ECG Master

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OUTLINE

- ECG Basics.
- The normal ECG.
- How to read an ECG.
- Most common Arrhythmias.
- Assessment.

ECG Master

ECG Basics

► What is the ECG?

Electrocardiography (ECG or EKG) is the process of recording the electrical activity of the heart over a period of time using electrodes placed on a patient's body. These electrodes detect the tiny electrical changes on the skin that arise from the heart muscle depolarizing during each heartbeat.

ECG Basics

► **What is the ECG Electrodes and Leads?**

Electrical activity going through the heart can be measured by external (skin)electrodes. The electrocardiogram (ECG) registers these activities from electrodes which have been attached onto different places on the body. In total, **twelve leads** are calculated using **ten electrodes**.

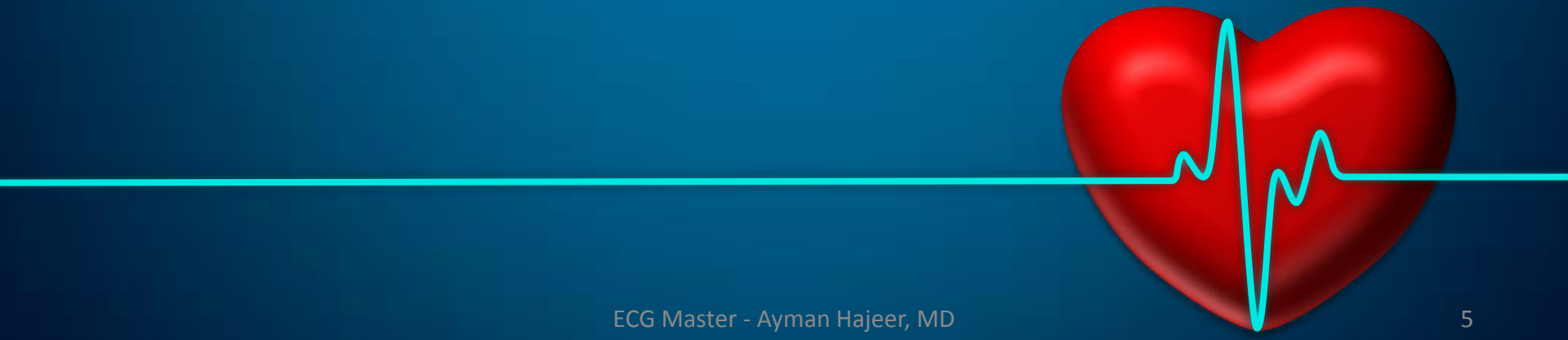
ECG Basics

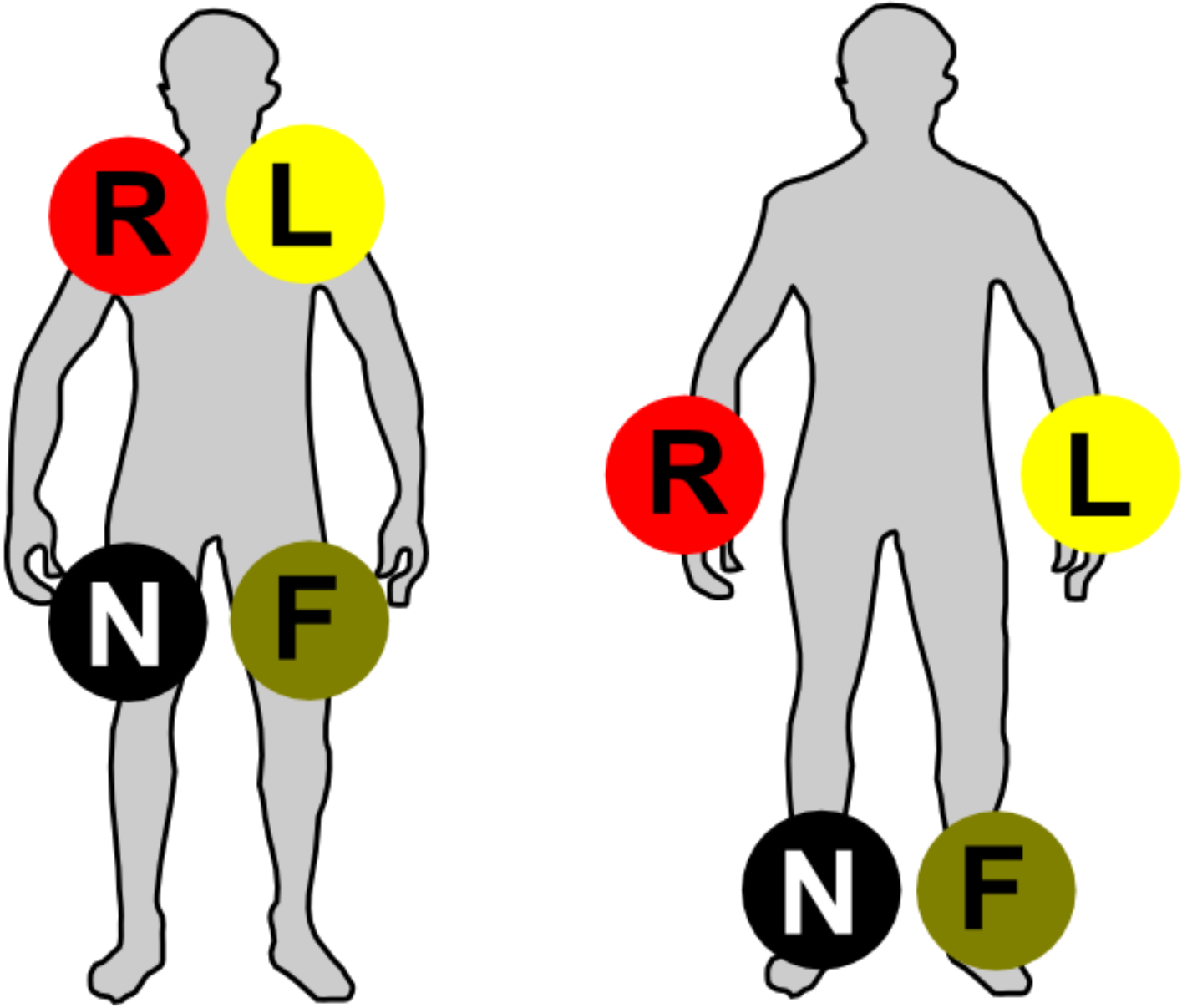
The ten electrodes are:

The four extremity electrodes:

- **LA - left arm**
- **RA - right arm**
- **N - neutral, on the right leg (= electrical earth, or point zero, to which the electrical current is measured)**
- **F - foot, on the left leg**

It makes no difference whether the electrodes are attached proximal or distal on the extremities. *However*, it is best to be uniform in this. (eg. do not attach an electrode on the left shoulder and one on the right wrist).




R
L
N
F
R
L
N
F

Animation 1

ECG Basics

The six chest electrodes:

V1 - placed in the 4th intercostal space, right of the sternum

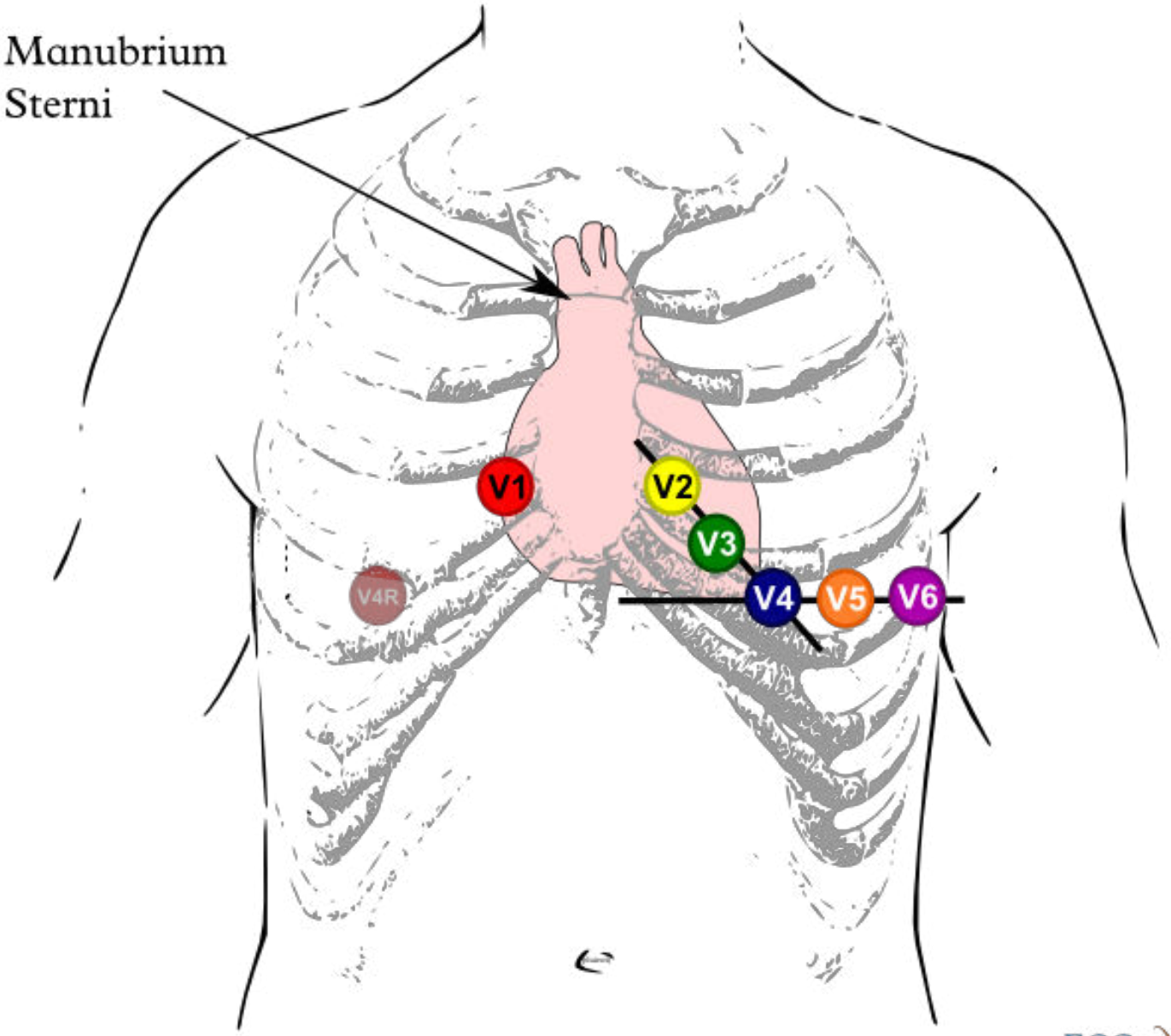
V2 - placed in the 4th intercostal space, left of the sternum

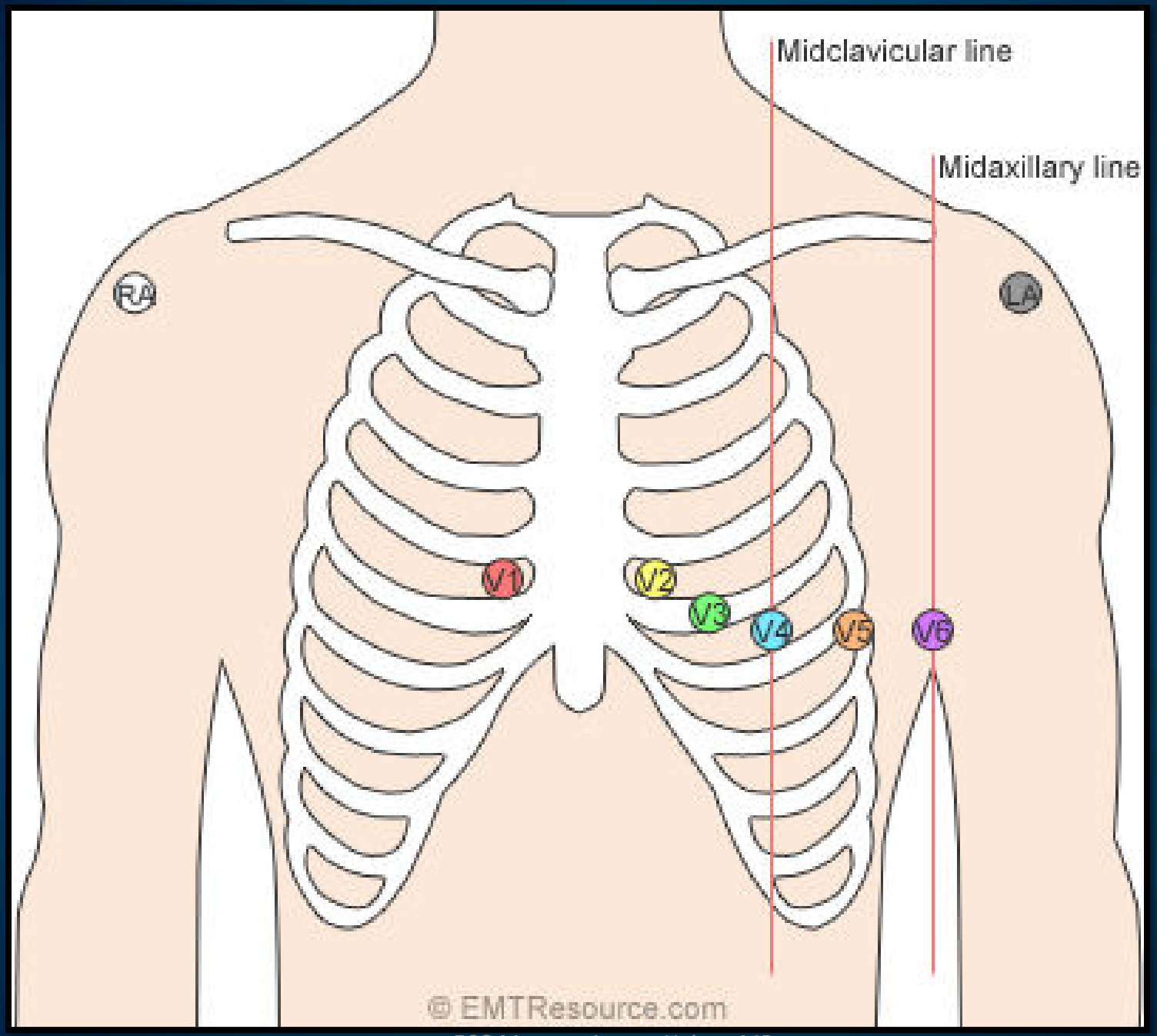
V3 - placed between V2 and V4

V4 - placed 5th intercostal space in the nipple line. Official recommendations are to place V4 under the breast in women.[1]

V5 - placed between V4 and V6

V6 - placed in the midaxillary line on the same height as V4 (horizontal line from V4, so not necessarily in the 5th intercostal space)


Manubrium
Sterni
V1
V2
V3
V4
V5
V6
V4R


Midclavicular line
Midaxillary line
RA
LA
V1
V2
V3
V4
V5
V6
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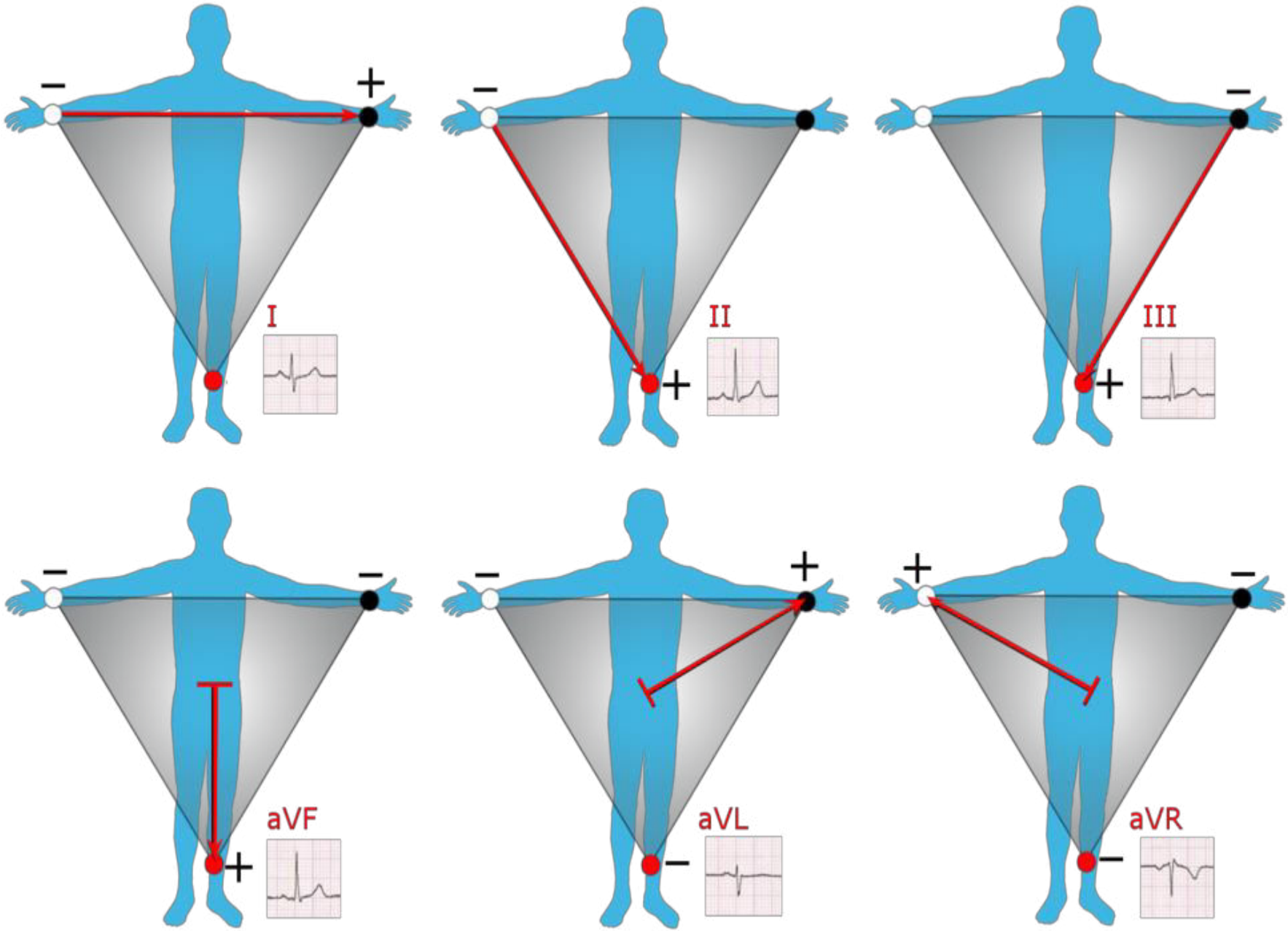
ECG Basics

With the use of these 10 electrodes, 12 leads can be derived. There are 6 extremity leads and 6 precordial leads.

