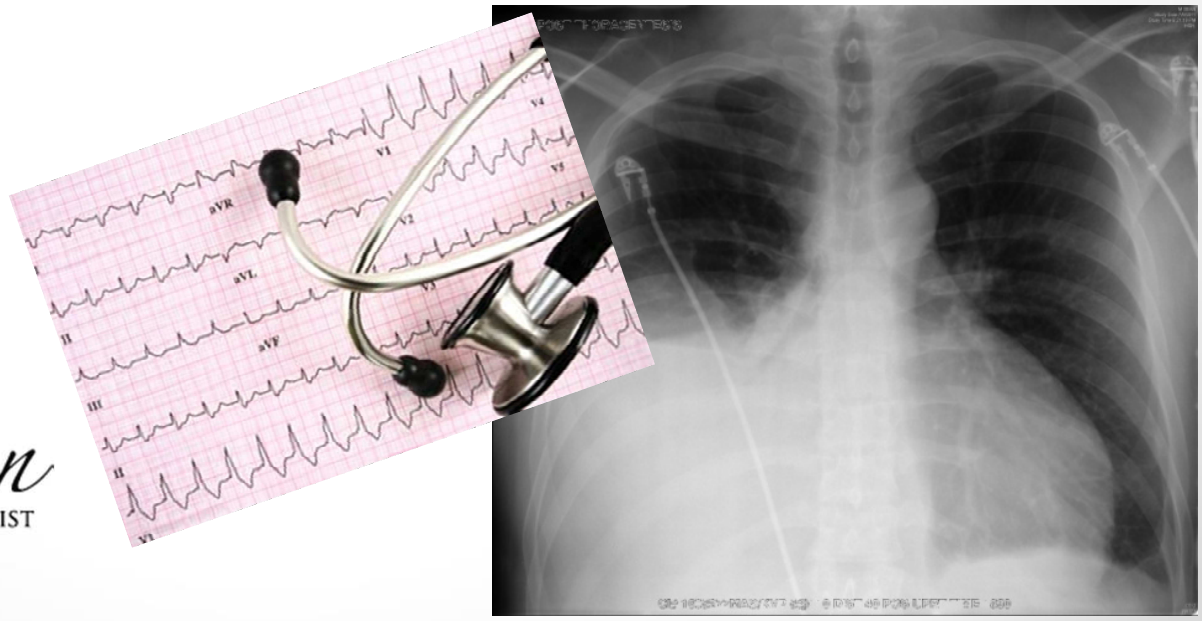
12 LEAD EKG

&

CXR INTERPRETATION



Cheryl Herrmann
CARDIAC CLINICAL NURSE SPECIALIST
APN, CCRN, CCNS-CSC-CMC

www.cherylherrmann.com
cherrmann@frontier.com

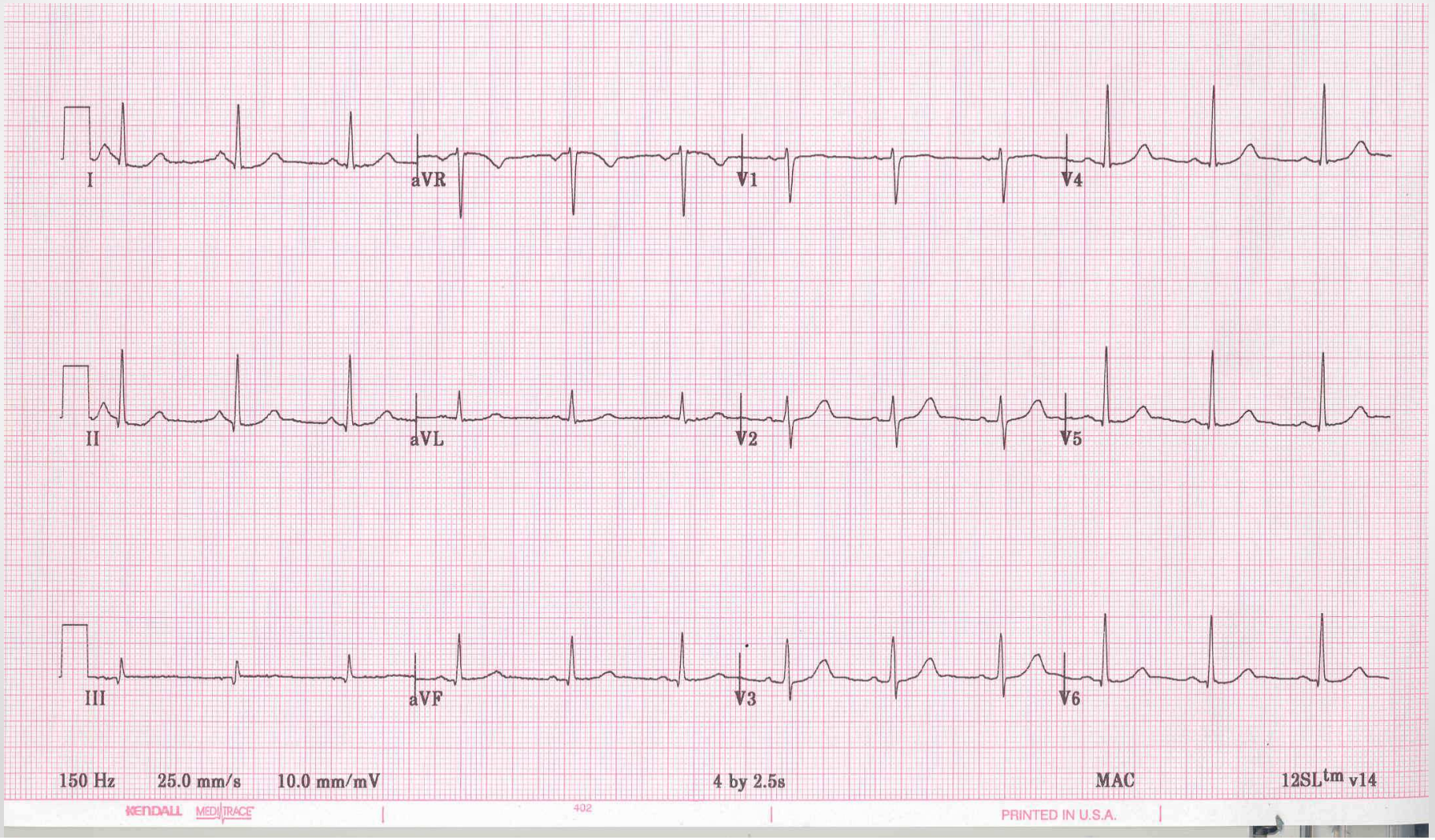
Audio Product

- Recording discount for participants $60
- Nonparticipants = $190
  - Get CEs and manual

https://catalog.vyne.com

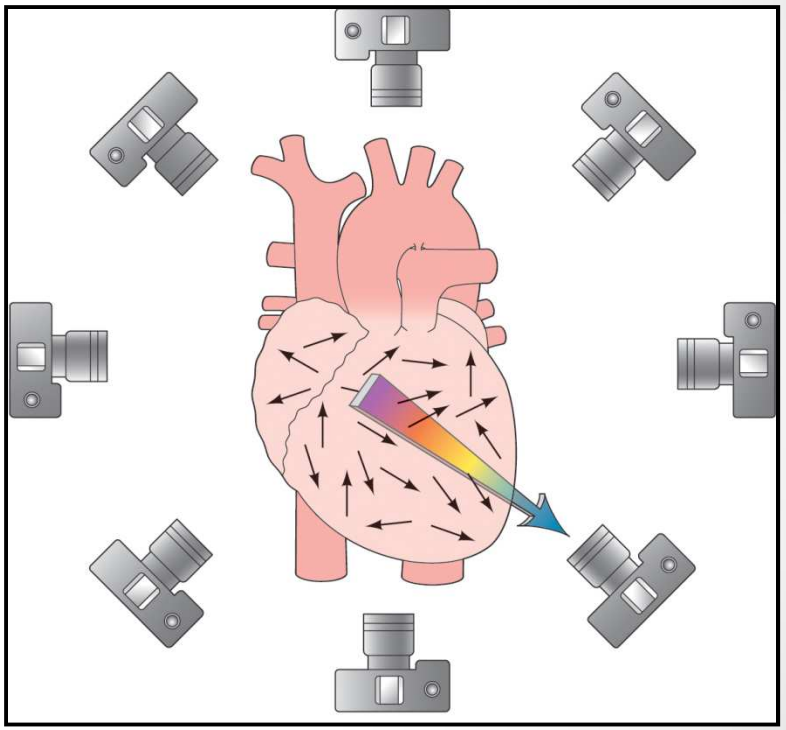
12 Lead EKG 101

Learn the *Normal* so you can detect the abnormal



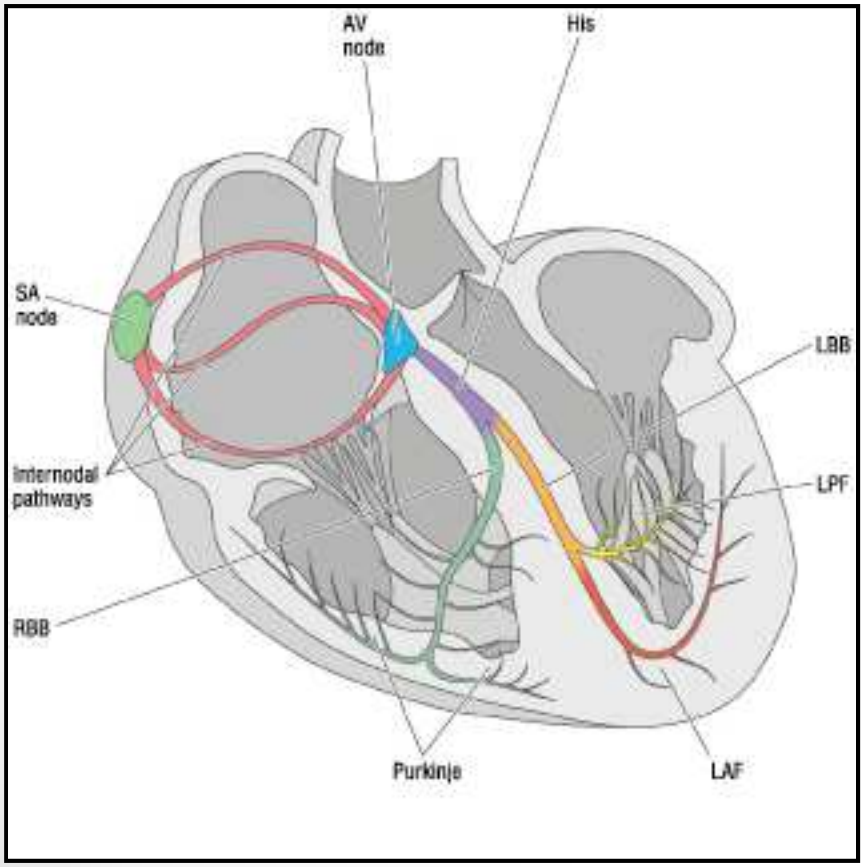
12 Lead EKG

- Taking pictures of the heart from 12 different angles
- Pictures (EKG complexes) are created by picking up the electrical energy from the electrodes



The Electrical Conduction System

Creates an electrical impulse and transmits it in an organized manner to the rest of the myocardium

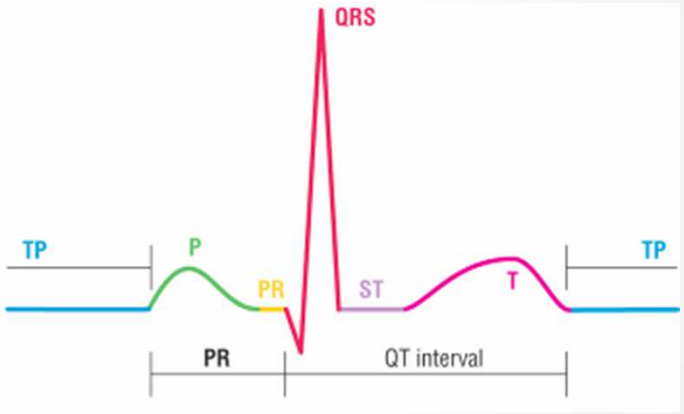


SA node	**60-100 BPM**
AV node	**40-60 BPM**
Purkinje cells	**20-40 BPM**

Basic Components of the Complex

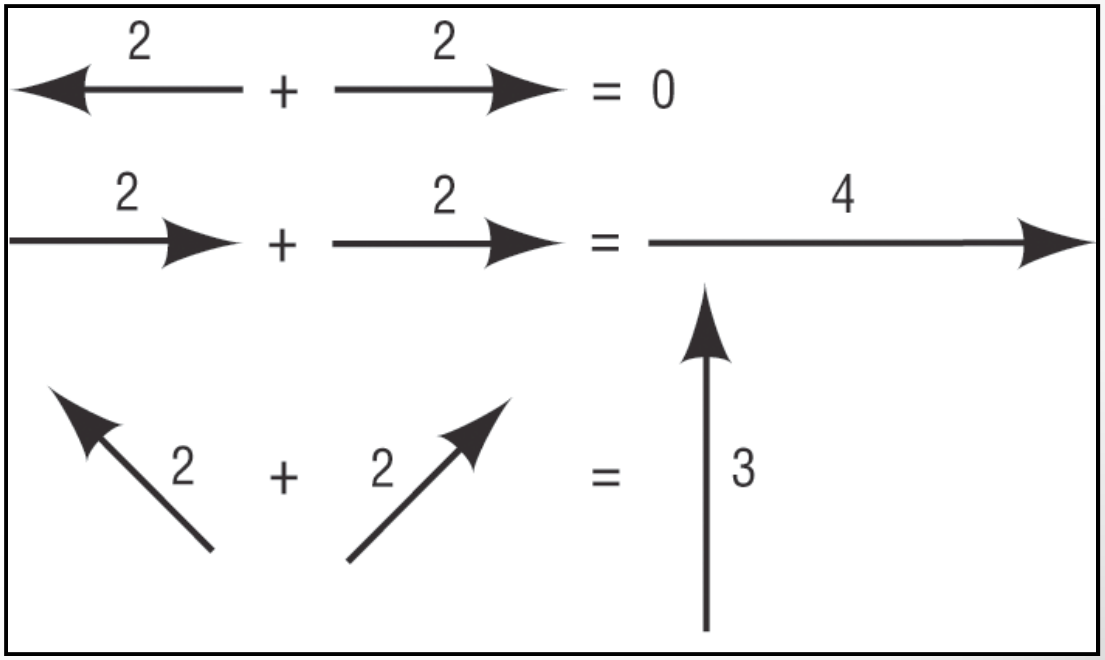
Deflections & Segments

- **P Wave**
  - Rounded, < 2-3 mm, ↑ in hypertrophy
- **QRS Segment**
  - ≤ .12 sec. & > 5 mm, transition occurs V3 or V4
  - presence of Q normal in children/elderly
  - Q wave sig. > 0.5 mm
- **T Wave**
  - < 5-10 mm, peaked in ↑ K+
- **U Wave**
  - Follows T wave, present in ↓ K+
- **ST Segment**
  - Isoelectric, sig. If > +1.0 above or below baseline
  - Depression = ischemia
  - Elevation = injury



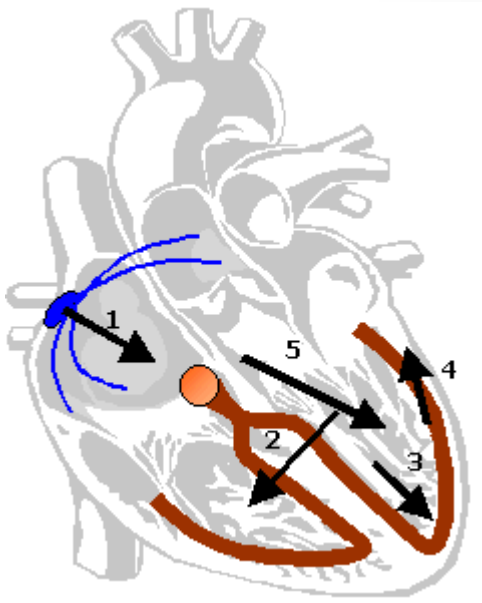
Vector

- A diagrammatic way of showing the strength and direction of an electrical impulse



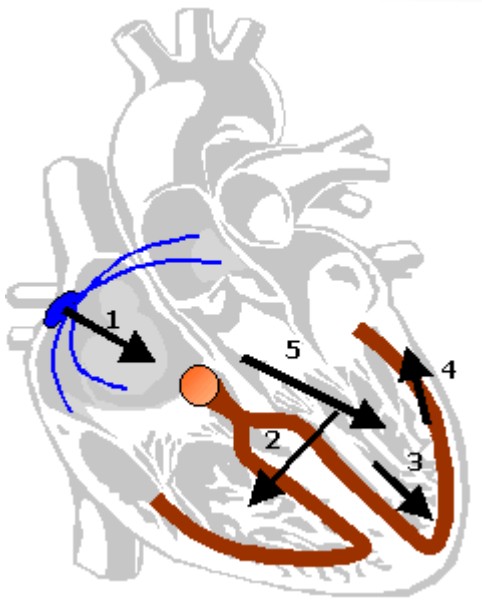
Vectors

- Atrial
- Septal
- Ventricular

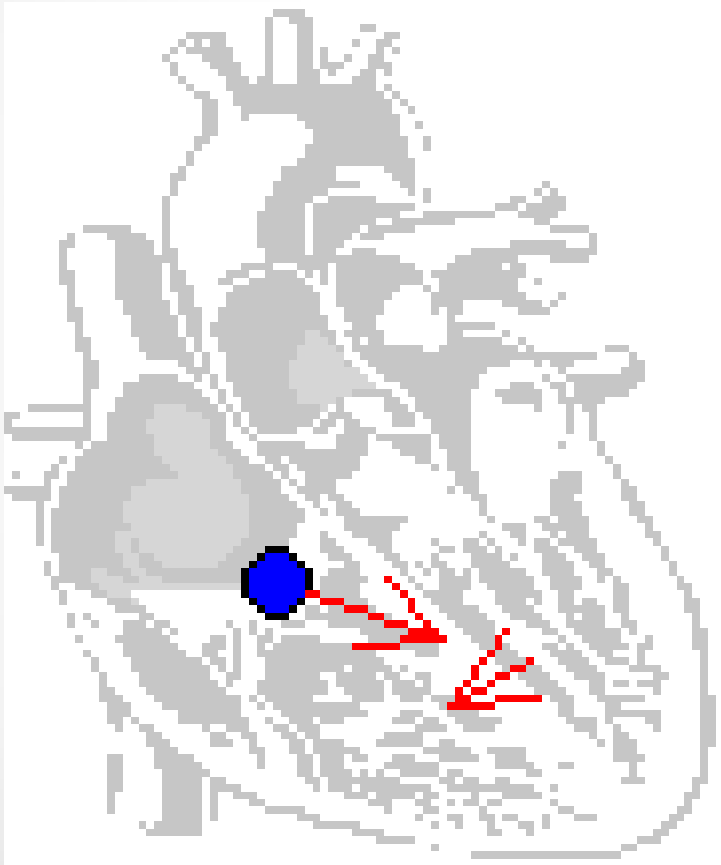


Atrial Vectors & Depolarization

- Two atrial vectors
- Initial wave spreads anteriorly through the RA towards the AV node
- Next wave travels posteriorly toward the LA
- The mean P wave vector represents the average direction and magnitude of depolarization through both atria
- Normal P wave configuration.

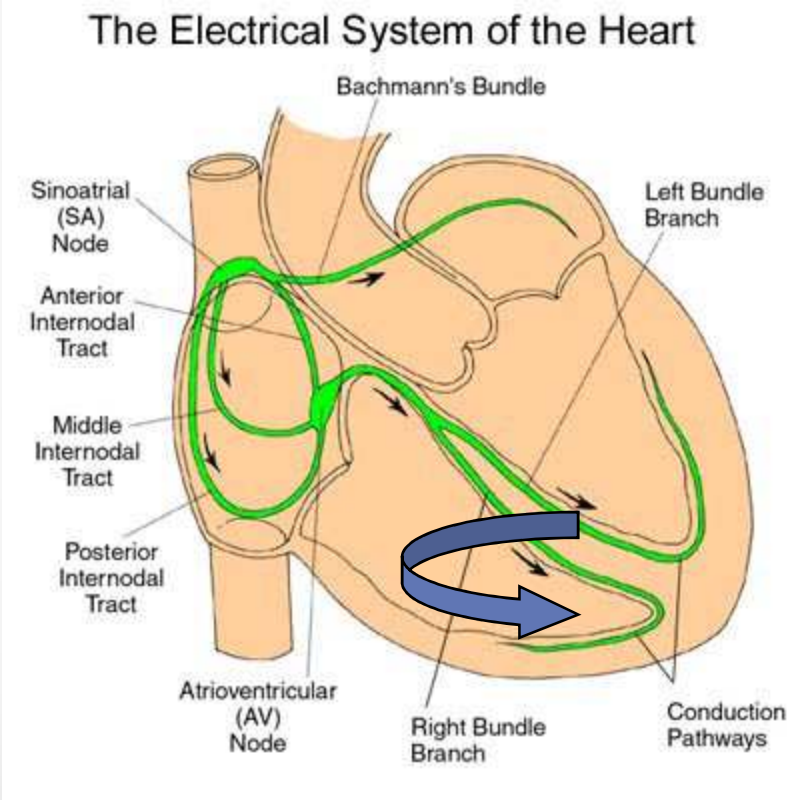


Three Stages of Ventricular Septal Depolarization



Phase I: Septum from left to right

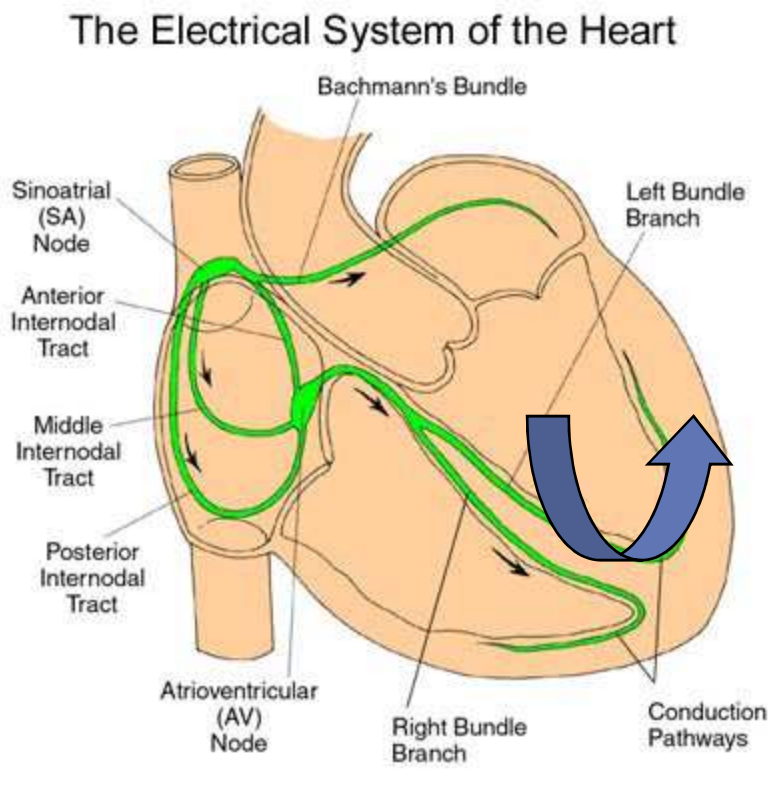
Right Ventricular Depolarization



- **Phase II: Right ventricle and apex**

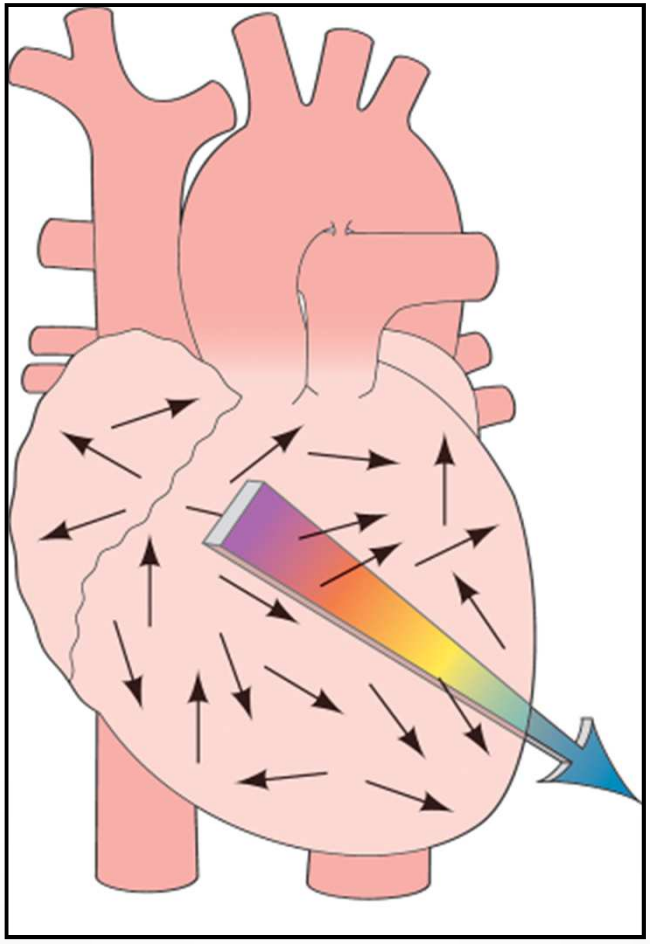
Left Ventricular Depolarization

- **Phase III: lateral wall of left ventricle**



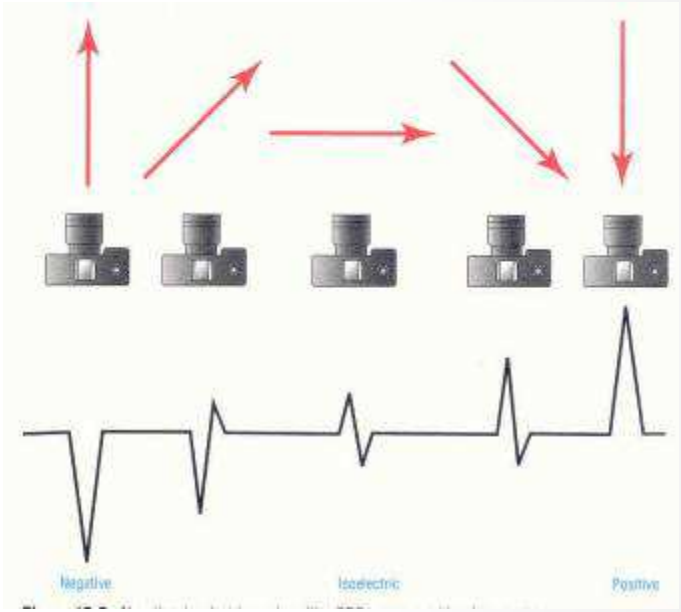
The Electrical Axis of the Heart

Sum of all the vectors found in the heart



Vectors and Leads Depolarization Parade

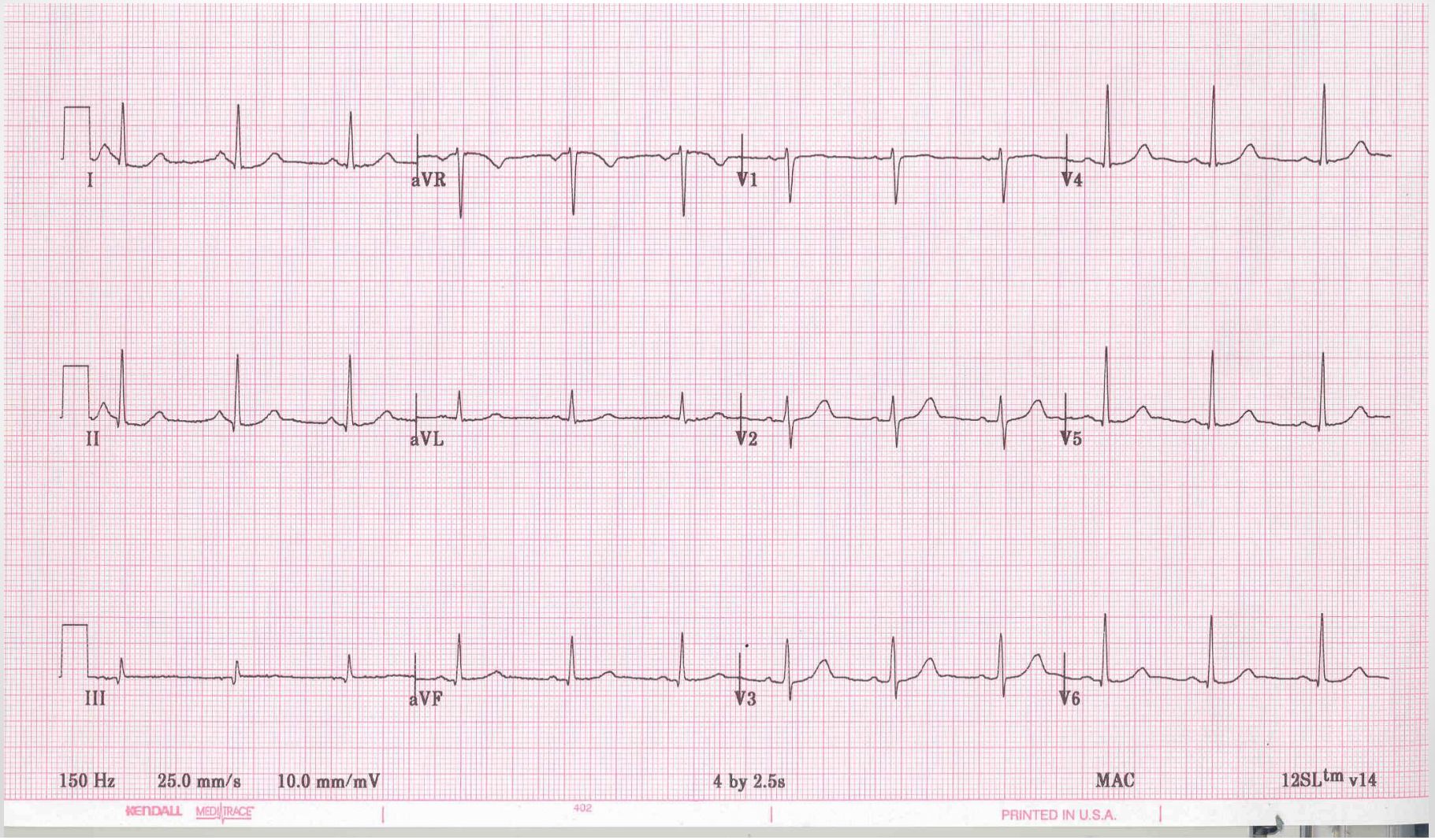
- **A vector moving toward an electrode is represented as a positive wave.**
  - **In a parade things moving towards the camera see the front or positive**
- **A vector moving away from an electrode is represented as a negative wave.**
  - **In a parade things moving away from the camera are the back or negative**



Source: Garcia. 12 Lead ECG 12:9

12 Lead EKG 101

Learn the *Normal* so you can detect the abnormal



The 12 Leads

Bipolar Leads

Each lead has two poles:

One positive & one negative

I, II, III

Unipolar Leads

Only one lead is physically positive

Negative lead is not a specific site on the body

AVR, AVL, AVF, V1-V6

Bipolar Leads
I, II, III

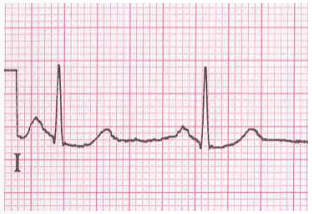
- Also referred to as extremity leads due to placement on the body
- Record electrical forces two points equidistant from the heart.
- Each lead has two poles: one positive & one negative
- Two leads to give the picture
- Current travels Negative to Positive to create the electrical complex
- 12 Lead EKG reads or takes the picture from the positive electrode to the heart

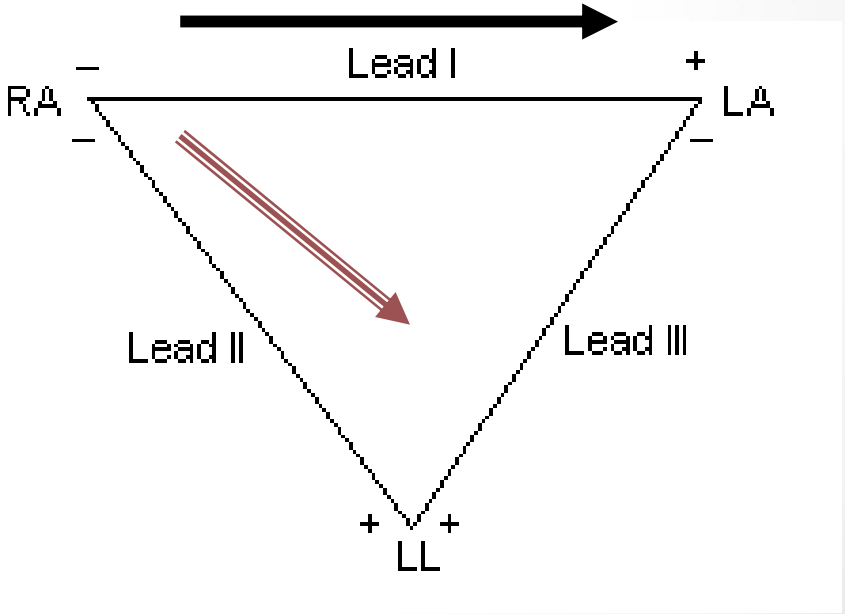
Negative poles & Positive poles… You must memorize

- The heart depolarizes right to left and then down
- Direction of the current indicates if the heart is depolarizing normally
- Current travels from negative to positive
- Arrow (→) goes from negative pole to positive pole. This is how the poles talk to each other. It will help with axis.
- Positive electrode on the body is the camera and looking at the heart ☺

Lead I

- Right arm (--) → Left arm (+)
- EKG complex = everything positive

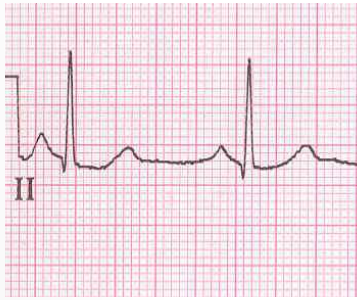


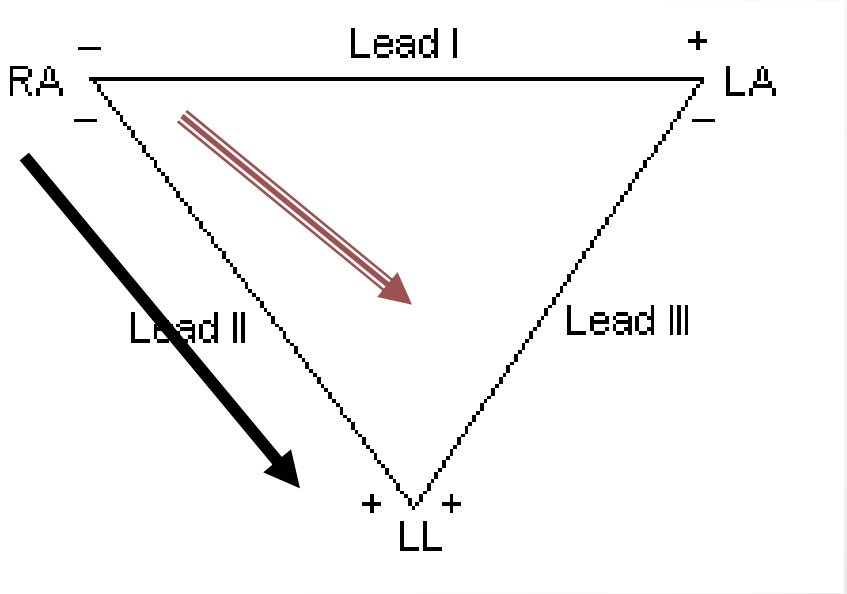


= Normal Axis of Heart

Lead II

- Right arm (--) → Left leg (+)
- EKG complex = everything positive

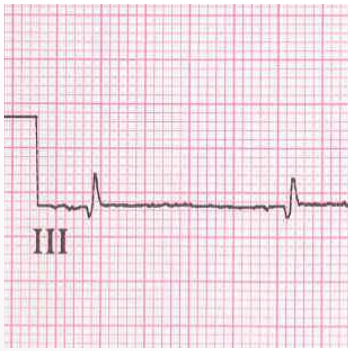


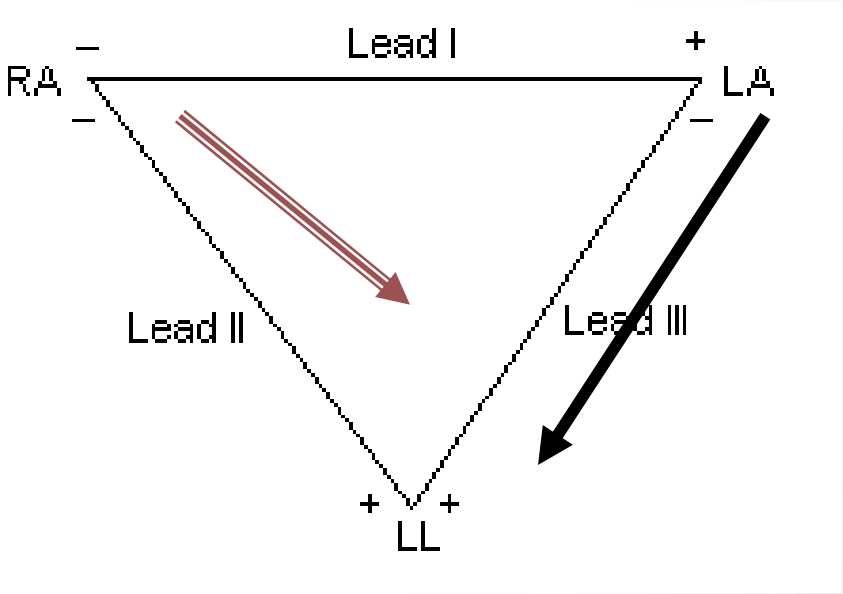


= Normal Axis of Heart

Lead III

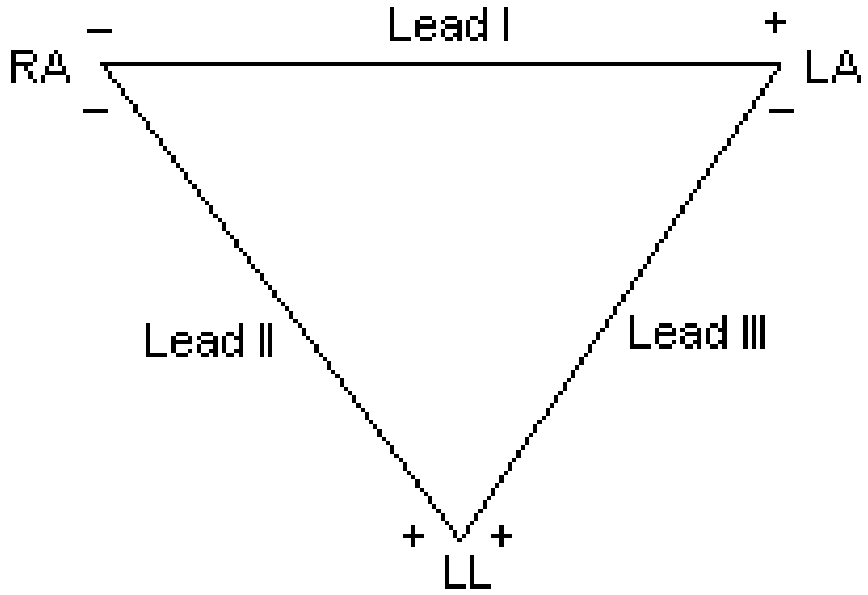
- Left arm (--) → Left leg (+)
- EKG complex = mostly positive, can be biphasic





= Normal Axis of Heart

Einthoven's Triangle



By connecting the electrodes of the limb leads, the Einthoven's Triangle is formed.

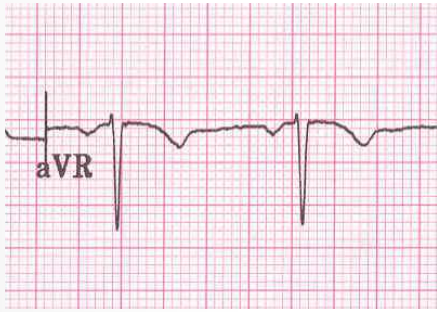
Augmented Limb Leads

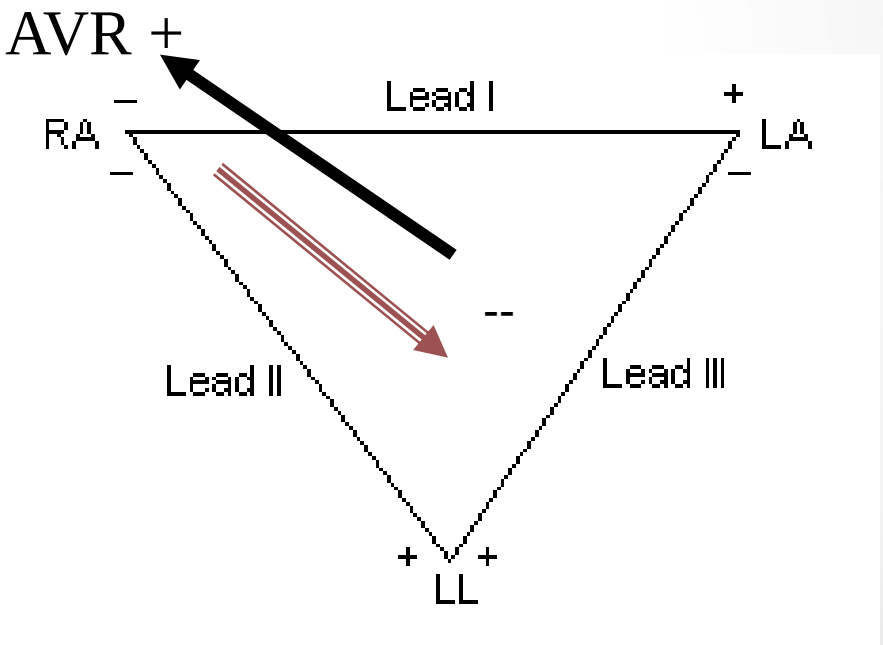
AVR, AVL, AVF

- Records electrical activity between the center of the heart and an extremity
- Since these leads are low voltage they are artificially augmented
- Unipolar leads: Negative pole is the heart

AVR: Augmented Voltage Right

- Heart (--) → Right Arm (+)
- EKG complex = negative

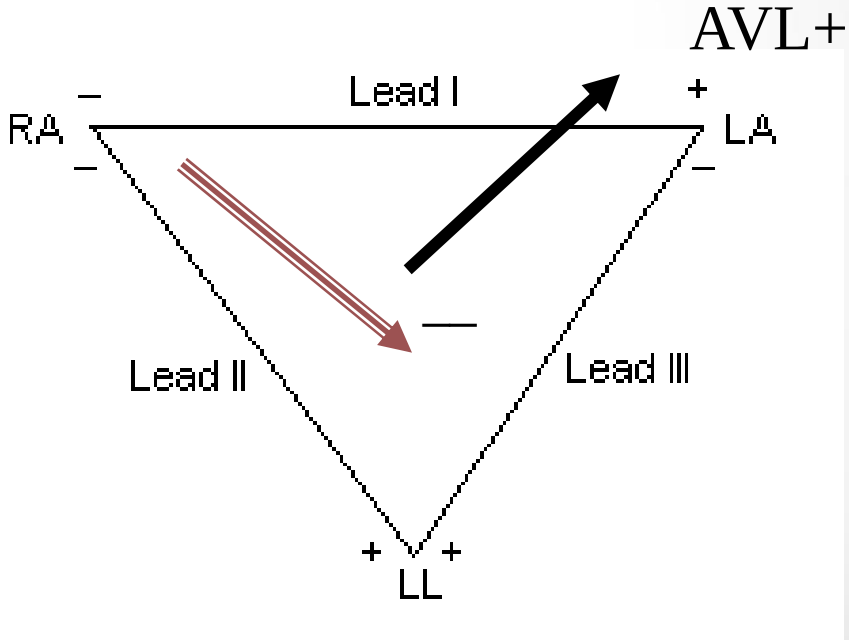




= Normal Axis of Heart

AVL: Augmented Voltage Left

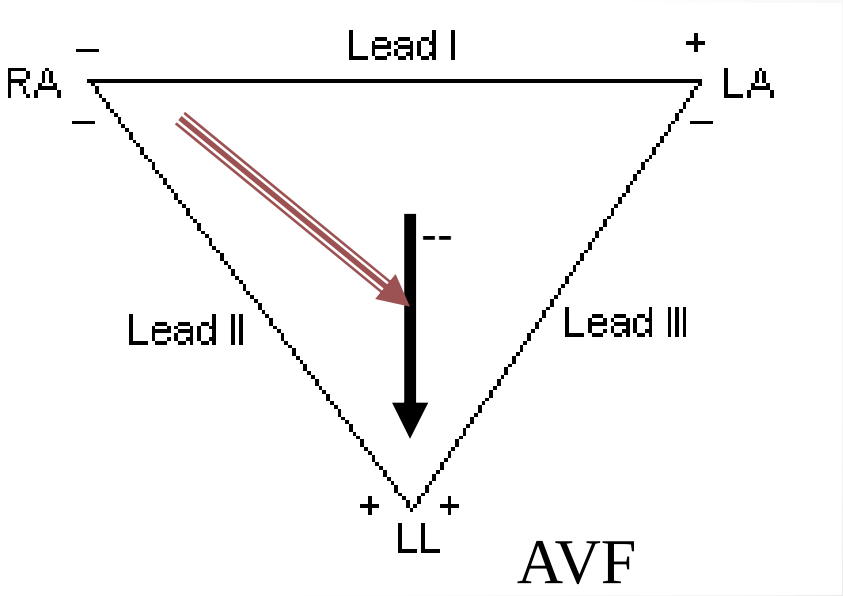
- Heart (--) → Left Arm (+)
- EKG complex = May be positive or negative or biphasic because it is perpendicular to axis



= Normal Axis of Heart

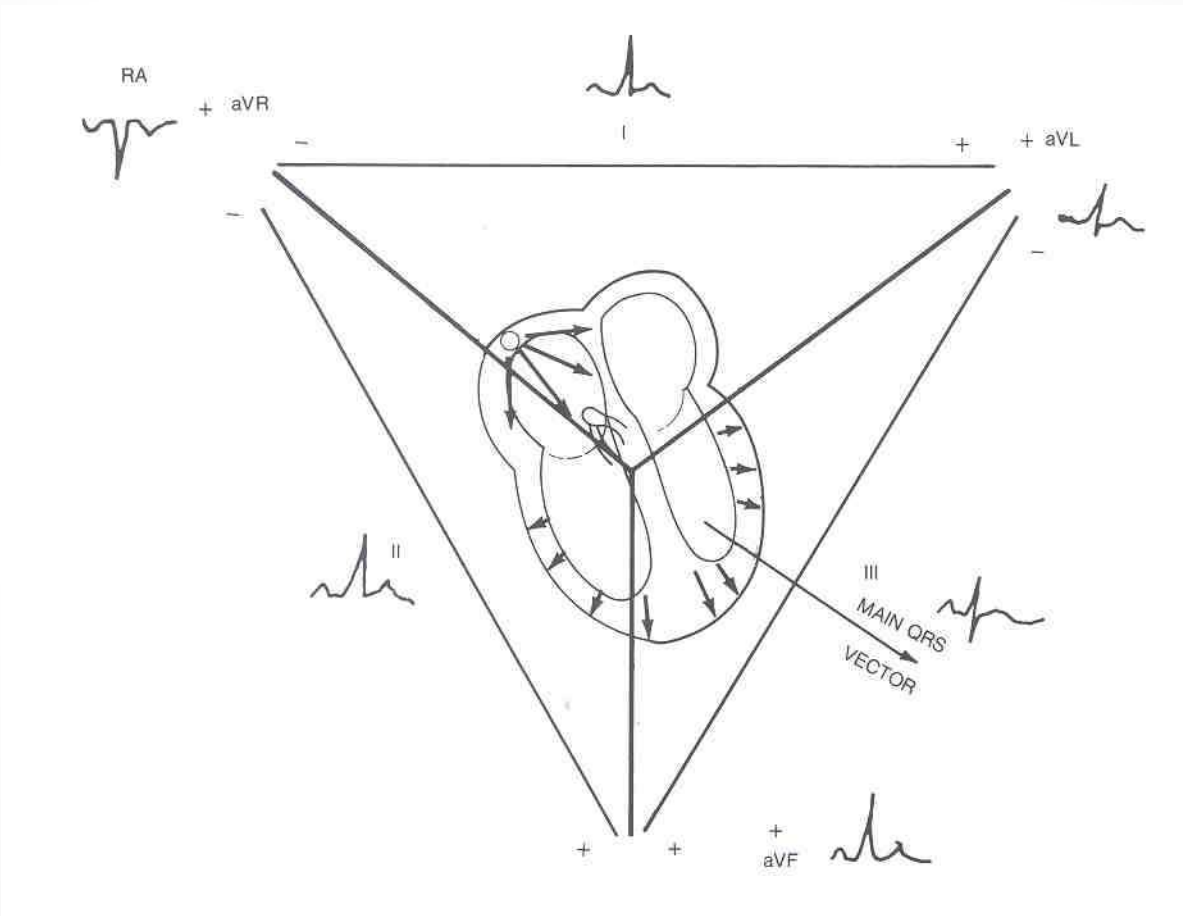
AVF: Augmented Voltage Foot

- Heart (--) → Left Leg (+)
- EKG complex = positive



= Normal Axis of Heart

Depolarization of limb & augmented leads



Sweetwood, H. Clinical Electrocardiography for Nurses. 1983

To learn you need to hear something….

