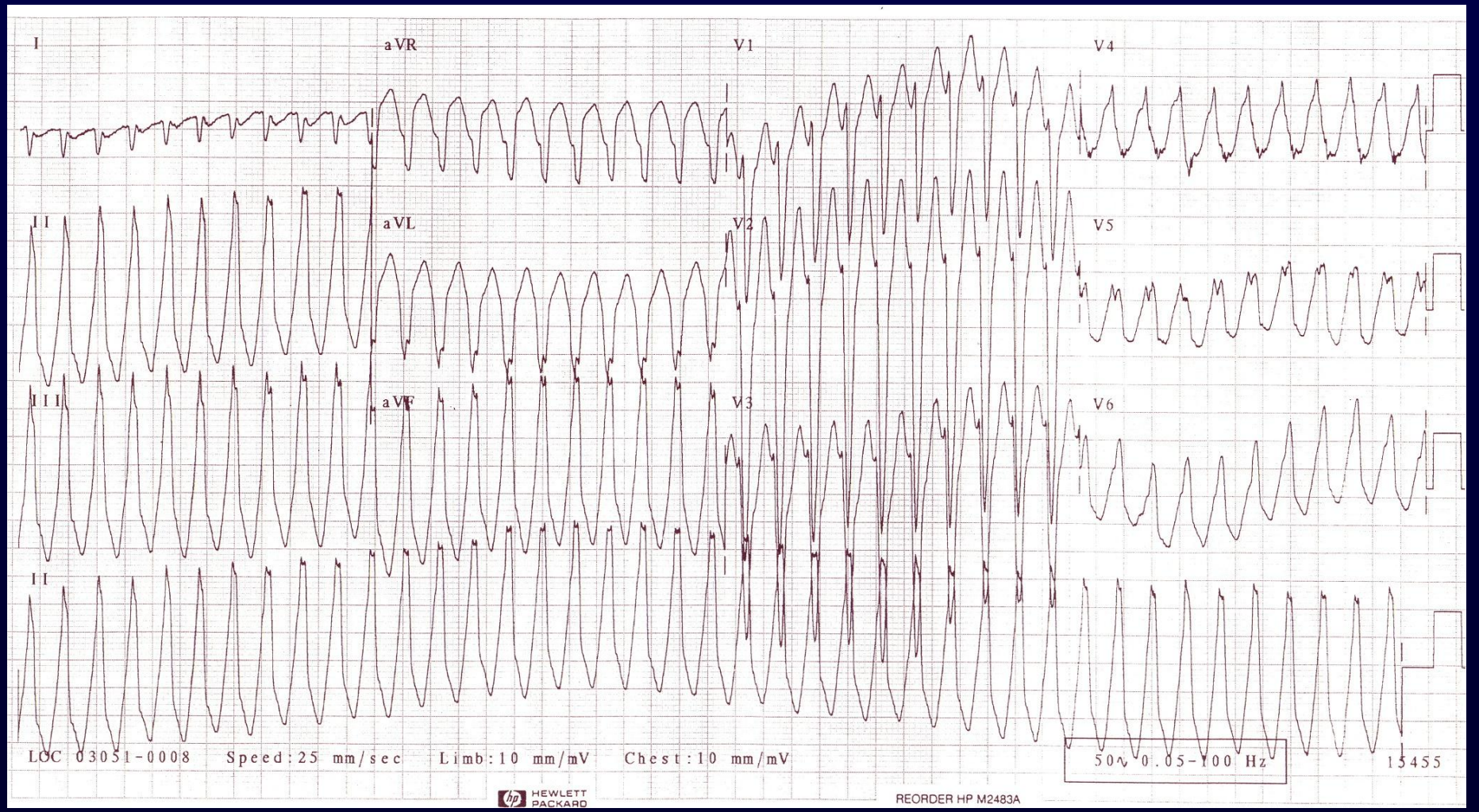
Quick-Fire ECGs

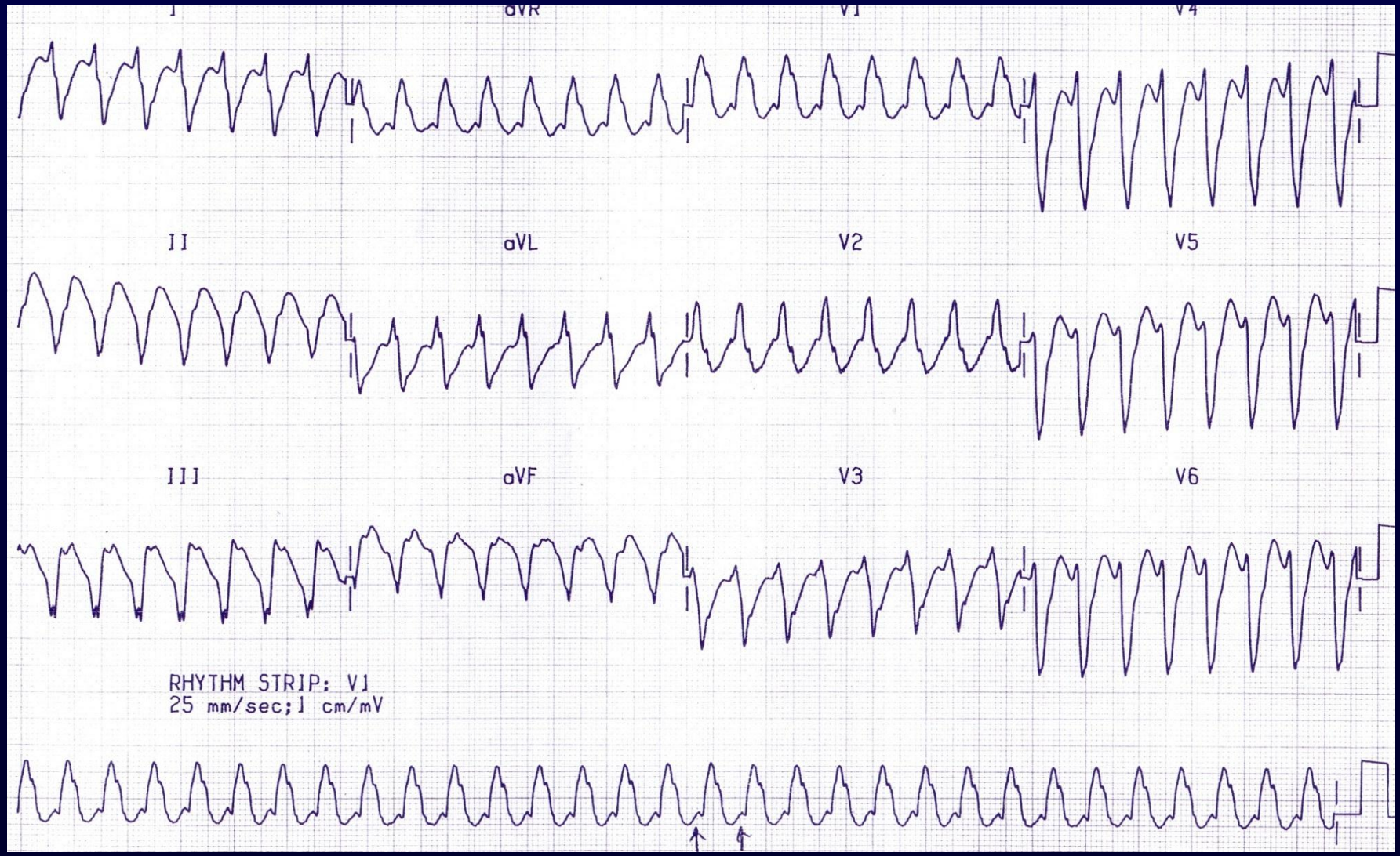

II
V1
V5

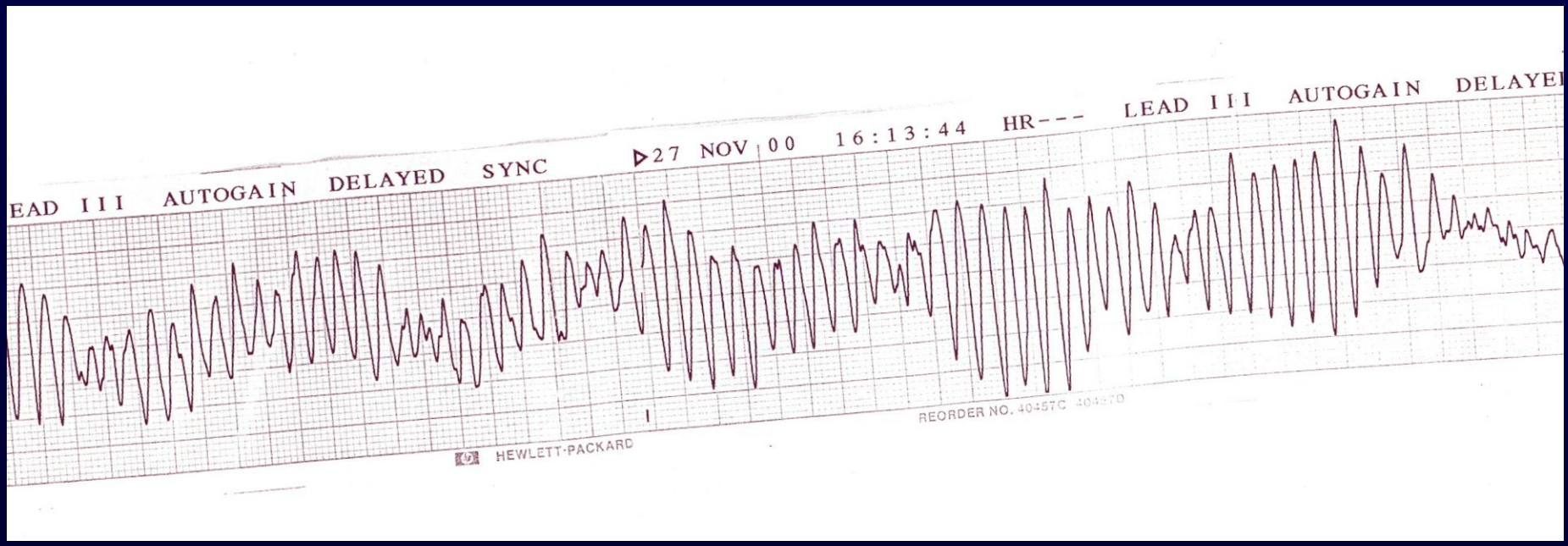


VF = Defibrillate asap!

