

10 EKGs Every Clinician Should Recognize!

Deepak Talreja, MD, FACC

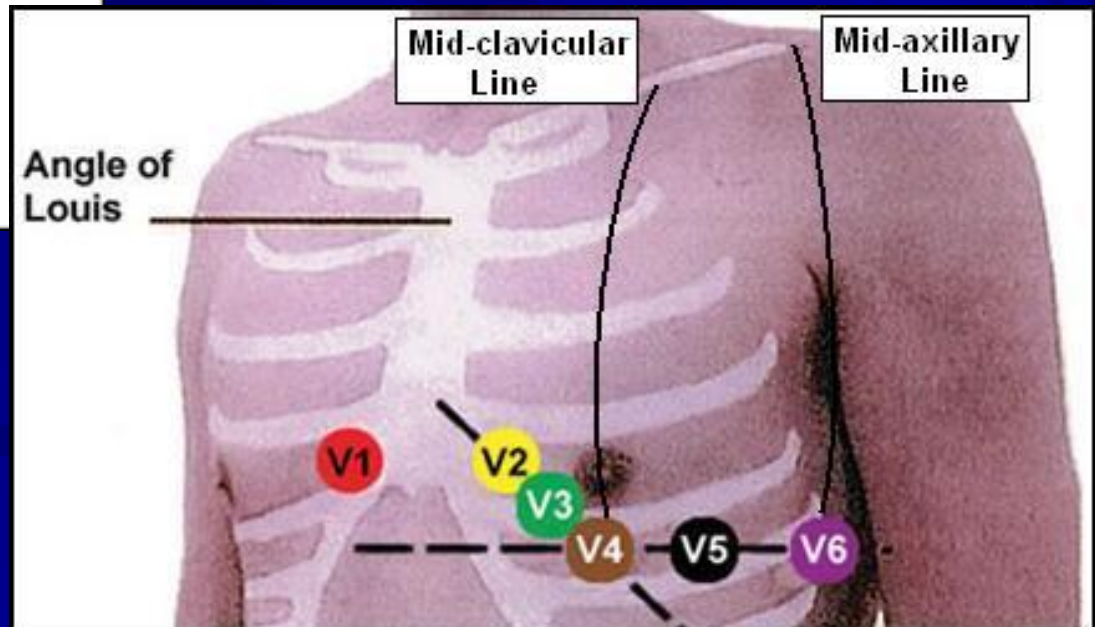
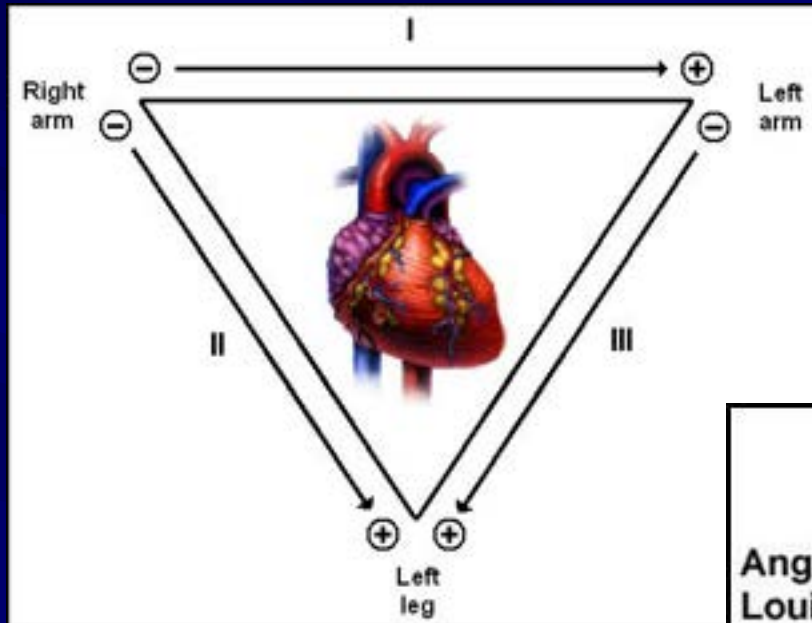
Clinical Chief of Cardiology | Sentara Health

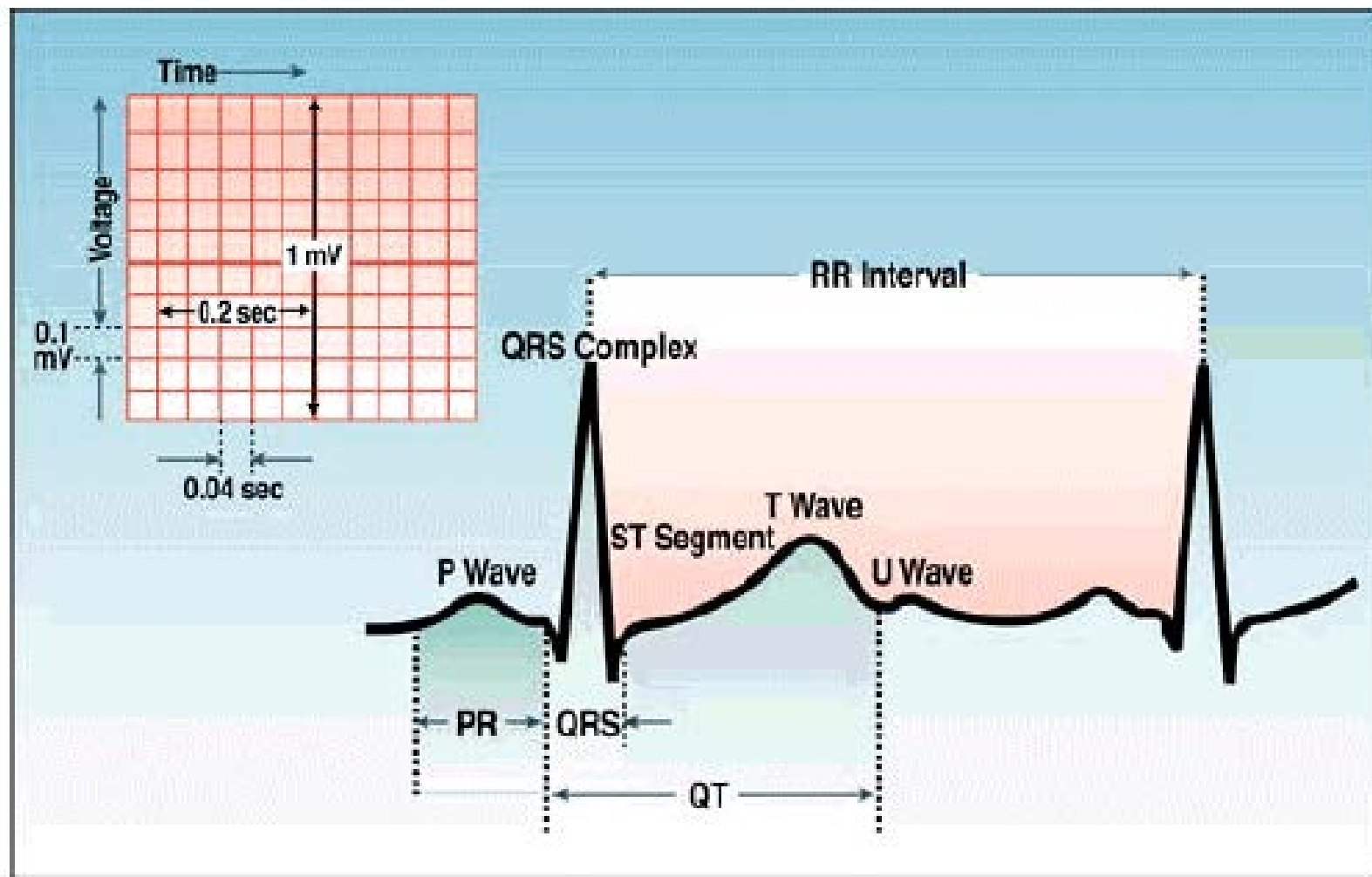
Medical Director, Cardiovascular Service Line | Sentara Heart

Associate Professor | Virginia Health Sciences at Old Dominion University



Standard 12 Leads





10-OCT-1996 10:14

MAYO CLINIC-A-1 ROUTINE RETRIEVAL

15-AUG-1944 (52 yr)

Male Unknown

73in 216lb

Room:7140

Loc:1 Option:0

Vent. rate 45 BPM

PR interval 164 ms

QRS duration 96 ms

QT/QTc 460/398 ms

P-R-T axes 57 41 31

Technician ID: 417

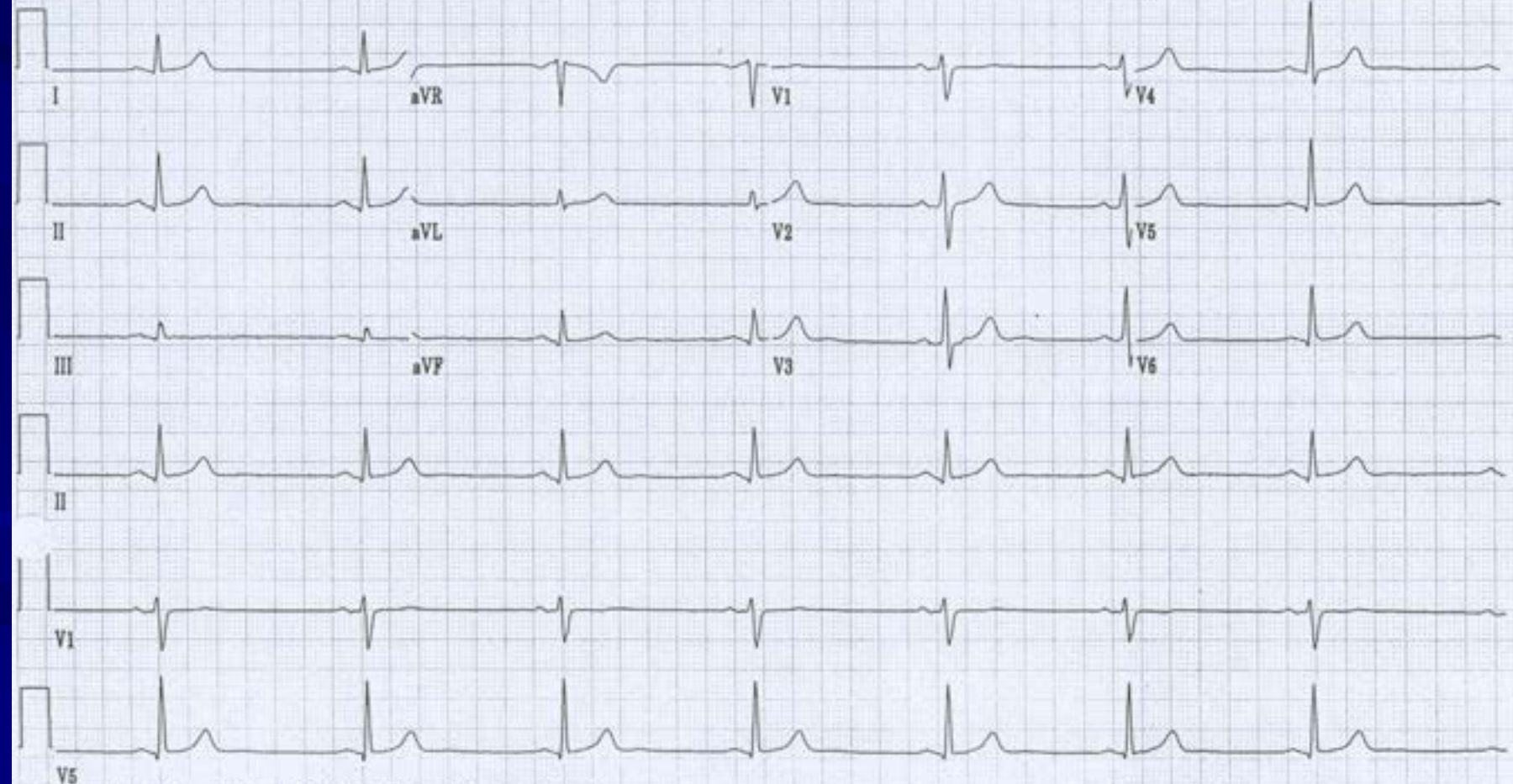
Unknown

Referred by: 7140

#1

Section:GIEAST

Location:E19



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 78 CID: 78

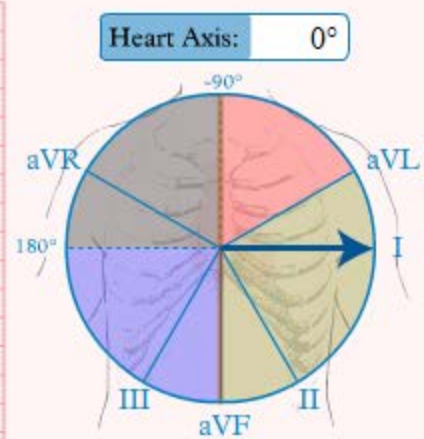
EID:902 EDT: 10:44 10-OCT-1996 ORDER: 960238152

Interpretation

- 1. Rate
- 2. Rhythm and Blocks
- 3. Axis
- 4. Hypertrophy
- 5. Infarction



Iso-electric lead: aVF Tallest R wave: I Heart axis: normal (intermediate)



ECG  PEDIA.ORG
Part of your ECG knowledge

Determining the Axis



Predominantly
Positive



Predominantly
Negative



Equiphasic

The Quadrant Approach

1. Examine the QRS complex in leads I and aVF to determine if they are predominantly positive or predominantly negative. The combination should place the axis into one of the 4 quadrants below.

		Lead aVF	
		Positive	Negative
Lead I	Positive	Normal Axis	LAD
	Negative	RAD	Indeterminate Axis



Lead Inversion

10-OCT-1996 10:05

MAYO CLINIC-A-1

ROUTINE RETRIEVAL

04-MAY-1911 (85 yr)

Vent. rate

89 BPM

Female Unknown

PR interval

*

69in 175lb

QRS duration

100 ms

Loc:1 Option:0

QT/QTc

356/433 ms

P-R-T axes

-1 -2 34

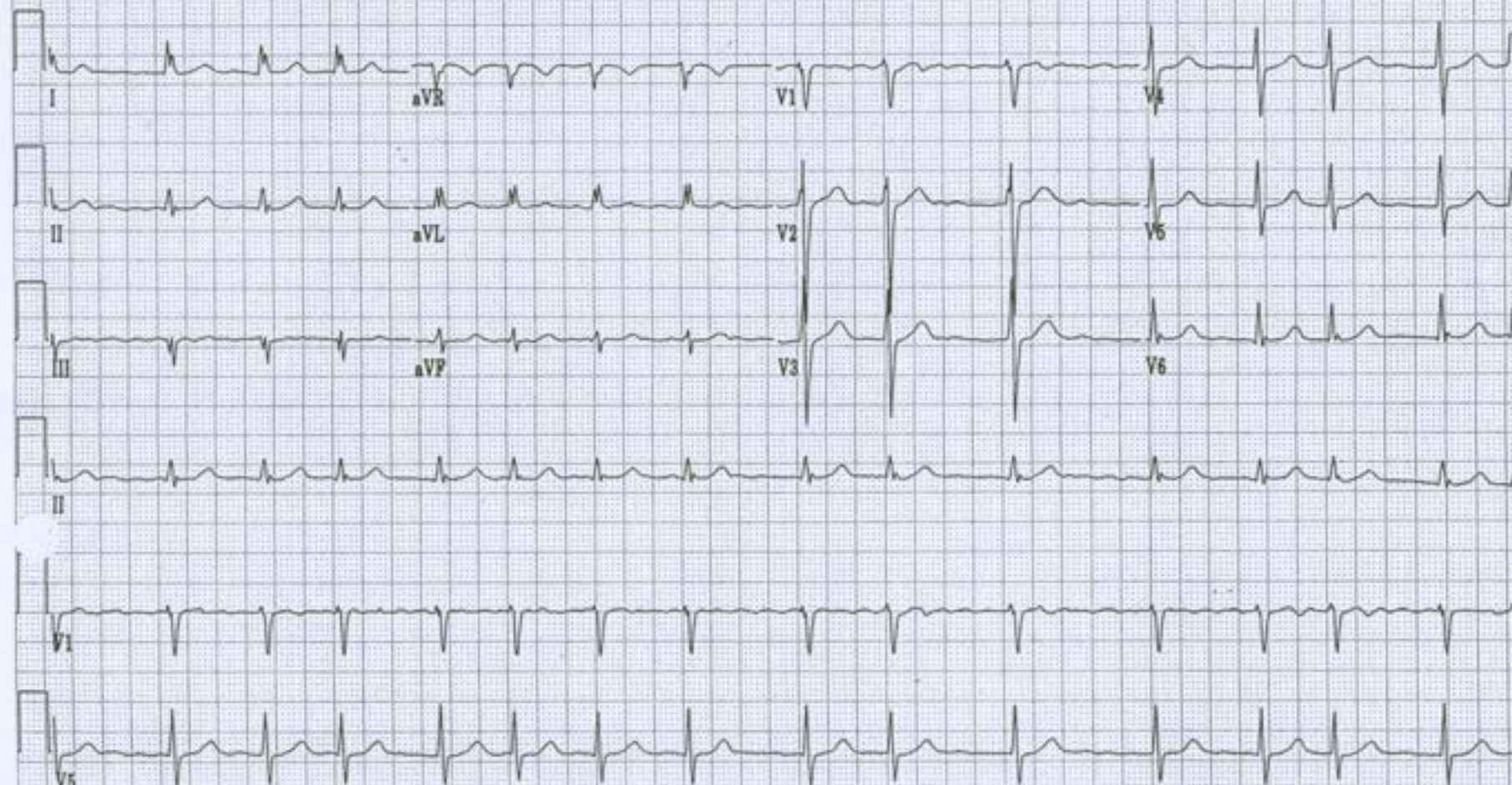
#2

Technician ID: 414

Unknown

Section:ENDO

Location:W18



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 78 CID: 76

EID:917 EDT: 10:49 10-OCT-1996 ORDER: 9602280

04-MAY-1911 (85 yr)

Female Unknown

69in 175lb

Loc:1 Option:0

Vent. rate

PR interval

QRS duration

QT/QTc

P-R-T axes

89 BPM

*

100 ms

356/433 ms

-1 -2 34

10-OCT-1996 10:05

MAYO CLINIC-A-1

ROUTINE RETRIEVAL

ATRIAL FIBRILLATION

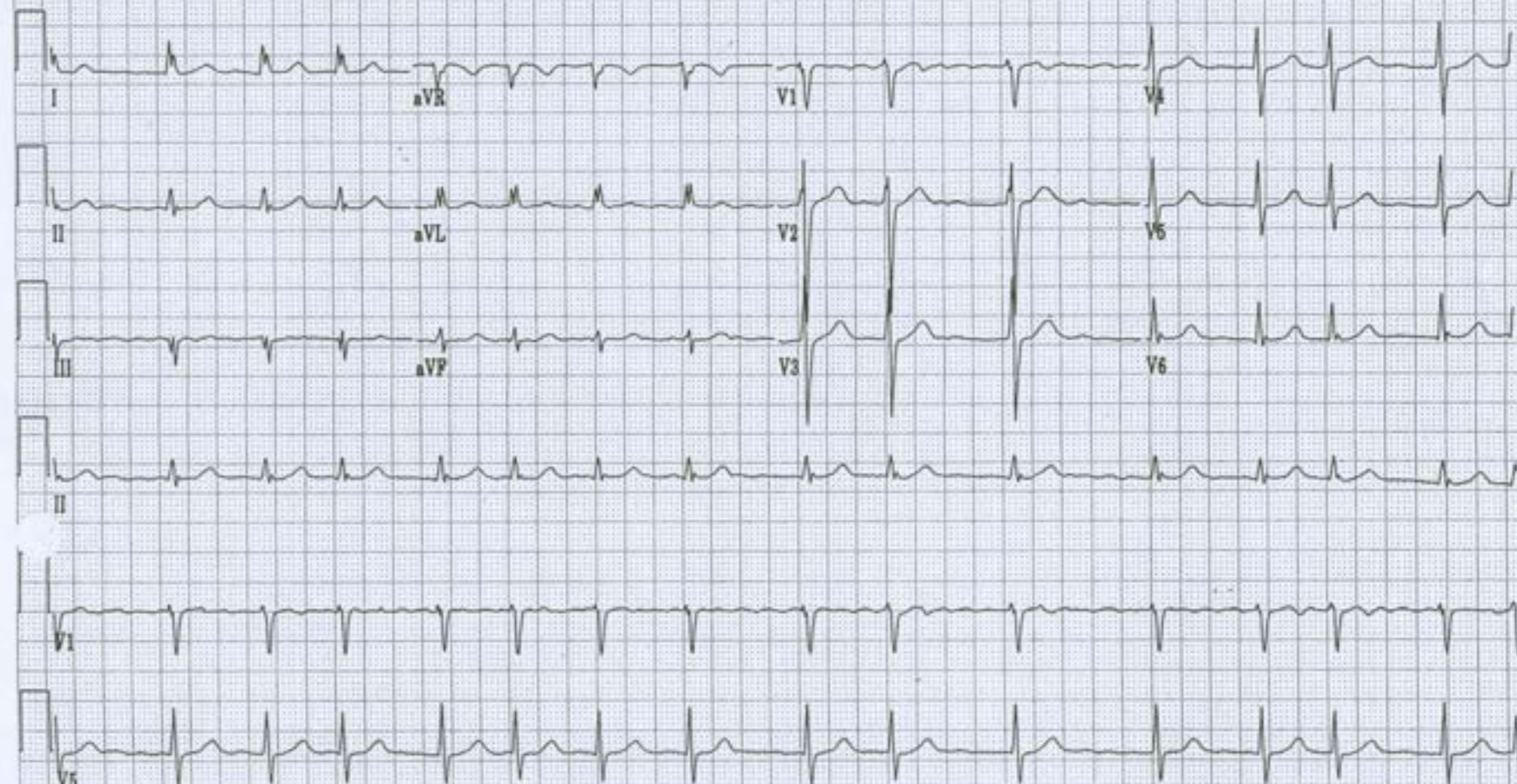
CRITERIA: IRREGULAR QRS'S WITHOUT VISIBLE P-WAVES.
ATRIAL ACTIVITY IS REPRESENTED BY
FIBRILLATORY (F) WAVES OF VARYING
AMPLITUDES, DURATION AND MORPHOLOGY.

Technician ID: 414

Unknown

Section:ENDO

Location:W18

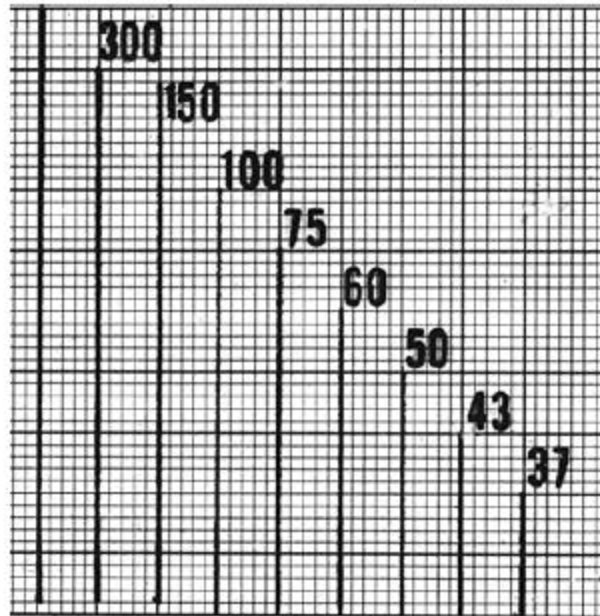


25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 78 CID: 76

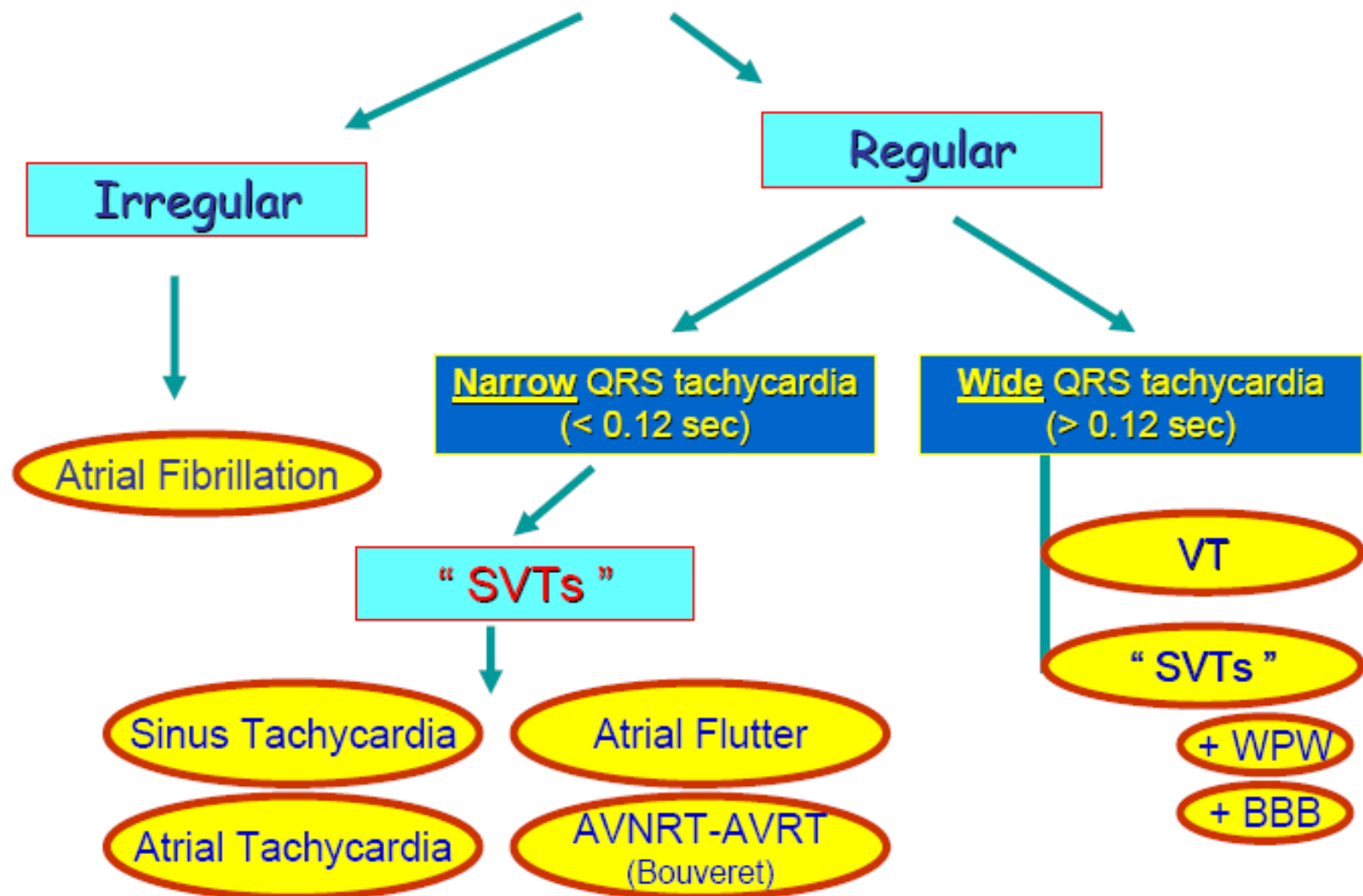
EID:917 EDT: 10:49 10-OCT-1996 ORDER: 9602280

Rate

- 1 small box = 0.04 sec
- 1 big box = 0.2 sec or 1/300 min
- For bradycardia use the "3 seconds" marks
- Count cycles in 6 seconds and multiply by 10

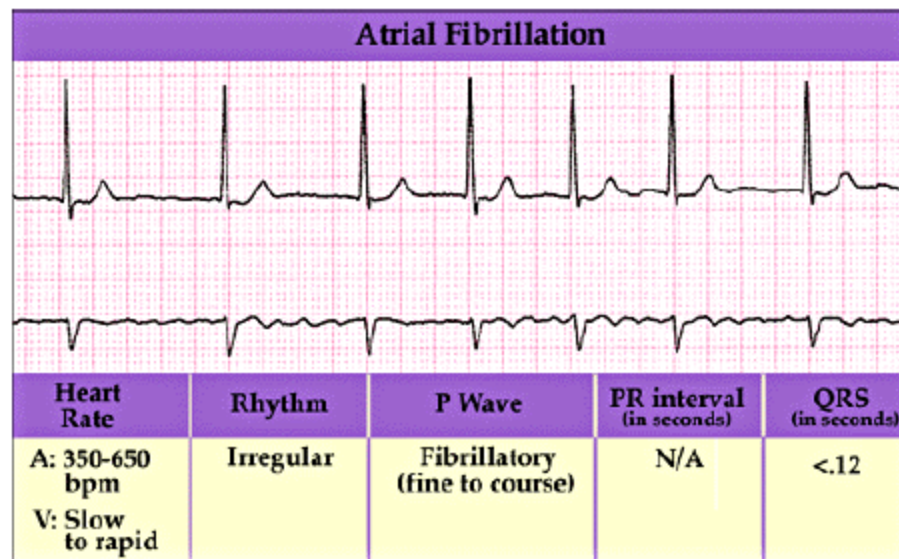


Tachycardia (HR > 100/min)