- **6 times**
- **6 different ways**

6

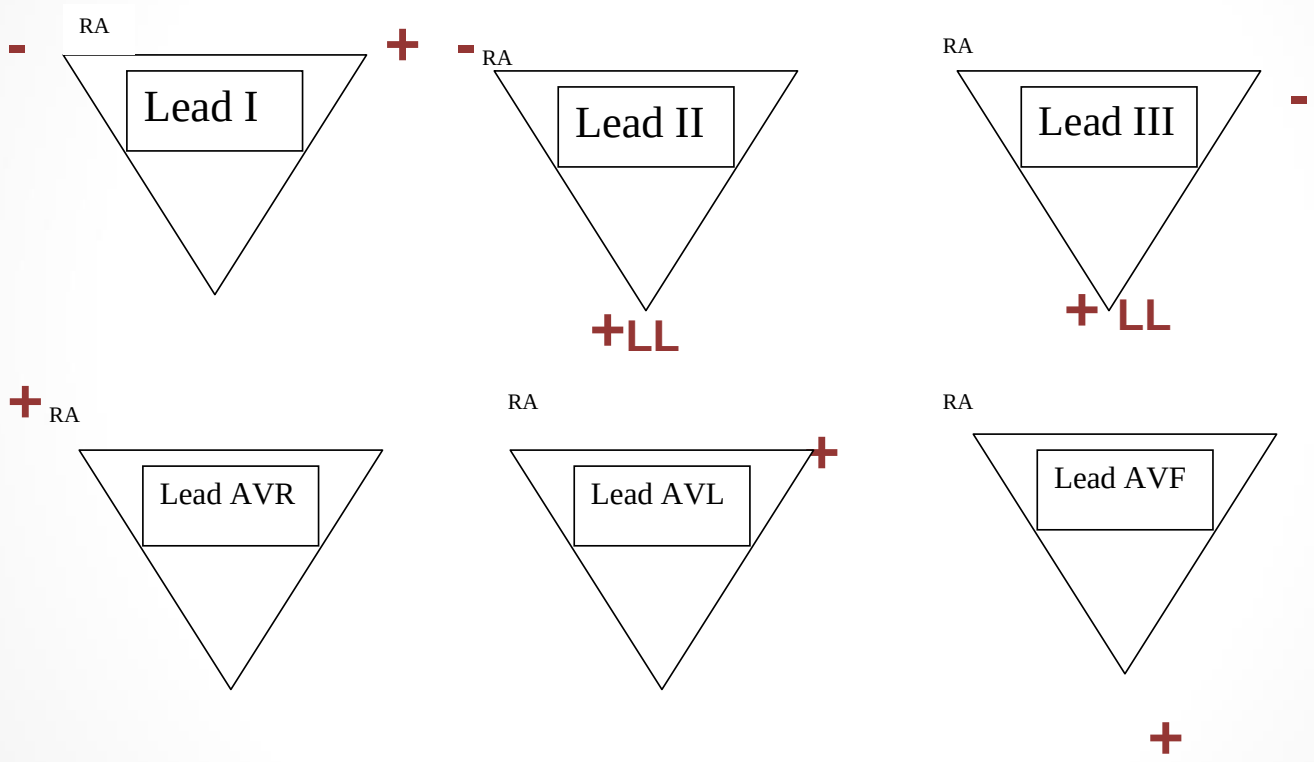
VI

seis

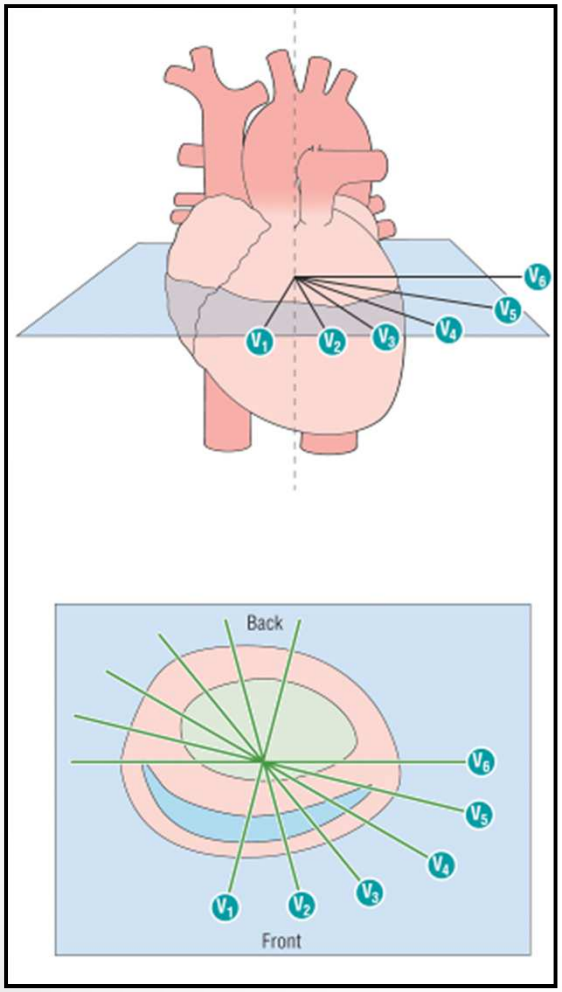
SIX

six

+ and - poles?

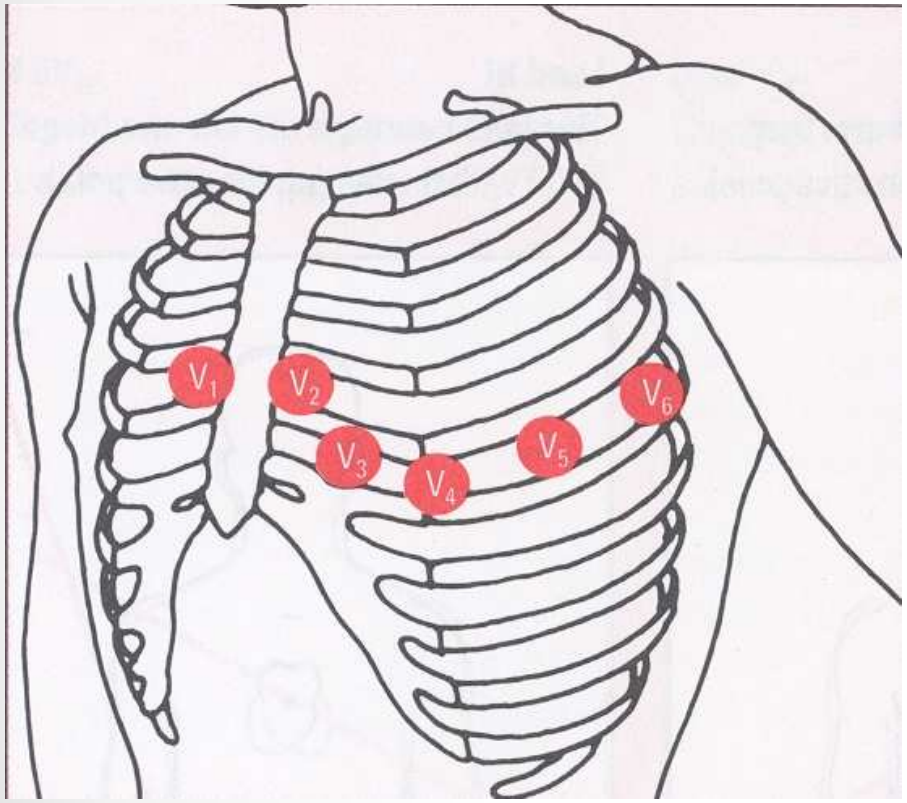

RA
-
+
Lead I
RA
-
Lead II
+LL
RA
Lead III
-
+LL
+
RA
Lead AVR
RA
Lead AVL
+
RA
Lead AVF
+

The Precordial System (Chest Leads V1 – V6)



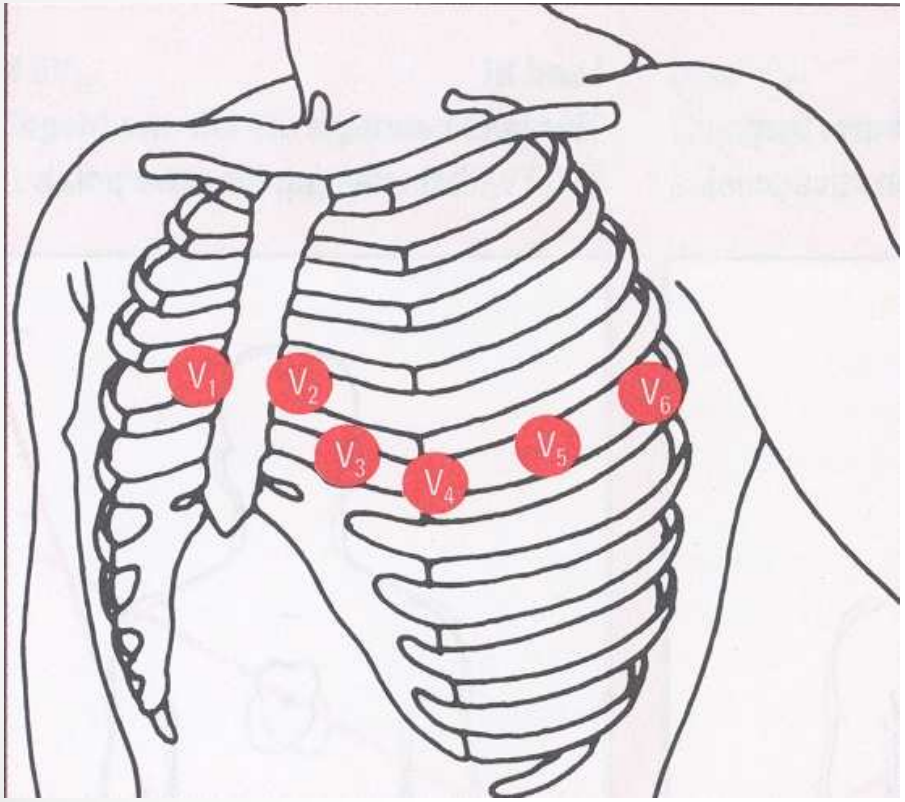
- Records electrical activity of the heart by placing electrodes on the anterior chest wall
- Heart is the negative pole
- Positive pole is where the electrode is placed
- Unipolar leads

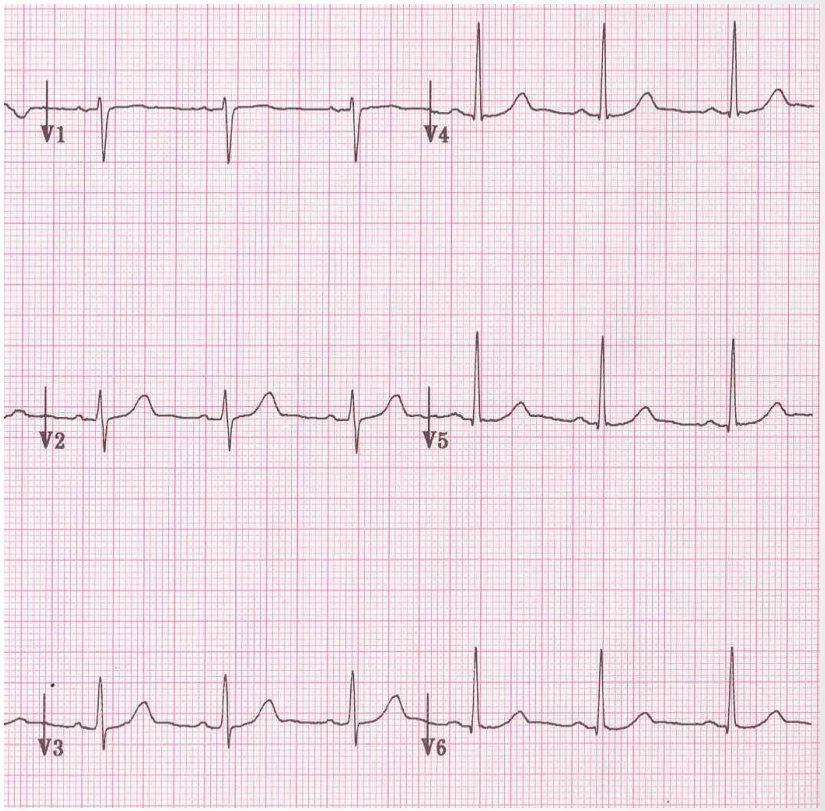
Precordial Leads Placement



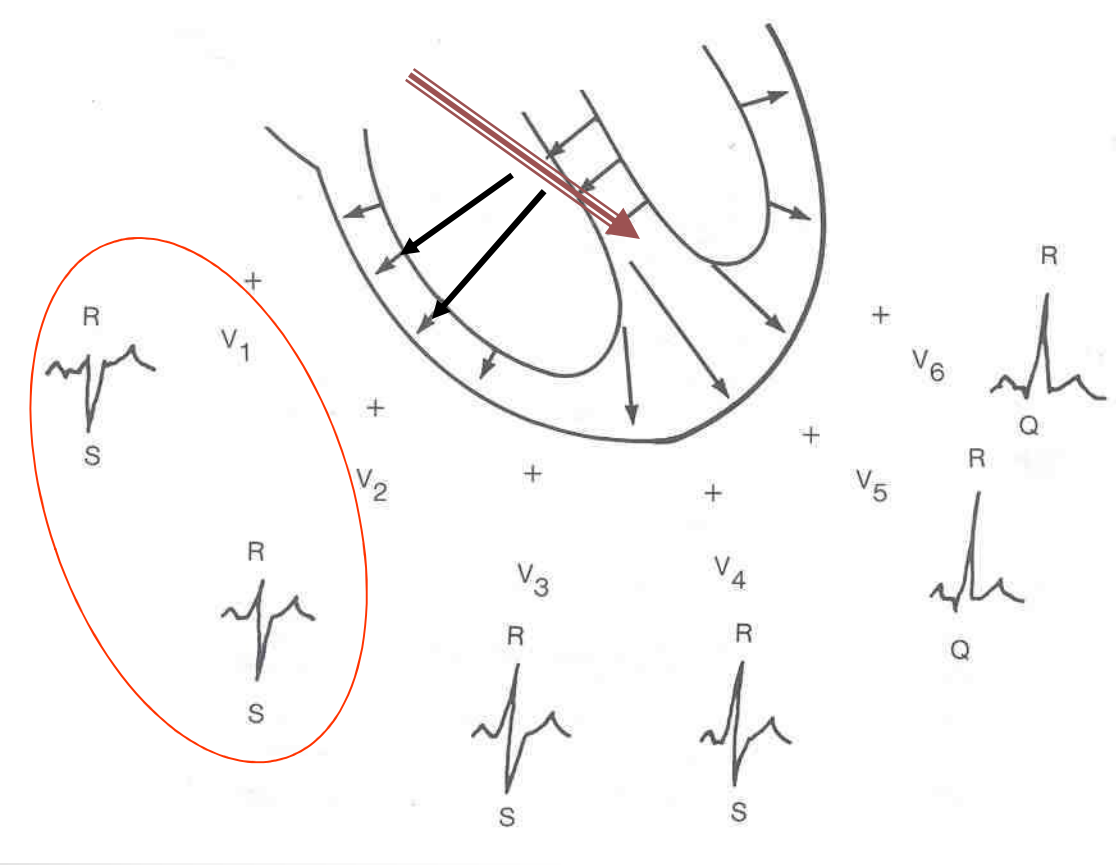
- V1 4th intercostal space (ICS) right sternal border (septum)
- V2 4th ICS, left sternal border (septum)
- V3 Midway between V2 and V4 (anterior)
- V4 5th ICS, left midclavicular line (anterior)
- V5 5th ICS, left anterior axillary line (lateral)
- V6 5th ICS, left midaxillary line (lateral)

Precordial Leads





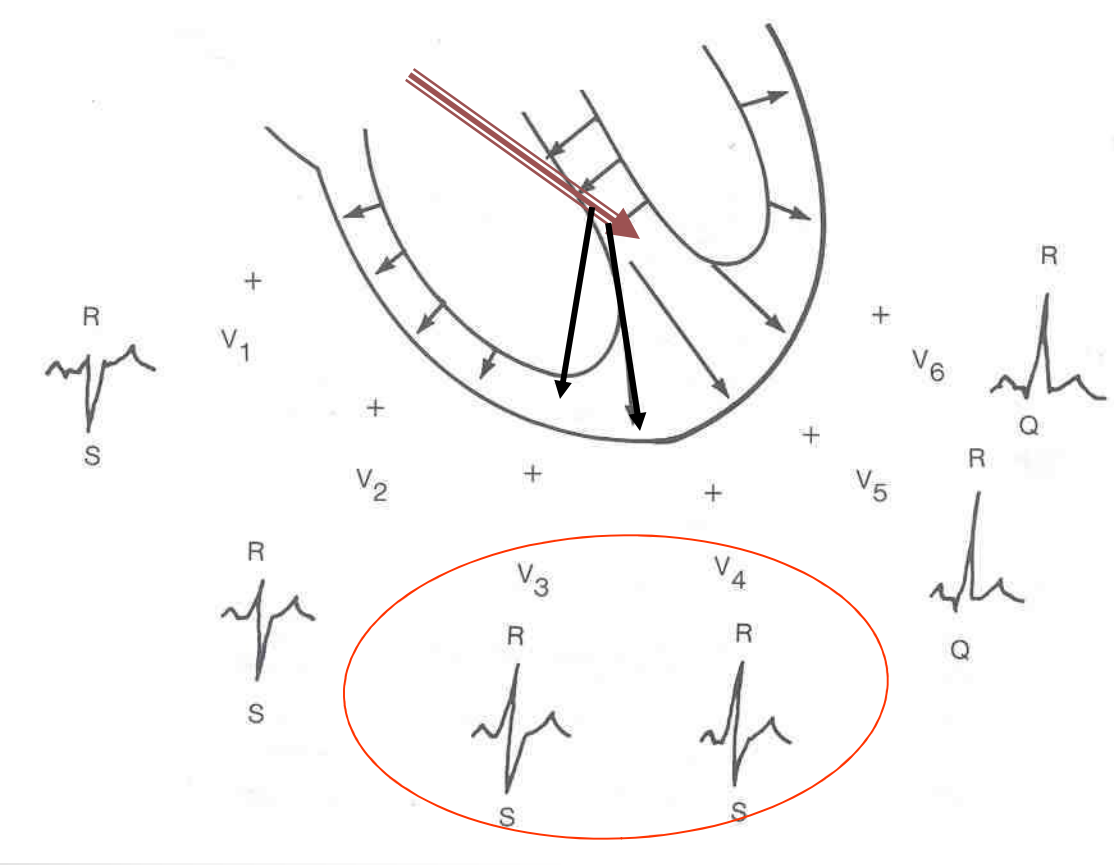
Depolarization of Precordial Leads



V1 & V2 = moving away from positive electrode so should be negative

Sweetwood, H. Clinical Electrocardiography for Nurses. 1983

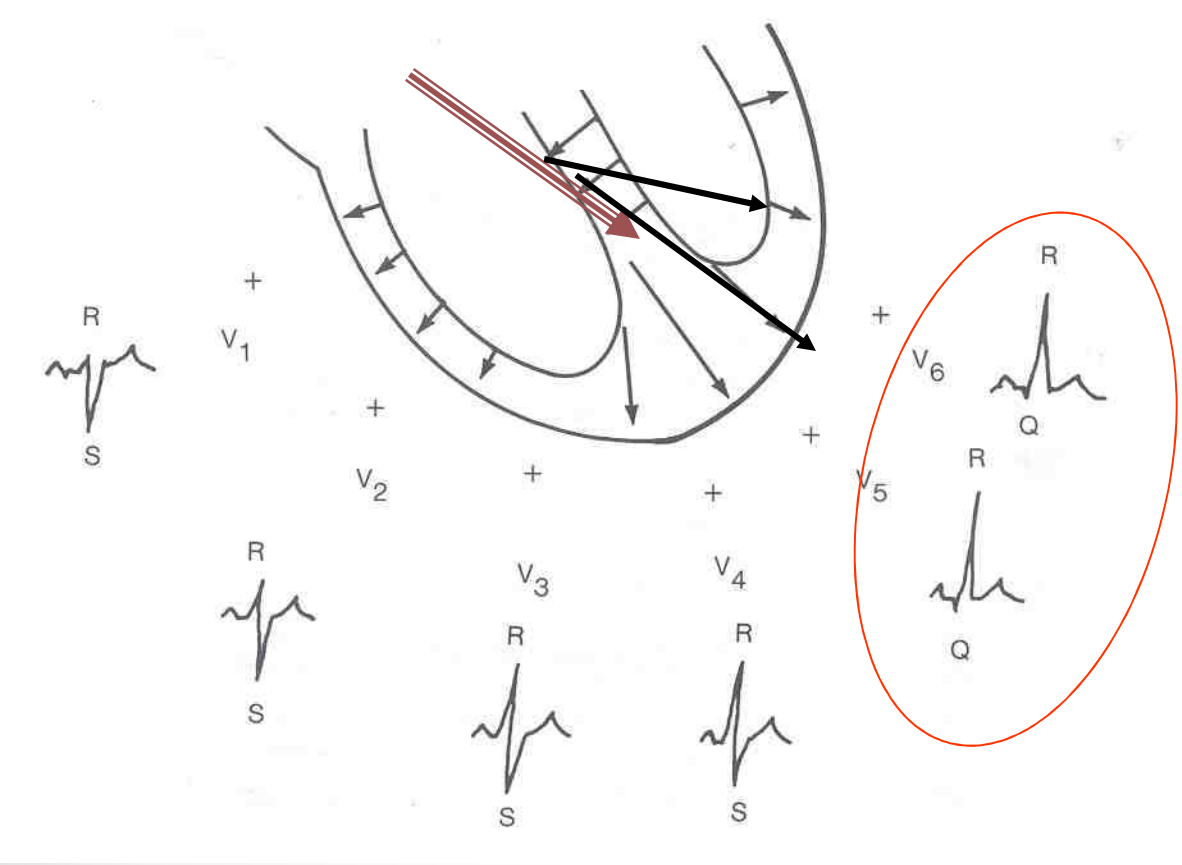
Depolarization of Precordial Leads



V3 & V4 = perpendicular so should be biphasic

Sweetwood, H. Clinical Electrocardiography for Nurses. 1983

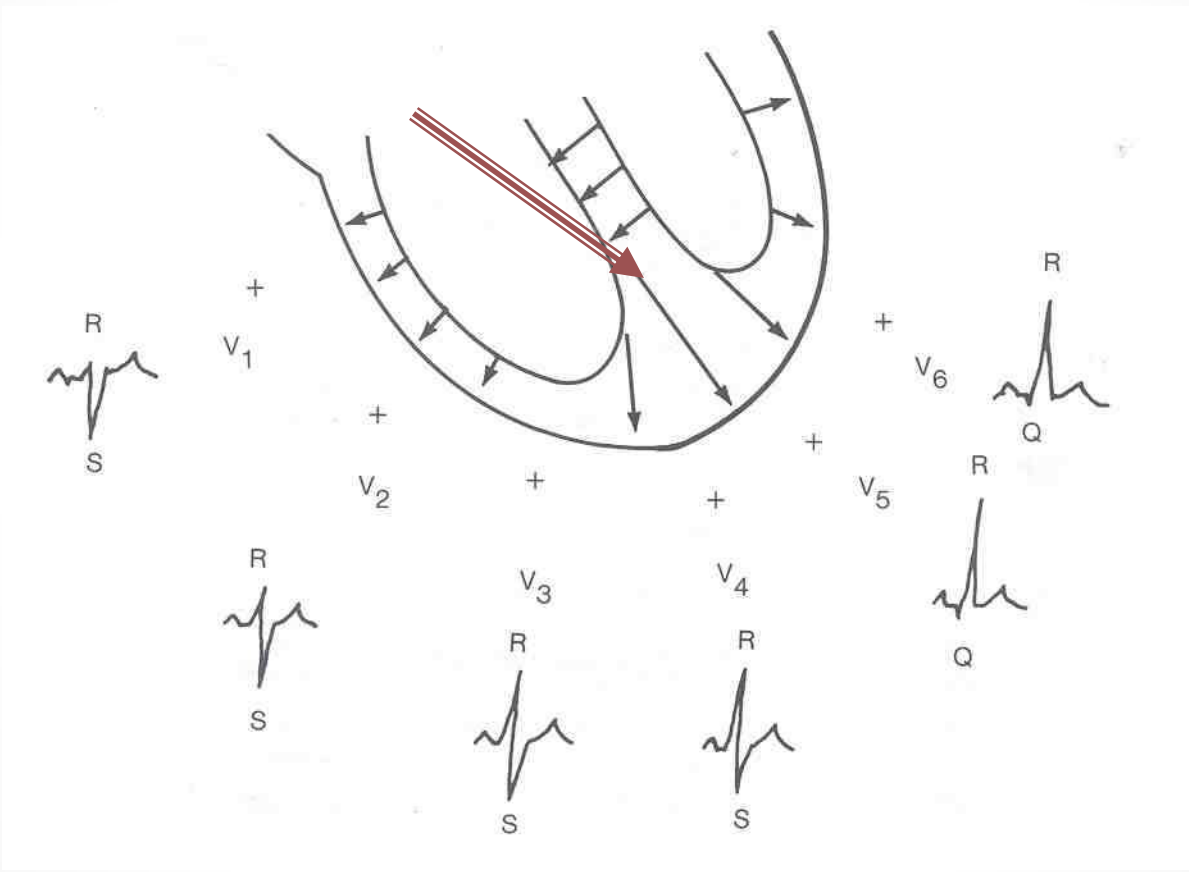
Depolarization of Precordial Leads



V5 & V6 = towards so positive

Sweetwood, H. Clinical Electrocardiography for Nurses. 1983

Depolarization of Precordial Leads

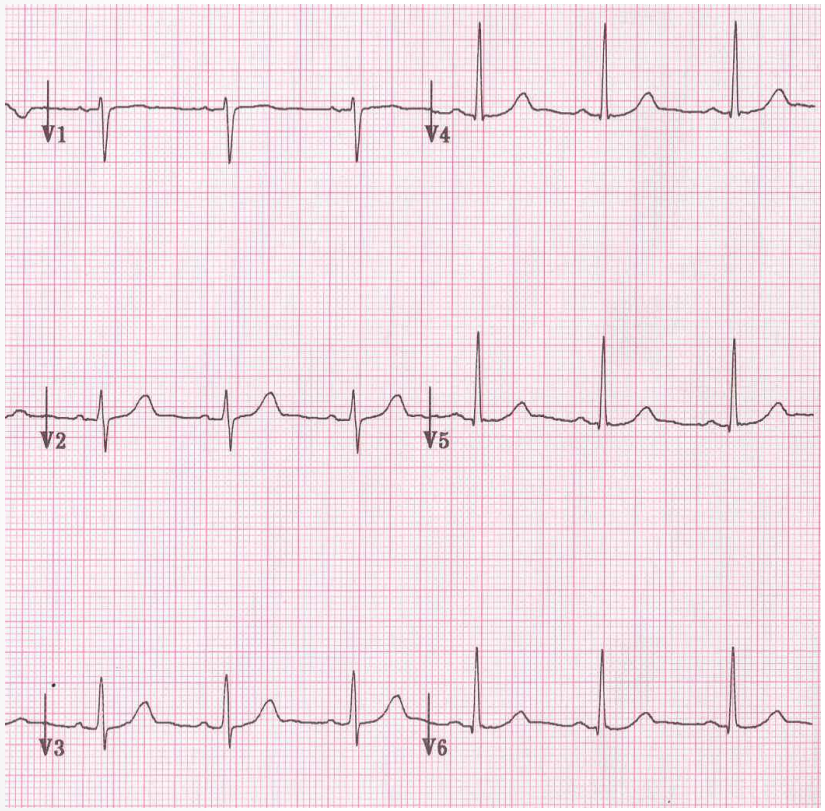


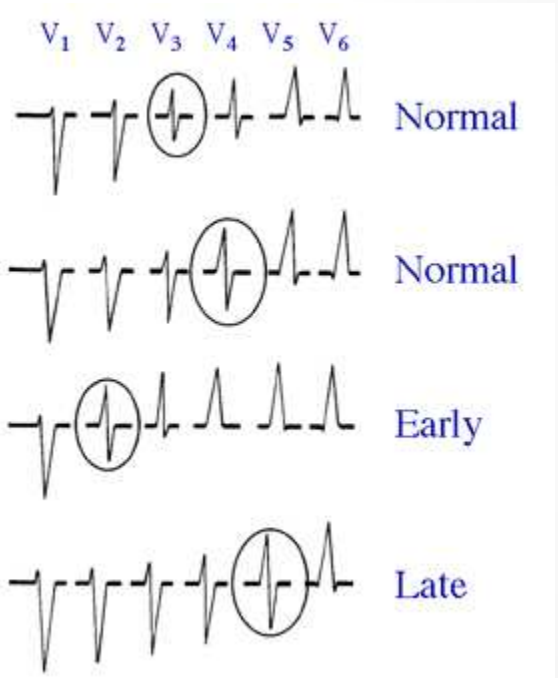
Sweetwood, H. Clinical Electrocardiography for Nurses. 1983

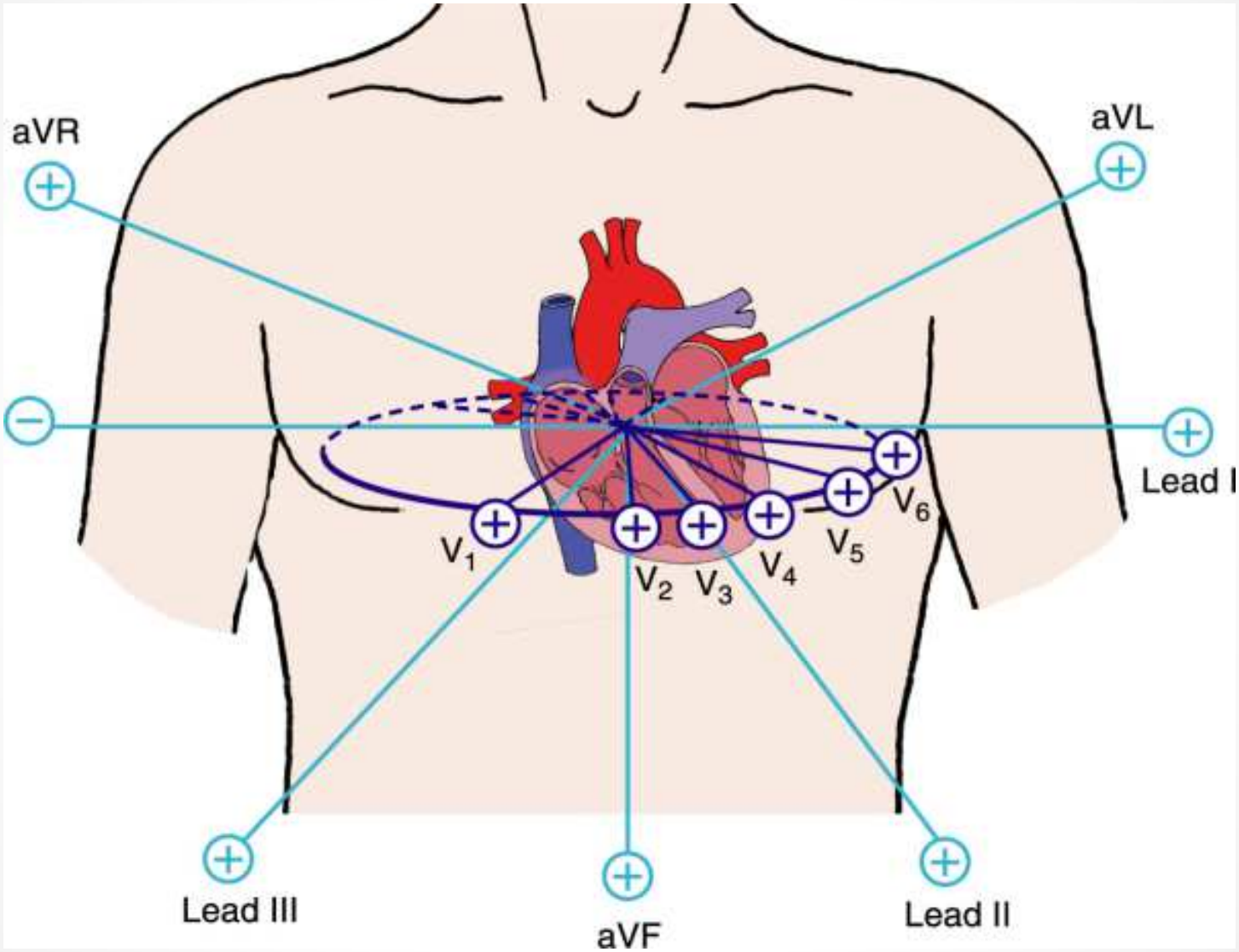
R Wave Transition

Indicates if the heart is depolarizing normally

R wave: Rises above baseline



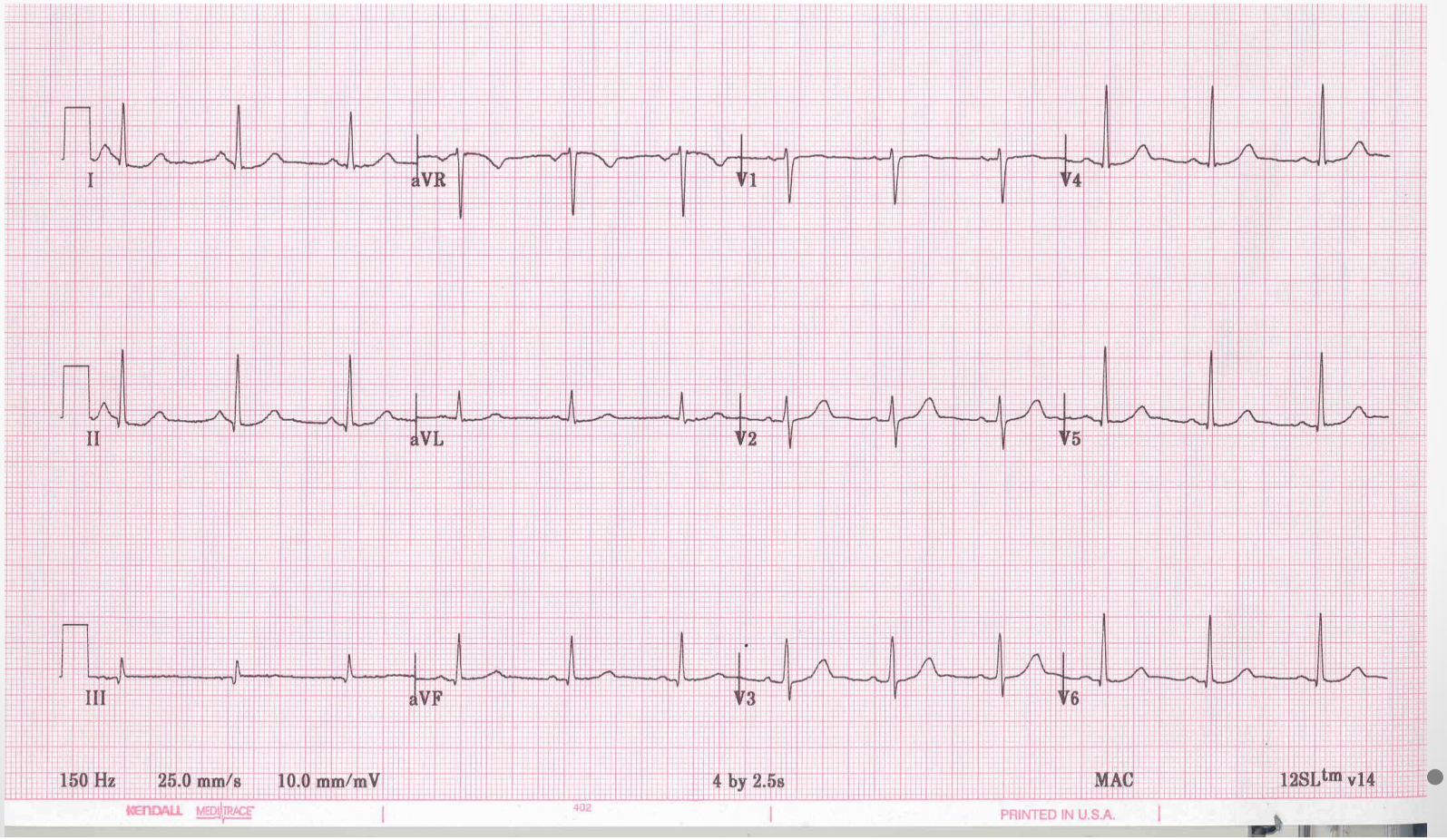



aVR
aVL
Lead I
V1
V2
V3
V4
V5
V6
Lead III
aVF
Lead II

12 Lead EKG 101

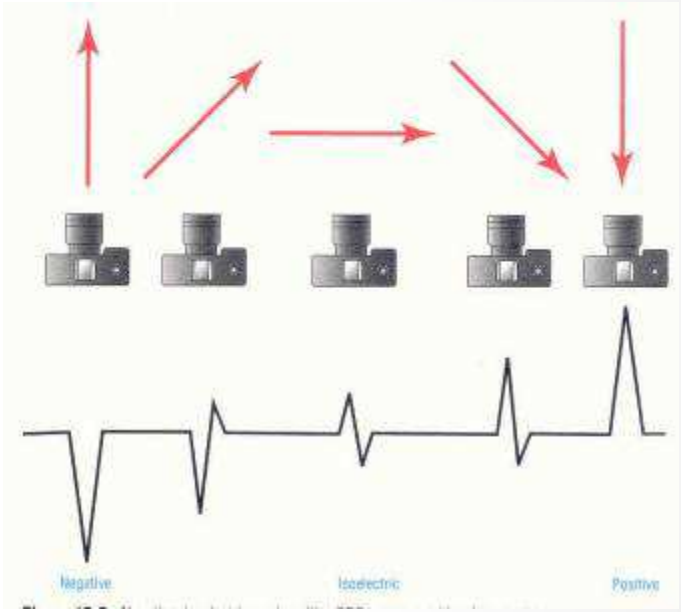
Learn the *Normal* so you can detect the abnormal

- **Is the EKG depolarizing normally**



Vectors and Leads
Depolarization parade

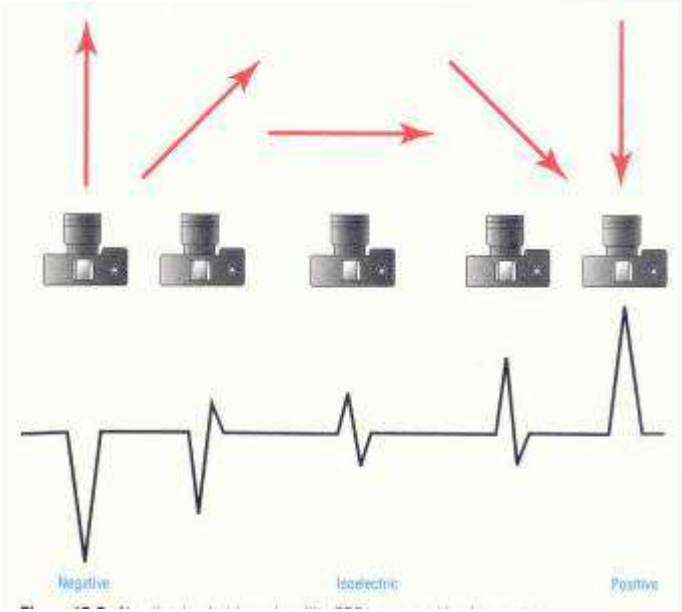
- **A vector moving toward an electrode is represented as a positive wave.**
  - **In a parade things moving towards the camera see the front or positive**
- **A vector moving away from an electrode is represented as a negative wave.**
  - **In a parade things moving away from the camera are the back or negative**



Source: Garcia. 12 Lead ECG 12:9

Normal Depolarization Review

- If the wave is moving towards the positive electrode or where the camera is, the wave will be positive
- If the wave is moving away from positive electrode, the wave will be negative
- If the wave is perpendicular to the positive electrode then can get a little positive or a little negative or biphasic complex



Source: Garcia. 12 Lead ECG 12:9

Normal Depolarization Review

Leads I, II, III

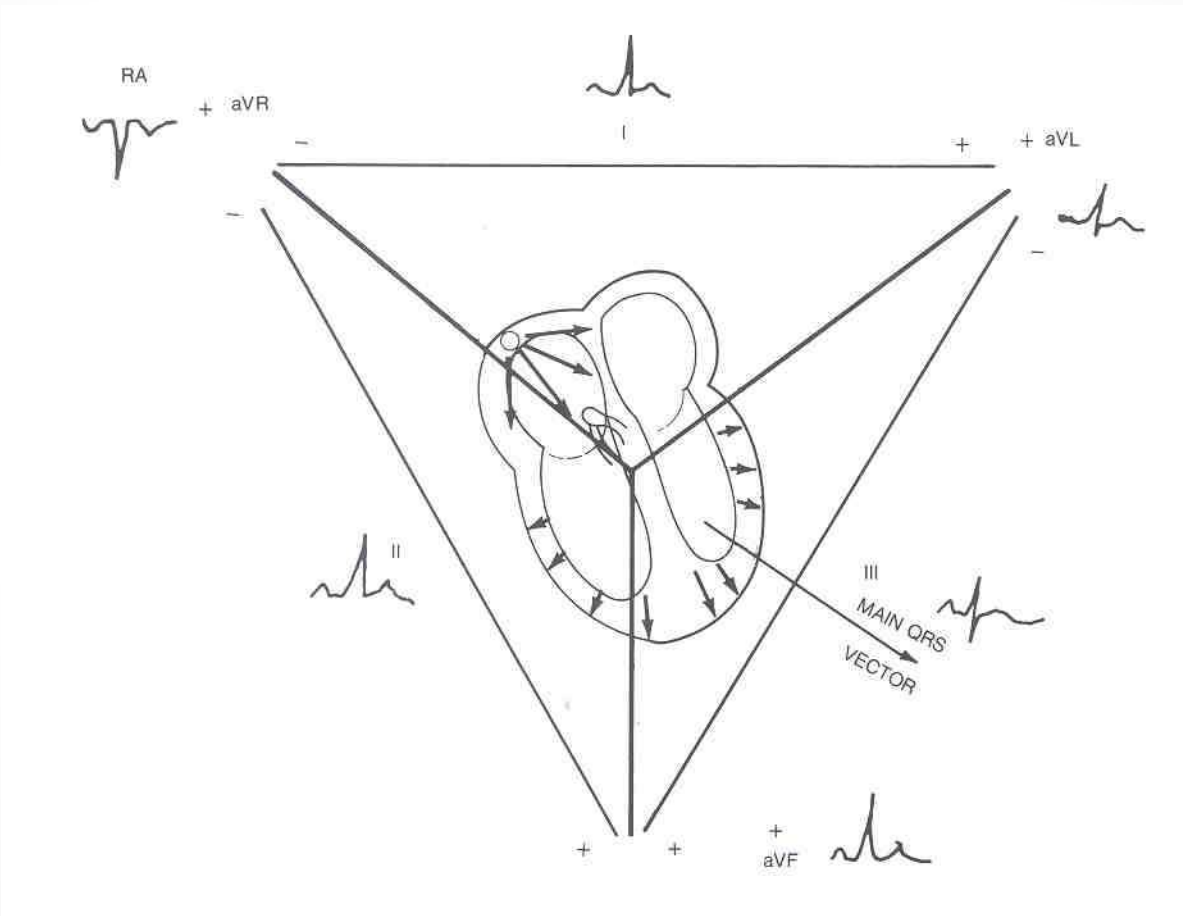
- **Lead I & II --- Everything positive**
- **Lead III – mostly positive – can be biphasic**

Normal Depolarization Review

AVR, AVL, AVF

- **AVR – Negative : Positive electrode on right shoulder and depolarize away from there creating a negative wave**
- **AVL – Camera perpendicular- may be up or down or biphasic**
- **AVF -- Positive**

Depolarization of limb & augmented leads



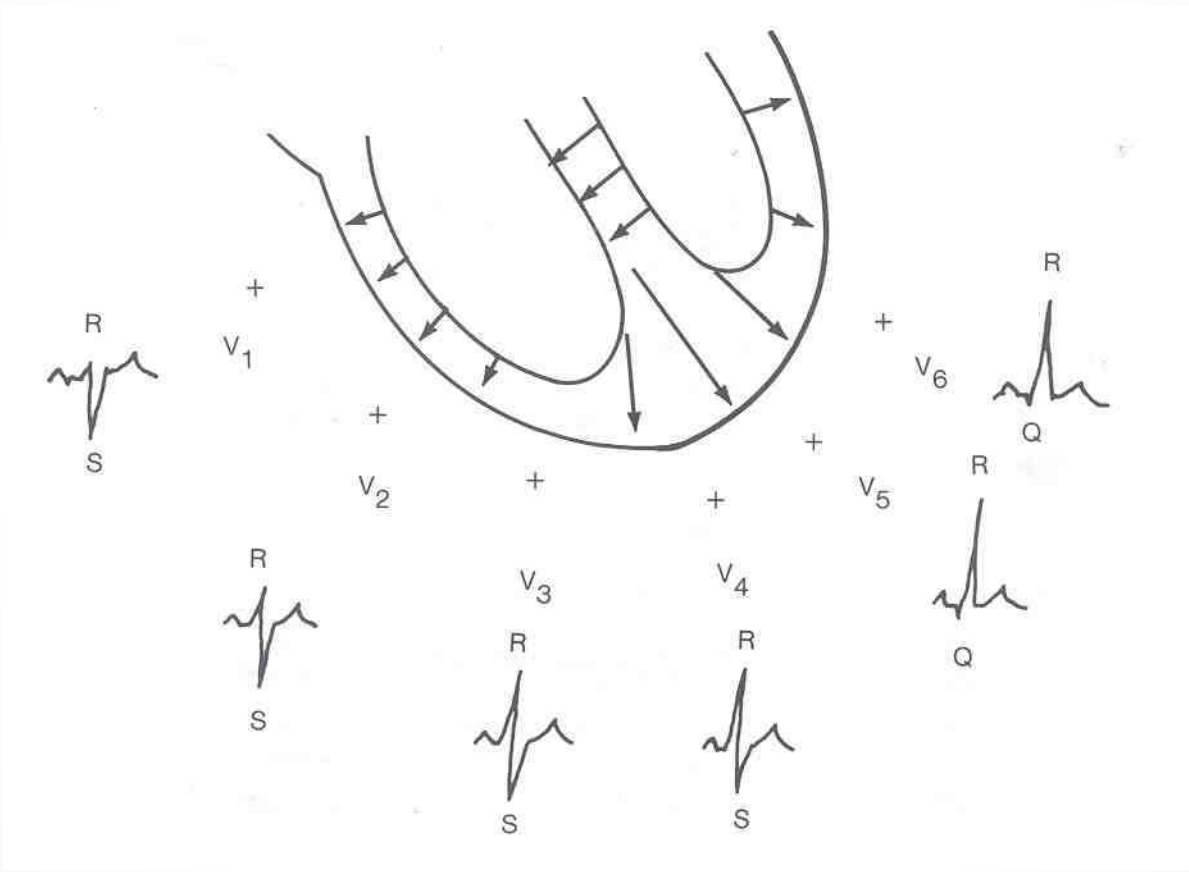
Sweetwood, H. Clinical Electrocardiography for Nurses. 1983

Normal Depolarization Review

Precordial Leads

- **V1 & V2 = moving away from positive electrode so should be negative**
- **V3 & V4 = perpendicular so should be biphasic**
- **V5 & V6 = towards so positive**

Depolarization of Precordial Leads



Sweetwood, H. Clinical Electrocardiography for Nurses. 1983

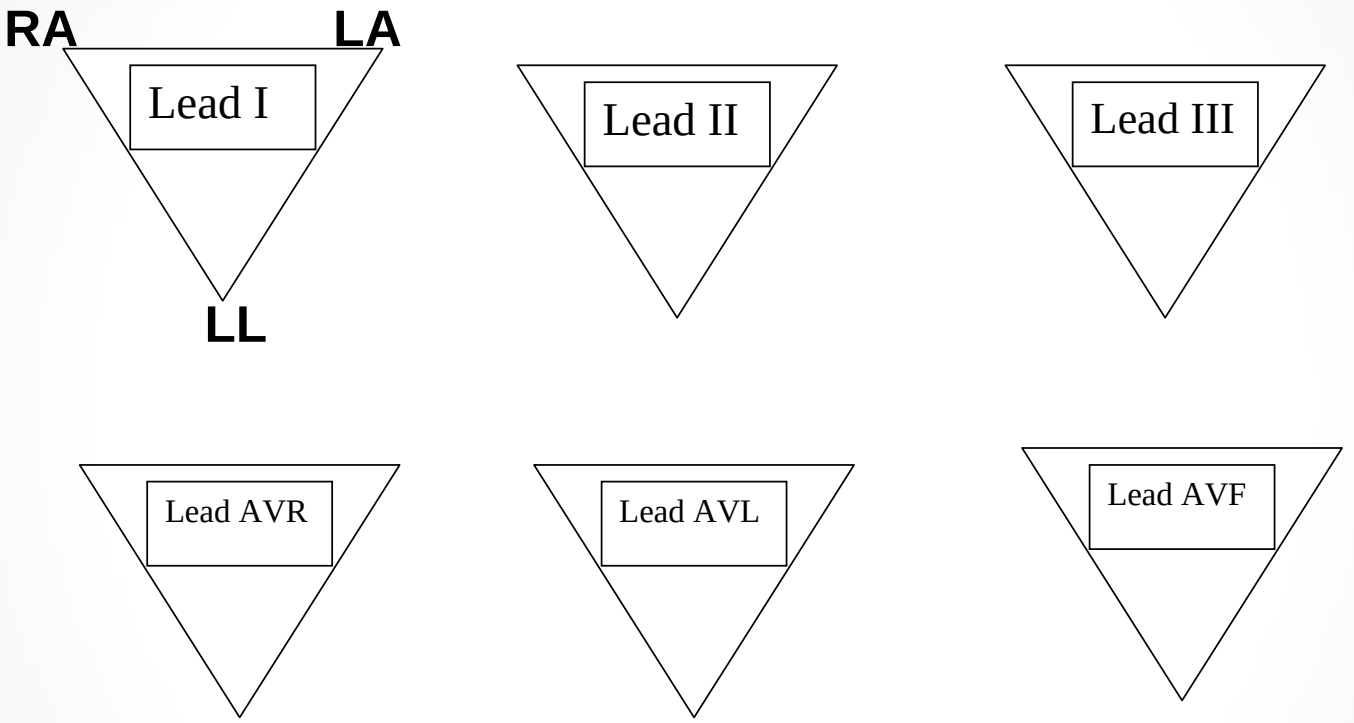
Normal EKG Depolarization

I ↑	**AVR** ↓	**V1** ↓	**V4** **Biphasic**
II ↑	**AVL** ↑ **or** ↓	**V2** ↓	**V5** ↑
III ↑	**AVF** ↑	**V3** **Biphasic**	**V6** ↑

Practice & Application Time

Practice Time:

1. Label the positive and negative poles in the limb leads
2. Label the positive poles appropriately for the augmented leads



Complete pages 75,76

1. List the correct placement of the positive pole in each chest lead.
   - V1
   - V2
   - V4
   - V6
2. Which polarity is the QRS primarily in V1?
   Positive Negative
3. Which polarity is the QRS primarily in V6?
   Positive Negative
4. In which leads should the R wave transition occur?