The extremity leads are:
I from the right to the left arm
II from the right arm to the left leg
III from the left arm to the left leg

Other extremity leads are:
AVL points to the left arm
AVR points to the right arm
AVF points to the feet

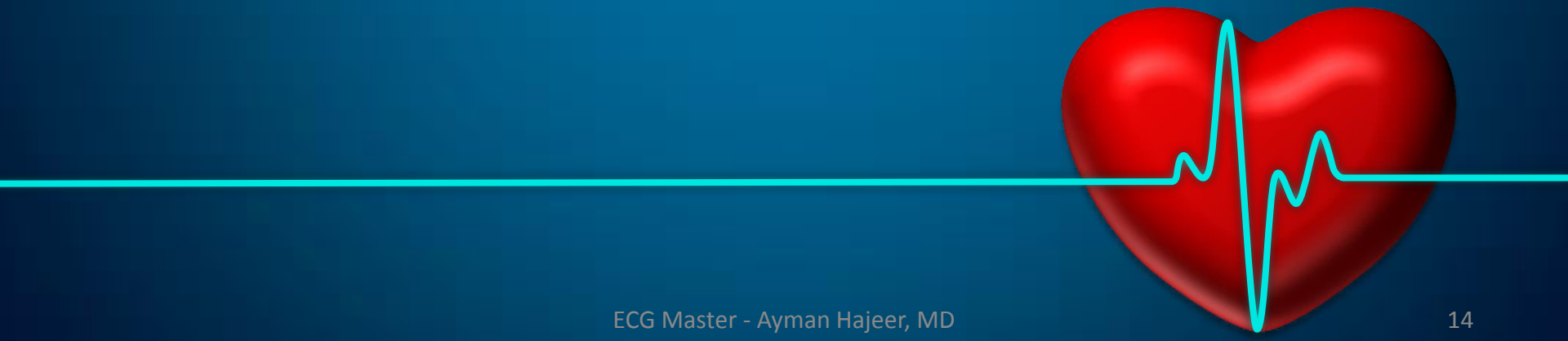
The capital A stands for "augmented" and V for "voltage"

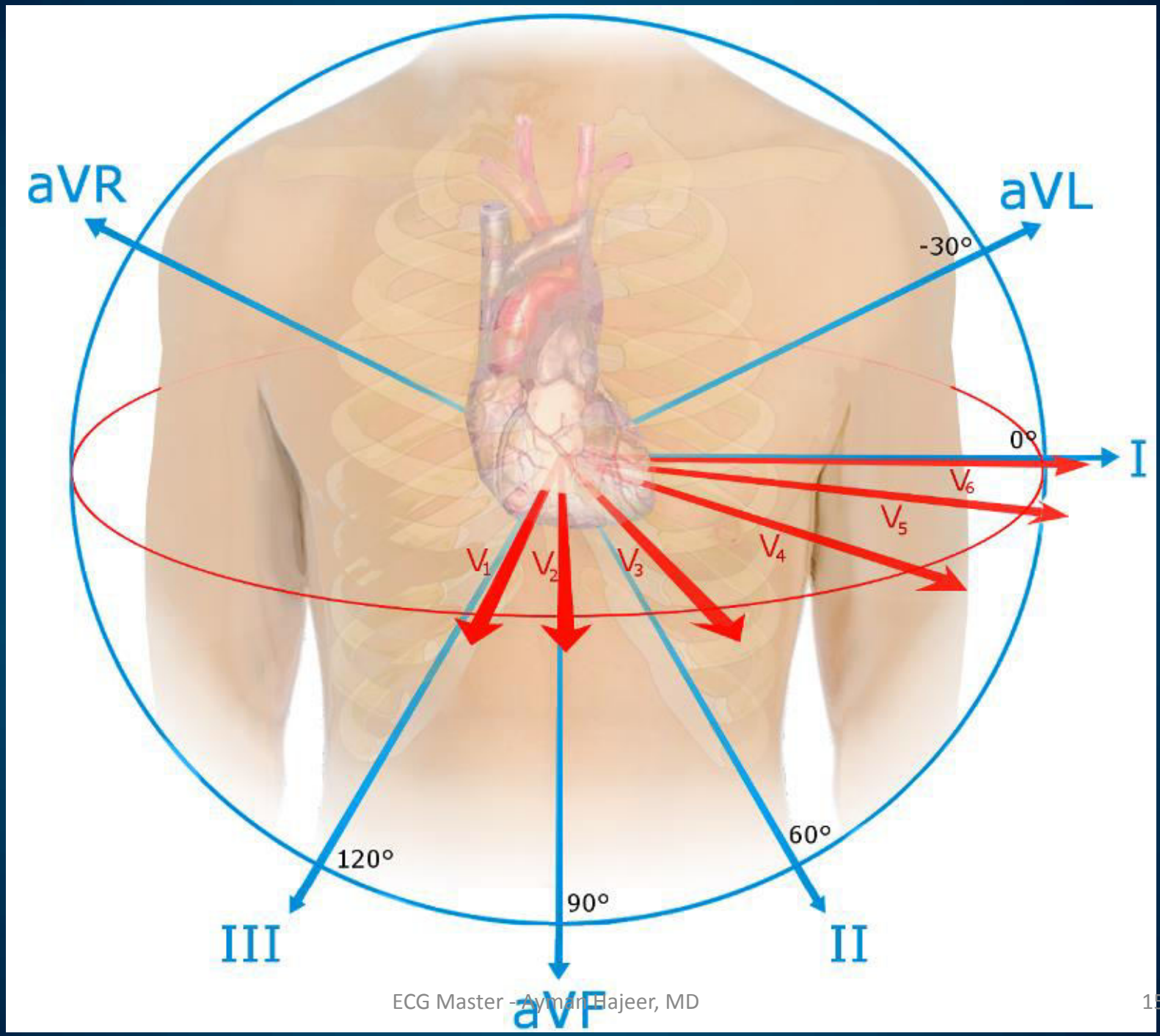

I
II
III
aVF
aVL
aVR

Animation 2

ECG Basics

The precordial leads lie in the transverse (horizontal) plane, perpendicular to the other six leads. The six precordial electrodes act as the positive poles for the six corresponding precordial leads: (V_1, V_2, V_3, V_4, V_5 and V_6).




aVR
aVL
-30°
0°
I
V6
V5
V4
V1
V2
V3
120°
90°
60°
III
II
aVF

ECG Basics

► What is the Axis of the heart?

The electrical activity of the heart starts at the SA node then spreads to the AV node.

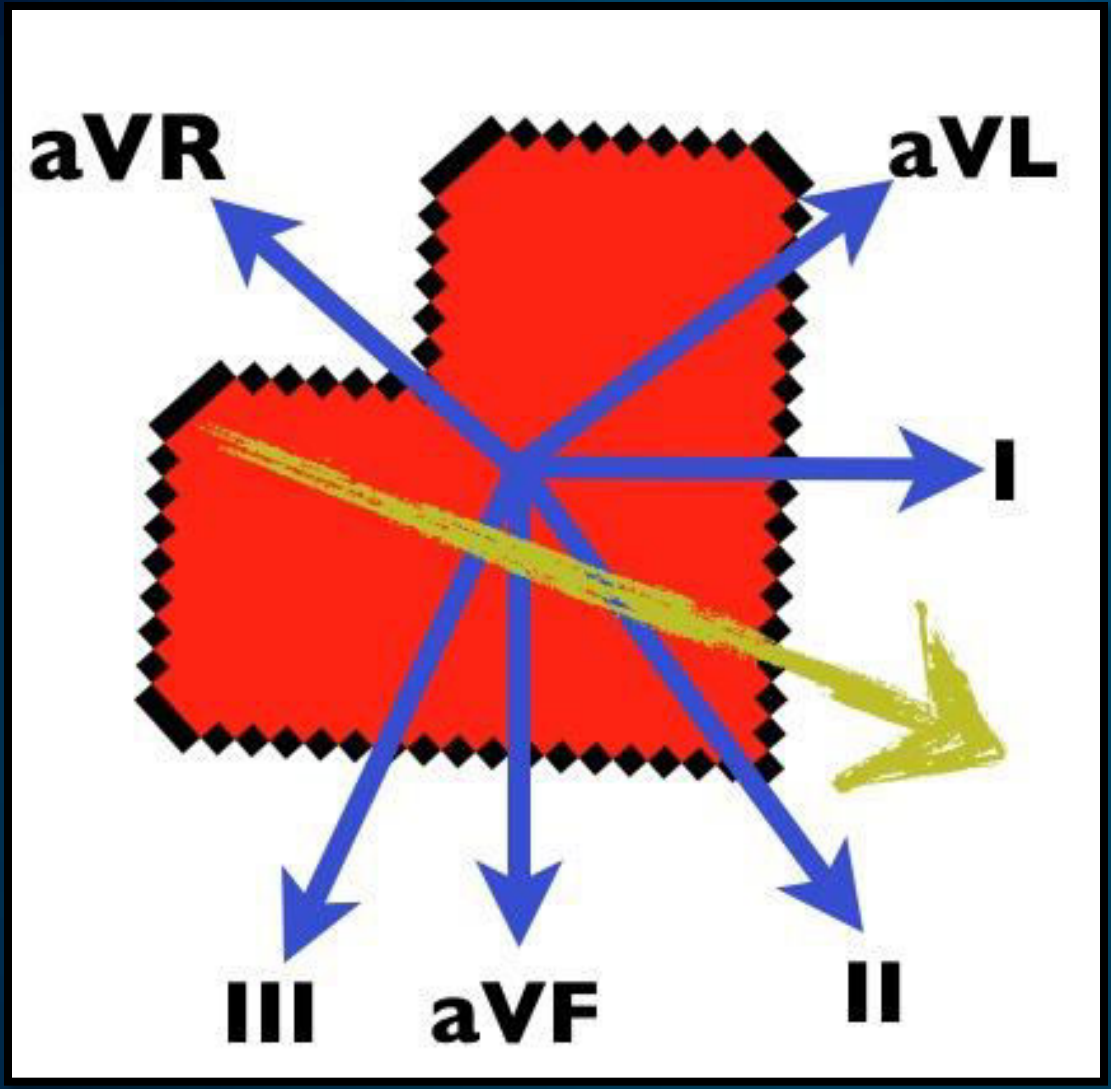
It then spreads down the bundle of his & then purkinje fibres to cause ventricular contraction

So when viewing the heart from the front, the direction of depolarization is 11 o'clock to 5 o'clock

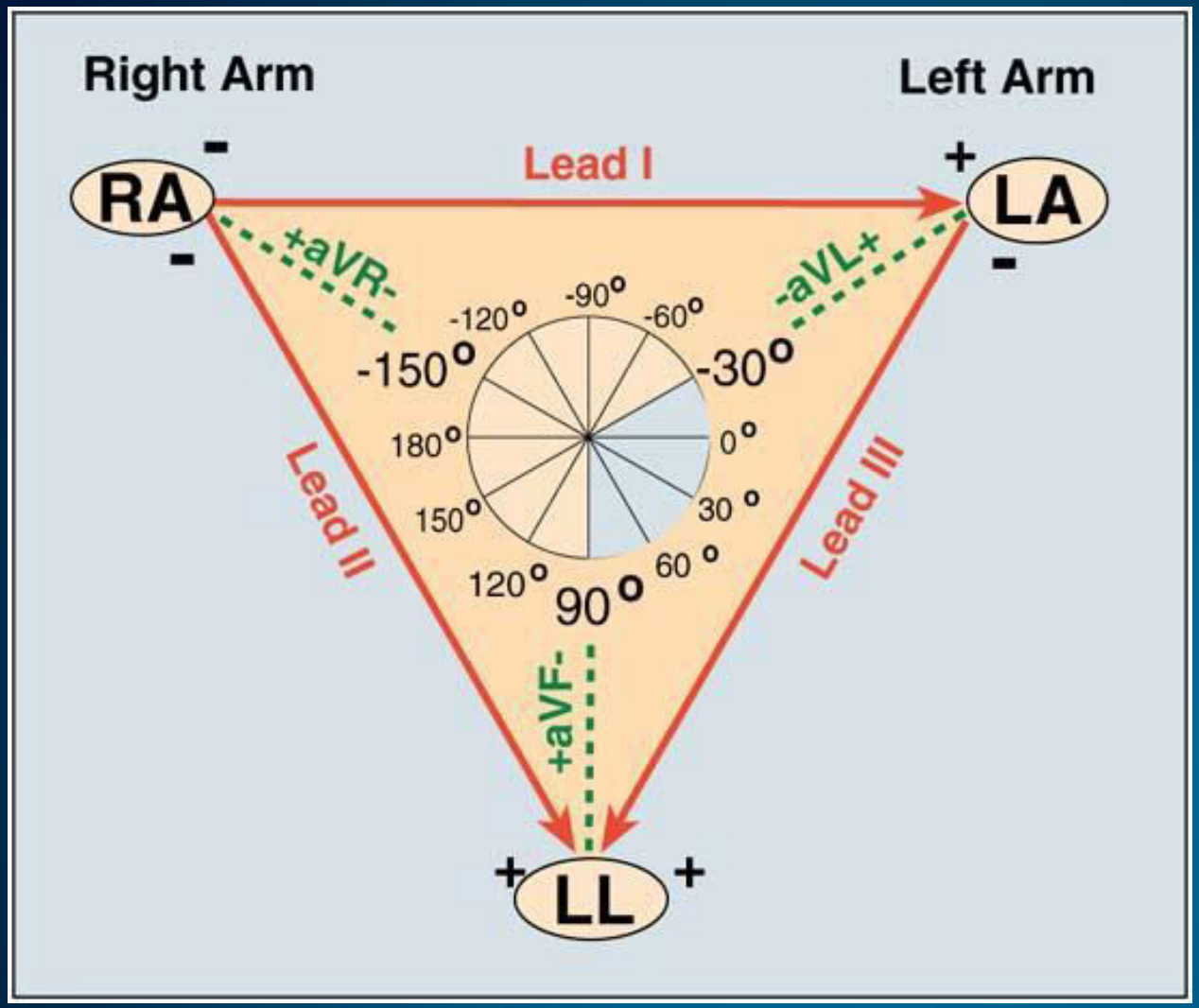
The general direction of depolarization is known as the cardiac axis

Animation 3 - A

Animation 3 - B



The normal QRS axis is generally *down and to the left*, following the anatomical orientation of the heart within the chest. An abnormal axis suggests a change in the physical shape and orientation of the heart, or a defect in its conduction system that causes the ventricles to depolarize in an abnormal way.

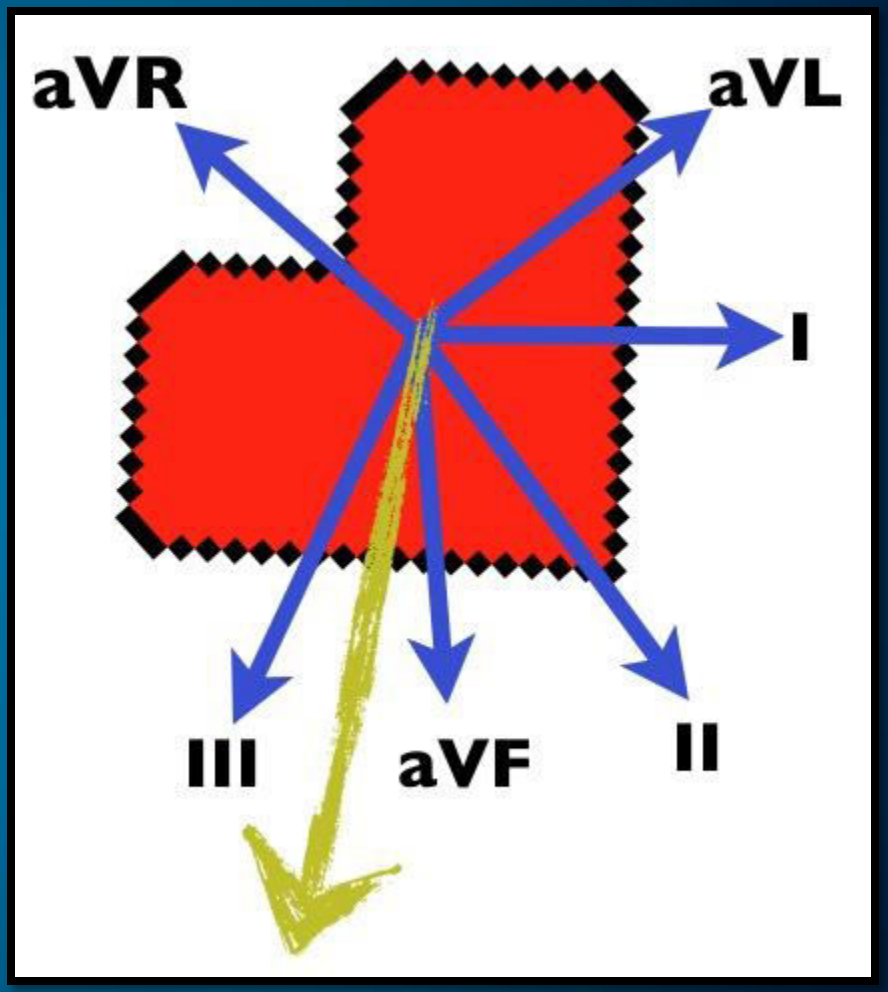

Right Arm
Left Arm
RA
LA
LL
Lead I
Lead II
Lead III
+aVR-
-aVL+
+aVF-
-150°
-120°
-90°
-60°
-30°
180°
0°
150°
30°
120°
90°
60°

ECG Basics

Normal	–30° to 90°	Normal
Left axis deviation	–30° to –90°	May indicate left ventricular hypertrophy, left anterior fascicular block, or an old inferior q-wave myocardial infarction
Right axis deviation	+90° to +180°	May indicate right ventricular hypertrophy, left posterior fascicular block, or an old lateral q-wave myocardial infarction