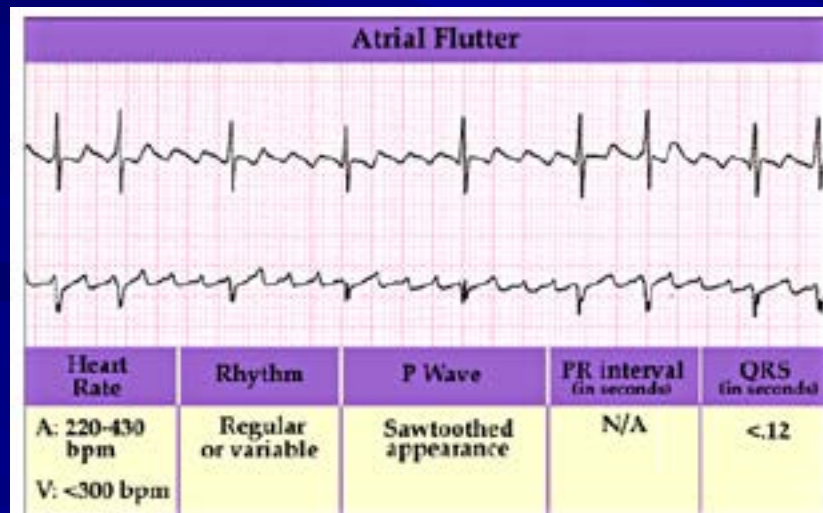
Atrial Fibrillation

- Atrial activity is poorly defined; may see coarse or fine undulations *or* no atrial activity at all.
- Ventricular response is ***irregularly irregular*** and may be fast (HR >100 bpm, indicates inadequate rate control), moderate (HR = 60-100 bpm), or slow (HR <60 bpm, indicates excessive rate control, AV node disease, or drug toxicity)



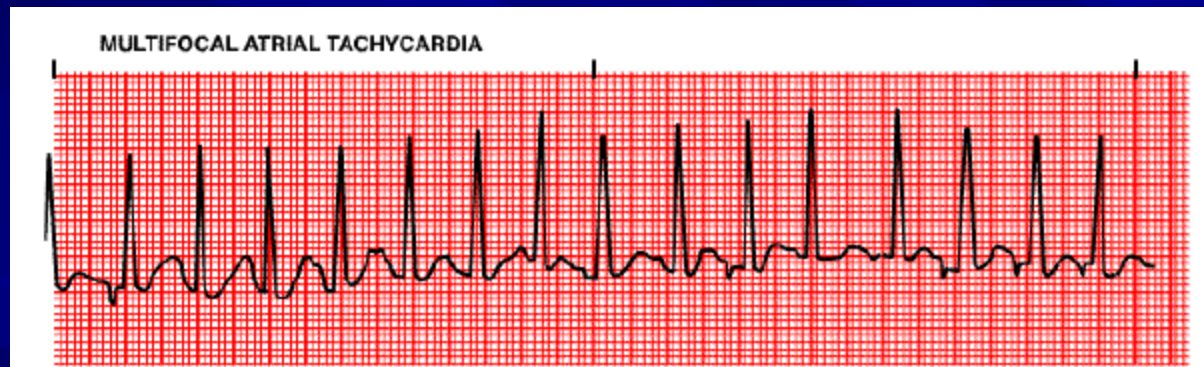
Atrial Flutter

- Regular atrial activity with a "clean" *saw-tooth* appearance in leads II, III, aVF, and usually discrete 'P' waves in lead V1. The atrial rate is usually about 300/min, but may be as slow as 150-200/min or as fast as 400-450/min.
- Untreated A-flutter often presents with a 2:1 A-V conduction ratio. This is the most commonly missed supraventricular tachycardia because the flutter waves are often difficult to find when there is 2:1 ratio.
- The ventricular response may be 2:1, 3:1, 4:1, or irregular depending upon the AV conduction properties and AV node slowing drugs on board



Multifocal Atrial Tachycardia

- Discrete, multifocal P' waves occurring at rates of 100-250/min and with varying P'R intervals (should see at least 3 different P wave morphologies in a given lead)
- Ventricular response is irregularly irregular
- Seen most often in elderly patients with chronic or acute medical problems such as exacerbation of chronic obstructive pulmonary disease



Rate 229
RR 262
PR 0
QRSD 122
QT 239
QTc 467

Job No.:1940074

#3

-- AXIS --

P

QRS -44

T 116

- ABNORMAL ECG -

Previous ECG:11-Jul-2008 21:27:33 - Abnormal Unconfirmed

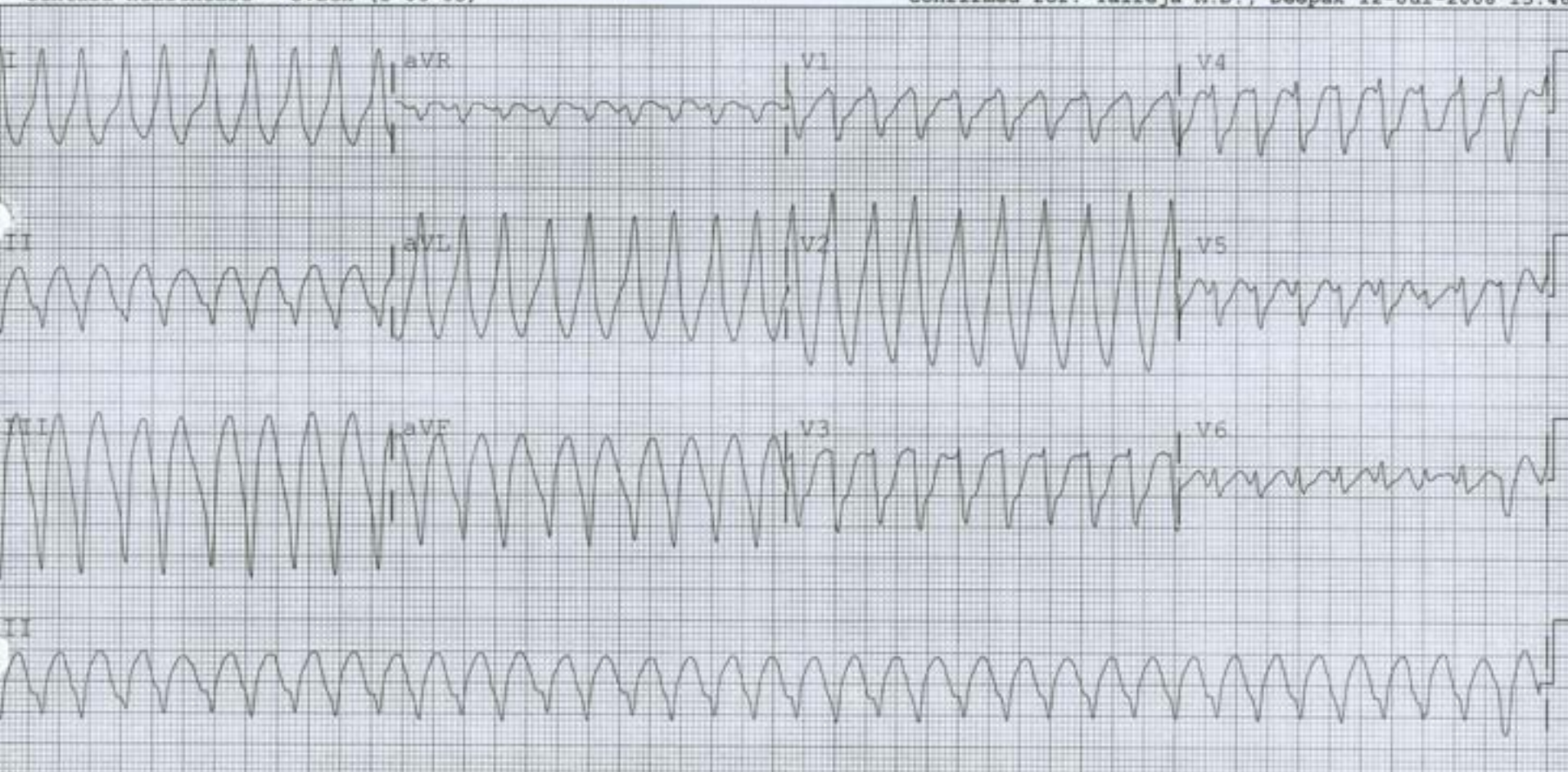
Edited

Standard 12

Requested By: EPT

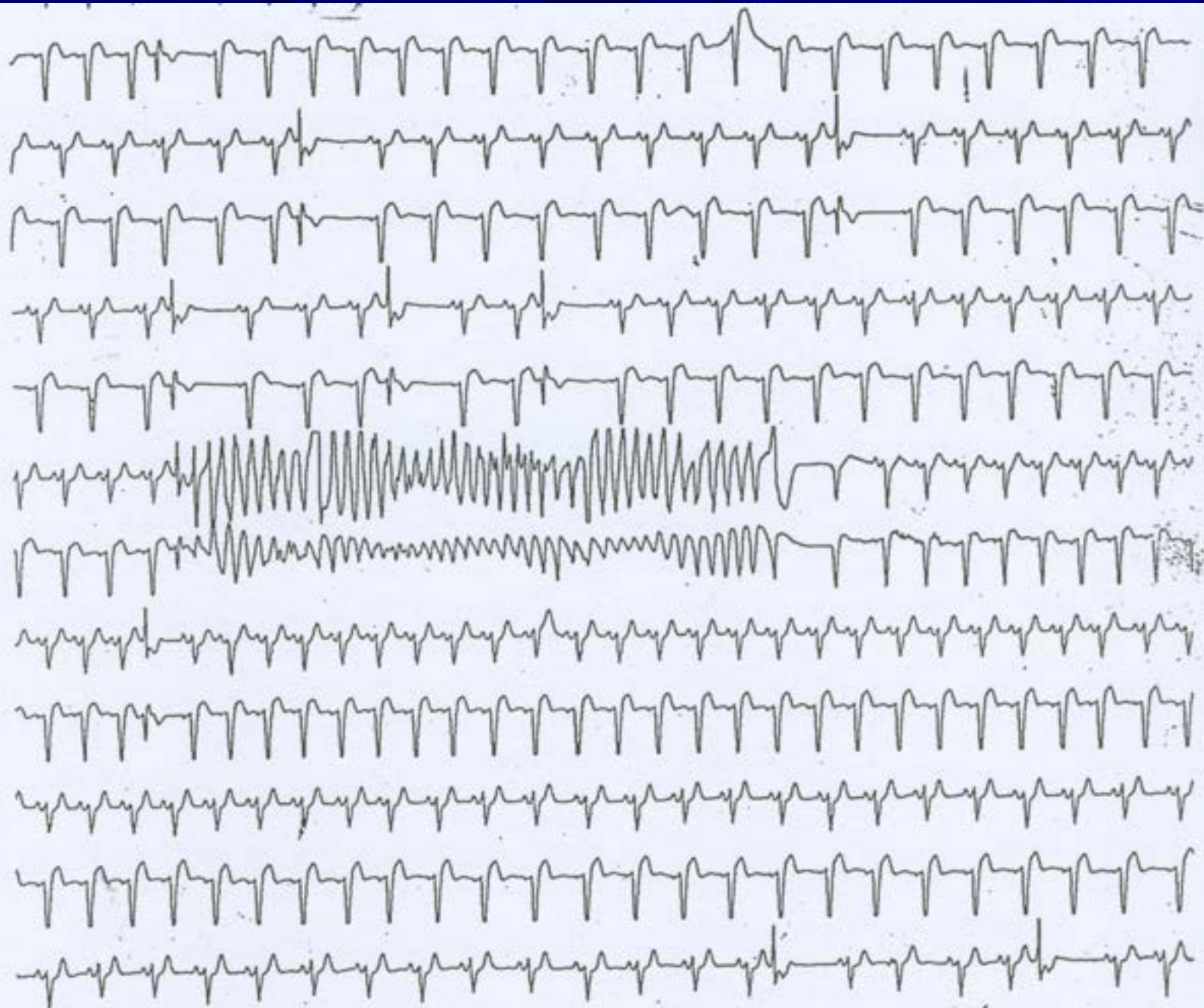
Sentara Healthcare - SVBGH (1-06-03)

Confirmed for: Talreja M.D., Deepak 12-Jul-2008 15:46



Device: Speed: 25 mm/sec Limb: 10 mm/mV Chest: 10 mm/mV

F 60~ 0.5-100 Hz W PH0709 P7



25-JAN-1990 13:45

MAYO CLINIC-S-ER

ROUTINE RETRIEVAL

05-MAR-1917 (72 yr)

Male

65in 207lb

Room: 83

Loc: 3

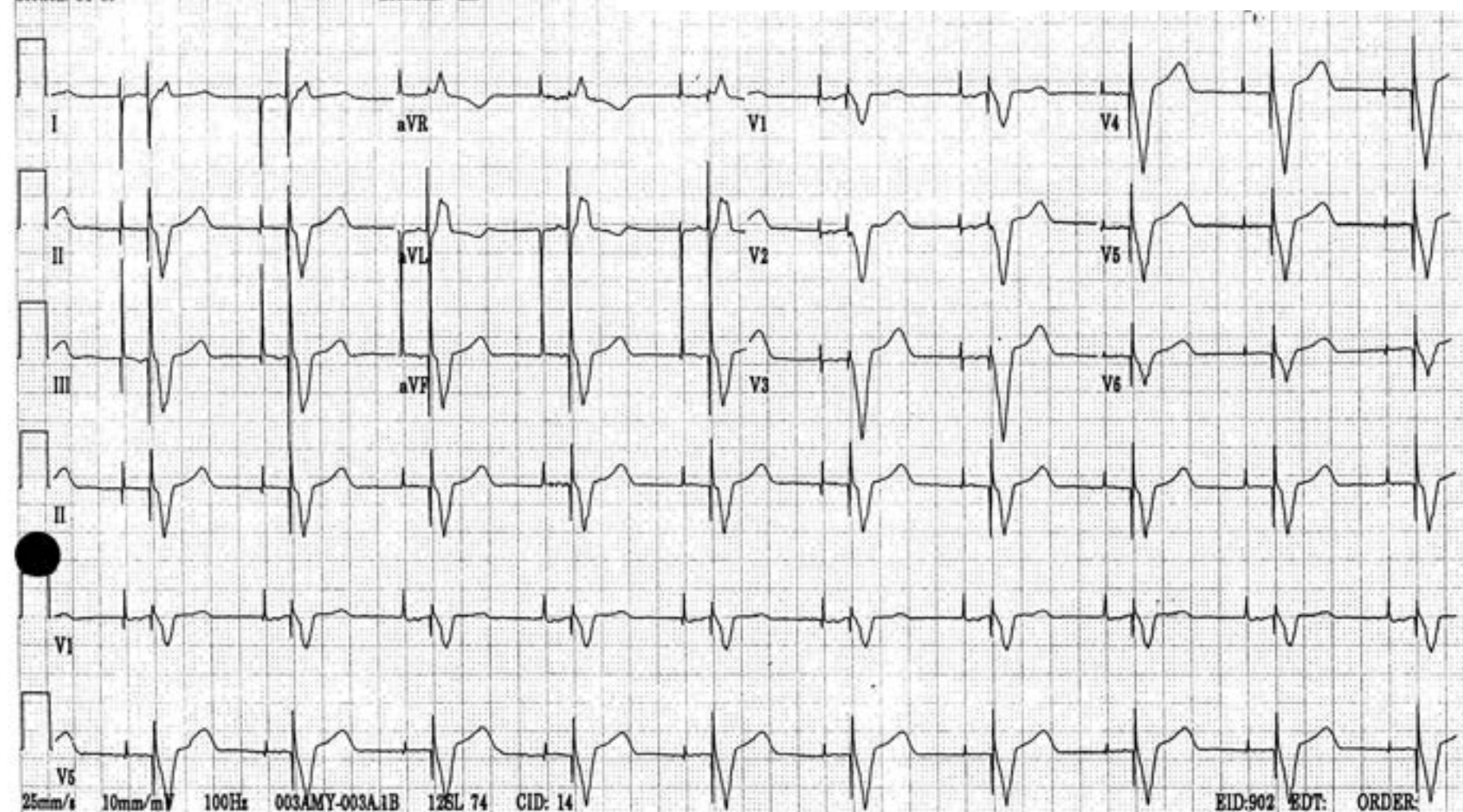
Vent. rate	60	BPM
PR interval	*	ms
QRS duration	176	ms
QT/QTc	292/292	ms
P-R-T axes	-1 155	79

#4

Unknown

Section: ST M

Location: ER-



25-JAN-1990 13:45

MAYO CLINIC-S-ER

ROUTINE RETRIEVAL

05-MAR-1917 (72 yr)

Male

65in 207lb

Room: 83

Loc: 3

Vent. rate	60	BPM
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P-R-T axes	-1 155	79

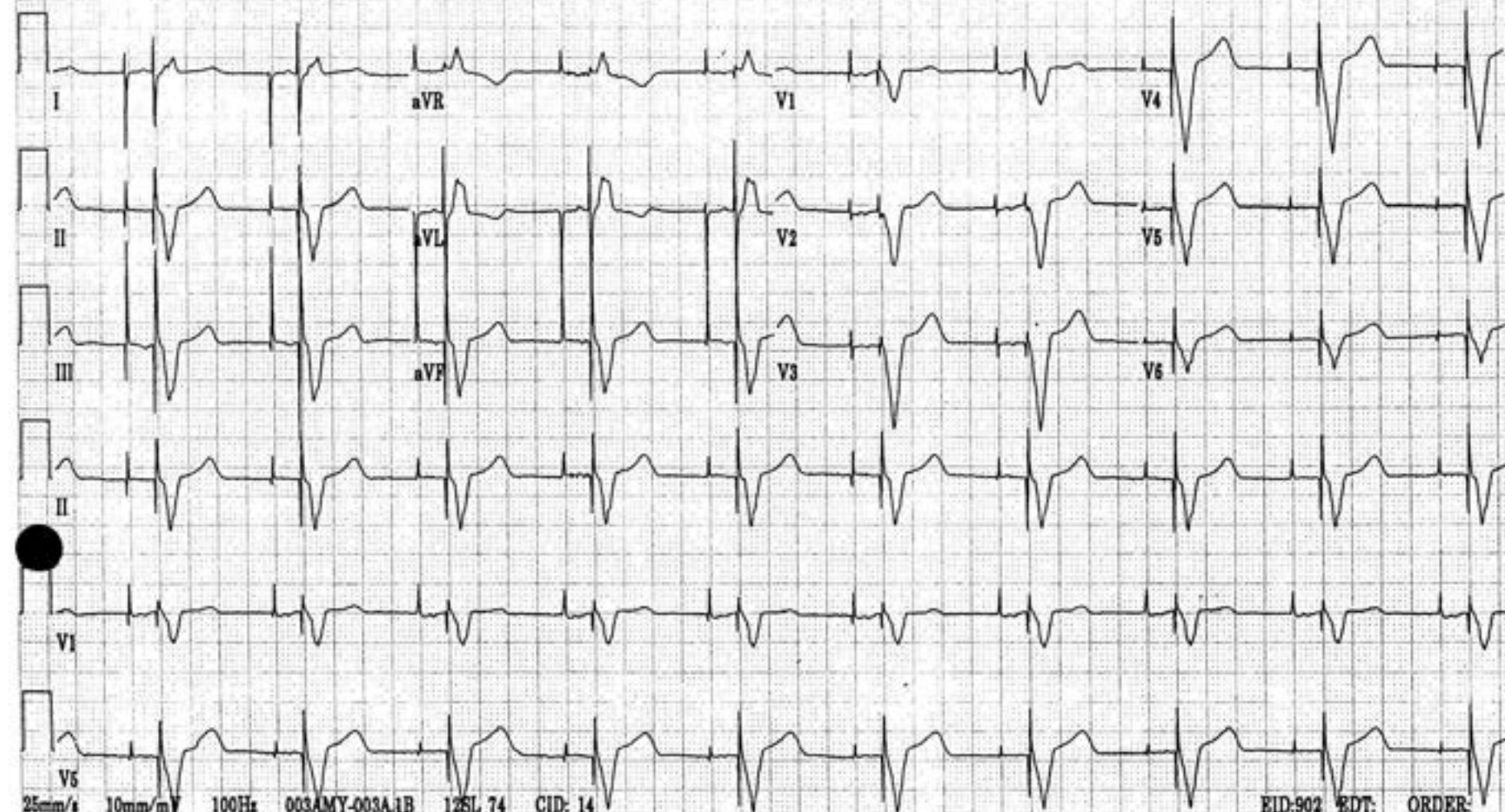
A-V SEQUENTIAL PACEMAKER (OR DUAL CHAMBER)

CRITERIA: ATRIAL PACING SPIKE FOLLOWED BY A VENTRICULAR PACING SPIKE.

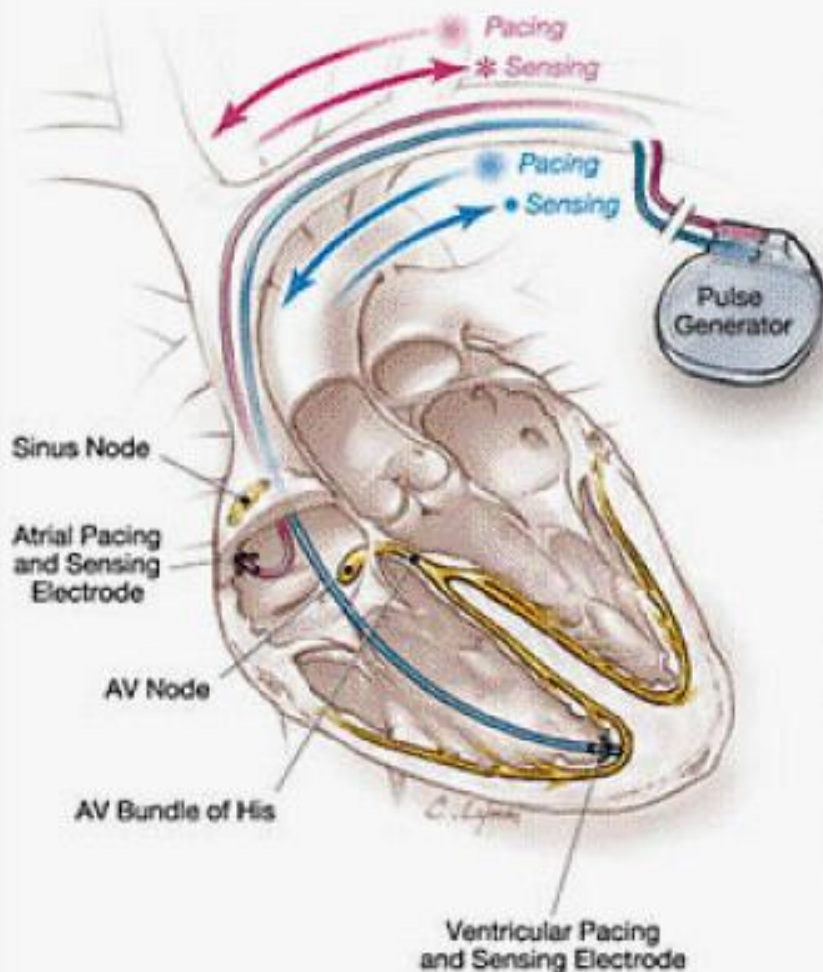
Unknown

Section: ST M

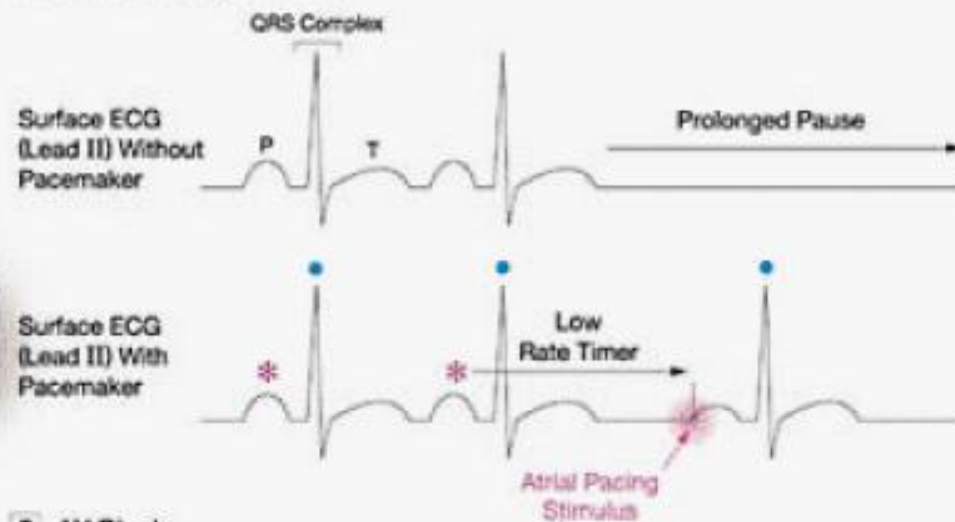
Location: ER-



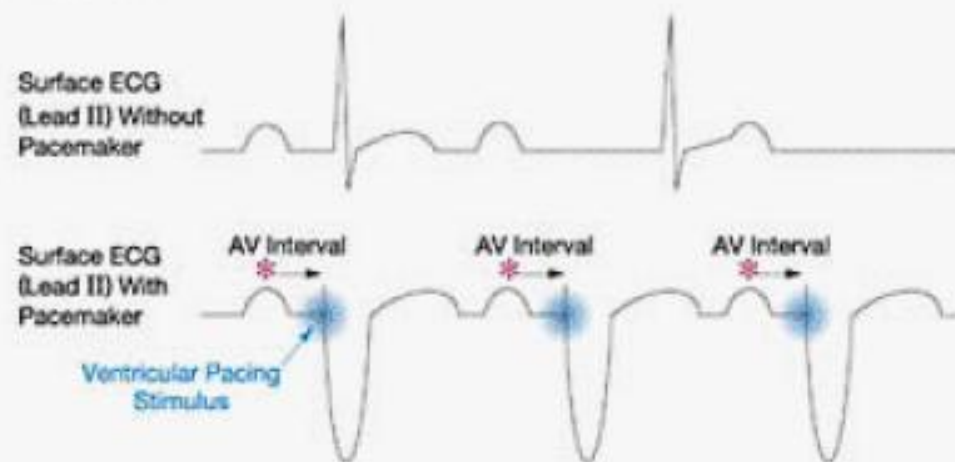
A Dual-Chamber Pacemaker



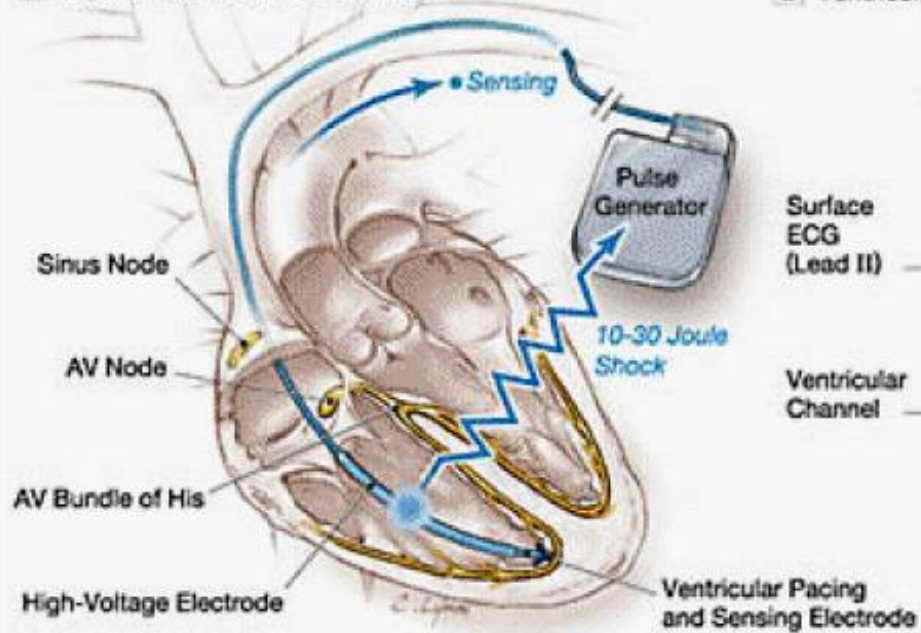
B Sinus Node Dysfunction



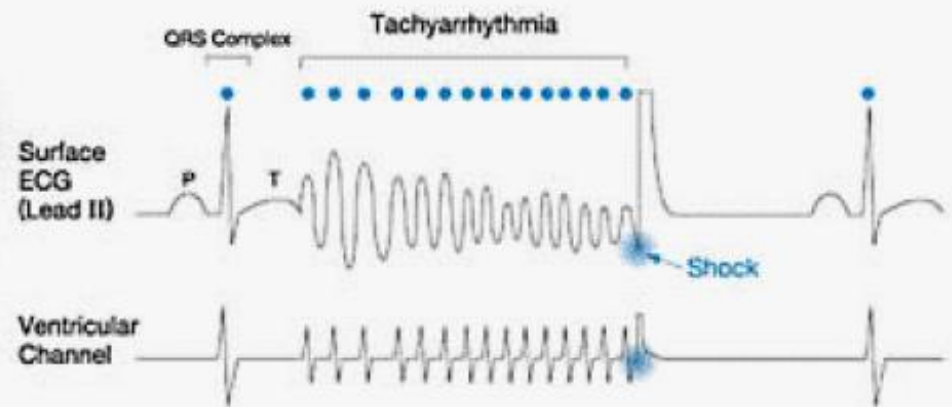
C AV Block



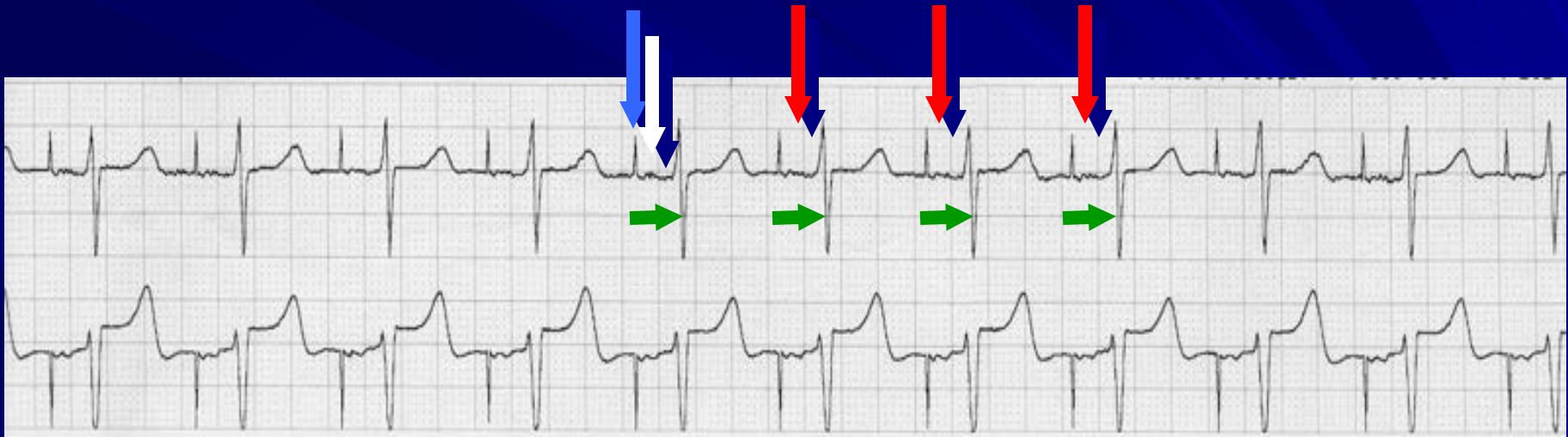
A Implantable Cardiac Defibrillator



B Ventricular Tachyarrhythmia



Atrial Pacing



Pacemaker stimulus followed by P wave **and native AV conduction**
in repetitive pattern