Identify the Normal EKG Depolarization in each of the 12 Leads

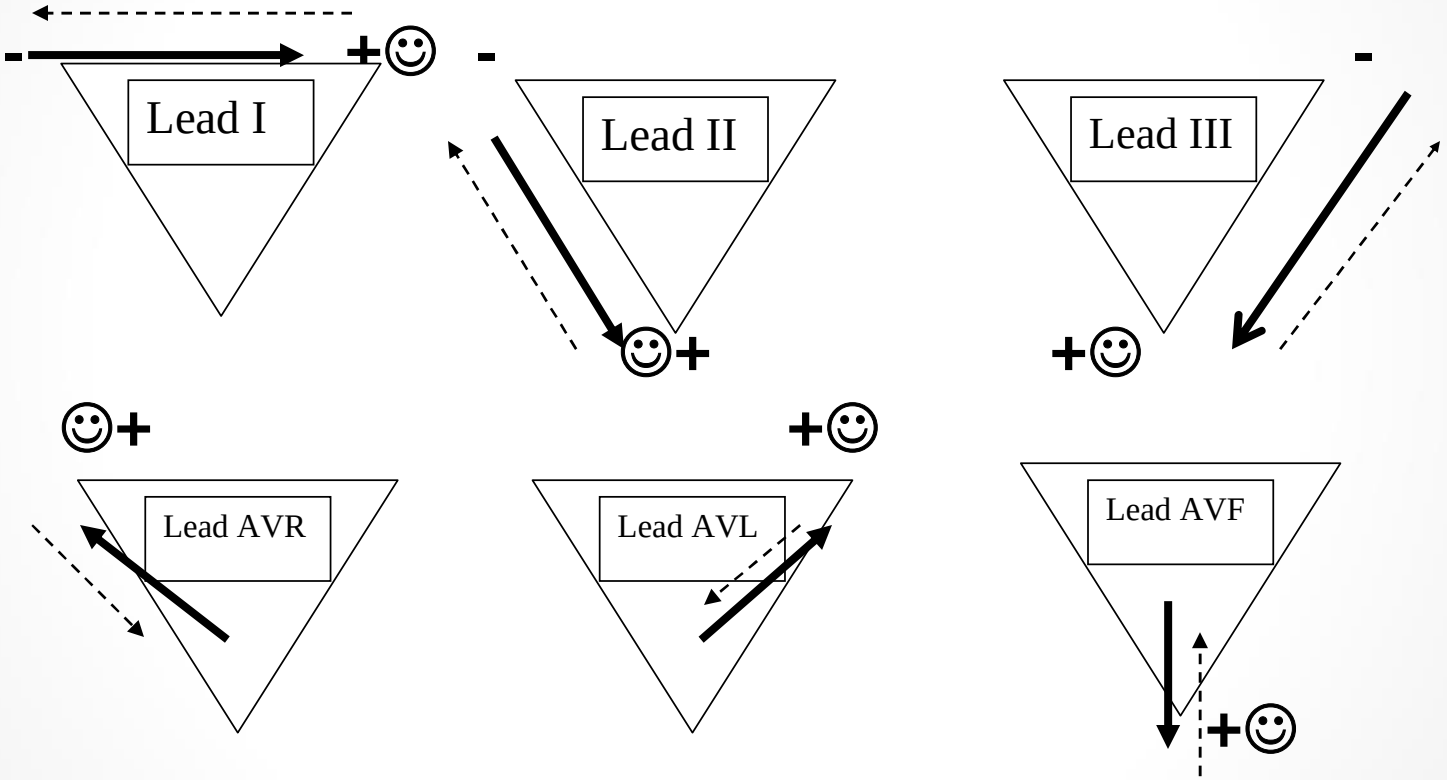
I	**AVR**	**V1**	**V4**
II	**AVL**	**V2**	**V5**
III	**AVF**	**V3**	**V6**

Answers

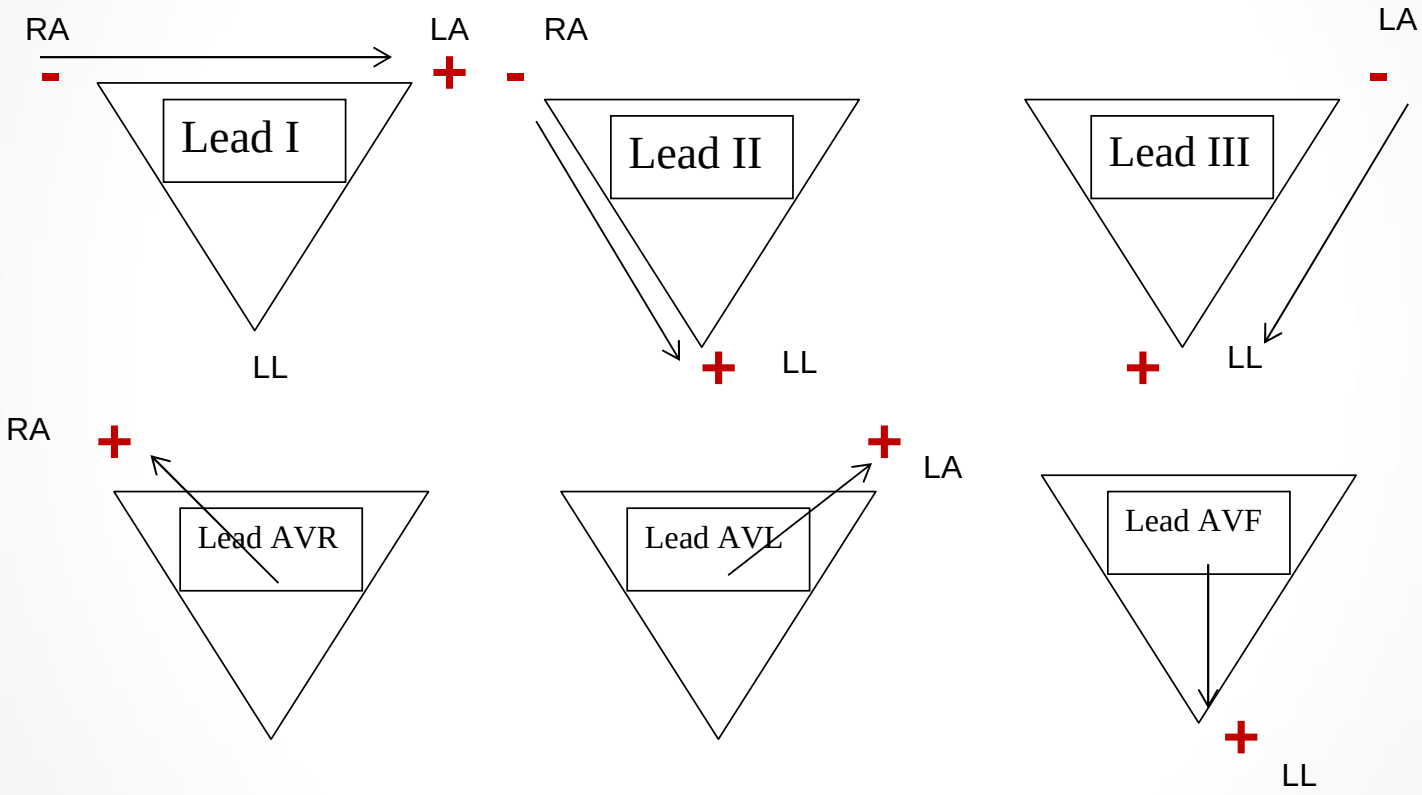
+ and – Poles Summary

☺ -----> = Camera looking from positive lead

= Direction of current Negative to Positive to get EKG complex



+ and - poles?

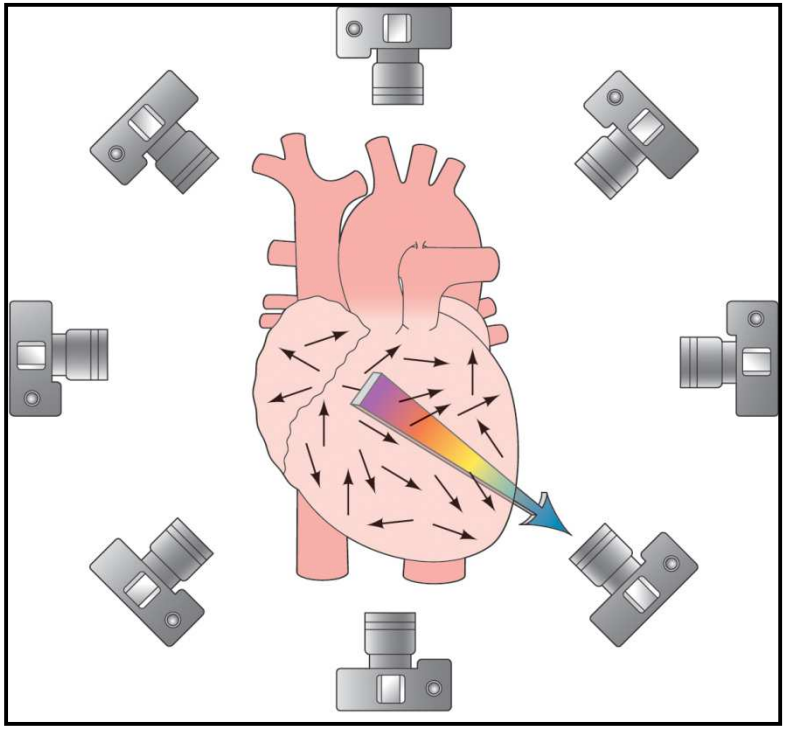

RA
LA
-
+
Lead I
LL
RA
-
Lead II
+
LL
LA
-
Lead III
+
LL
RA
+
Lead AVR
+
LA
Lead AVL
Lead AVF
+
LL

1. List the correct placement of the positive pole in each chest lead.
   - V1 4th ICS, right sternal border
   - V2 4th ICS, left sternal border
   - V4 5th ICS, mid clavicular line
   - V6 5th ICS, mid axillary line
2. Which polarity is the QRS primarily in V1?
   Positive Negative
3. Which polarity is the QRS primarily in V6?
   Positive Negative
4. In which leads should the R wave transition occur?
   V3 or V4

Normal EKG Depolarization

I ↑	**AVR** ↓	**V1** ↓	**V4** **Biphasic**
II ↑	**AVL** ↑ **or** ↓	**V2** ↓	**V5** ↑
III ↑	**AVF** ↑	**V3** **Biphasic**	**V6** ↑

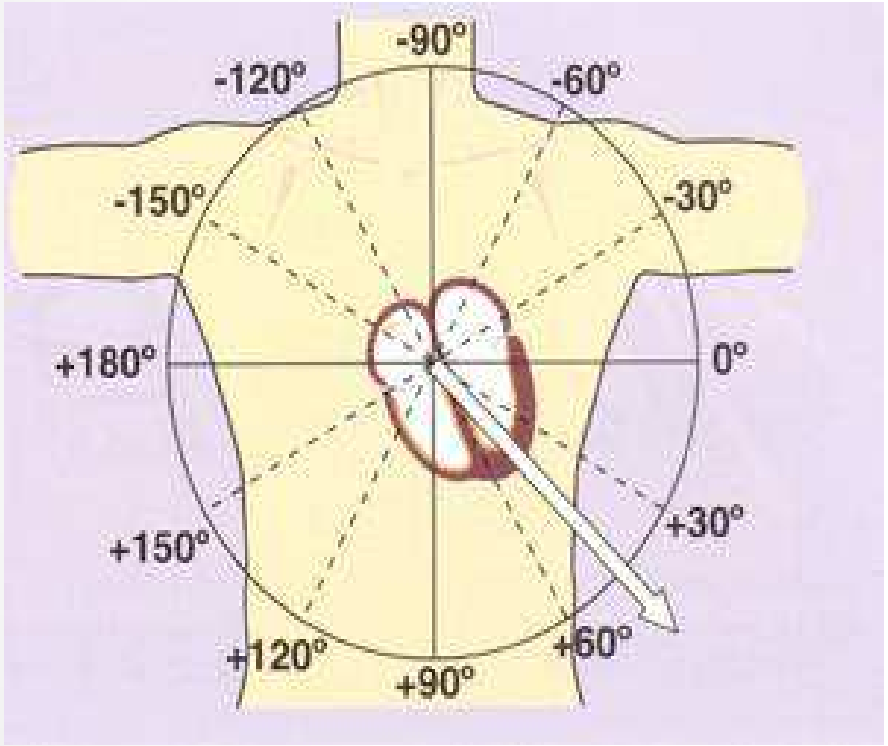
Ace the Axis - Axis Deviation

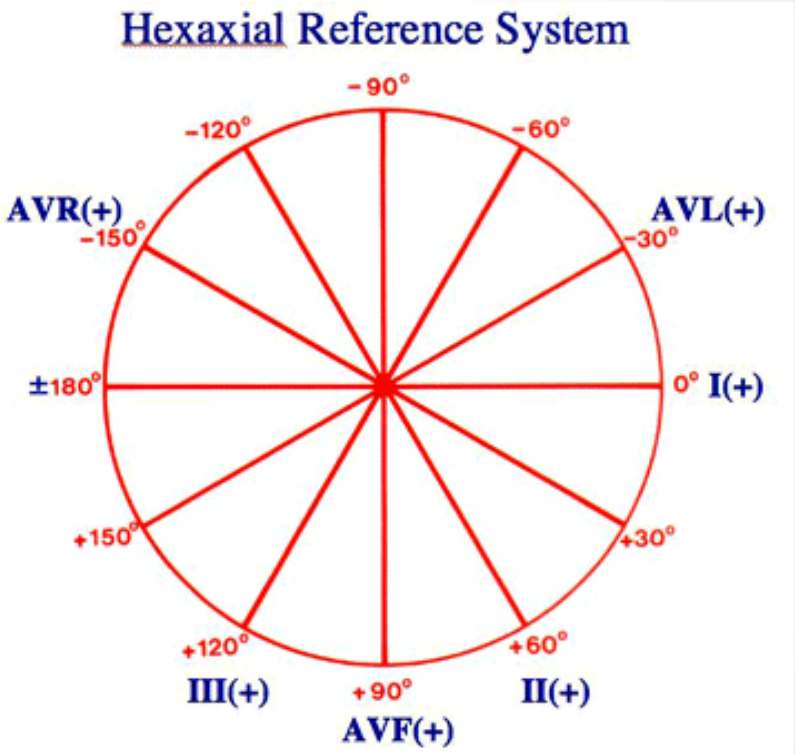


Axis

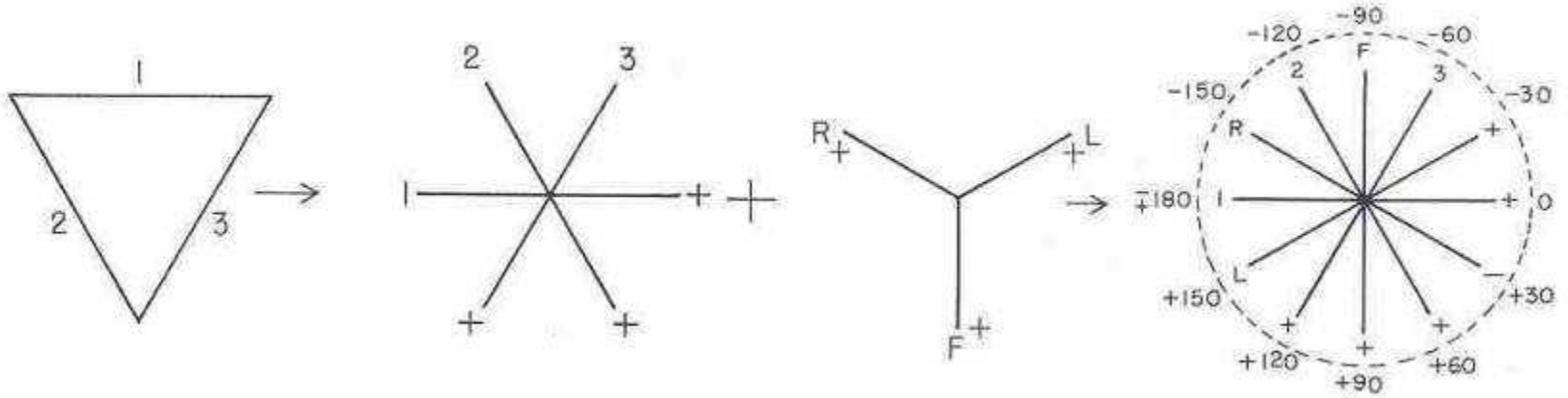
- Tells that the heart is depolarizing normally
- Average direction of mean vectors of the heart
- Described on a 360 degree wheel
- Only way an axis shift can be determined is by an ECG
- Axis shift represents an underlying problem – the axis is asymptomatic, the cause may have S/S

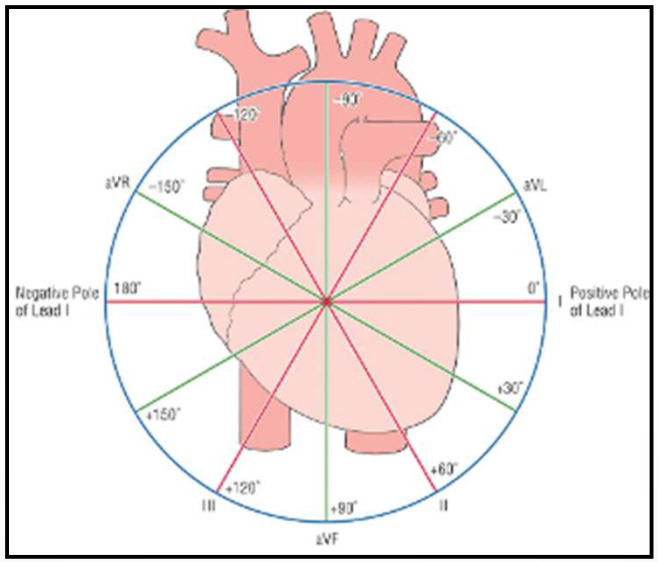
Hexaxial Reference System



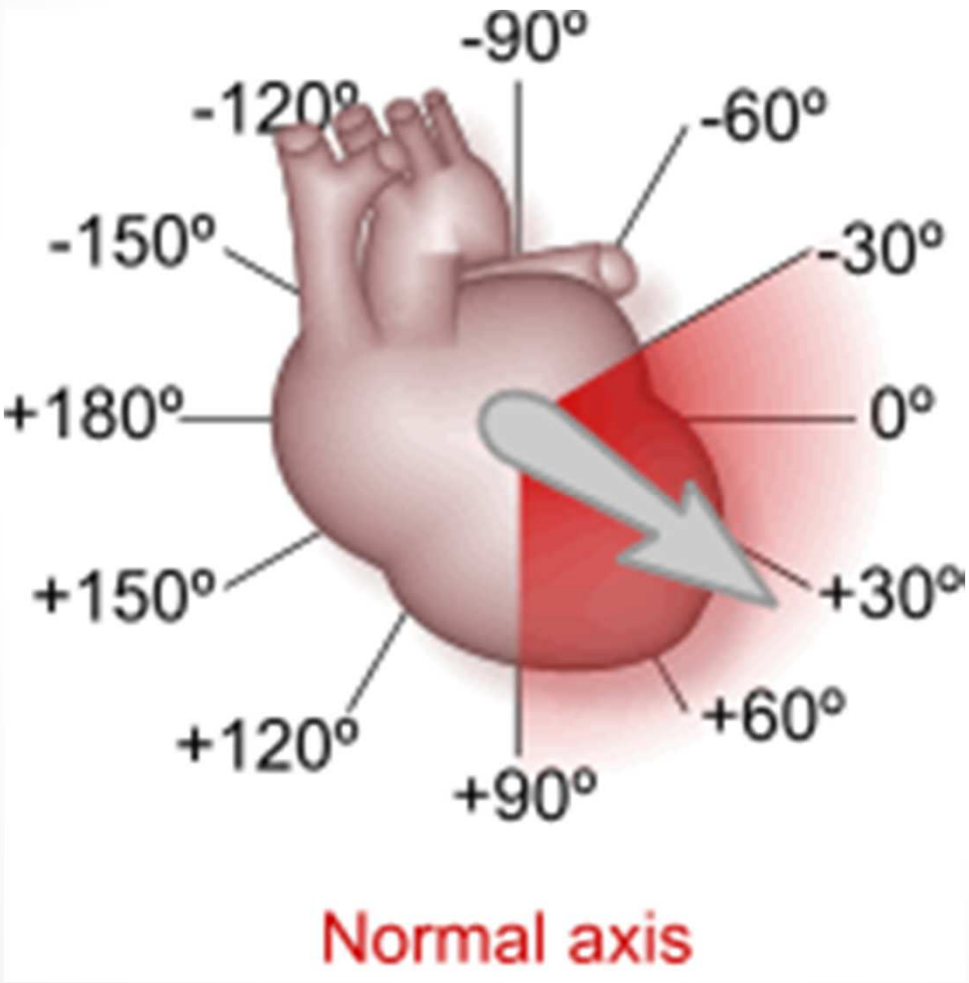


Hexaxial Reference System





Axis



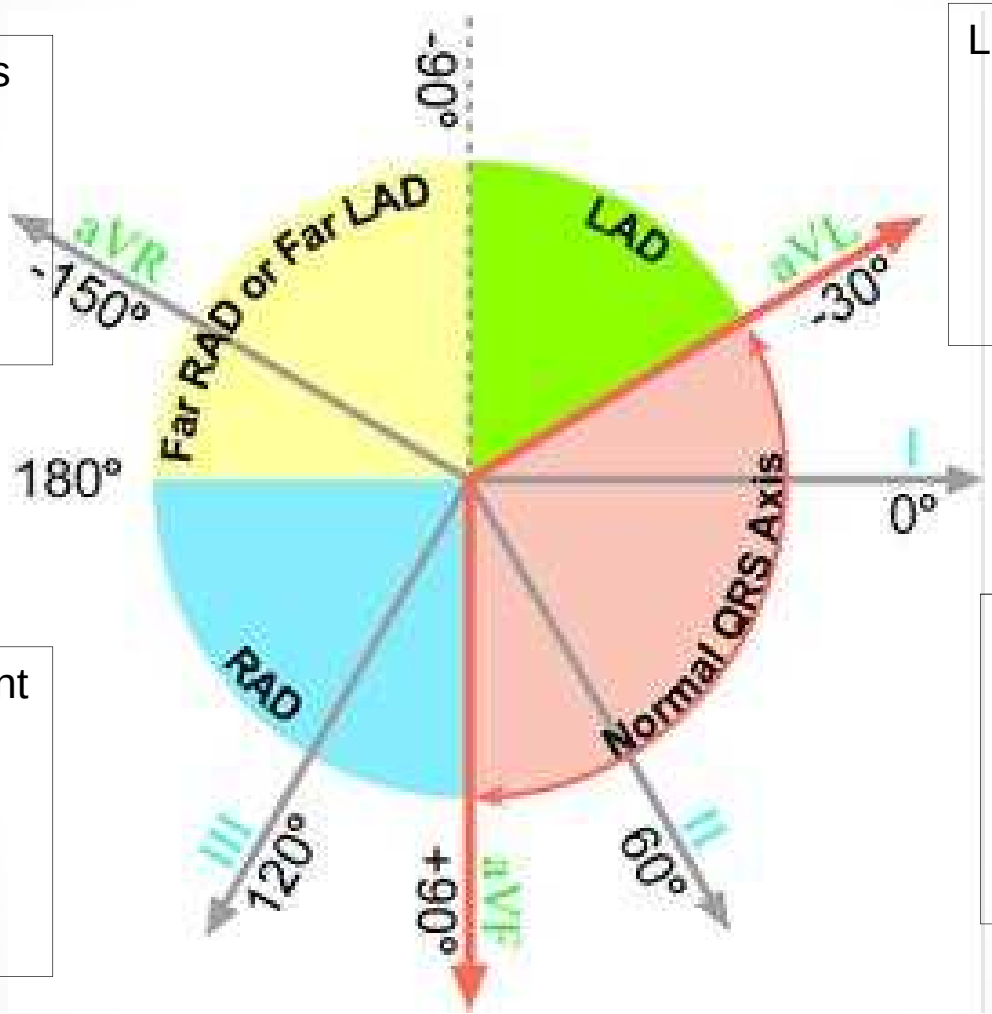
Four Quadrants of Hexaxial System

Extreme Right Axis
-90 to ±180/270

Lead I AVF

Left Axis Quadrant
-30 to - 90

Lead I AVF



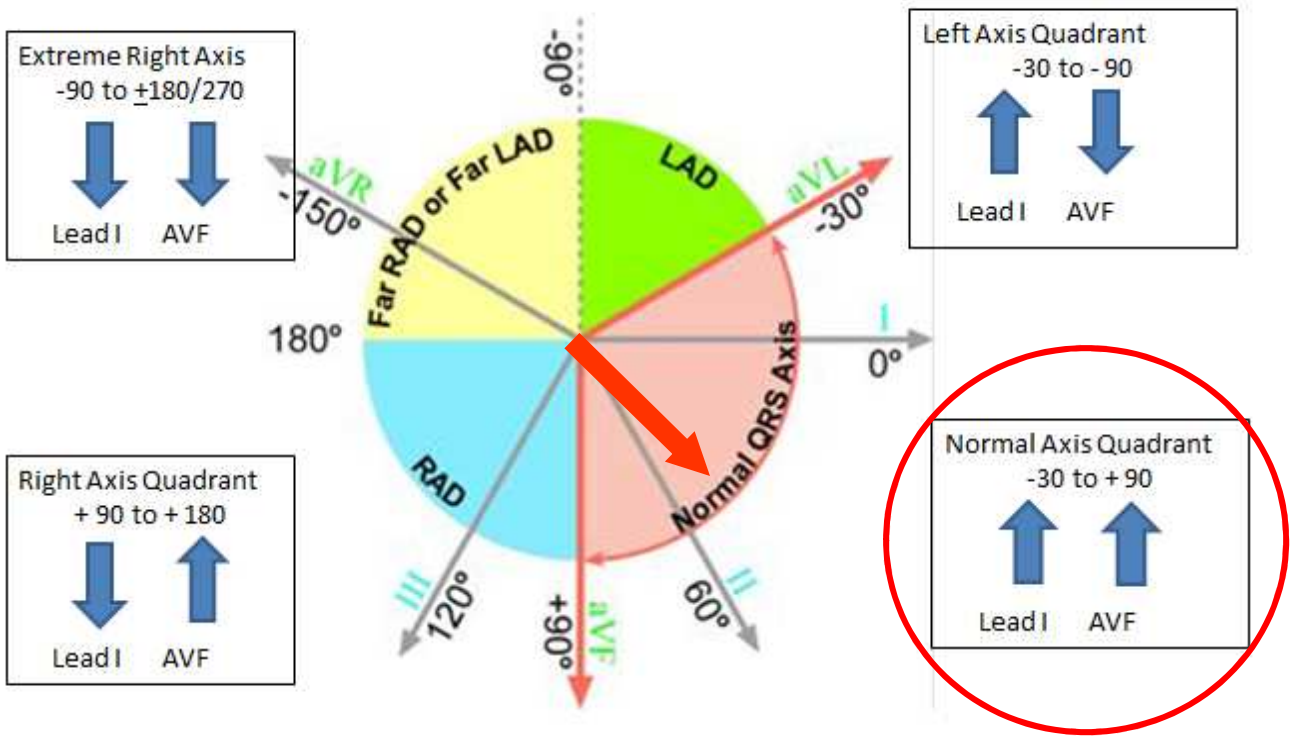
Right Axis Quadrant
+ 90 to + 180

Lead I AVF

Normal Axis Quadrant
-30 to + 90

Lead I AVF

Normal Axis



- Downward & to the left
- -30 to + 90

Alterations in Axis

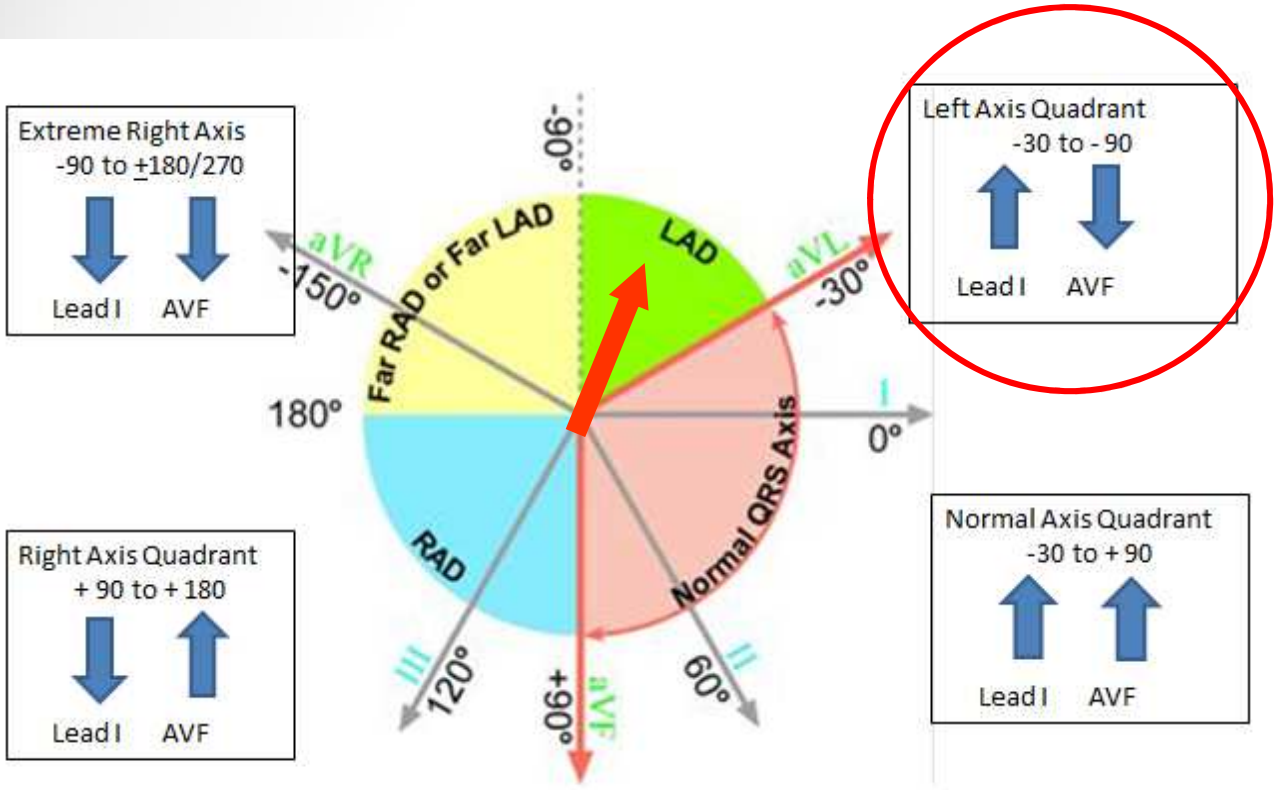
Axis shifts TOWARDS

- area of increased muscle mass – hypertrophy
- bundle branch blocks

Axis shifts AWAY

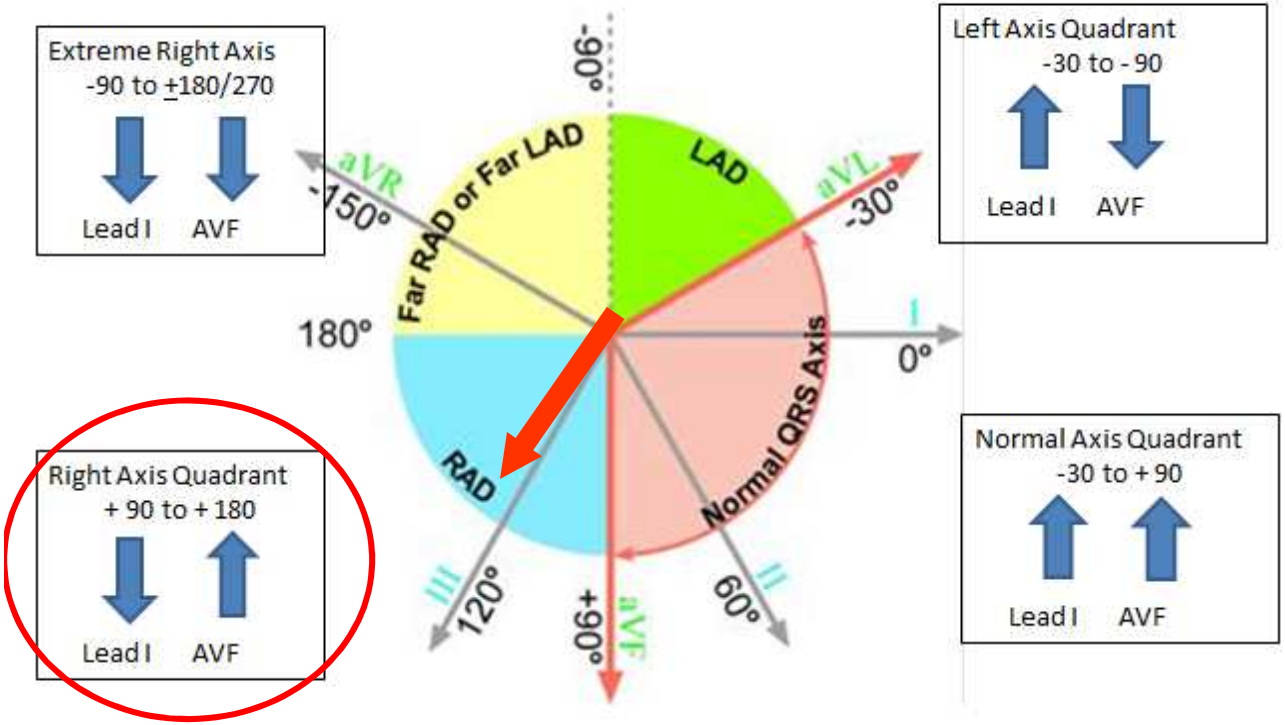
- from area of AMI
- from hemiblocks

Left Axis



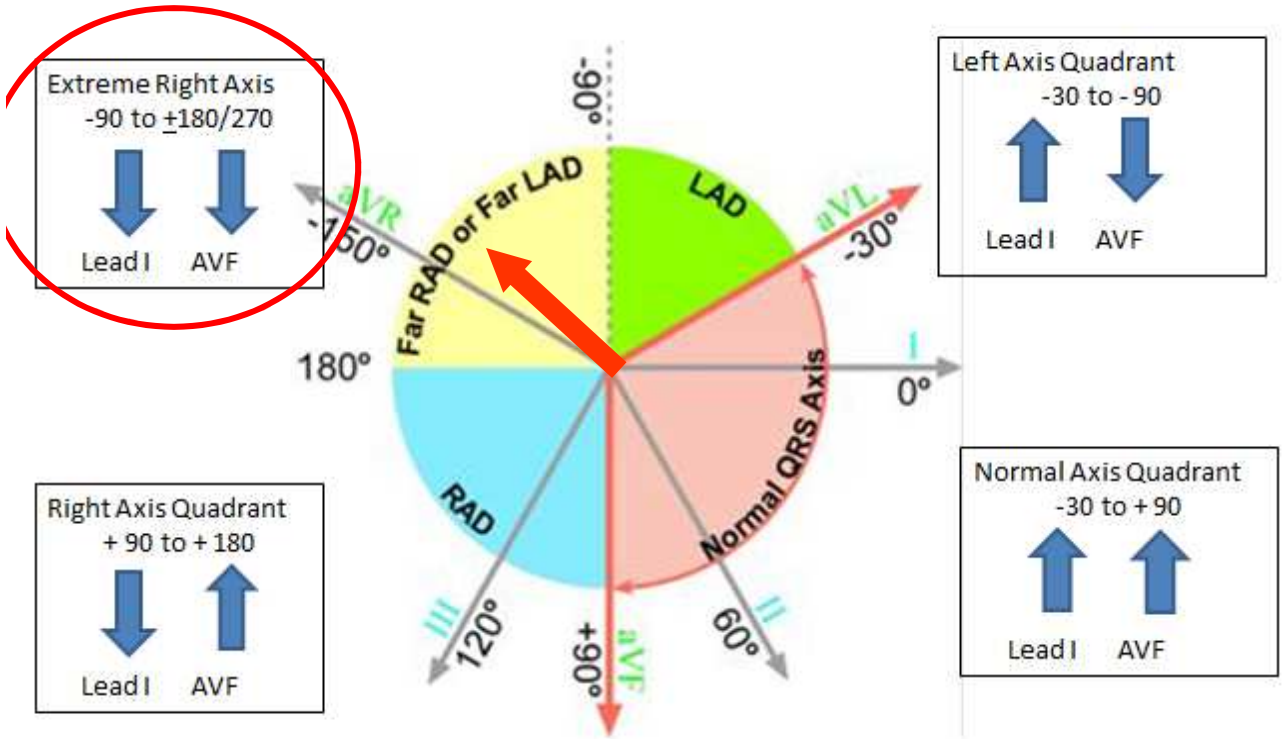
- Upward & to the left
- - 30 to – 90
- Left Ventricular Hypertrophy
- LAH. LBBB
- Inferior infarct
- Mechanical shift of the heart to more horizontal – PG, ascites, abdominal tumor
- WPW

Right Axis



- Downward & to the right
- + 90 to ± 180
- Right ventricular hypertrophy
- LPH
- Lateral infarction
- Dextrocardia
- RBBB
- PE
- Pulmonary Infarct
- Emphysema
- Anything that affects the RV

Extreme Right Axis



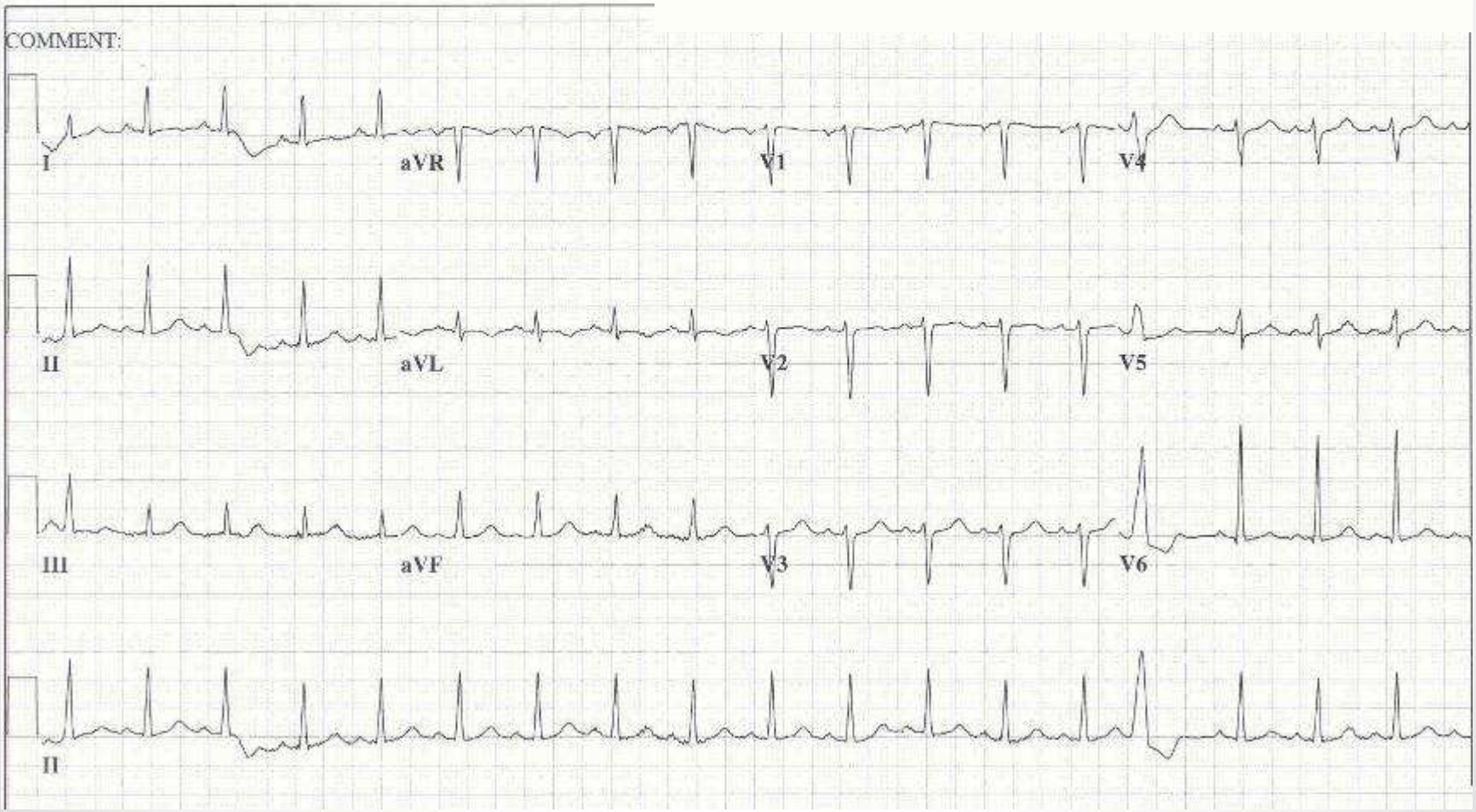
- Upward & to the right
- - 90 to ± 180/270
- Ventricular Tach
- Multiple infarctions
- Never good

Methods of Axis Determination

- Can only be determined by EKG
- Technology – electrography machine calculates

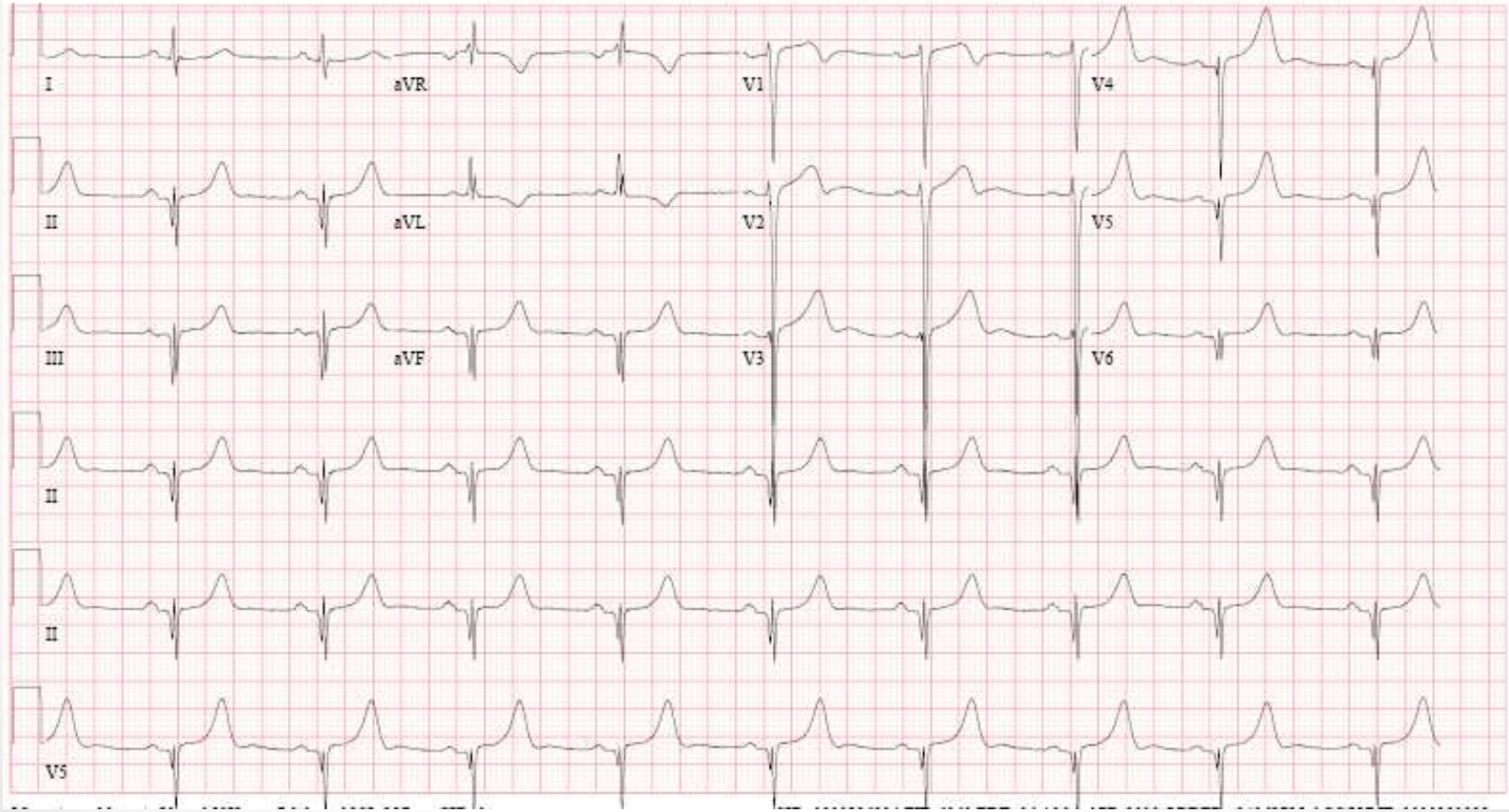
Vent. rate	110	BPM
PR interval	136	ms
QRS duration	88	ms
QT/QTc	350/473	ms
P–R–T axes	13 54	88

Axis 54 = Normal
Lead I & AVF = ↑ ↑



Vent. rate	56	BPM
PR interval	180	ms
QRS duration	110	ms
QT/QTc	498/480	ms
P-R-T axes	42 -78	79