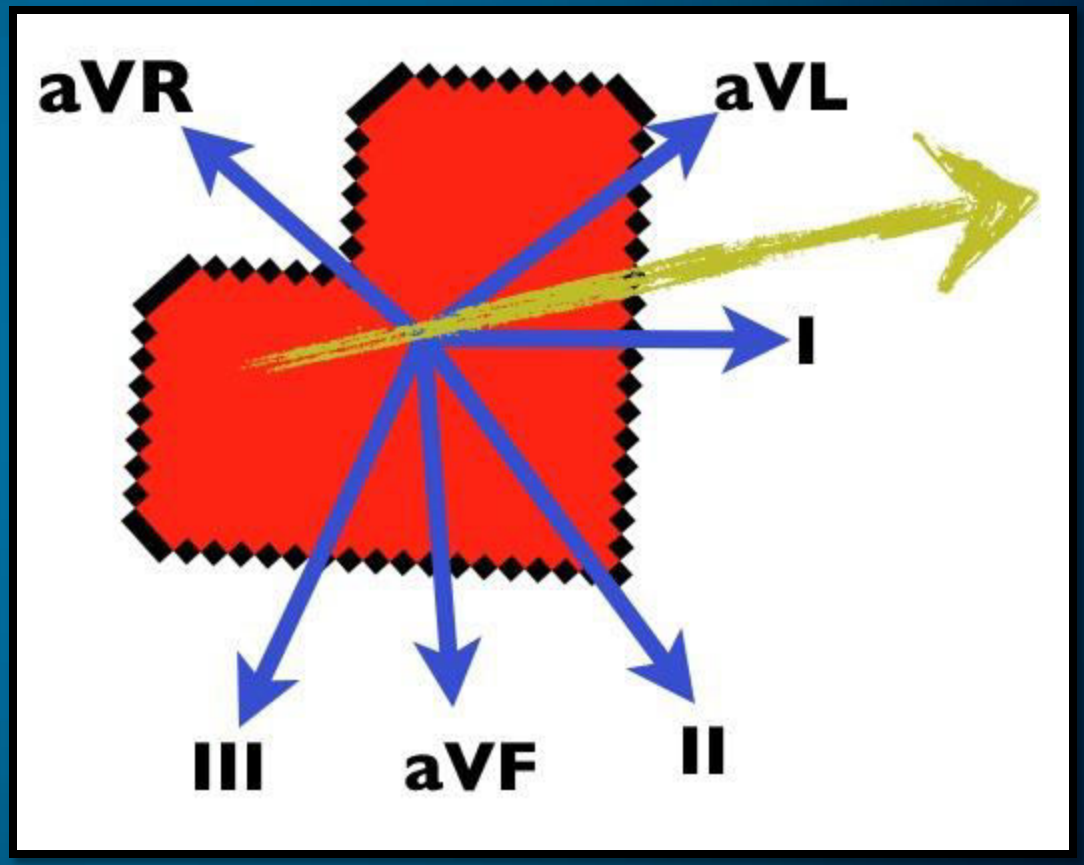
Right axis deviation:

- **Right axis deviation** (*RAD*) is usually caused by **right ventricular hypertrophy.**
- In **right axis deviation** the **direction** of **depolarisation** is **distorted** to the **right** (*1-7 o'clock*).
- **Extra heart muscle** causes a **stronger** signal to be generated by the **right side** of the **heart.**
- This causes the **deflection** in **lead I** to become **negative** & **deflection** in **lead aVF & III** to be **more +ve.**
- **RAD** is associated with **pulmonary conditions** as they put **strain** on the **right side** of the **heart.**
- It can be a **normal finding** in **very tall individuals.**



Left axis deviation

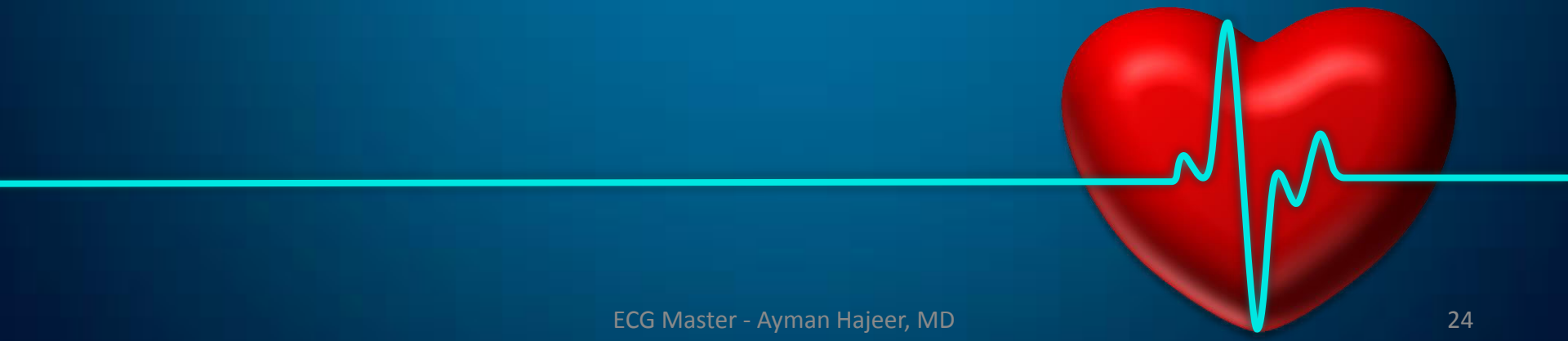
- In **left axis deviation** *(LAD)* the general **direction** of **depolarisation** becomes **distorted** to the **left.**
- This causes the **deflection** in **lead III** to become **negative.**
- It is only considered **significant** if the **deflection** of **Lead II** also becomes **negative.**
- **LAD** is usually caused by **conduction defects** & **not by increased mass** of the **left ventricle.**



ECG Basics

- **How to determine the Axis of the heart?**

2 Methods!!



ECG Basics

► **Method 1 – The Quadrant Method:**

The most efficient way to estimate axis is to look at leads I + aVF.

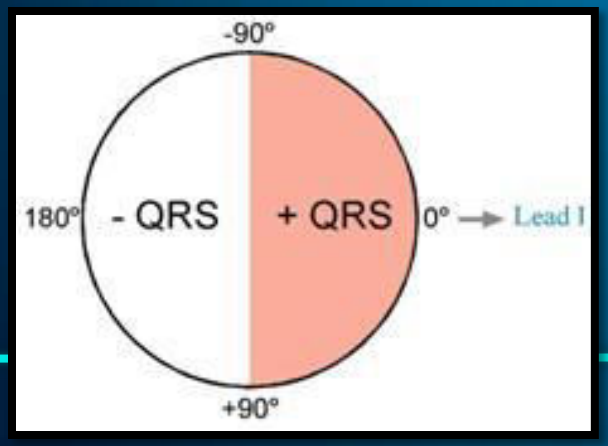
Lead I	Lead aVF	Quadrant	Axis
Positive	Positive	Left lower quadrant	Normal (0 to +90 degrees)
Positive	Negative	Left upper quadrant	Possible LAD (0 to -90 degrees)
Negative	Positive	Right lower quadrant	RAD (+90 to 180 degrees)
Negative	Negative	Right upper quadrant	Extreme Axis Deviation (-90 to 180 degrees)

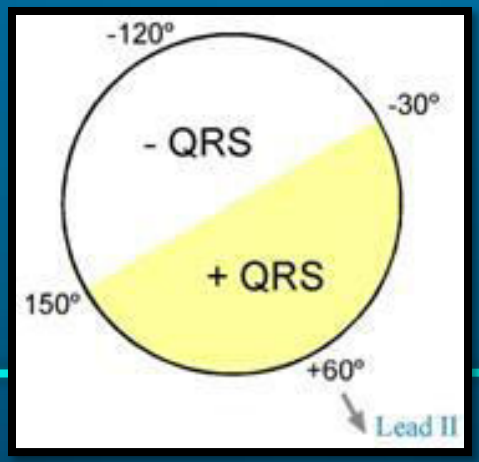
ECG Basics

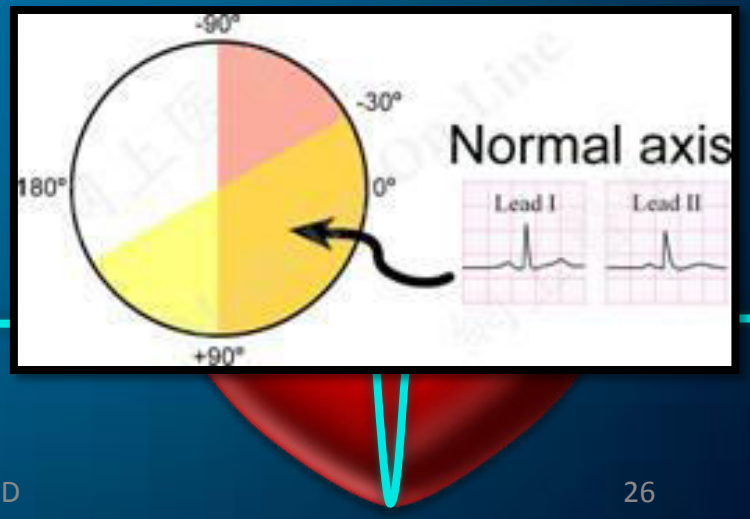
► Method 2 – Leads I + II:

Another rapid method is to look at leads I + II.

- A positive QRS in lead I puts the axis in roughly the same direction as lead I.
- A positive QRS in lead II similarly aligns the axis with lead II.
- Therefore, if leads I and II are *both* positive, the axis is between -30 and +90 degrees (i.e. normal axis).







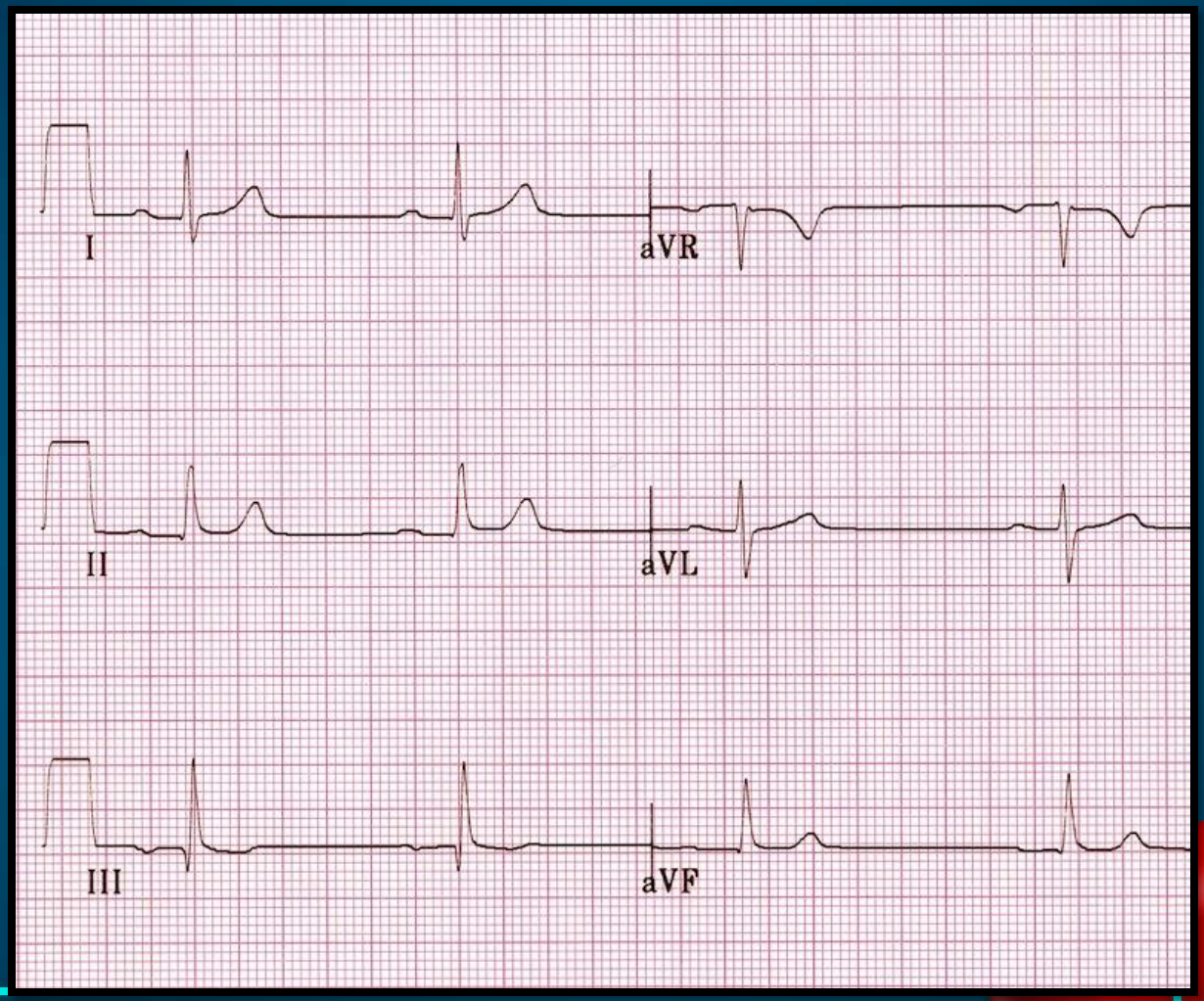
ECG Basics

► **Combining Methods 1 and 2:**

By combining these two methods, you can rapidly and accurately assess axis.

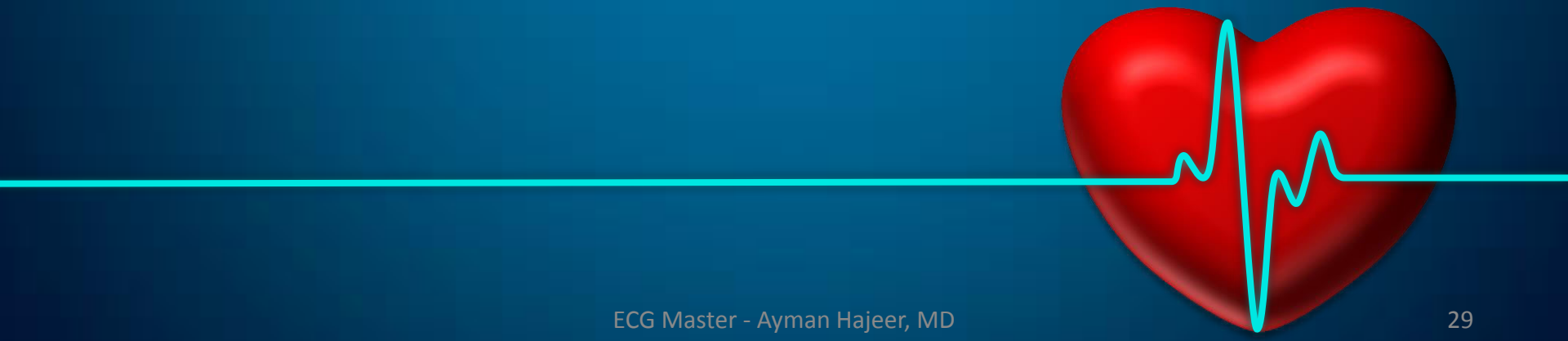
Lead I	Lead aVF	Axis
Positive	Positive	Normal (0 to +90 degrees)
Positive	Negative	Possible LAD Is lead II positive? Yes -> Normal (0 to -30 degrees) No -> LAD (-30 to -90 degrees)
Negative	Positive	RAD (+90 to 180 degrees)
Negative	Negative	Extreme Axis Deviation (-90 to 180 degrees)

Example 1:

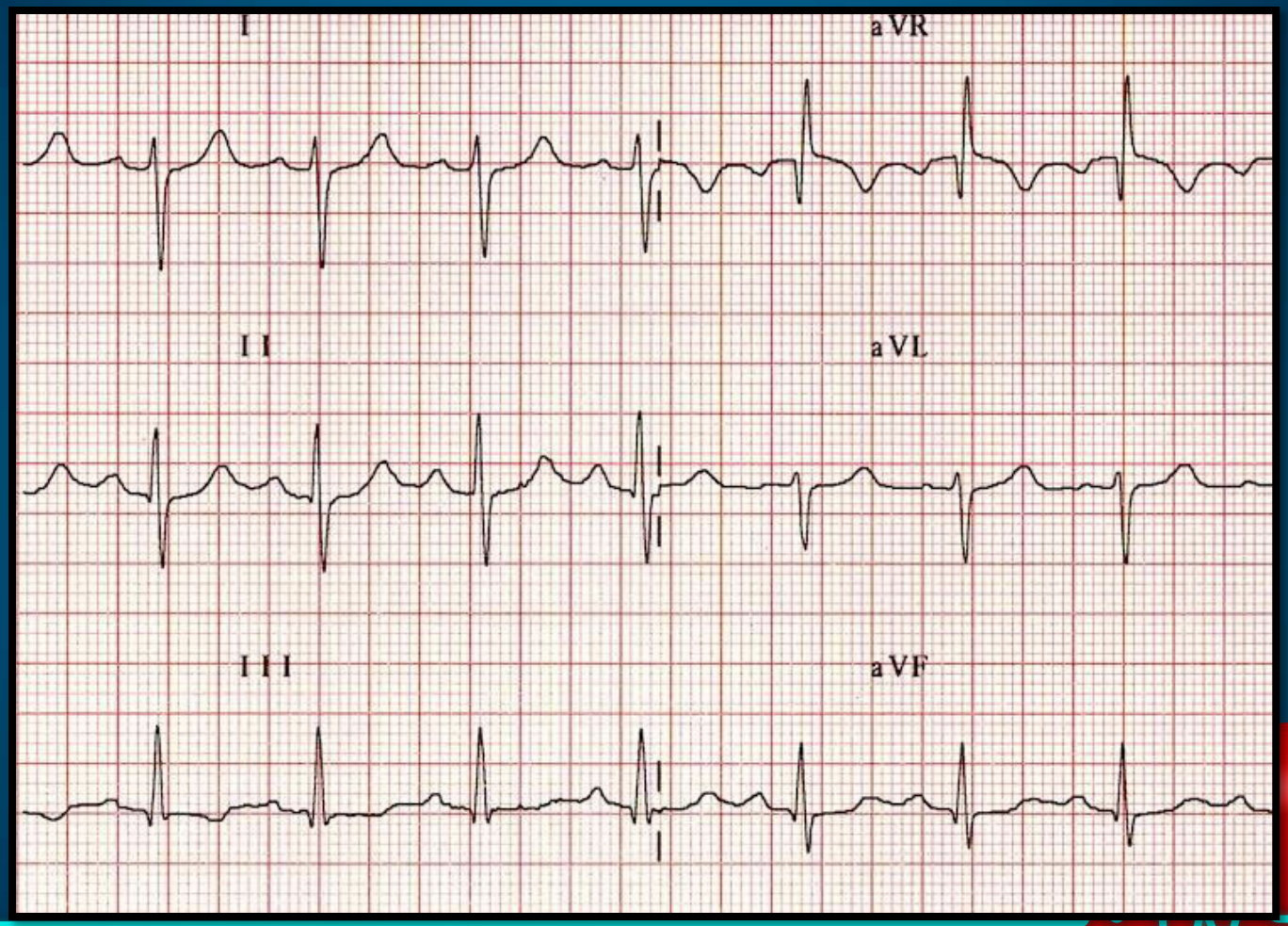


Answer – Example 1:

- Leads I + aVF are both positive.
- This puts the axis in the left lower quadrant, between 0 and +90 degrees, i.e. normal axis.
- Lead II is also positive, which confirms the normal axis.