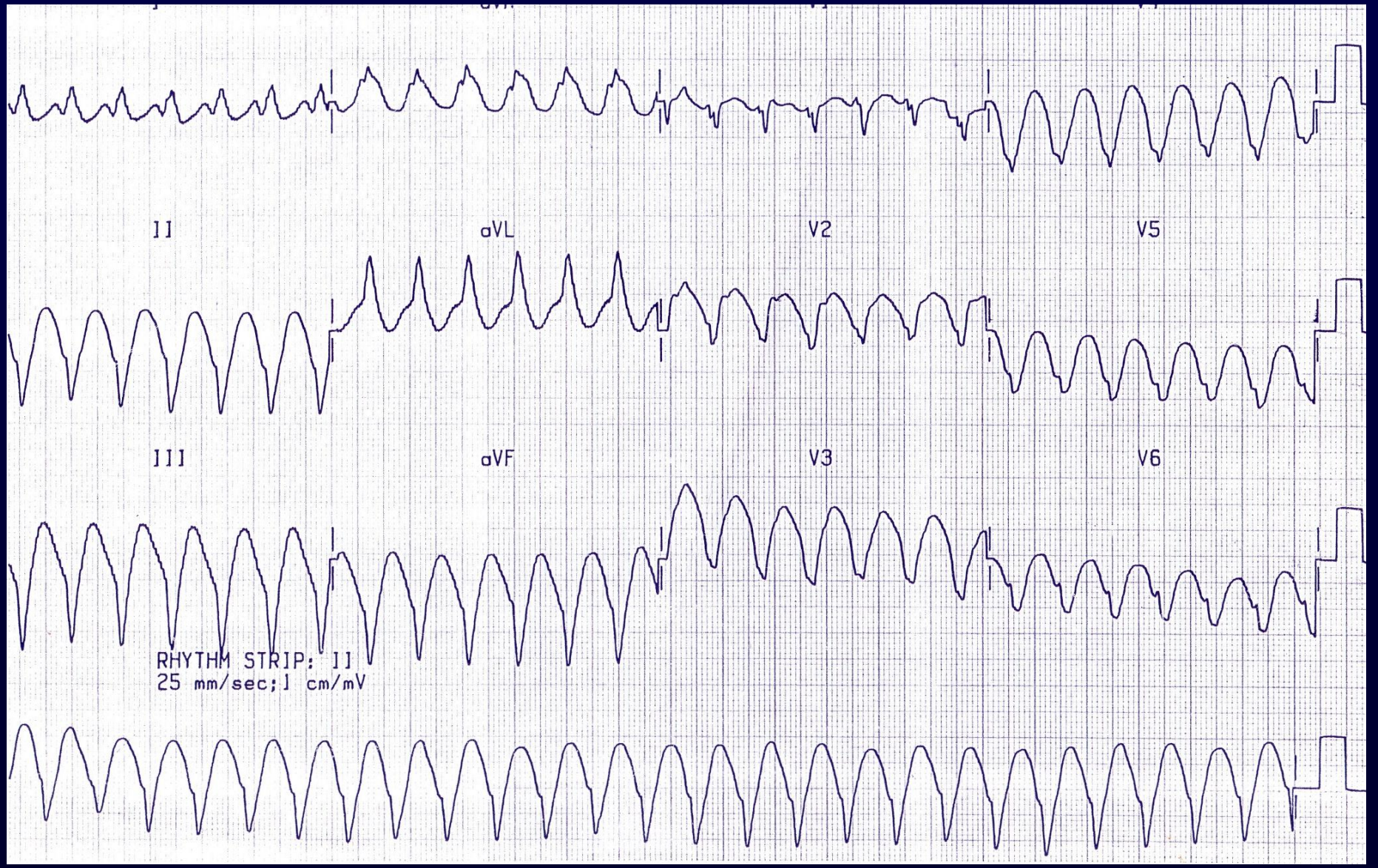


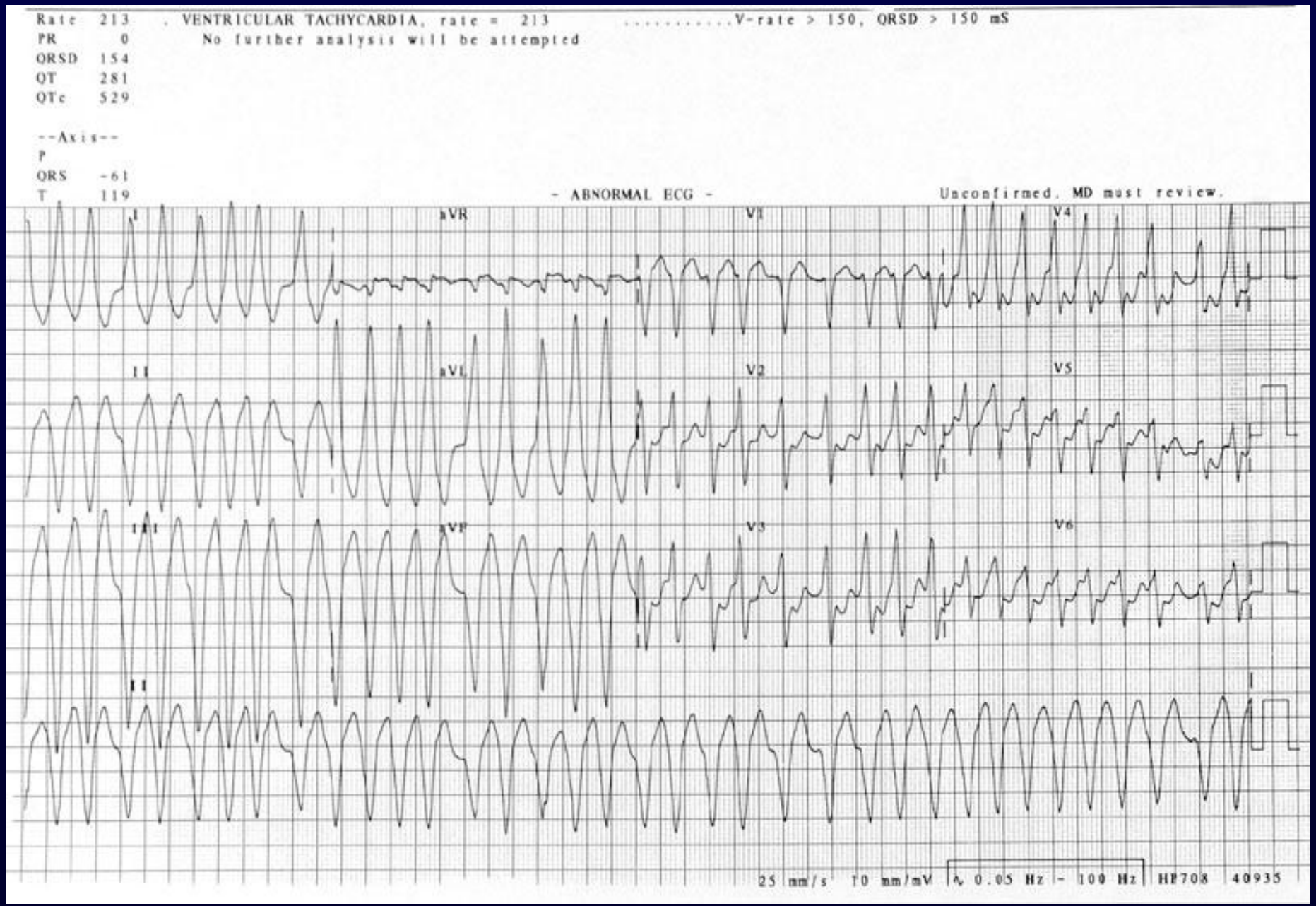

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
LOC 03051-0008 Speed:25 mm/sec Limb:10 mm/mV Chest:10 mm/mV
50∿ 0.05-100 Hz
15455
HEWLETT PACKARD
REORDER HP M2483A

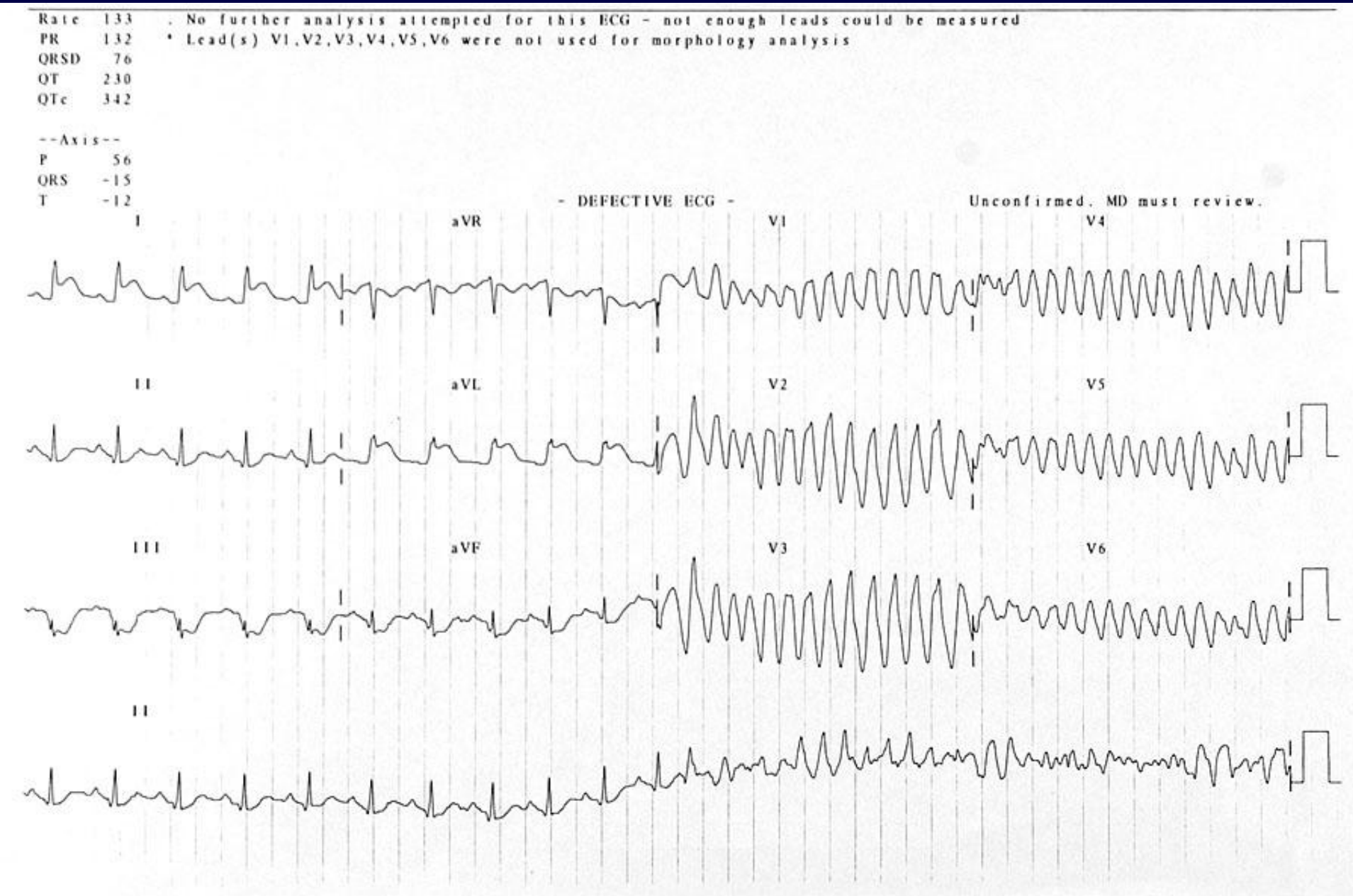

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
RHYTHM STRIP: V1
25 mm/sec;1 cm/mV