Axis - 78 = Left Axis
Lead I & AVF = ↑ ↓



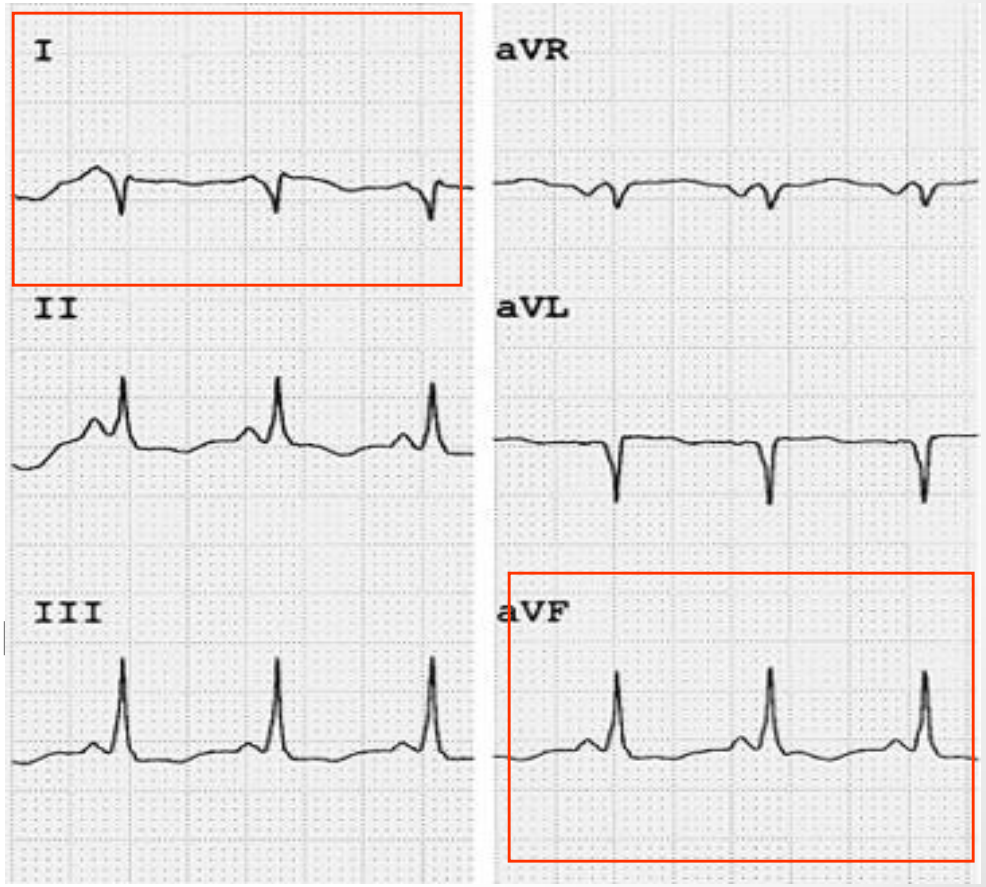
Methods of Axis Determination

- **Leads I, II, III, AVR, AVL & AVF are used**
- **Three different methods can be used for confirmation**
  - **Quadrant**
  - **Parallel**
  - **Perpendicular**

Quadrant Method

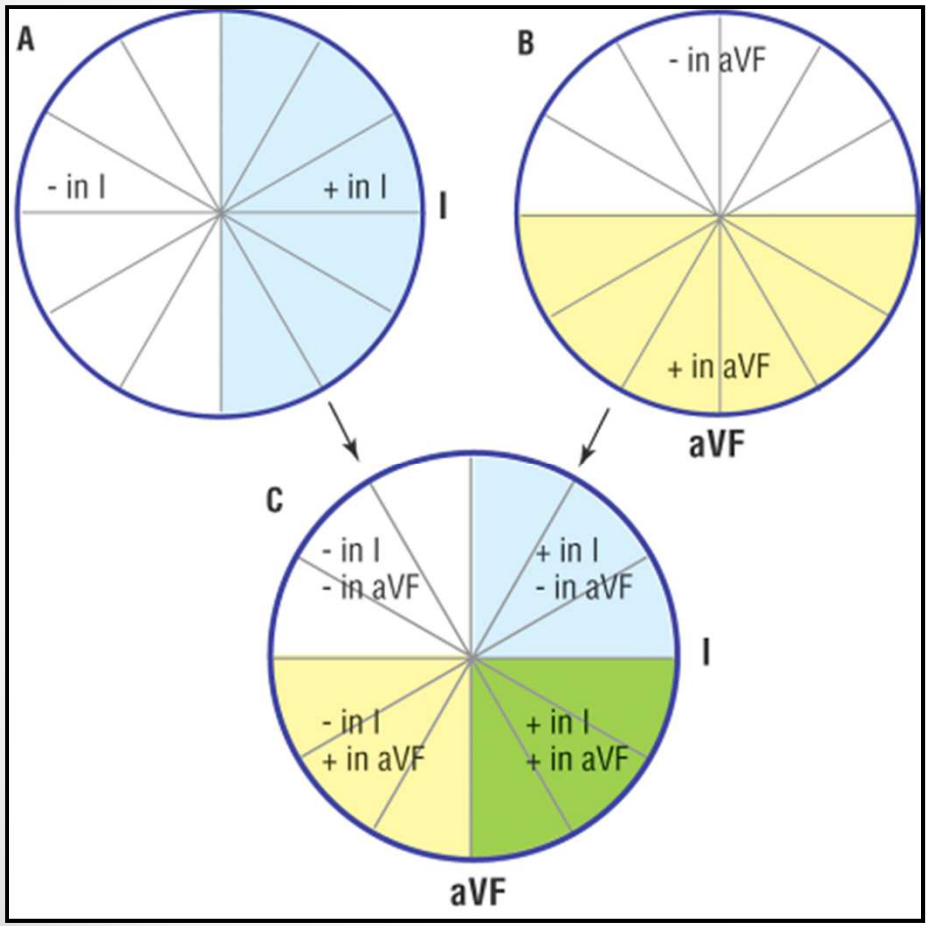
- Identify polarity of Lead I and AVF

- ↑↑ = normal axis
- ↑↓ = LAD
- ↓↑ = RAD
- ↓↓ = Extreme right o
  left



Isolating the Direction of the Axis

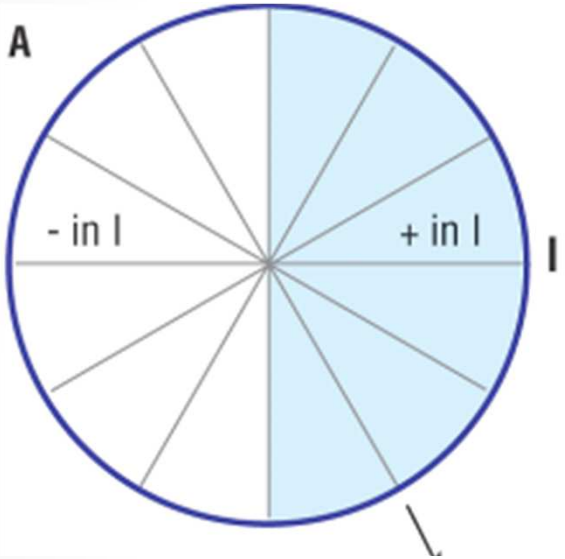
Quadrant Method



- **Lead I & AVF**
  - **Are they positive or negative?**
  - **Place in appropriate quadrant**

Quadrant Method

Step 1

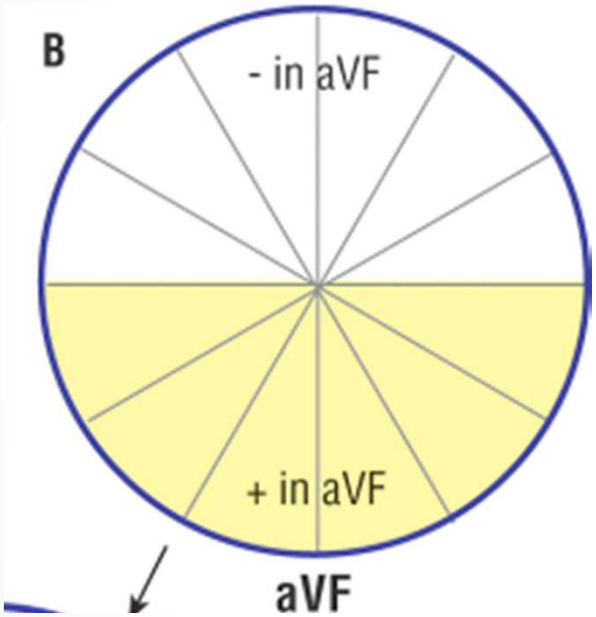


Lead I

- **Is it positive or negative?**
- **Place in appropriate quadrant**

Quadrant Method

Step II

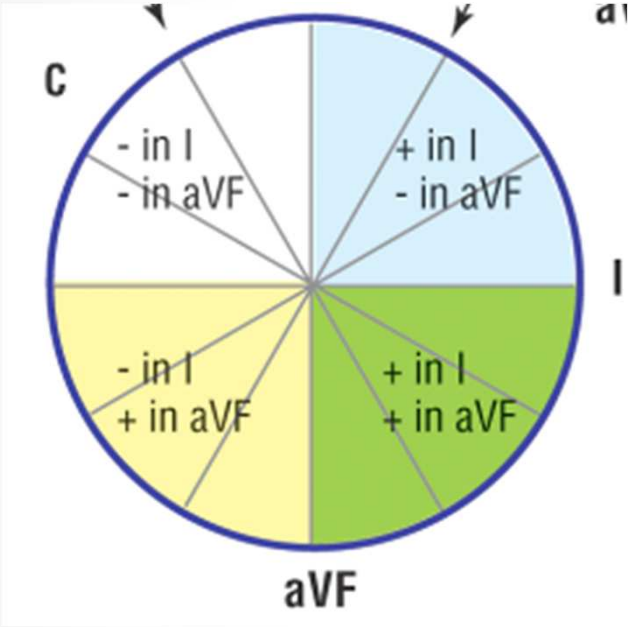


AVF

- **Is it positive or negative?**
- **Place in appropriate quadrant**

Quadrant Method

Step III



- Combine the quadrants to determine the QRS axis quadrant

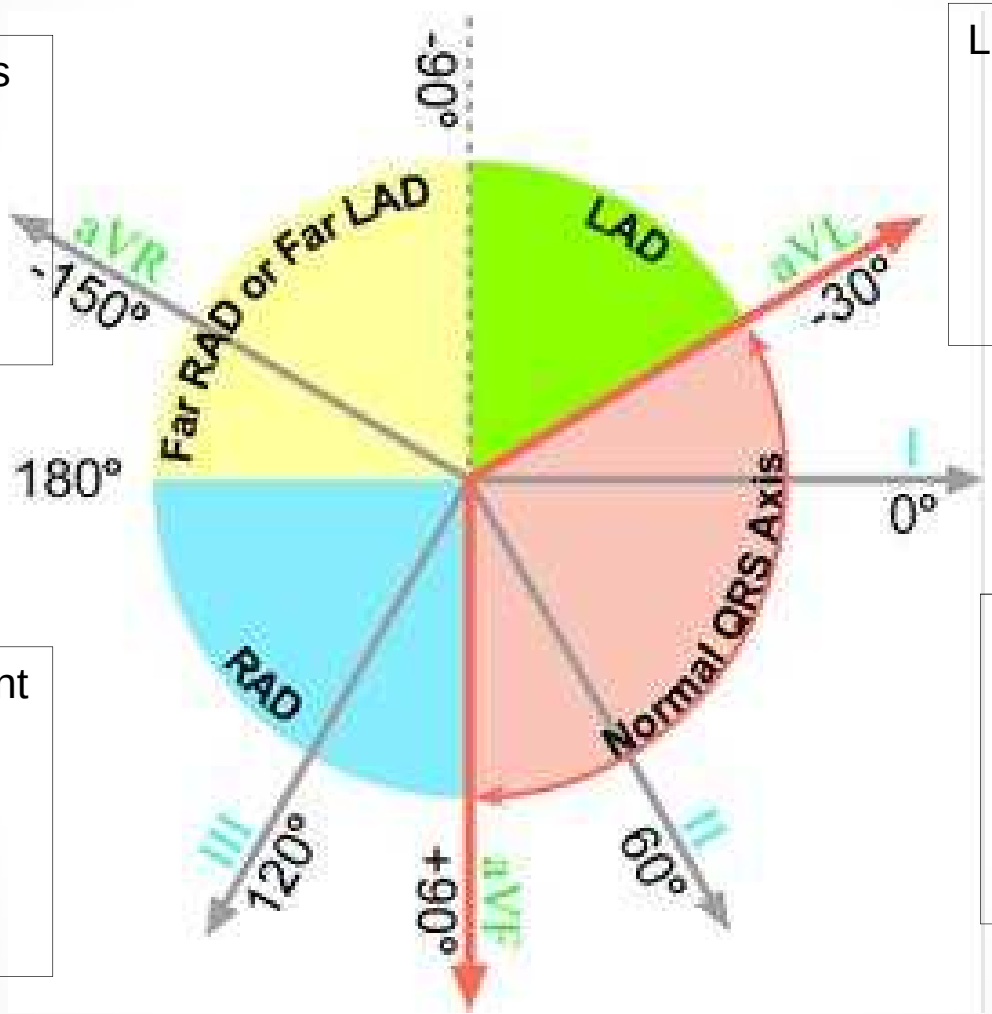
Four Quadrants of Hexaxial System

Extreme Right Axis
-90 to ±180/270

Lead I AVF

Left Axis Quadrant
-30 to - 90

Lead I AVF



Right Axis Quadrant
+ 90 to + 180

Lead I AVF

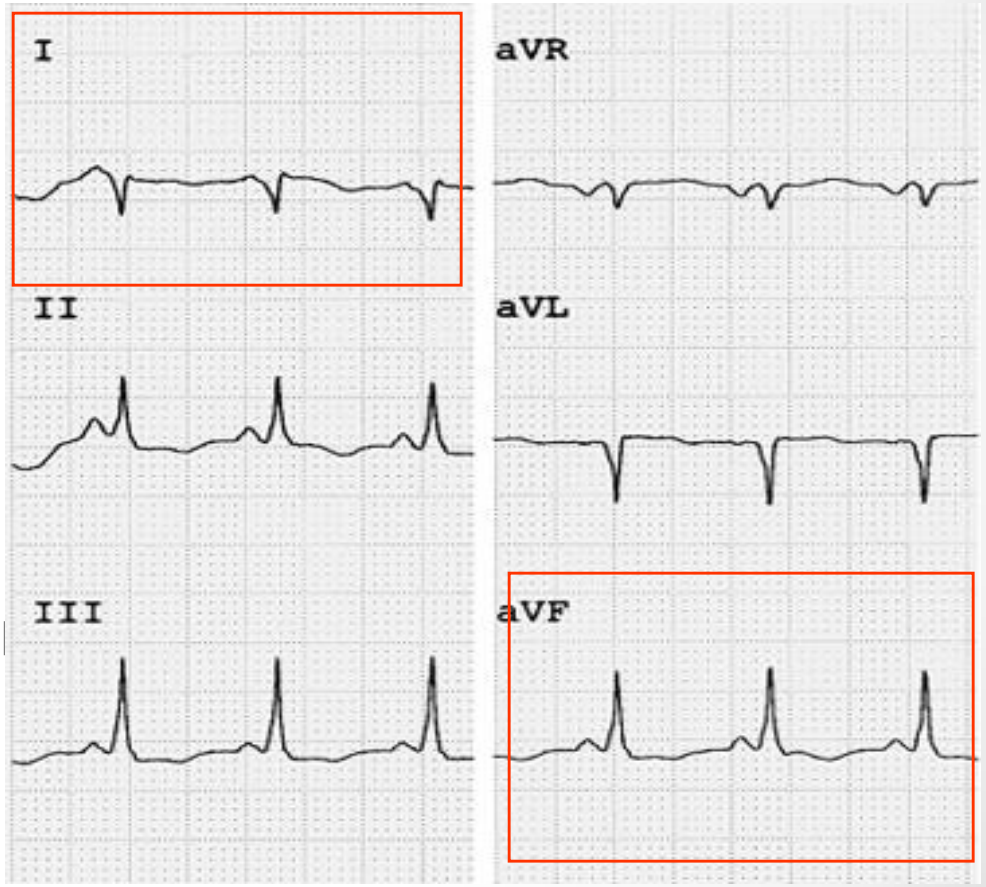
Normal Axis Quadrant
-30 to + 90

Lead I AVF

Quadrant Method

- Identify polarity of Lead I and AVF

- ↑↑ = normal axis
- ↑↓ = LAD
- ↓↑ = RAD
- ↓↓ = Extreme right o
  left



Thumb Method

Normal Axis

- Lead I – Positive
- Left thumb up

- AVF – Positive
- Right thumb up

Left Axis

- Lead I – Positive
- **Left thumb up**

- AVF – Negative
- Right thumb down

Right Axis

- Lead I – Negative
- Left thumb down

- AVF – Positive
- **Right thumb up**

Extreme Axis

- Lead I –Negative
- Left thumb down

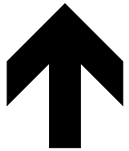
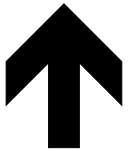
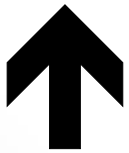
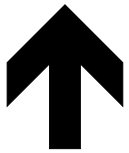
- AVF – Negative
- Right thumb down

Practice & ApplicationTime

Indicate if Lead I and AVF are ↑ or ↓

Axis **Degrees**	**Normal**	**Left**	**Right**	**Extreme right**
Lead I				
AVF				

Axis Summary

Axis	Normal - 30 to +90	Left -30 to - 90	Right +90 to ±180	Extreme -90 to ±180/270
Lead I				
AVF				

Left Apart Right Together

Alterations in Axis

Match Column A with B

Column A

Axis shifts AWAY

Axis shifts TOWARDS

Column B

- **area of increased muscle mass – hypertrophy**
- **from area of AMI**
- **from hemiblocks**
- **bundle branch blocks**

Alterations in Axis

Axis shifts TOWARDS

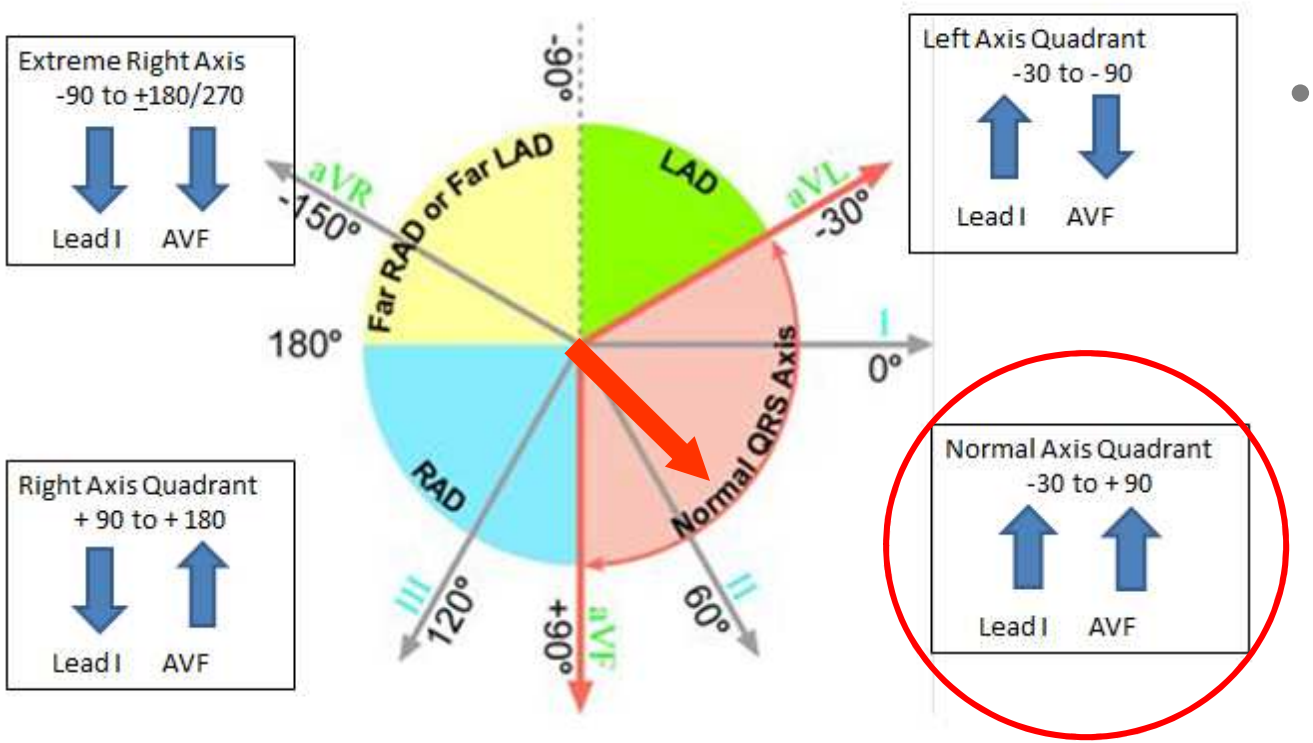
- area of increased muscle mass – hypertrophy
- bundle branch blocks

Axis shifts AWAY

- from area of AMI
- from hemiblocks

Normal Axis

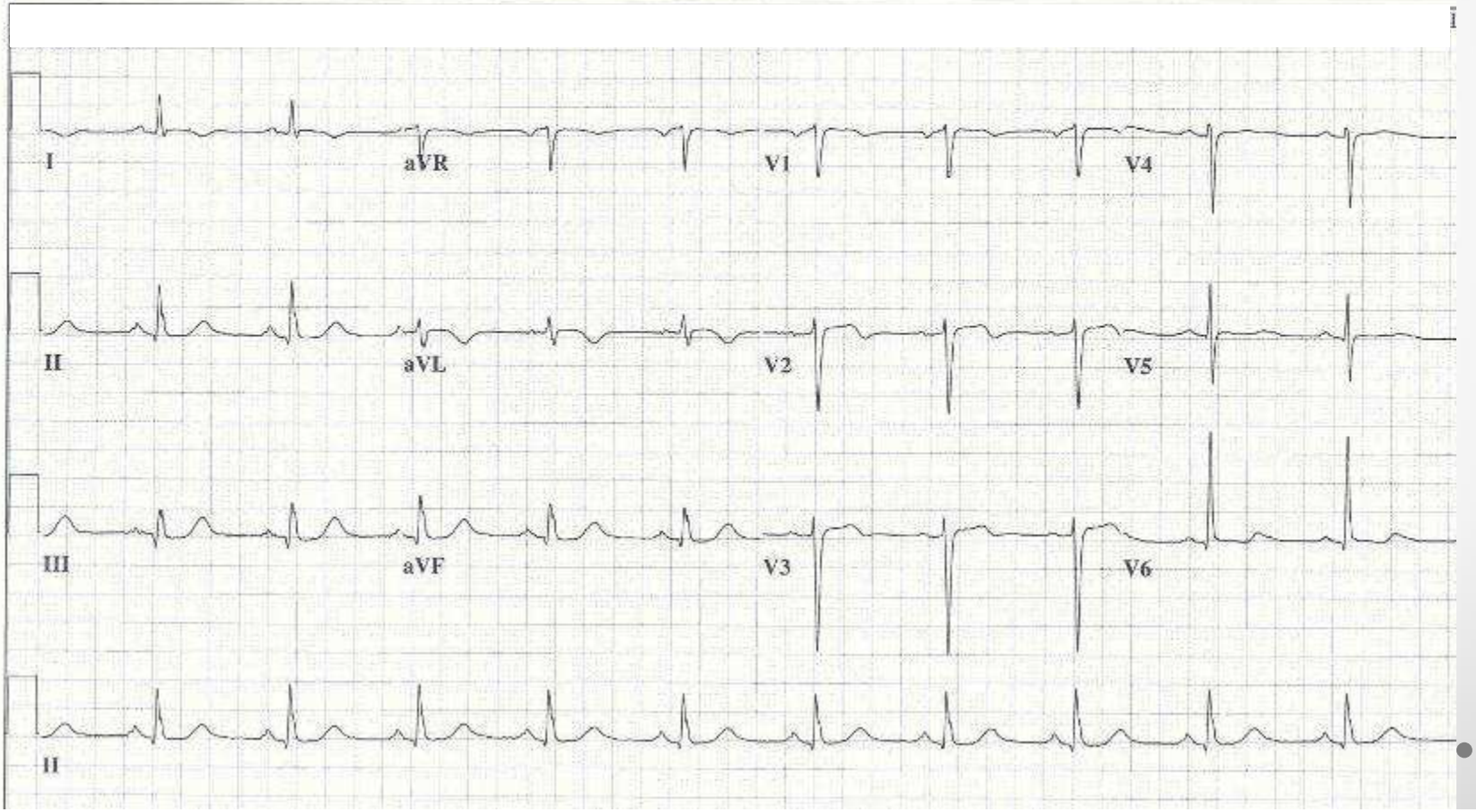
- Downward & to the left
- -30 to + 90



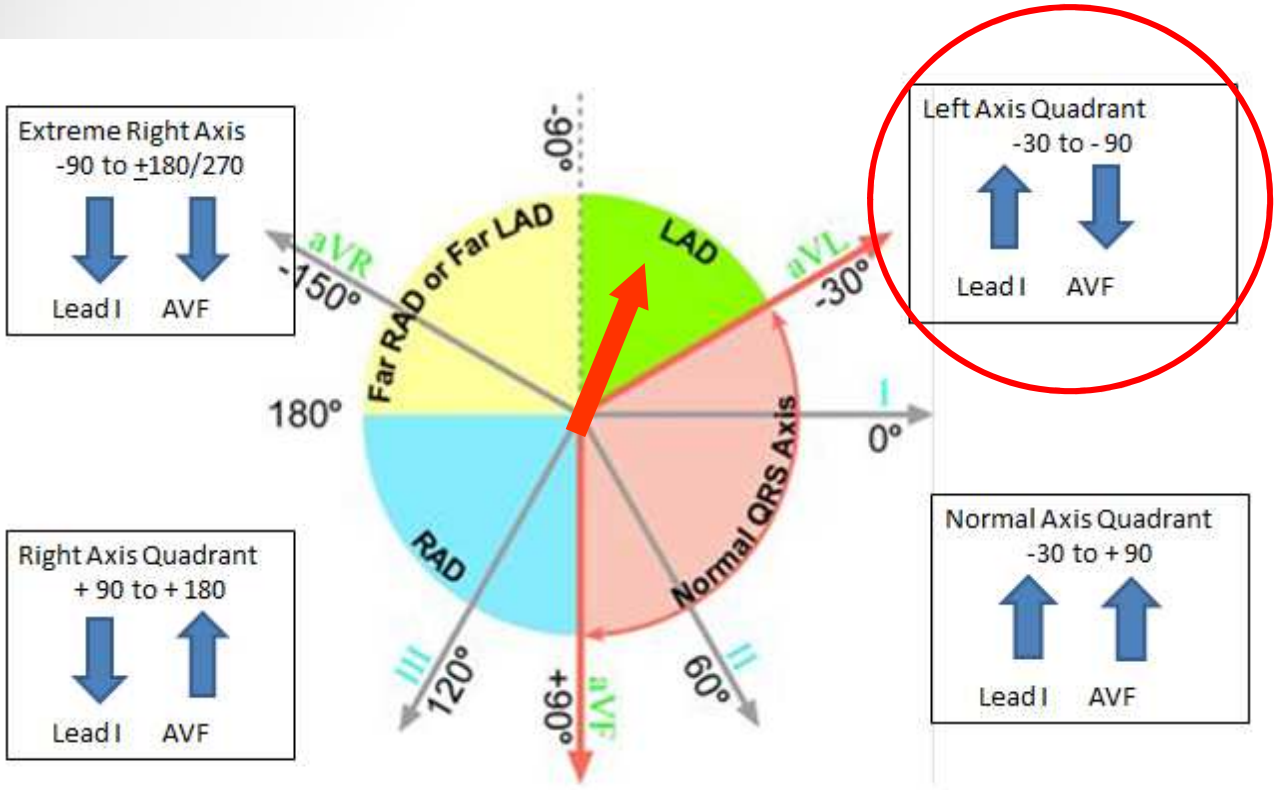
Admission EKG --Troponin bumped to 2.0 ng/ml
Taken emergently to Cath lab

Vent. rate	65	BPM
PR interval	168	ms
QRS duration	98	ms
QT/QTc	434/451	ms
P–R–T axes	58 49	92

Axis = 49

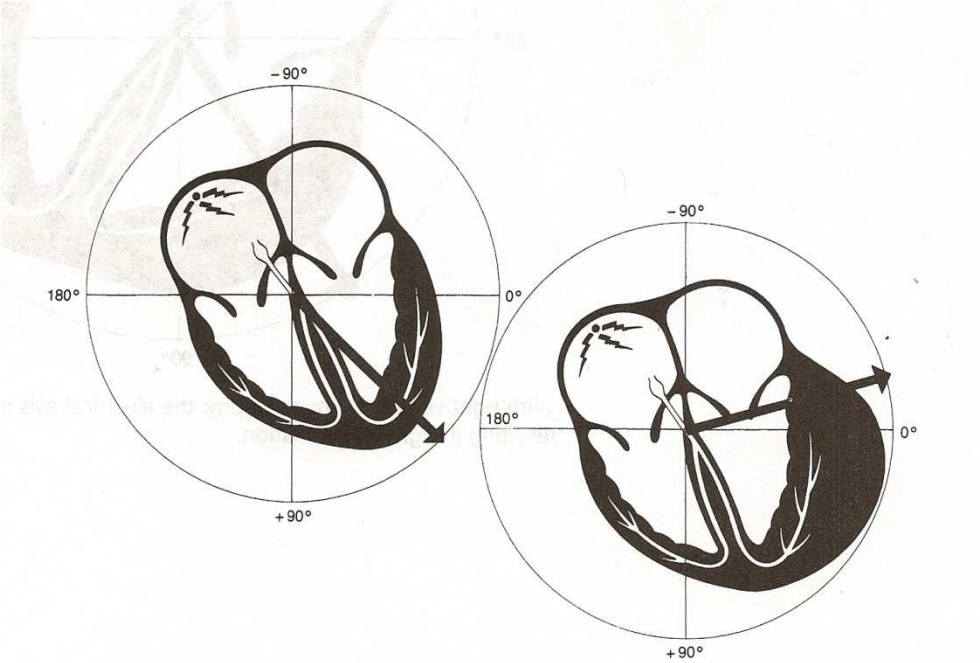


Left Axis



- Upward & to the left
- - 30 to – 90
- Left Ventricular Hypertrophy
- LAH. LBBB
- Inferior infarct
- Mechanical shift of the heart to more horizontal – PG, ascites, abdominal tumor
- WPW

Left Axis Deviation from Left Ventricular Hypertrophy

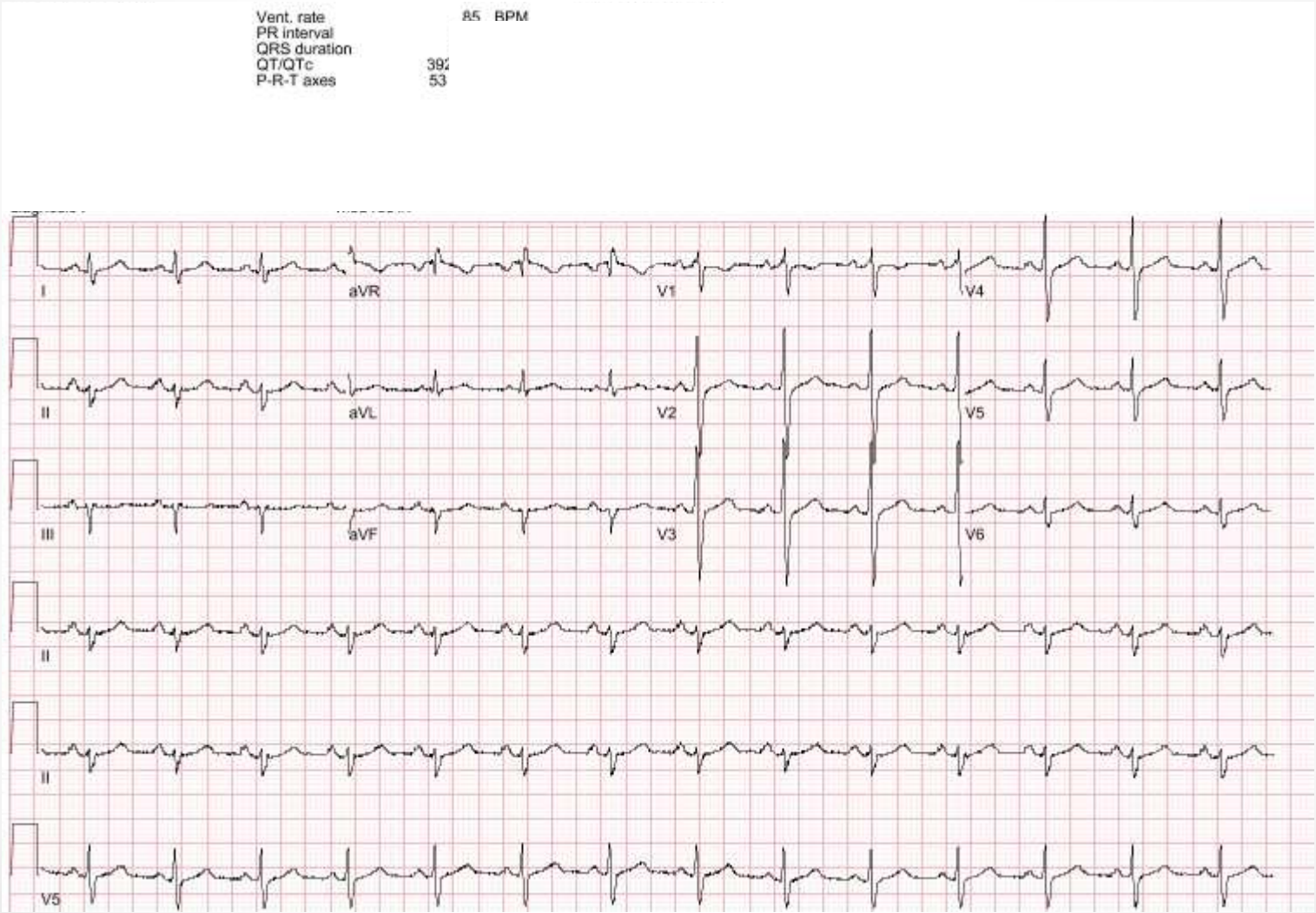


With left ventricular hypertrophy, the electrical axis moves further leftward, resulting in left axis deviation.

Source: Thaler, M. The Only EKG Book You'll Ever Need, 5th ed

EF 30% -- Left Ventricular Hypertrophy

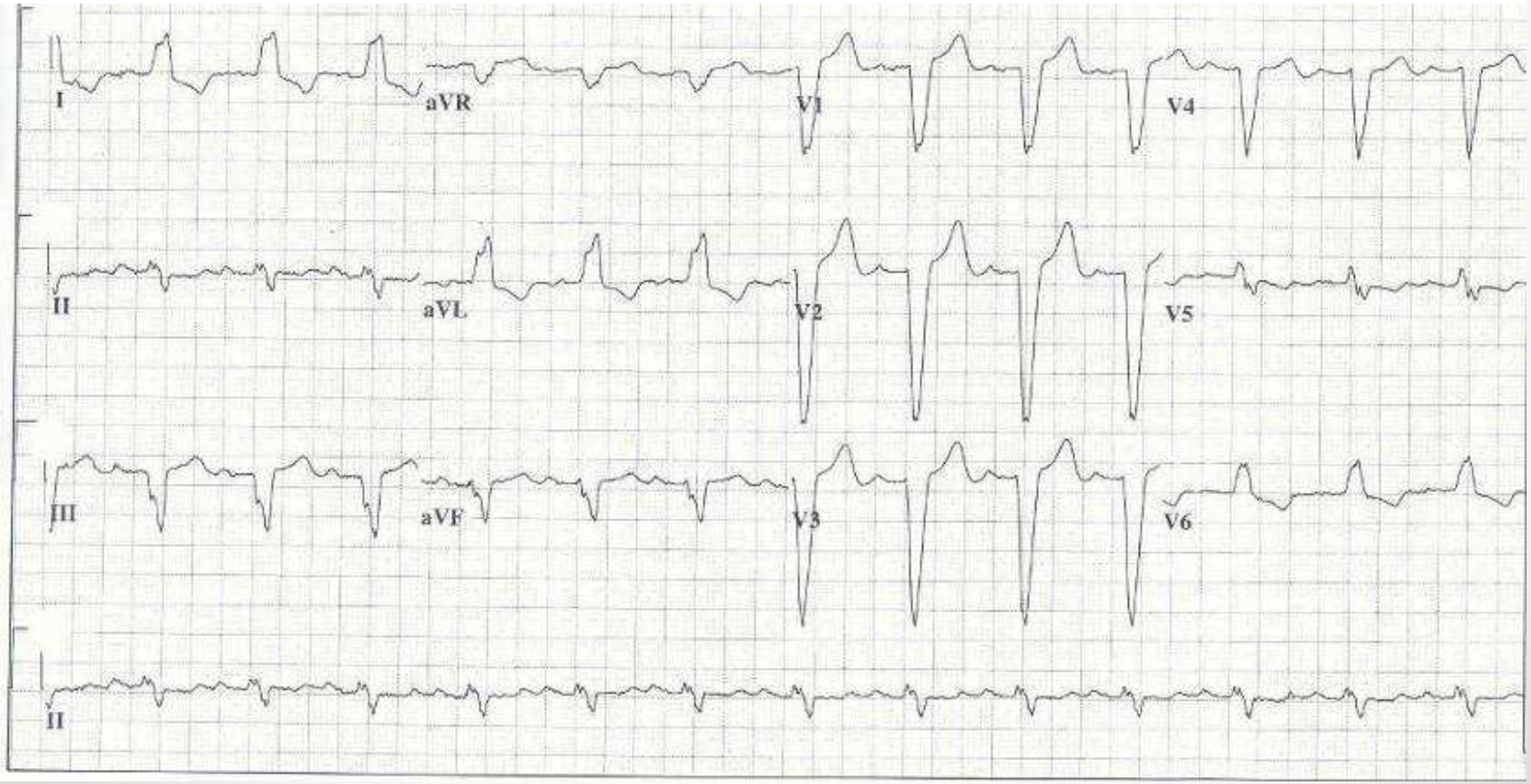
Axis = -63



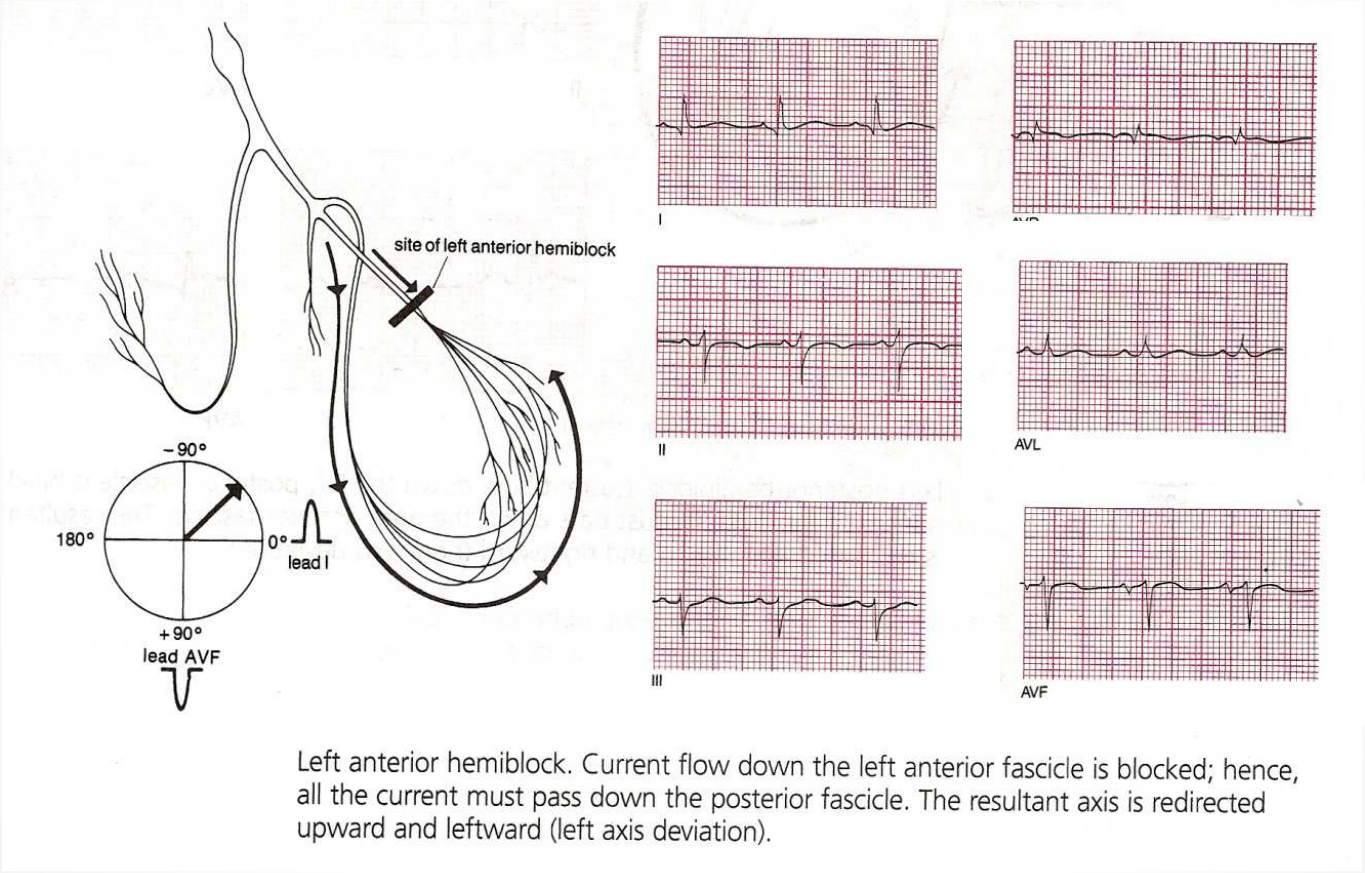
LBBB

Vent. rate	81	BPM	Sinus rhythm with 1st degree A–V block
PR interval	234	ms	Left axis deviation
QRS duration	162	ms	Left bundle branch block
QT/QTc	452/525	ms	Abnormal ECG
P–R–T axes	69 –43	149	When compared with ECG of 16–NOV–2009 18:17,
			No significant change was found

Axis = - 43



Left Axis Deviation from Left Anterior Hemiblock



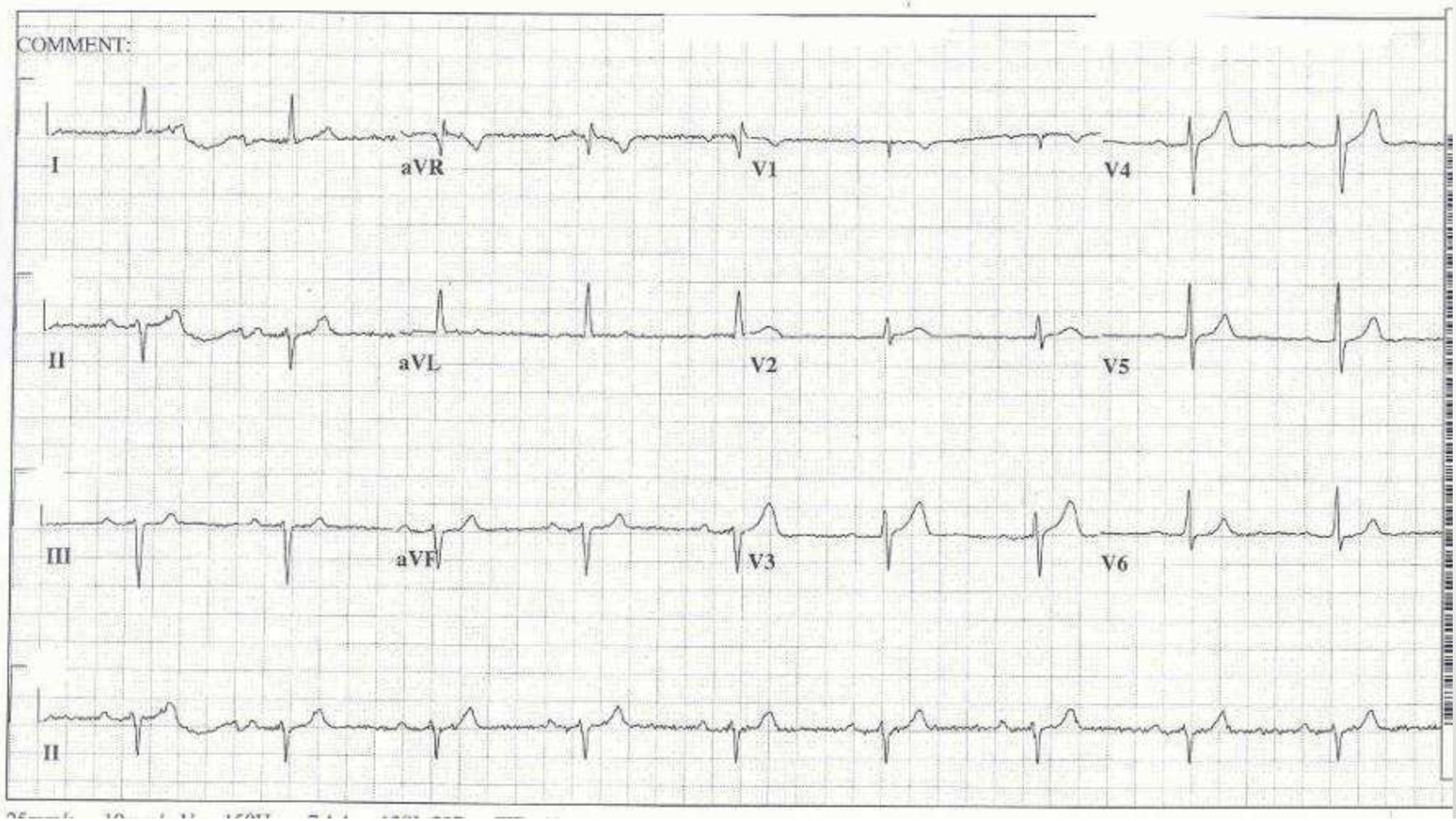
Left anterior hemiblock. Current flow down the left anterior fascicle is blocked; hence, all the current must pass down the posterior fascicle. The resultant axis is redirected upward and leftward (left axis deviation).

