12 Lead EKG

&

CXR Interpretation

www.cherylherrmann.com
cherrmann@frontier.com
Audio Product

• Recording discount for participants $60
• Nonparticipants = $190
  o 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.
  o 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.
  o 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

\[\text{VI seis \text{SIX}}\]
+ and - poles?

Lead I

Lead II

Lead III

Lead AVR

Lead AVL

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
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.
  o 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.
  o 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

<table>
<thead>
<tr>
<th>I</th>
<th>AVR</th>
<th>V1</th>
<th>V4 Biphasic</th>
</tr>
</thead>
<tbody>
<tr>
<td>←</td>
<td>↑</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>↑</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II</th>
<th>AVL</th>
<th>V2</th>
<th>V5 ↑</th>
</tr>
</thead>
<tbody>
<tr>
<td>←</td>
<td>↑ or ↓</td>
<td></td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td>↑</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>III</th>
<th>AVF</th>
<th>V3 Biphasic</th>
<th>V6 ↑</th>
</tr>
</thead>
<tbody>
<tr>
<td>←</td>
<td>↑</td>
<td></td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td>↑</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>I</th>
<th>AVR</th>
<th>V1</th>
<th>V4</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>AVL</td>
<td>V2</td>
<td>V5</td>
</tr>
<tr>
<td>III</td>
<td>AVF</td>
<td>V3</td>
<td>V6</td>
</tr>
</tbody>
</table>
Answers
+ and – Poles Summary

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

= Direction of current Negative to Positive to get EKG complex

Lead I

Lead II

Lead III

Lead AVR

Lead AVL

Lead AVF
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

<table>
<thead>
<tr>
<th>I</th>
<th>AVR</th>
<th>V1</th>
<th>V4</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑</td>
<td>↓</td>
<td>↓</td>
<td>Biphasic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II</th>
<th>AVL</th>
<th>V2</th>
<th>V5</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑</td>
<td>↑ or ↓</td>
<td>↓</td>
<td>↑</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>III</th>
<th>AVF</th>
<th>V3</th>
<th>V6</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑</td>
<td>↑</td>
<td>Biphasic</td>
<td>↑</td>
</tr>
</tbody>
</table>
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

Normal axis
Four Quadrants of Hexaxial System

**Left Axis Quadrant**
-90 to -30
- Lead I
- AVF

**Normal Axis Quadrant**
-30 to +90
- Lead I
- AVF

**Right Axis Quadrant**
+90 to +180
- Lead I
- AVF

**Extreme Right Axis**
-90 to +180/270
- 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
Axis 54 = Normal
Lead I & AVF = ↑↑
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
  o Quadrant
  o Parallel
  o Perpendicular
Quadrant Method

- Identify polarity of Lead I and AVF
  - ↑↑↑ = normal axis
  - ↑↓↓ = LAD
  - ↓↑↑ = RAD
  - ↓↓↓ = Extreme right or 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 or 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 & Application Time
Indicate if Lead I and AVF are ↑ or ↓

<table>
<thead>
<tr>
<th>Axis Degrees</th>
<th>Normal</th>
<th>Left</th>
<th>Right</th>
<th>Extreme right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Axis Summary

<table>
<thead>
<tr>
<th>Axis</th>
<th>Normal -30 to +90</th>
<th>Left -30 to -90</th>
<th>Right +90 to ±180</th>
<th>Extreme -90 to ±180/270</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead I</td>
<td>![Up Arrow]</td>
<td>![Up Arrow]</td>
<td>![Down Arrow]</td>
<td>![Down Arrow]</td>
</tr>
<tr>
<td>AVF</td>
<td>![Up Arrow]</td>
<td>![Down Arrow]</td>
<td>![Up Arrow]</td>
<td>![Down Arrow]</td>
</tr>
</tbody>
</table>

**Legend:**
- **Left Apart**
- **Right Together**
### Alterations in Axis

#### Match Column A with B

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Axis shifts AWAY</strong></td>
<td>• area of increased muscle mass – hypertrophy</td>
</tr>
<tr>
<td><strong>Axis shifts TOWARDS</strong></td>
<td>• from area of AMI</td>
</tr>
<tr>
<td></td>
<td>• from hemiblocks</td>
</tr>
<tr>
<td></td>
<td>• bundle branch blocks</td>
</tr>
</tbody>
</table>
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

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

Axis = - 43

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

Axis = - 52

| 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 |
Old Inferior AMI

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

Extreme Right Axis
-90 to +180/270

Lead I AVF

Right Axis Quadrant
+ 90 to + 180

Lead I AVF

Left Axis Quadrant
-30 to - 90

Lead I AVF

Normal Axis Quadrant
-30 to + 90

Lead I AVF
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

Axis = 92
LPH
PMH: HF with EF 15 – 20%, COPD, NSTEMI

Axis = 112
Right Axis Deviation from Left Posterior Hemiblock

Source: Thaler, M. The Only EKG Book You’ll Ever Need, 5th ed
1 week old infant, murmur
? Dextrocardia
Echo ASD, mild pulmonary regurgitation

Axis = 164
RBBB, PE

Axis = 103
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

Axis = 212
Wide Complex Tachycardia

Axis = 221
Axis changes during AMI
66 y/o preop EKG #1

Axis = 9
EKG #2 upon admission to ICU after thoracotomy. Sent to Cath lab. Stent to RCA

Axis = 93
EKG #3 – 3 hours later

Axis = 86

Vent. rate: 87 BPM
PR interval: 216 ms
QRS duration: 94 ms
QT/QTc: 388/442 ms
P-R-T axes: 4/86/101