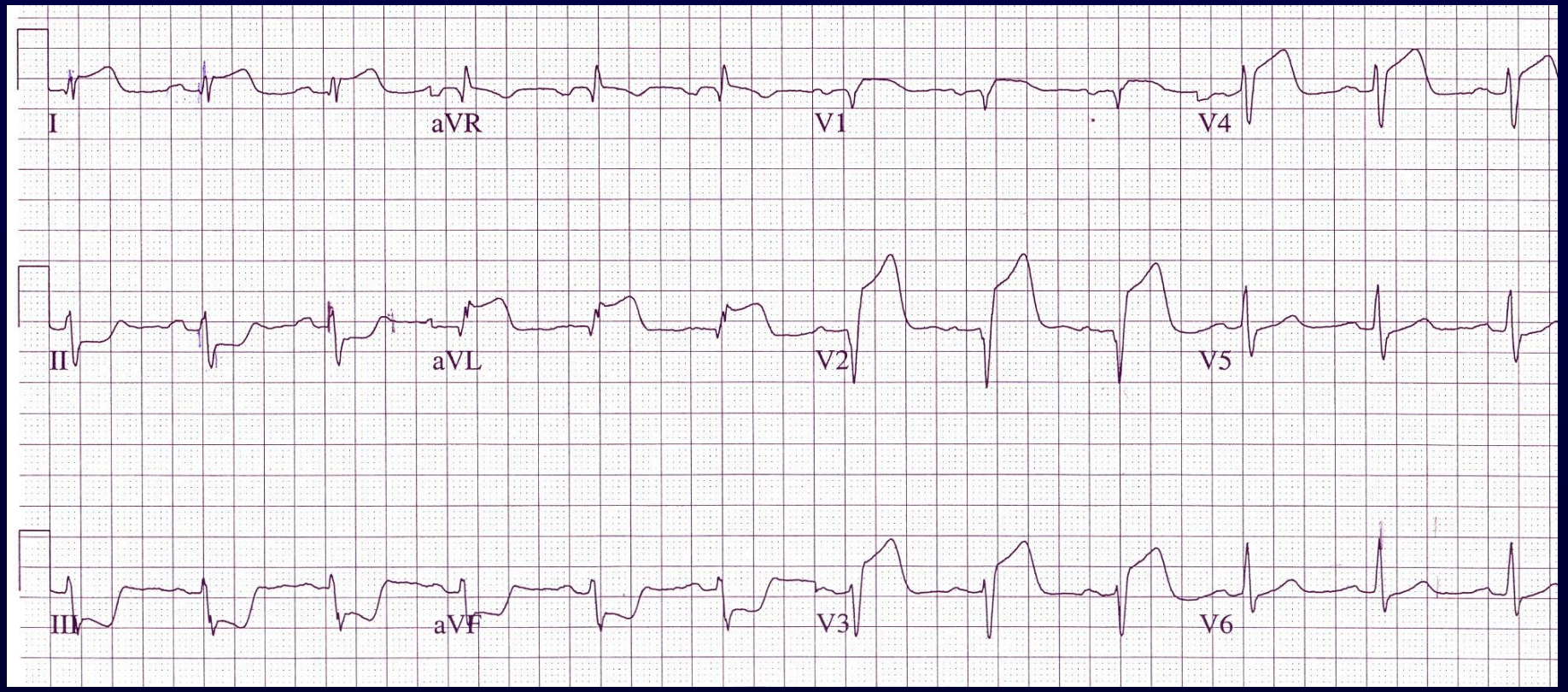

EAD III AUTOGAIN DELAYED SYNC
27 NOV 00 16:13:44 HR---
LEAD III AUTOGAIN DELAYE
HEWLETT-PACKARD
REORDER NO. 40457C 40457D

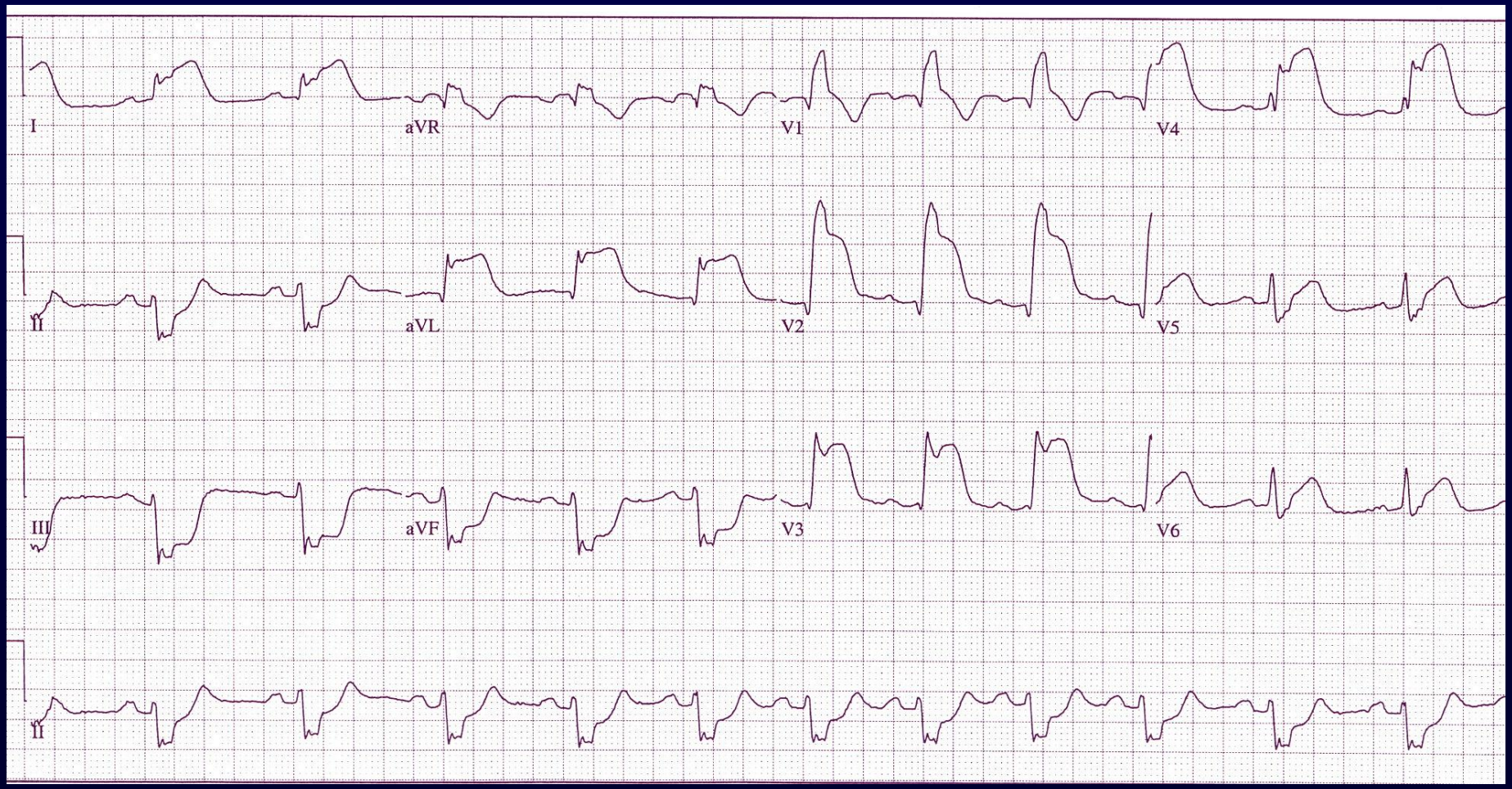
"I can't even pronounce what you've got!"