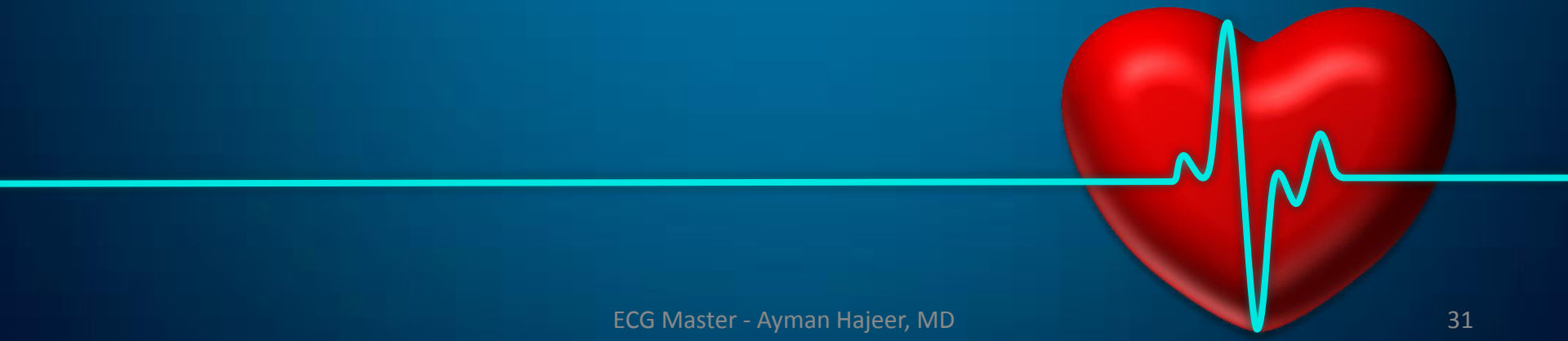


Example 2:

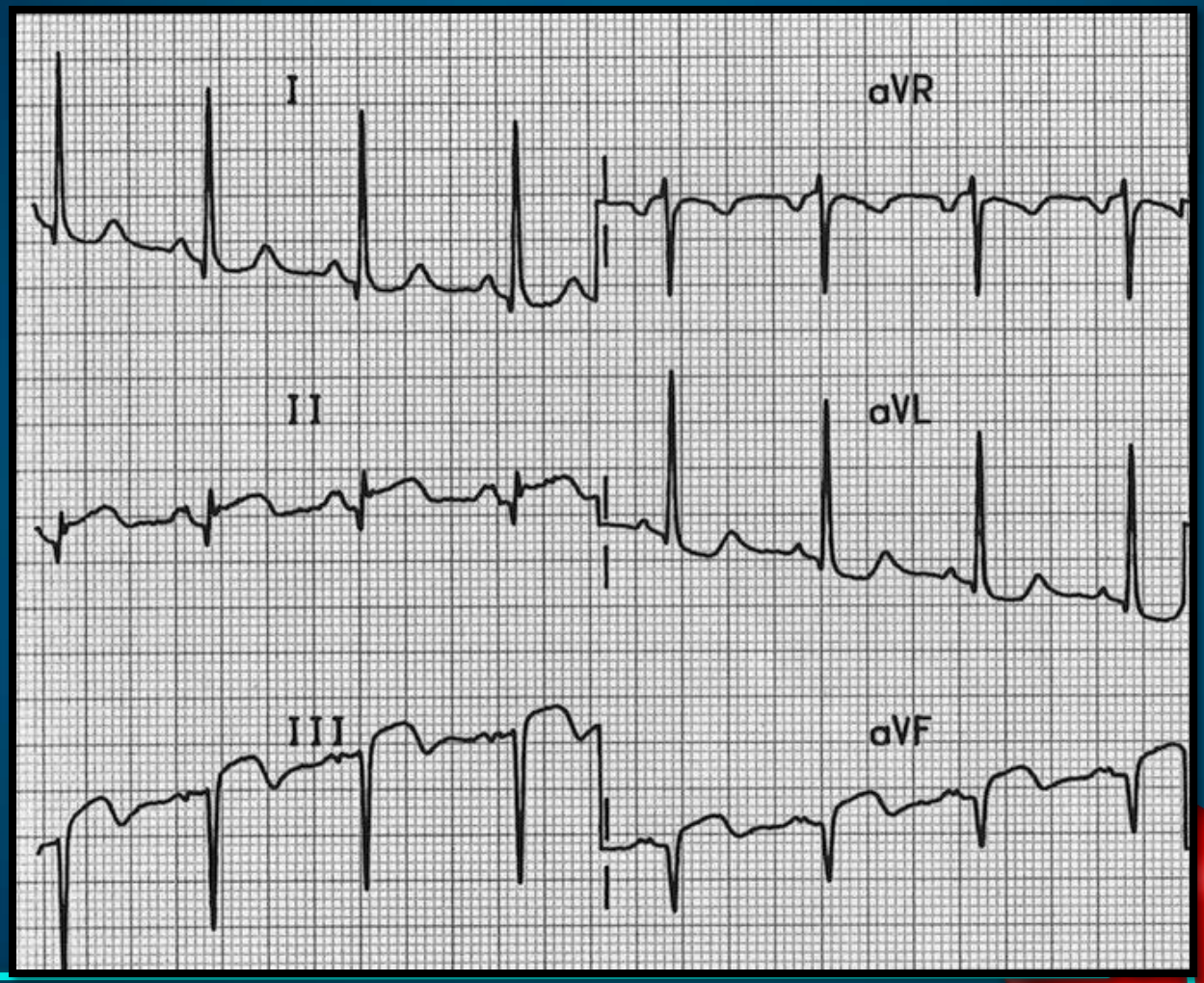


Answer – Example 2:

- Lead I = negative.
- Lead aVF = positive.
- This puts the axis in the right lower quadrant, between +90 and +180 degrees, i.e. RAD.

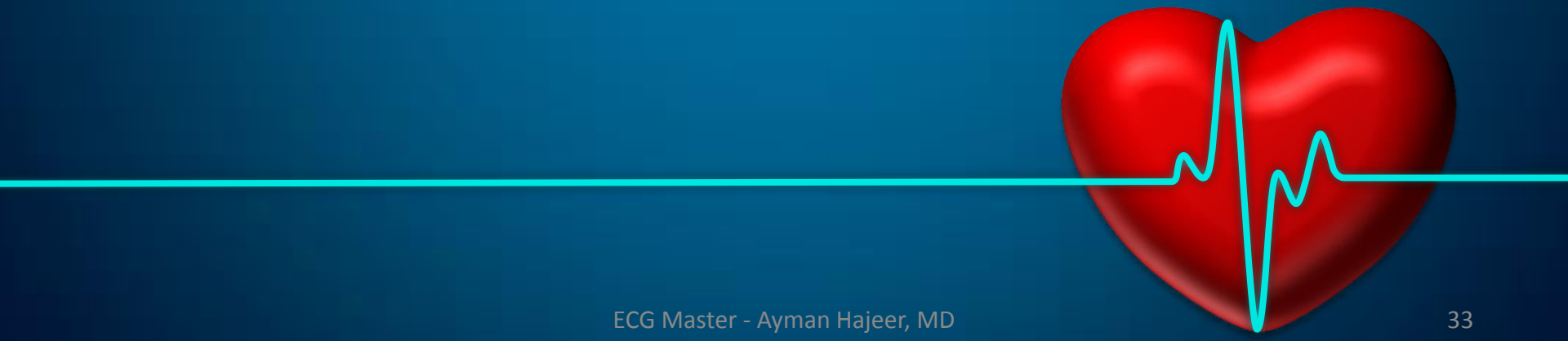


Example 3:



Answer – Example 3:

- Lead I = positive.
- Lead aVF = negative.
- This puts the axis in the left upper quadrant, between 0 and -90 degrees, i.e. normal or LAD.
- Lead II is neither positive nor negative (isoelectric), indicating borderline LAD.



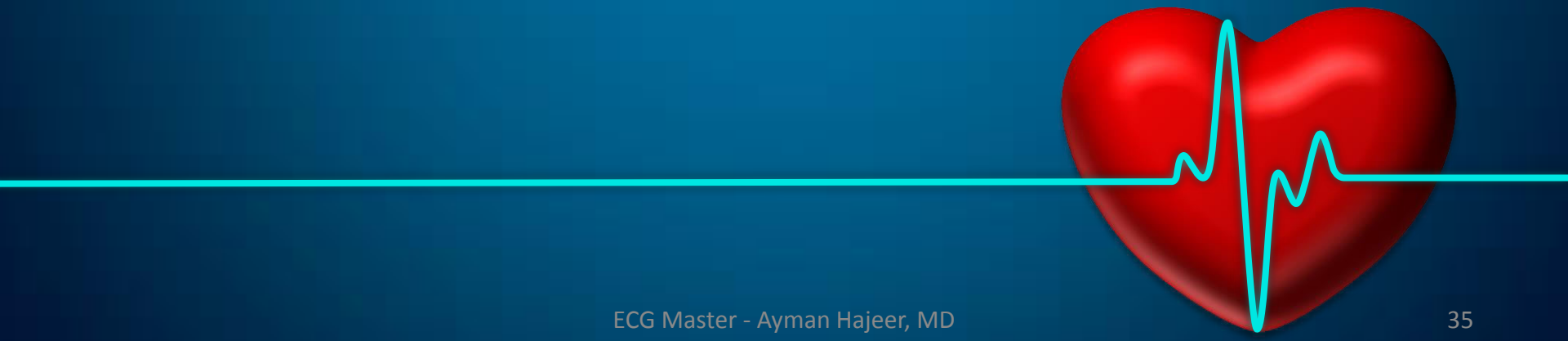
OUTLINE

- ✓ ECG Basics. ✓
- The normal ECG.
- How to read an ECG.
- Most common Arrhythmias.
- Assessment.

ECG Master

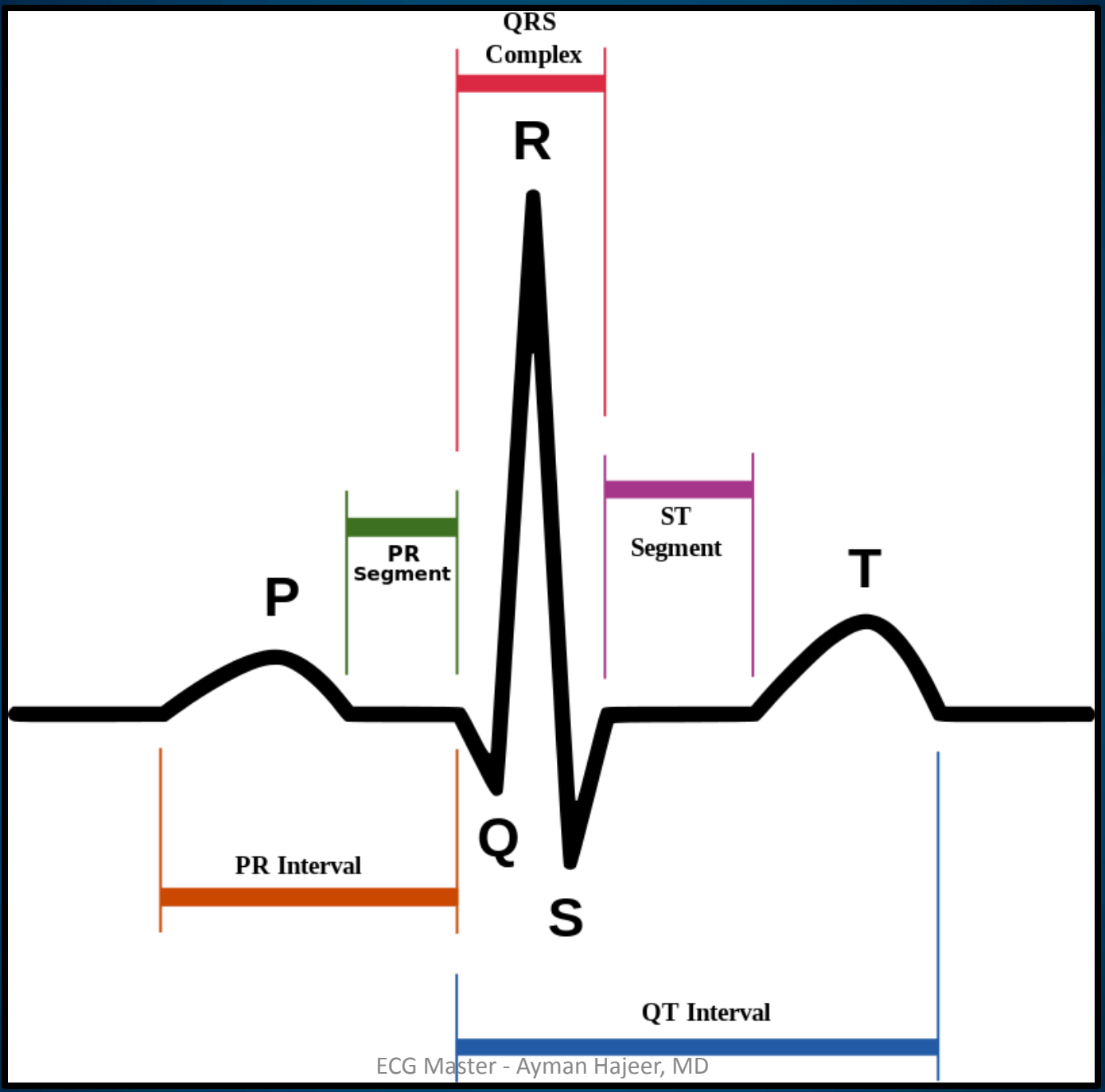
The Normal ECG

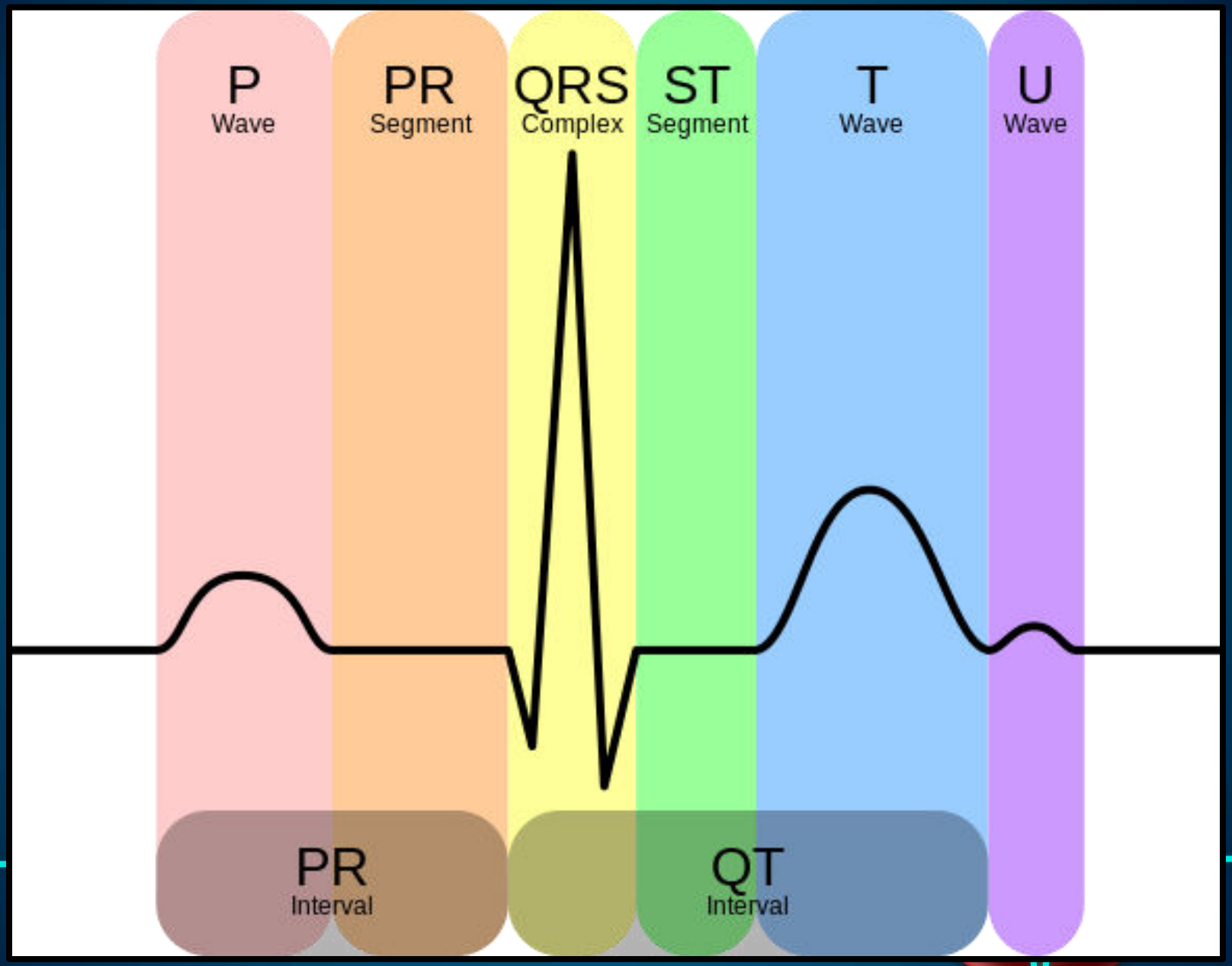
- The ECG consists of waves, sigments, intervals and complexes.



The EKG tracing:

1. ♥ A wave is something with amplitude
2. ♥ A segment is a flat line
3. ♥ An interval comprises a wave & segment
4. ♥ A complex comprises several waves


QRS
Complex
R
ST
Segment
PR
Segment
P
T
Q
S
PR Interval
QT Interval


P
Wave
PR
Segment
QRS
Complex
ST
Segment
T
Wave
U
Wave
PR
Interval
QT
Interval

The Normal ECG

► **ECG Waves and Intervals:** What do they mean?