Source: Thaler, M. The Only EKG Book You'll Ever Need, 5th ed

LAH

Vent. rate	56	BPM	Sinus bradycardia with 1st degree A–V block
PR interval	212	ms	Left anterior fascicular block
QRS duration	100	ms	Abnormal ECG
QT/QTc	386/372	ms	When compared with ECG of 07–NOV–2009 08:46,
P–R–T axes	77 –52	56	No significant change was found

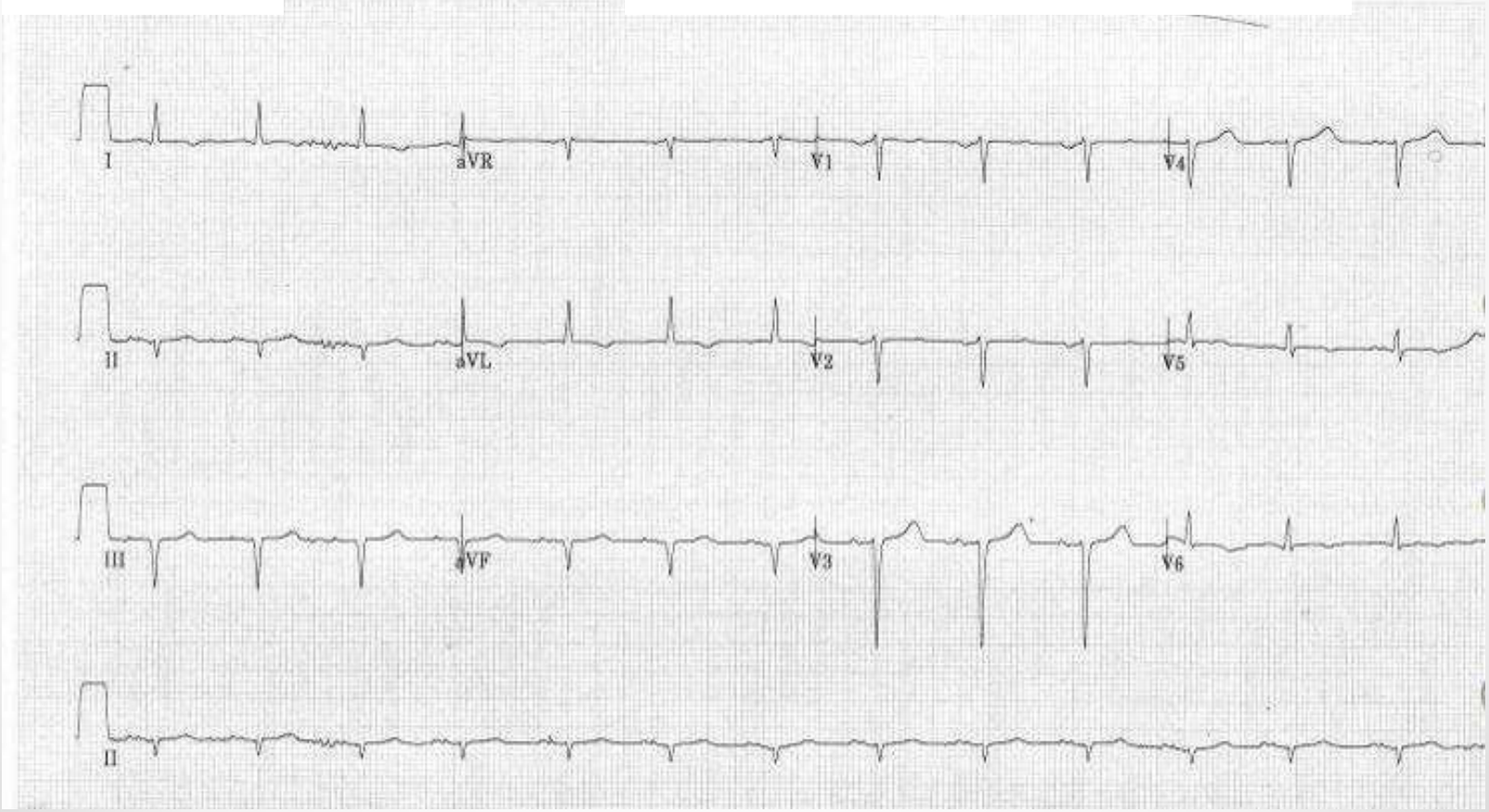
Axis = - 52



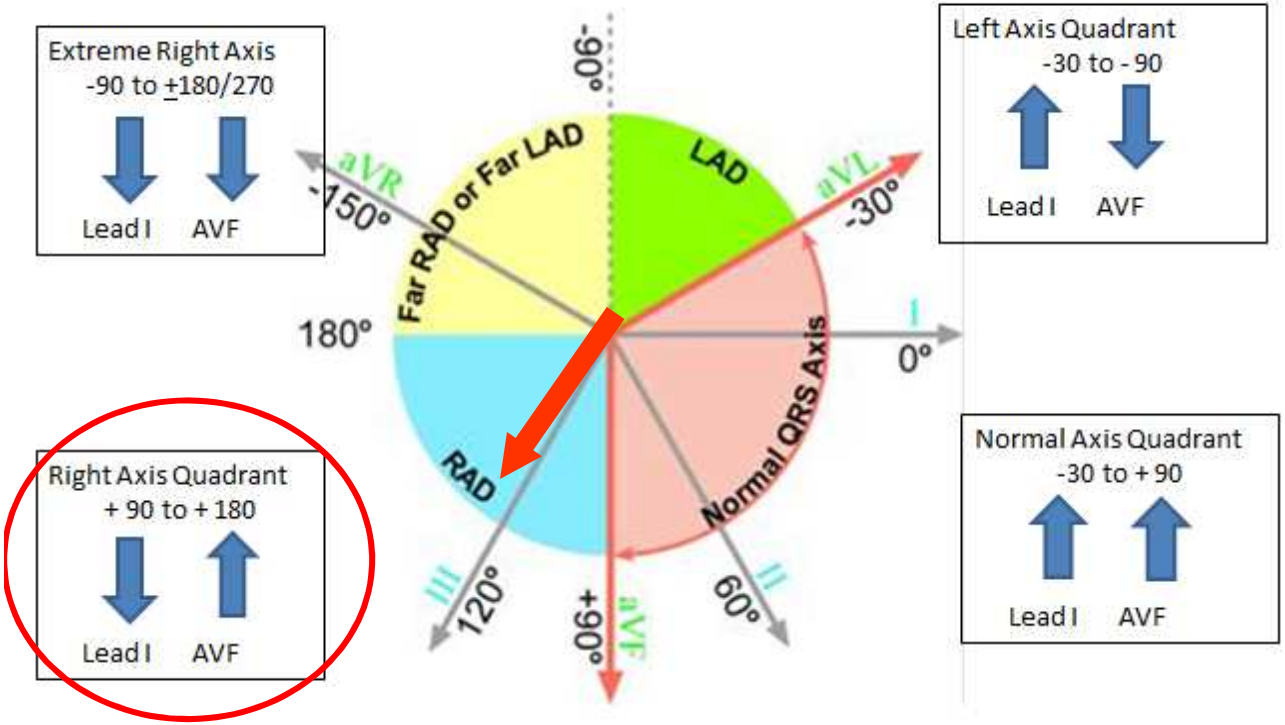
Old Inferior AMI

Vent. rate	82 bpm	Normal sinus rhythm
PR interval	152 ms	Left axis deviation
QRS duration	86 ms	Inferior infarct, age undetermined
QT/QTc	406/474 ms	Abnormal ECG
P-R-T axes	62 -44 102	

Axis = -44

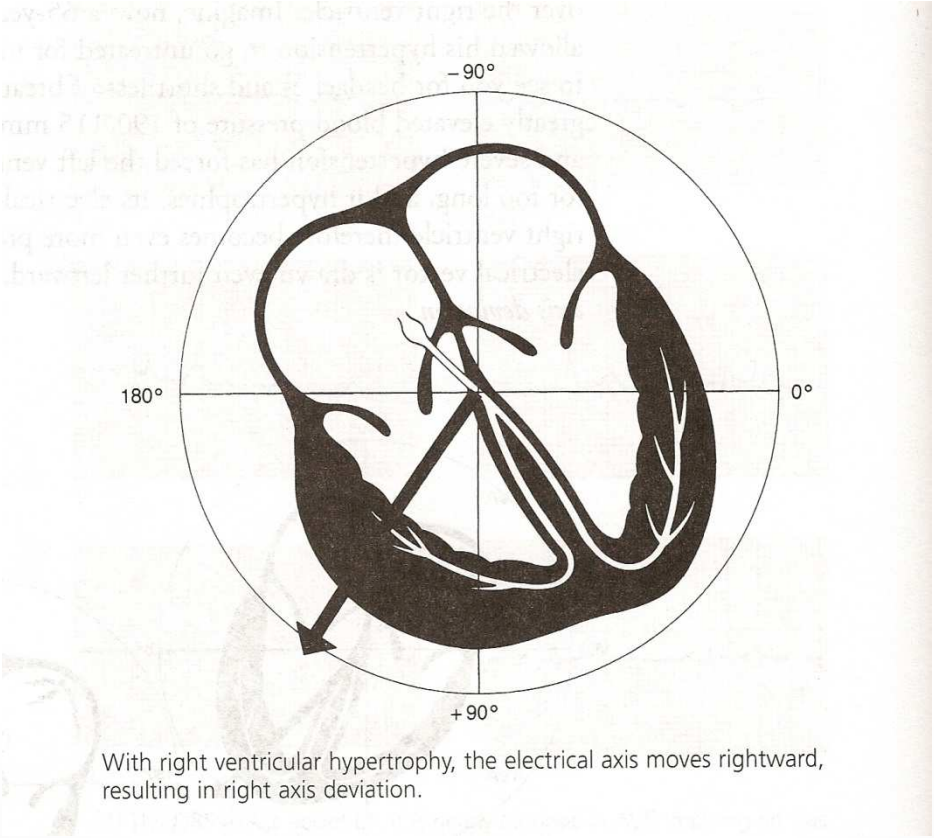


Right Axis



- Downward & to the right
- + 90 to ± 180
- Right ventricular hypertrophy
- LPH
- Lateral infarction
- Dextrocardia
- RBBB
- PE
- Pulmonary Infarct
- Emphysema
- Anything that affects the RV

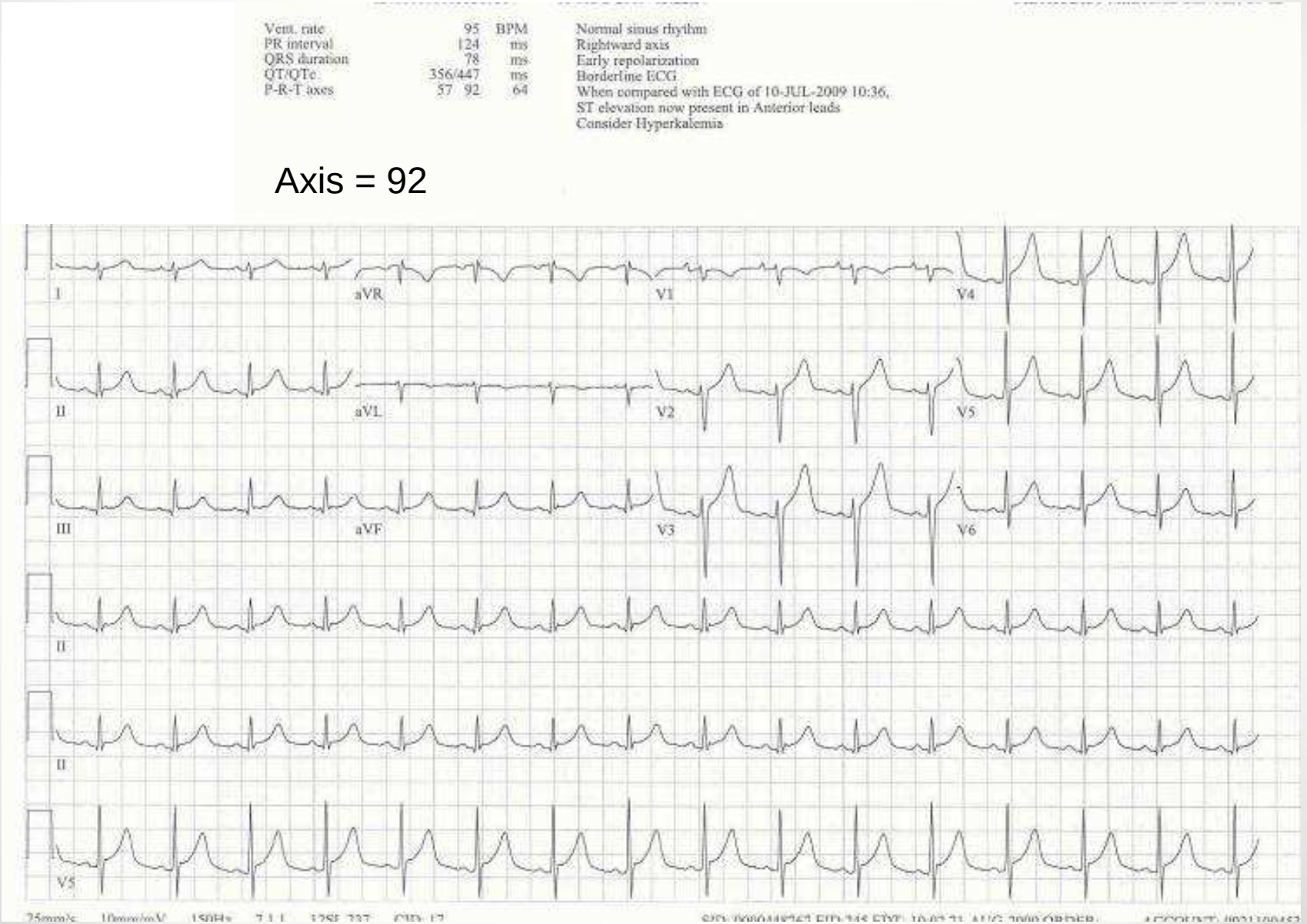
Right Axis Deviation from Right Ventricular Hypertrophy



With right ventricular hypertrophy, the electrical axis moves rightward, resulting in right axis deviation.

Source: Thaler, M. The Only EKG Book You'll Ever Need, 5th ed

PMH: 3 year history Chronic lung infection. Mycobacterium avium-intracellular 1 year ago, Cavitary lung lesion, right pneumonectomy day before this EKG



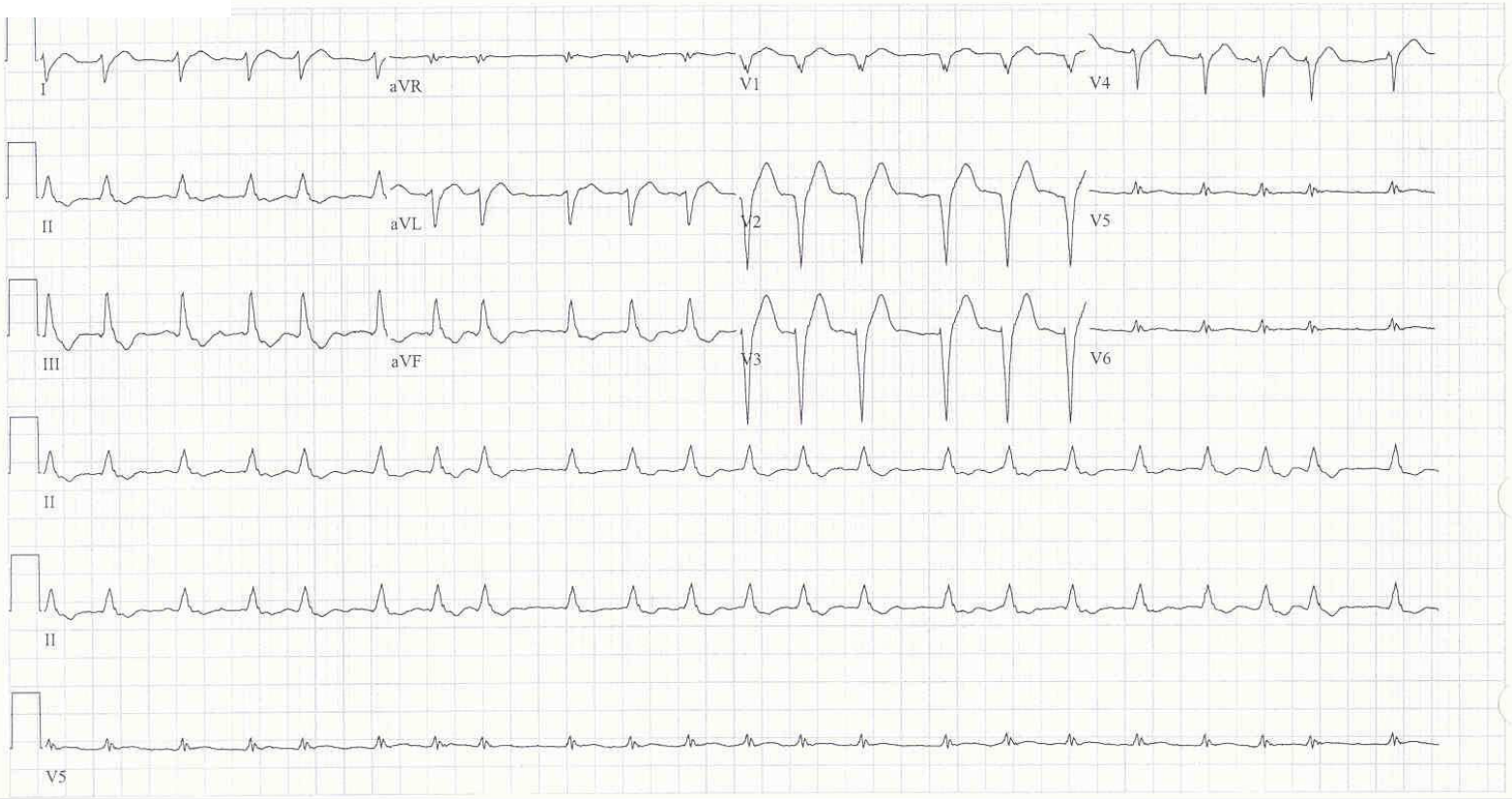
LPH

PMH: HF with EF 15 – 20%, COPD, NSTEMI

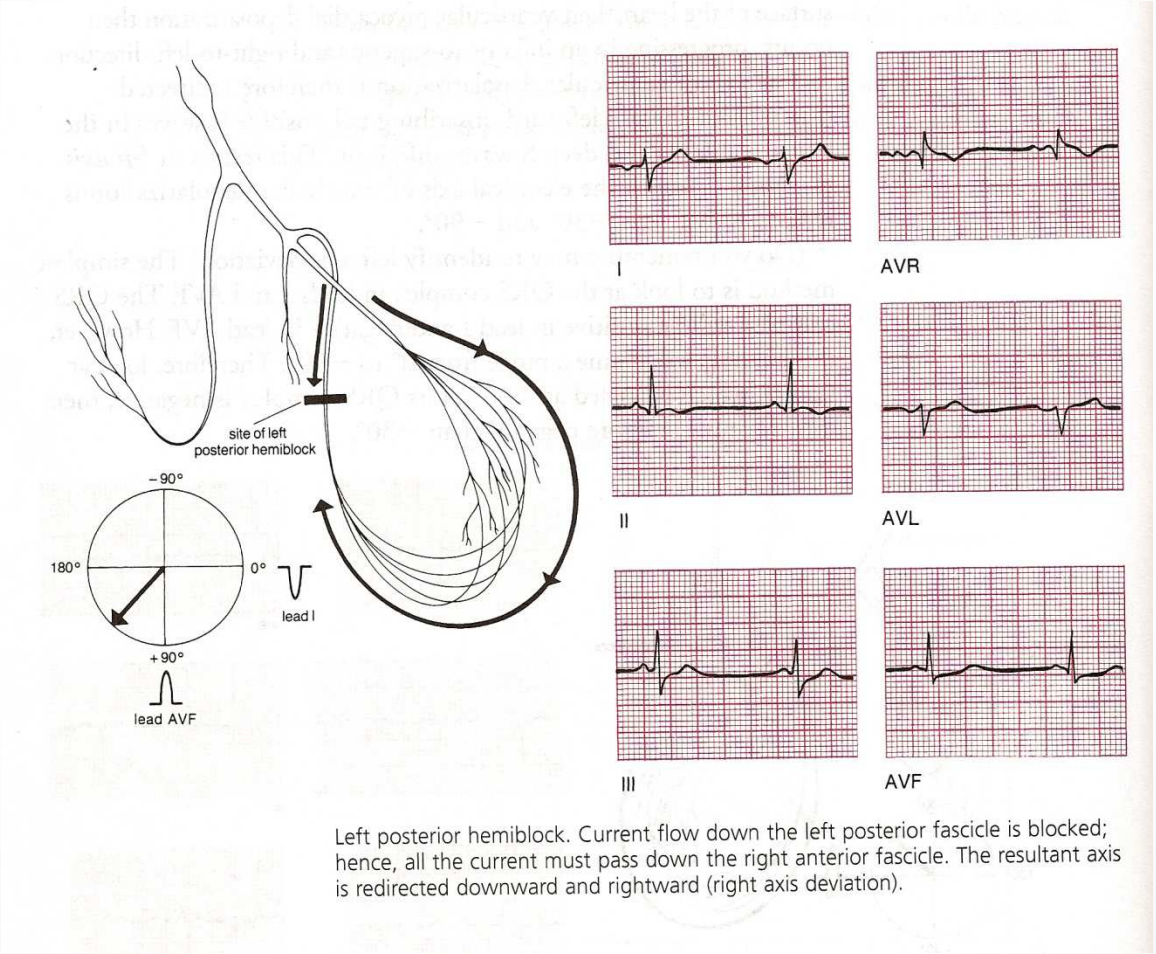
Vent. rate	130	BPM
PR interval	*	ms
QRS duration	102	ms
QT/QTc	292/429	ms
P-R-T axes	* 112	-48

Atrial fibrillation with rapid ventricular response
Left posterior fascicular block
Septal infarct (cited on or before 06-NOV-2009)
T wave abnormality, consider inferior ischemia or digitalis effect
Abnormal ECG
When compared with ECG of 05-DEC-2009 10:13,
Atrial fibrillation has replaced Sinus rhythm
T wave inversion more evident in Inferior leads

Axis = 112



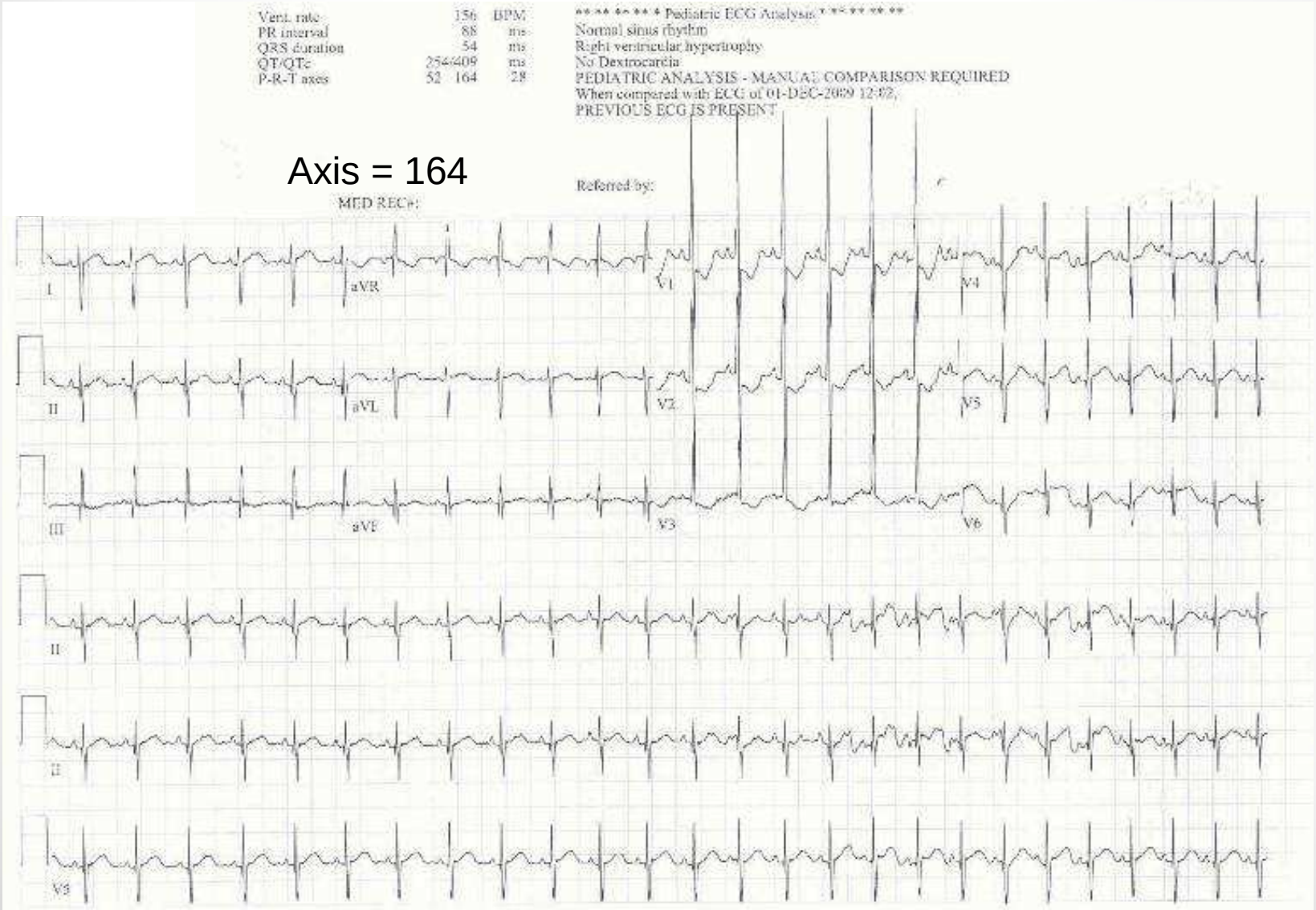
Right Axis Deviation from Left Posterior Hemiblock



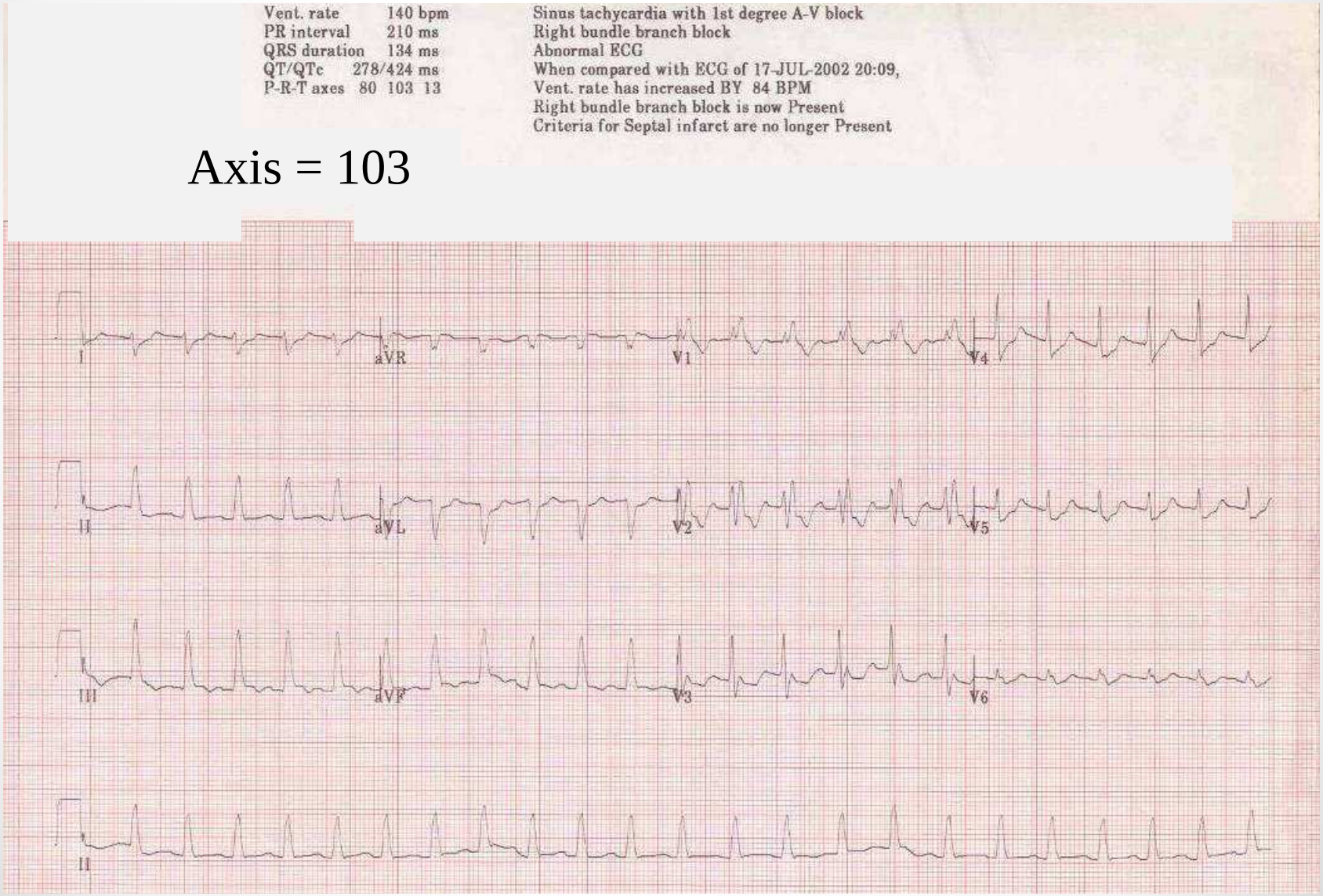
Left posterior hemiblock. Current flow down the left posterior fascicle is blocked; hence, all the current must pass down the right anterior fascicle. The resultant axis is redirected downward and rightward (right axis deviation).

Source: Thaler, M. The Only EKG Book You'll Ever Need, 5th ed

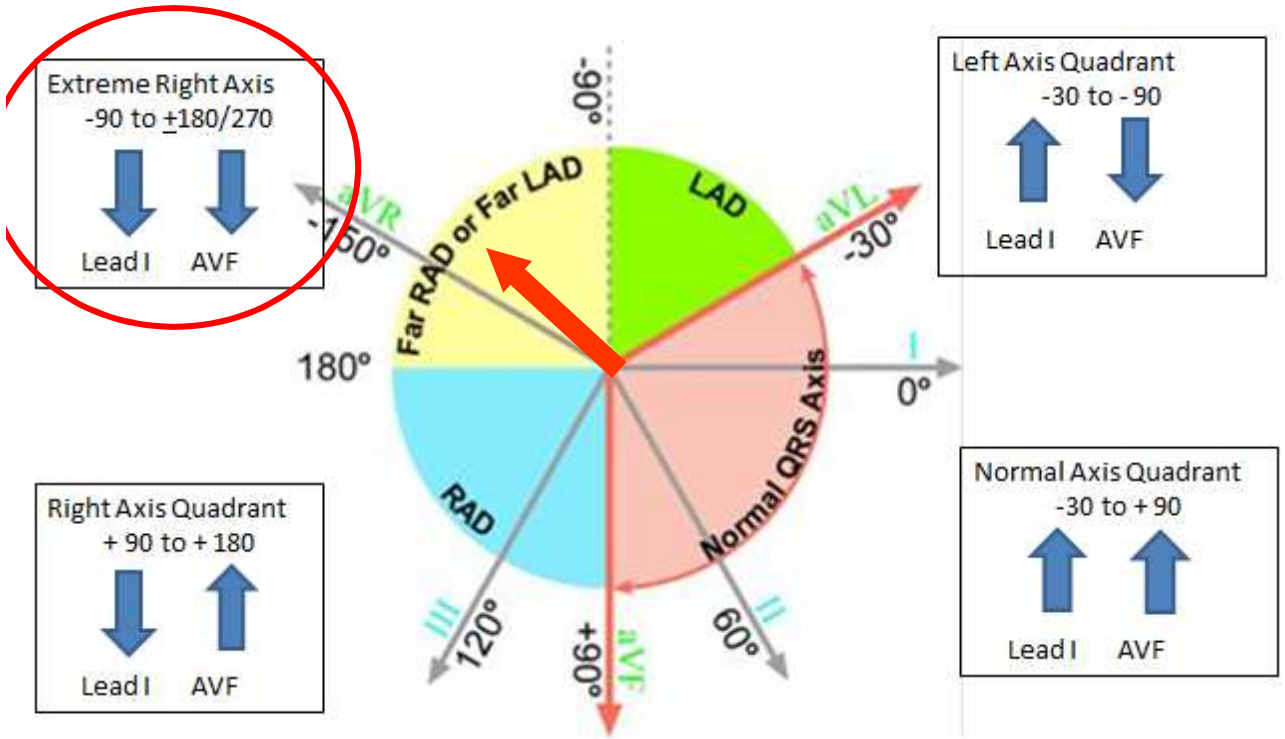
1 week old infant, murmur
? Dextrocardia
Echo ASD, mild pulmonary regurgitation



RBBB, PE


Vent. rate 140 bpm
PR interval 210 ms
QRS duration 134 ms
QT/QTc 278/424 ms
P-R-T axes 80 103 13
Sinus tachycardia with 1st degree A-V block
Right bundle branch block
Abnormal ECG
When compared with ECG of 17-JUL-2002 20:09,
Vent. rate has increased BY 84 BPM
Right bundle branch block is now Present
Criteria for Septal infarct are no longer Present
Axis = 103
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

Extreme Right Axis



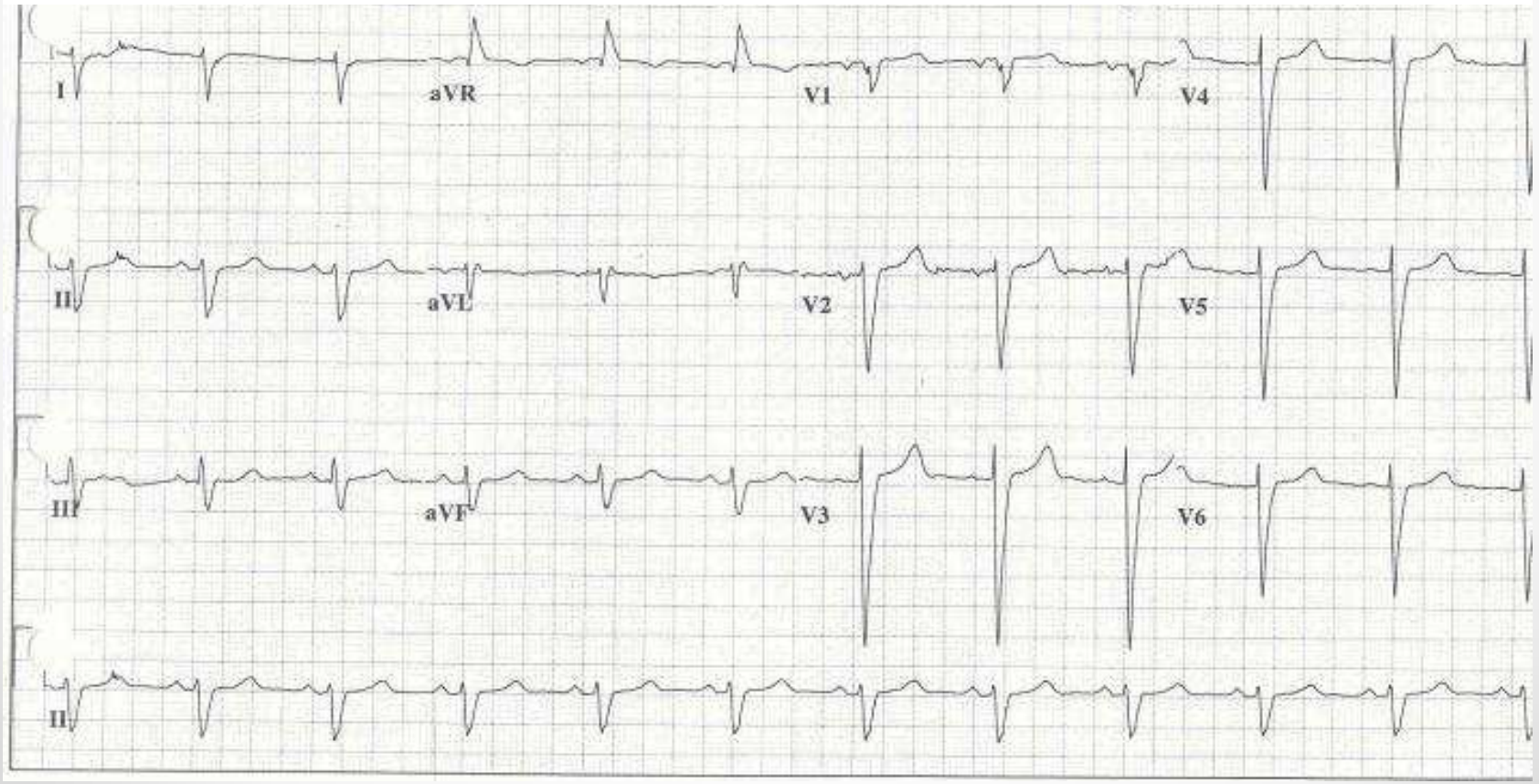
- Upward & to the right
- - 90 to ± 180/270
- Ventricular Tach
- Multiple infarctions
- Never good

83 y/o, PMH: pulmonary hypertension and pulmonary fibrosis

Vent. rate	68	BPM
PR interval	166	ms
QRS duration	134	ms
QT/QTc	470/499	ms
P–R–T axes	81 212	72

Normal sinus rhythm
Possible Left atrial enlargement
Right superior axis deviation
Non–specific intra–ventricular conduction block
Abnormal ECG
When compared with ECG of 31–OCT–2009 05:45,
No significant change was found

Axis = 212

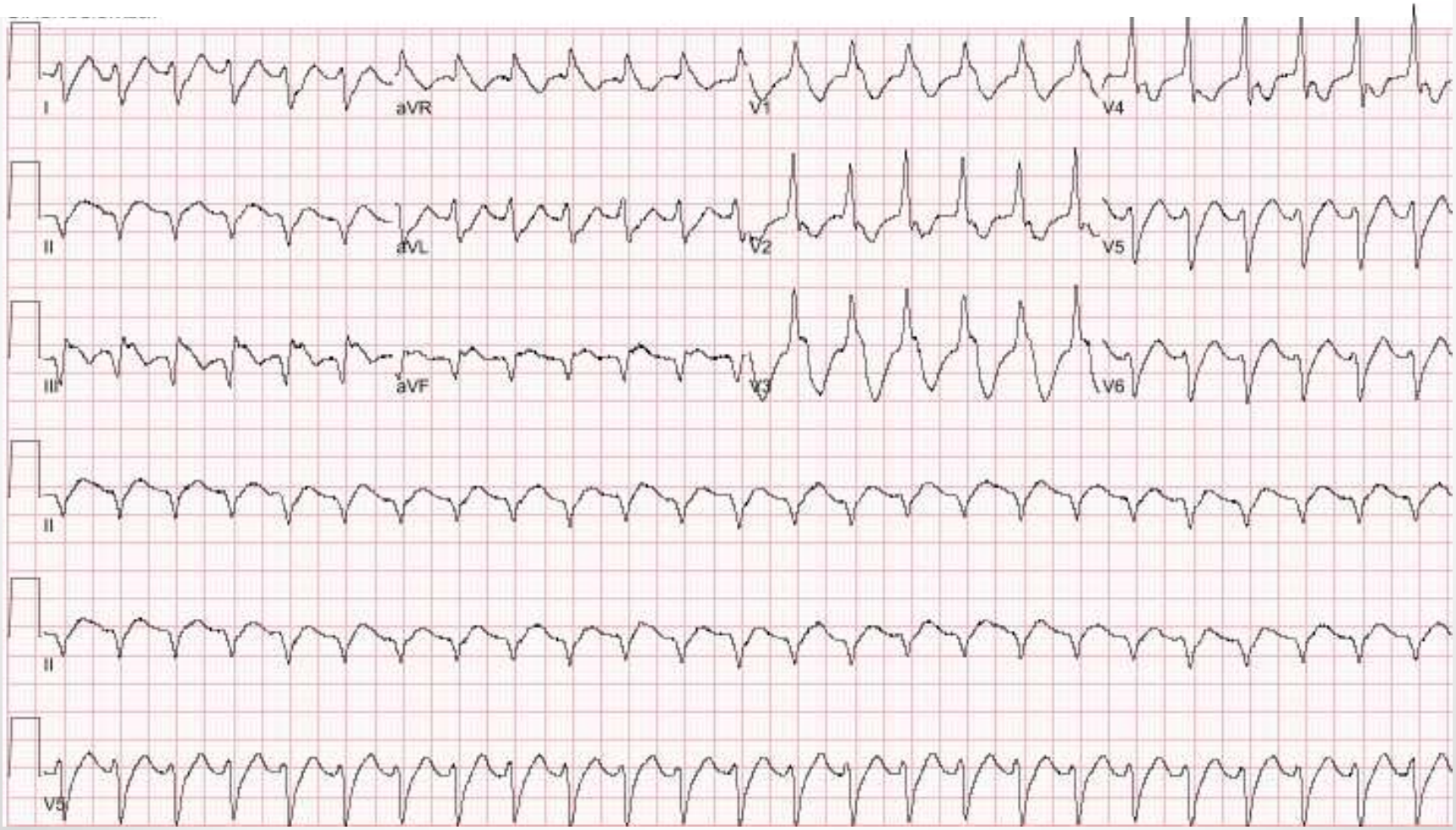


Wide Complex Tachycardia

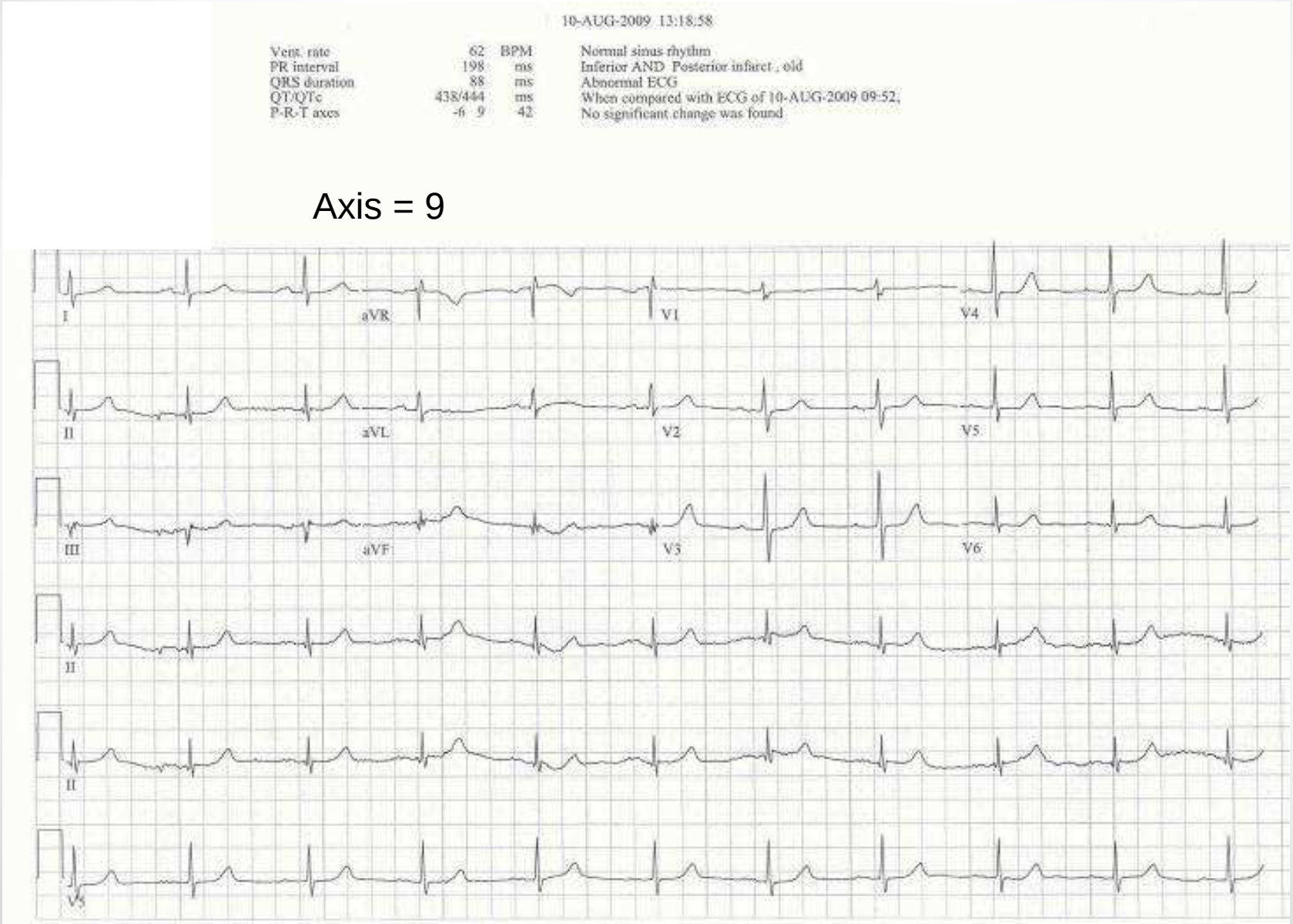
Vent. rate	150	BPM
PR interval	120	ms
QRS duration	170	ms
QT/QTc	310/489	ms
P-R-T axes	* 221	11

Wide QRS tachycardia
When compared with ECG of 27-JUN-2013 11:23,
Significant changes have occurred

Axis = 221



Axis changes during AMI
66 y/o preop EKG #1



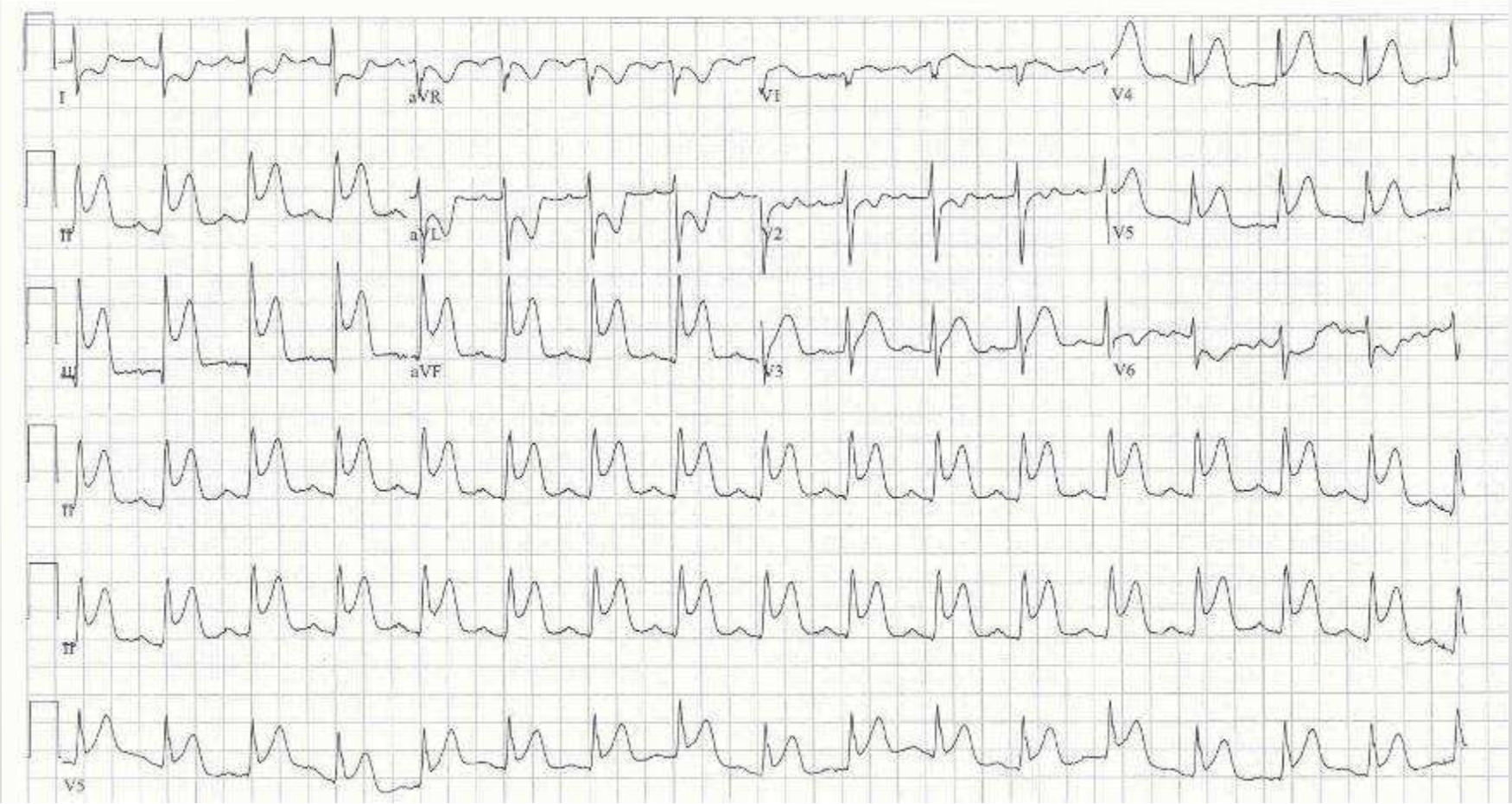
EKG #2 upon admission to ICU after thorocotomy. Sent to Cath lab. Stent to RCA

23-NOV-2009 14:47:38

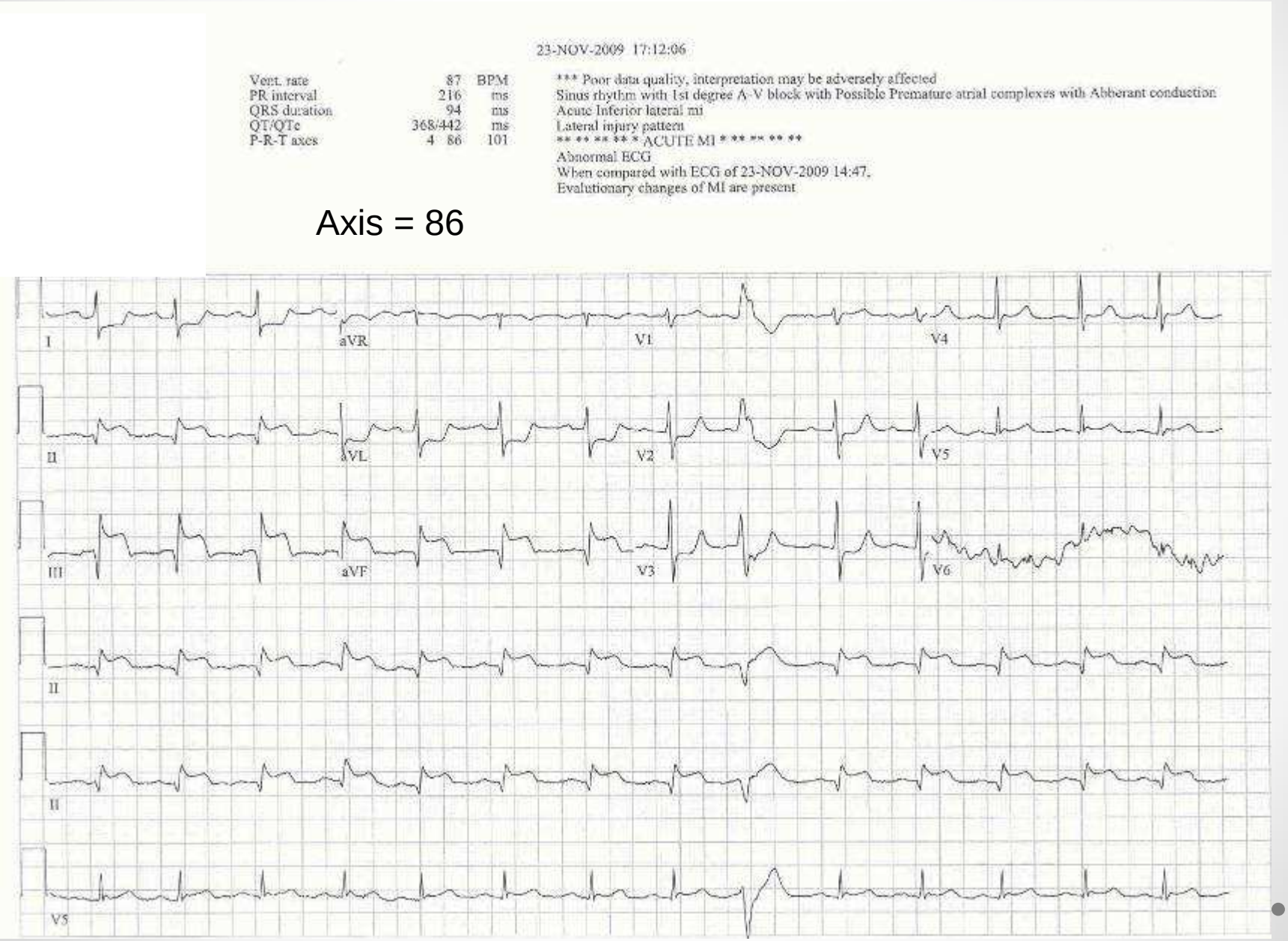
Vent. rate	98	BPM
PR interval	196	ms
QRS duration	96	ms
QT/QTc	356/454	ms
P-R-T axes	42 93	95