II
aVL
V2
V5
III
aVF
V3
V6
RHYTHM STRIP: II
25 mm/sec; 1 cm/mV

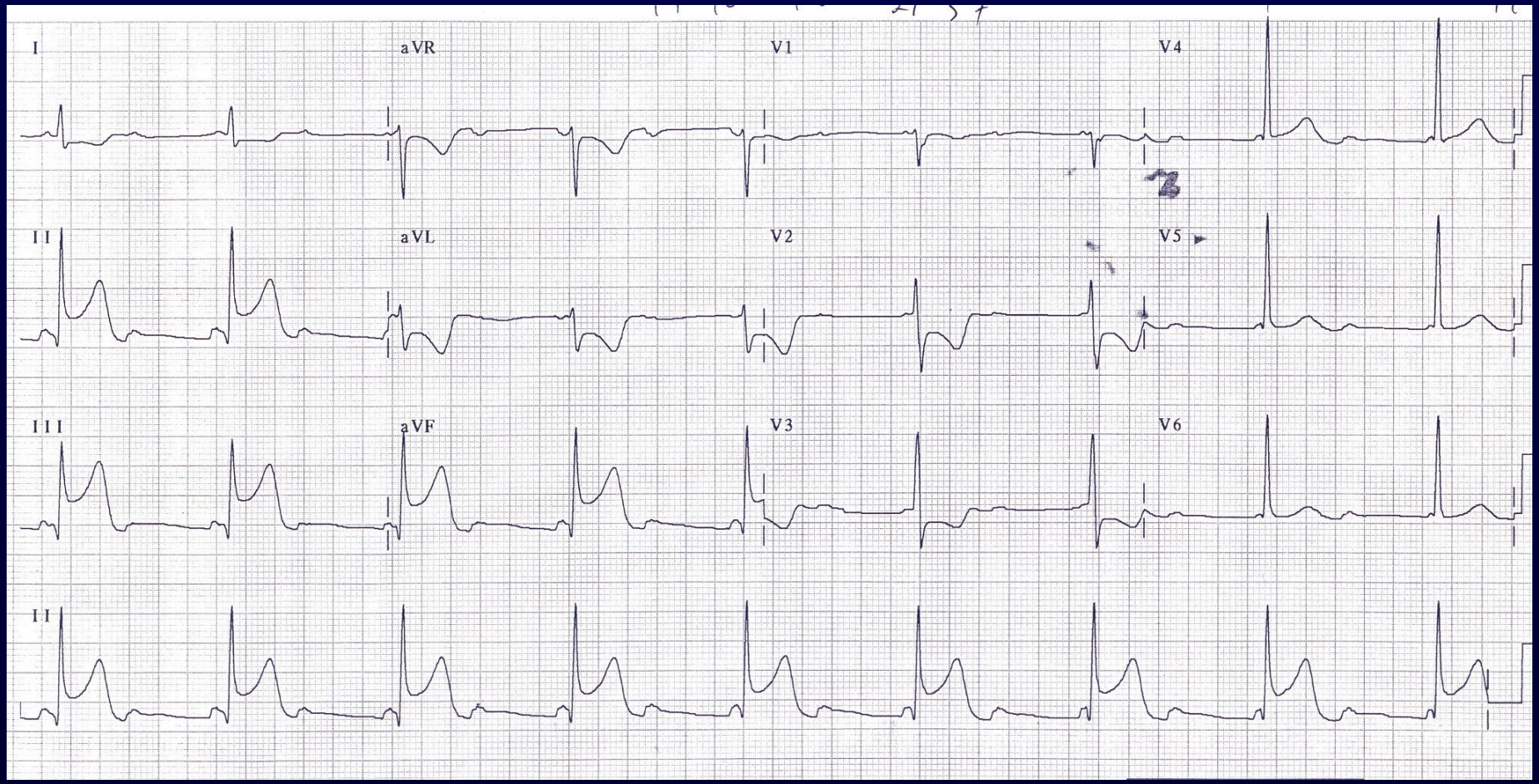

Rate 213
PR 0
ORSD 154
QT 281
QTc 529
--Axis--
P
ORS -61
T 119
. VENTRICULAR TACHYCARDIA, rate = 213
No further analysis will be attempted
.....V-rate > 150, QRSD > 150 mS
- ABNORMAL ECG -
Unconfirmed. MD must review.
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
25 mm/s 10 mm/mV 0.05 Hz - 100 Hz HP708 40935


Rate 133
PR 132
QRSD 76
QT 230
QTc 342
--Axis--
P 56
QRS -15
T -12
. No further analysis attempted for this ECG - not enough leads could be measured
* Lead(s) V1,V2,V3,V4,V5,V6 were not used for morphology analysis
- DEFECTIVE ECG -
Unconfirmed. MD must review.
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