*** Poor data quality, interpretation may be adversely affected
Sino rhythm with 1st degree A-V block with Possible Premature atrial complexes with Abberant conduction
Acute Inferior lateral MI
Lateral injury pattern
*** *** *** ACUTE MI *** *** ***
Abnormal ECG
When compared with ECG of 23-NOV-2009 14:47,
Evolutionary changes of MI are present
EKG # 4  12 hours later

Axis = - 43
Occluded old RCA Stent

Post procedure after deploying new stent
Axis Summary

<table>
<thead>
<tr>
<th>Axis</th>
<th>Normal -30 to +90</th>
<th>Left -30 to -90</th>
<th>Right +90 to ±180</th>
<th>Extreme -90 to ±180/270</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Beat 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

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 Criteria

- QRS $> 0.12$ sec or 120msec
- Slurred S wave leads I & V6
- RSR’ pattern V1

Easy way:
- $V1 = \text{Positive, QRS} \geq 0.12$ sec
- Rabbit Ears

Source: Garcia. 12 Lead ECG
RBBB

- Half a rabbit ear
- QRS mostly postive

Figure 13-7: If you see a Q wave in lead V1 in the presence of RBBB, the first positive deflection is called an R' wave instead of an R wave.

Source: Garcia. 12 Lead ECG
QRS = 136 ms

Slurred S wave Lead I & V6

Positive V1
QRS = 134 ms
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, monomorphous R waves in I & V6, with no Q waves
• Broad, monomorphous S waves in V1; may have a small r wave

Easy way
• QRS ≥ 0.12 sec
• Negative V1 = Carrot
QRS = 140 ms

- Negative V1
- Broad, monomorphc R waves in I & V6, with no Q waves
- Broad, monomorphc S waves in V1

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

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 = 144 ms
LVH, LBBB, LAD

QRS = 134 ms
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
QRS = 108ms

- 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 = 110 ms
QRS = 108 ms

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

![ECG Diagram]
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
Axis = -61

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>abnormality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vent. rate</td>
<td>40 BPM</td>
<td>Marked sinus bradycardia</td>
</tr>
<tr>
<td>PR interval</td>
<td>202 ms</td>
<td>Possible Left atrial enlargement</td>
</tr>
<tr>
<td>QRS duration</td>
<td>108 ms</td>
<td>Left anterior fascicular block</td>
</tr>
<tr>
<td>QT/QTC</td>
<td>486/396 ms</td>
<td>Abnormal ECG</td>
</tr>
<tr>
<td>P–R–T axes</td>
<td>39 –61 0</td>
<td>When compared with ECG of 18–MAY–2009 10:10, No significant change was found</td>
</tr>
</tbody>
</table>
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
Axis = -52

- 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 = -60
Left Posterior Hemiblock

LPH

- Negative polarity Lead I
- Positive polarity Leads II & III
- \( \downarrow \uparrow \uparrow \)
- Rare
- Right Axis Deviation
- If RBBB, ask if there a LPH

Source: Garcia 12 Lead EKG 13:19
Axis = 112

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
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

<table>
<thead>
<tr>
<th></th>
<th>LAH</th>
<th>LPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead III</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# LAH & LPH Summary

<table>
<thead>
<tr>
<th></th>
<th>LAH</th>
<th>LPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead I</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Lead II</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Lead III</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Axis</td>
<td>Left</td>
<td>Right</td>
</tr>
</tbody>
</table>
Bi & Tri Blocks

- **Bifascicular Block:** RBBB with LPH or LAH

- **Trifascicular 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

- Vent. rate: 81 BPM
- PR interval: 188 ms
- QRS duration: 186 ms
- QT-QTc: 568-571 ms
- F-Te-T axis: 52-55°

- Normal sinus rhythm
- Right bundle branch block
- Left anterior fascicular block
- *** Difascicular Block ***
- Marked T wave abnormality, Consider Anterolateral Ischemia

When compared with ECG of 24-MAY-2007 12:32:
- Sinus rhythm has replaced Electronic atrial overrider
- (RBBB and left anterior fascicular block) has replaced
- Non-specific intra-ventricular conduction block...
Tetralogy of Fallot Patient 2 years later. 100% paced
## Axis Summary

<table>
<thead>
<tr>
<th>Axis</th>
<th>Normal</th>
<th>Left</th>
<th>Right</th>
<th>Extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-30 to +90</td>
<td>-30 to -90</td>
<td>+90 to ±180</td>
<td>-90 to ±180/270</td>
</tr>
<tr>
<td>Lead I</td>
<td><img src="#" alt="Arrow Up" /></td>
<td><img src="#" alt="Arrow Up" /></td>
<td><img src="#" alt="Arrow Down" /></td>
<td><img src="#" alt="Arrow Down" /></td>
</tr>
<tr>
<td>AVF</td>
<td><img src="#" alt="Arrow Up" /></td>
<td><img src="#" alt="Arrow Down" /></td>
<td><img src="#" alt="Arrow Up" /></td>
<td><img src="#" alt="Arrow Down" /></td>
</tr>
</tbody>
</table>
# LAH & LPH Summary

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<td>↑</td>
</tr>
<tr>
<td>Lead III</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Axis</td>
<td>Left</td>
<td>Right</td>
</tr>
</tbody>
</table>
+ 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
Answers

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


• [www.12LeadECG.com](http://www.12LeadECG.com)