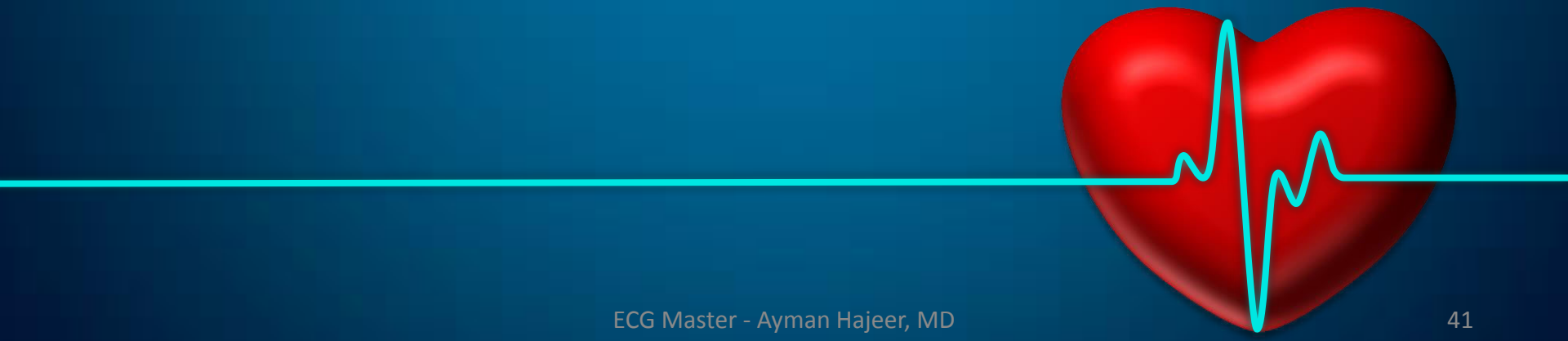
- **P wave:** the sequential activation (depolarization) of the right and left atria
- **QRS complex:** right and left ventricular depolarization (normally the ventricles are activated simultaneously)
- **ST-T wave:** ventricular repolarization
- **U wave:** origin for this wave is not clear - but probably represents "afterdepolarizations" in the ventricles
- **PR interval:** time interval from onset of atrial depolarization (P wave) to onset of ventricular depolarization (QRS complex)
- **QRS duration:** duration of ventricular muscle depolarization
- **QT interval:** duration of ventricular depolarization and repolarization
- RR interval: duration of ventricular cardiac cycle (an indicator of ventricular rate)
- **PP interval:** duration of atrial cycle (an indicator of atrial rate)

Animation 4 and 3-B

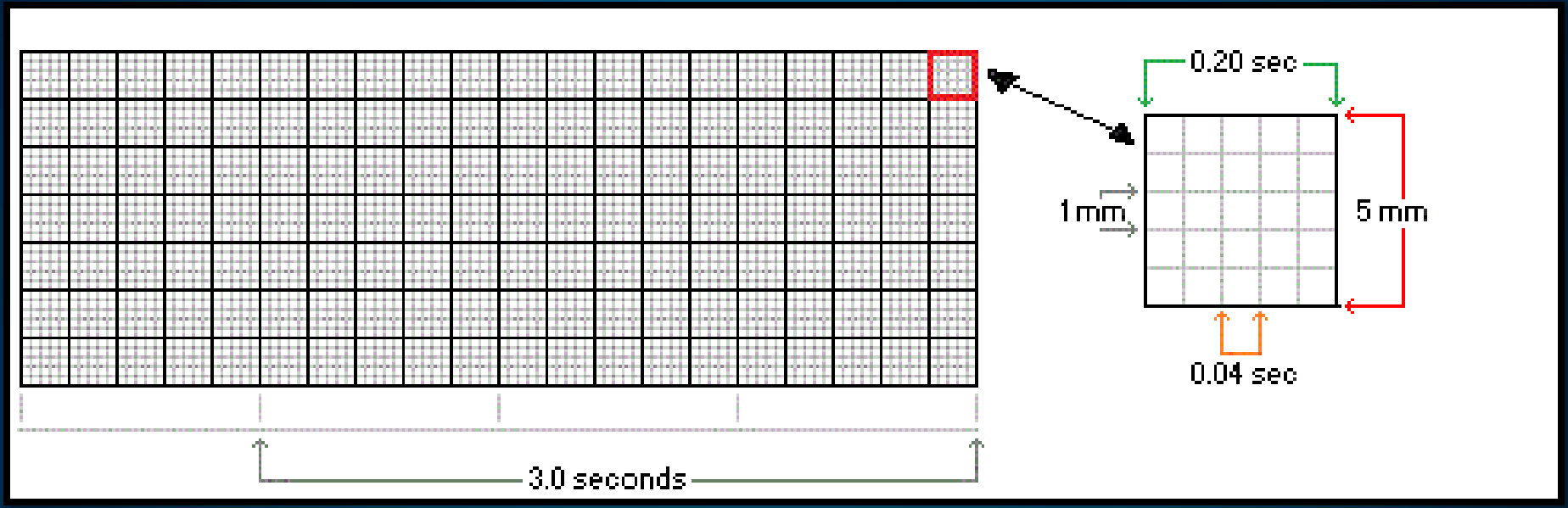
The Normal ECG

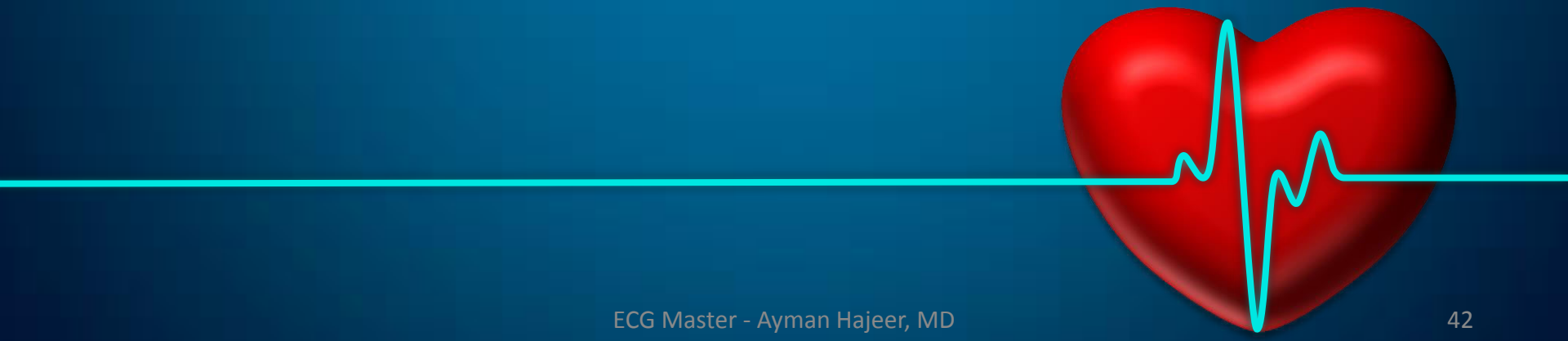
How these waves are represented on the ECG chart?

First, you have to know the meaning of the chart!

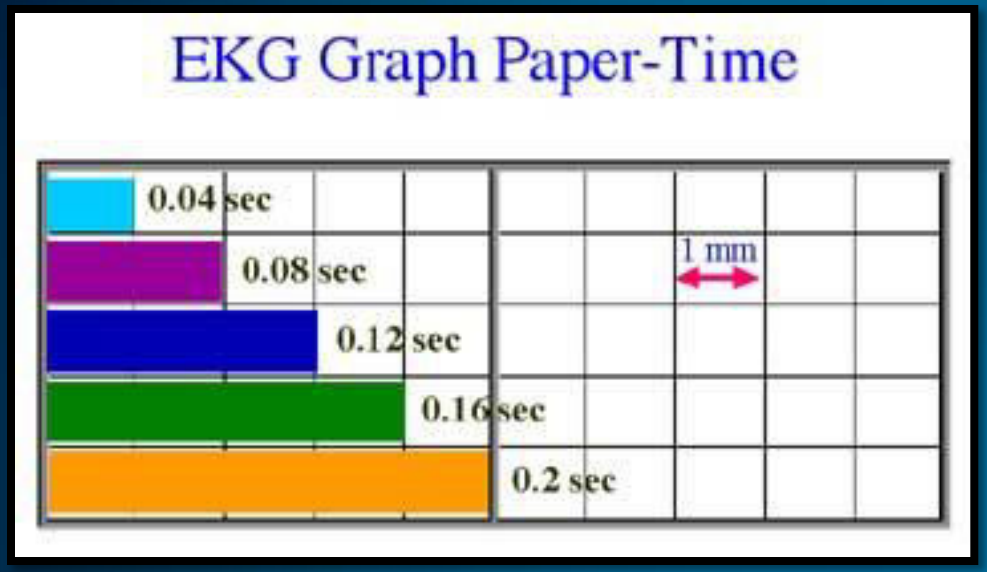


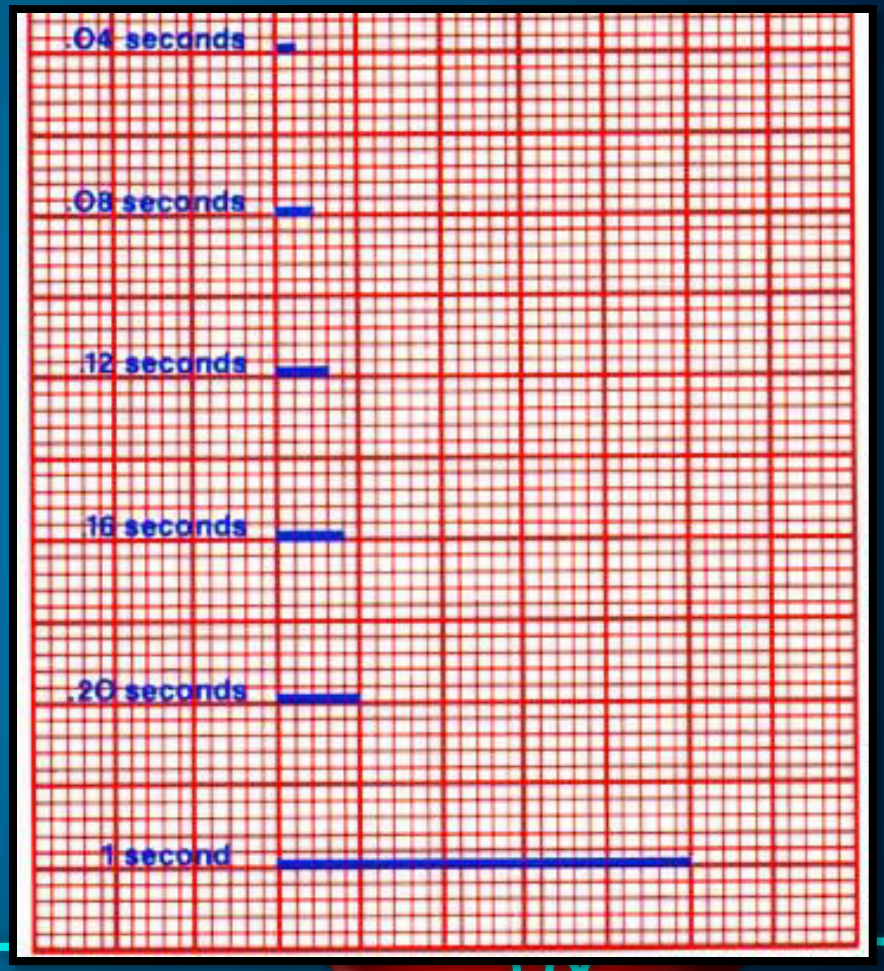
The Normal ECG





The Normal ECG

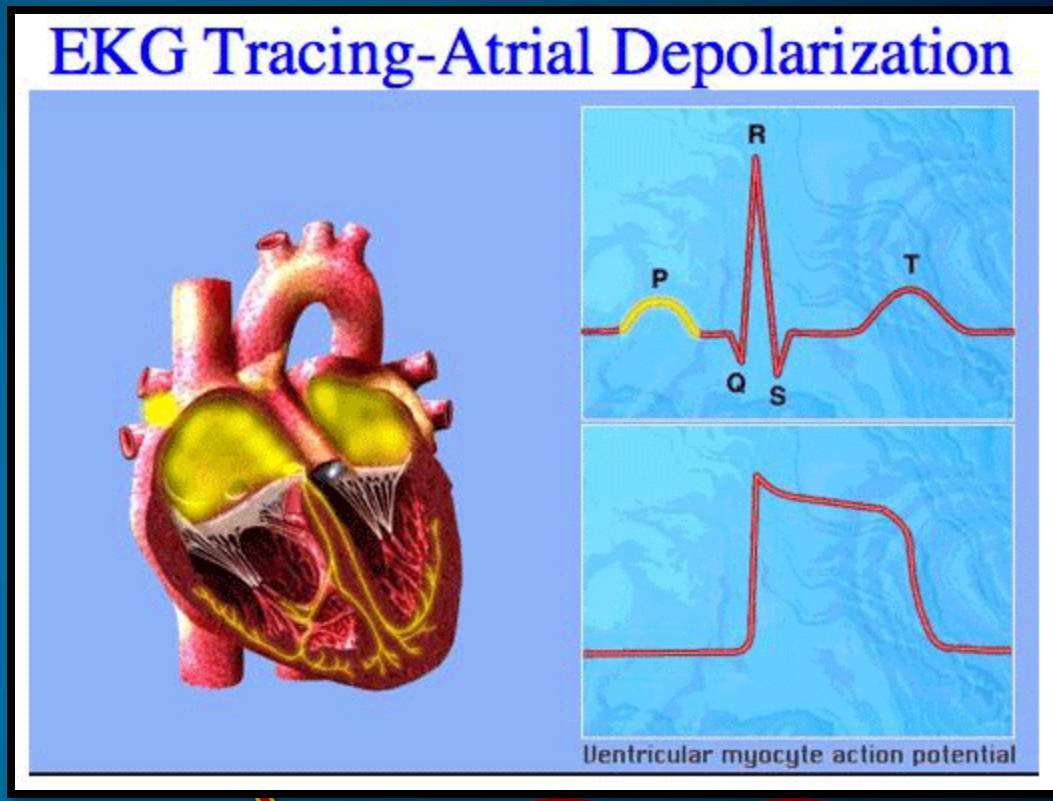




The Normal ECG

► P wave:

- Indicates atrial depolarization, or contraction of the atrium.
- Normal duration is not longer than 0.11 seconds (less than 3 small squares)
- Amplitude (height) is no more than 3 mm
- No notching or peaking

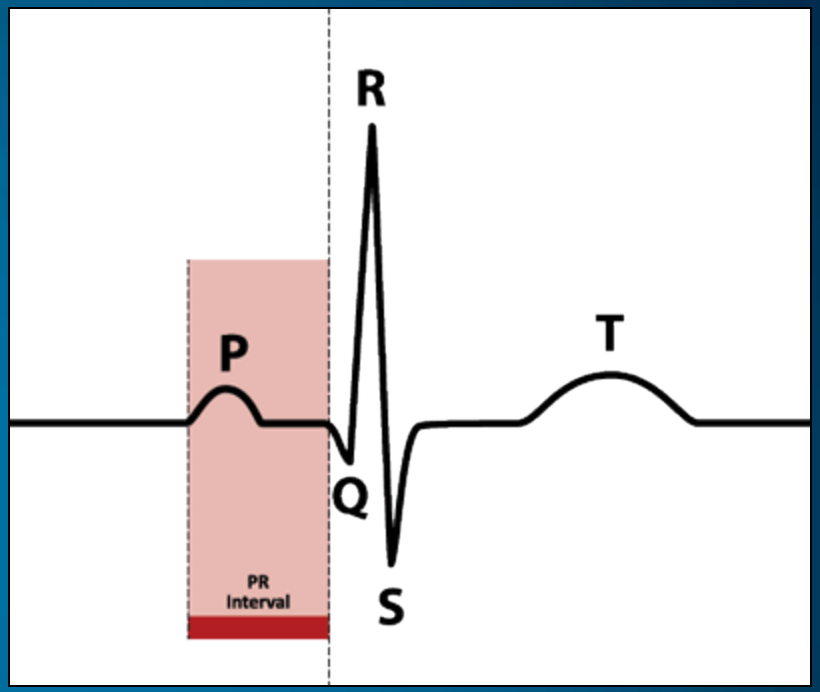


Normal Values

The Normal ECG

► **PR interval:**

- Indicates AV conduction time.
- Duration time is 0.12 to 0.20 seconds.



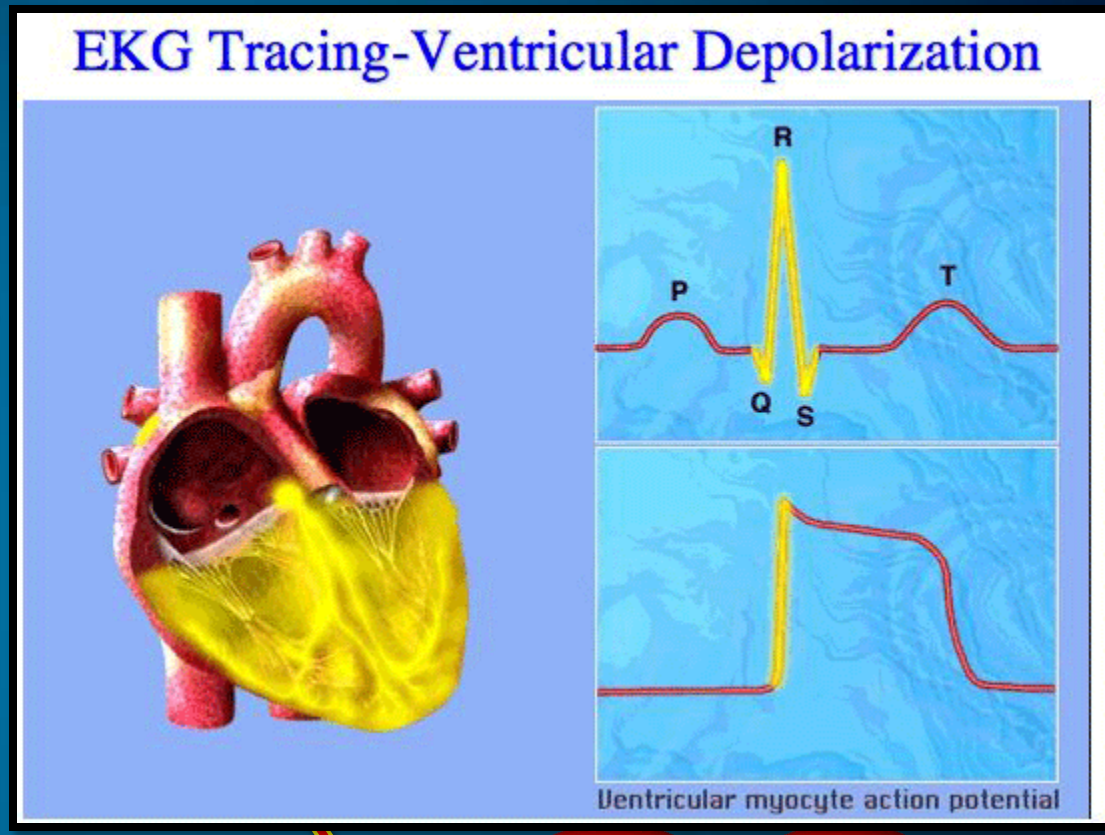
Normal Values

The Normal ECG

► **QRS complex:**

- Indicates ventricular depolarization, or contraction of the ventricles.
- Normally not longer than 0.10 seconds in duration
- Amplitude is not less than 5 mm in lead II or 9 mm in V3 and V4

R waves are deflected positively and the Q and S waves are negative



Normal Values

QRS Complex – Further to know!

• QRS amplitude is quite variable from lead to lead and from person to person. Two determinates of QRS voltages are:

1) Size of the ventricular chambers (i.e., the larger the chamber, the larger the voltage; often seen in young aerobic trained athletes)

2) Proximity of chest electrodes to ventricular chamber (the closer, the larger the voltage; seen in tall, thin people)

• Frontal plane leads:

1) The normal QRS axis range (+90° to -30°) implies that the QRS direction must always be positive (i.e., up going) in leads I and II.

2) Small "septal" q-waves are often seen in leads I and aVL when the QRS axis is to the left of +60°, or in leads II, III, aVF when the QRS axis is to the right of +60°.