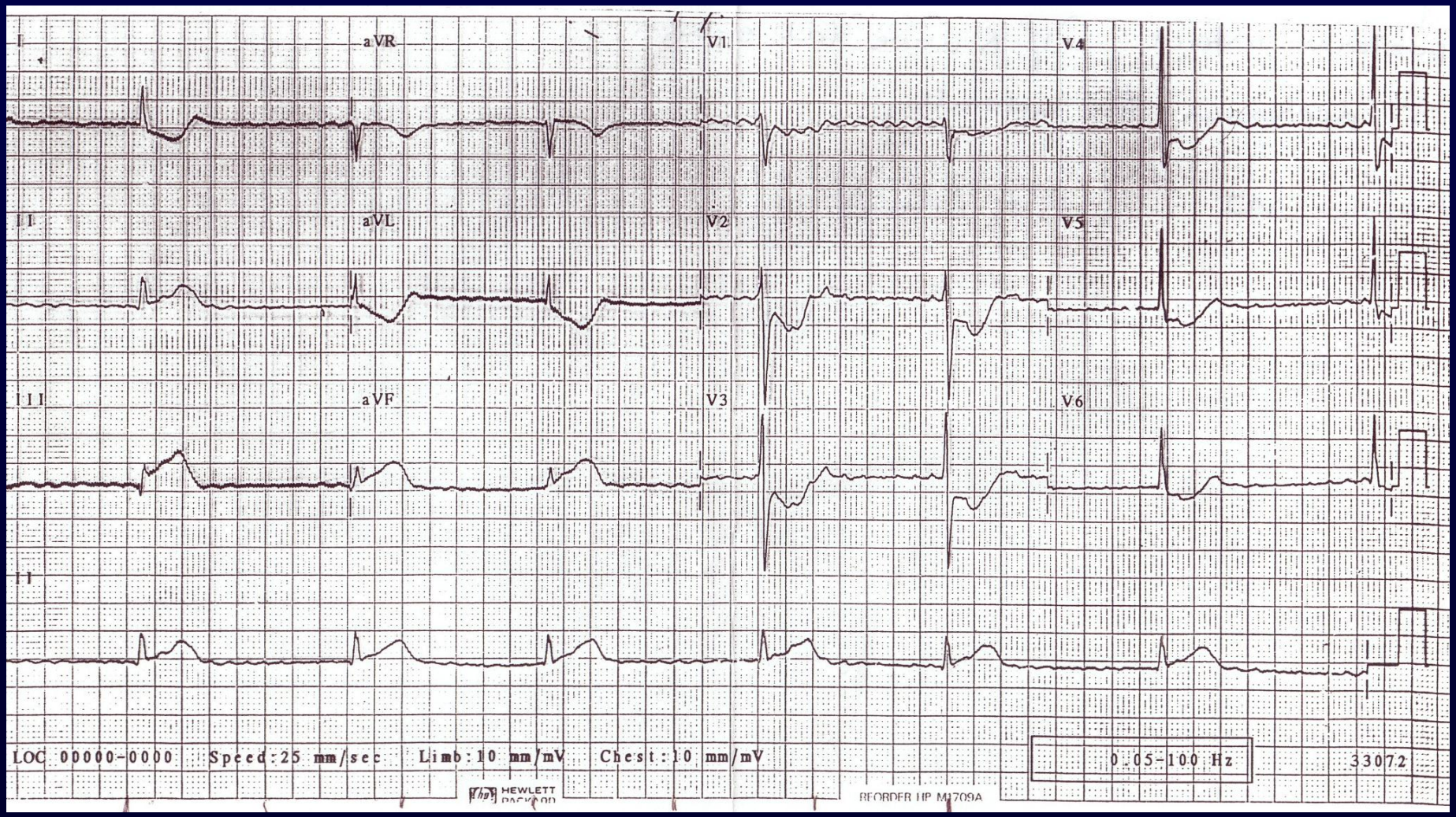

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

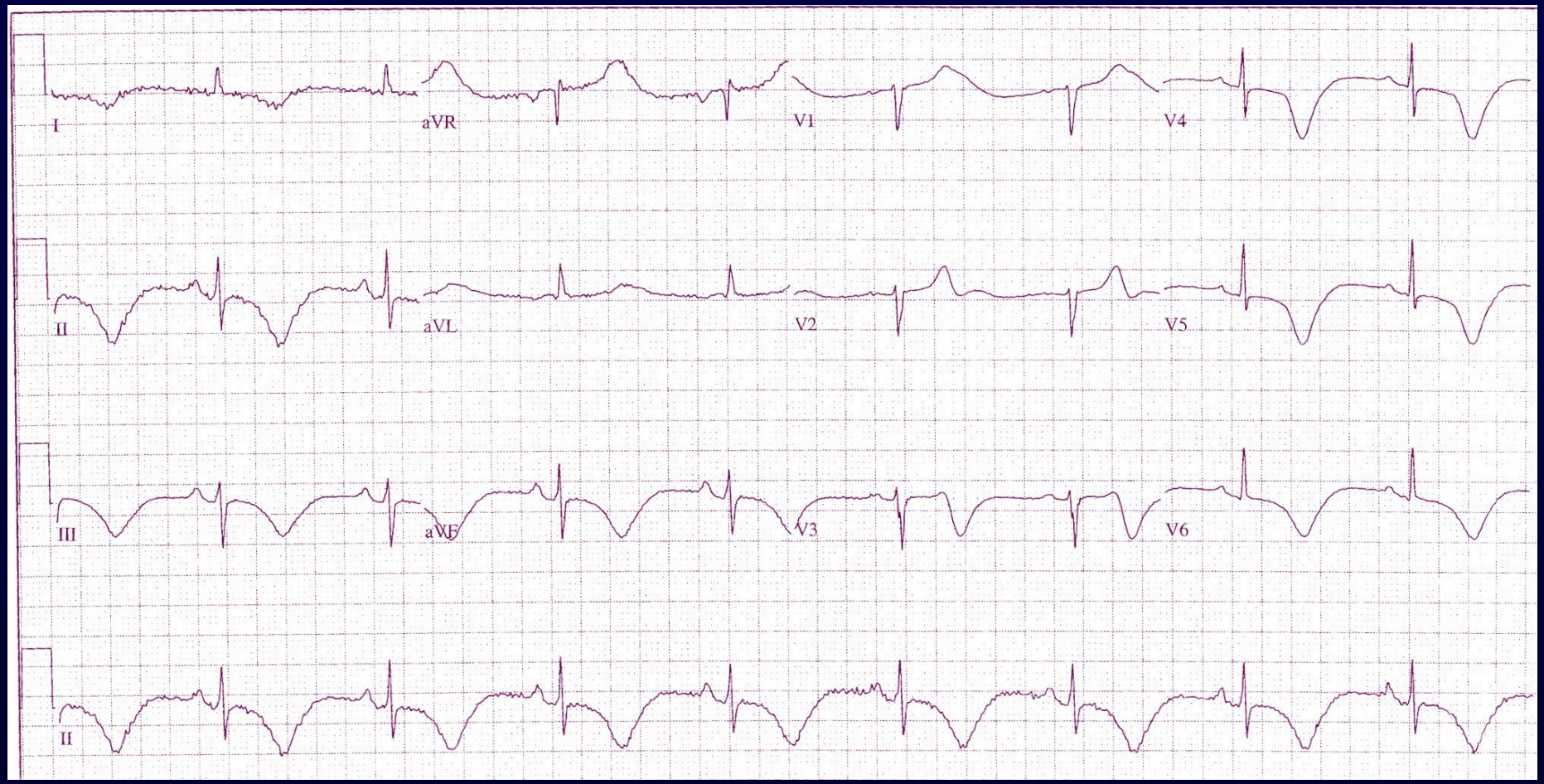

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

Inferior STEMI with CHB



Inferior STEMI with Atrial Fibrillation



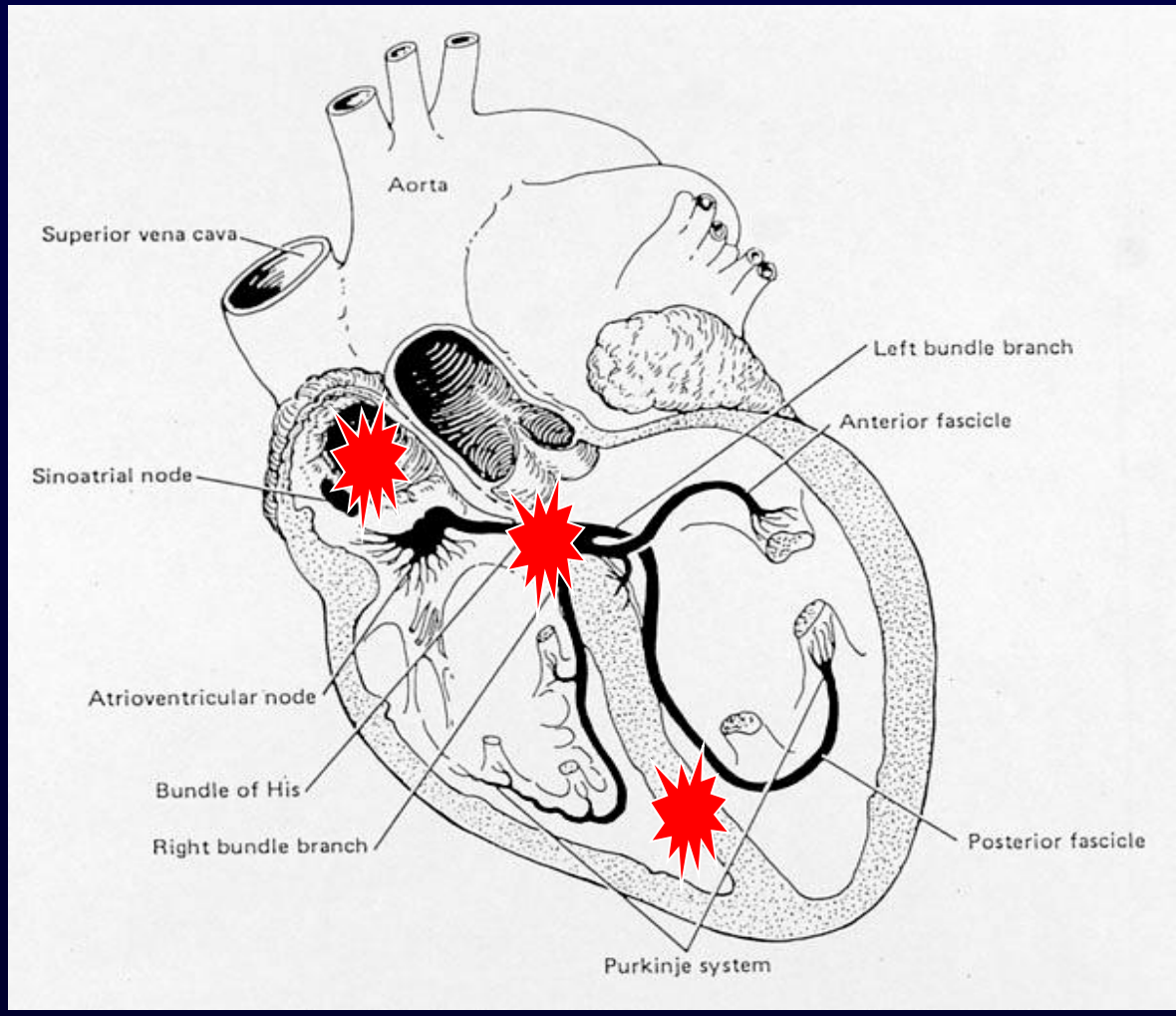

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

Intrinsic depolarisation rates

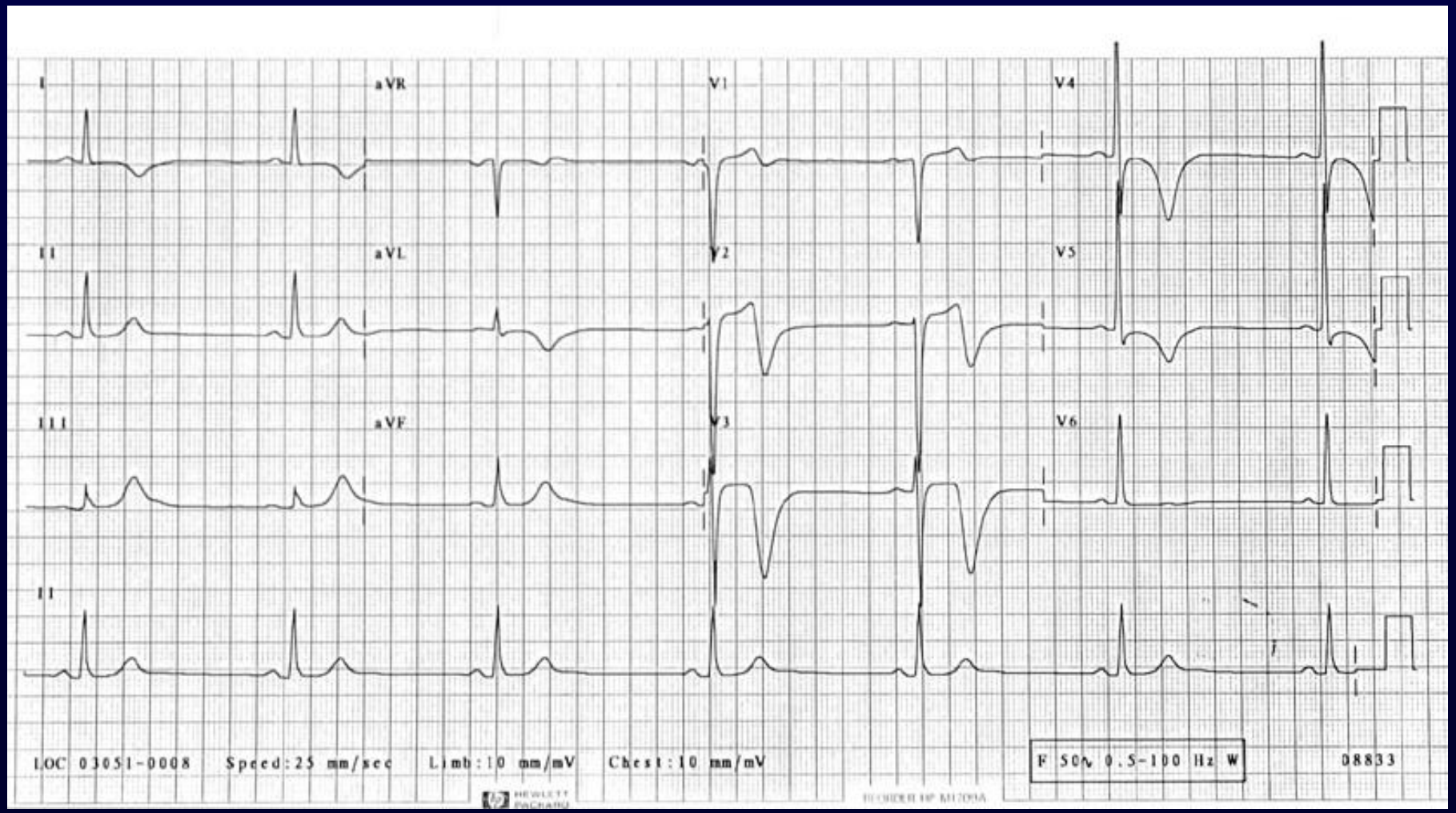