Normal sinus rhythm
Rightward axis
ST elevation Consider Lateral injury or acute infarct
ST elevation consider inferior injury or acute infarct
** ** ** ** * ACUTE MI * ** ** ** **
Abnormal ECG
When compared with ECG of 10-AUG-2009 13:18,
Acute Inferolateral MI

Axis = 93

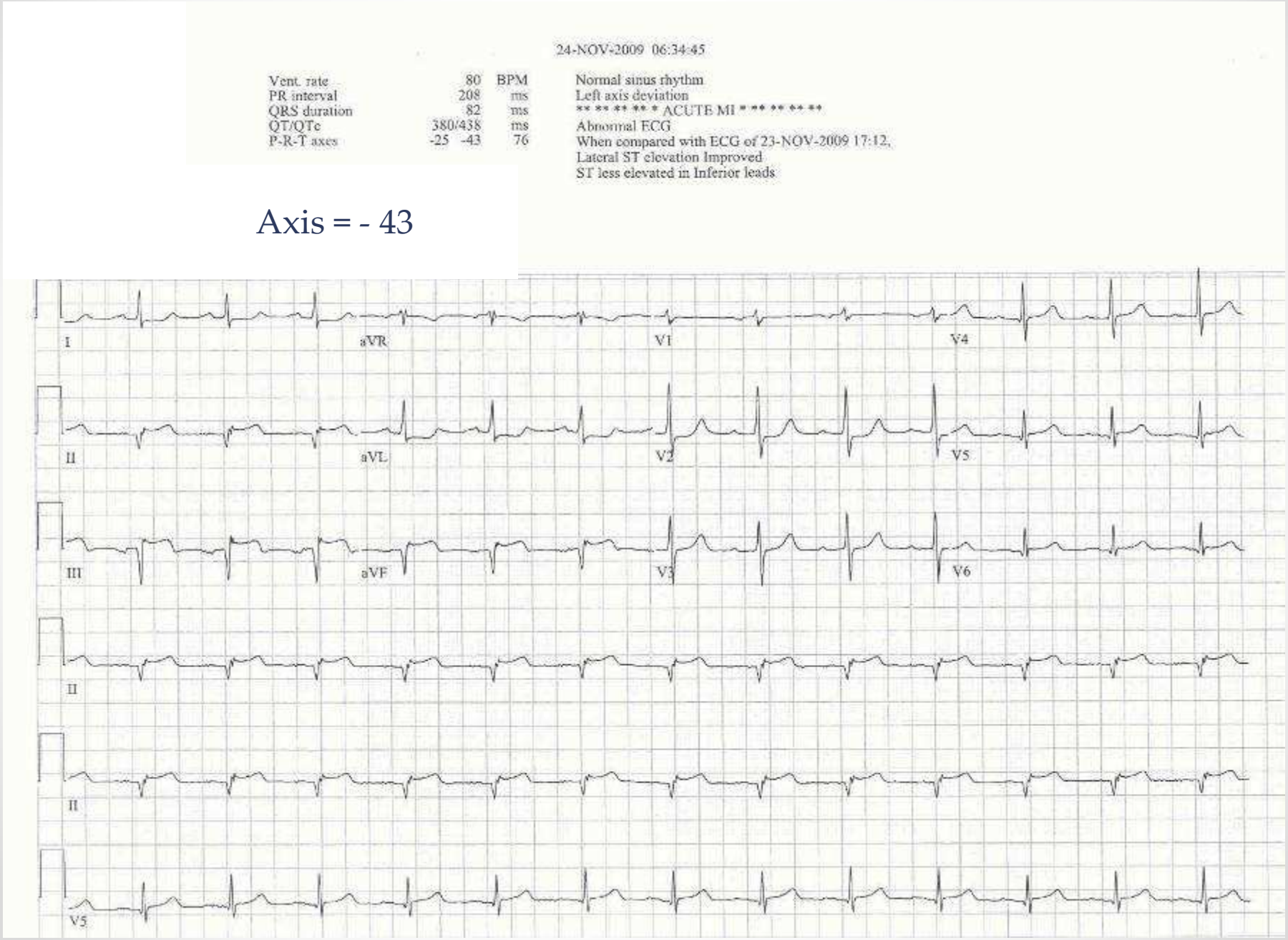


EKG #3 – 3 hours later



Axis = 86

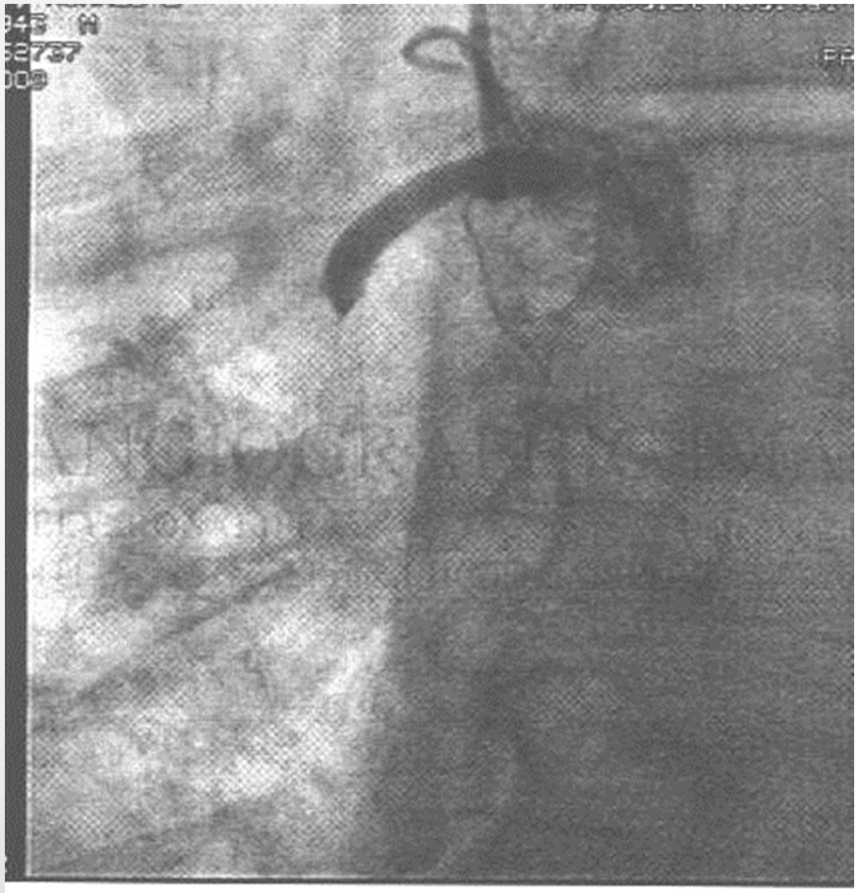
EKG # 4 12 hours later



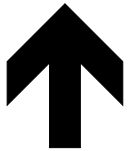
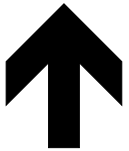
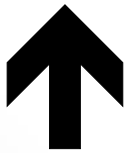
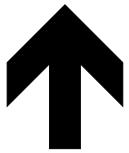
Axis = - 43

Occluded old RCA Stent

Post procedure after deploying new stent



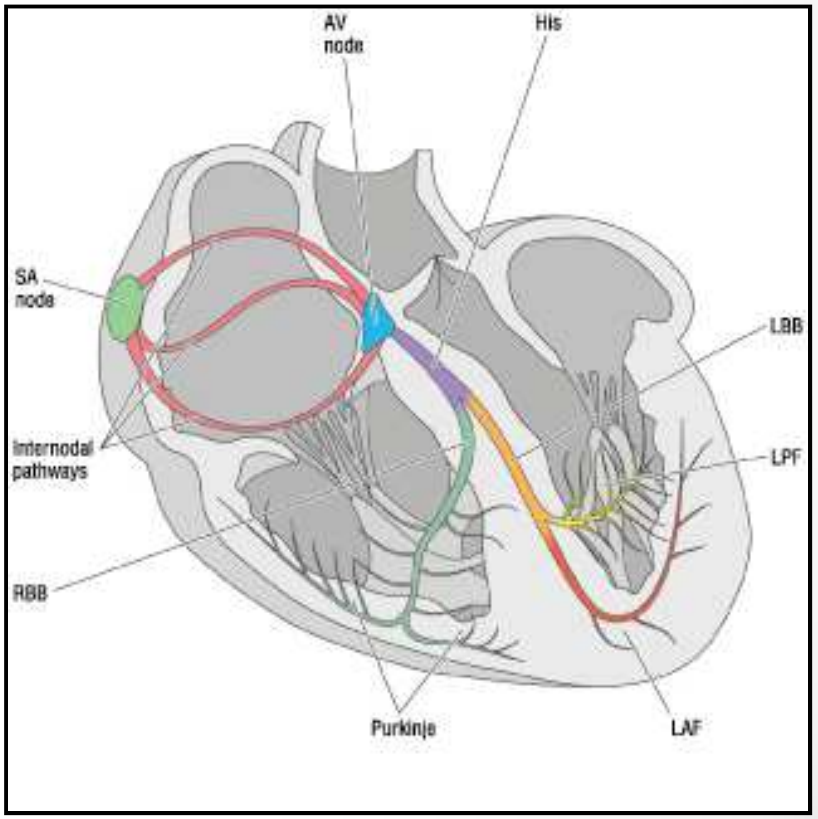
Axis Summary

Axis	Normal - 30 to +90	Left -30 to - 90	Right +90 to ±180	Extreme -90 to ±180/270
Lead I				
AVF				

*B*eat the Bundles

Bundle Branch Blocks

- Complete RBBB
- Complete LBBB
- Left Posterior Hemiblock (LPH)
- Left Anterior Hemiblock (LAH)
- Bifascicular, Trifascicular Blocks



Right Bundle Branch Block

RBBB

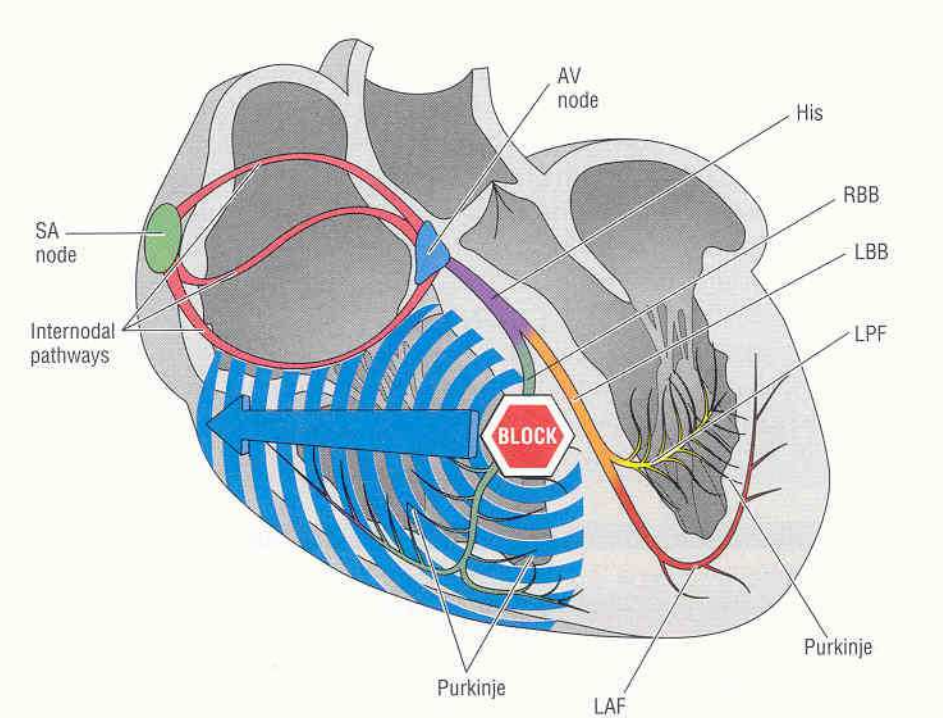
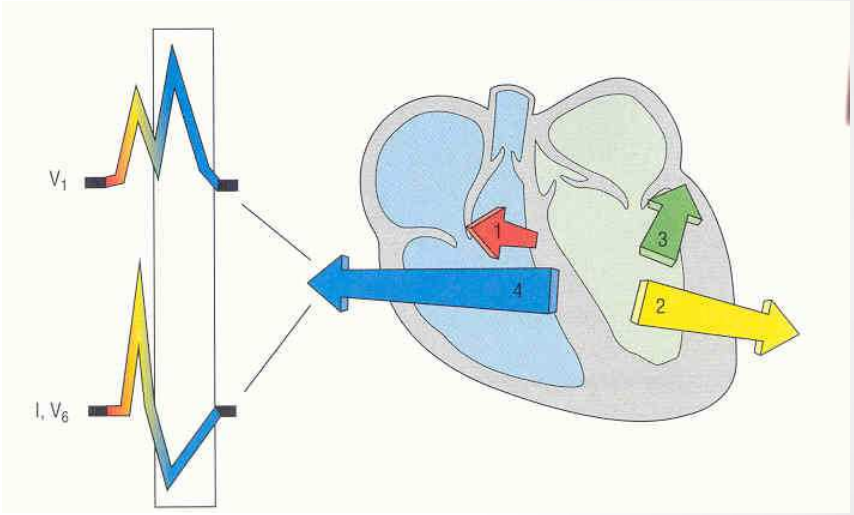


Figure 13-2: Right bundle branch block.



Source: Garcia 12 Lead EKG 13:2 & 13:3

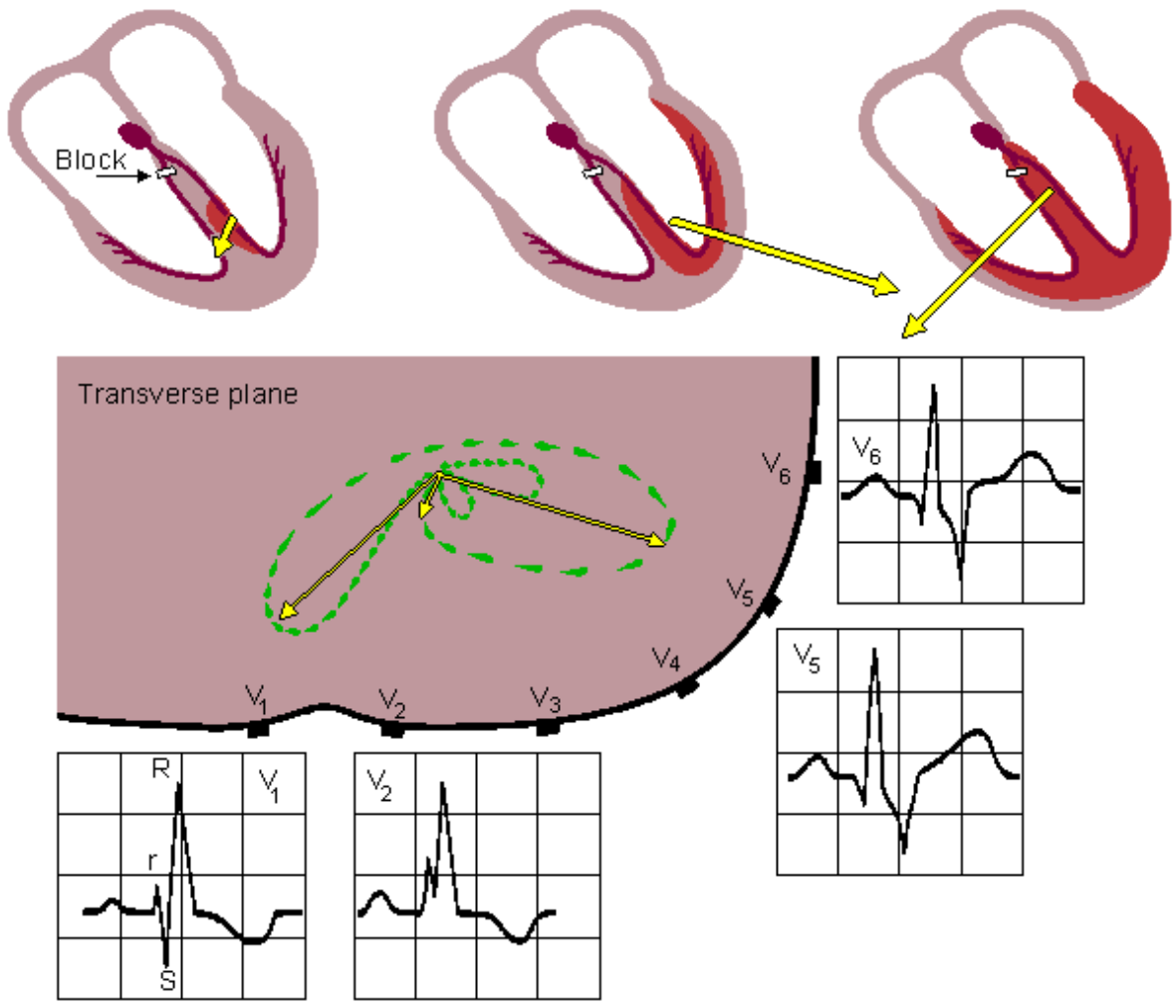
Right Bundle Branch Block

RBBB

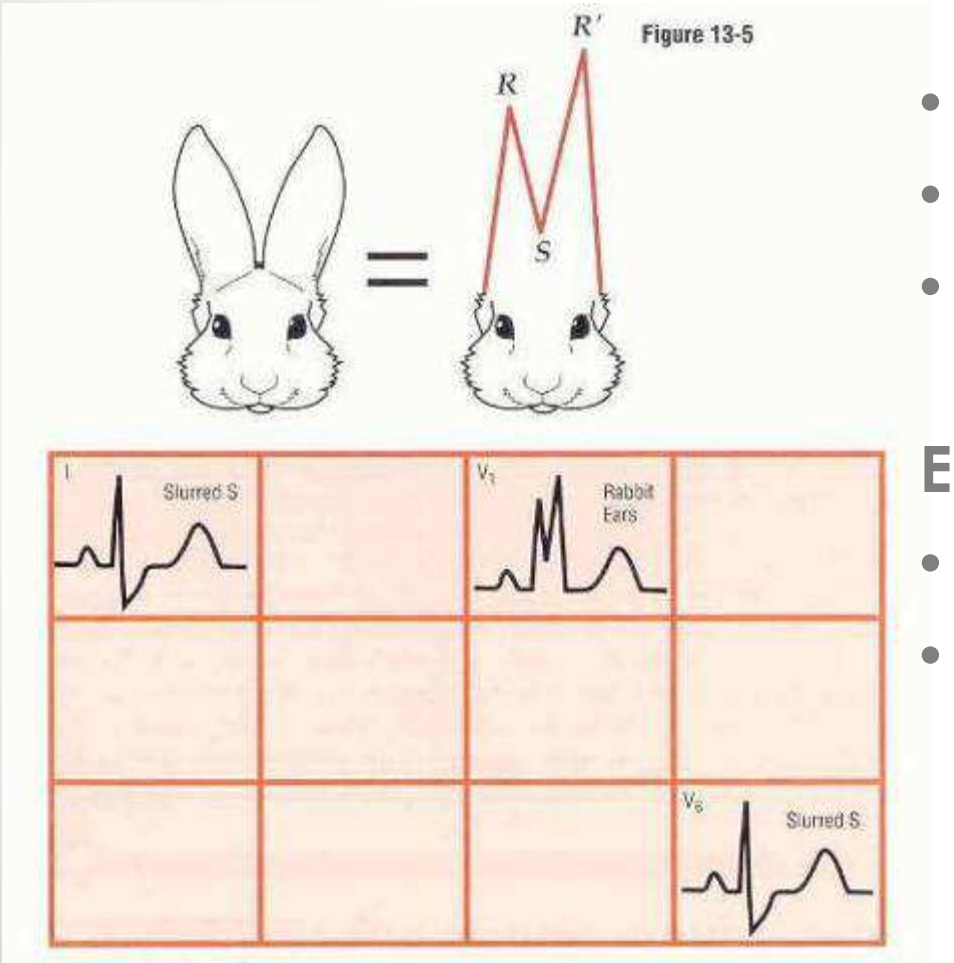
Causes

- **Chronically increased right ventricular pressure, as in cor pulmonale**
- **Right ventricular hypertrophy**
- **A sudden increase in right ventricular pressure with stretch, as in pulmonary embolism.**
- **Congenital heart disease (atrial septal defect)**
- **Myocardial ischemia or infarction**
- **Myocarditis**
- **Hypertension**

RBBB



RBBB Criteria



- QRS ≥ 0.12 sec or 120msec
- Slurred S wave leads I & V6
- RSR' pattern V1

Easy way:

- V1 = Positive, QRS ≥ 0.12 sec
- Rabbit Ears

Source: Garcia. 12 Lead ECG

RBBB

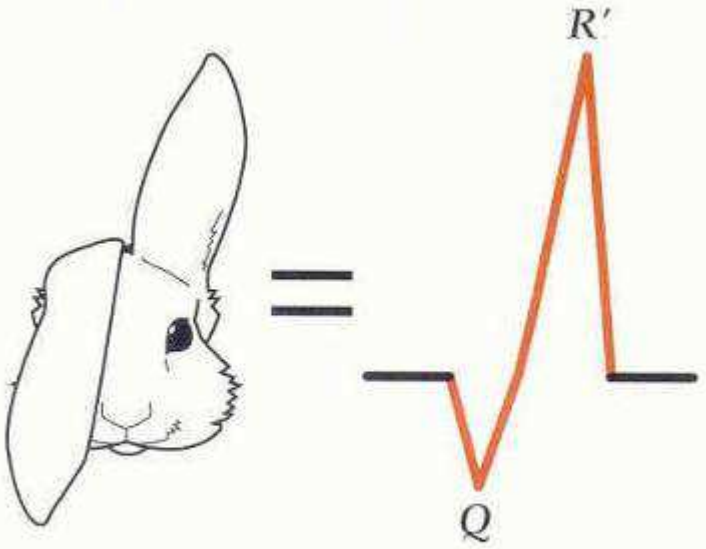
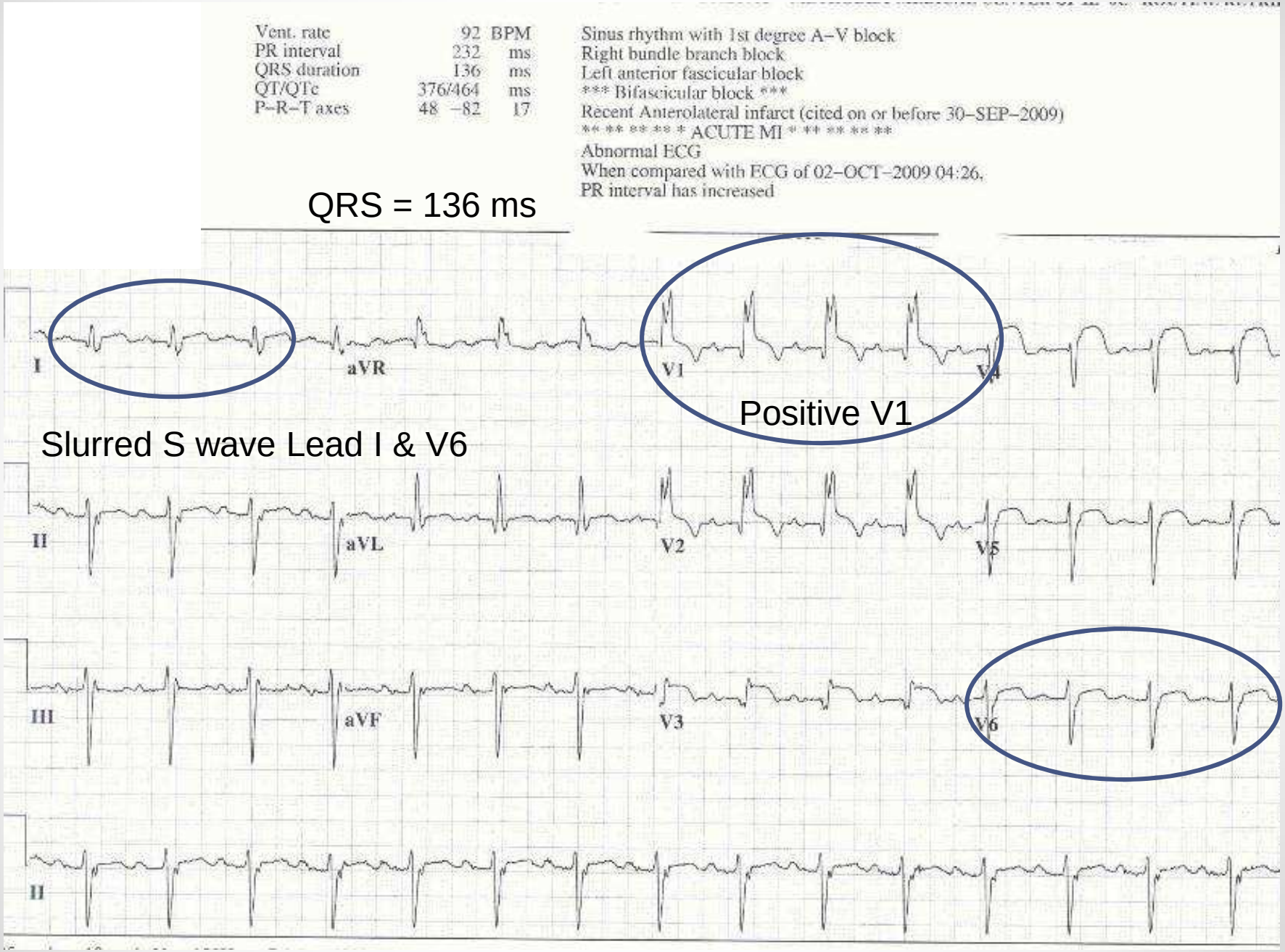


Figure 13-7: If you see a Q wave in lead V_1 in the presence of RBBB, the first positive deflection is called an R′ wave instead of an R wave.

- Half a rabbit ear
- QRS mostly postive

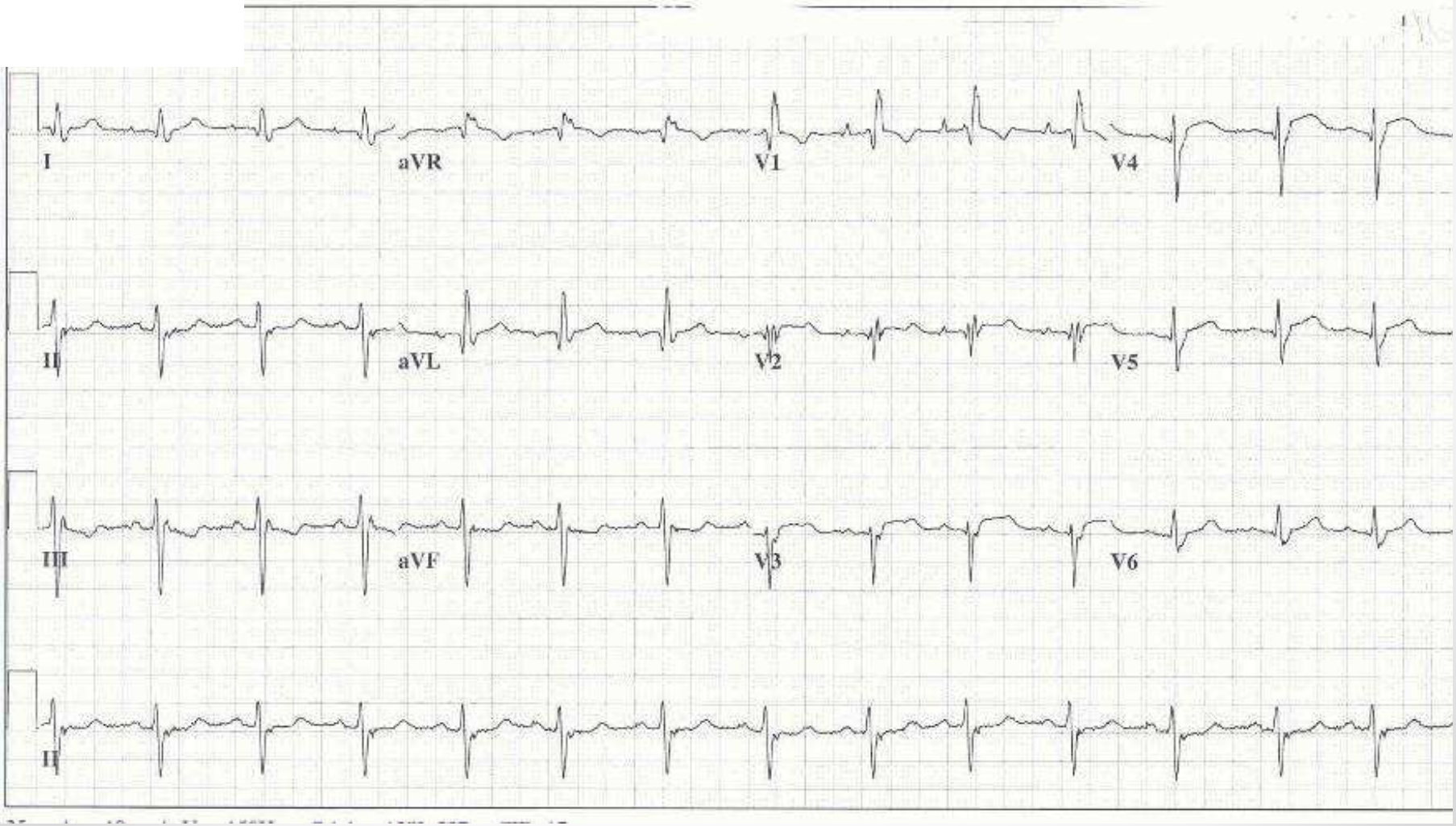
Source: Garcia. 12 Lead ECG

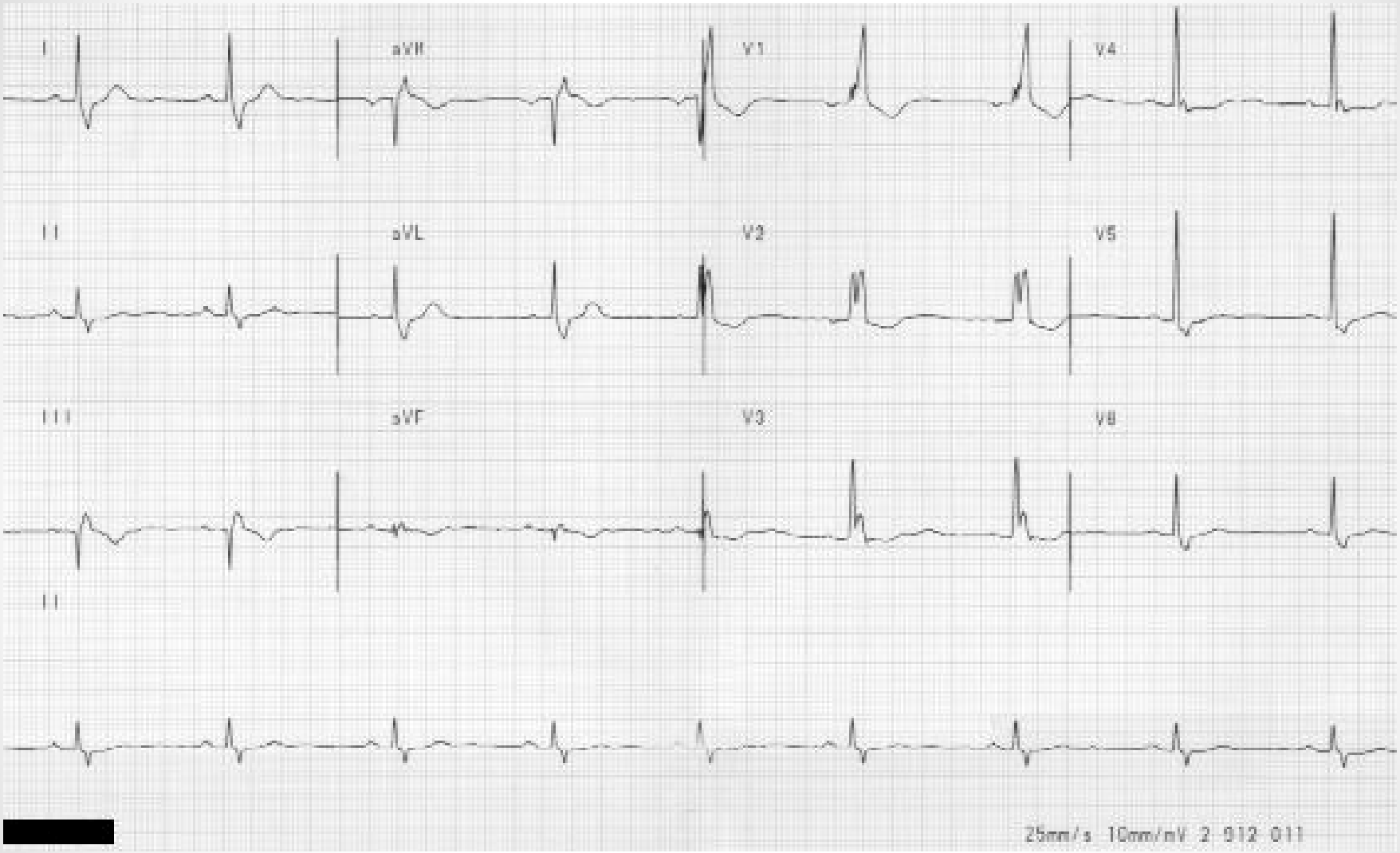

Vent. rate 92 BPM
PR interval 232 ms
QRS duration 136 ms
QT/QTc 376/464 ms
P-R-T axes 48 -82 17
Sinus rhythm with 1st degree A-V block
Right bundle branch block
Left anterior fascicular block
*** Bifascicular block ***
Recent Anterolateral infarct (cited on or before 30-SEP-2009)
** ** ** ** * ACUTE MI * ** ** ** **
Abnormal ECG
When compared with ECG of 02-OCT-2009 04:26,
PR interval has increased
QRS = 136 ms
I
aVR
V1
V4
Positive V1
Slurred S wave Lead I & V6
II
aVL
V2
V5
III
aVF
V3
V6
II

Vent. rate	84	BPM
PR interval	168	ms
QRS duration	134	ms
QT/QTc	420/496	ms
P–R–T axes	92 –71	5

Normal sinus rhythm
Right bundle branch block
Left anterior fascicular block
*** Bifascicular block ***
Abnormal ECG
No previous ECGs available

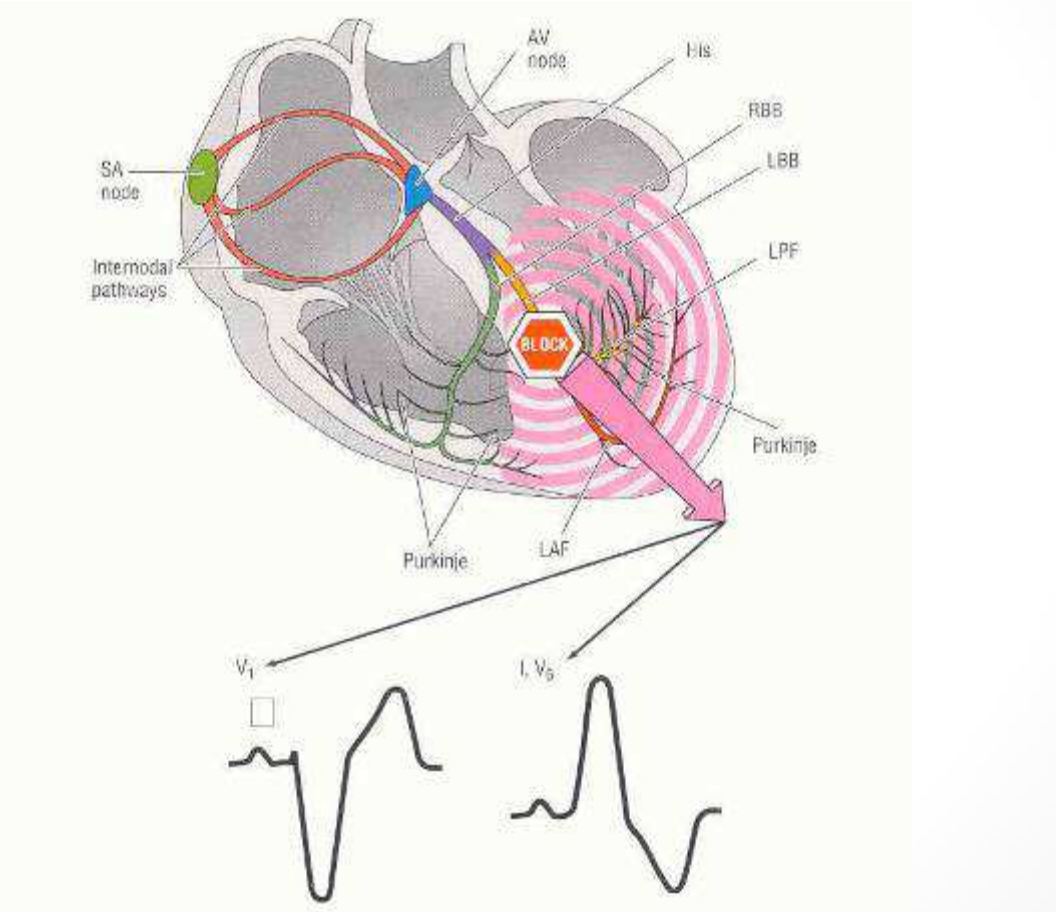
QRS = 134 ms




I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
25mm/s 10mm/mV 2 512 011

Left Bundle Branch Block

LBBB



Source: Garcia 12 Lead EKG 13:19

Left Bundle Branch Block

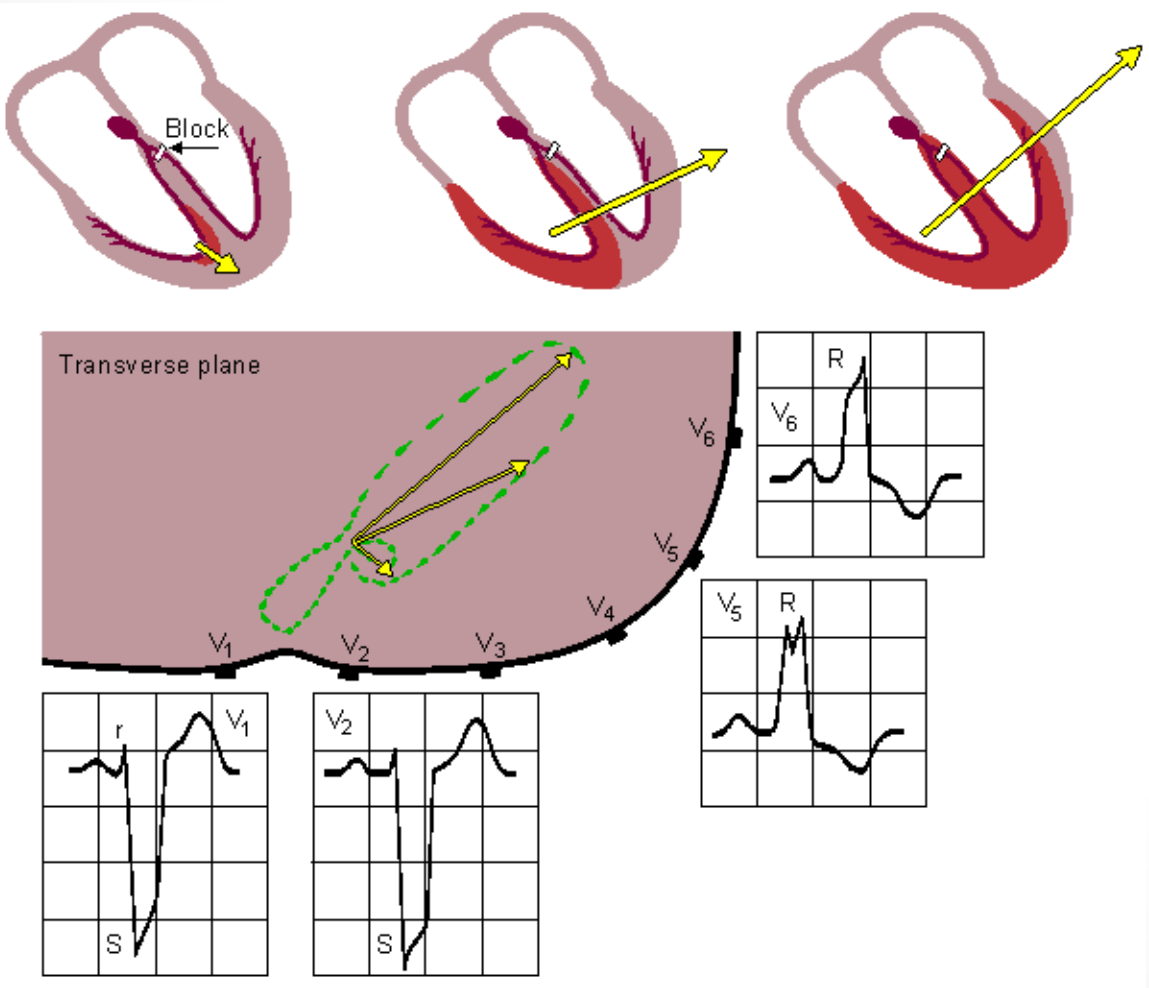
LBBB

- Higher mortality than RBBB
- Most often seen in large Anterior MIs
- Lower EFs
- Often seen in later stages of Heart Failure

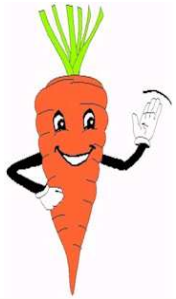
Causes

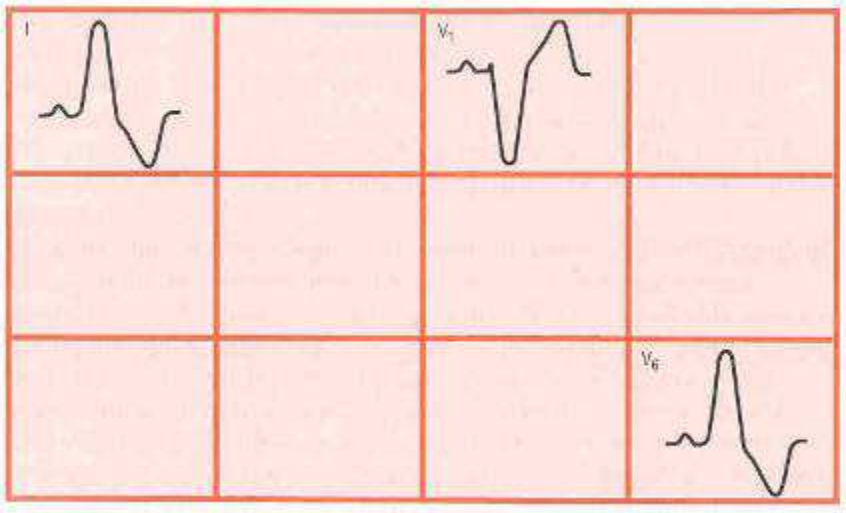
- Dilated cardiomyopathy
- CAD
- Hypertension
- Infiltrative diseases of the heart
- Benign or idiopathic causes

LBBB



LBBB Criteria





- QRS ≥ 0.12 sec or 120msec
- Broad, monomorphic R waves in I & V6, with no Q waves
- Broad, monomorphic S waves in V1; may have a small r wave

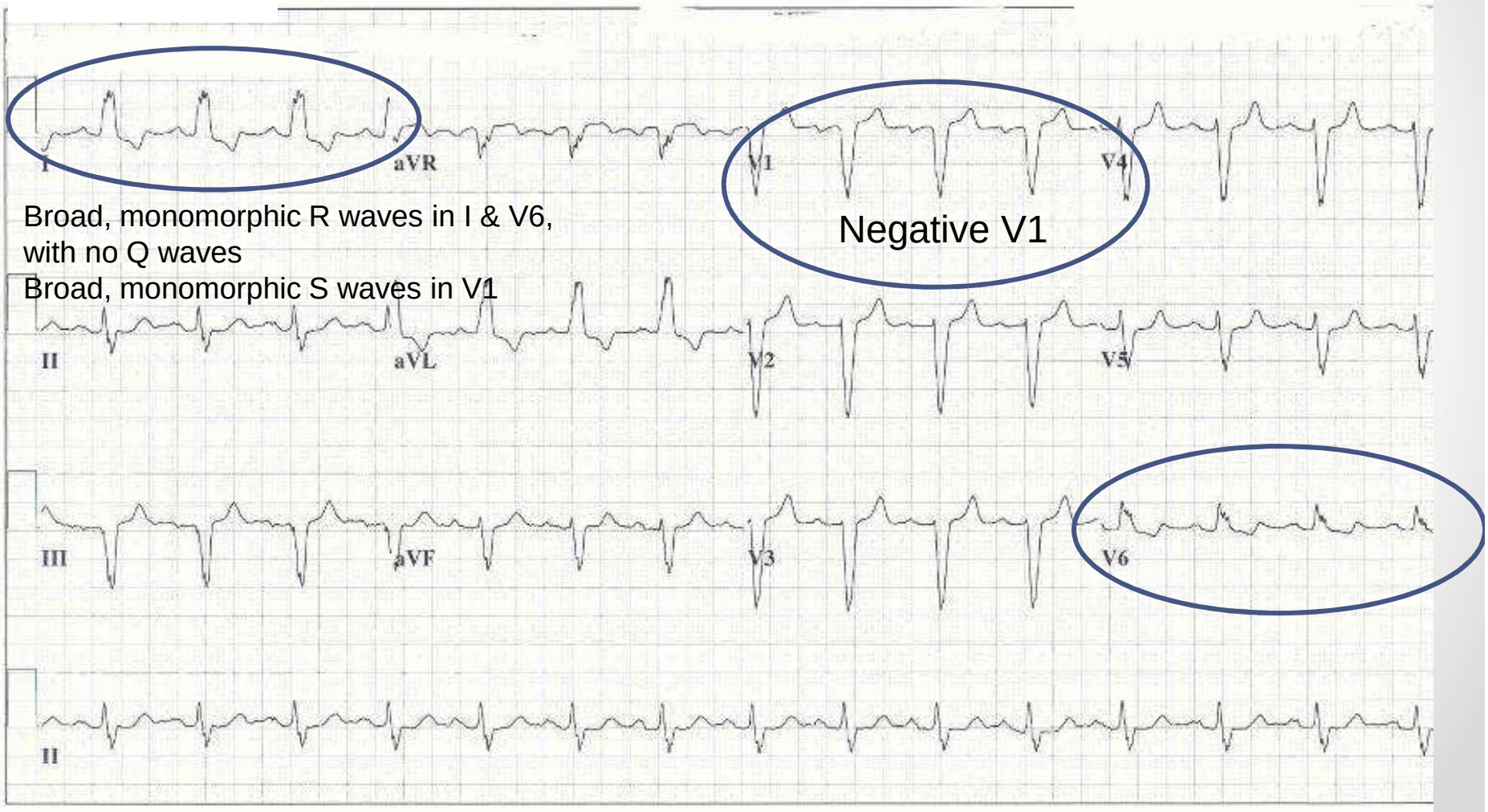
Easy way

- QRS ≥ 0.12 sec
- Negative V1 = Carrot

Vent. rate	90	BPM
PR interval	180	ms
QRS duration	140	ms
QT/QTc	382/467	ms
P–R–T axes	34 –34	119

Normal sinus rhythm
Left axis deviation
Left bundle branch block
Abnormal ECG
When compared with ECG of 26–NOV–2005 13:21,
Vent. rate has increased BY 31 BPM
T wave inversion no longer evident in Inferior leads
T wave inversion more evident in Lateral leads