Probably AAI, but cannot exclude:

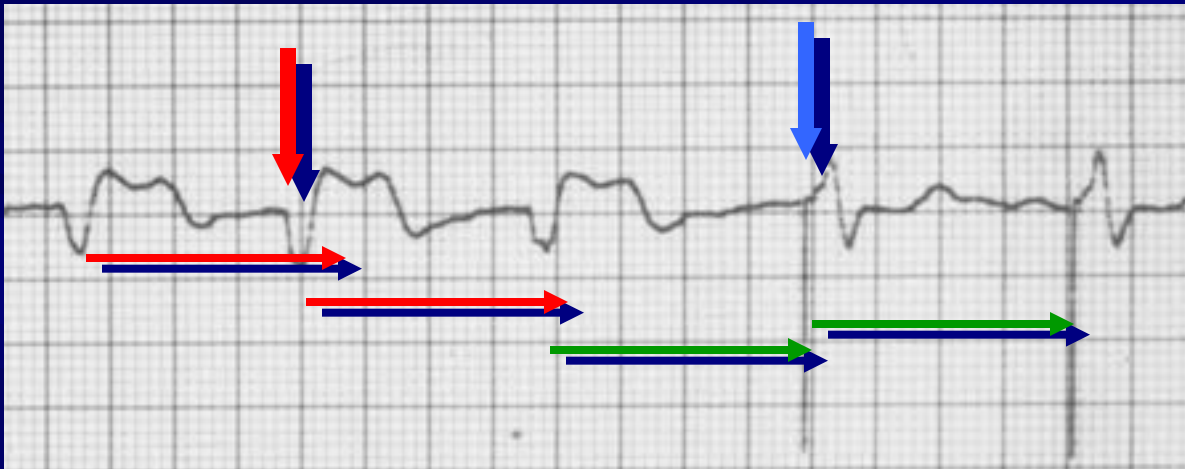
- AOO - since there are no P waves to assess sensing
- AAT - again, since there are no native P waves
- DVI with long programmed AV interval
- DDD with long AV and lower rate limit of 75 bpm

[more](#)

[Return to ECG interpretation](#)

[Return to Modes](#)

Ventricular Pacing



Stimulus is followed by ventricular depolarization.

Escape cycle length (ECL) is the interval between a ventricular event (paced or sensed) and the next ventricular impulse.

An appropriately sensed event (QRS) within the ECL will inhibit output and reset to the beginning of a new ECL in a VVI pacemaker.

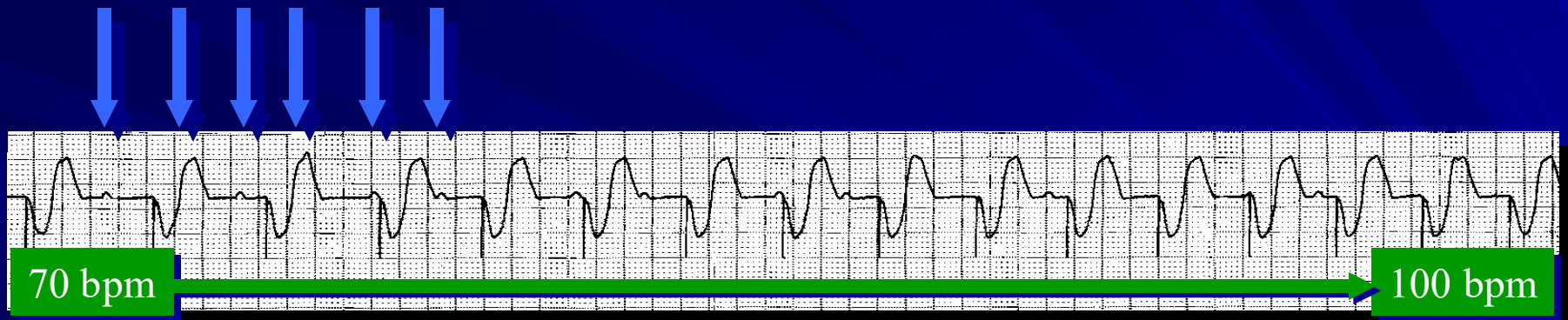
See
ventricular
failure to
capture

ecg

[Return to ECG interpretation](#)

[Return to Modes](#)

Ventricular Pacing



Ventricular pacing is dissociated from **P waves** in patients with sinus mechanism* since there is no sensing in the atrium.

Gradual acceleration is evidence that this is a rate-responsive ventricular pacemaker - **VVIR ...or VOOR** (since there are no QRS's to assess sensing).

*Ventricular pacing (VVI, VVIR) is generally NOT the mode of choice in patients with sinus rhythm.

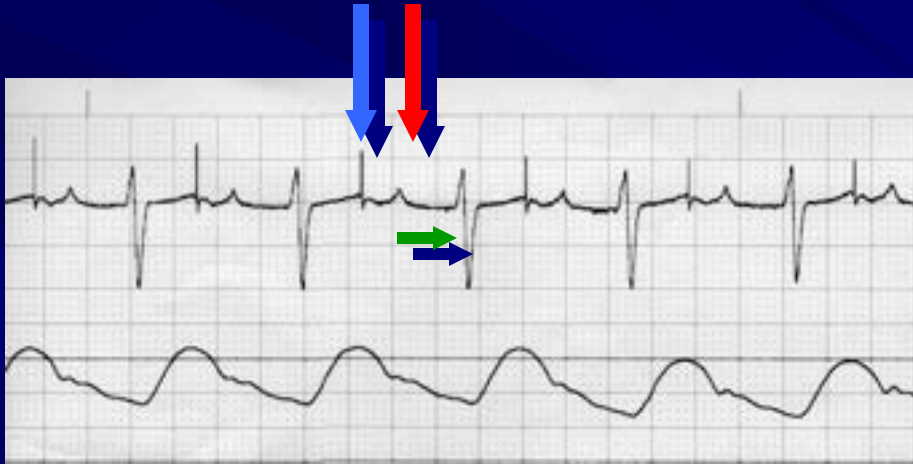
See
[ventricular failure to capture](#)

[more](#)

[Return to ECG interpretation](#)

[Return to Modes](#)

Atrial Capture



■ Characterized by

- stimulus artifacts
- followed by atrial depolarization (P-waves)
- followed by AV conduction if patient not in heart block and not AV sequentially pacing

See atrial capture in AV pacing

See atrial failure to capture

Return to ECG interpretation

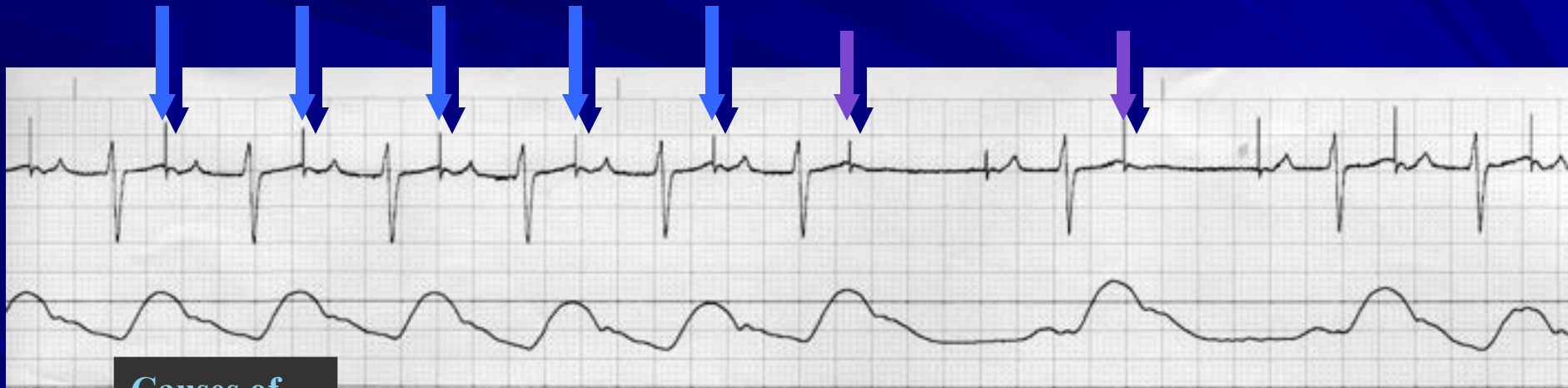
Failure to Capture

•Capture

- Stimuli
- Atrial Depolarizations
- AV Conduction

•Failure to Capture

- Stimuli
- No Atrial Depolarizations
- No evidence of AV conduction

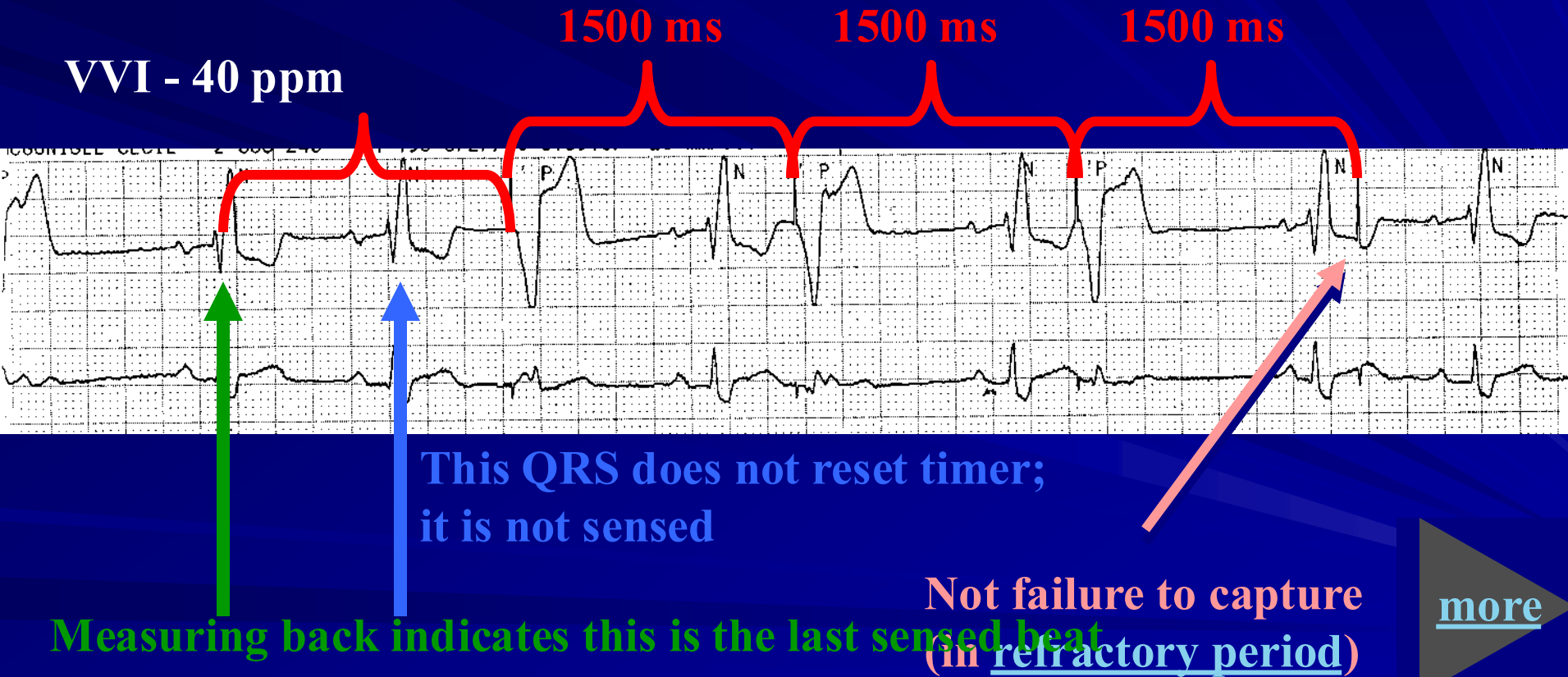


Causes of
failure to
capture

Intermittent Atrial Failure to Capture

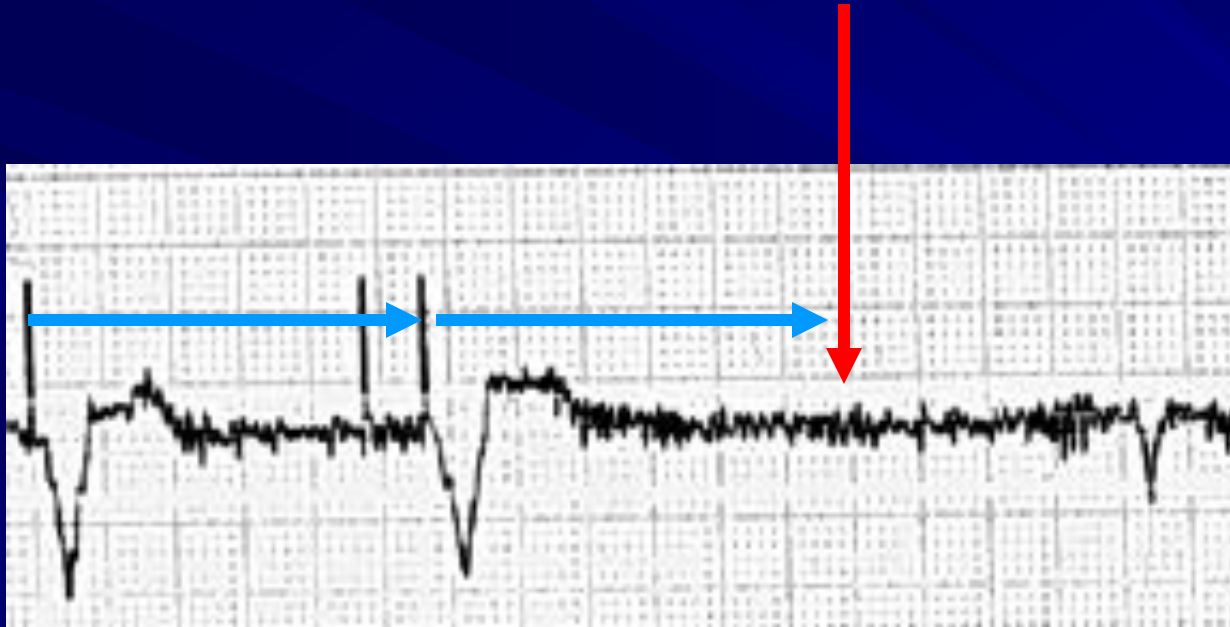
Return to ECG interpretation

Ventricular Undersensing



[Return to ECG interpretation](#)

Oversensing



Programmed
Cycle Length **No stimulus** after
Programmed Cycle Length



Myopotential Oversensing

[Return to ECG interpretation](#)

28-MAR-1989 09:38

MAYO CLINIC-BA ROUTINE RETRIEVAL

12-DEC-1944 (44 yr)

Vent. rate 39 BPM

Male

PR interval 142 ms

68in 154lb

QRS duration 97 ms

Room:0

QT/QTc 508/409 ms

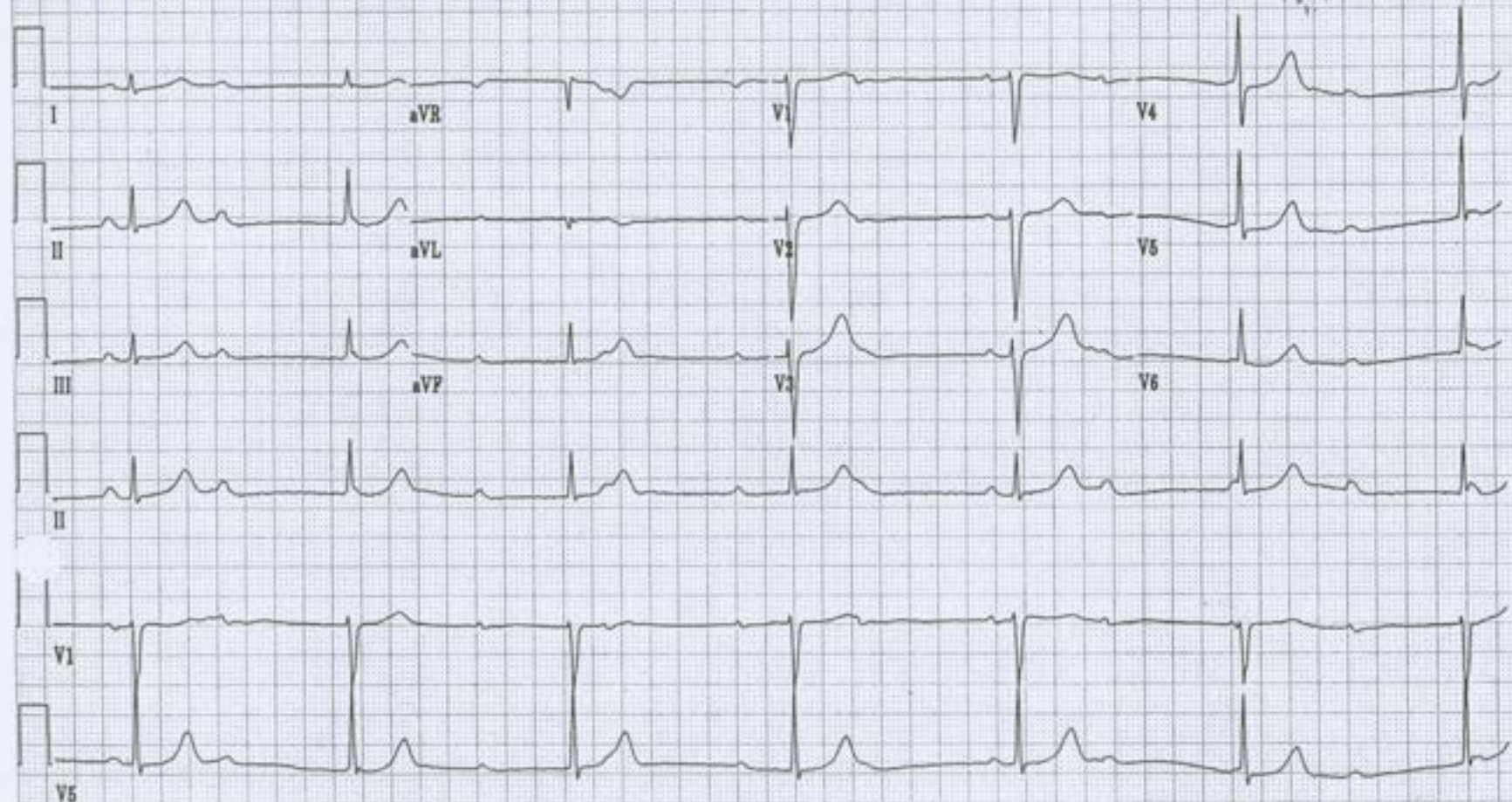
Loc:6

P-R-T axes -1 -1 71

#5

Section: CMB

Location: 2A



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 0 CID: 6

EID: Cnvtid EDT: ORDER:

Page 1 of

28-MAR-1989 09:38

MAYO CLINIC-BA ROUTINE RETRIEVAL

12-DEC-1944 (44 yr)

Vent. rate 39 BPM

Male

PR interval 142 ms

68in 154lb

QRS duration 97 ms

Room:0

QT/QTc 508/409 ms

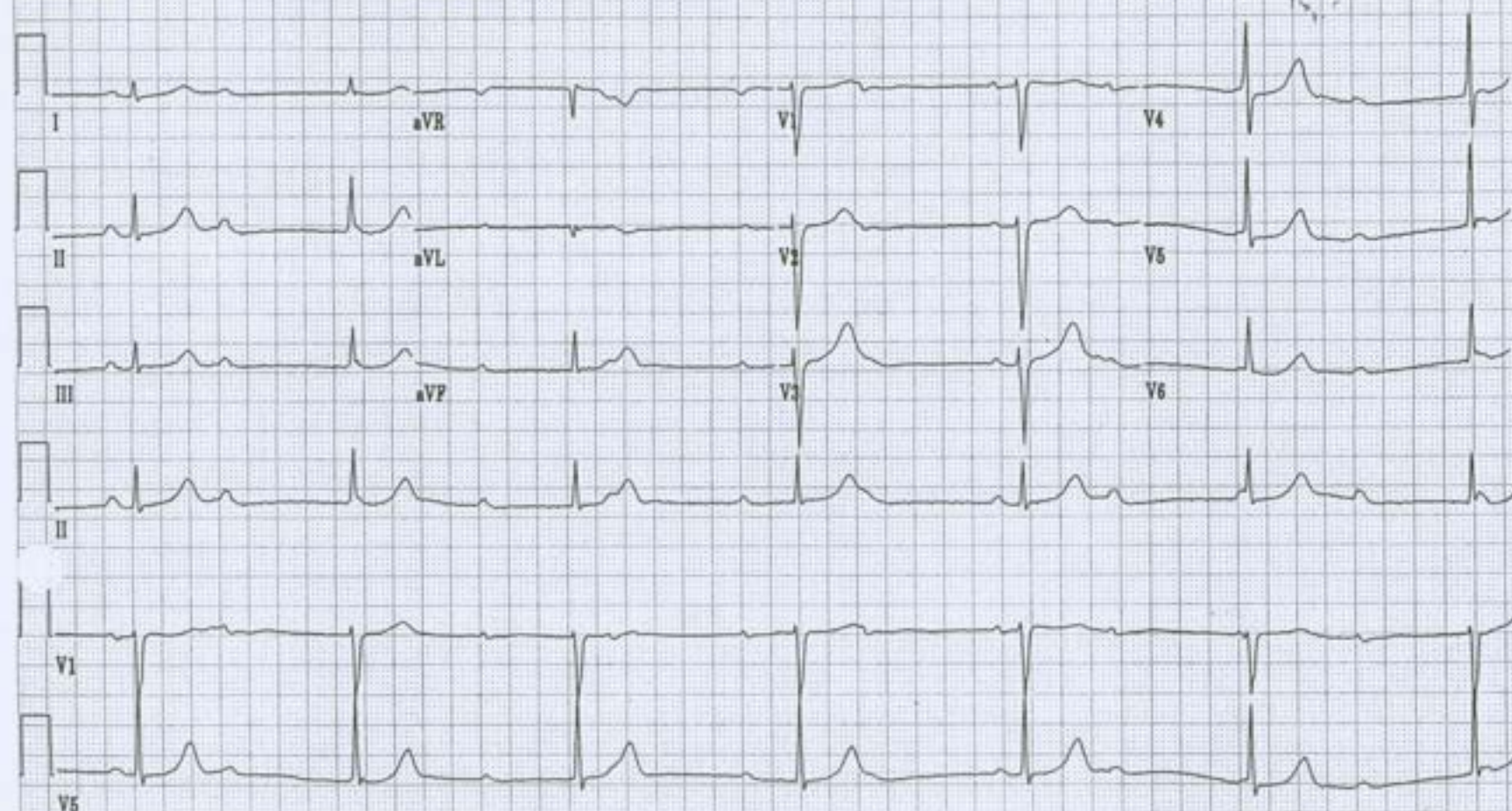
Loc:6

P-R-T axes -1 -1 71

THIRD DEGREE A-V BLOCK (COMPLETE HEART BLOCK)

Section: CMB

Location: 2A

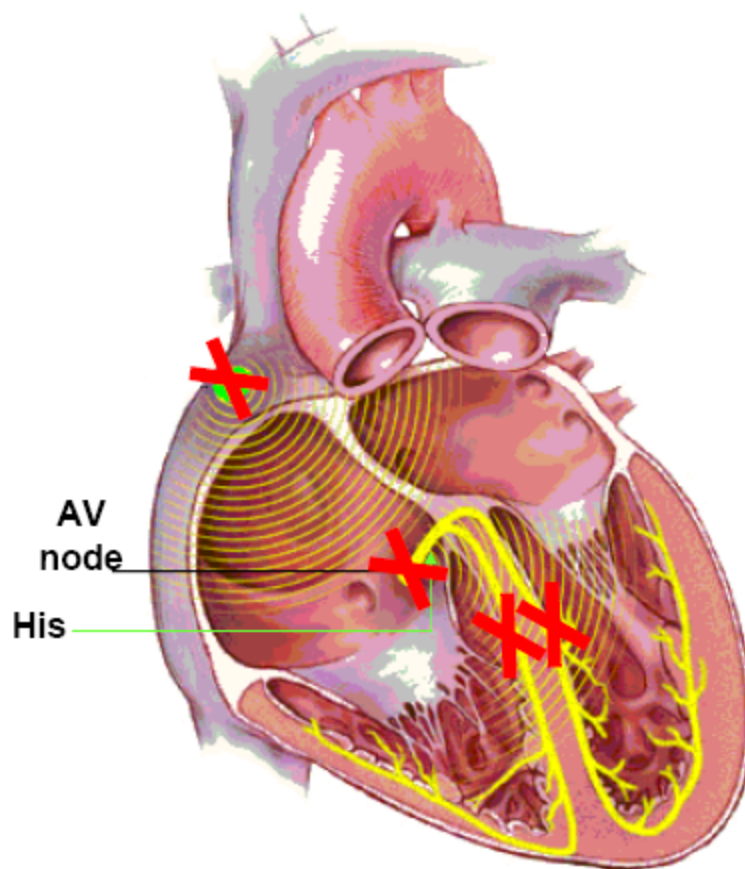


25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 0 CID: 6

EID: Cnvtid EDT: ORDER:

Page 1 of

Heart blocks

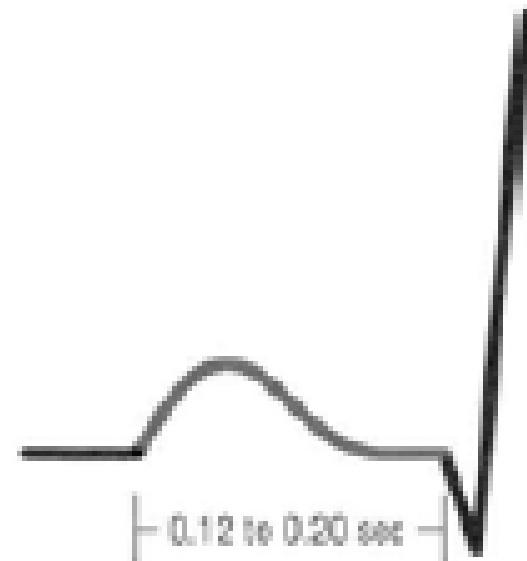


- Sinus dysfunction

- AV Block

PR Interval

- * Represents time for atrial to ventricular depolarization
- * Normal duration 0.12 to 0.2 sec
 - * Measured in the lead with the widest P

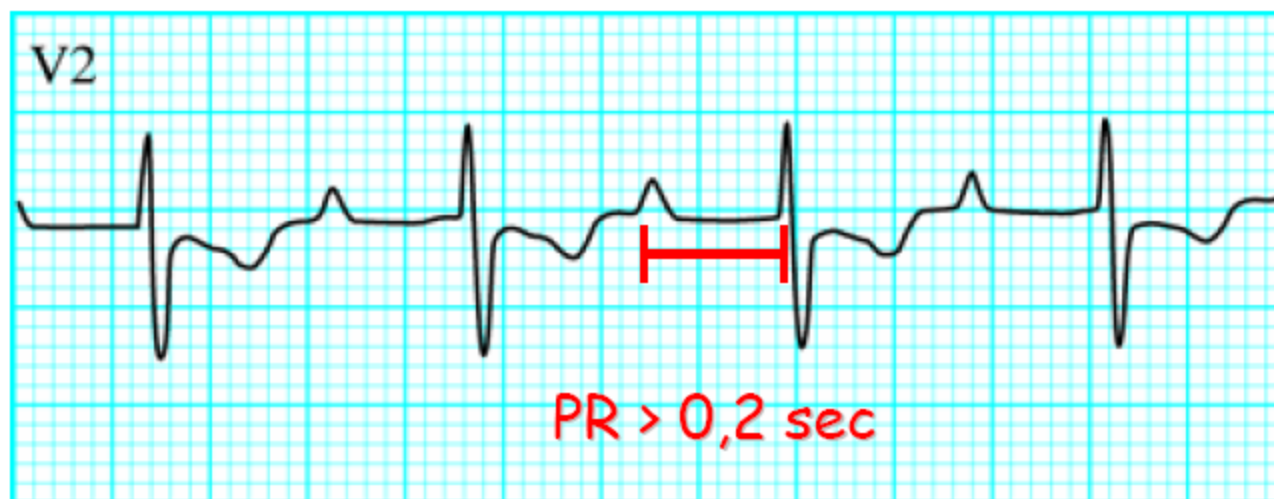


Long PR Interval

- * 1° AV block
 - * PR intervals are all the same and always followed by QRS
 - * D/Dx:
 - * Drug toxicity, hypercalcemia, hypothermia, increased vagal stimulation (ie IWMI)

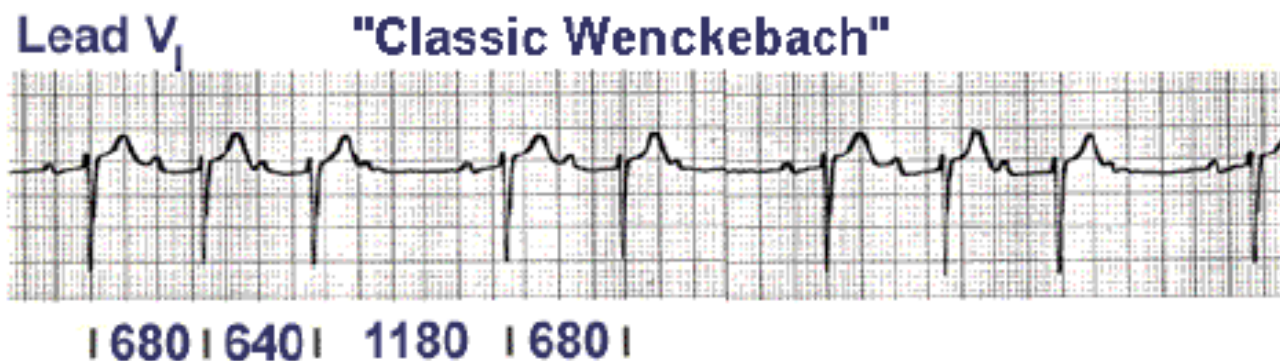


1st degree AV block



Wenckebach

- In "classic" *Wenckebach* the PR interval gets longer until a nonconducted P wave occurs. The RR interval of the pause is *less than* the two preceding RR intervals, and the RR interval after the pause is *greater than* the RR interval before the pause.
- Located in AV node.