SA node **60-70/min**

AV Jn **35-50/min**

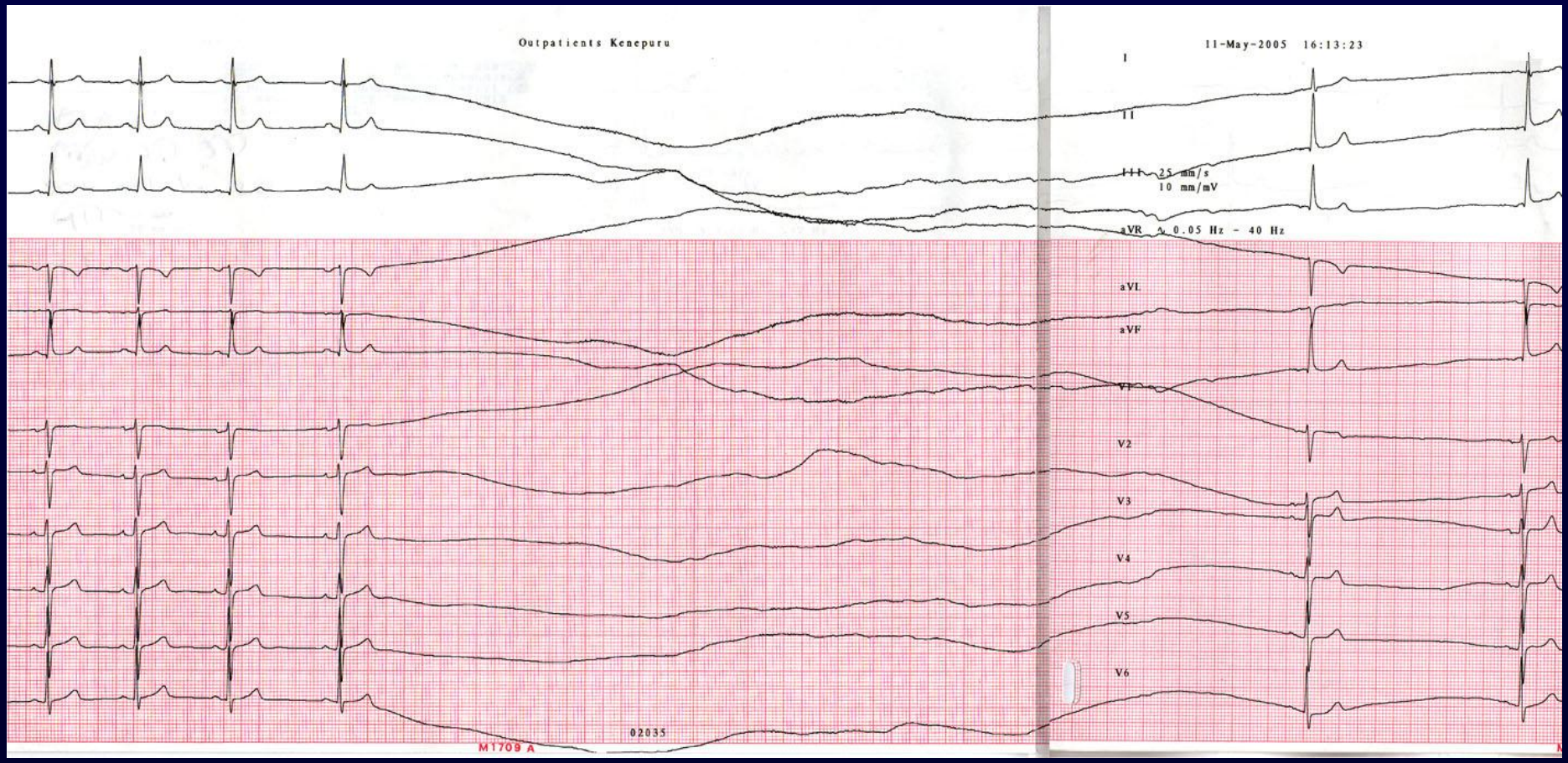
Ventricles **30-40/min**

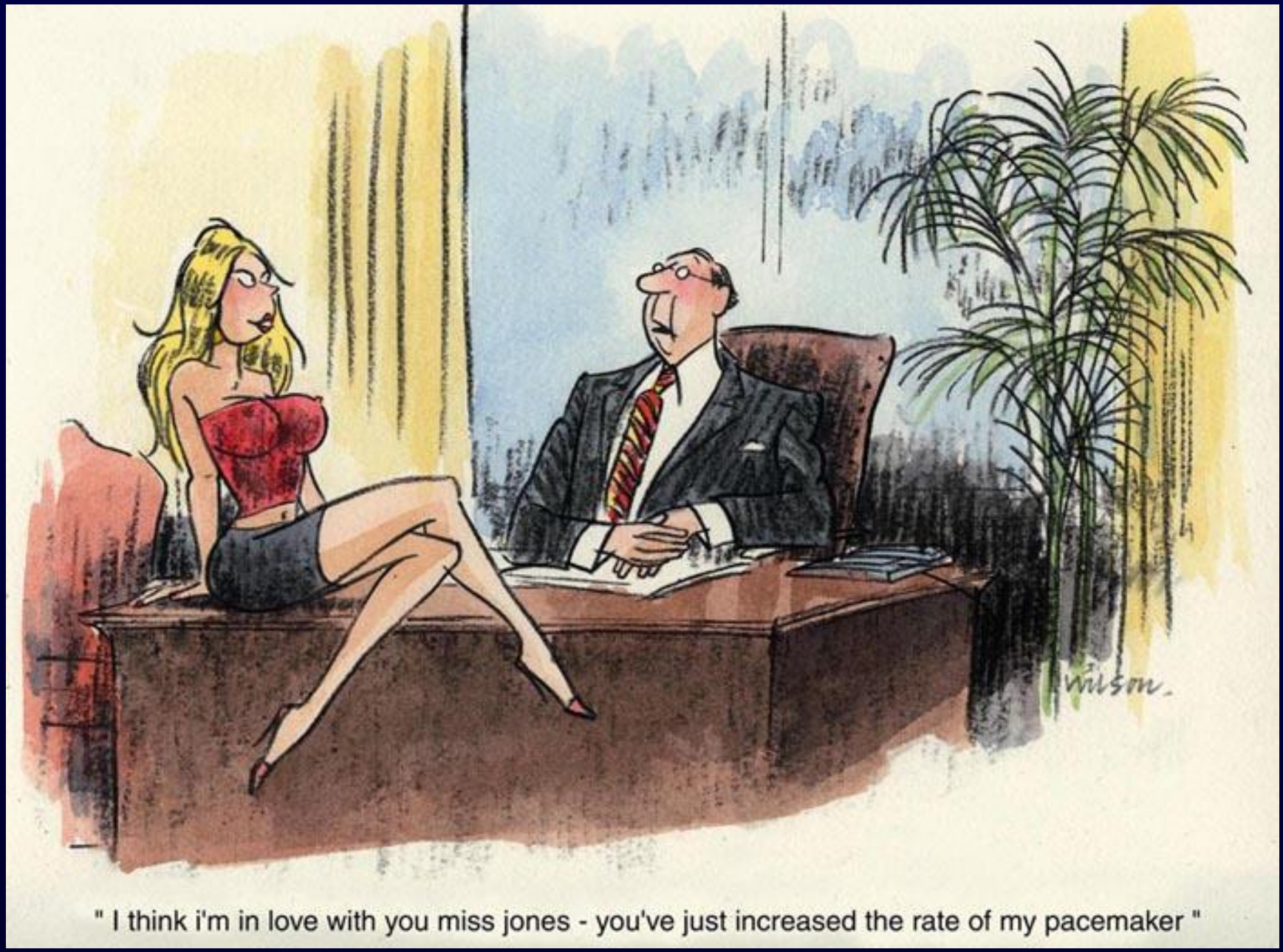


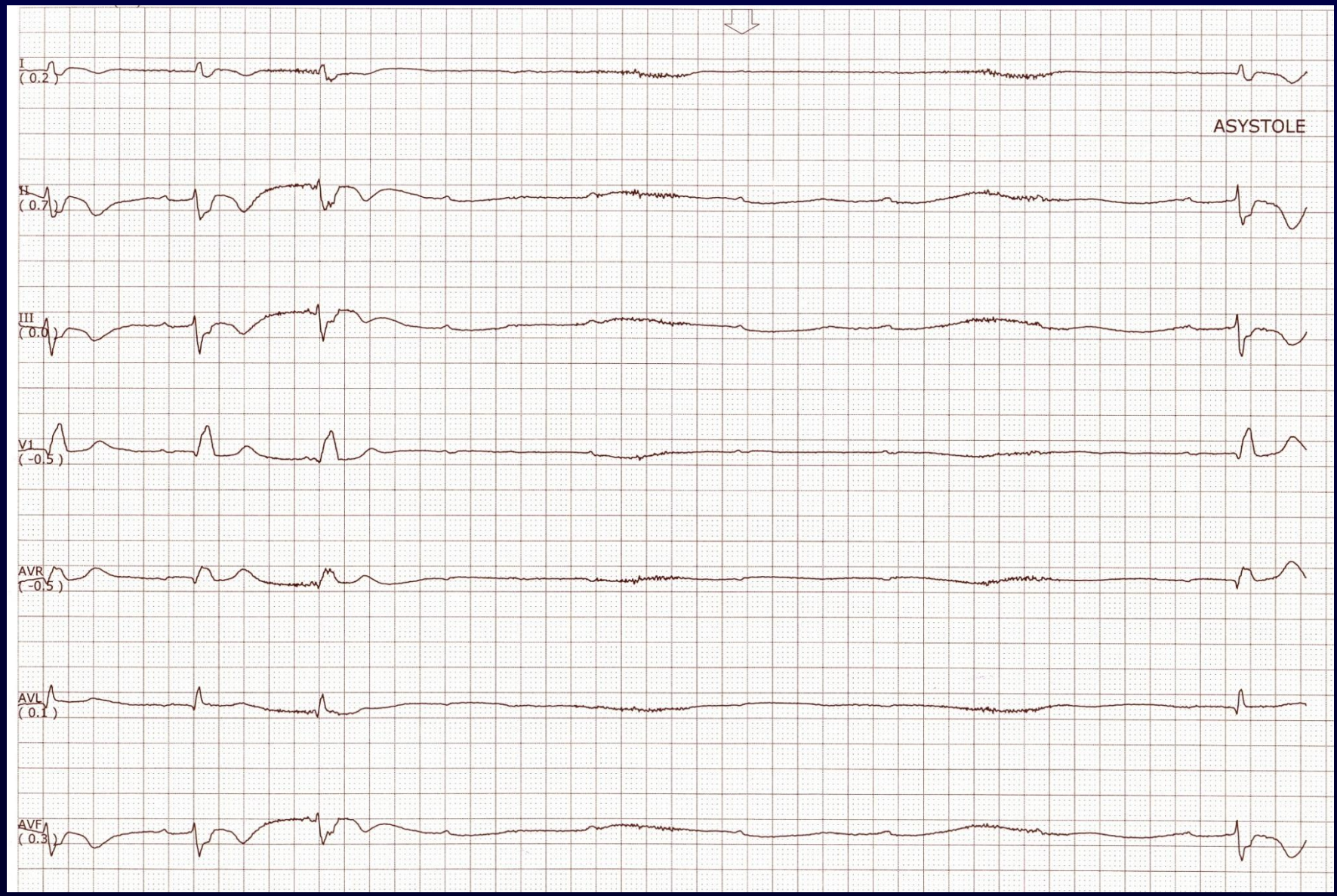
Sinus Bradycardia with Anterior ST/T Wave changes



Recurrent Syncope: Sinus Pauses




" I think i'm in love with you miss jones - you've just increased the rate of my pacemaker "


I
(0.2)
ASYSTOLE
II
(0.7)
III
(0.0)
V1
(-0.5)
AVR
(-0.5)
AVL
(0.1)
AVF
(0.3)