• Precordial leads:

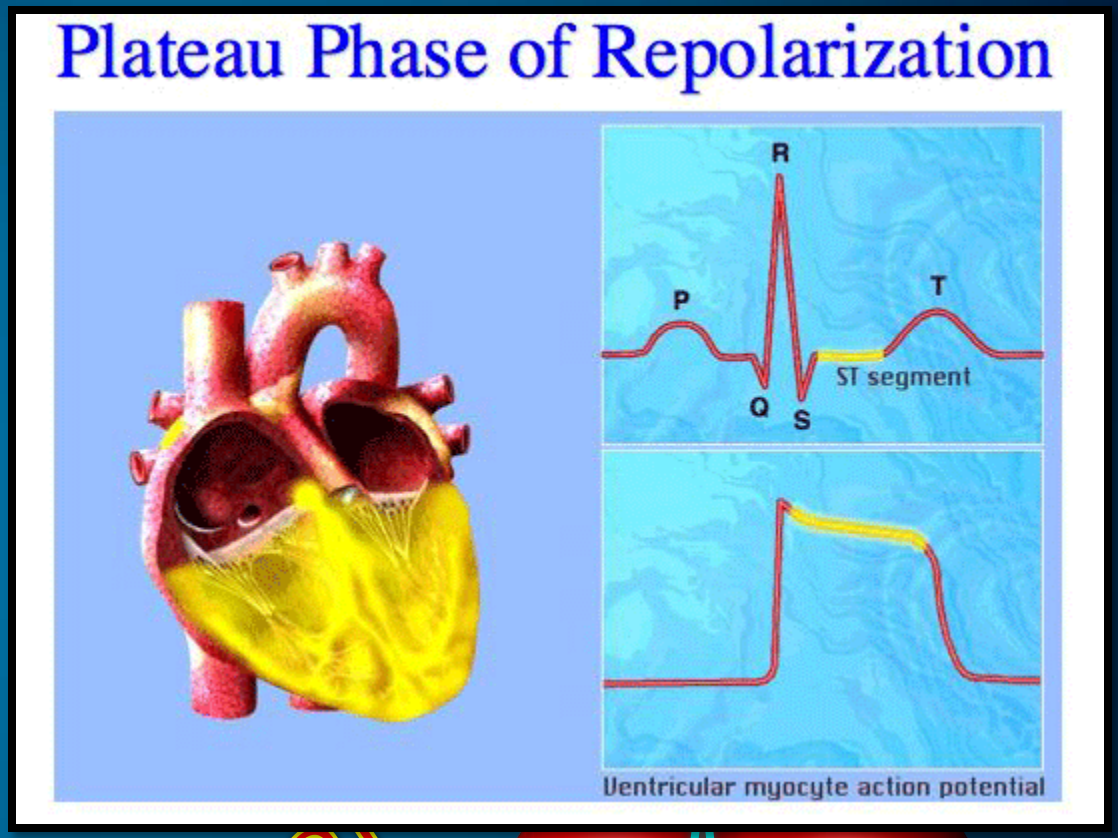
3) Small r-waves begin in V1 or V2 and increase in size up to V5. The R-V6 is usually smaller than R-V5.

4) In reverse, the s-waves begin in V6 or V5 and increase in size up to V2. S-V1 is usually smaller than S-V2.

The Normal ECG

► **ST segment:**

- Indicates early ventricular repolarization
- Normally not depressed more than 0.5 mm
- May be elevated slightly in some leads (no more than 1 mm)

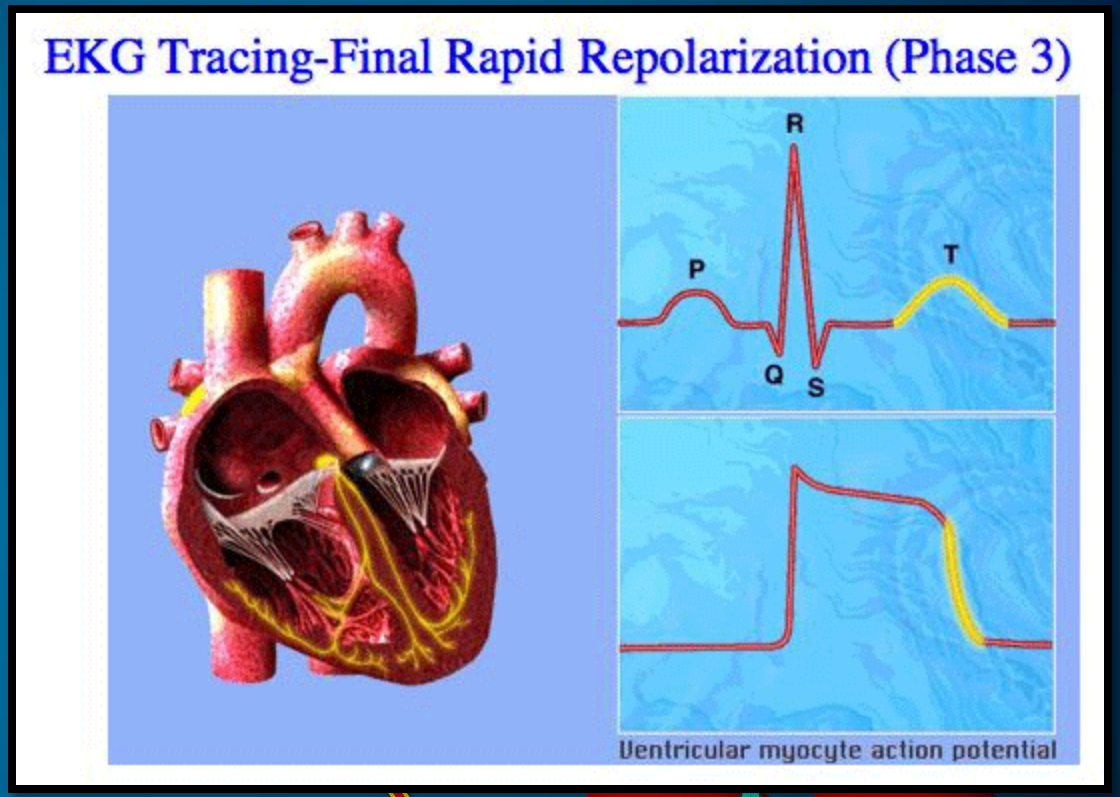


Normal Values

The Normal ECG

► **T wave:**

- Indicates ventricular repolarization
- Not more than 5 mm in amplitude in standard leads and 10 mm in precordial leads
- Rounded and asymmetrical

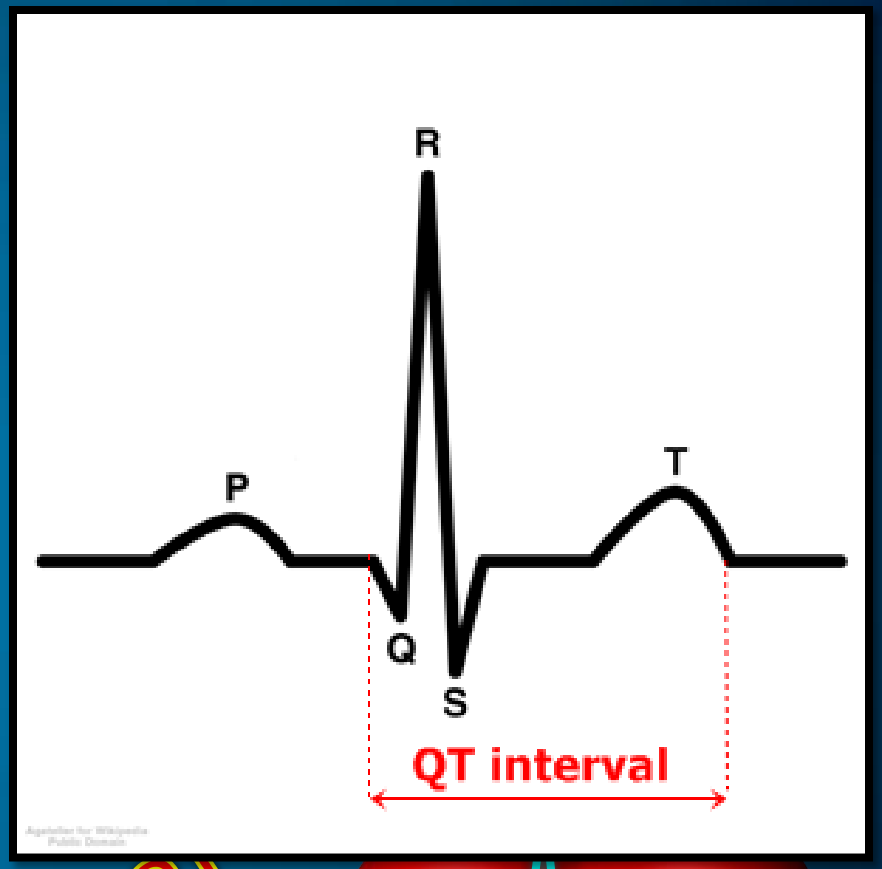


Normal Values

The Normal ECG

► **QT interval:**

- Measured from the Q to the end of the T.
- Represents ventricular depolarization and repolarization (sodium influx and potassium efflux)
- QT usually less than half the R-R interval
- Prolonged QT may be inherited or acquired



Normal Values

The Normal ECG

I. Normal Rate: Heart Rate: 50 - 90 bpm (some ECG readers use 60-100 bpm)

II. Normal RHYTHM: Normal sinus rhythm

III. Normal CONDUCTION: Normal Sino-Atrial (SA), Atrio-Ventricular (AV), and Intraventricular (IV) conduction

The Normal Sinus Rhythm

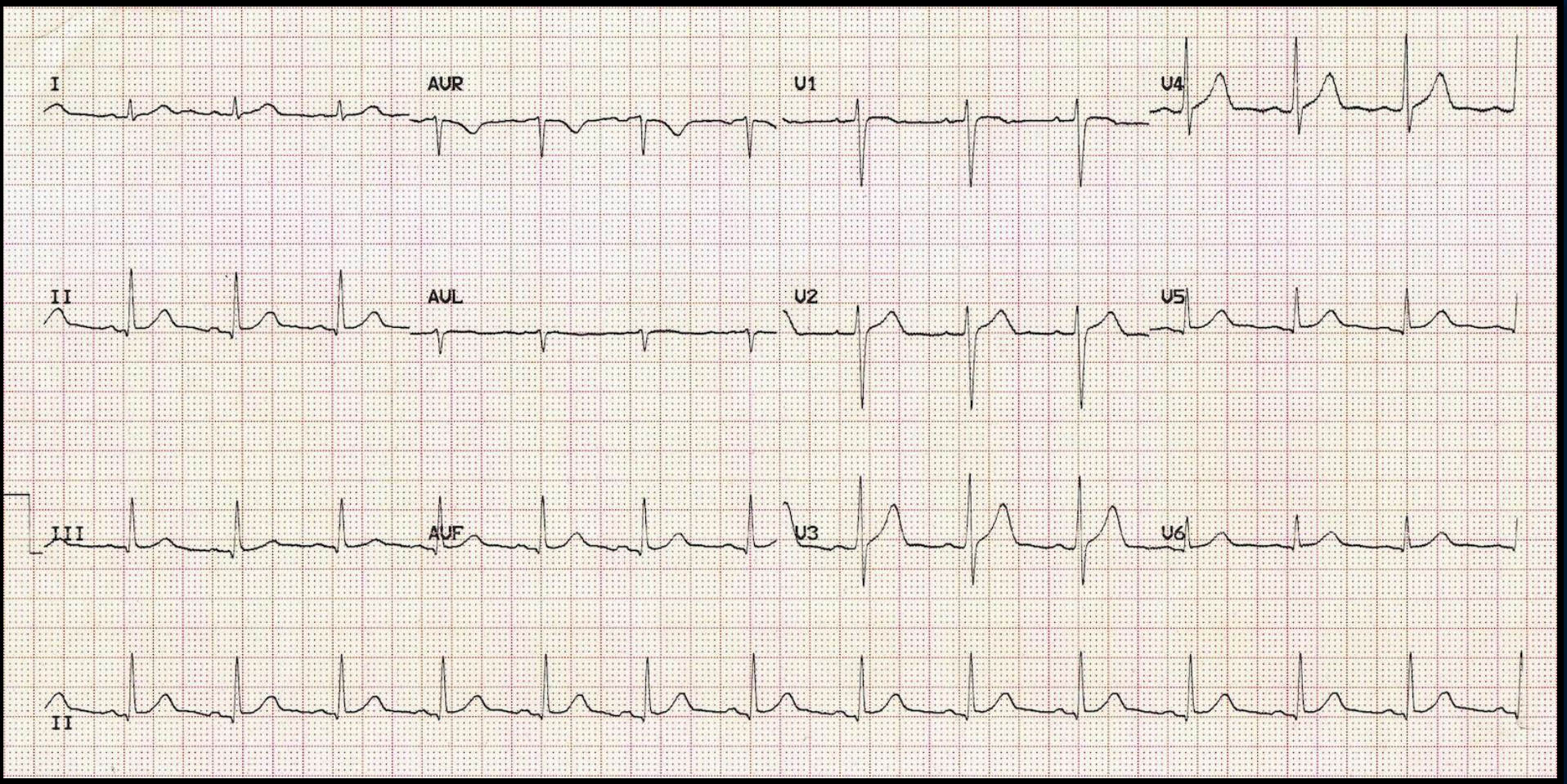
Sinus rhythm refers to any cardiac rhythm where depolarization of the cardiac muscle begins at the sinus node. It is characterized by the presence of correctly-oriented P waves on the electrocardiogram (ECG). Sinus rhythm is necessary, but not sufficient, for normal electrical activity within the heart.

The term normal sinus rhythm (NSR) is sometimes used to denote a specific type of sinus rhythm where all other measurements on the ECG also fall within designated normal limits, giving rise to the characteristic appearance of the ECG when the electrical conduction system of the heart is functioning normally.

Characteristics of normal sinus rhythm

- Regular rhythm at a rate of 60-100 bpm (or age-appropriate rate in children).
- Each QRS complex is preceded by a normal P wave.
- Normal P wave axis: P waves should be upright in leads I and II, inverted in aVR.
- The PR interval remains constant.
- QRS complexes are < 100 ms wide (unless a co-existent interventricular conduction delay is present).

Example of a normal Sinus Rhythm



OUTLINE

- ECG Basics. ✓
- The normal ECG. ✓
- How to read an ECG.
- Most common Arrhythmias.
- Assessment.

ECG Master

How to read an ECG

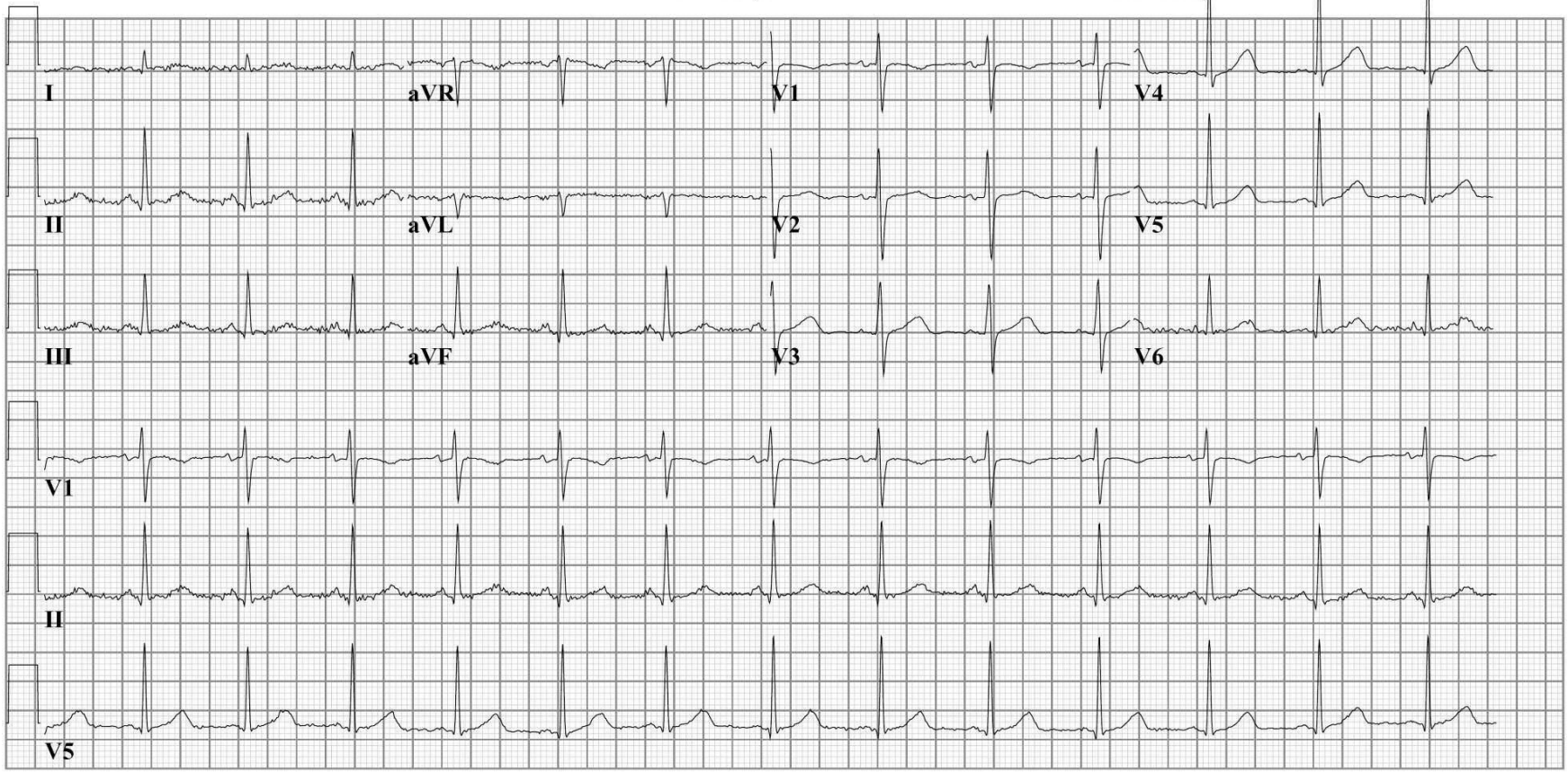
Vent. rate	81	BPM	*** Leeftijds en geslacht specifieke ECG analyse ***
PR interval	120	ms	Normaal sinusritme
QRS duration	80	ms	Normaal ECG
QT/QTc	376/436	ms	Geen oud ECG aanwezig
P-R-T axes	81 80	73	

Loc:23

Technician:

Referred by:

Confirmed By:

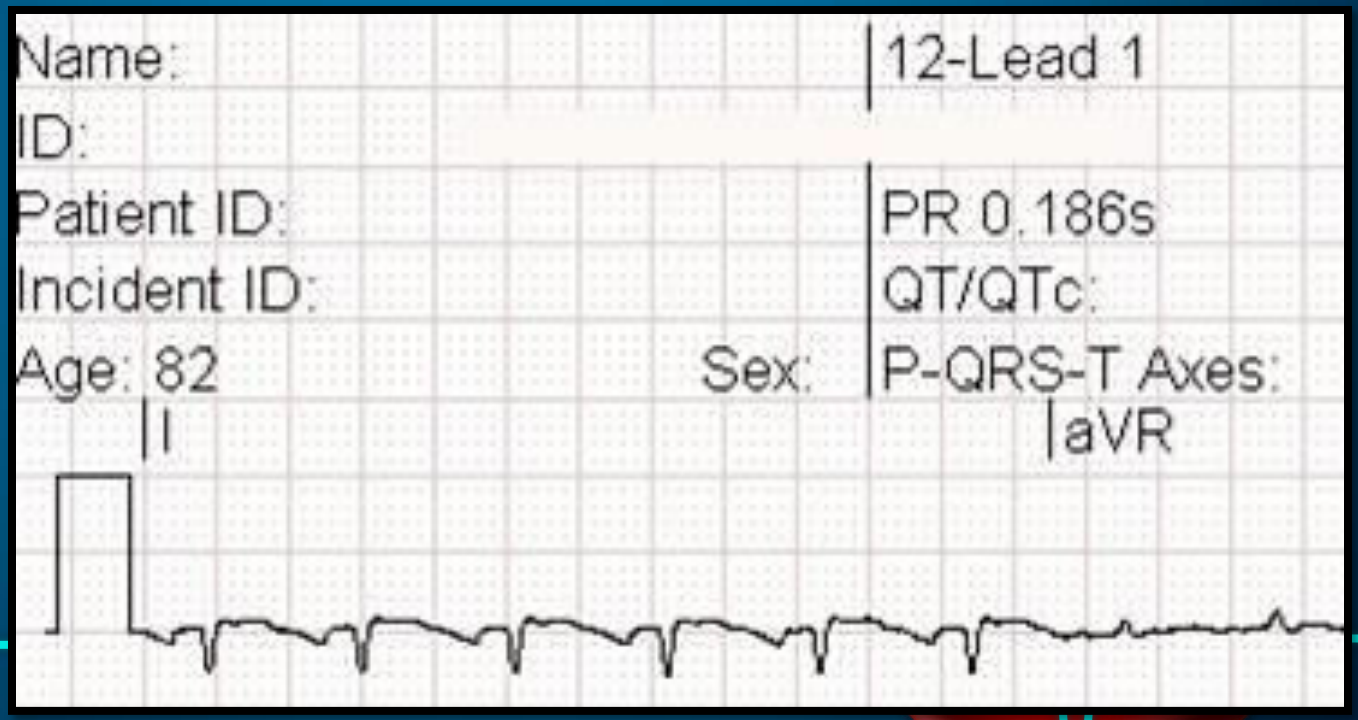


25mm/s 10mm/mV 40Hz 005E 12SL 233 CID: 10

How to read an ECG

1. Patient's Information:

- On the top left are the patient's information, name, sex and date of birth



How to read an ECG

2. The Rhythm:

Regular vs. Irregular

To consider it regular, The R-R interval should be regular

How to read an ECG

3. The Rate:

► Heart rate can be easily calculated from the ECG strip:

1. When the rhythm is regular, the heart rate is 300 divided by the number of large squares between the QRS complexes.

   For example, if there are 4 large squares between regular QRS complexes, the heart rate is 75 (300/4=75).