Mobitz 1 AV block



« progressive » AV block

Mobitz

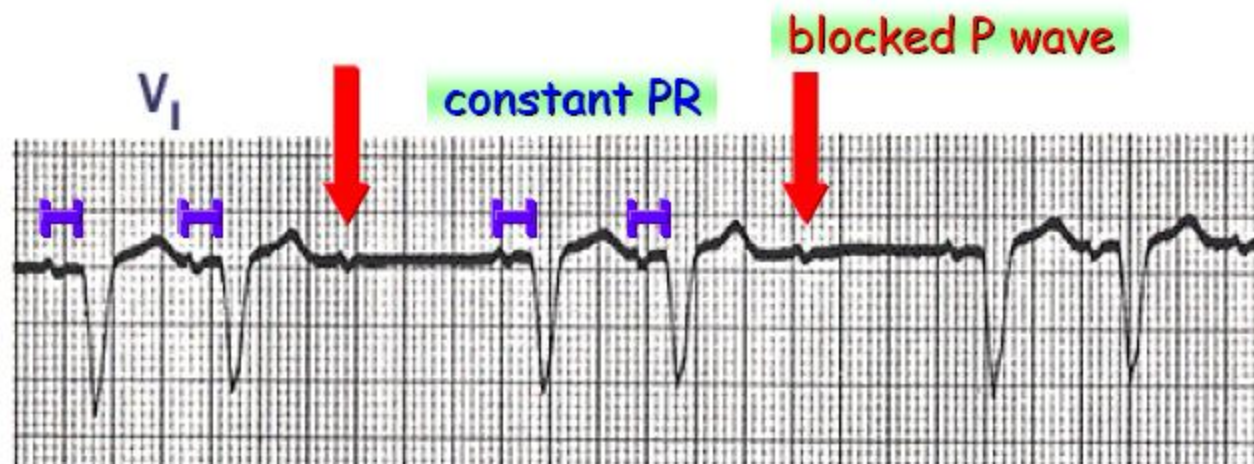
- In *Mobitz* AV block the PR intervals are constant until a nonconducted P wave occurs. There must be two consecutive constant PR intervals to diagnose Type II AV block
- Located in the bundle branches, which means that the QRS duration is wide indicating complete block of one bundle

Lead V₁



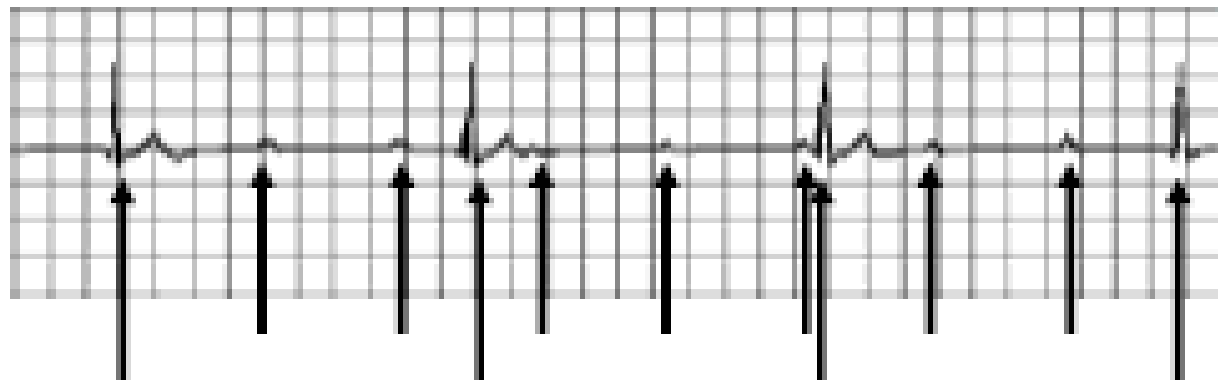
2nd degree AV block (type II) with LBBB

Mobitz 2 AV block



Long PR Interval

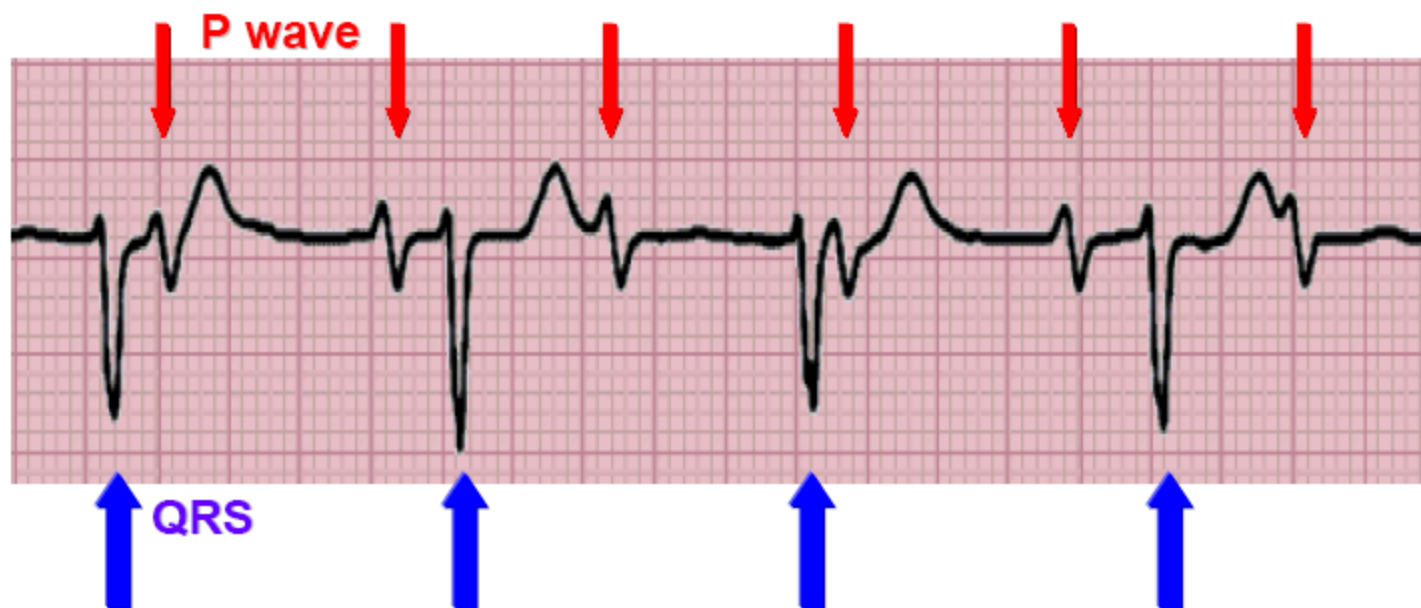
- * 3° AV block
 - * P waves and QRS are dissociated from each other
 - * Always more P's than QRS complexes



Have a pacemaker close at hand

Complete AV block

AV dissociation



09-DEC-1956 (39 yr)

Male

72in 220lb

Room: 02168

Loc: 2 Option: 0

Vent. rate 71 BPM

PR interval 116 ms

QRS duration 144 ms

QT/QTc 416/452 ms

P-R-T axes 9 -39 135

01-SEP-1996 21:13

MAYO CLINIC-STMA

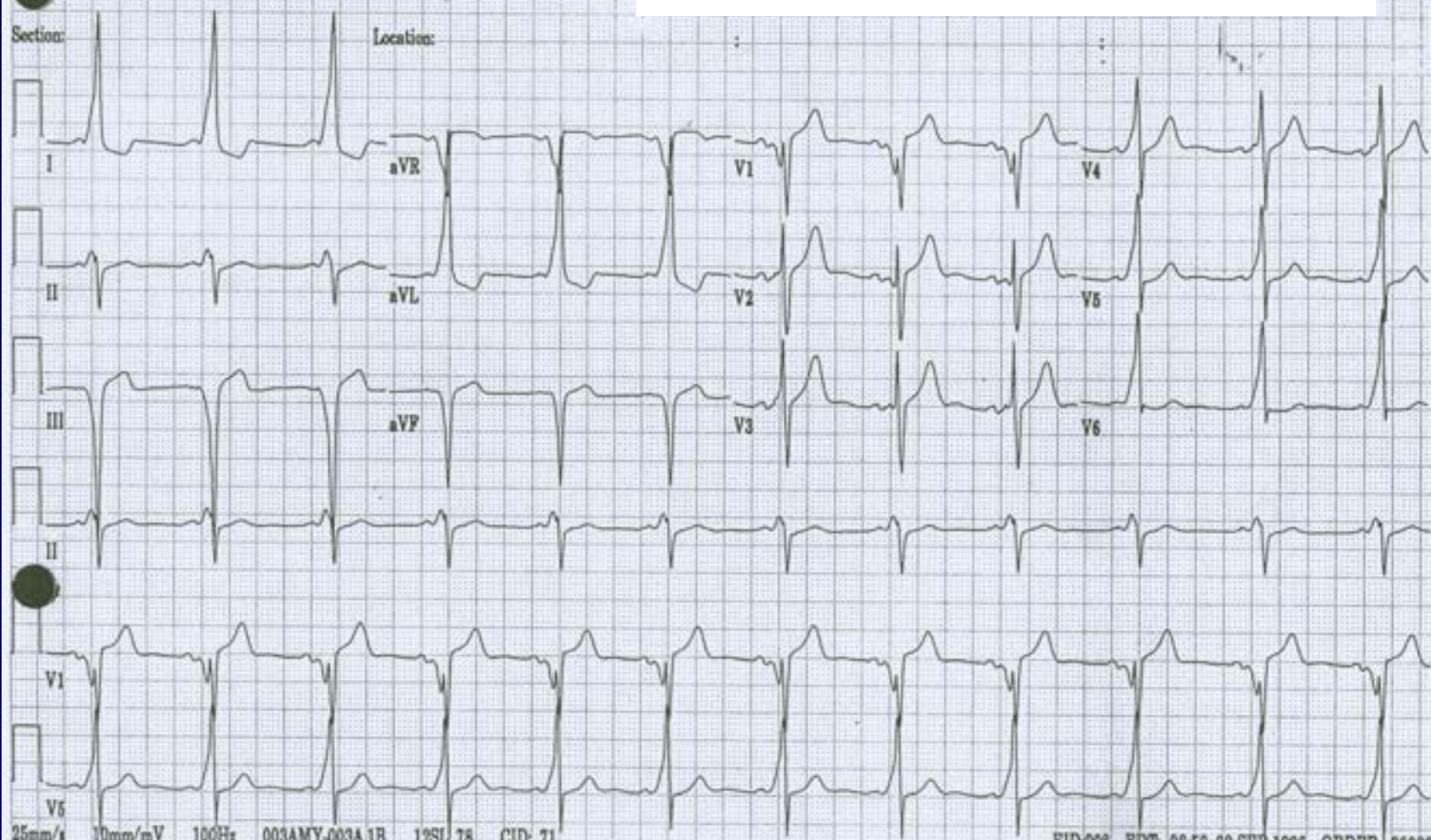
ROUTINE RETRIEVAL

Technician ID: 454

#6

Section:

Location:



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 78 CID: 71

EID:908 EDT: 08:50 02-SEP-1996 ORDER: 9602261

09-DEC-1956 (39 yr)

Male

72in 220lb

Room: 02168

Loc: 2 Option: 0

Vent. rate 71 BPM

PR interval 116 ms

QRS duration 144 ms

QT/QTc 416/452 ms

P-R-T axes 9 -39 135

01-SEP-1996 21:13

MAYO CLINIC-STMA

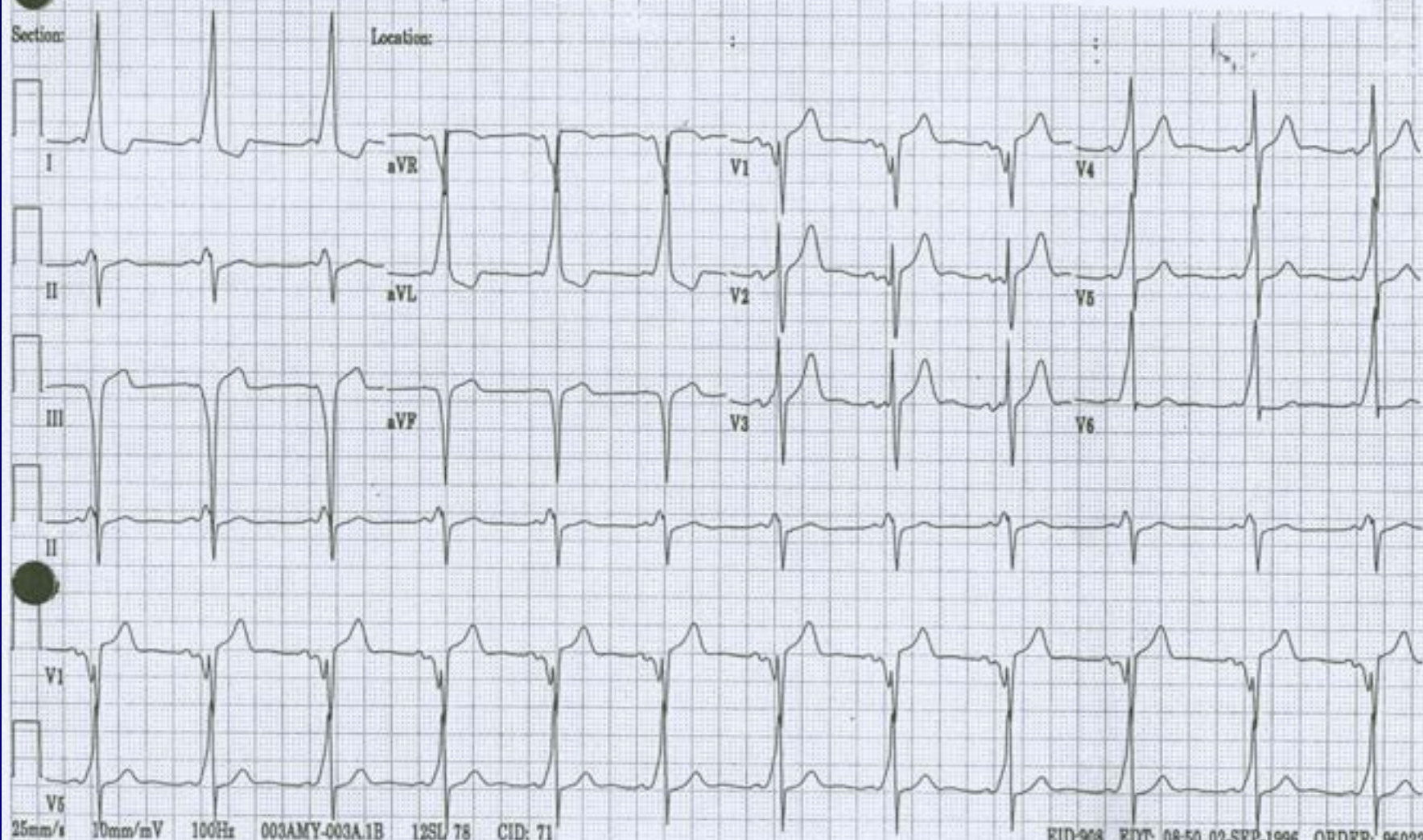
ROUTINE RETRIEVAL

Technician ID: 454

WOLF-PARKINSON-WHITE PATTERN (WPW)

Section:

Location:



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 78 CID: 71

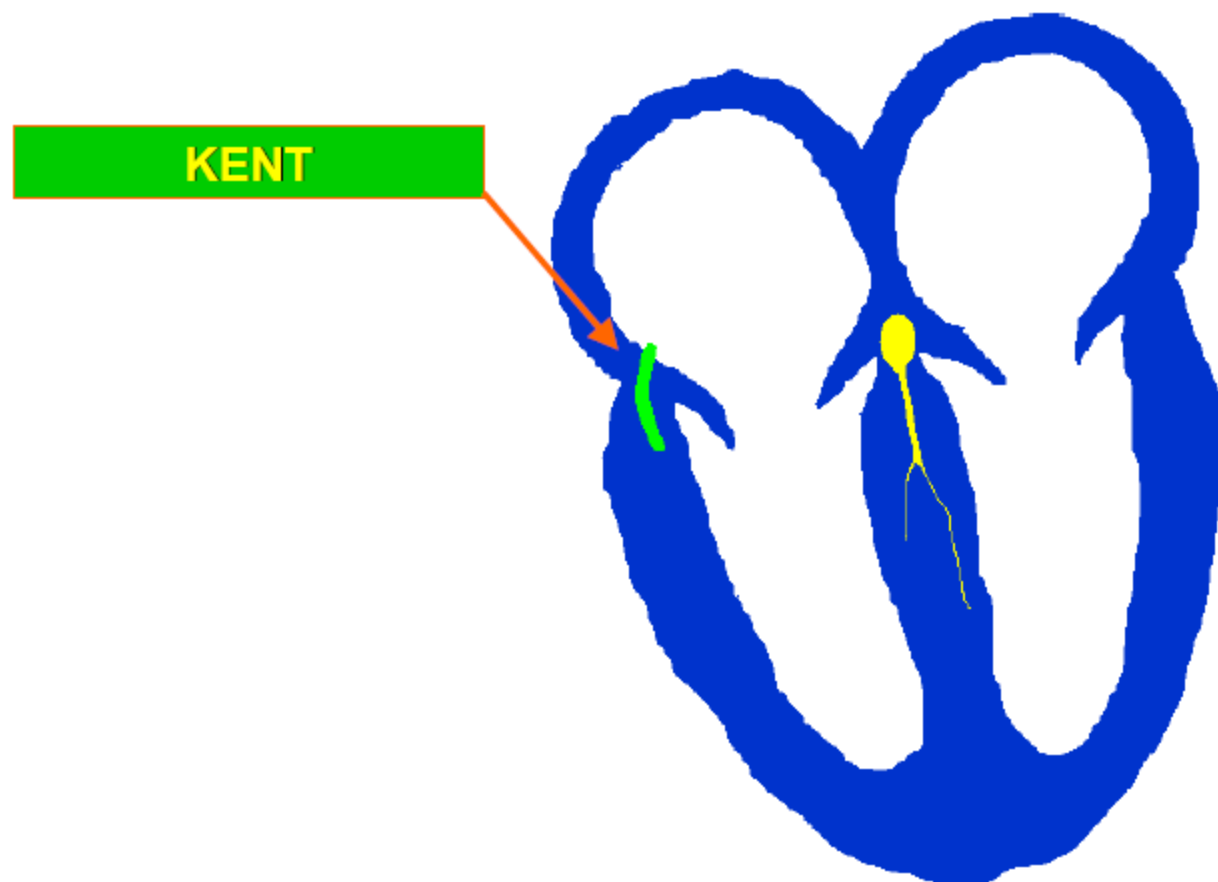
EID:908 EDT: 08:50 02-SEP-1996 ORDER: 9602261

Short PR Interval

- * PR segment ≤ 0.11 sec*
- * D/Dx:
 - * Retrograde Junctional P waves
 - * Lown-Ganong-Levine syndrome
 - * Wolf-Parkinson-White pattern & syndrome
 - * Glycogen storage disease
 - * Pheochromocytoma
 - * Fabry's disease
 - * Normal variant

* Important to recognize in pts with C/O palpitations

Wolf Parkinson White Syndrome



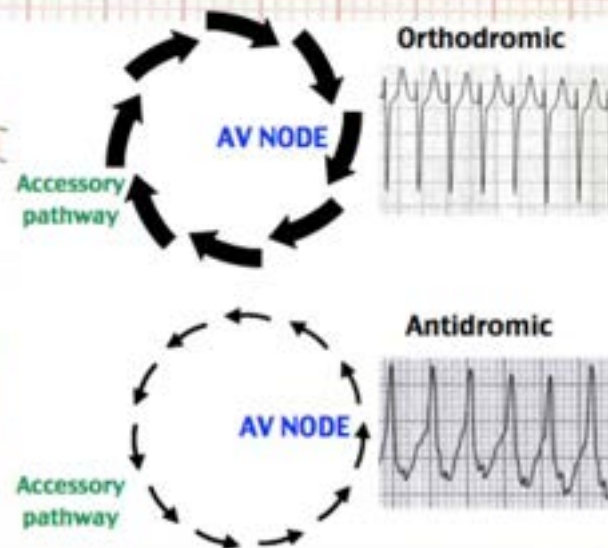
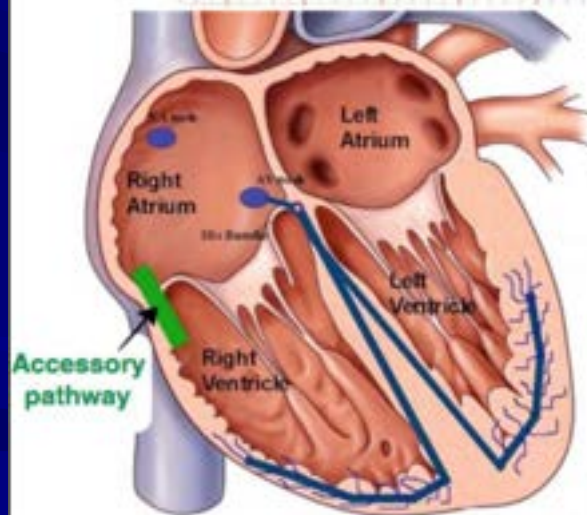
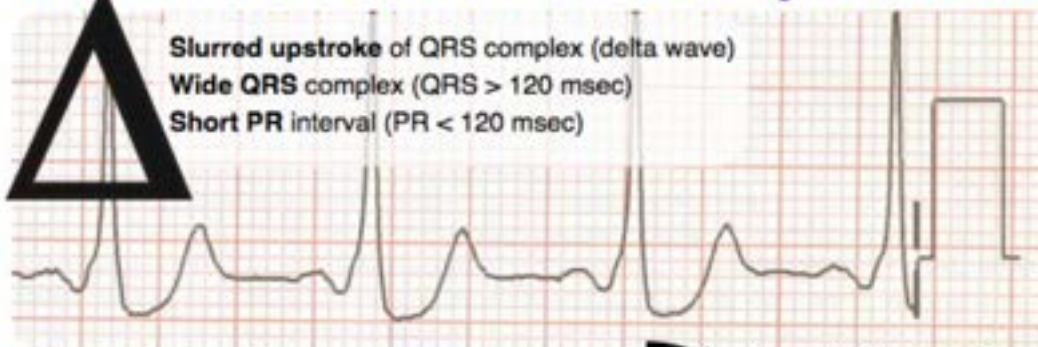
Wolff-Parkinson-White Syndrome



Slurred upstroke of QRS complex (delta wave)

Wide QRS complex (QRS > 120 msec)

Short PR interval (PR < 120 msec)

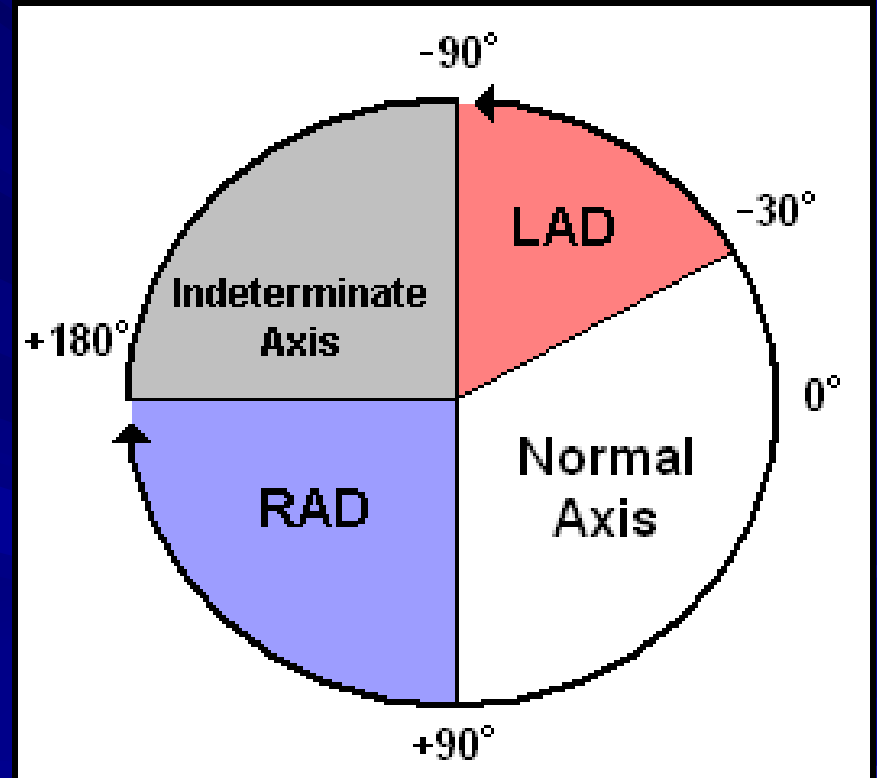


The QRS Axis

By near-consensus, the normal QRS axis is defined as ranging from -30° to $+90^\circ$.