AV Block

First degree **heart block (1°)**

- **prolonged PR interval, constant**

Second degree **heart block (2°)**

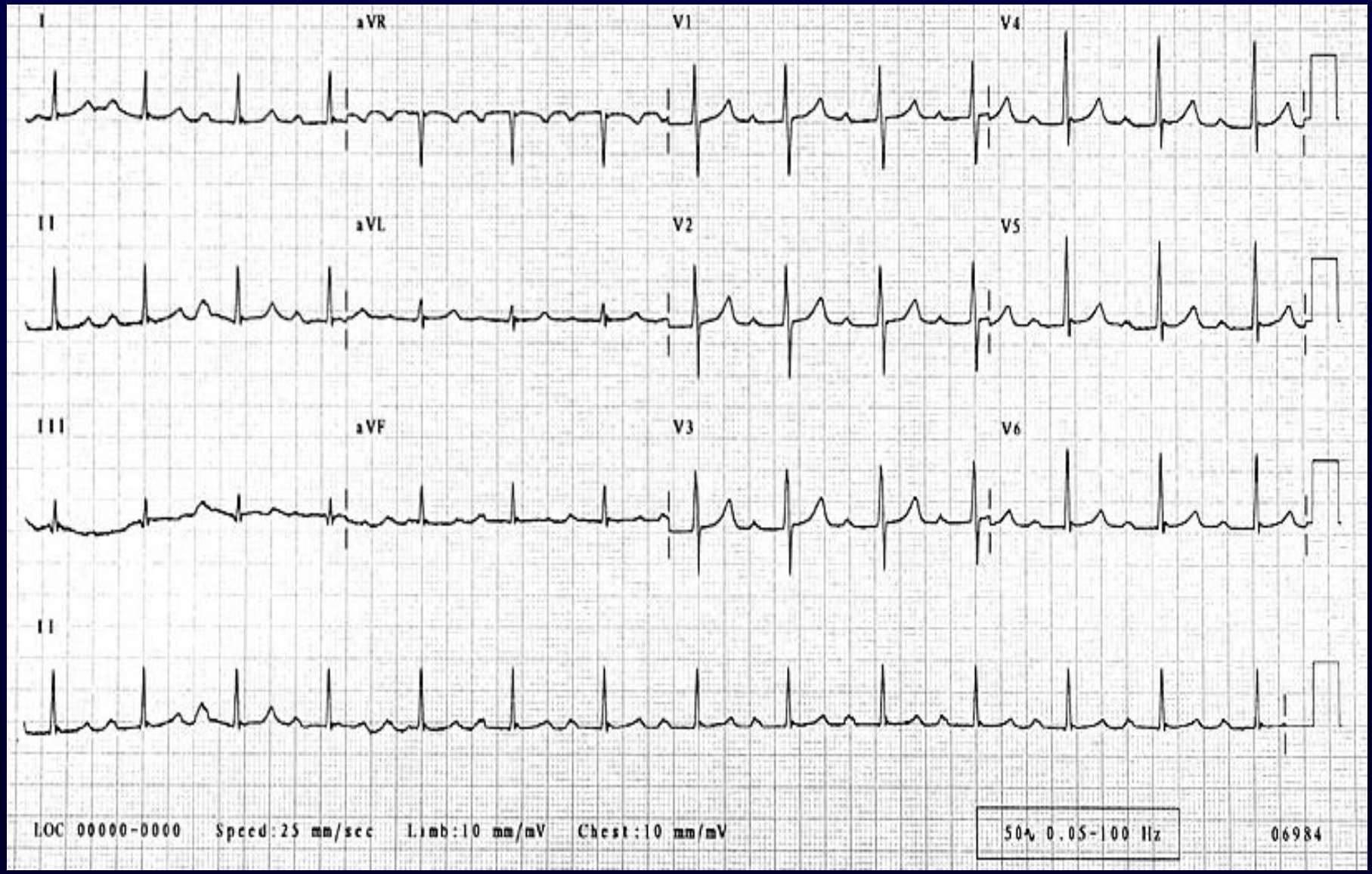
- ***Mobitz Type I*** **- Wenkebach**
- ***Mobitz Type II***

Third degree heart block (CHB)