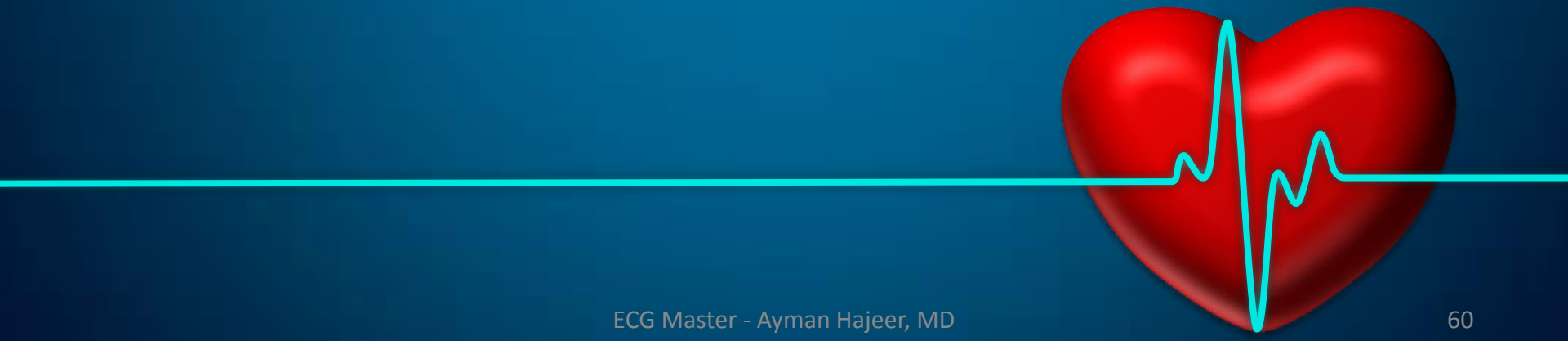
2. The second method can be used with an irregular rhythm to estimate the rate. Count the number of R waves in a 6 second (30 big squares) strip and multiply by 10.

   For example, if there are 7 R waves in a 6 second strip, the heart rate is 70 (7x10=70).

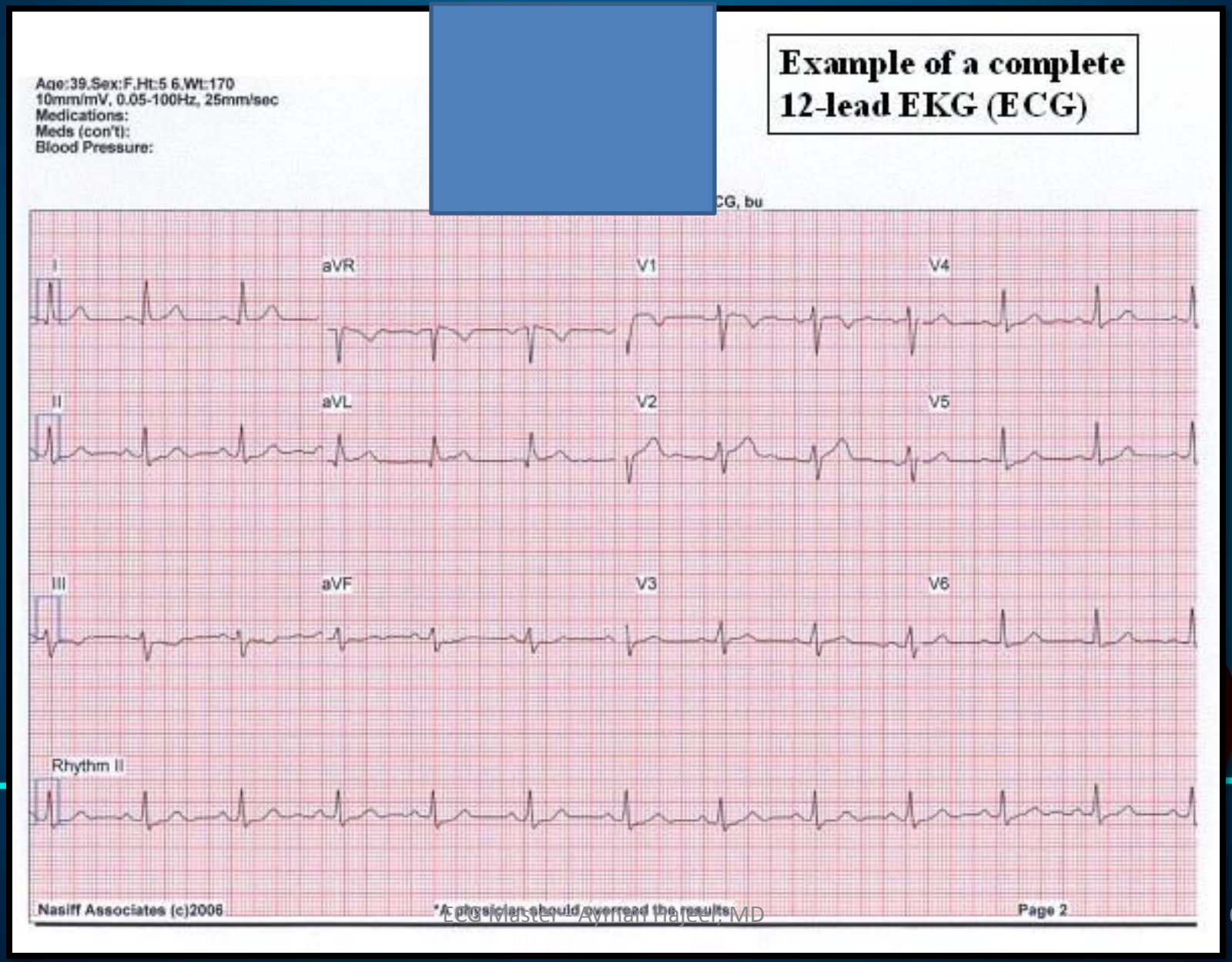
How to read an ECG

4. Assess the rest of the values.
5. Assess the Axis.

Previously Mentioned



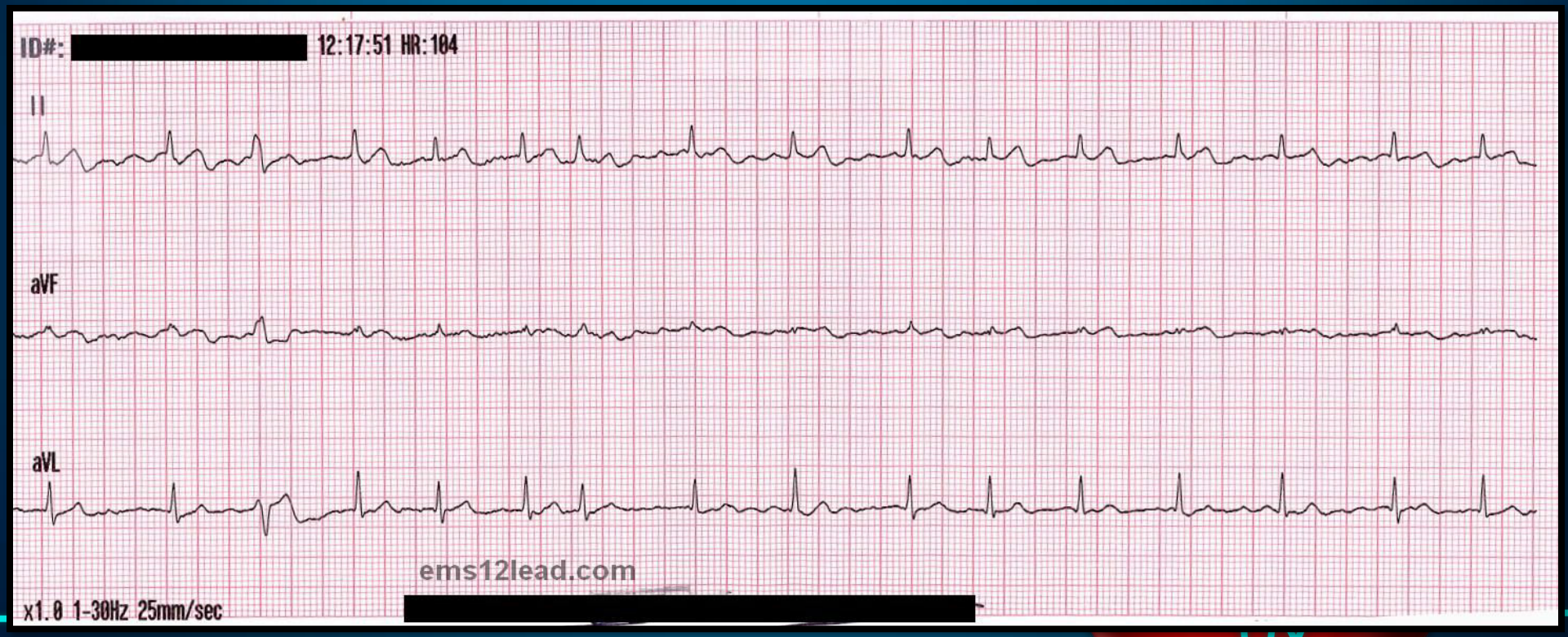
Example 1:


Age:39,Sex:F,Ht:5 6,Wt:170
10mm/mV, 0.05-100Hz, 25mm/sec
Medications:
Meds (con't):
Blood Pressure:
Example of a complete 12-lead EKG (ECG)
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
Rhythm II
Nasiff Associates (c)2006
*A physician should overread the results
Page 2

Answer – Example 1:

1. Patient info: 39 Y/O, Female
2. Rhythm: R-R interval is Regular. >> Regular Rhythm.
3. Rate: since it is Regular, the R-R contains 4 Large squares >> 300/4 = 75.
4. The Values are within Normal.

Example 2: please calculate the Rhythm



Answer - Example 2:

To calculate the rate, the Rhythm should be assessed first.

Here, the R-R interval is Irregular >> which means Irregular Rhythm.

Count the number of QRS complexes within 6 seconds >> 10

Rate = 10 x 10 = 100

OUTLINE

- ECG Basics. ✓
- The normal ECG. ✓
- How to read an ECG. ✓
- Most common Arrhythmias.
- Assessment.

ECG Master

Arrhythmias

Cardiac arrhythmia, also known as cardiac dysrhythmia or irregular heartbeat, is a group of conditions in which the heartbeat is irregular, too fast, or too slow. A heartbeat that is too fast - above 100 beats per minute in adults - is called tachycardia and a heartbeat that is too slow - below 60 beats per minute - is called bradycardia.

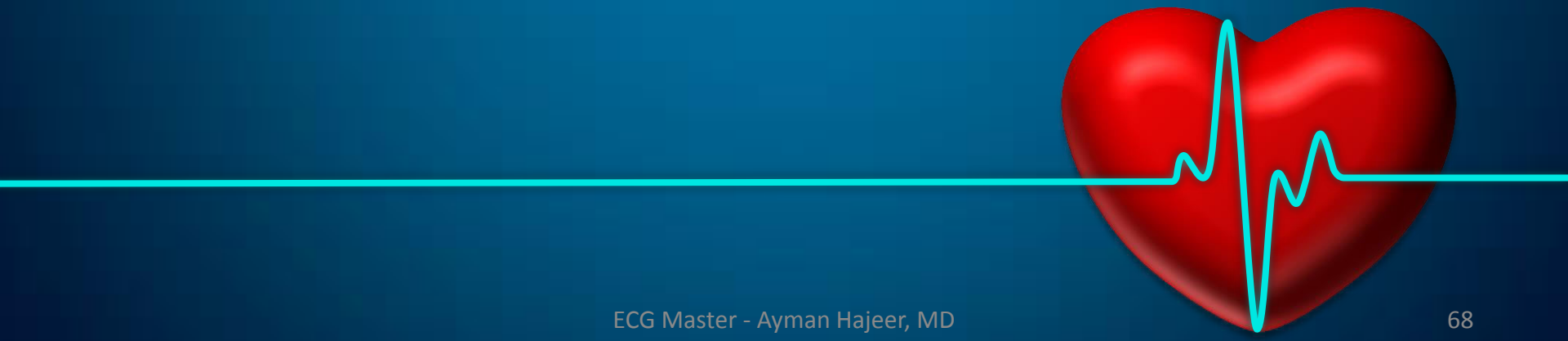
Arrhythmias

Many types of arrhythmia have no symptoms. When symptoms are present these may include palpitations or feeling a pause between heartbeats. More seriously there may be lightheadedness, passing out, shortness of breath, or chest pain. While most types of arrhythmia are not serious some predispose a person to complications such as stroke or heart failure. Others may result in cardiac arrest.

Arrhythmias

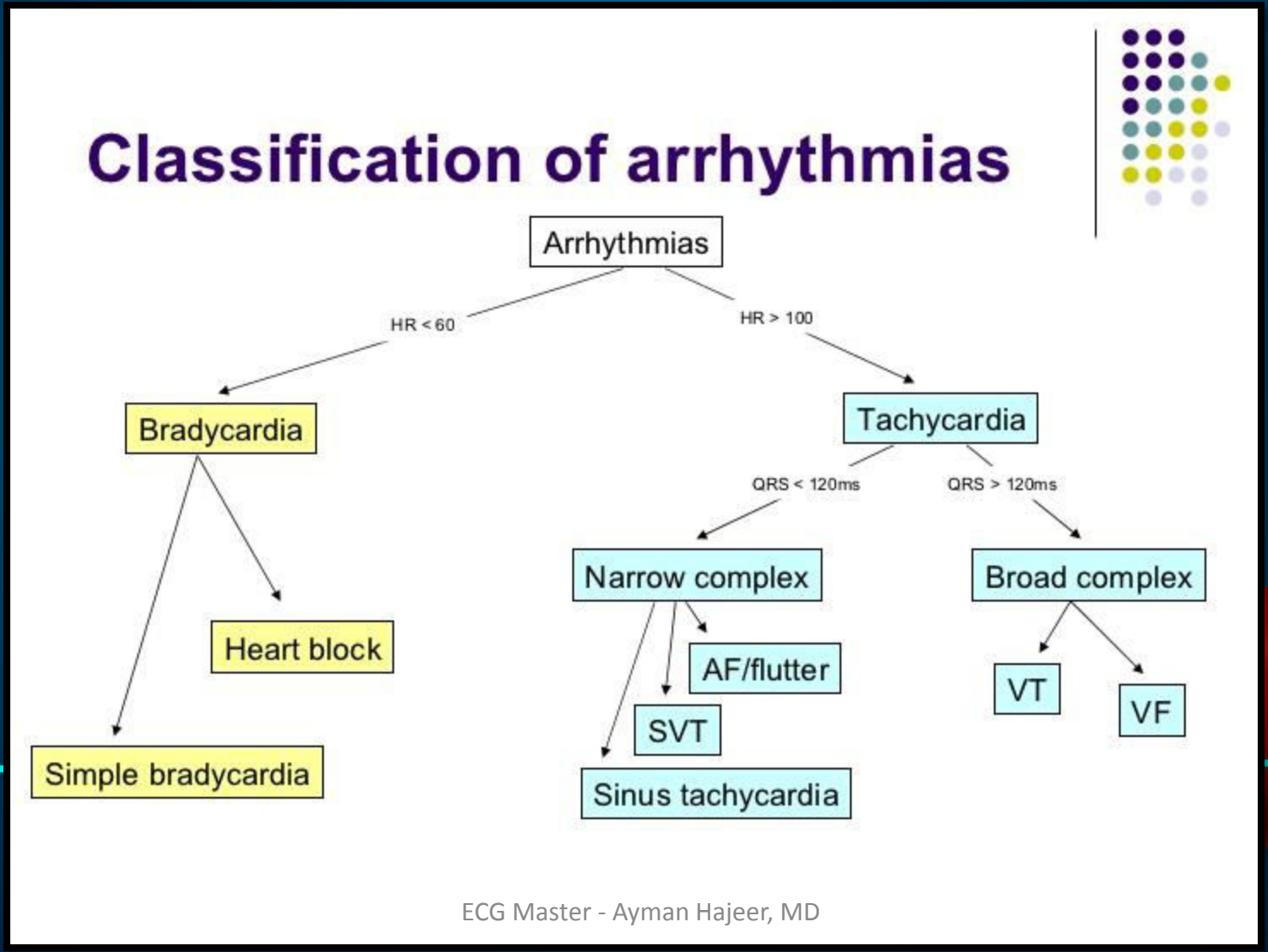
Classification

General and detailed



Arrhythmias

General Classification (according to the rate):



Arrhythmias

Detailed Classification (according to the Rhythm and origin):

1. Sinus Dysrhythmias.
2. Atrial Dysrhythmias.
3. Junctional Dysrhythmias.
4. Blocks.
5. Ventricular Dysrhythmias.

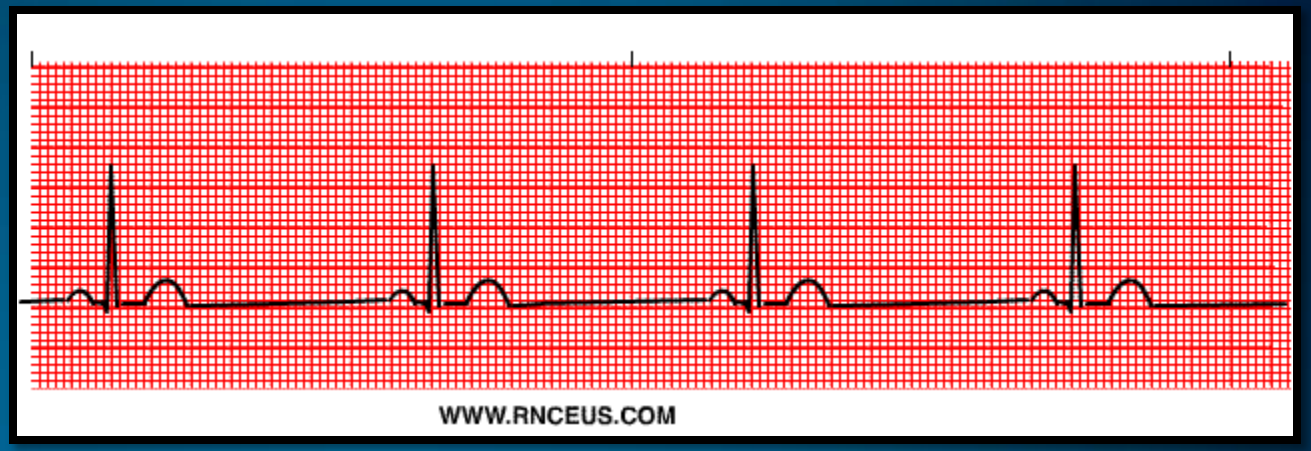
Arrhythmias

1. Sinus Dysrhythmias:

a. Sinus Bradycardia.
b. Sinus Tachycardia.
c. Sinus Arrhythmia.