-30° to -90° is referred to as a left axis deviation (LAD)

$+90^\circ$ to $+180^\circ$ is referred to as a right axis deviation (RAD)



31-AUG-1961 (45 yr)

Vent. rate 70 BPM

Male Unknown

PR interval 180 ms

70in 205lb

QRS duration 204 ms

QT/QTc 512/553 ms

Loc:1 Option:0

P-R-T axes 18 -29 130

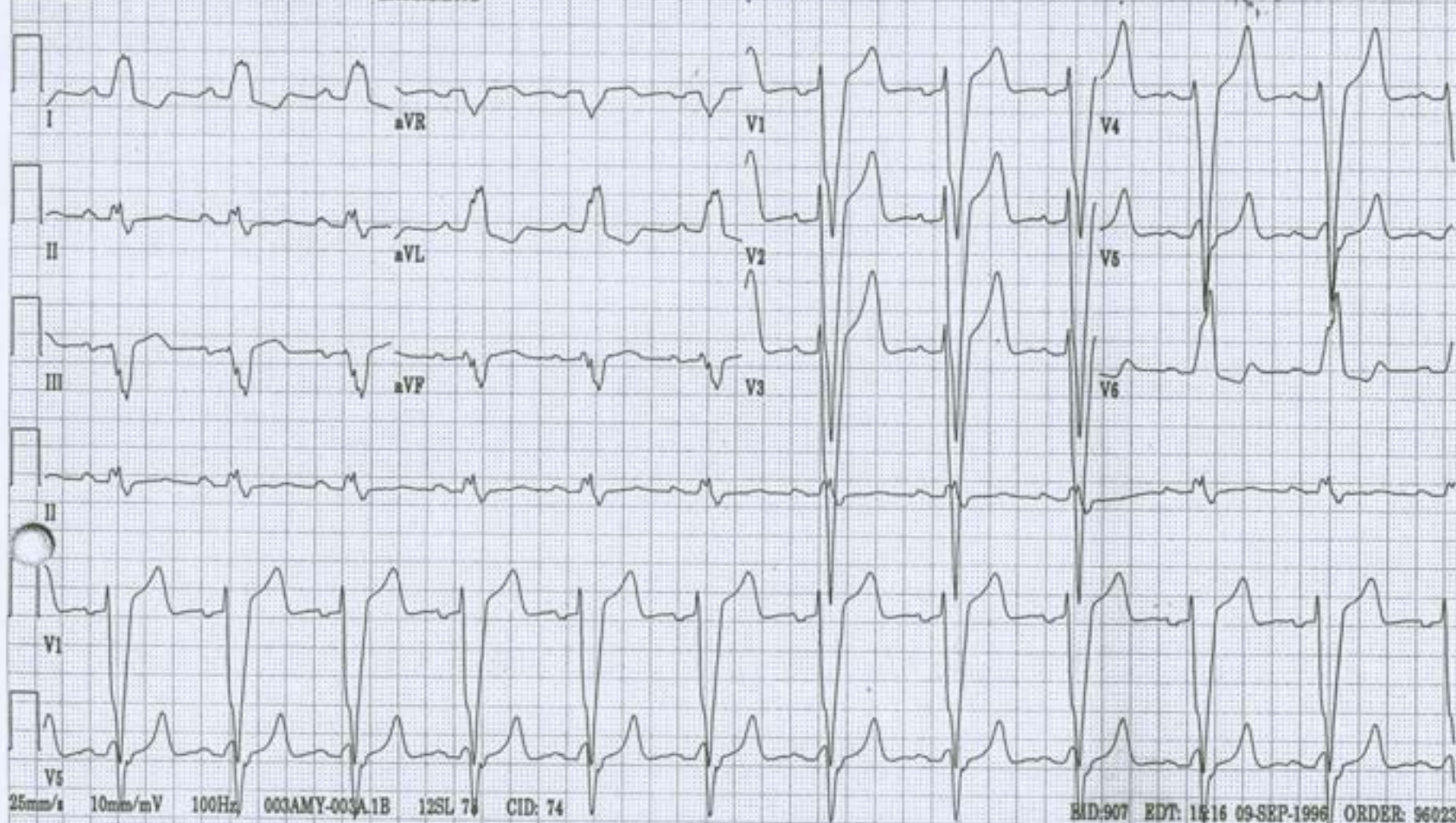
#7

Technician ID: 408

Unknown

Section:HPL

Location:E16B



31-AUG-1961 (45 yr)

Vent. rate 70 BPM

Male Unknown

PR interval 180 ms

70in 205lb

QRS duration 204 ms

QT/QTc 512/553 ms

Loc:1 Option:0

P-R-T axes 18 -29 130

LEFT BUNDLE BRANCH BLOCK (LBBB)

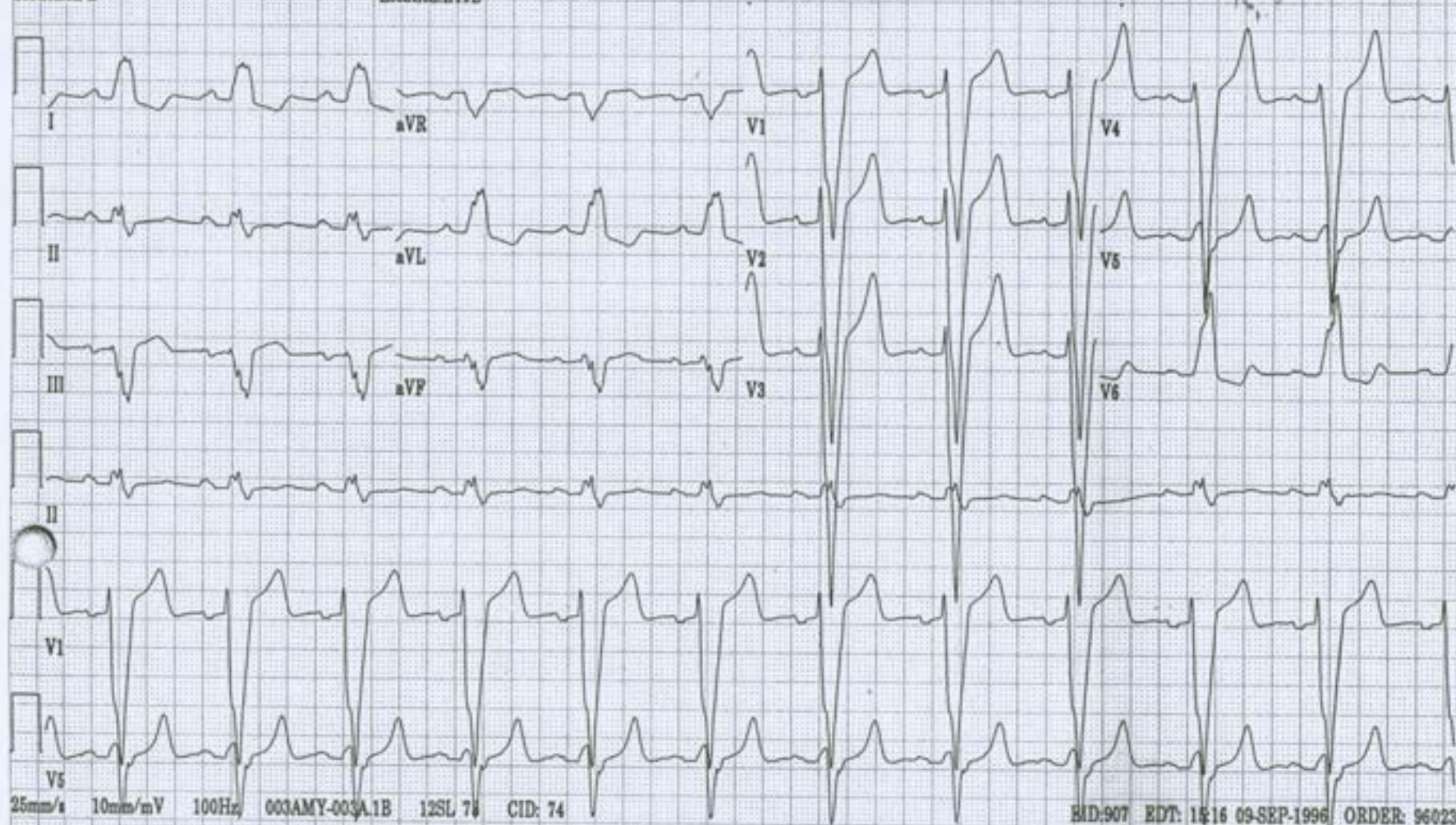
CRITERIA: QRS DURATION GREATER THAN 124 msec.
NOTCHED QRS SEEN IN LEAD I, V5 AND V6.

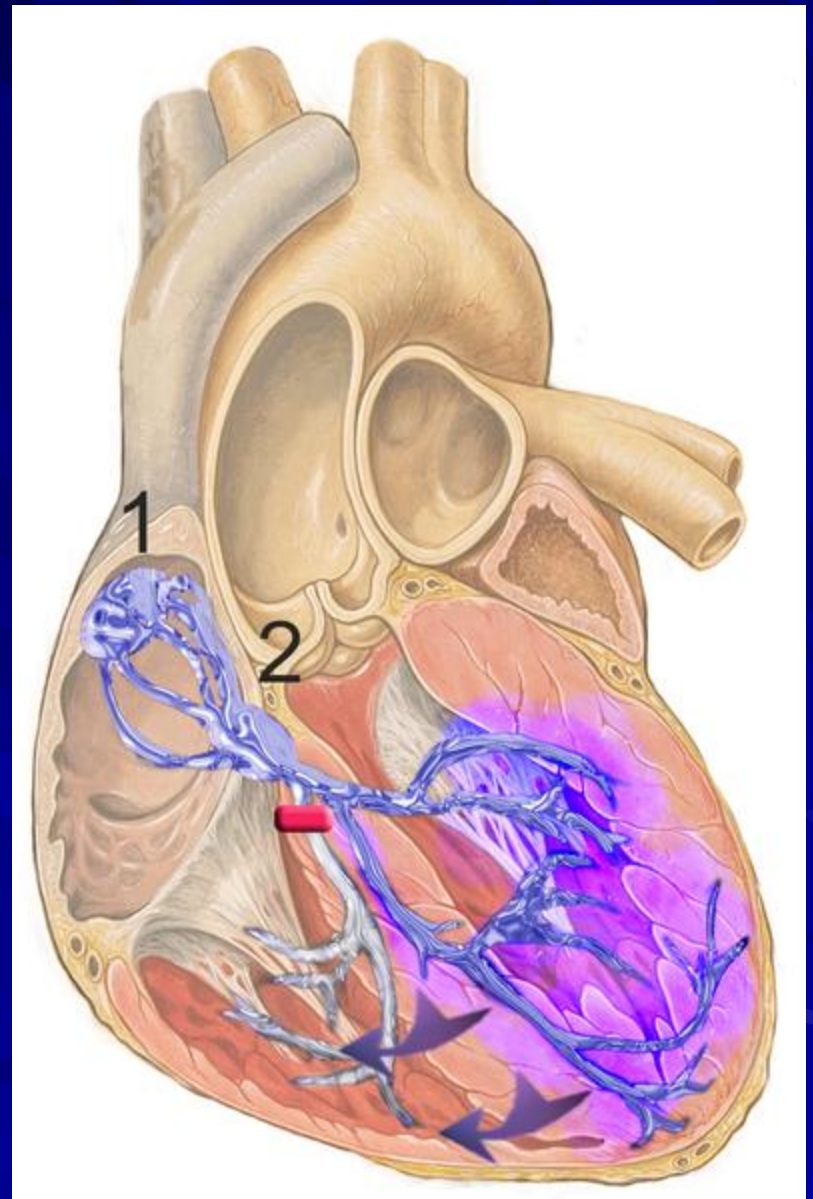
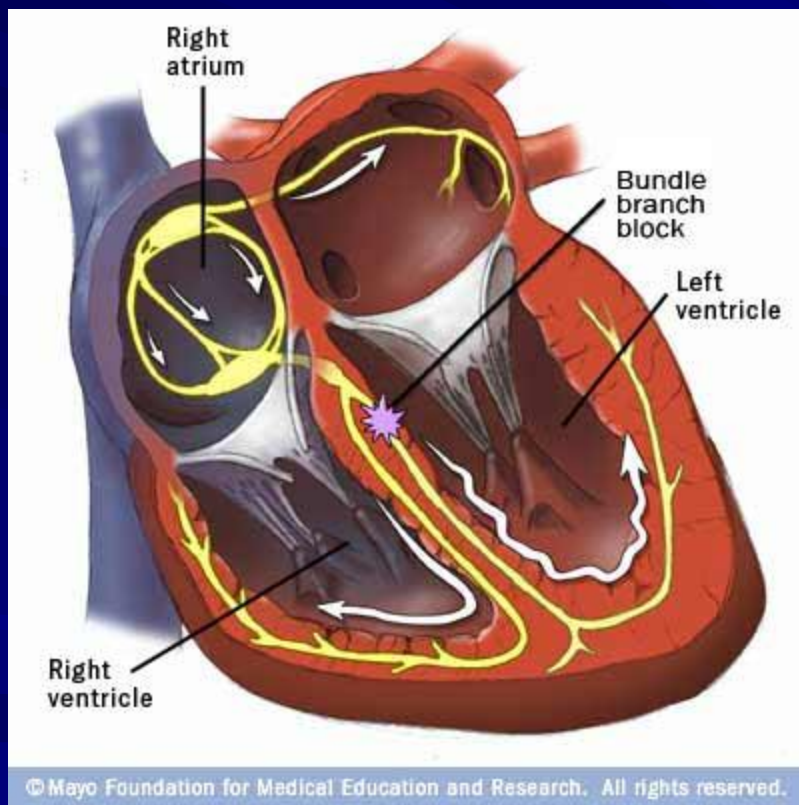
Technician ID: 408

Unknown

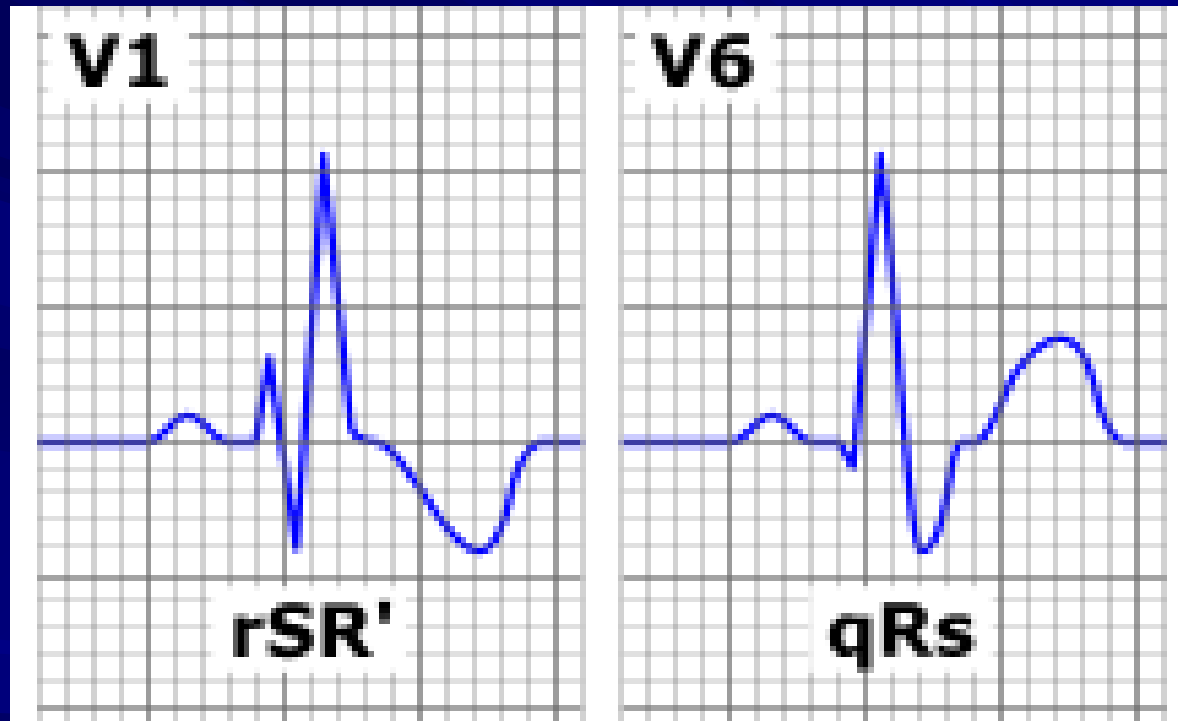
Section:HPL

Location:E16B

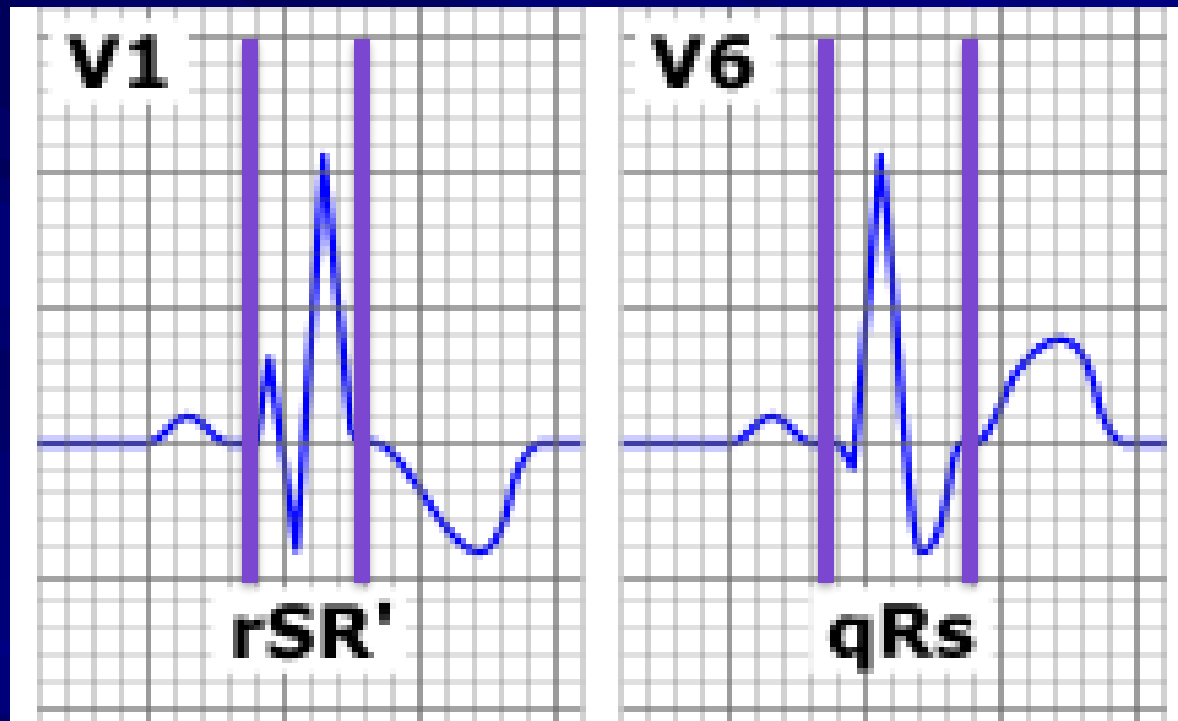




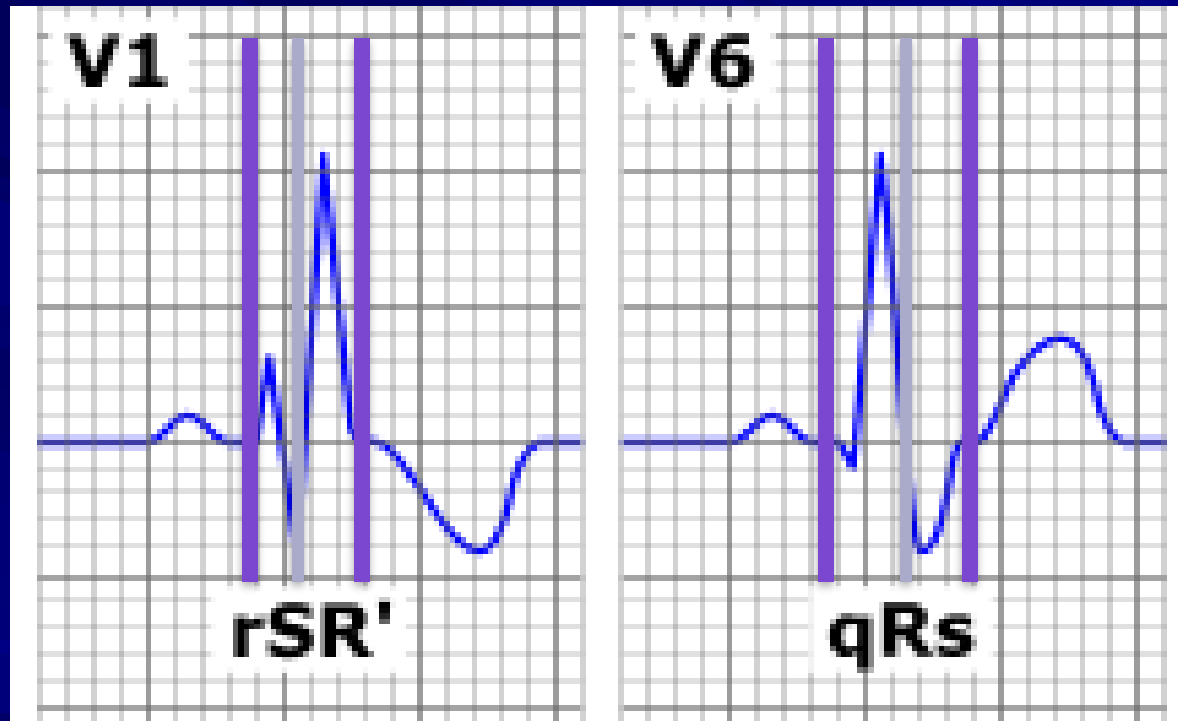
Determine direction of Current in the late (2nd half) of the QRS Complex



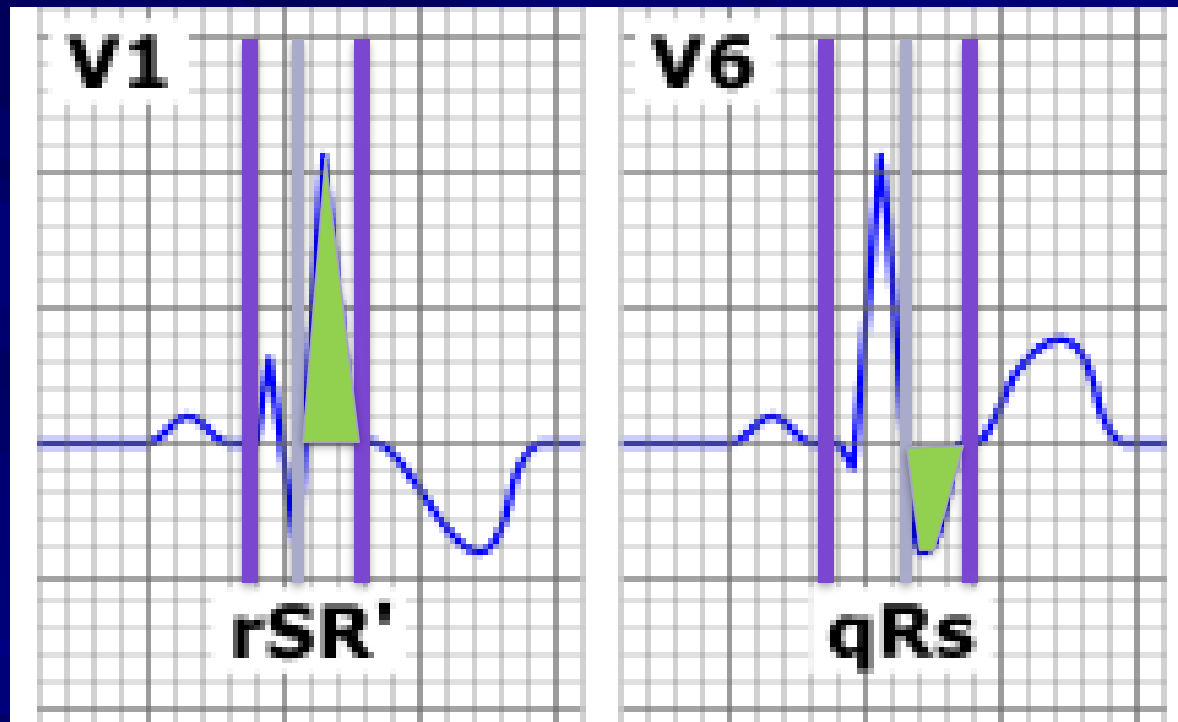
Determine direction of Current in the late (2nd half) of the QRS Complex



Determine direction of Current in the late (2nd half) of the QRS Complex



Determine direction of Current in the late (2nd half) of the QRS Complex



V



1



NSIVCD

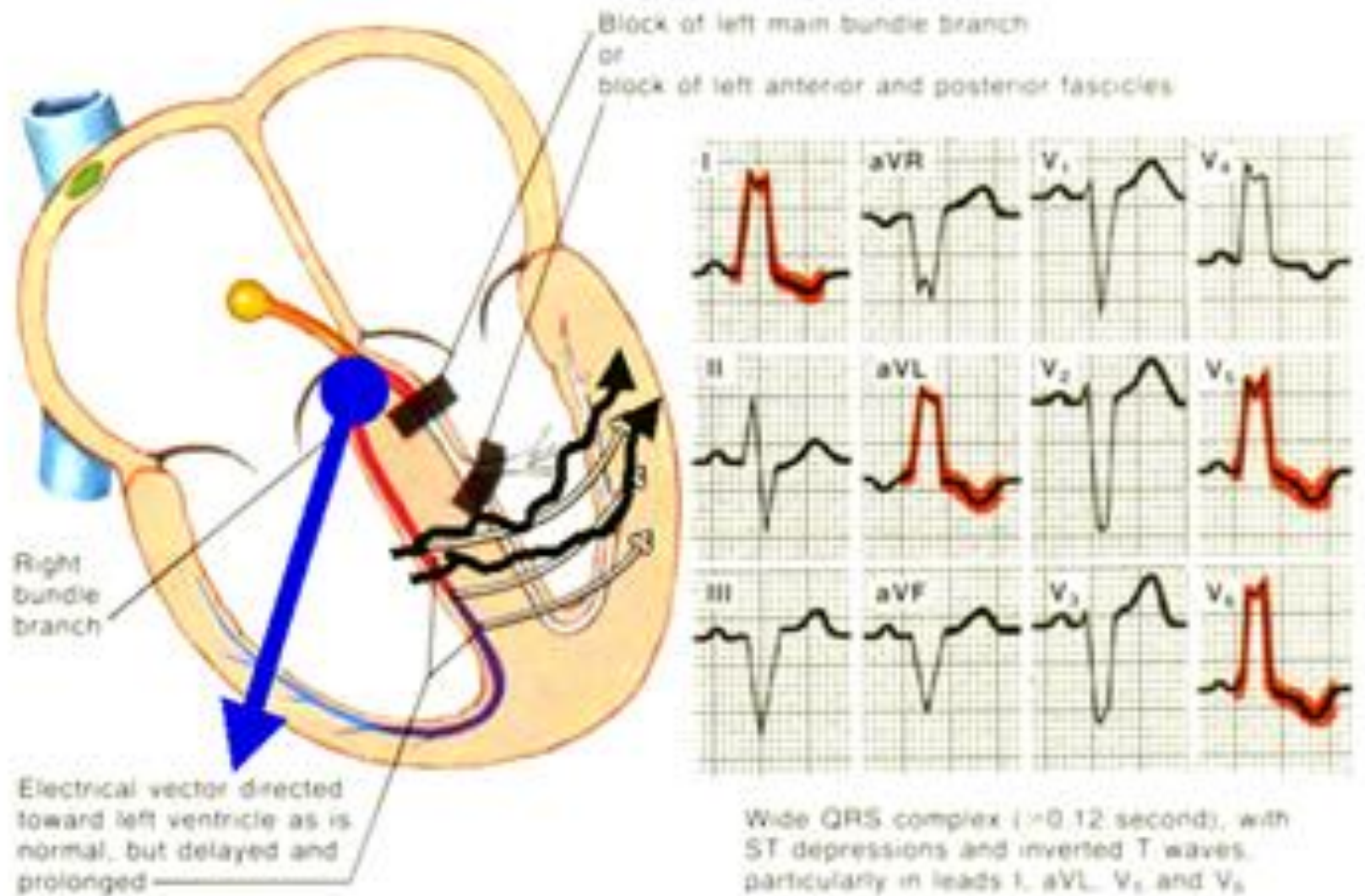
RBBBB

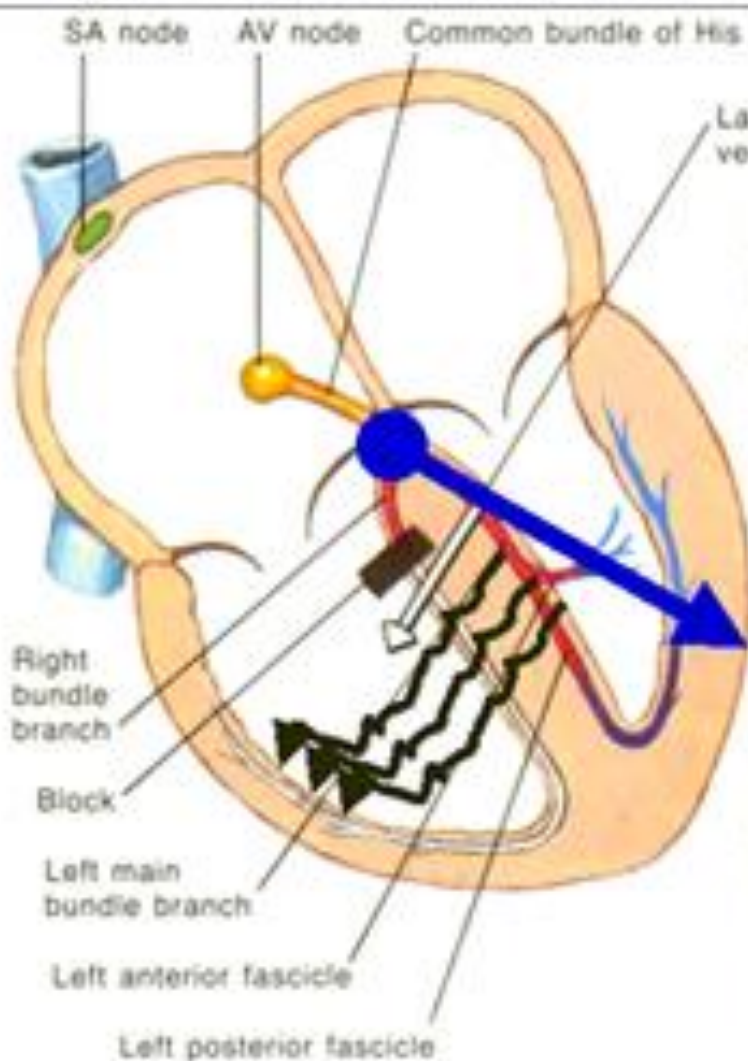
LBBBB

NSIVC

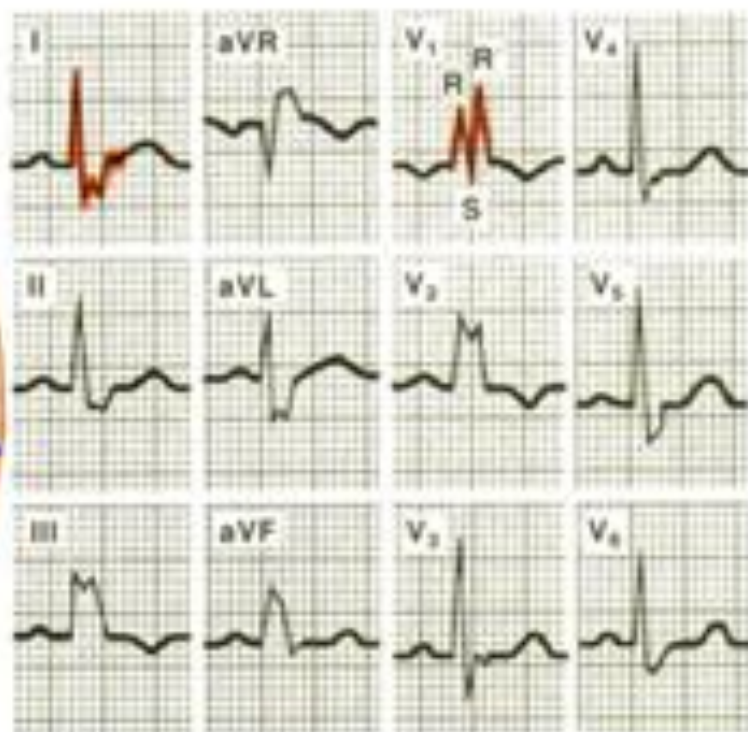
D







Late abnormal electrical vector bypasses block



Total QRS complex prolonged (≥ 0.12 second).
Terminal broad S wave in lead I. RSR' complex in lead V₁.