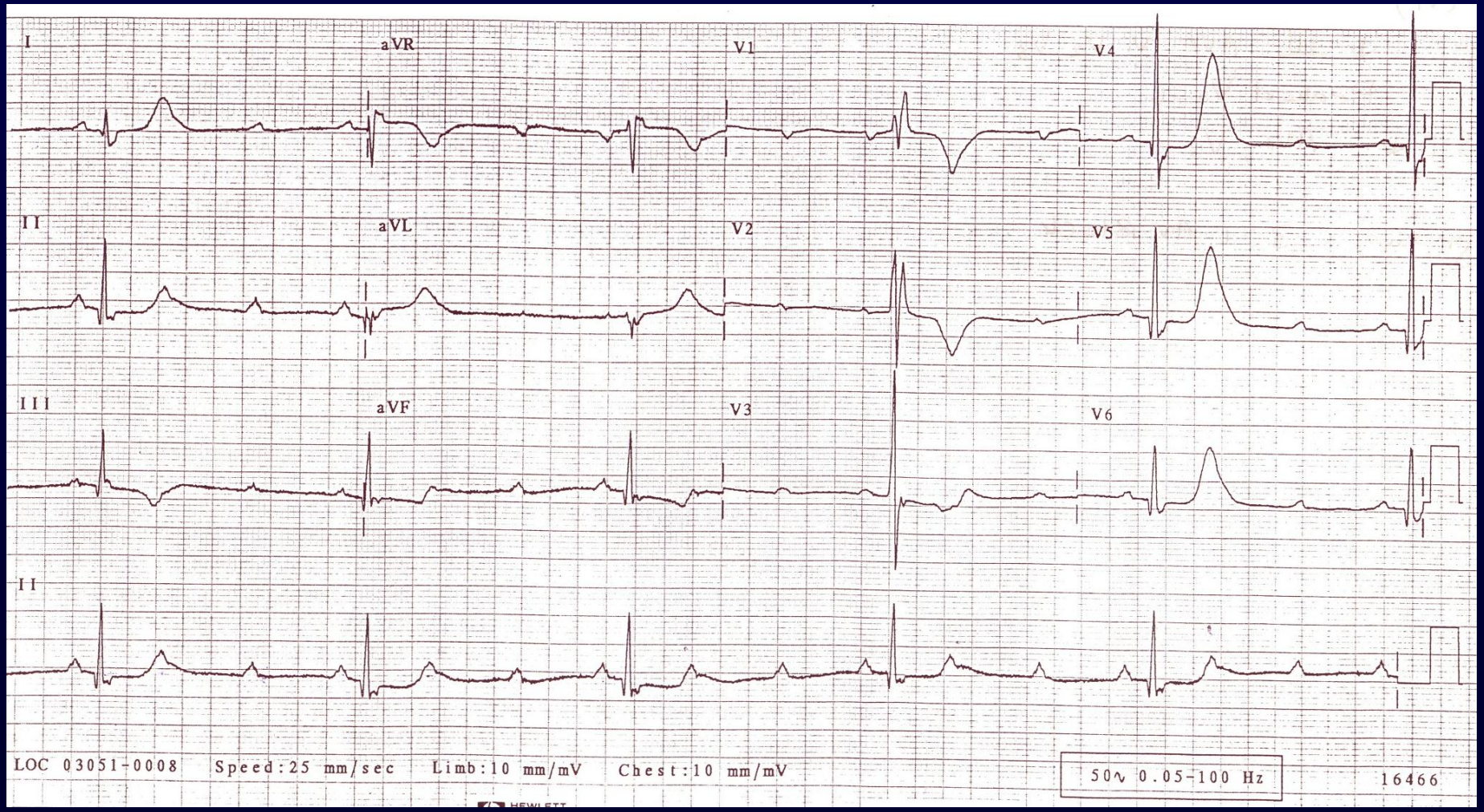
Aetiology of AV Block

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

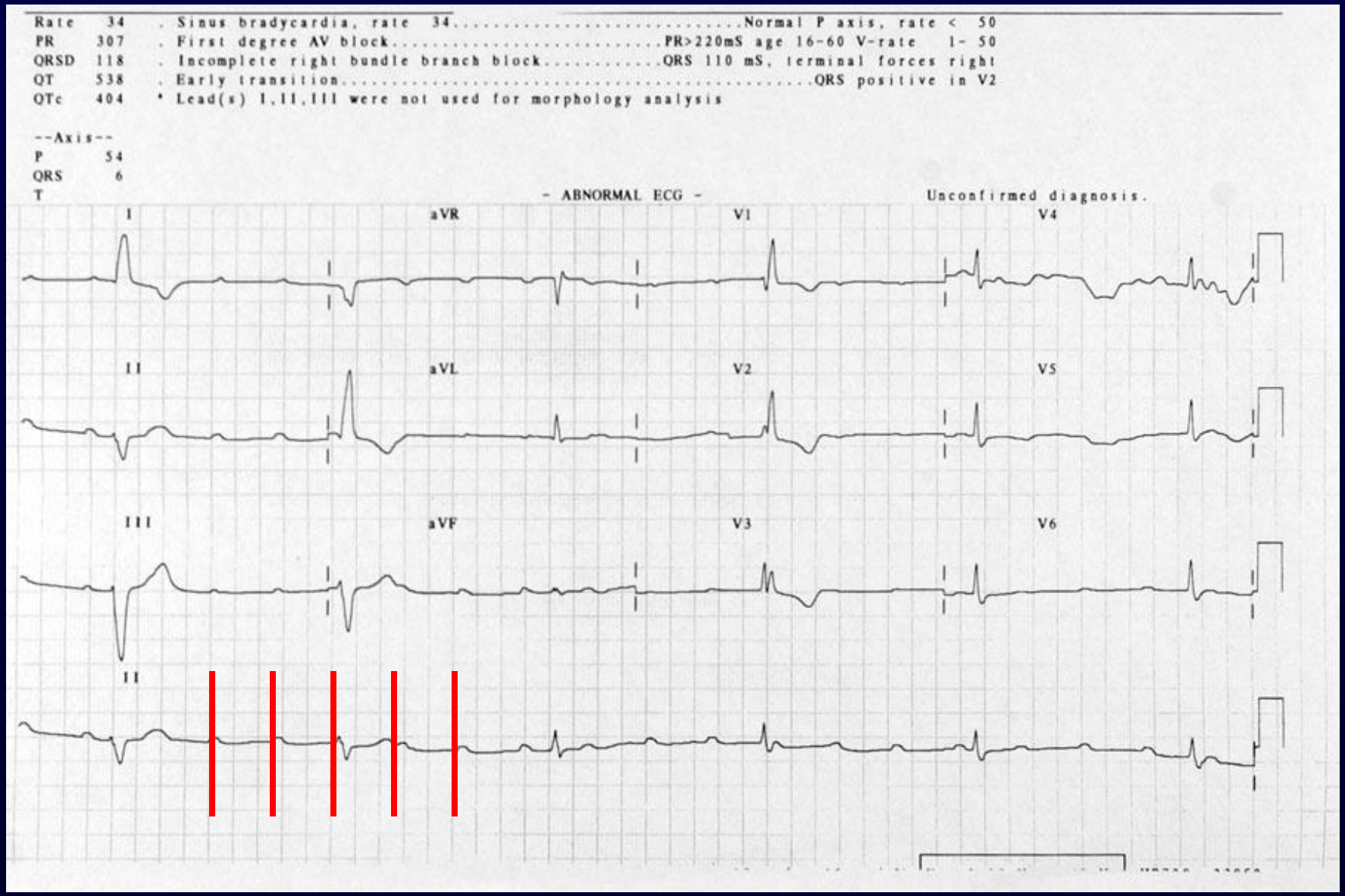
First Degree Heart Block

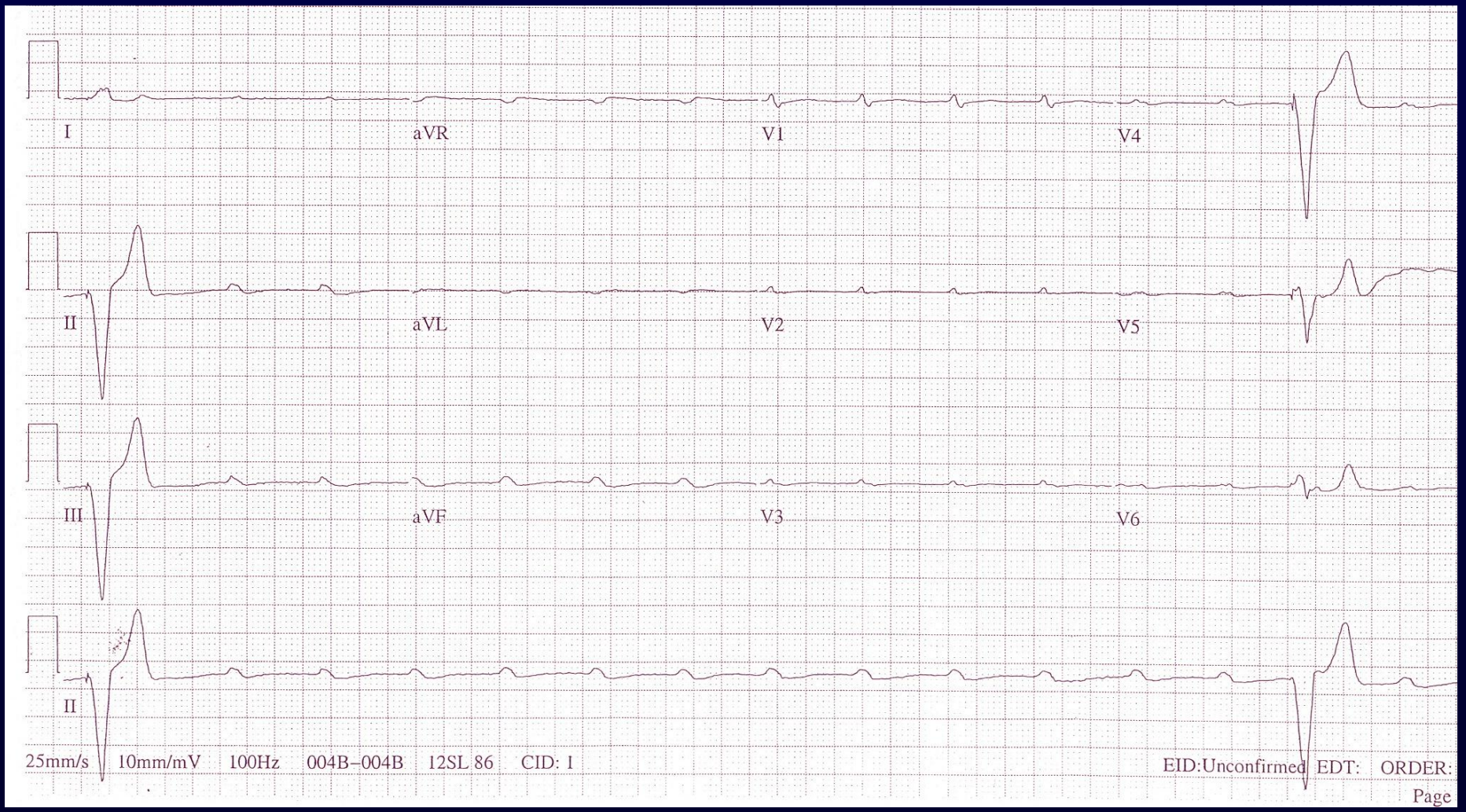


Second Degree Heart Block: 3 to 1



Third Degree [Complete] Heart Block

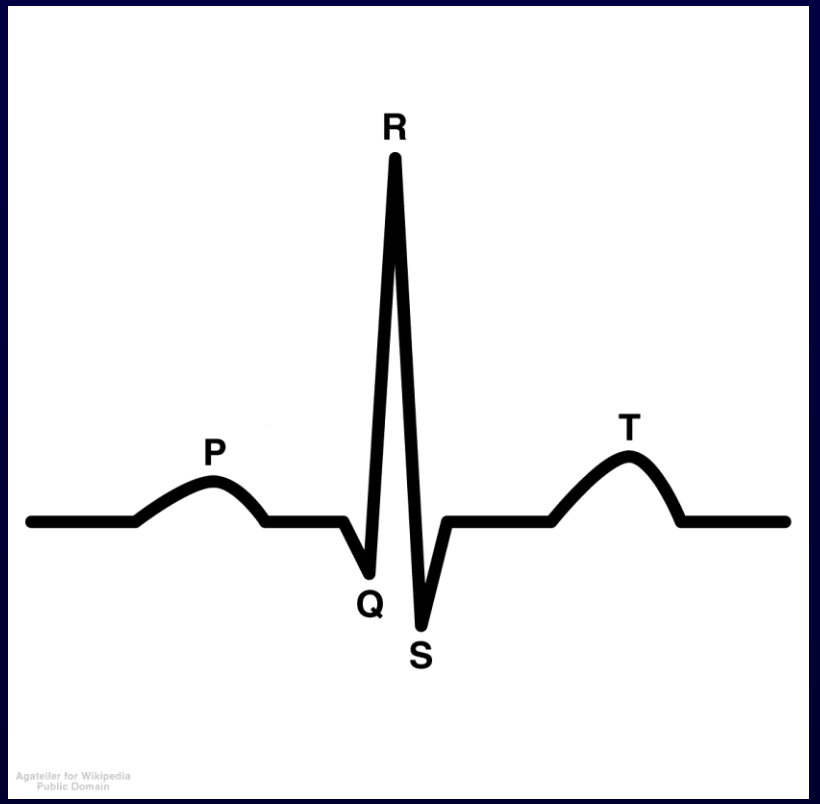


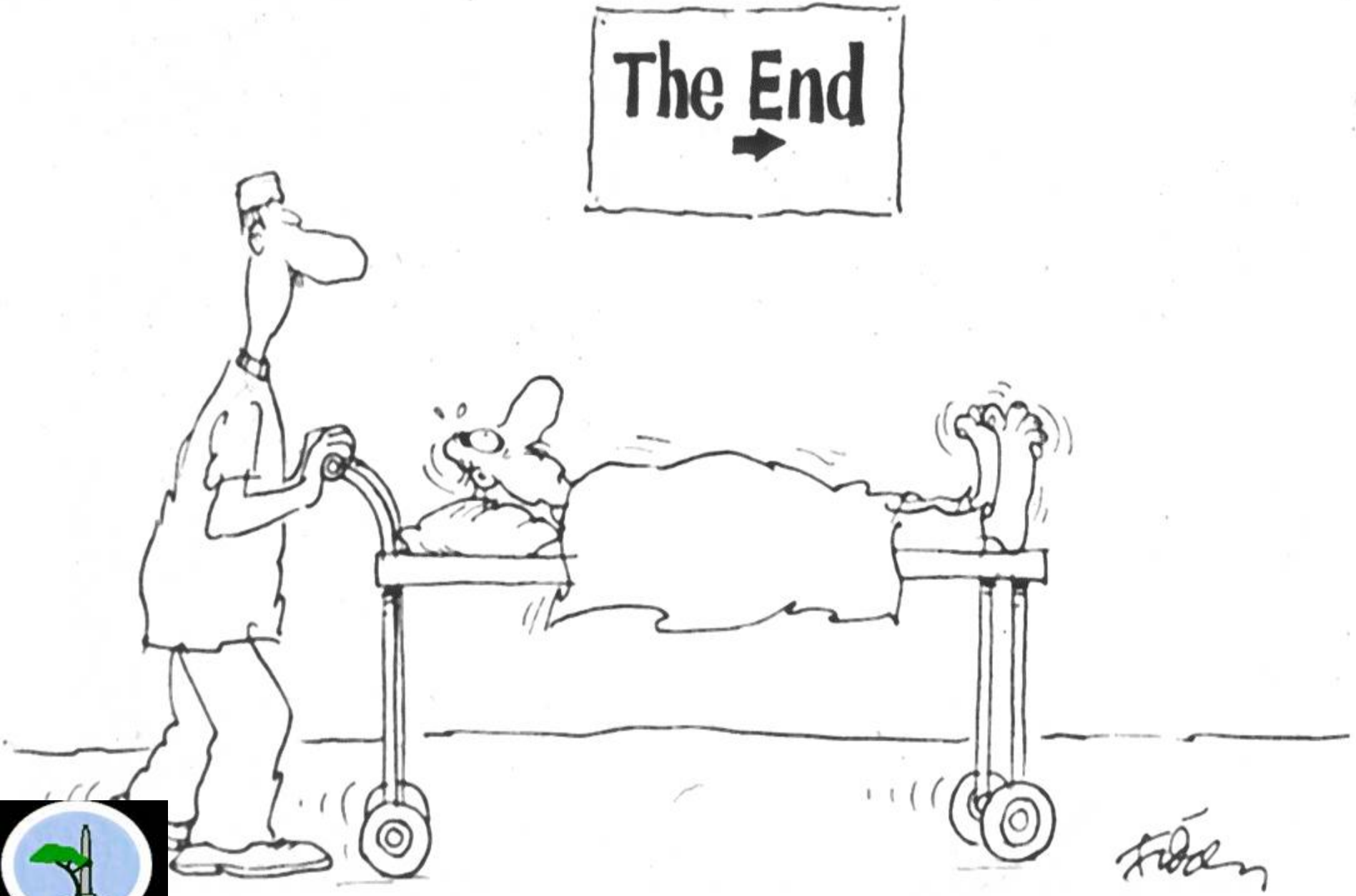

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
25mm/s 10mm/mV 100Hz 004B–004B 12SL 86 CID: I
EID:Unconfirmed EDT: ORDER:
Page

Heart Disease: The Central Role of the ECG

Community Assessment:

- History, Examination
- ECG
- Blood tests, Chest X-Ray




The End