QRS = 140 ms



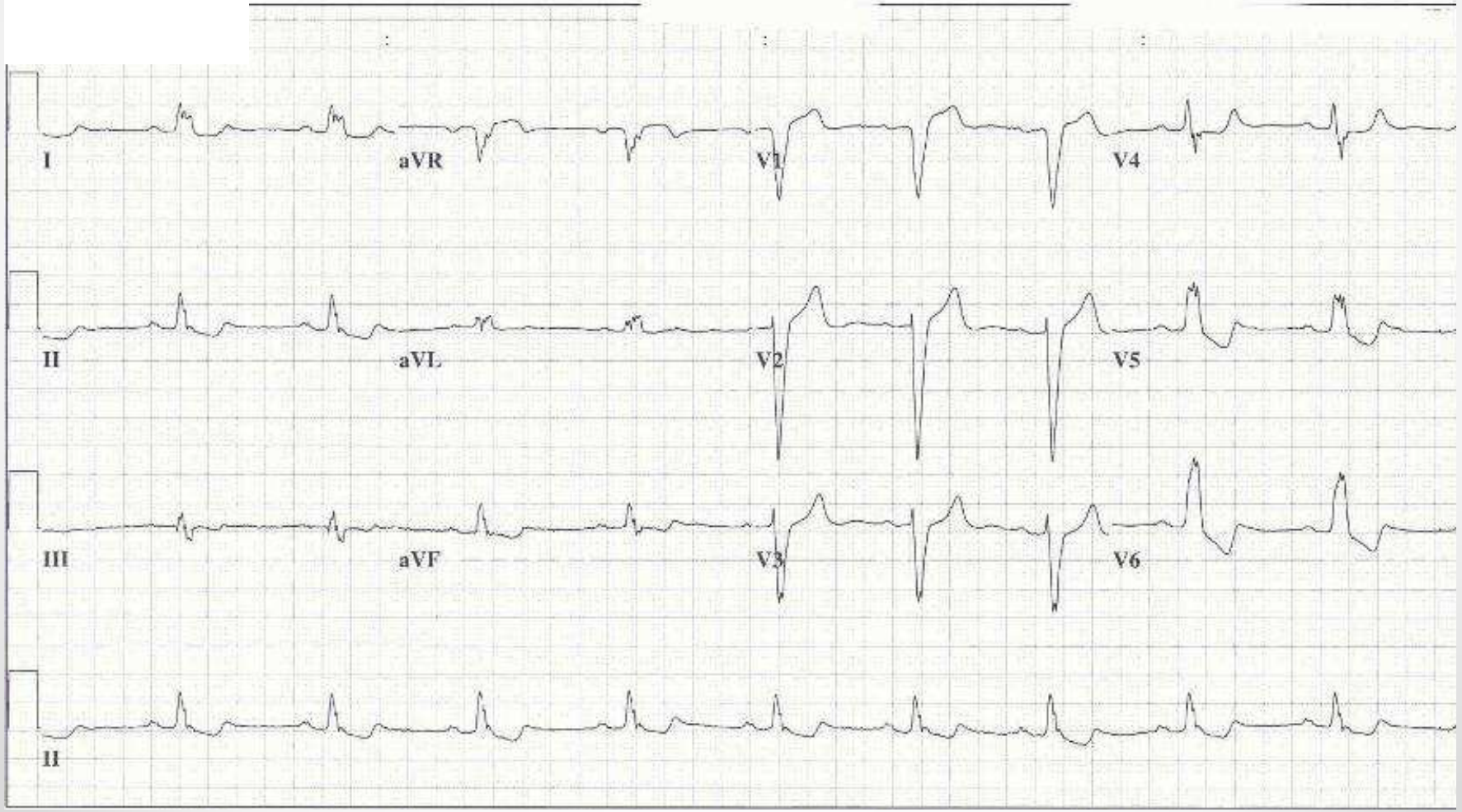
Broad, monomorphic R waves in I & V6, with no Q waves

Broad, monomorphic S waves in V1

Negative V1

Vent. rate	59	BPM	Sinus bradycardia
PR interval	206	ms	Left bundle branch block
QRS duration	144	ms	Abnormal ECG
QT/QTc	442/437	ms	No previous ECGs available
P–R–T axes	37 35	0	

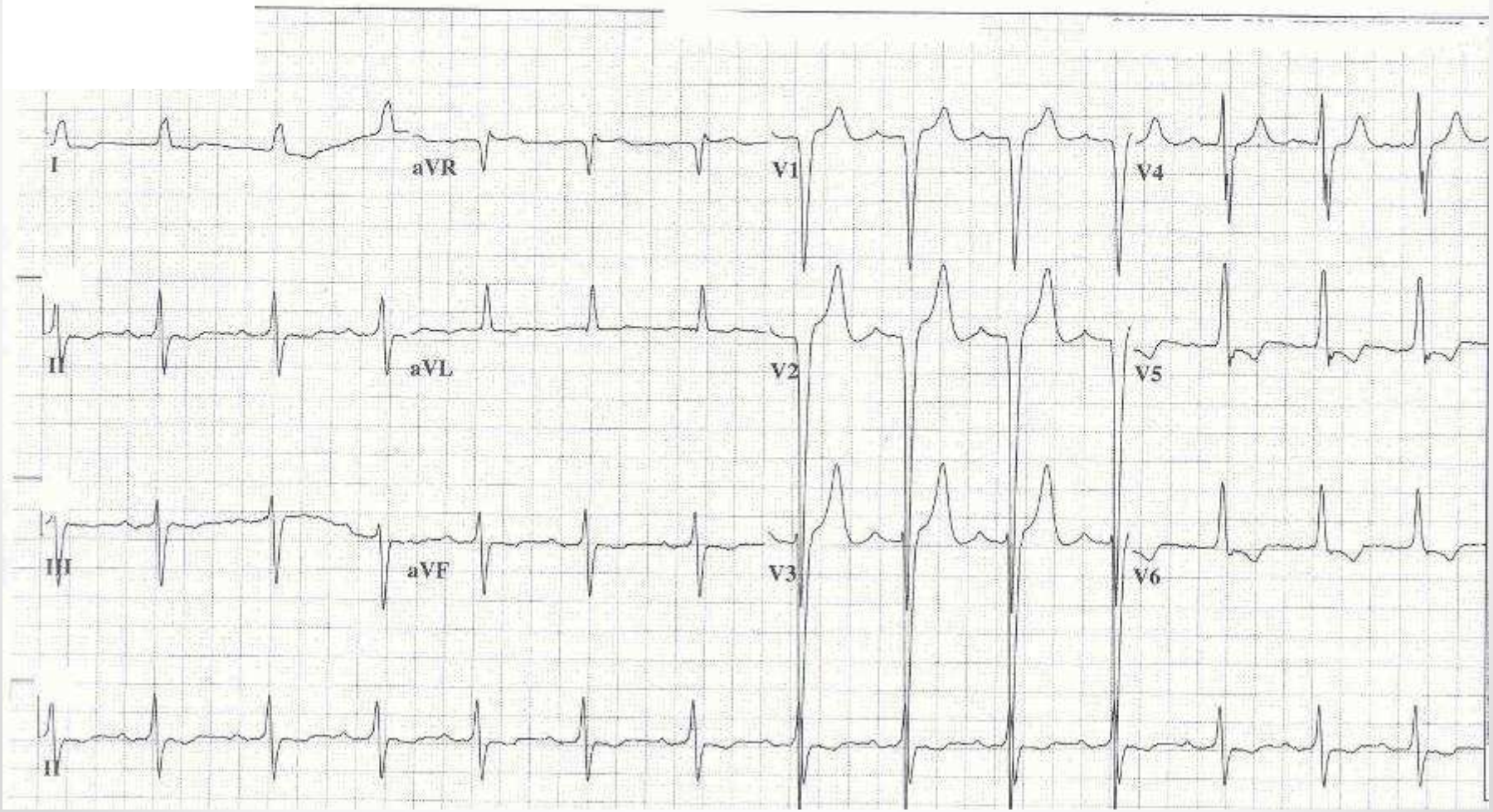
QRS = 144 ms

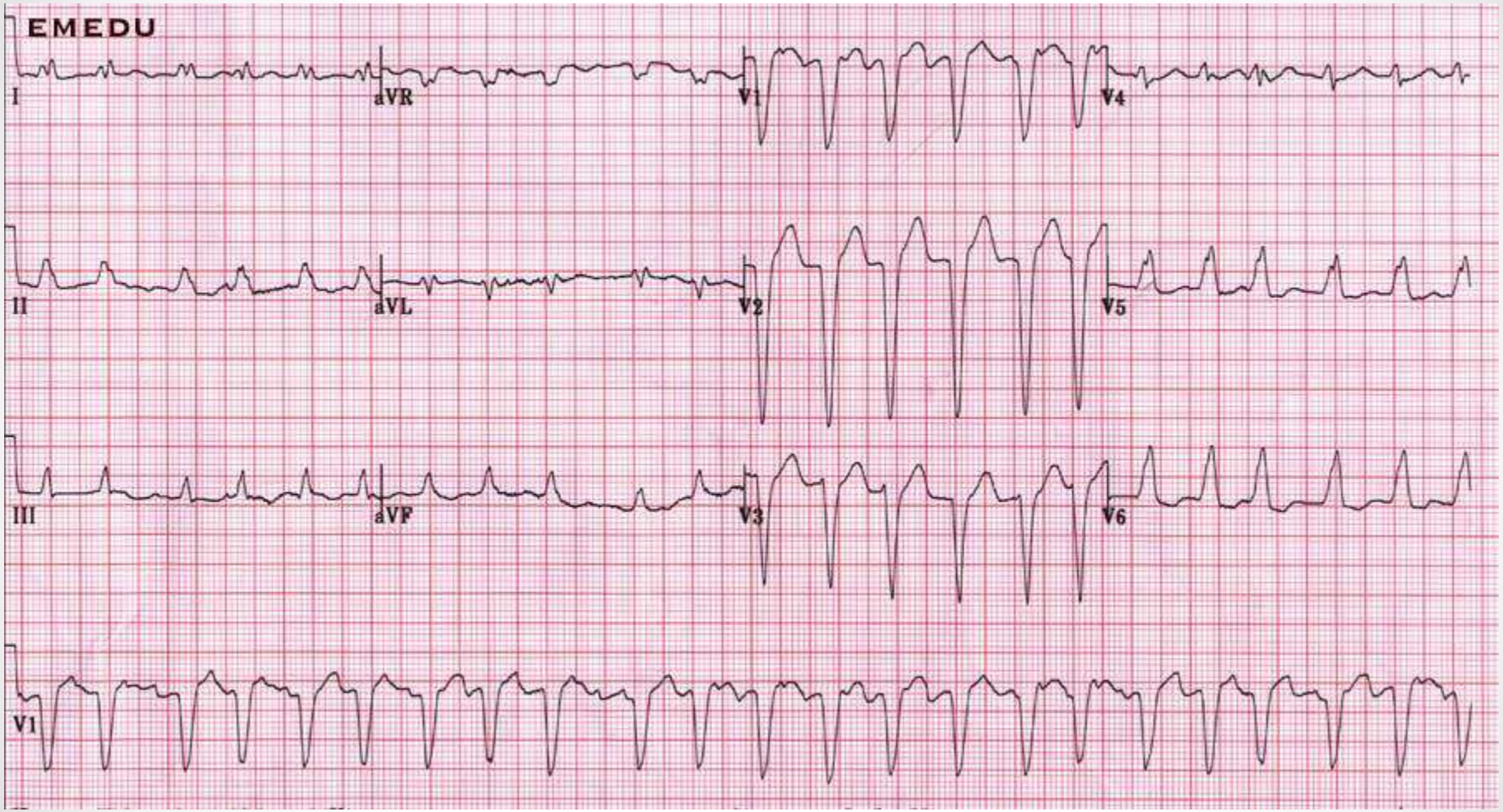


LVH, LBBB, LAD

Vent. rate	83	BPM	Normal sinus rhythm
PR interval	206	ms	Left axis deviation
QRS duration	134	ms	Left ventricular hypertrophy with QRS widening and repolarization abnormality
QT/QTc	388/455	ms	Cannot rule out Septal infarct (cited on or before 29–APR–2005)
P–R–T axes	92 –34	218	Abnormal ECG
			No change

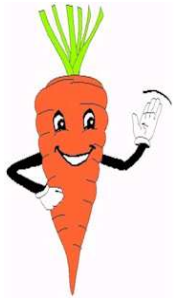
QRS = 134 ms



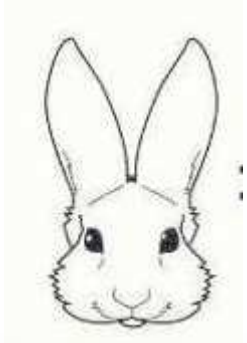

EMEDU
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1

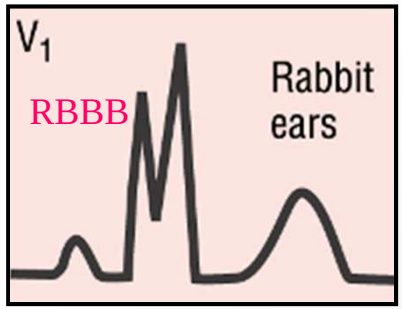
BBB = QRS > 0.12sec

- **LBBB = QRS > 0.12 sec, Negative QRS in V1 (carrot)**



- **RBBB = QRS > 0.12sec; Positive QRS in V1 (rabbit ears)**





Incomplete Bundle Branch Block
QRS in no man's land

Incomplete RBBB

- O.09 – 0.10 sec
- RBBB pattern

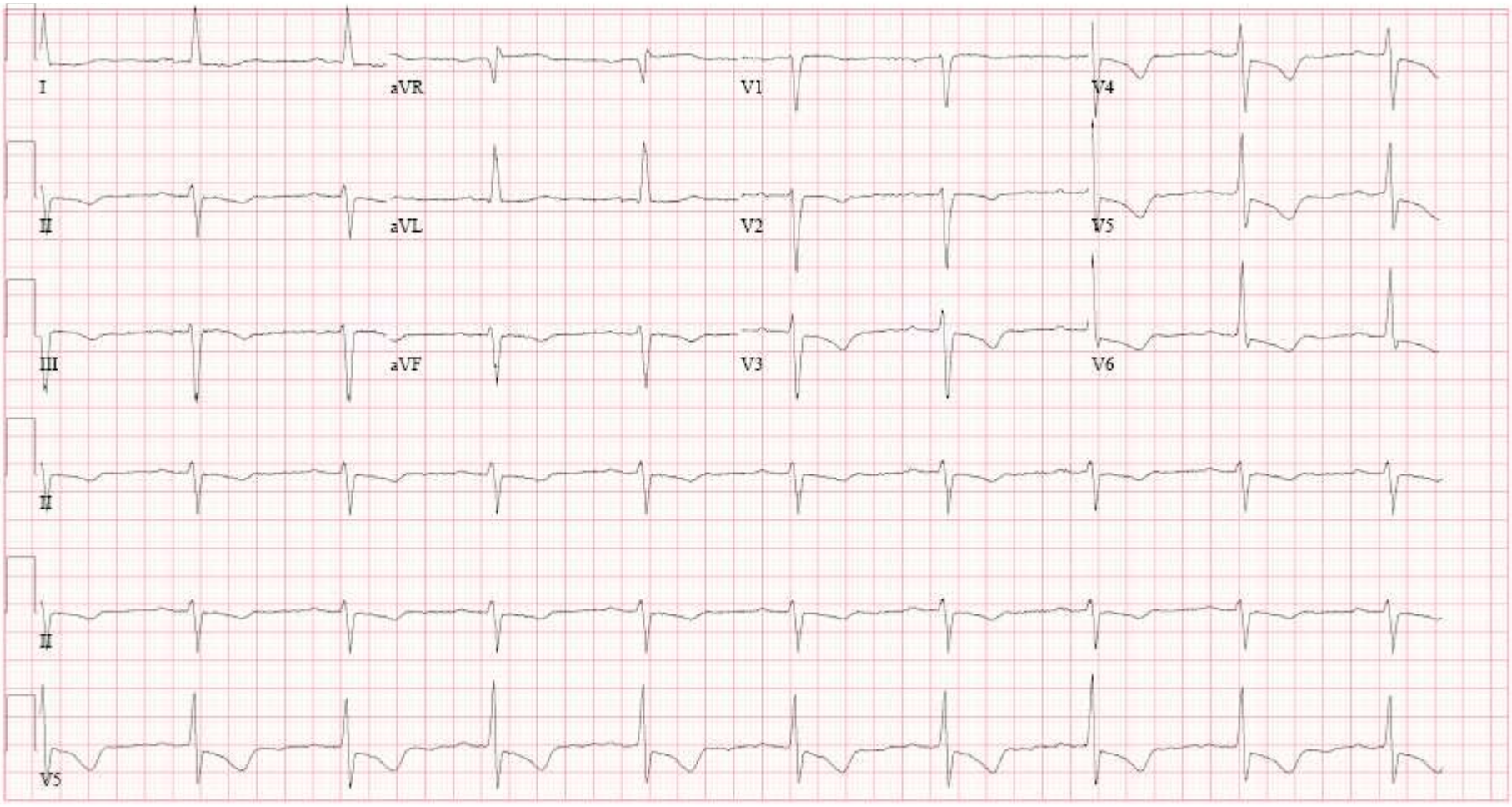
Incomplete LBBB

- O.10 – 0.11 sec
- LBBB pattern

Vent. rate	56	BPM
PR interval	232	ms
QRS duration	108	ms
QT/QTc	502/484	ms
P-R-T axes	8 -49	257

Sinus bradycardia with 1st degree A-V block
Left axis deviation
Incomplete left bundle branch block
ST & T wave abnormality, consider inferior ischemia
ST & T wave abnormality, consider anterolateral ischemia
Prolonged QT
Abnormal ECG
When compared with ECG of 14-OCT-2009 07:07,
Incomplete left bundle branch block is now Present

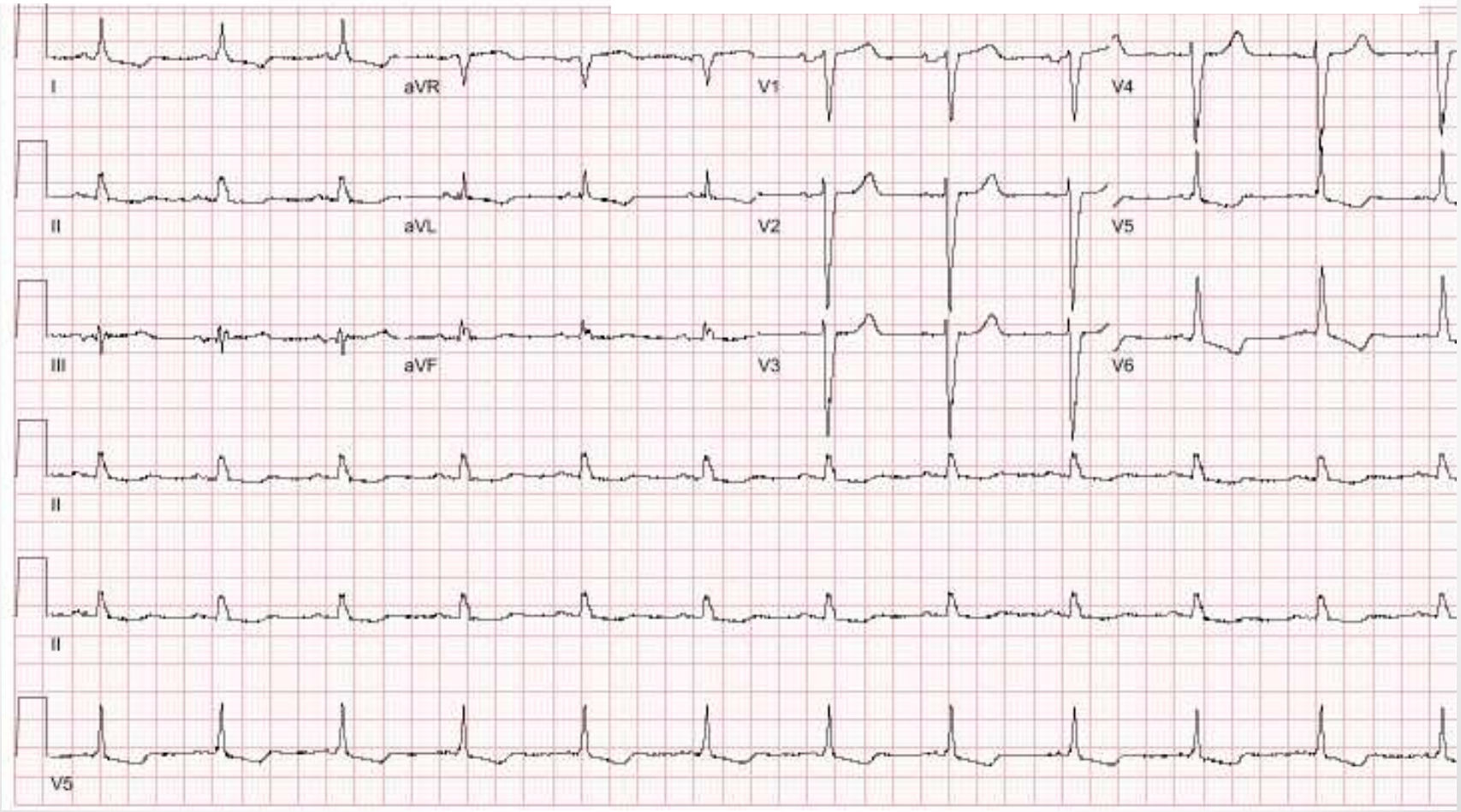
QRS = 108ms



Vent. rate	70	BPM
PR interval	160	ms
QRS duration	110	ms
QT/QTc	432/466	ms
P-R-T axes	29 16	170

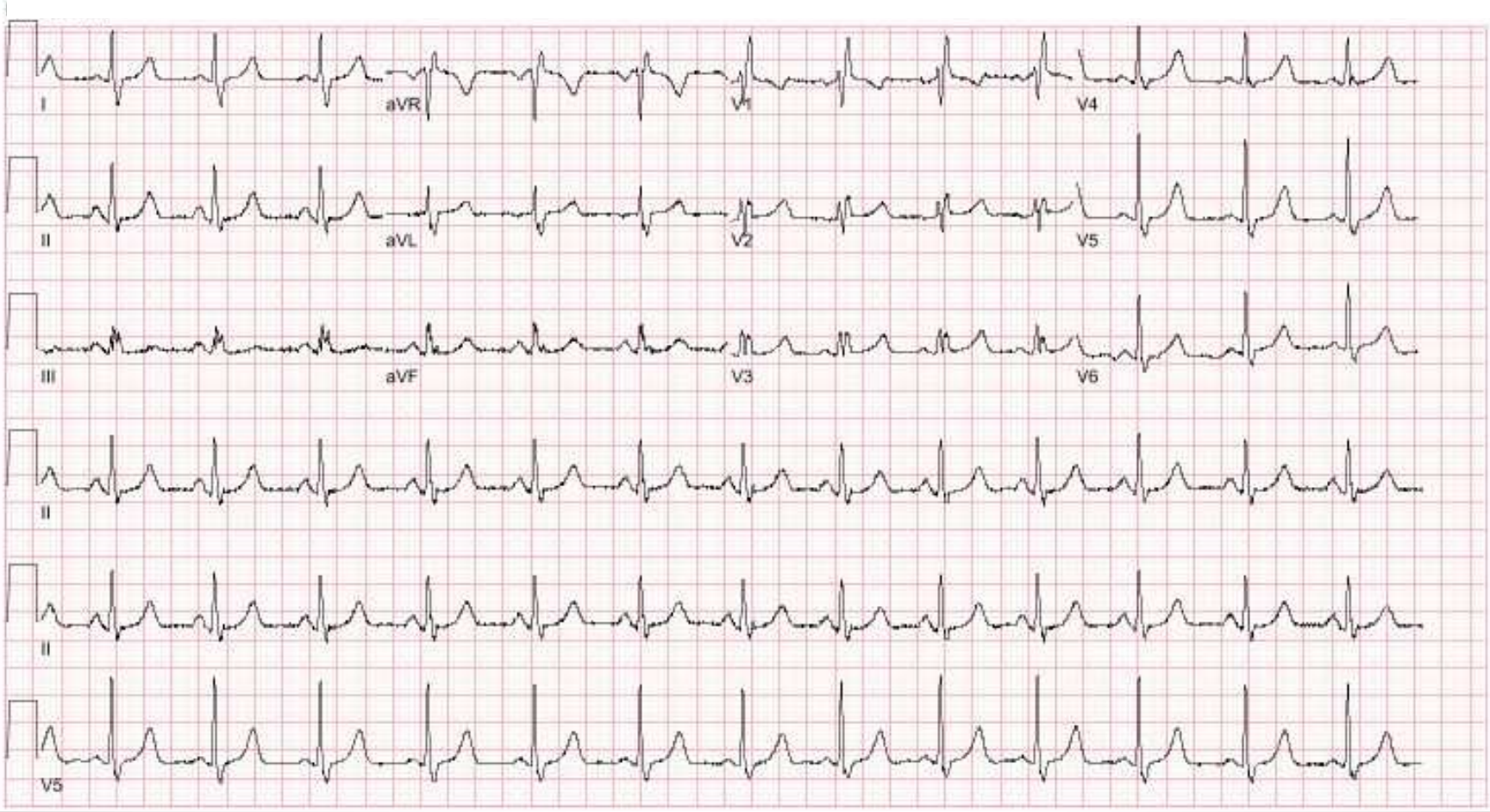
Normal sinus rhythm
Incomplete left bundle branch block
ST & T wave abnormality, consider lateral ischemia
Prolonged QT
Abnormal ECG
When compared with ECG of 08-AUG-2003 10:24,
Incomplete left bundle branch block is now Present
Nonspecific T wave abnormality has replaced inverted T waves in Inferior leads

QRS = 110 ms



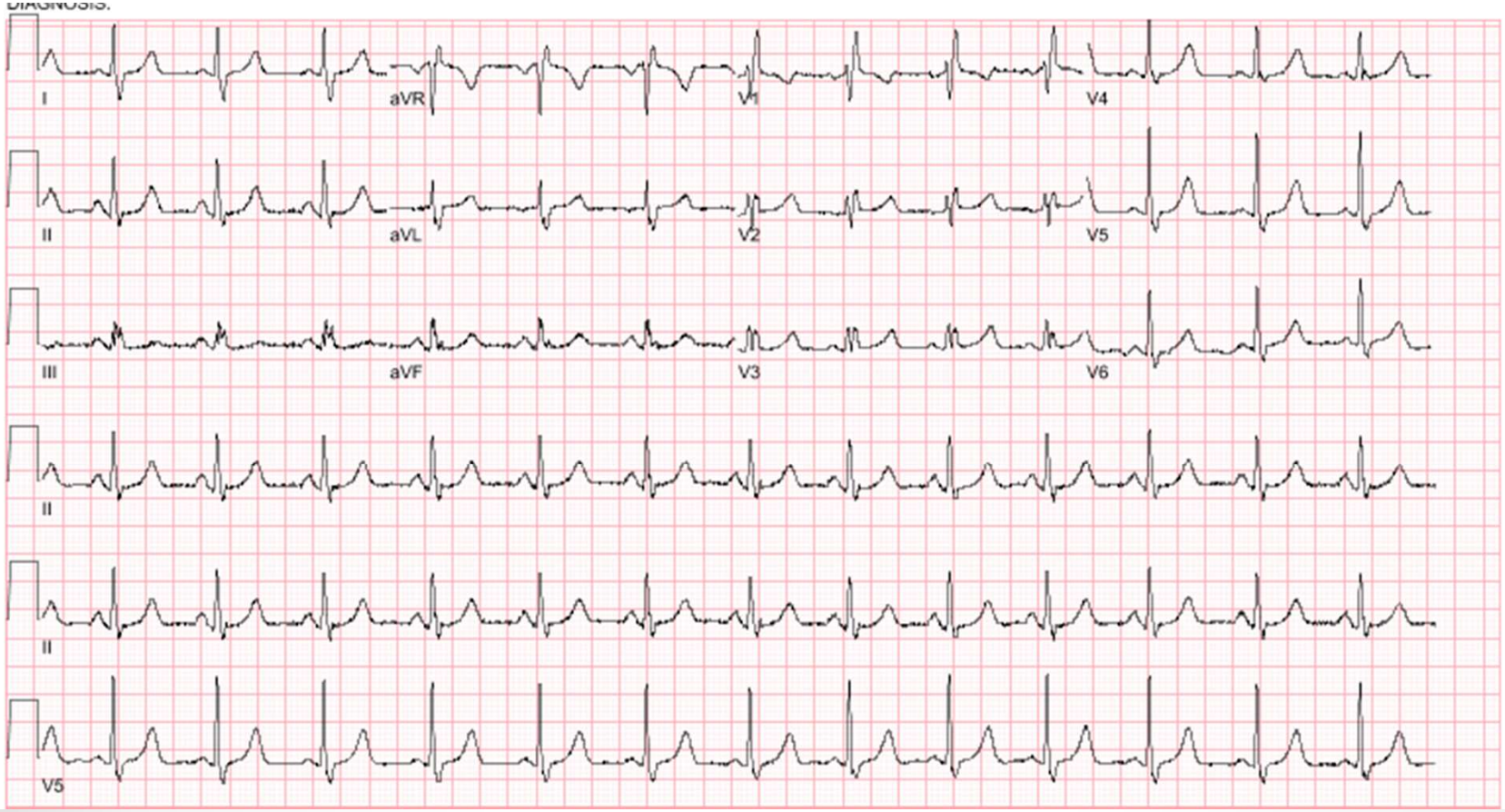
Vent. rate	80	BPM	Normal sinus rhythm
PR interval	128	ms	Incomplete right bundle branch block
QRS duration	108	ms	Borderline ECG
QT/QTc	404/465	ms	No previous ECGs available
P-R-T axes	66 60	39	

QRS = 108 ms



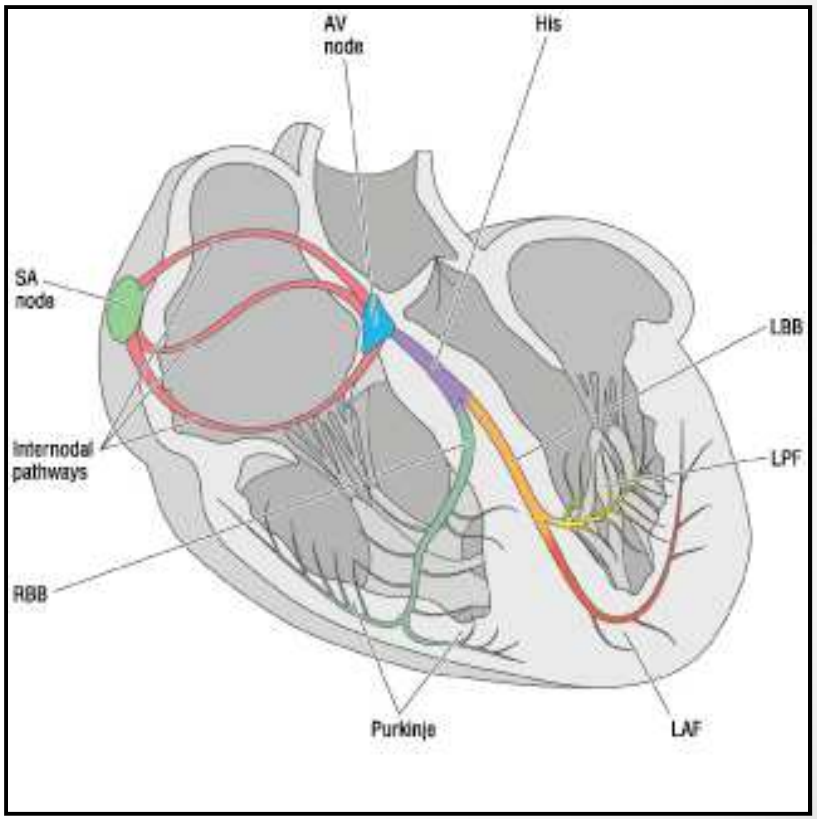
Vent. rate	80	BPM	Normal sinus rhythm
PR interval	128	ms	Incomplete right bundle branch block
QRS duration	108	ms	Borderline ECG
QT/QTc	404/465	ms	No previous ECGs available
P-R-T axes	66 60	39	

QRS = 106 ms



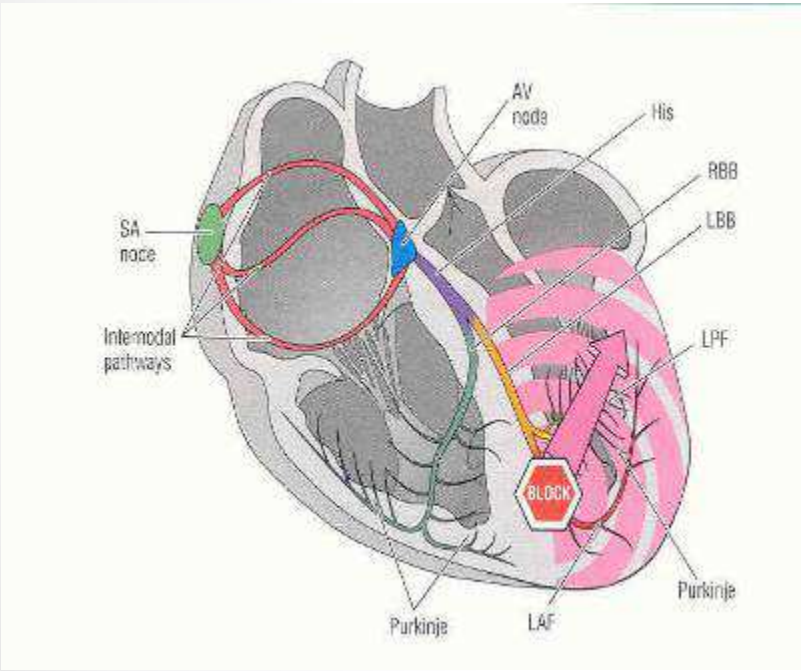
Hemiblocks

- Block of one of the two fascicles of the left bundle branch system
- LAH & LPH
- 4 X higher mortality rate for pts with AMI
- Risk factor for developing CHB
- Can indicate proximal artery occlusion



Left Anterior Hemiblock

LAH

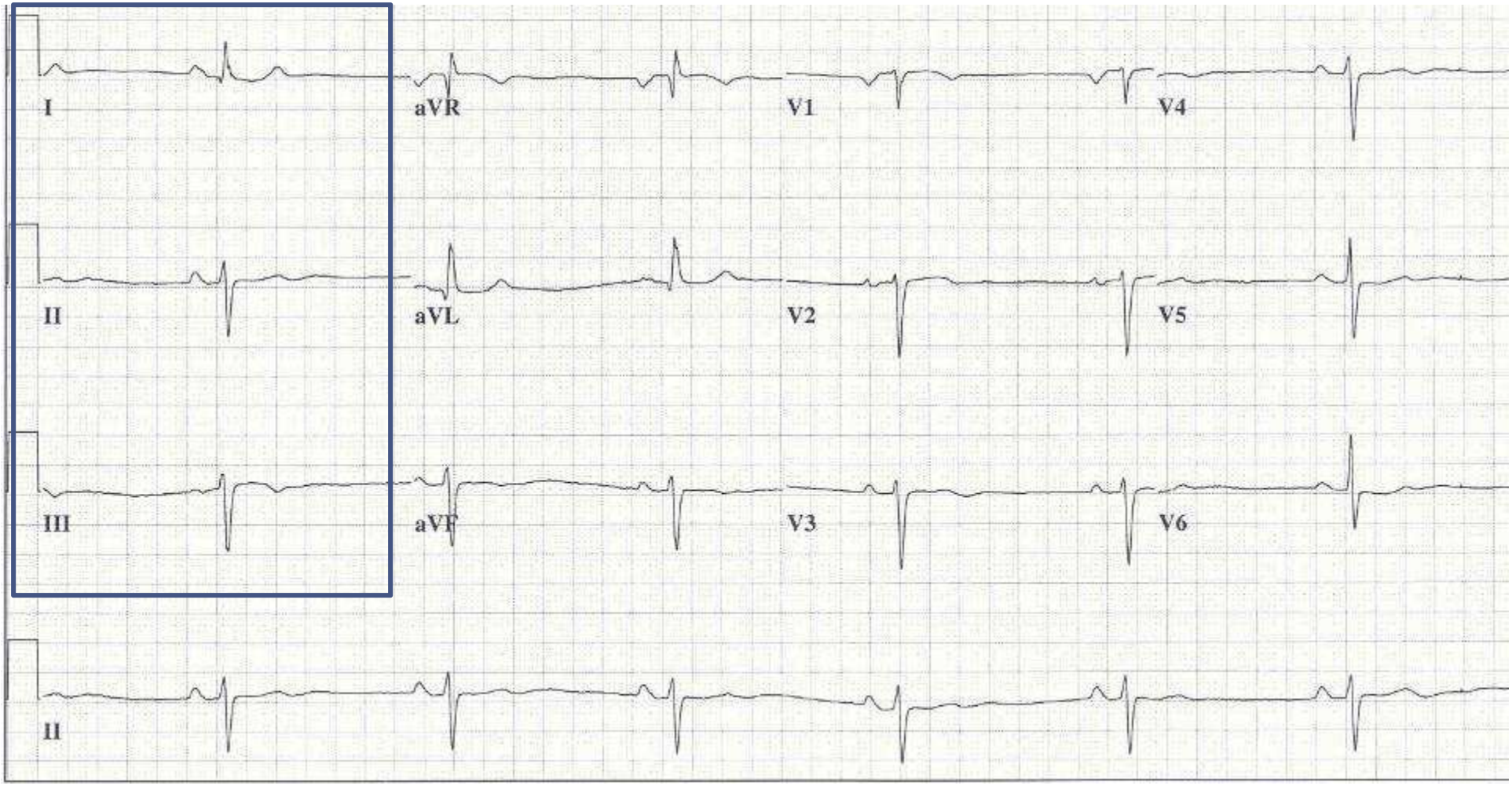


- **Positive polarity Lead I**
- **Negative polarity Leads II & III**
- ↑↓↓
- **Left Axis Deviation**

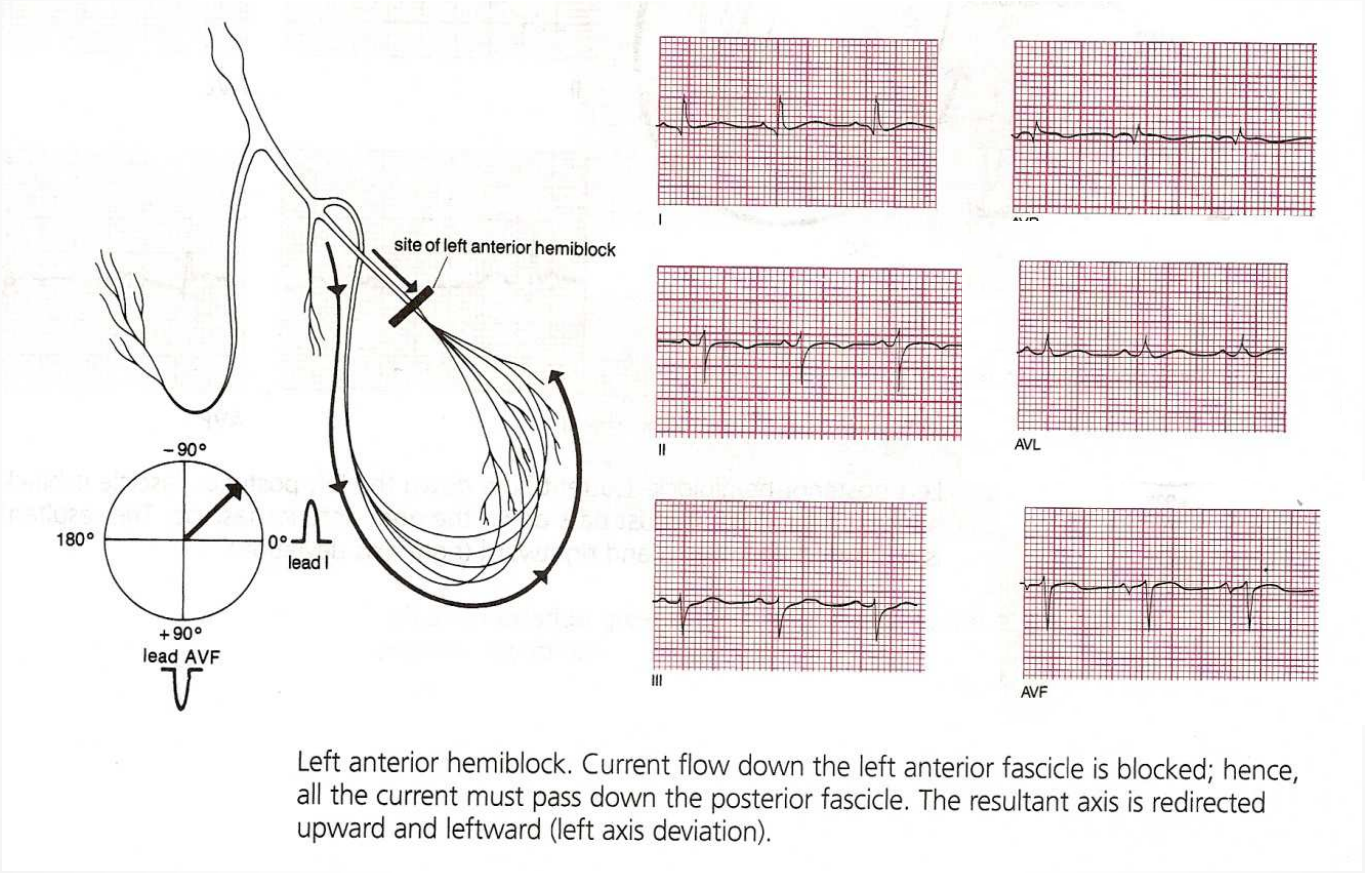
Source: Garcia 12 Lead EKG 13:15

Vent. rate	40	BPM	Marked sinus bradycardia
PR interval	202	ms	Possible Left atrial enlargement
QRS duration	108	ms	Left anterior fascicular block
QT/QTc	486/396	ms	Abnormal ECG
P–R–T axes	39 –61	0	When compared with ECG of 18–MAY–2009 10:10, No significant change was found

Axis = -61



Left Axis Deviation from Left Anterior Hemiblock



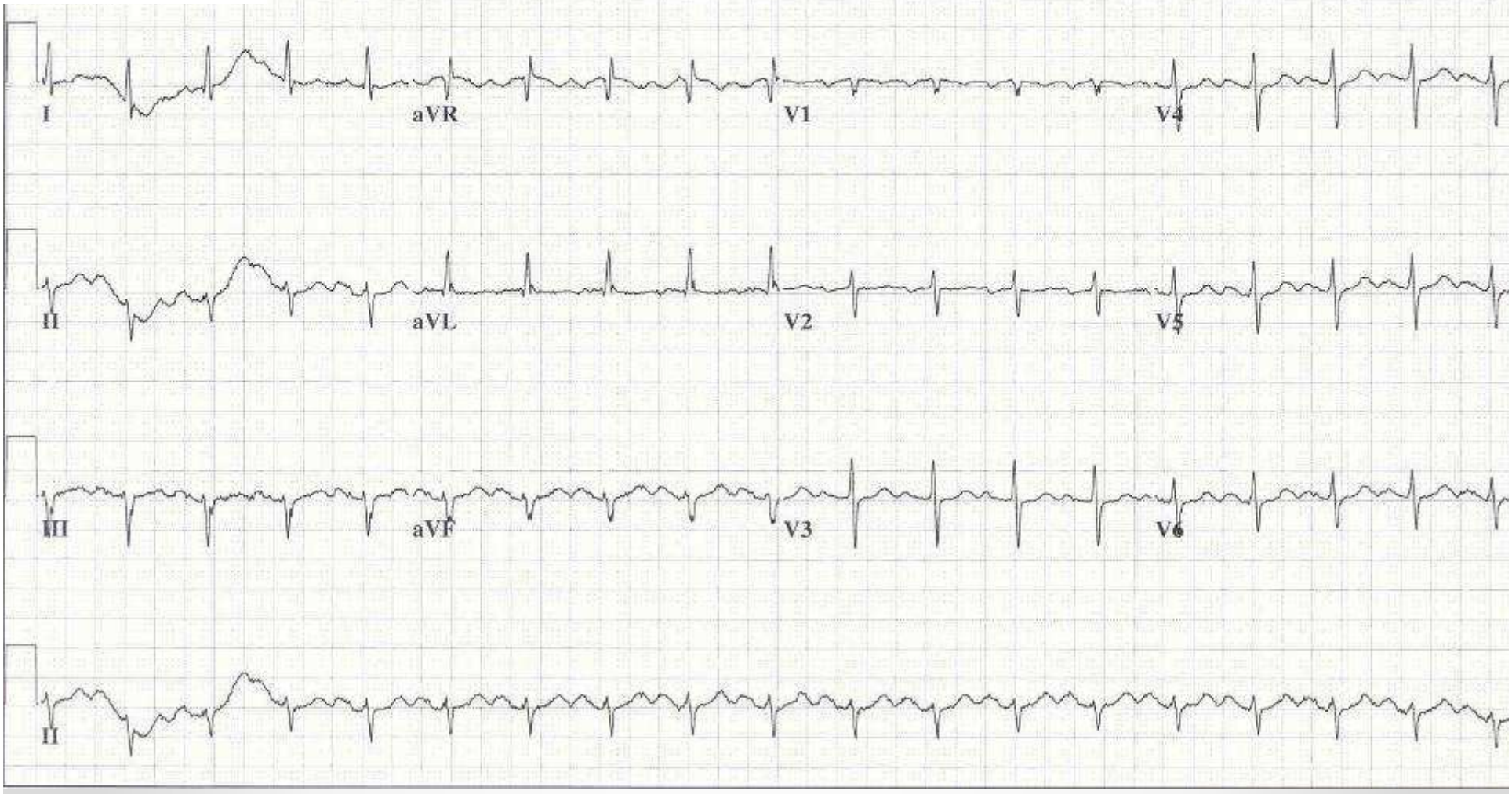
Left anterior hemiblock. Current flow down the left anterior fascicle is blocked; hence, all the current must pass down the posterior fascicle. The resultant axis is redirected upward and leftward (left axis deviation).