Bundle Branch Block

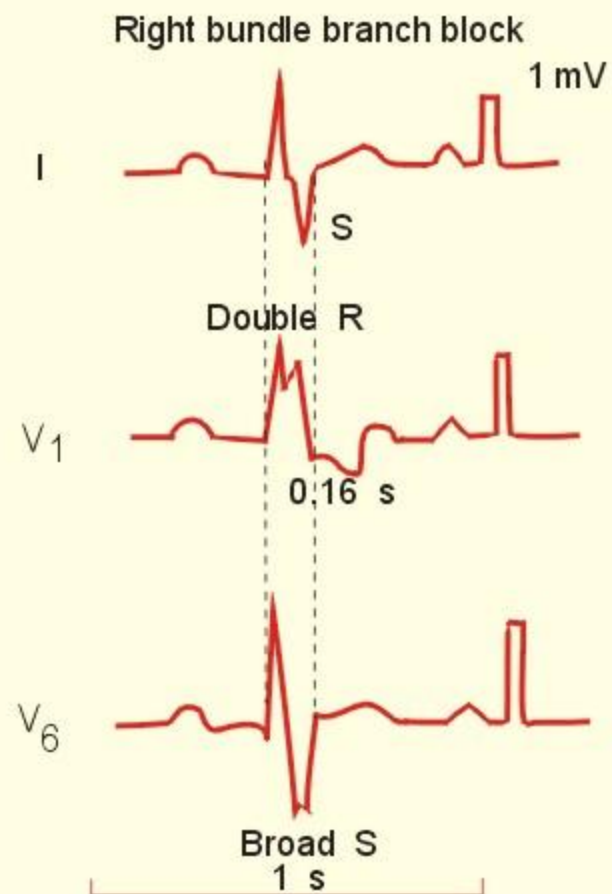
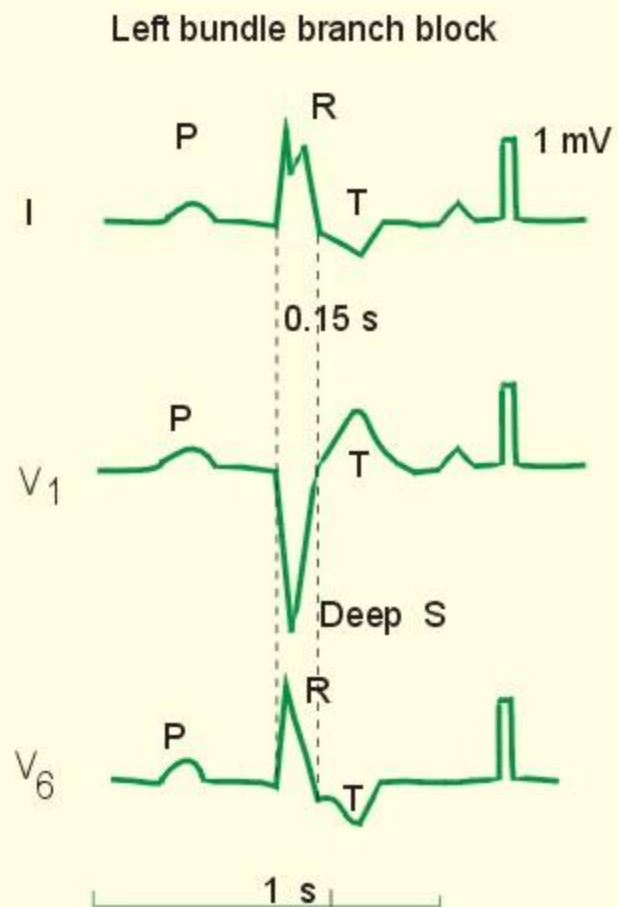


Fig. 11-13

V



1



NSIVCD

RB B B B

L B B B B

NSIVC

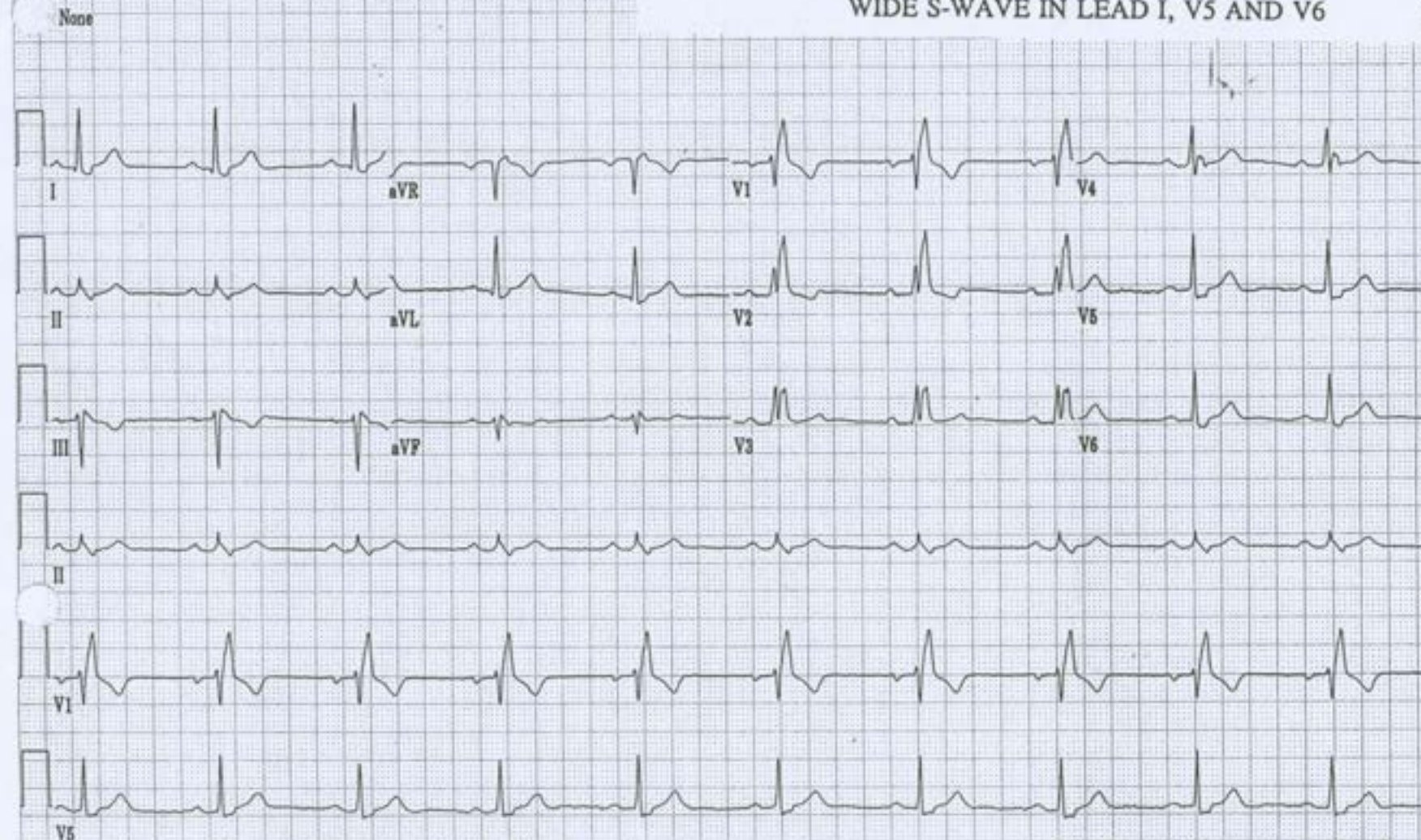
D

55 yr		Vent. rate	59	BPM
Male	Hispanic	PR interval	184	ms
70in	195lb	QRS duration	144	ms
		QT/QTc	424/420	ms
Loc:13		P-R-T axes	32 -18	2

Technician ID: 135

RIGHT BUNDLE BRANCH BLOCK (RBBB)

CRITERIA: QRS DURATION GREATER THAN 124 msec.
RSR' IN V1
WIDE S-WAVE IN LEAD I, V5 AND V6



05-NOV-1926 (69 yr)

Male Caucasian

70in 200lb

Room:04195

Loc:2 Option:0

Vent. rate

101 BPM

PR interval

164 ms

QRS duration

92 ms

QT/QTc

328/425 ms

P-R-T axes

45 55 -141

08-SEP-1996 20:25

MAYO CLINIC-STMA

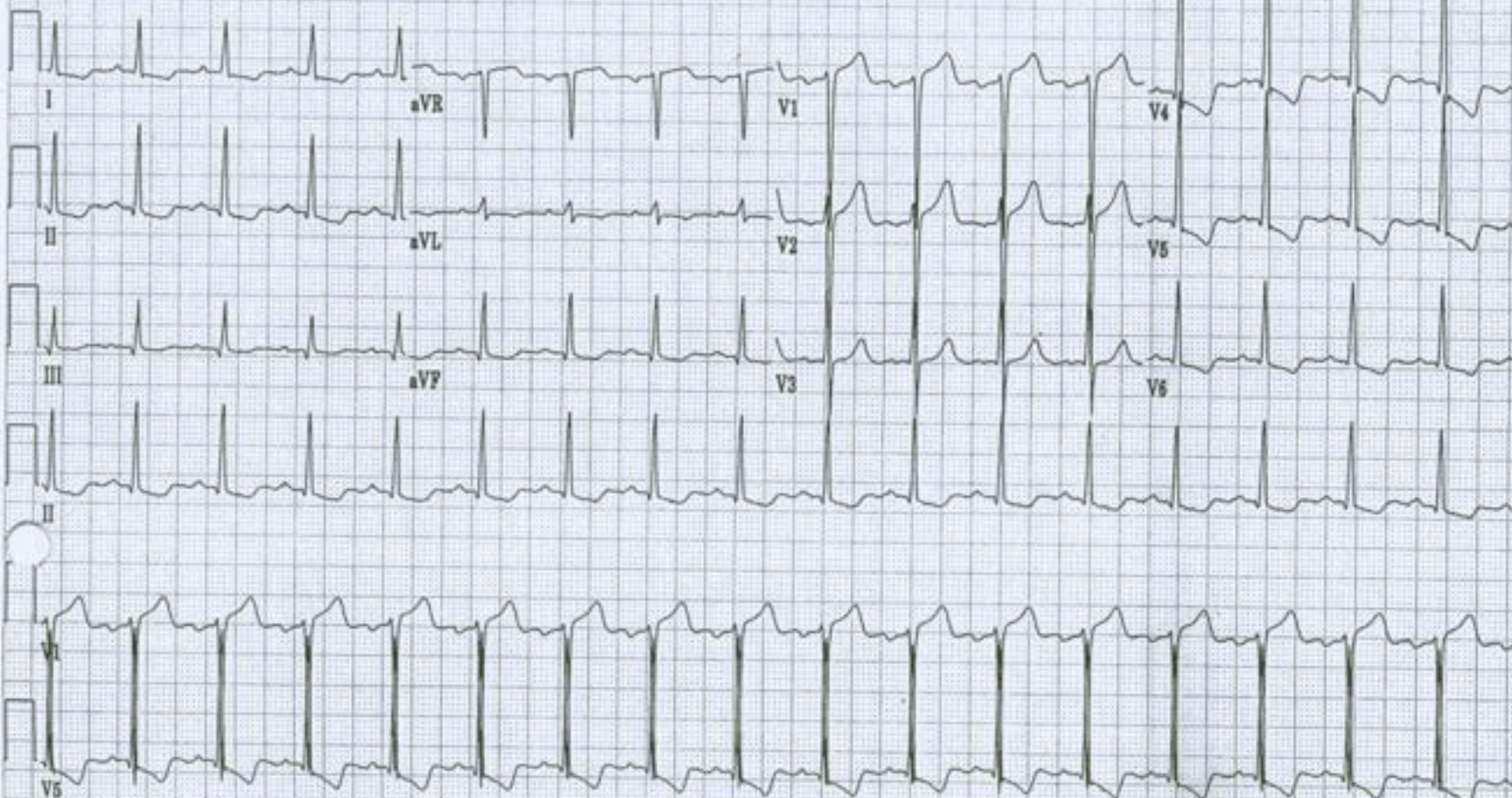
ROUTINE RETRIEVAL

#8

Technician ID: 446

Section:

Location:



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 78 CID: 71

EID:910 EDT: 00:42 09-SEP-1996 ORDER: 96022965

05-NOV-1926 (69 yr)

Male Caucasian

70in 200lb

Room: 04195

Loc: 2 Option: 0

Vent. rate

101 BPM

PR interval

164 ms

QRS duration

92 ms

QT/QTc

328/425 ms

P-R-T axes

45 55 -141

08-SEP-1996 20:25

MAYO CLINIC-STMA

ROUTINE RETRIEVAL

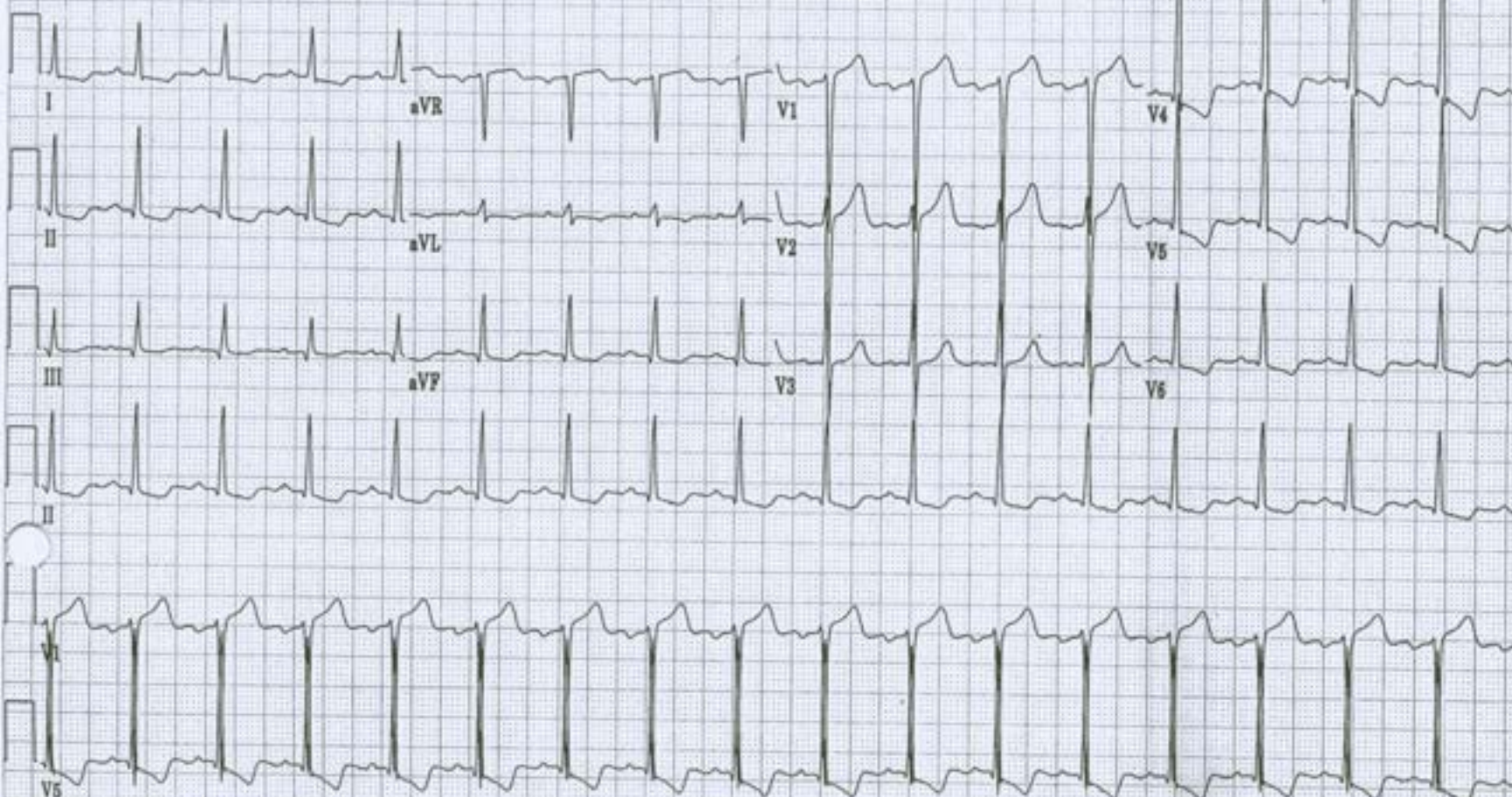
LEFT VENTRICULAR HYPERTROPHY (LVH)

CRITERIA: 1. AMPLITUDE IN V1 AND V5 SHOULD TOTAL AT LEAST 35 mm.
2. AVL AMPLITUDE GREATER THAN 13 mm BUT WITHOUT LAD.
3. ANY LIMB LEAD (R OR S) AMPLITUDE GREATER THAN 20 mm.
4. AMPLITUDE IN V1 OR V2 ALONE GREATER THAN 30 mm.
NOTE: IF PERSON UNDER 30 YRS. OLD VOLTAGE MUST BE 45 mm IN V1 AND V5.

Technician ID: 446

Section:

Location:



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 78 CID: 71

EID:910 EDT: 00:42 09-SEP-1996 ORDER: 96022965

LVH with Strain

- * LVH criteria:

- * $S(V1 \text{ or } V2) + R(V5 \text{ or } V6) \geq 35\text{mm}$
- * Largest $(R + S)$ in precordial leads $\geq 45\text{mm}$
- * R wave in aVL ≥ 11

- * Strain:

- * Depressed concave downward ST segment with a flipped, asymmetric T wave in V4 to V6
- * Reciprocal changes in right precordial leads
 - * ST elevation with upward concavity and an upright asymmetric T wave

The strain pattern is greatest in the lead with the tallest QRS

ESTES Criteria for LVH

diagnostic ≥ 5 points; probable 4 points

+ECG Criteria	Points
<u>Voltage Criteria (any of):</u> a.R or S in limb leads ≥ 20 mm b.S in V1 or V2 ≥ 30 mm c.R in V5 or V6 ≥ 30 mm	3 points
<u>ST-T Abnormalities:</u> Without digitalis	3 points
With digitalis	1 point
<u>Left Atrial Enlargement in V1</u>	3 points
<u>Left axis deviation</u>	2 points
<u>QRS duration 0.09 sec</u>	1 point
<u>Delayed intrinsicoid deflection in V5 or V6</u> (>0.05 sec)	1 point

RVH with Strain

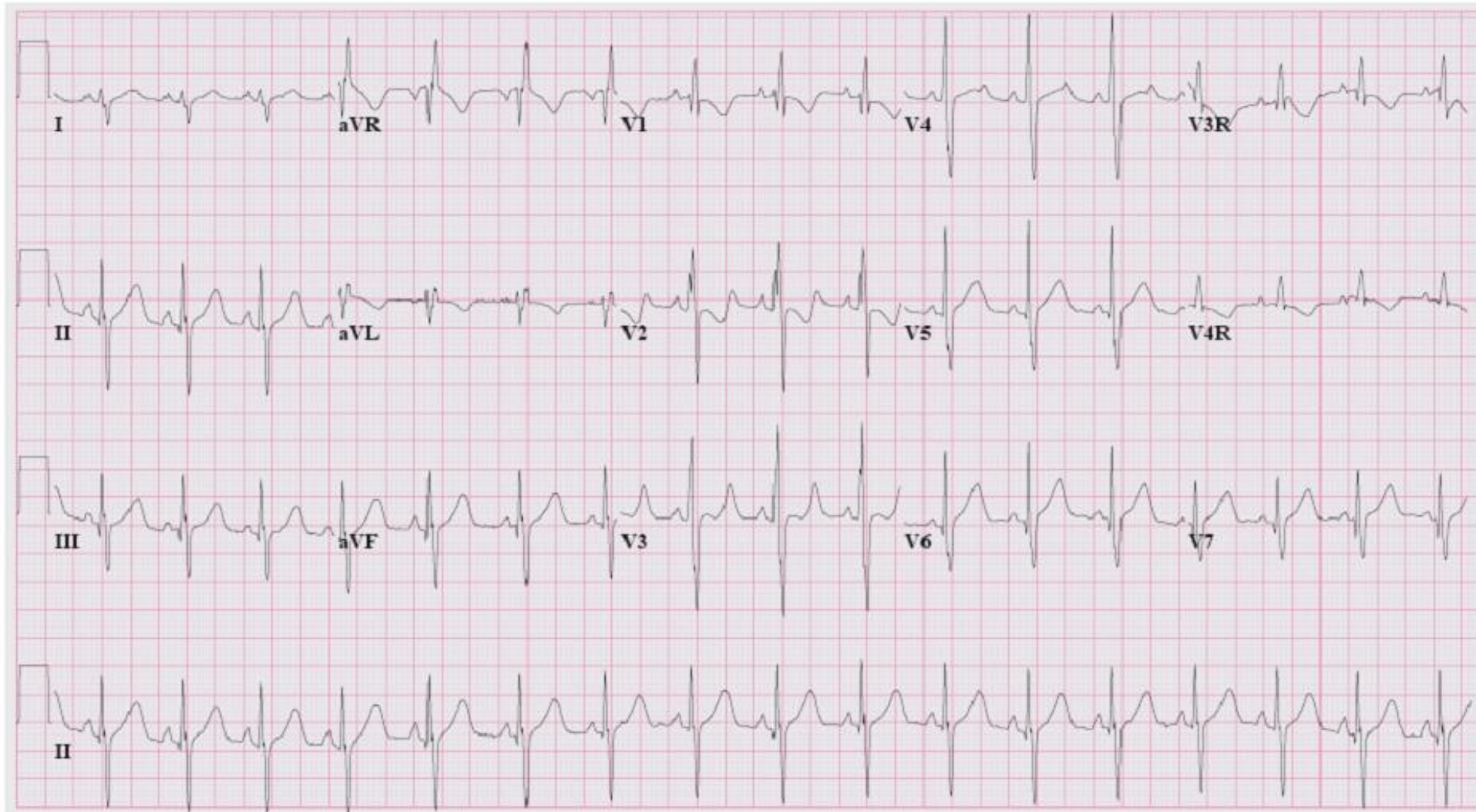
- RVH criteria:

- R:S ratio in V1 and V2 >1

- Strain

- Depressed concave downward ST segment with a flipped, asymmetric T wave





"P" Wave

- ✱ Left Atrial Enlargement

- ✱ ≥ 0.12 sec

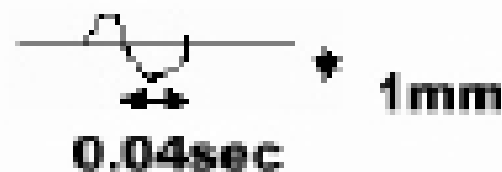
- ✱ If Biphasic

- ✱ second half wider than 0.04 sec or

- ✱ [width x depth] > 0.3

- ✱ D/Dx:

- ✱ HTN, Aortic or Mitral valve disease, restrictive cardiomyopathy, LV failure



Left = Long

07-FEB-1990 12:00

MAYO CLINIC-STMA ROUTINE RETRIEVAL

25-AUG-1939 (50 yr)

Vent. rate

72 BPM

Female

PR interval

188 ms

64in 152lb

QRS duration

84 ms

Room: 3116

QT/QTc

432/473 ms

Loc 2

P-R-T axes

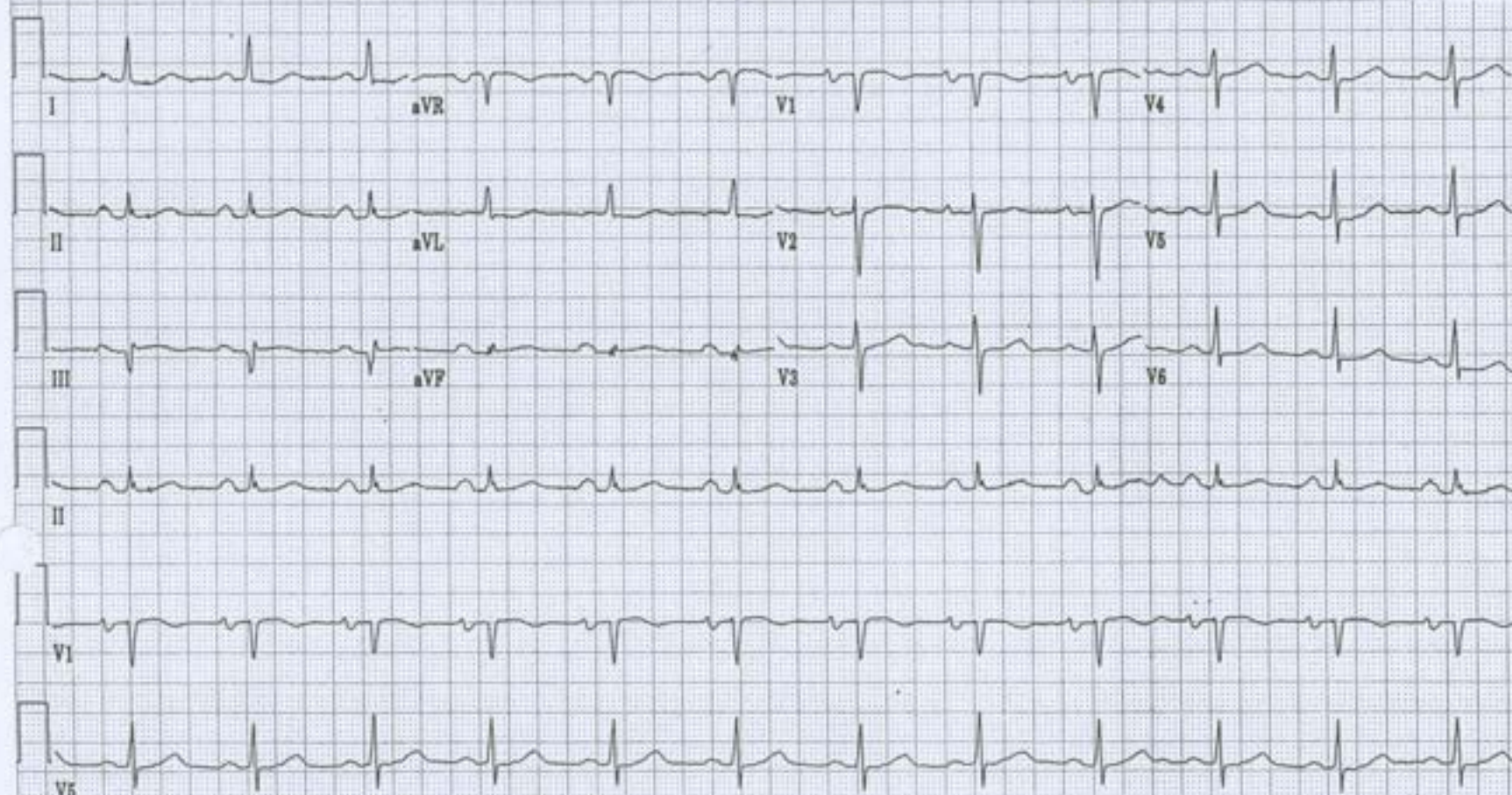
61 13 75

LEFT ATRIAL ENLARGEMENT (LAE)

CRITERIA: P-WAVE DURATION GREATER THAN .12 SEC. (3 SMALL BOXES)
BIPHASIC P-WAVE. NEGATIVE AMPLITUDE OF P-WAVE IN V1
IS 1 mm AND DURATION IS .04 SEC.

1x Unknown

Section: ST M



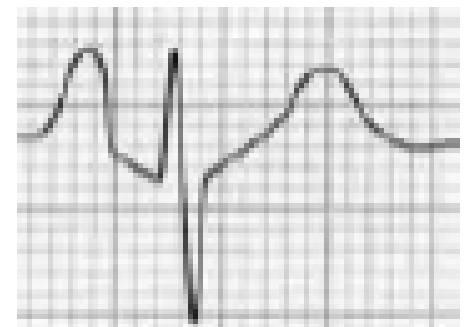
25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 74 CID: 12

EID:1067 EDT: ORDER:

"P" Wave

- * Right Atrial Enlargement
 - * $>2.5\text{mm}$ (II, III, aVF)
 - * If Biphasic
 - * first half is taller in V_1 than V_6
- * D/Dx:
 - * COPD, PE, pulmonary HTN, Mitral/Tricuspid or Pulmonary Valve disease

Right = Height



25-JAN-1990 06:57

MAYO CLINIC-STMA ROUTINE RETRIEVAL

09-JUL-1908 (81 yr)

Vent. rate 86 BPM

Male

PR interval 180 ms

701s 1196

QRS duration 92 ms

Room:4279

QT/QTc 332/397 ms

Loc:2

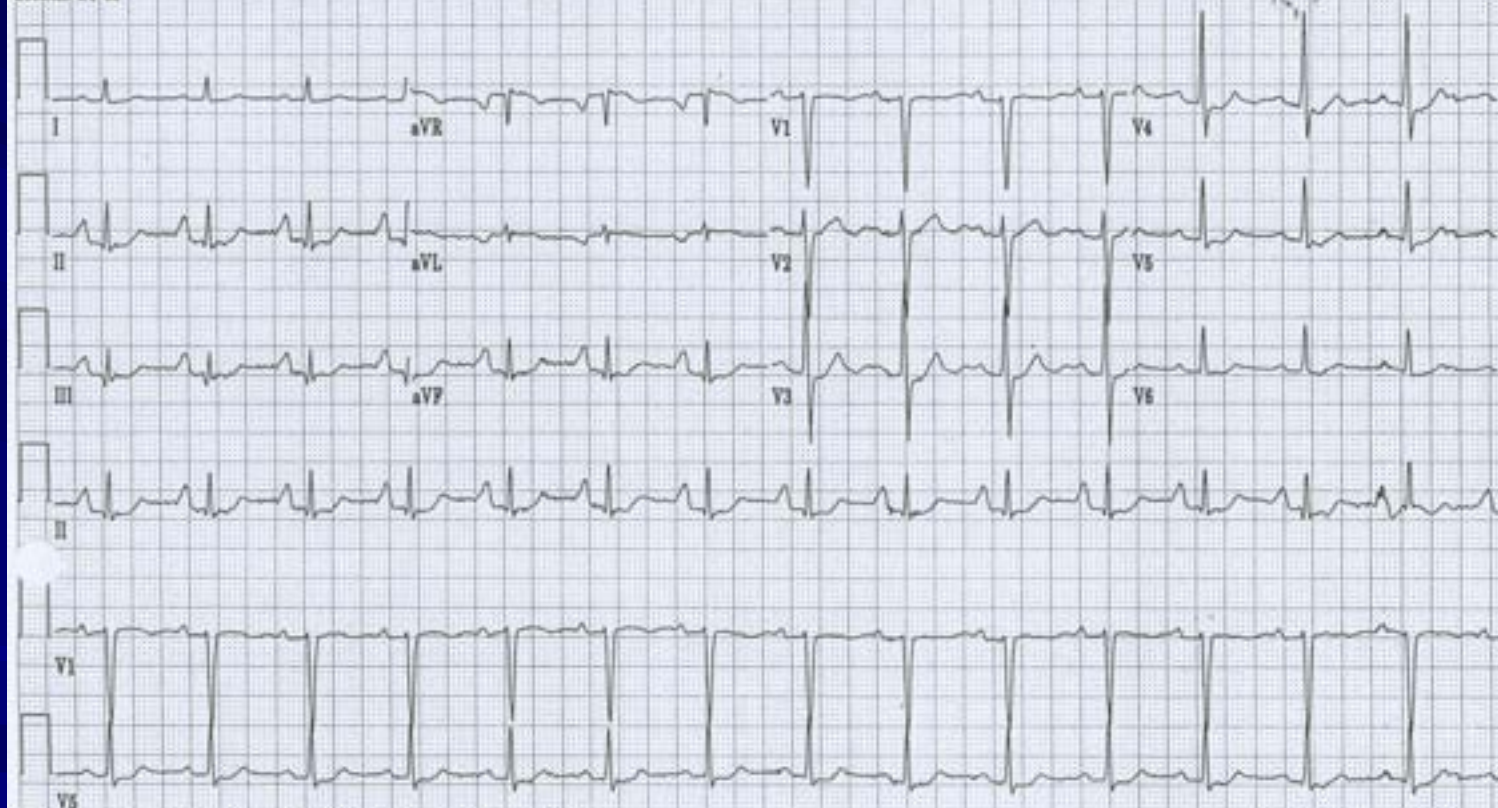
P-R-T axes 82 53 65

RIGHT ATRIAL ENLARGEMENT (RAE)

CRITERIA: HIGH PEAKED P-WAVE. AMPLITUDE IS GREATER THAN 2.5 mm IN LEADS II, III, AVF. AMPLITUDE GREATER THAN 1.5 mm IN V1 OR V2.

Unknown

Section: ST M



25mm/s 10mm/mV 100Hz 003AMY-003A.13 12SL 74 CID: 10

EID-902 EDT: ORDER:

23-AUG-1996 15:40

MAYO CLINIC-STMA ROUTINE RETRIEVAL

13-AUG-1943 (53 yr)

Male Unknown

77in 253lb

Room:02256

Loc:2 Option:0

Vent. rate 90 BPM

PR interval 140 ms

QRS duration 100 ms

QT/QTc 336/411 ms

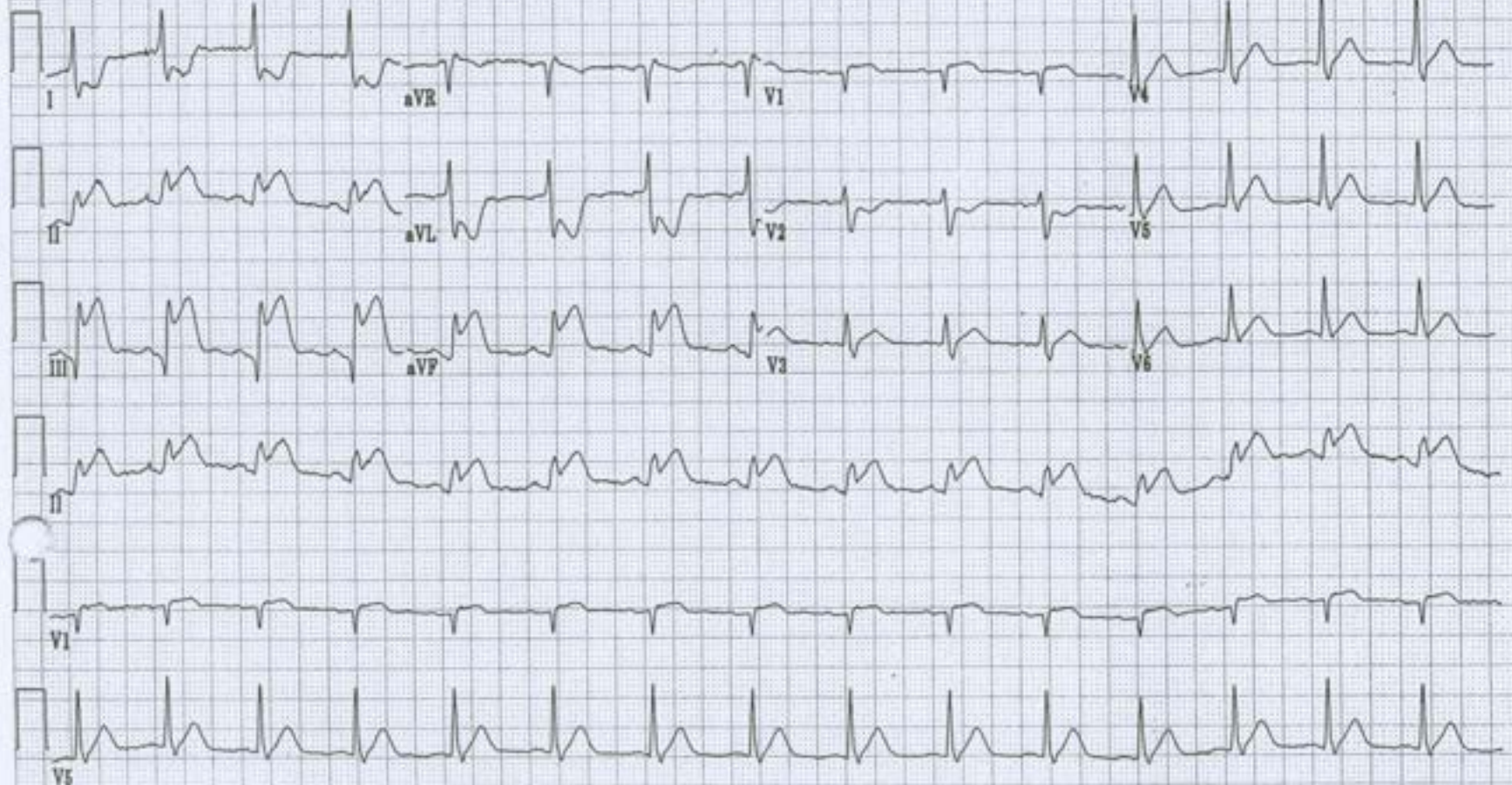
P-R-T axes 80 76 112

Technician ID: 456

#9

Section:

Location:



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 78 CID: 71

EID:908 EDT: 15:51 23-AUG-1996 ORDER: 96022162

Page 1 of 1

23-AUG-1996 15:40

MAYO CLINIC-STMA ROUTINE RETRIEVAL

13-AUG-1943 (53 yr)

Male Unknown

77in 253lb

Room:02256

Loc:2 Option:0

Vent. rate 90 BPM

PR interval 140 ms

QRS duration 100 ms

QT/QTc 336/411 ms

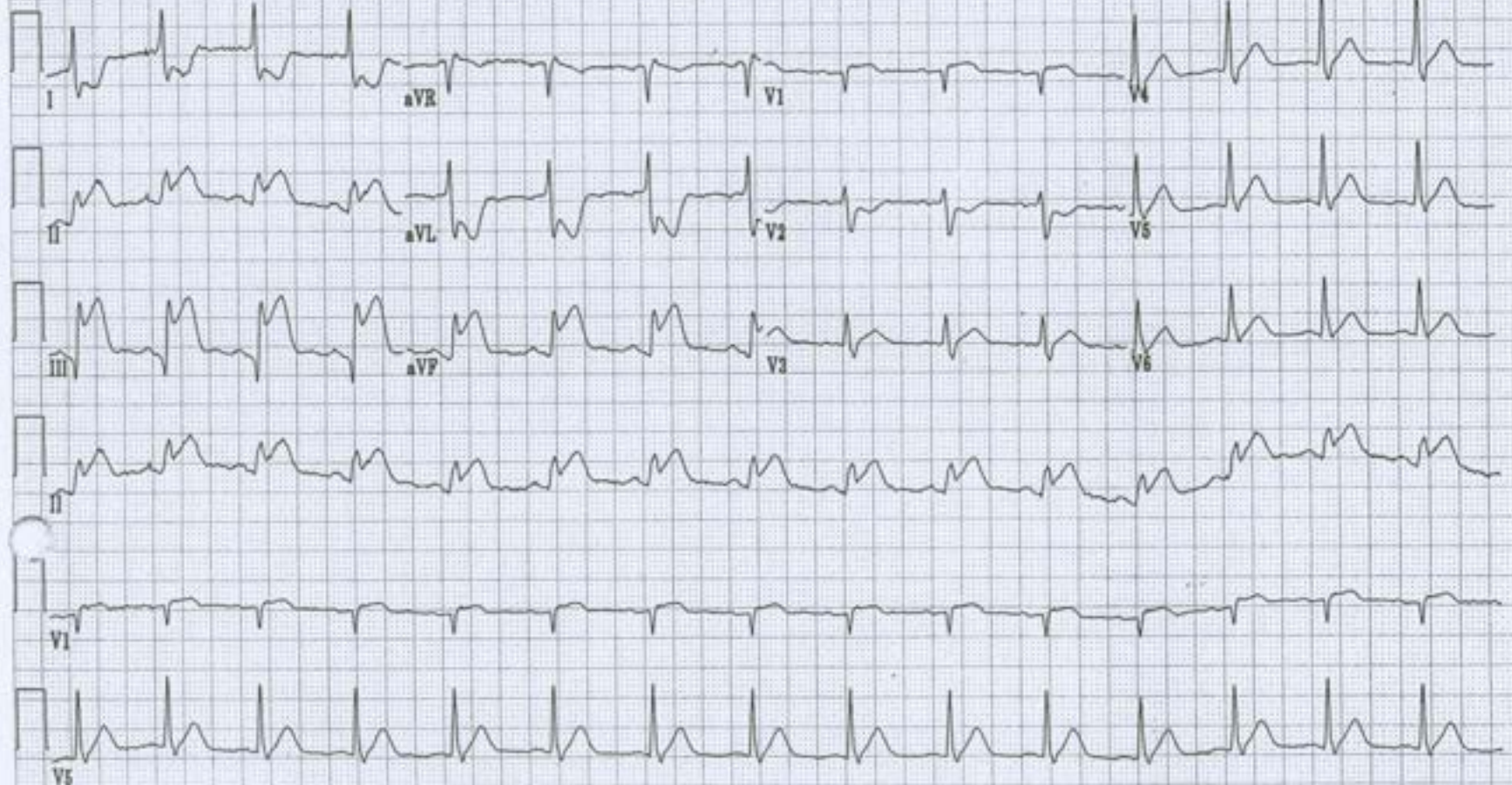
P-R-T axes 80 76 112

Technician ID: 456

ST ELEVATION IN INFERIOR LEADS

Section:

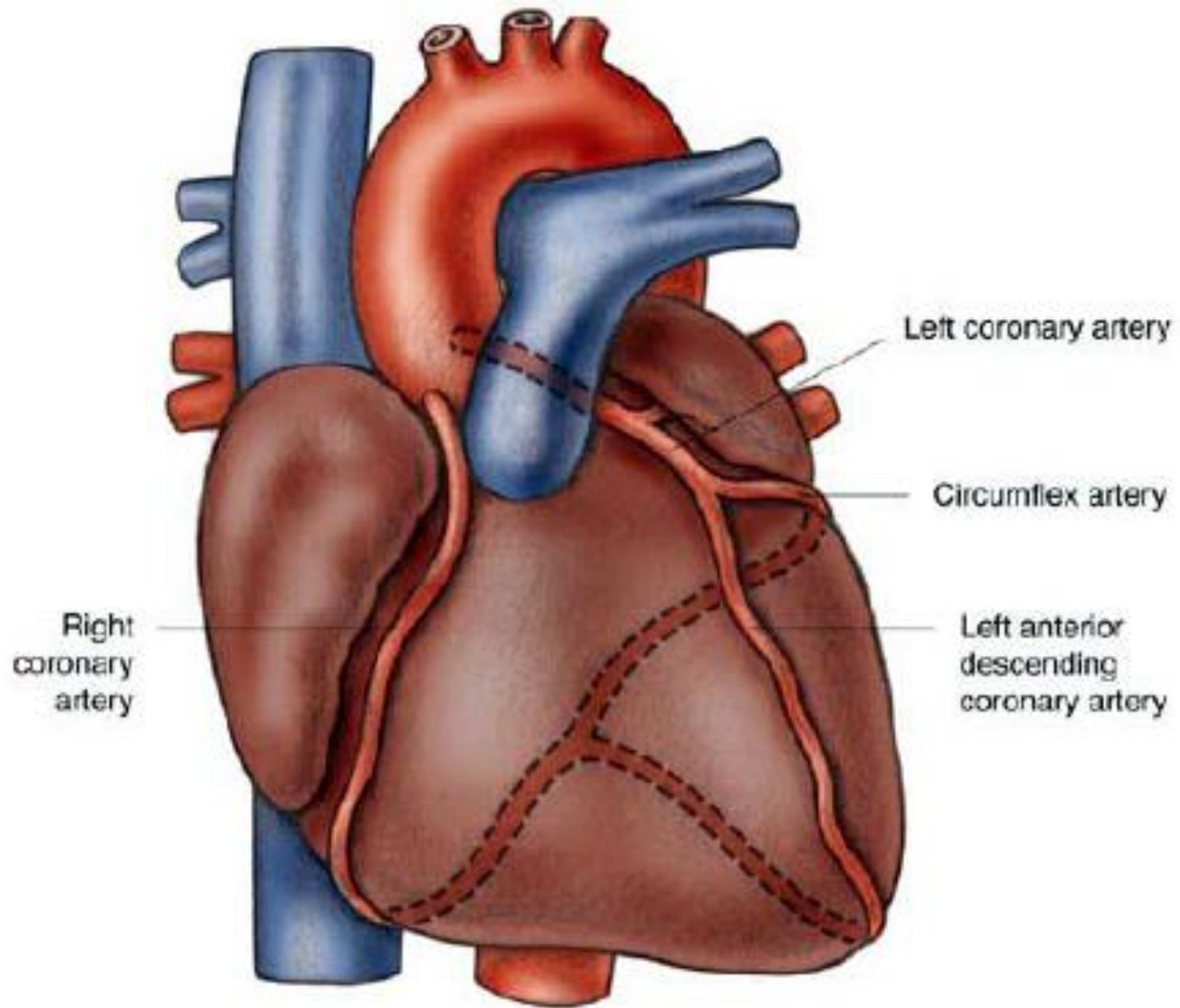
Location:



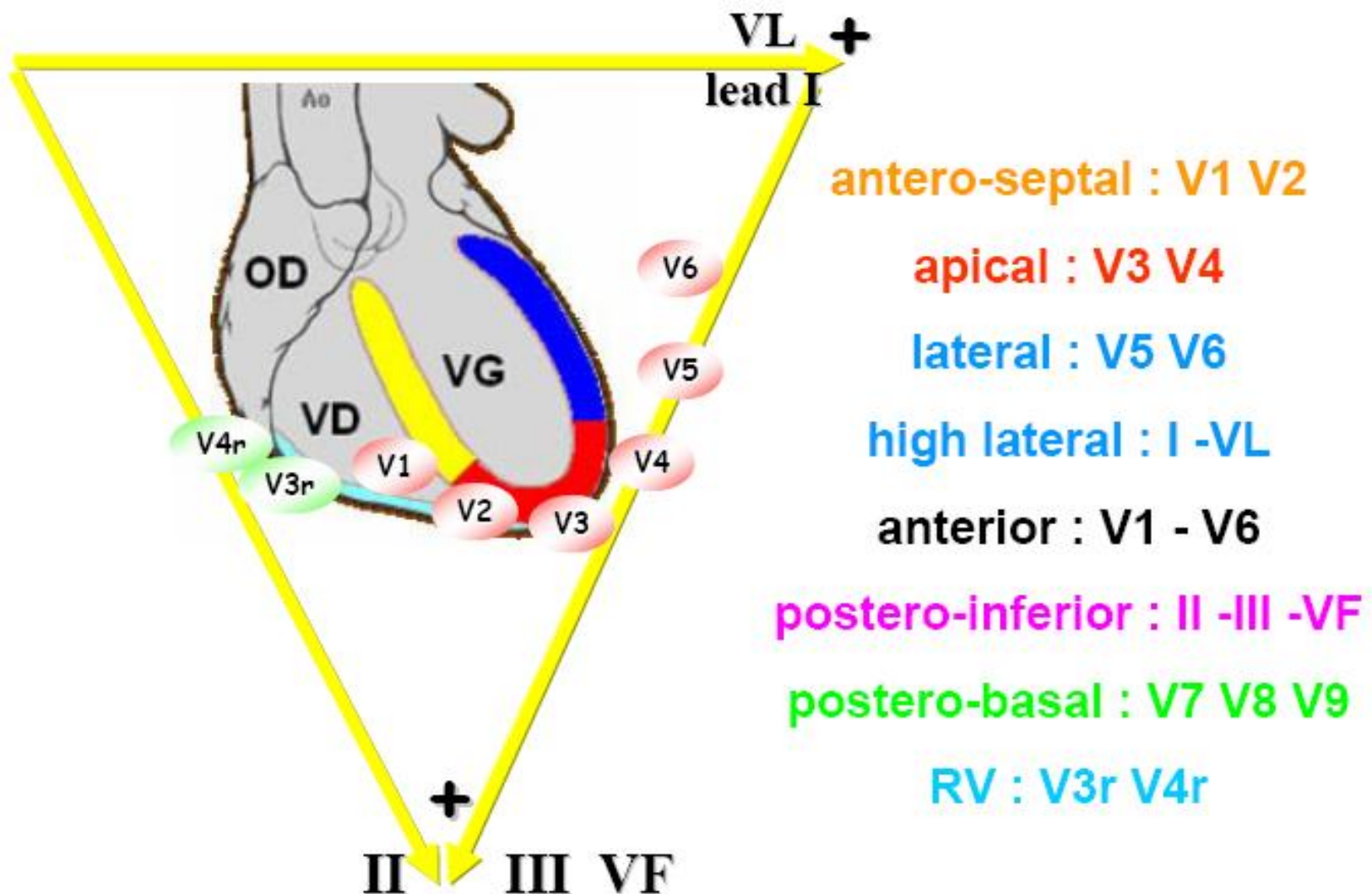
25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 78 CID: 71

EID:908 EDT: 15:51 23-AUG-1996 ORDER: 96022162

Page 1 of 1



Localization of ischemic changes



Arrangement of Leads on the EKG

I	aVR	V ₁	V ₄
II	aVL	V ₂	V ₅
III	aVF	V ₃	V ₆

Anatomic Groups (Septum)

I Lateral	aVR None	V ₁ Septal	V ₄ Anterior
II Inferior	aVL Lateral	V ₂ Septal	V ₅ Lateral
III Inferior	aVF Inferior	V ₃ Anterior	V ₆ Lateral

Anatomic Groups (Anterior Wall)

I Lateral	aVR None	V ₁ Septal	V ₄ Anterior
II Inferior	aVL Lateral	V ₂ Septal	V ₅ Lateral
III Inferior	aVF Inferior	V ₃ Anterior	V ₆ Lateral

Anatomic Groups (Lateral Wall)

I Lateral	aVR None	V₁ Septal	V₄ Anterior
II Inferior	aVL Lateral	V₂ Septal	V₅ Lateral
III Inferior	aVF Inferior	V₃ Anterior	V₆ Lateral

Anatomic Groups (Summary)

I Lateral	aVR None	V ₁ Septal	V ₄ Anterior
II Inferior	aVL Lateral	V ₂ Septal	V ₅ Lateral
III Inferior	aVF Inferior	V ₃ Anterior	V ₆ Lateral

21-JAN-1988 22:40

MAYO CLINICS-ER ROUTINE ECG

MAY-1932 (55 yr)

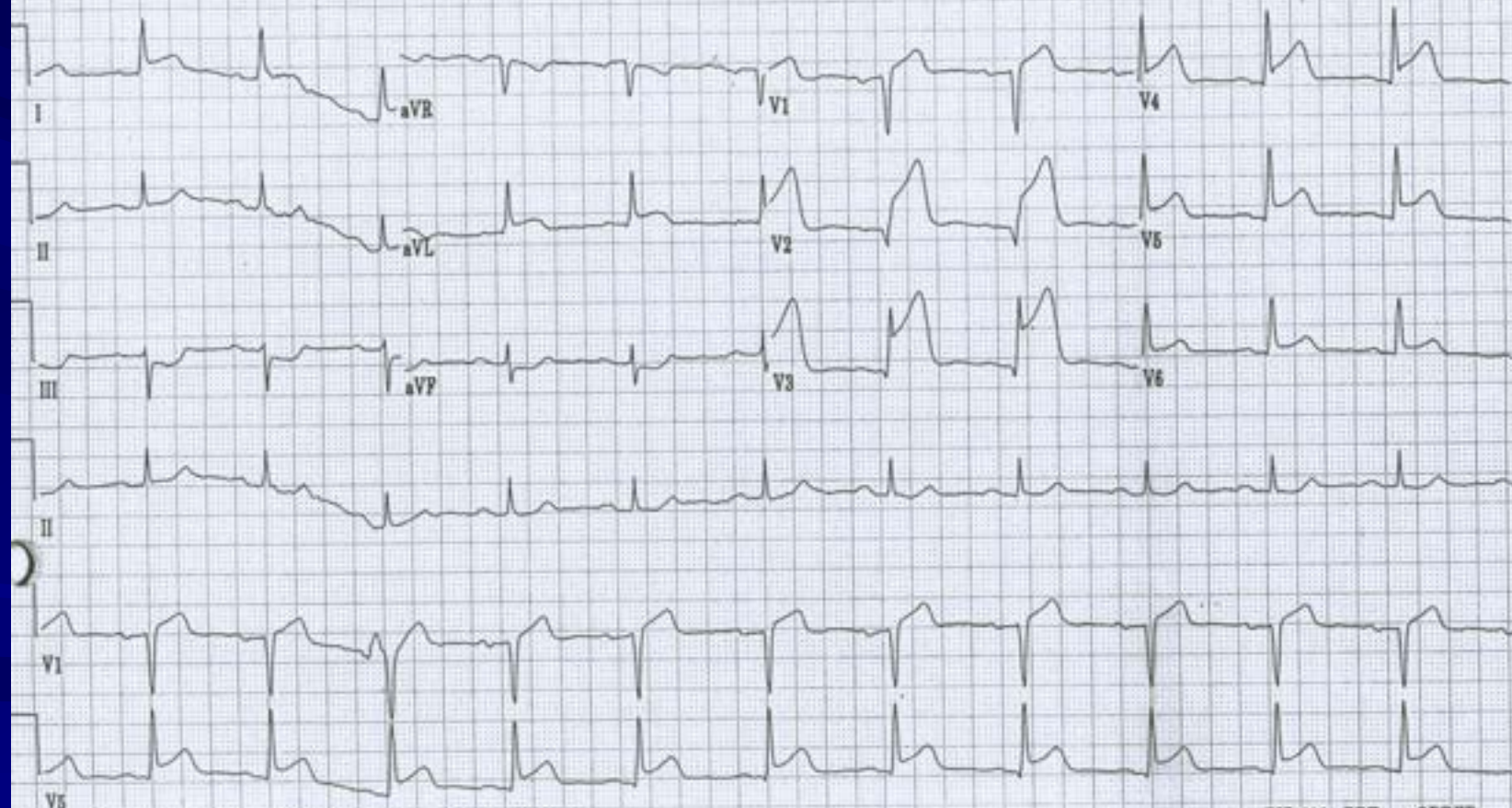
le
in 185lb
om:83
c:3

Vent. rate	71	BPM
PR interval	209	ms
QRS duration	72	ms
QT/QTc	362/393	ms
P-R-T axes	54 -1 7	

ST ELEVATION IN ANTERIOR LEADS

Location: ST M

Location: ER



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 0 CID: 13

EID:902 EDT: ORDER:

Page 1 of 1

22-MAR-1990 12:25

MAYO CLINIC-A-1 ROUTINE RETRIEVAL

16-AUG-1960 (29 yr)

Male

70in 169lb

Loc:1

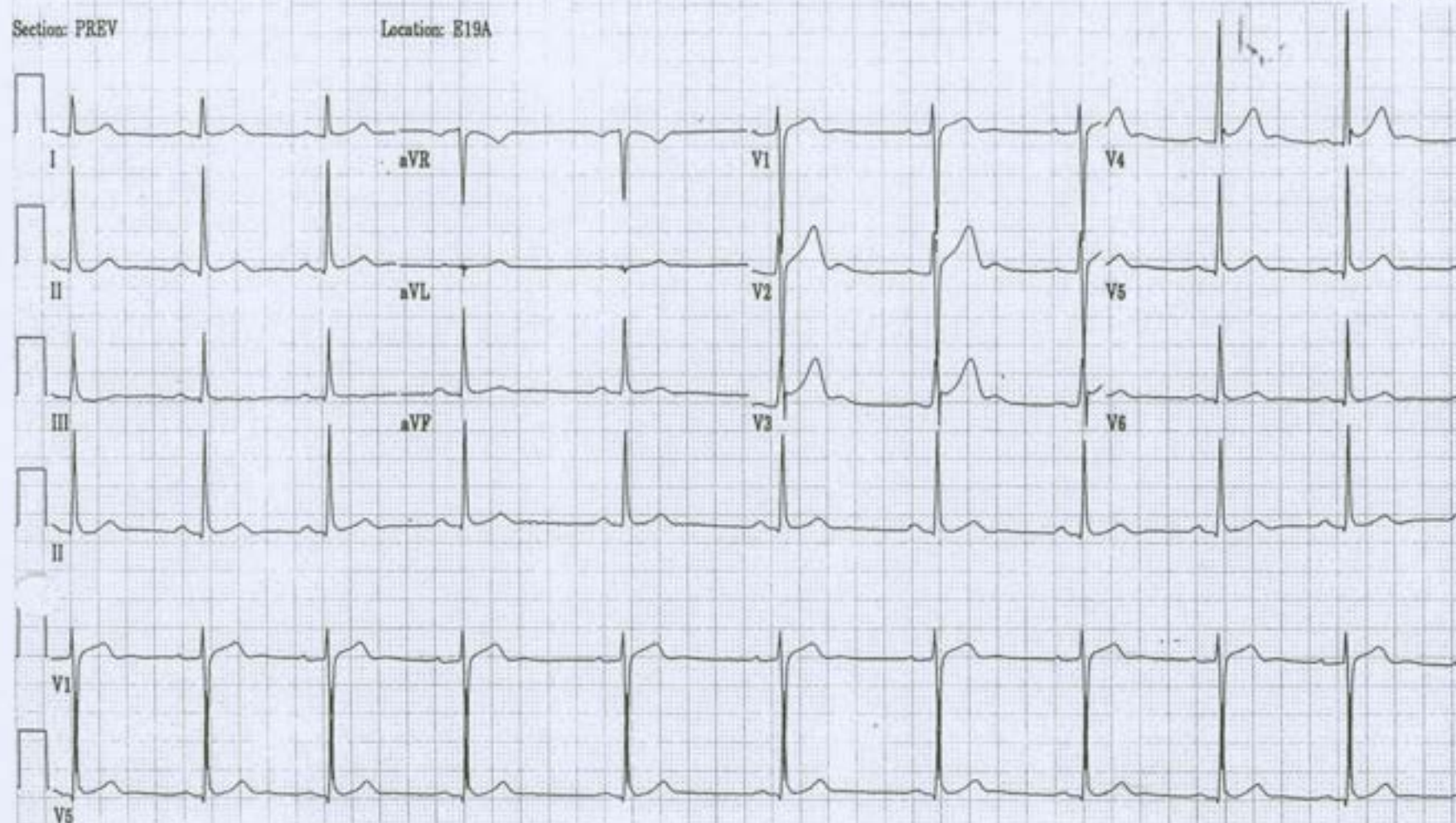
Vent. rate	59	BPM
PR interval	176	ms
QRS duration	92	ms
QT/QTc	388/384	ms
P-R-T axes	57 68	41

EARLY REPOLARIZATION

CRITERIA: SOME DEGREE OF ST ELEVATION IS PRESENT IN THE MAJORITY OF YOUNG HEALTHY INDIVIDUALS. MOST COMMONLY SEEN IN V2-V5. ALMOST NEVER IN V6.