Source: Thaler, M. The Only EKG Book You'll Ever Need, 5th ed

Vent. rate	111	BPM
PR interval	196	ms
QRS duration	84	ms
QT/QTc	334/454	ms
P–R–T axes	62 –52	70

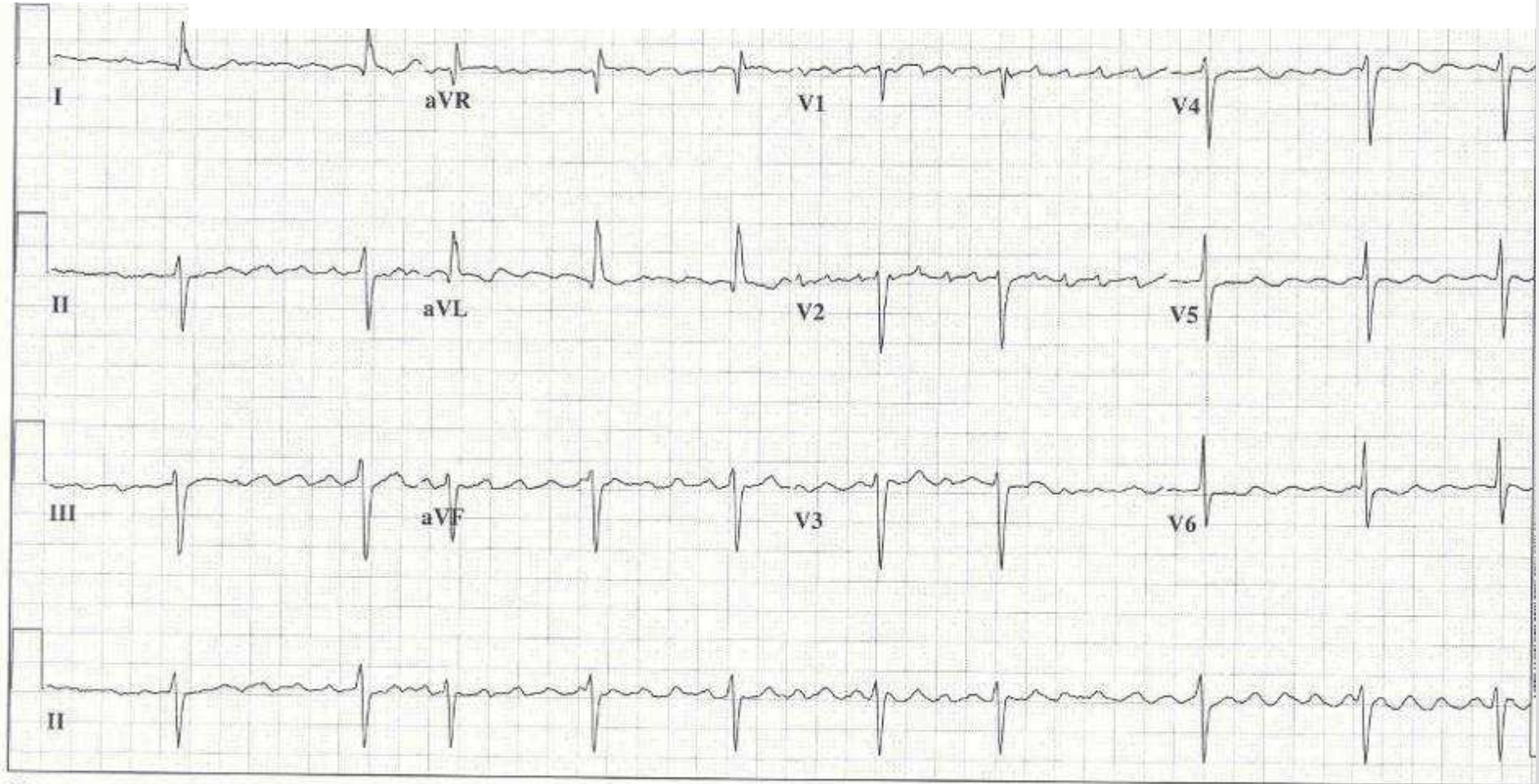
Sinus tachycardia
Left anterior fascicular block
Nonspecific ST abnormality
Abnormal ECG
When compared with ECG of 20–NOV–2007 13:48,
Vent. rate has increased BY 42 BPM
Left anterior fascicular block is now Present

Axis = -52



Vent. rate	61	BPM	Atrial flutter with variable A–V block
PR interval	*	ms	Pulmonary disease pattern
QRS duration	106	ms	Left anterior fascicular block
QT/QTc	434/436	ms	Nonspecific ST abnormality
P–R–T axes	88 –60	59	Abnormal ECG
			When compared with ECG of 03–JUN–2009 10:24,
			Atrial flutter has replaced Sinus rhythm

Axis = -60



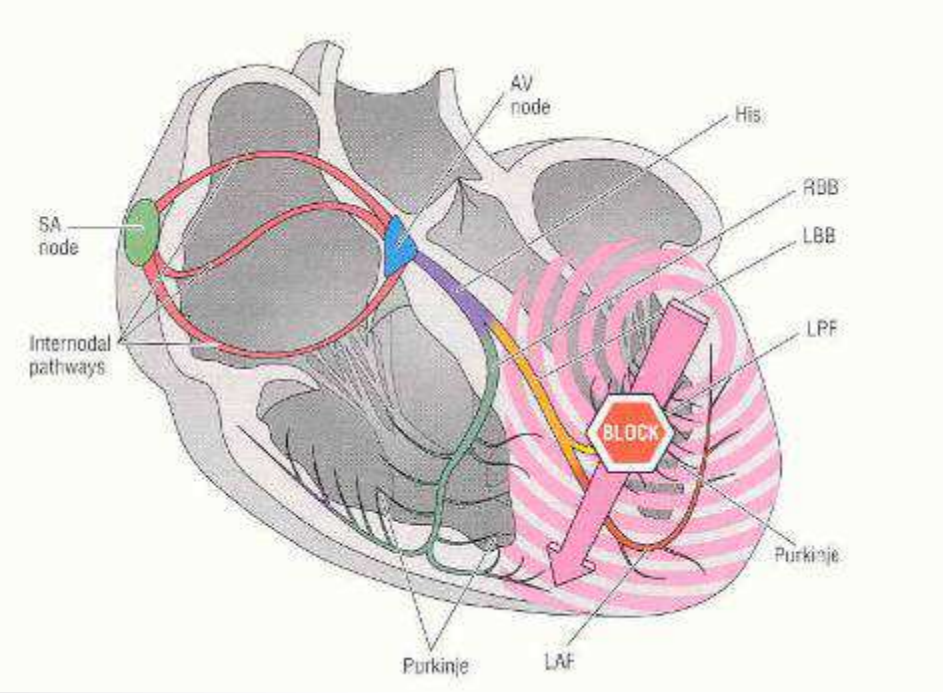
25mm/s 10mm/mV 150Hz 7.1.1 12SL 237 CID: 41

SID: 0000746988 EID: 148 EDT: 18:42 03–JUN–2009 ORDER: 28543855 ACCOUNT: 0915

Page

Left Posterior Hemiblock

LPH



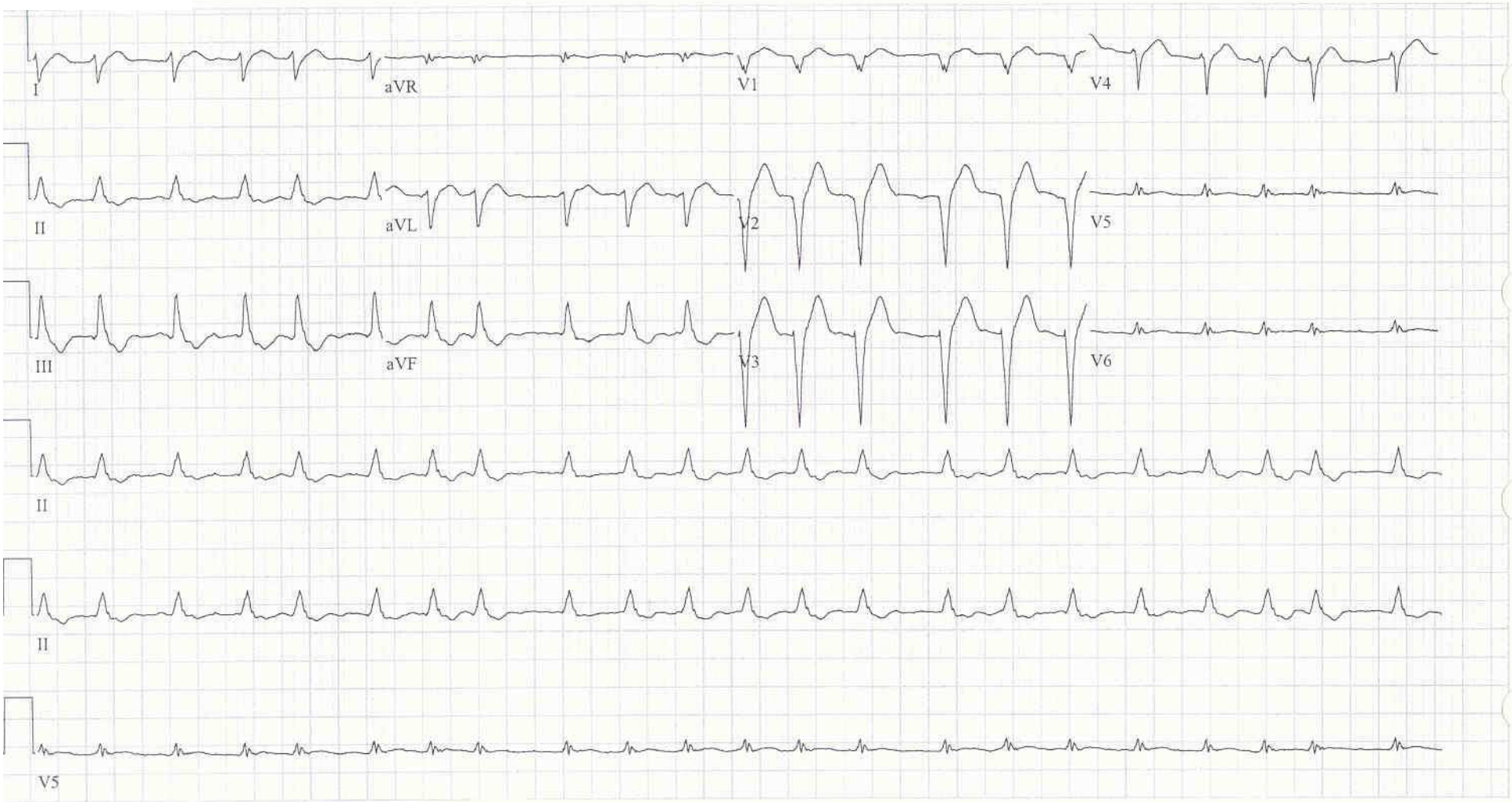
- **Negative polarity Lead I**
- **Positive polarity Leads II & III**
- **↓↑↑**
- **Rare**
- **Right Axis Deviation**
- **If RBBB, ask if there a LPH**

Source: Garcia 12 Lead EKG 13:19

Vent. rate	130	BPM	Atrial fibrillation with rapid ventricular response
PR interval	*	ms	Left posterior fascicular block
QRS duration	102	ms	Septal infarct (cited on or before 06-NOV-2009)
QT/QTc	292/429	ms	T wave abnormality, consider inferior ischemia or digitalis effect
P-R-T axes	* 112	-48	Abnormal ECG

When compared with ECG of 05-DEC-2009 10:13,
Atrial fibrillation has replaced Sinus rhythm
T wave inversion more evident in Inferior leads

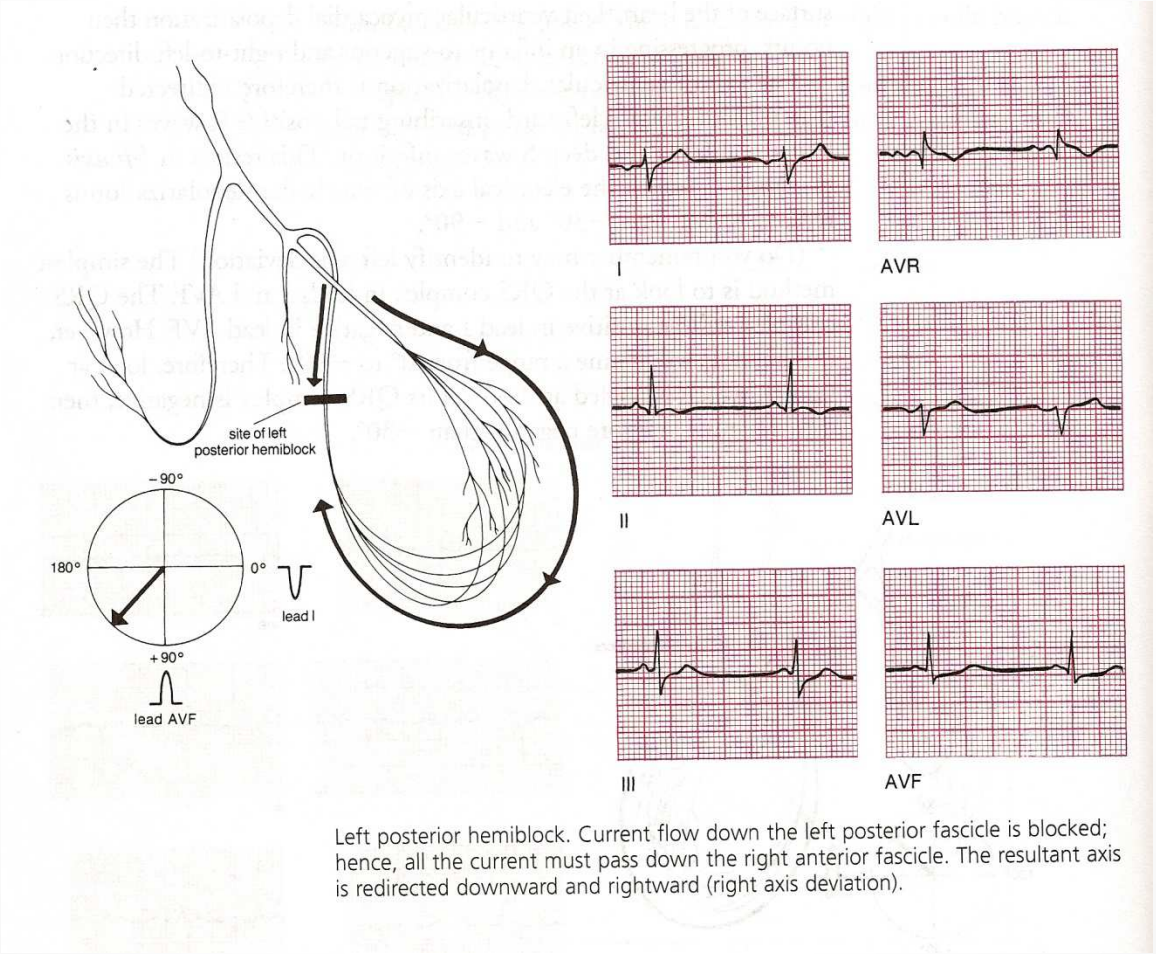
Axis = 112



25mm/s 10mm/mV 150Hz 7.1.1 12SL 237 CID: 17

SID: 0000812940 EID:245 EDT: 13:12 07-DEC-2009 ORDER: ACCOUNT: 0933500776

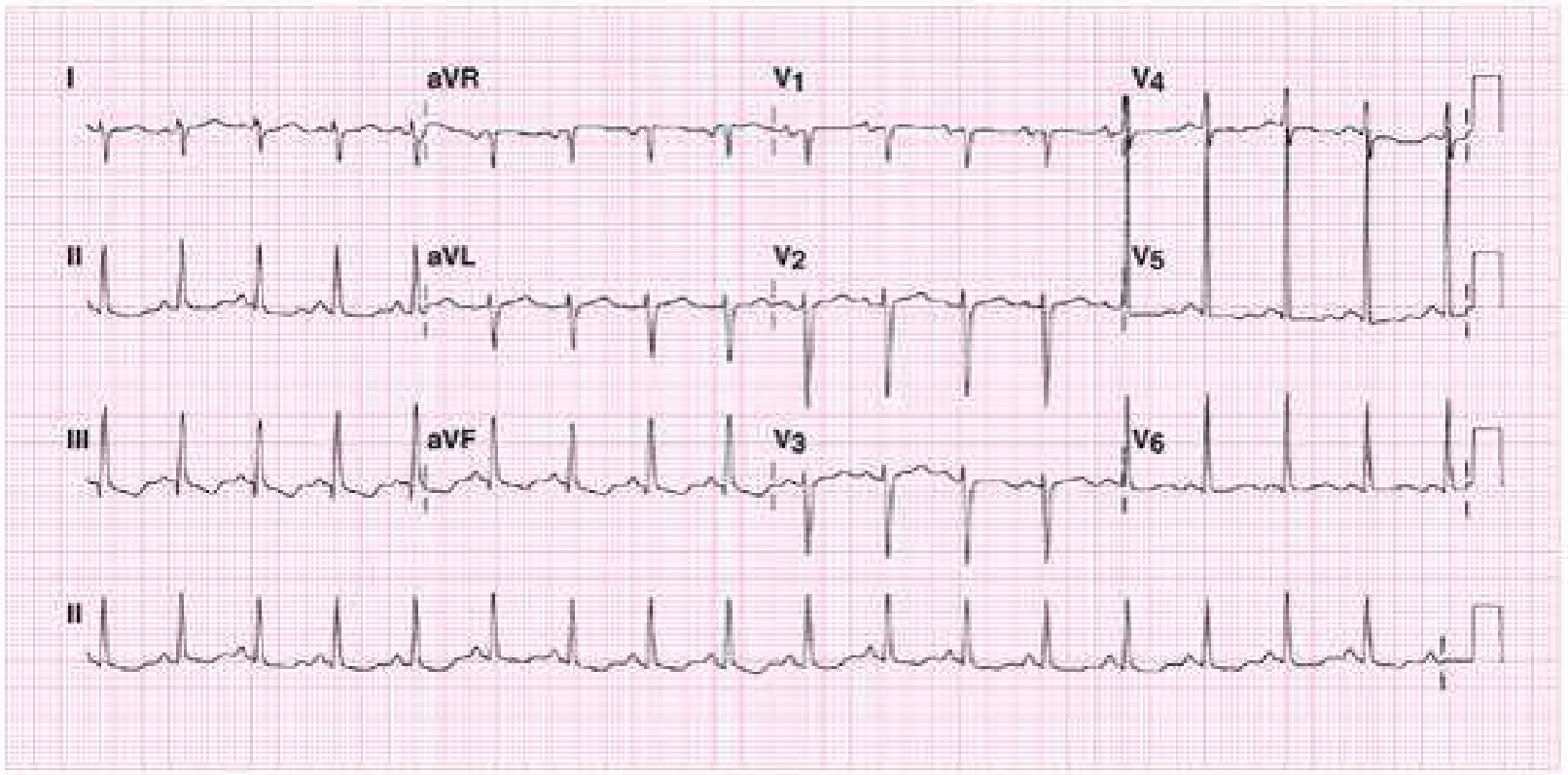
Right Axis Deviation from Left Posterior Hemiblock



Left posterior hemiblock. Current flow down the left posterior fascicle is blocked; hence, all the current must pass down the right anterior fascicle. The resultant axis is redirected downward and rightward (right axis deviation).

Source: Thaler, M. The Only EKG Book You'll Ever Need, 5th ed

ECG 13-27 Left Posterior Hemiblock



LAH = (Anterior) Lead I up

LPH = (Posterior) Lead I down

LAH & LPH Summary

	LAH	LPH
Lead I		
Lead II		
Lead III		
Axis		

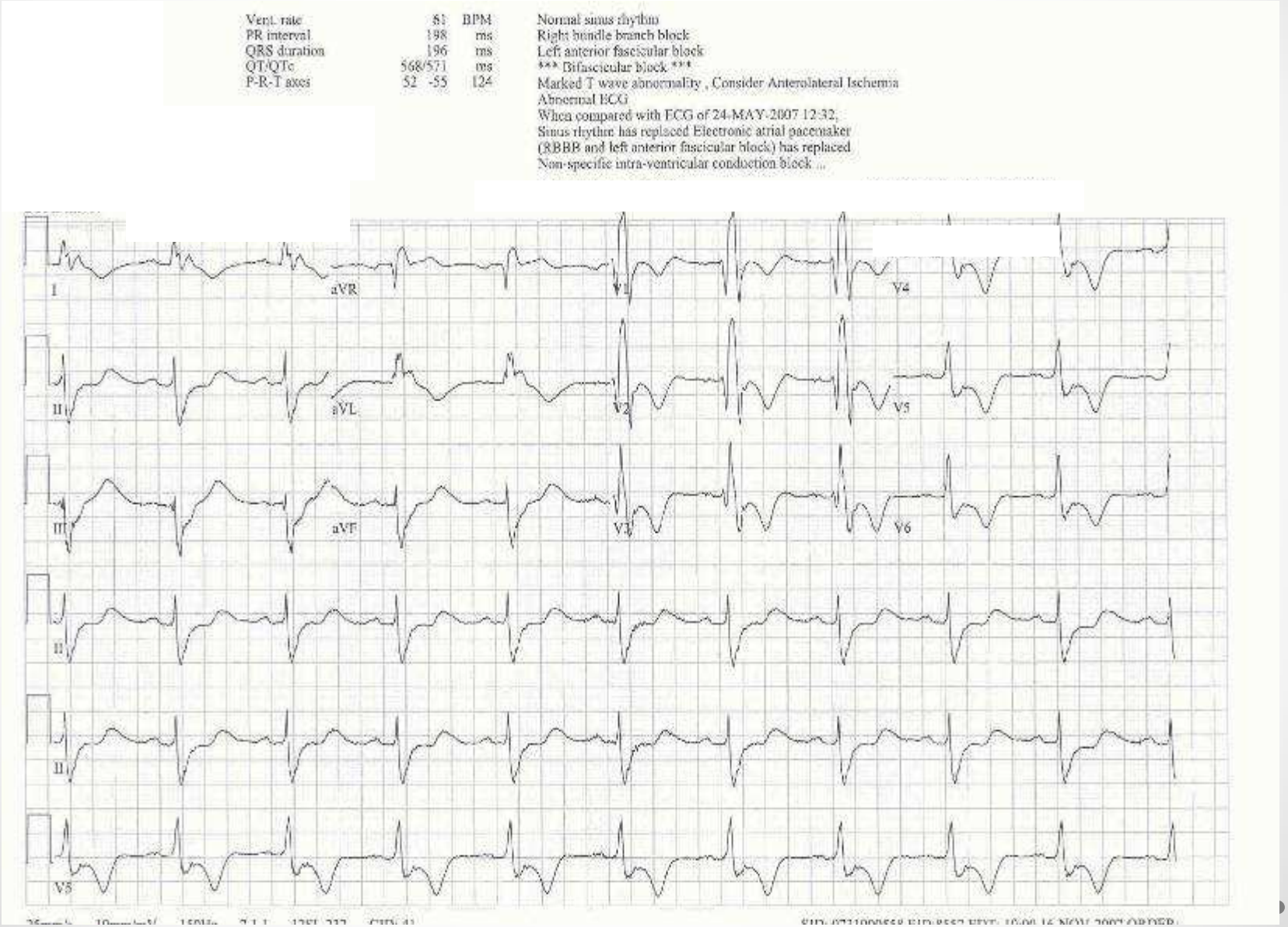
LAH & LPH Summary

	LAH	LPH
Lead I	↑	↓
Lead II	↓	↑
Lead III	↓	↑
Axis	**Left**	**Right**

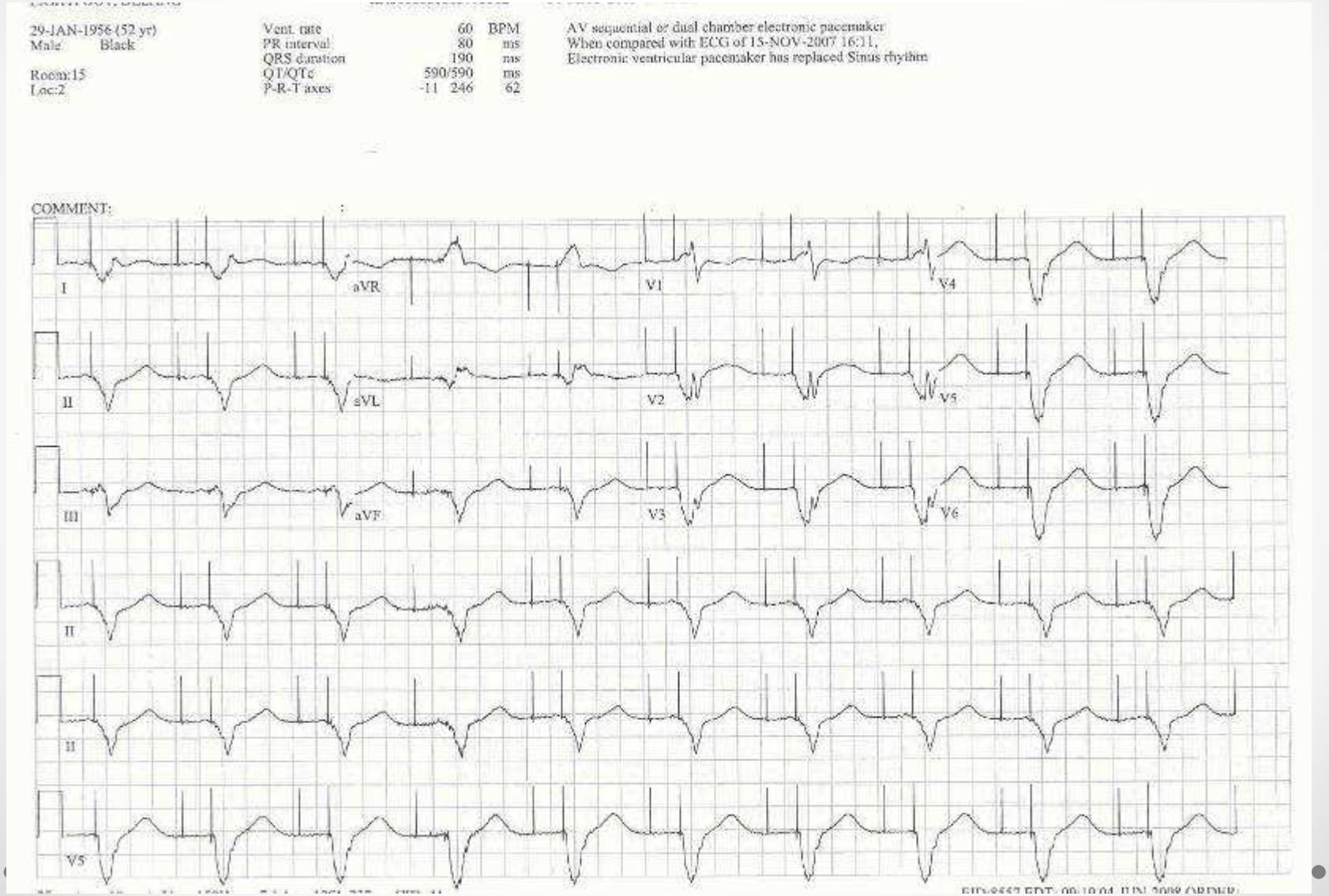
Bi & Tri Blocks

- **Bifascicular Block: RBBB with LPH or LAH**
- **Trifasicular Block: RBBB with LPH/LAH & any type of AV Block (1°, Wenckebach, Classical or CHB)**

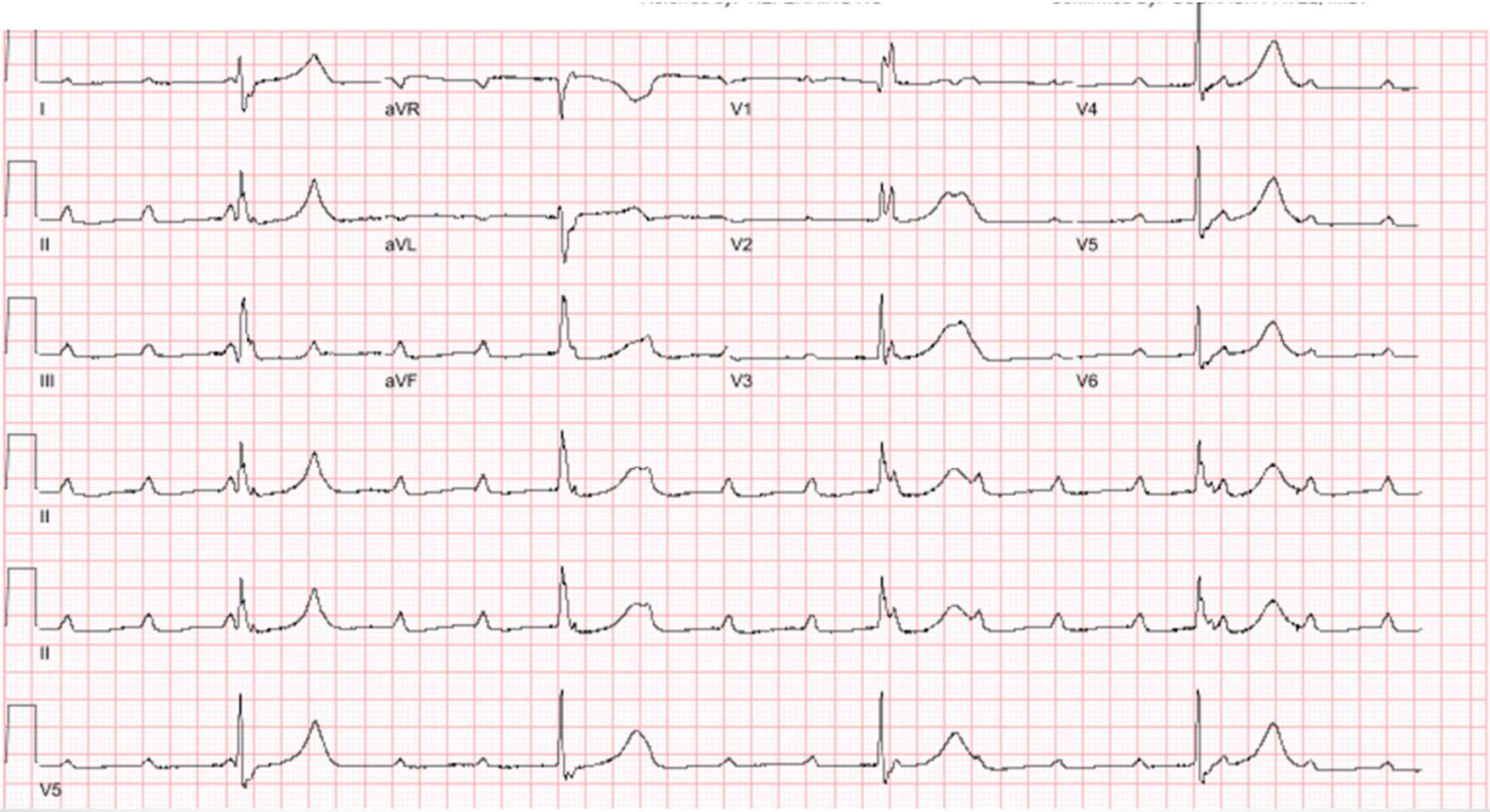
Tetralogy of Fallot – Septal defect repaired at age of 3 (50 years ago)
Severe Right Ventricular Hypertrophy



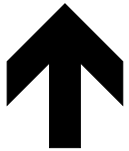
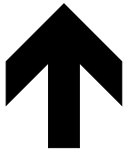
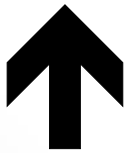
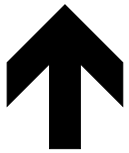
Tetralogy of Fallot Patient 2 years later. 100% paced



Vent. rate	52	BPM	complete heart block
PR interval	*	ms	Right bundle branch block
QRS duration	138	ms	Abnormal ECG
QT/QTc	720/669	ms	When compared with ECG of 02-DEC-2013 13:19,
P-R-T axes	* 92	31	No significant change was found



Axis Summary

Axis	Normal - 30 to +90	Left -30 to - 90	Right +90 to ±180	Extreme -90 to ±180/270
Lead I				
AVF				

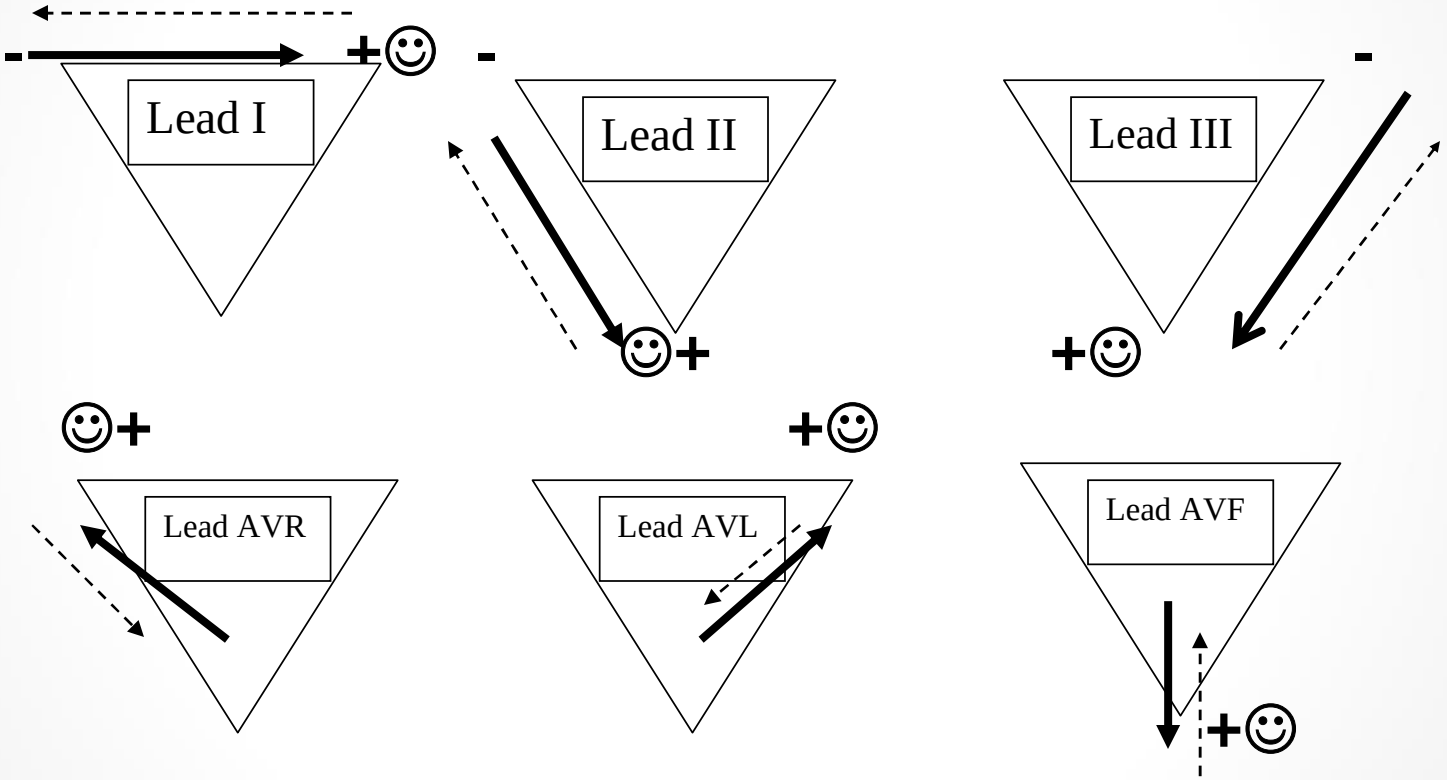
LAH & LPH Summary

	LAH	LPH
Lead I	↑	↓
Lead II	↓	↑
Lead III	↓	↑
Axis	**Left**	**Right**

+ and – Poles Summary

☺ -----> = Camera looking from positive lead

= Direction of current Negative to Positive to get EKG complex



Pattern to Read EKG

Be consistent

- Rate & Rhythm
- QRS Interval V1 – for RBBB or LBBB
- QT interval
- Normal Depolarization – If not, why not
- ST & T waves
- What lead is abnormal and what other lead goes with it

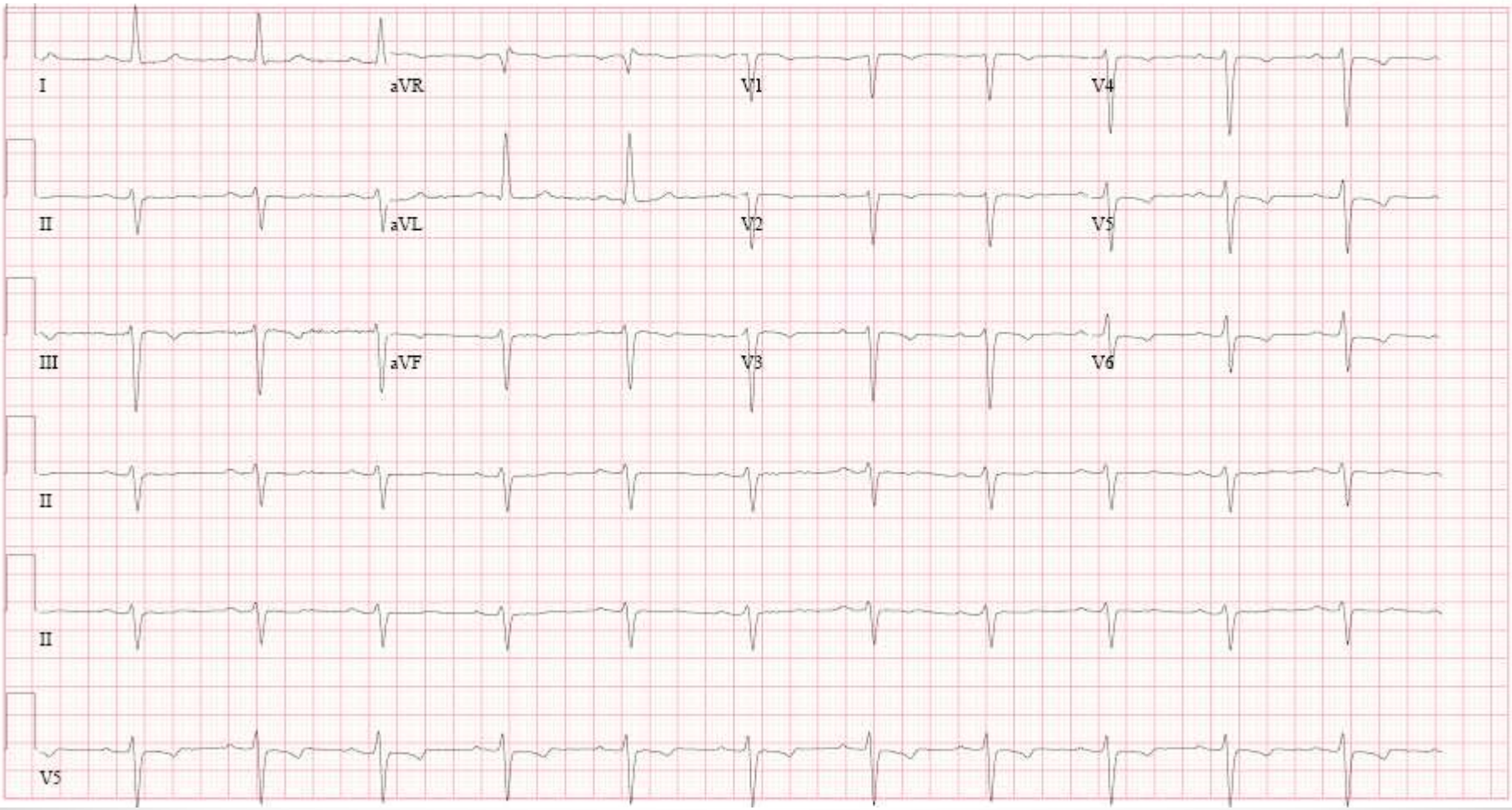
Practice & Application Time

For each EKG

- Identify if the depolarization is correct
- Identify any BBB present
- Identify any hemiblocks
- Determine the axis

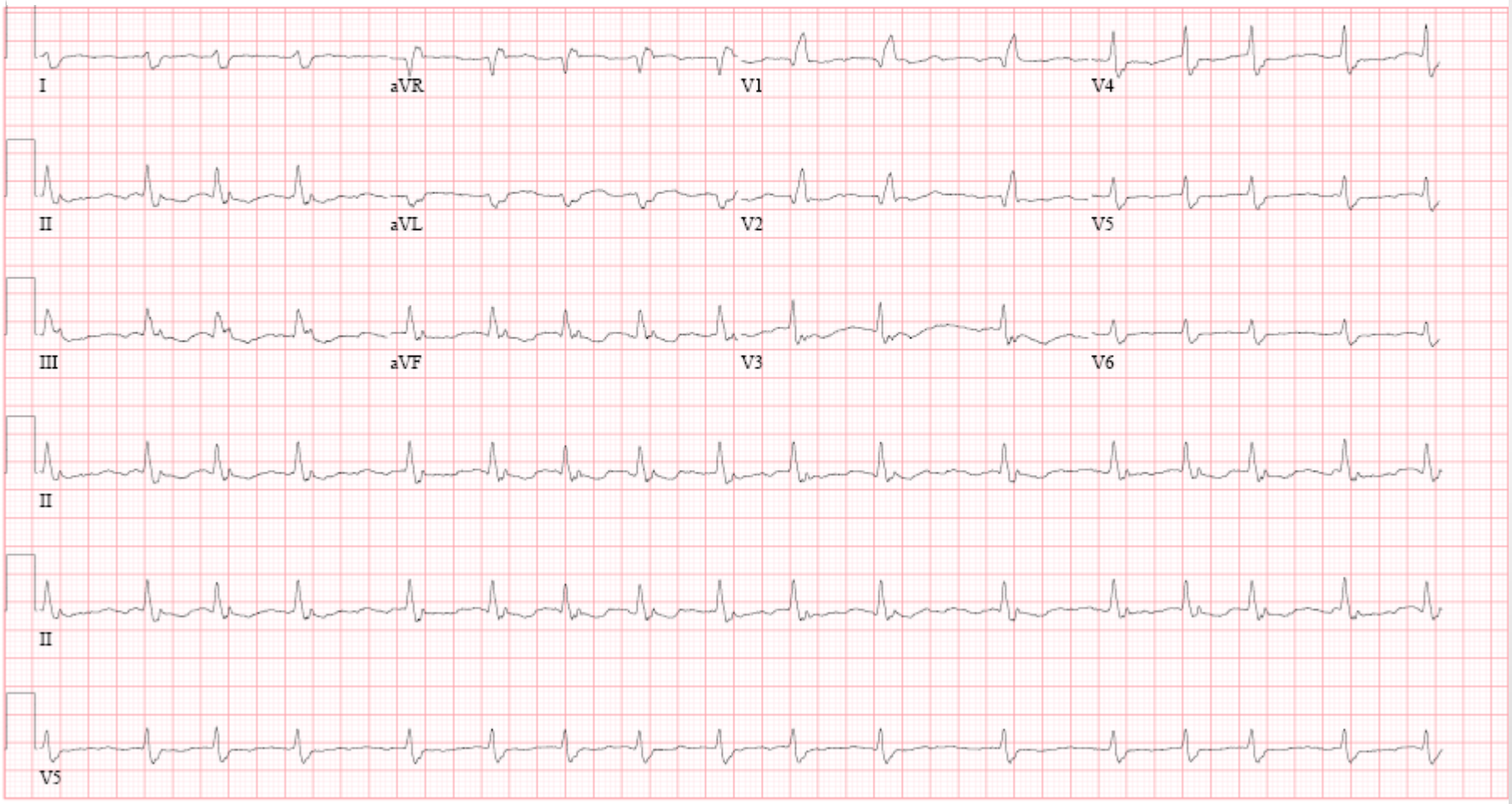
EKG 1

Vent. rate	69	BPM
PR interval	188	ms
QRS duration	108	ms
QT/QTc	380/407	ms
P-R-T axes	15 -49	-34



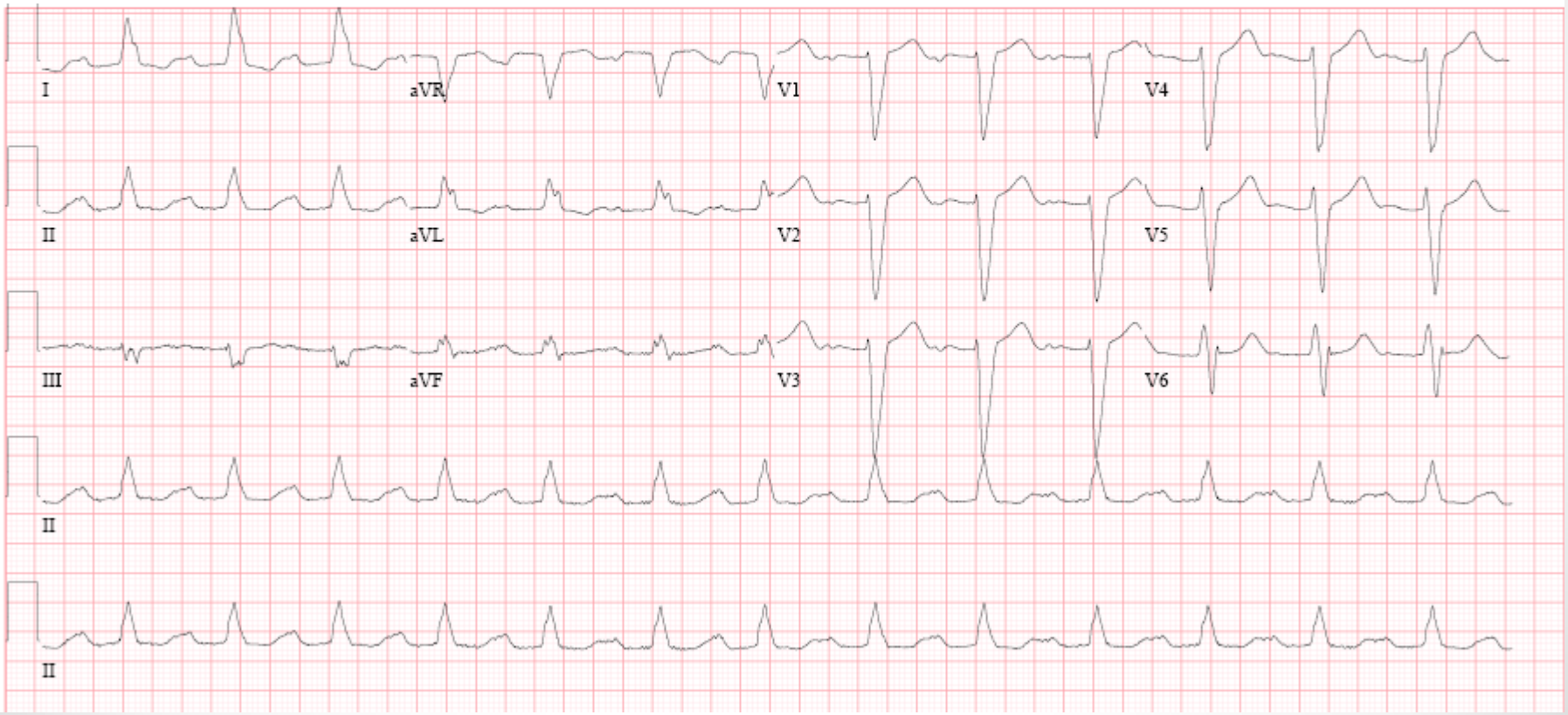
EKG 2

Vent. rate	99	BPM
PR interval	*	ms
QRS duration	144	ms
QT/QTc	384/492	ms
P-R-T axes	* 104	-79

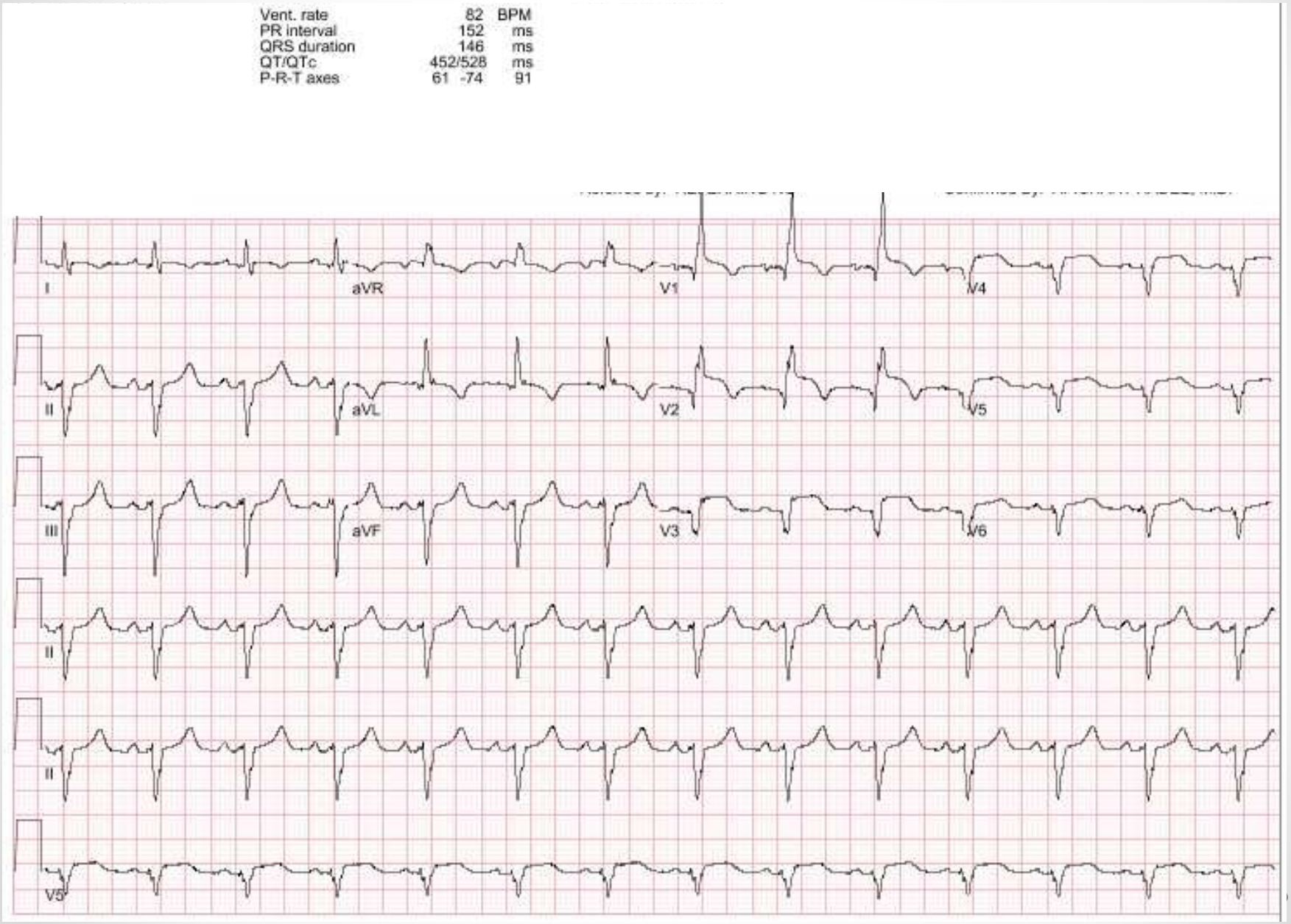


EKG 3

Vent. rate	81	BPM
PR interval	296	ms
QRS duration	156	ms
QT/QTc	476/552	ms
P-R-T axes	47 18	93



EKG 4


Vent. rate 82 BPM
PR interval 152 ms
QRS duration 146 ms
QT/QTc 452/528 ms
P-R-T axes 61 -74 91
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
II
V5

Answers

1. LAD, incomplete LBBB, LAH
2. RAD, RBBB, LPH
3. Normal axis, LBBB
4. LAD, RBBB, LAH

Reference List

- Field, J. (2008). *STEMI provider manual*. Dallas: American Heart Association.
- Garcia, T.B., & Holtz, N.E. (2001). *12 lead ECG: The art of interpretation*. Boston: Jones and Bartlett Publishers.
- Garcia, T.B., & Holtz, N.E. (2015). *12 lead ECG: The art of interpretation*., 2nd Ed. Boston: Jones and Bartlett Publishers.
- Goldich, G. (2006). Understanding the 12-lead ECG, part I. *Nursing2006*, 36(11), 36-42.
- Goldich, G. (2006). Understanding the 12-lead ECG, part II. *Nursing2006*, 36(12), 36-41.
- Krasover, T. (1982). A conceptual approach to the electrocardiogram. *Critical Care Nurse*, March/April, pp 66-76.
- www.12LeadECG.com