Section: PREV

Location: E19A



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 74 CID: 71

EID:914 EDT: ORDER:

Page 1 of

12-JUL-1994 05:38

MAYO CLINIC-STMA ROUTINE RETRIEVAL

27-FEB-1923 (71 yr)

Male Caucasian

68in 104lb

Room:05118

Loc:2 Option:0

Vent. rate 85 BPM

PR interval 168 ms

QRS duration 88 ms

QT/QTc 348/414 ms

P-R-T axes 75 73 72

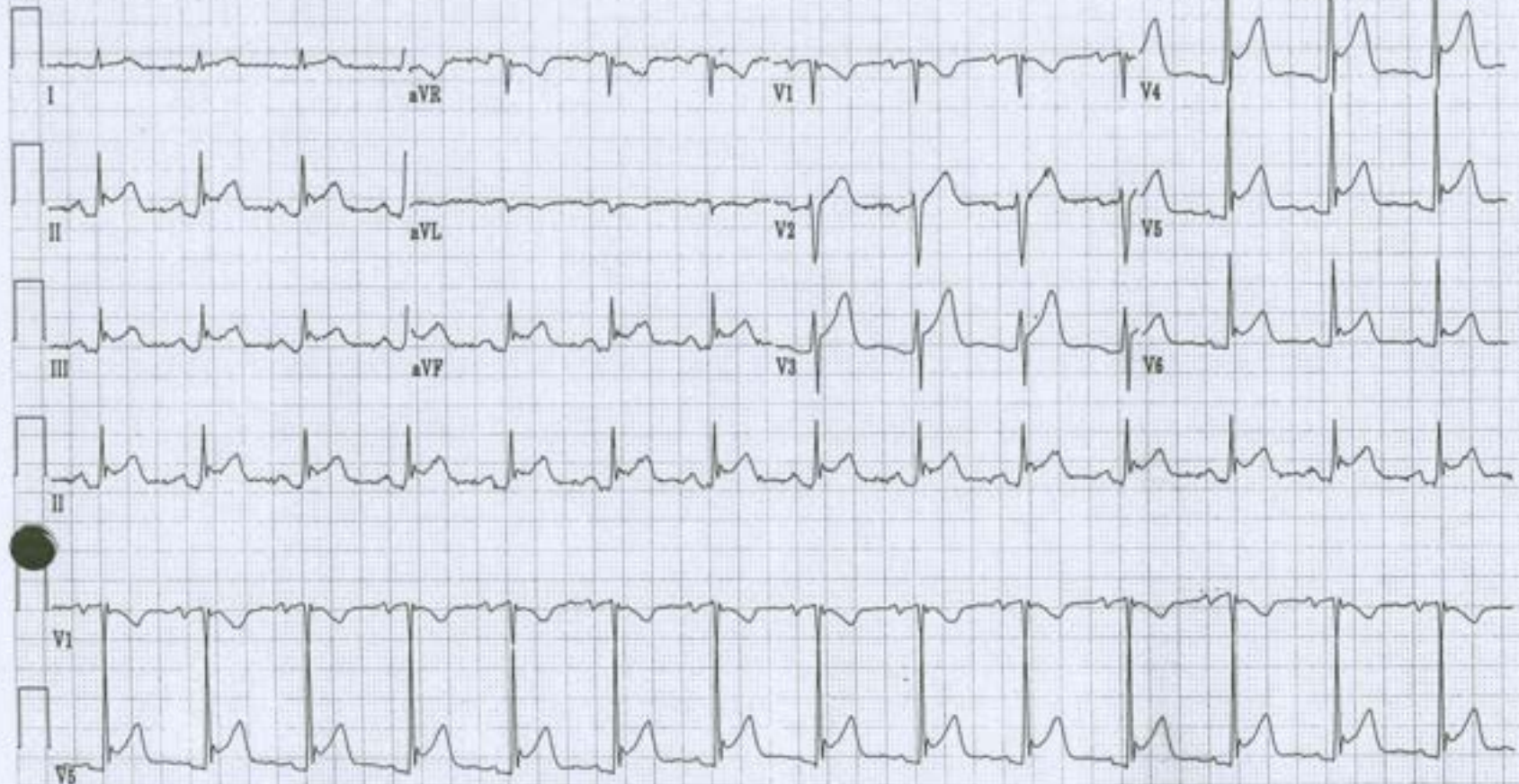
Technician ID: 433

#10

Unknown

Section:

Location:



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 78 CID: 13

EID:902 EDT: 07:00 12-JUL-1994 ORDER: 9420155

Page 1 of

12-JUL-1994 05:38

MAYO CLINIC-STMA ROUTINE RETRIEVAL

27-FEB-1923 (71 yr)

Male Caucasian

68in 104lb

Room:05118

Loc:2 Option:0

Vent. rate 85 BPM

PR interval 168 ms

QRS duration 88 ms

QT/QTc 348/414 ms

P-R-T axes 75 73 72

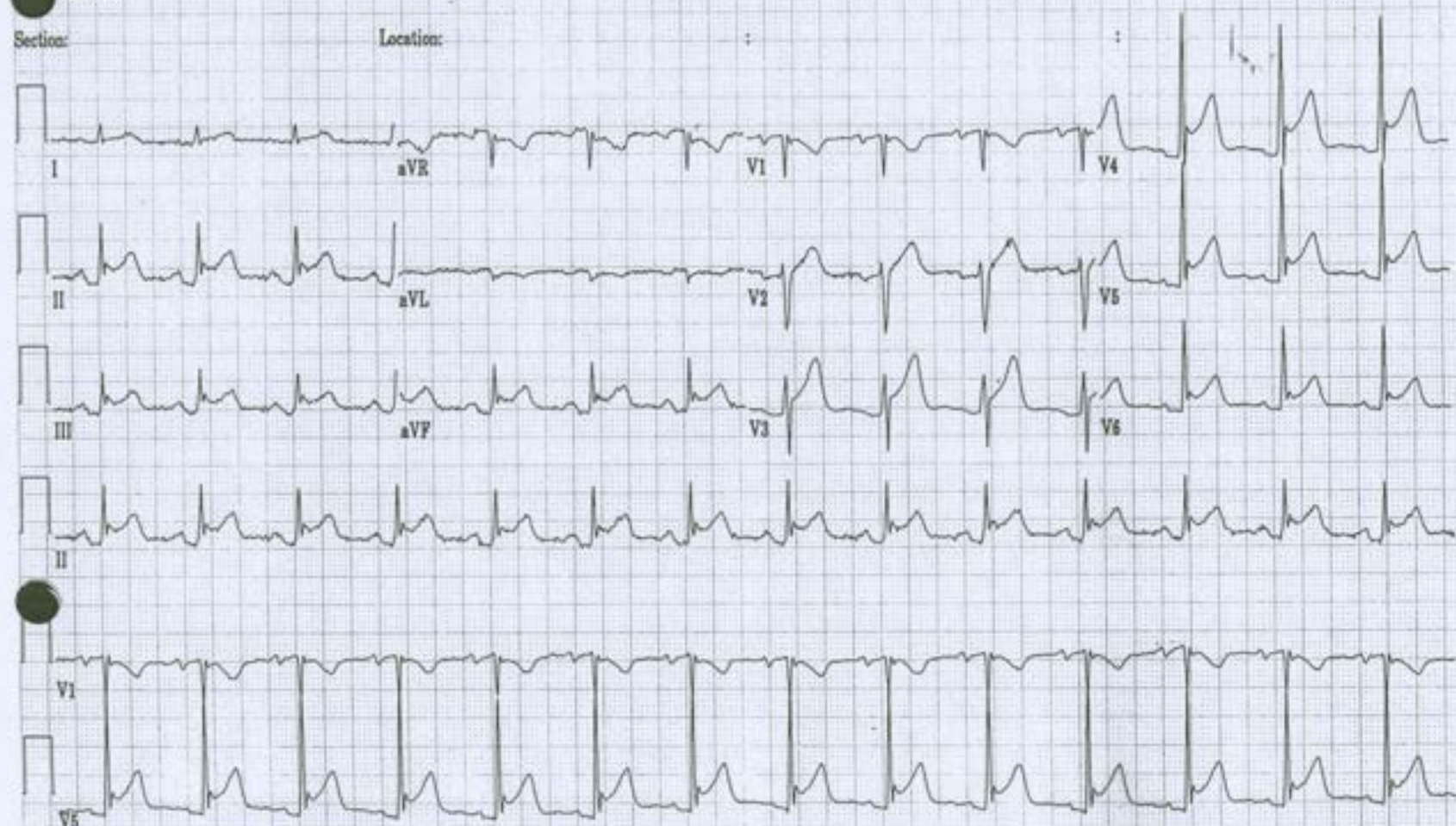
Technician ID: 433

ACUTE PERICARDITIS

Unknown

Section:

Location:



25mm/s 10mm/mV 100Hz 003AMY-003A.1B 12SL 78 CID: 13

EID:902 EDT: 07:00 12-JUL-1994 ORDER: 9420155

Page 1 of

Backup Slides

The QRS Axis

The QRS axis represents the net overall direction of the heart's electrical activity.

Abnormalities of axis can hint at:

- Ventricular enlargement

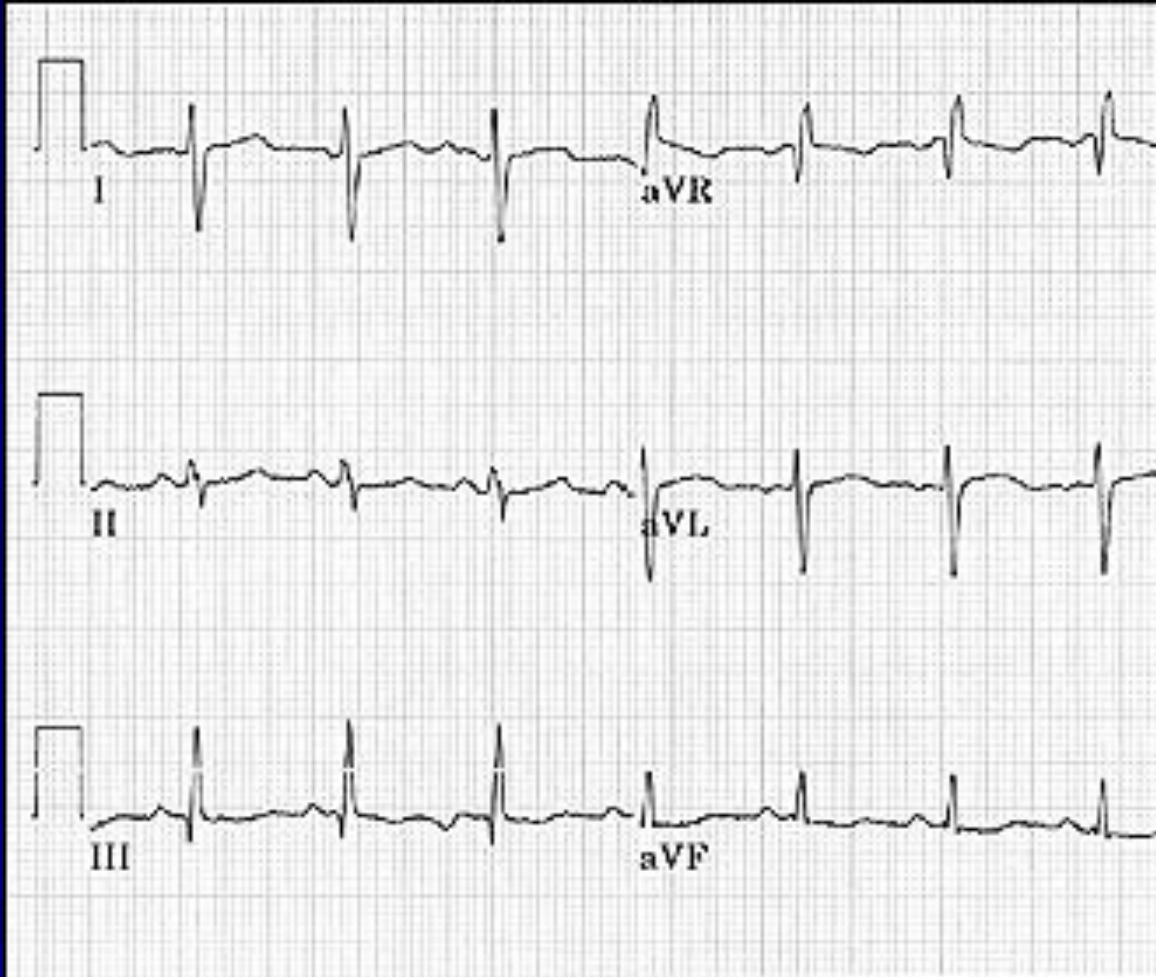
- Conduction blocks (i.e. hemiblocks)

The Quadrant Approach

2. In the event that LAD is present, examine lead II to determine if this deviation is pathologic. If the QRS in II is predominantly positive, the LAD is non-pathologic (in other words, the axis is normal). If it is predominantly negative, it is pathologic.

		Lead aVF	
		Positive	Negative
Lead I	Positive	Normal Axis	LAD
	Negative	RAD	Indeterminate Axis

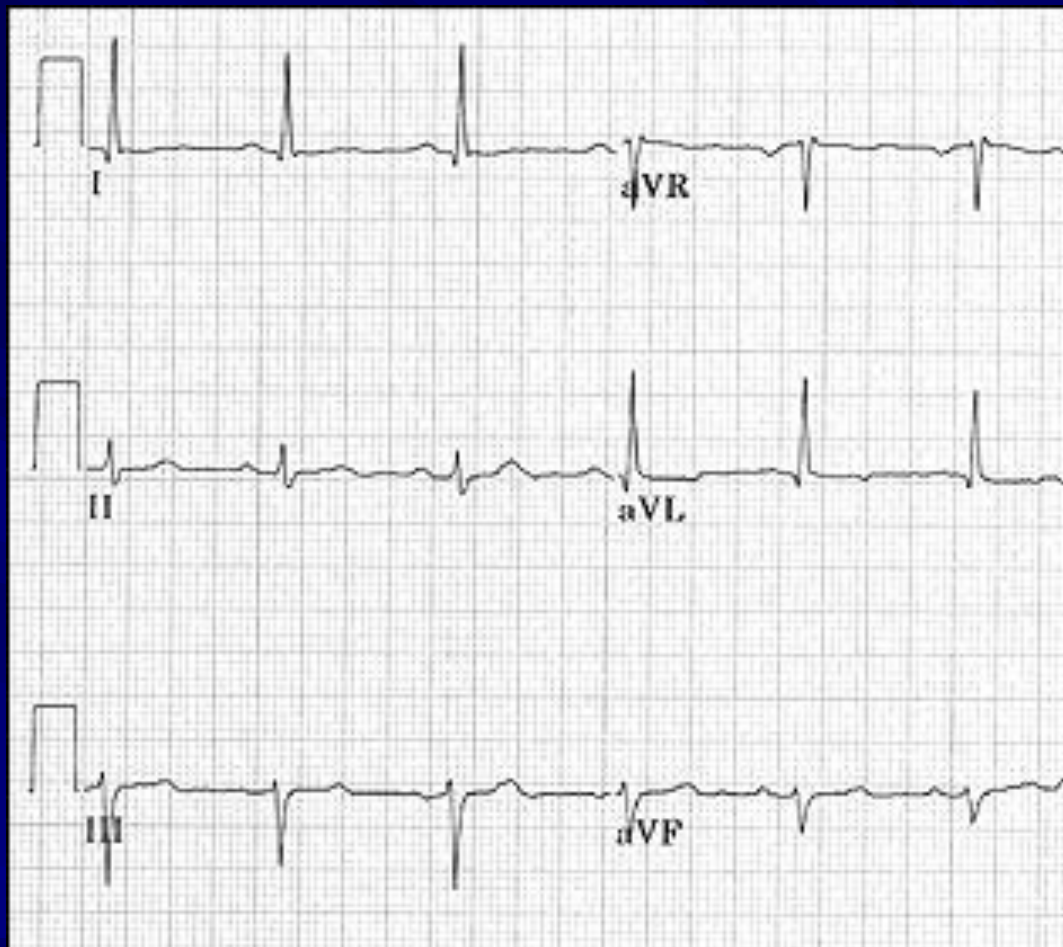
Quadrant Approach: Example 1



The Alan E. Lindsay
ECG Learning Center
<http://medstat.med.utah.edu/kw/ecg/>

Negative in I, positive in aVF → RAD

Quadrant Approach: Example 2



The Alan E. Lindsay
ECG Learning Center
<http://medstat.med.utah.edu/kw/ecg/>

**Positive in I, negative in aVF → Predominantly positive in II →
Normal Axis (non-pathologic LAD)**

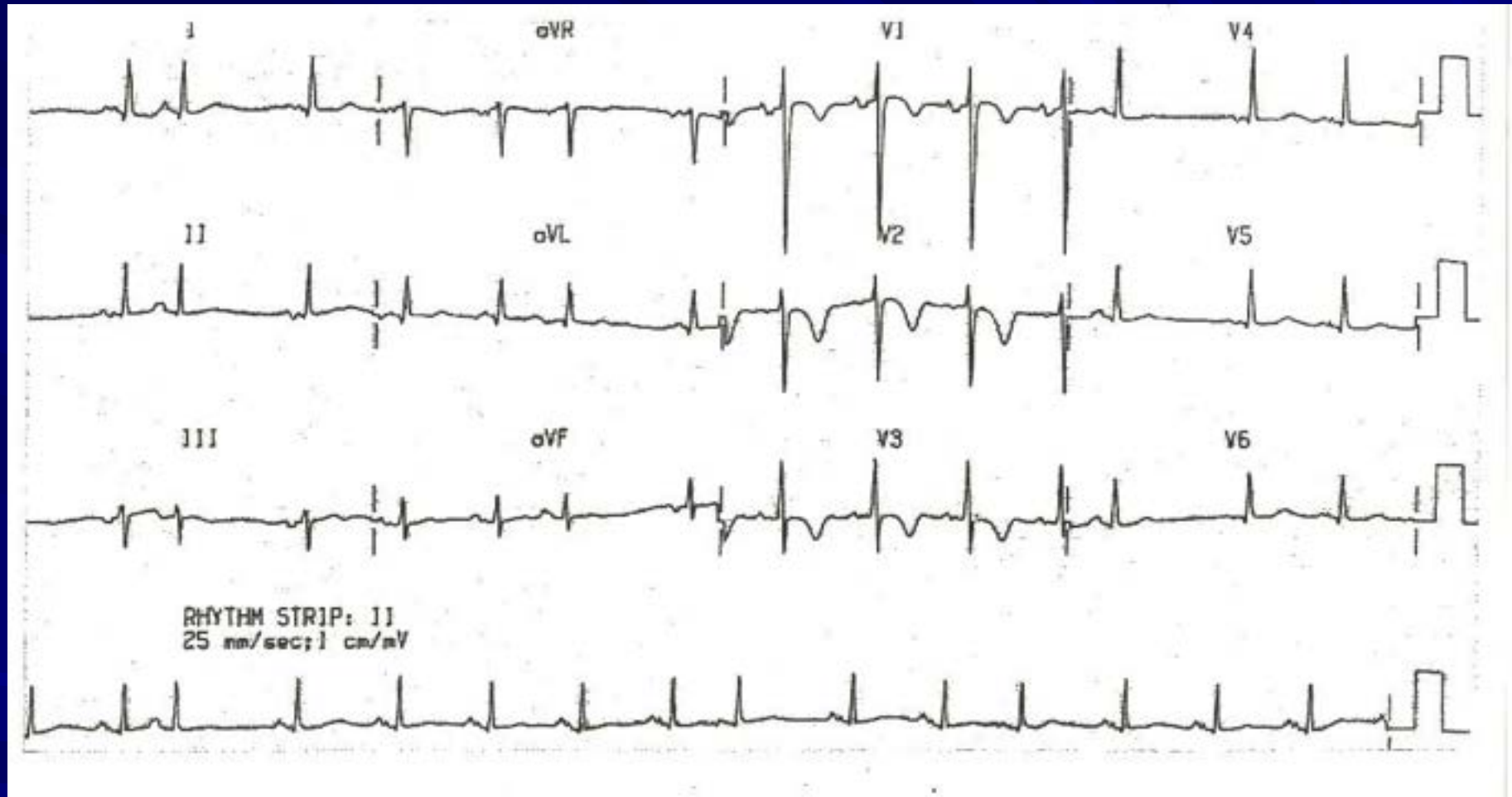
The Equiphasic Approach

1. Determine which lead contains the most equiphasic QRS complex. The fact that the QRS complex in this lead is equally positive and negative indicates that the net electrical vector (i.e. overall QRS axis) is perpendicular to the axis of this particular lead.
2. Examine the QRS complex in whichever lead lies 90° away from the lead identified in step 1. If the QRS complex in this second lead is predominantly positive, then the axis of this lead is approximately the same as the net QRS axis. If the QRS complex is predominantly negative, then the net QRS axis lies 180° from the axis of this lead.

Anatomic Groups (Inferior Wall)

I Lateral	aVR None	V ₁ Septal	V ₄ Anterior
II Inferior	aVL Lateral	V ₂ Septal	V ₅ Lateral
III Inferior	aVF Inferior	V ₃ Anterior	V ₆ Lateral

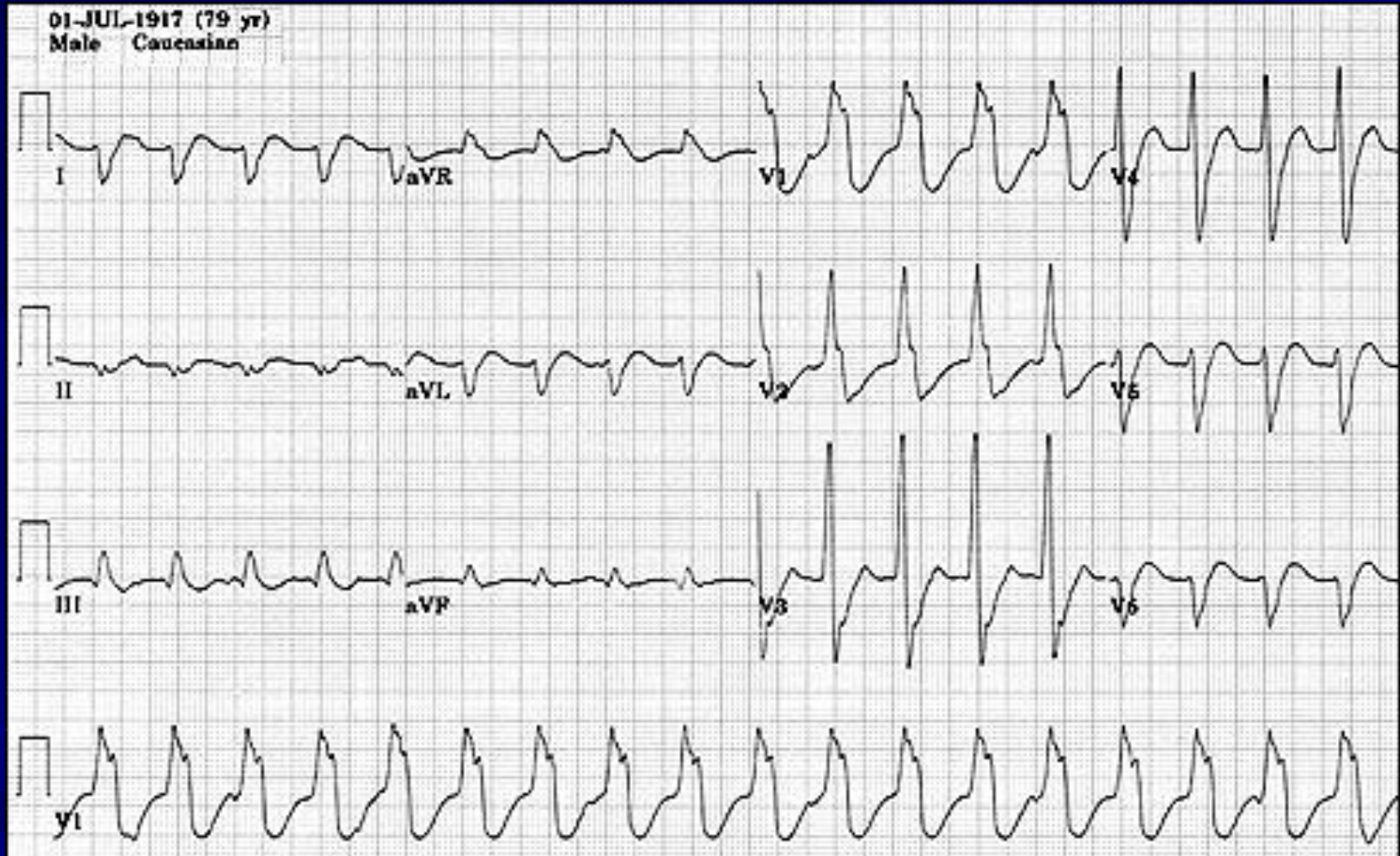
Equiphasic Approach: Example 1



The Alan E. Lindsay ECG Learning Center ; <http://medstat.med.utah.edu/kw/ecg/>

Equiphasic in aVF → Predominantly positive in I → QRS axis $\approx 0^\circ$

Equiphasic Approach: Example 2



The Alan E. Lindsay ECG Learning Center ; <http://medstat.med.utah.edu/kw/ecg/>

Equiphasic in II → Predominantly negative in aVL → QRS axis $\approx +150^\circ$