Arrhythmias

a. Sinus Bradycardia



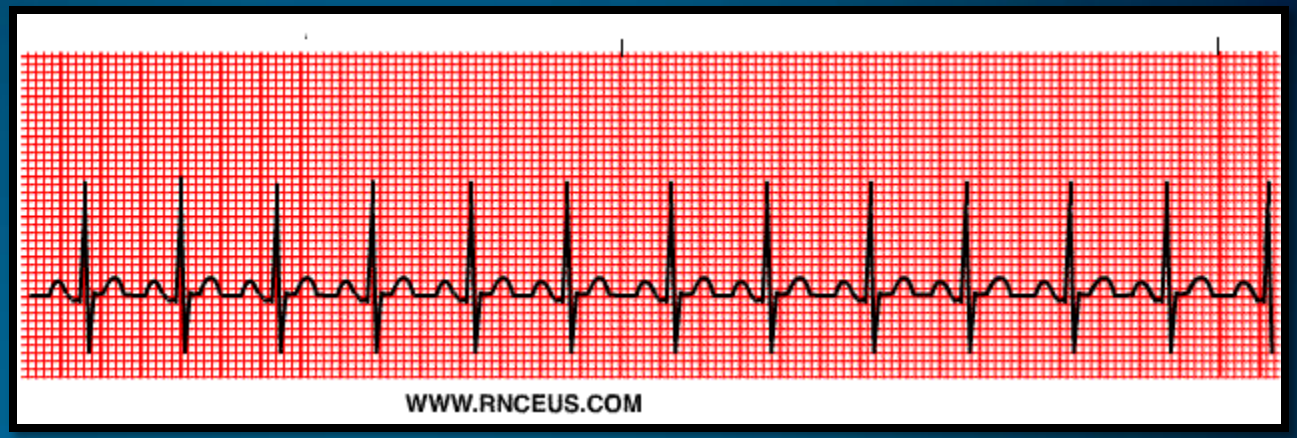
- This rhythm is often seen as a normal variation in athletes, during sleep, or in response to a vagal maneuver.

- Treatment includes: treat the underlying cause, atropine, or artificial pacing if patient is hemodynamically compromised.

Rate	40-59 bpm
P wave	Sinus
QRS	Normal (.06-.12)
Conduction	P-R normal or slightly prolonged at slower rates
Rhythm	Regular

Arrhythmias

b. Sinus Tachycardia.

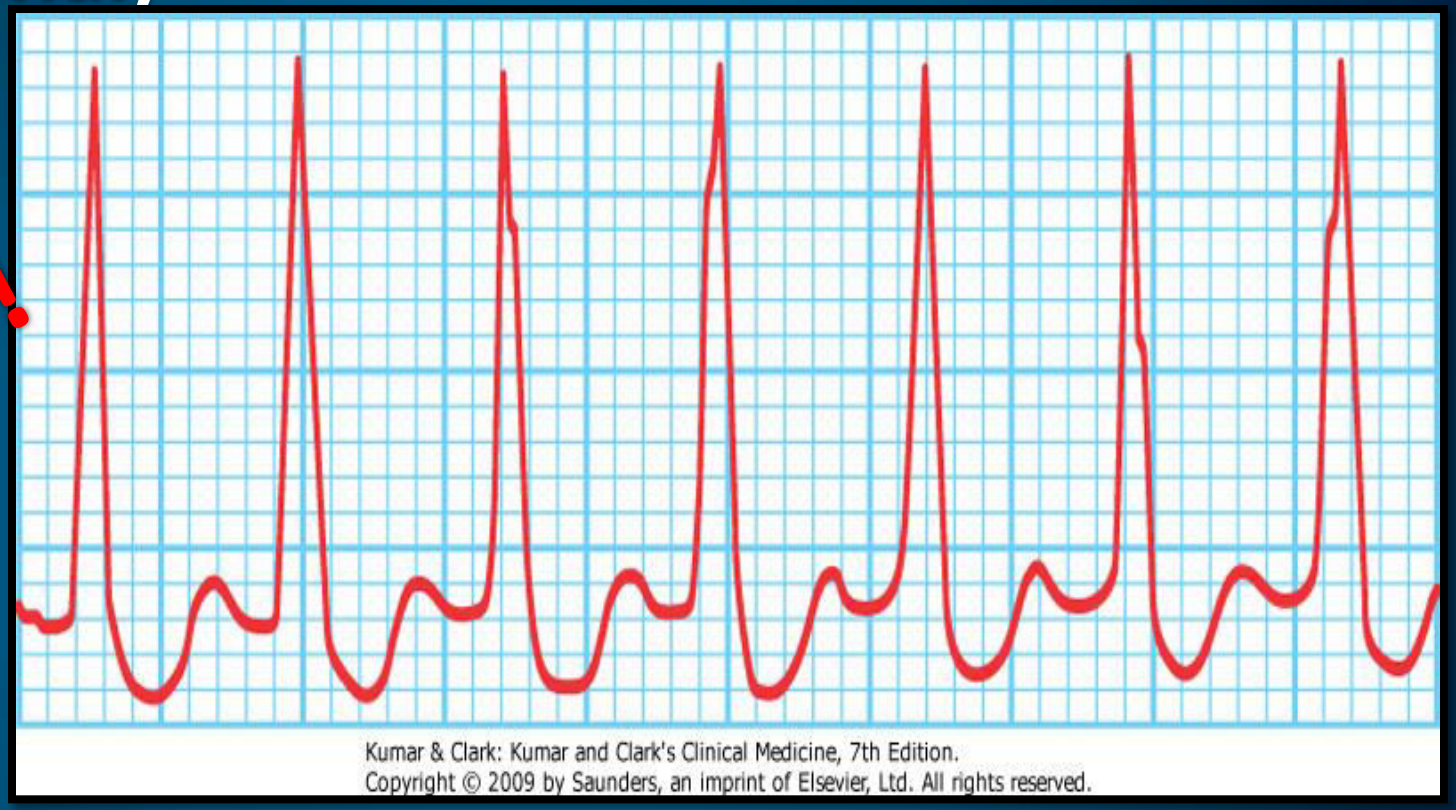


- The clinical significance of this dysrhythmia depends on the underlying cause. It may be normal.
- Underlying causes include:
increased circulating catecholamines
CHF, hypoxia, PE, increased temperature
Stress, response to pain
- Treatment includes identification of the underlying cause and correction.

Rate	101-160/min
P wave	Sinus
QRS	Normal
Conduction	Normal
Rhythm	Regular

► Supraventricular tachycardia (junctional)

NOTE!!



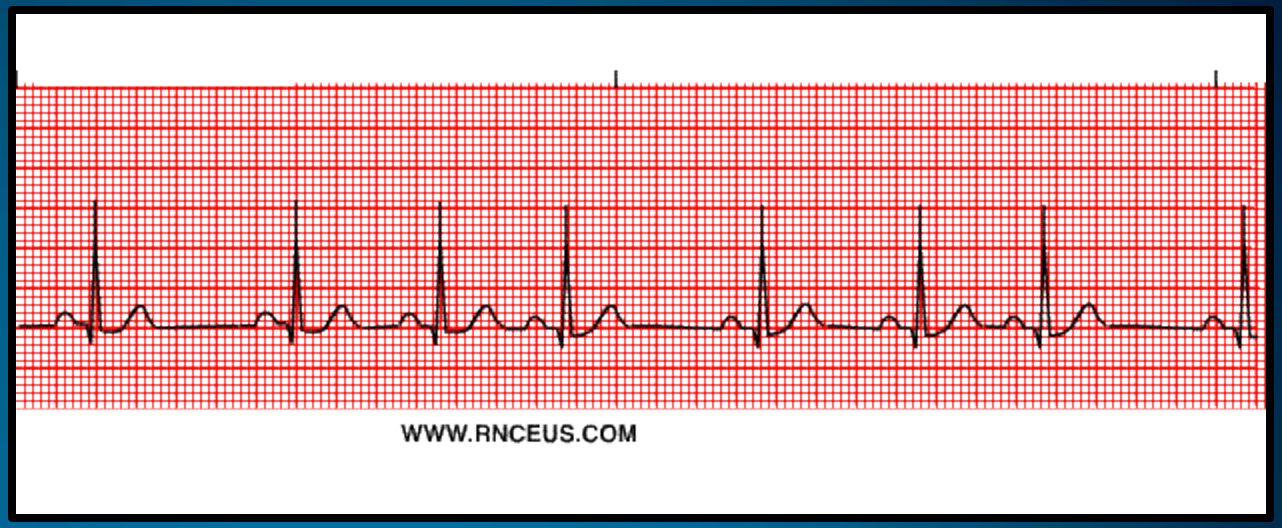
Don't mix between Sinus Tchycardia and SVT.
In SVT the P wave is not seen due to the rapid rate, it will be embedded within the QES complex.

► SVT:

- Treatment:
  - If stable >> Right Carotid massage.
  - If hemodynamically unstable >> Cardioversion.

Arrhythmias

c. Sinus Arrhythmia.



- The rate usually increases with inspiration and decreases with expiration.
- This rhythm is most commonly seen with breathing due to fluctuations in parasympathetic vagal tone. During inspiration stretch receptors in the lungs stimulate the cardioinhibitory centers in the medulla via fibers in the vagus nerve.
- Treatment is not usually required unless symptomatic bradycardia is present.

Rate	45-100/bpm
P wave	Sinus
QRS	Normal
Conduction	Normal
Rhythm	Regularly irregular

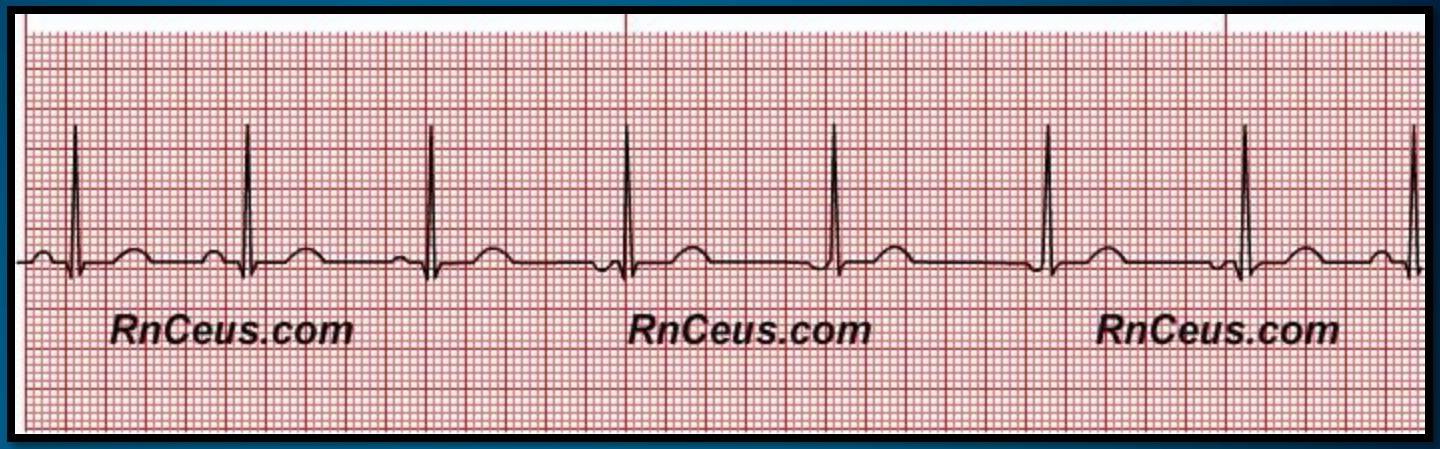
Arrhythmias

2. Atrial Dysrhythmias.

a. Wandering Atrial Pacemaker
b. Premature Atrial Contractions
c. Sinus Arrest
d. Sinoatrial Block
e. Multifocal Atrial Tachycardia
f. Paroxysmal Atrial Tachycardia
g. Atrial Flutter
h. Atrial Fibrillation

Arrhythmias

a. Wandering Atrial Pacemaker

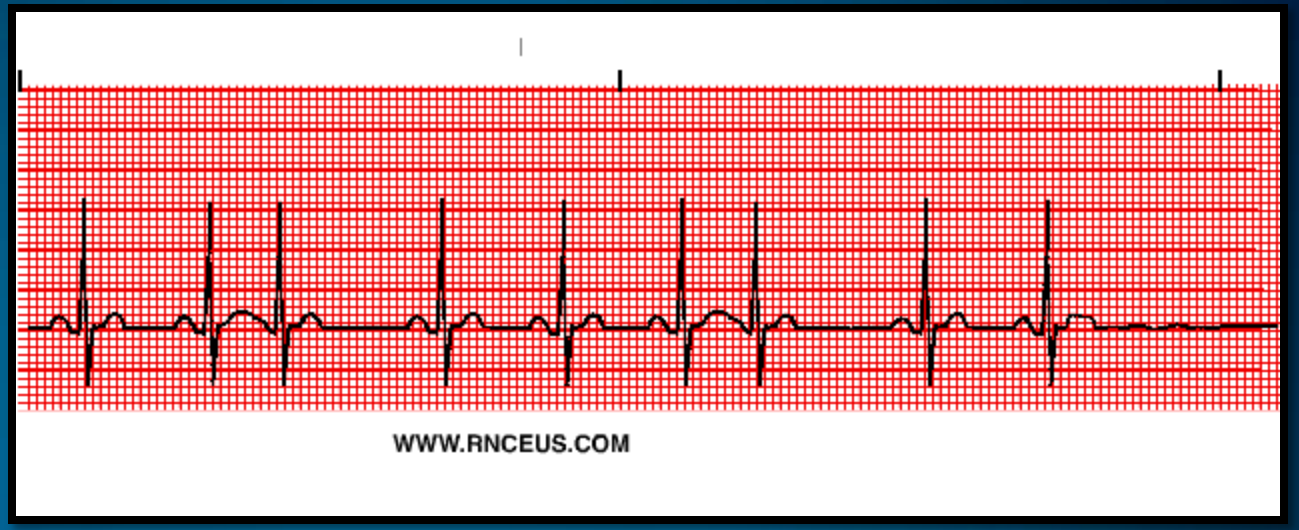


- This dysrhythmia may occur in normal hearts as a result of fluctuations in vagal tone. It may also be seen in patients with heart disease or COPD.
- There is usually no treatment required.

Rate	Variable depending on the site of the pacemaker; usually 45-100/ bpm.
P wave	Also variable in morphology
QRS	Normal
Conduction	P-R interval varies depending on the site of the pacemaker
Rhythm	Irregular

Arrhythmias

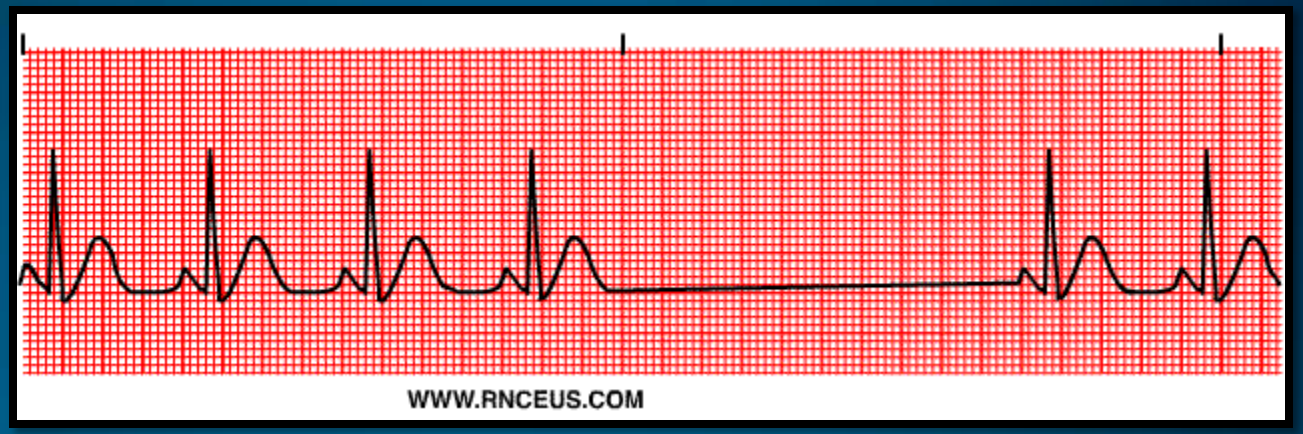
b. Premature Atrial Contractions



Rate	Normal or accelerated
P wave	Usually have a different morphology than sinus P waves because they originate from an ectopic pacemaker
QRS	Normal
Conduction	Normal, however the ectopic beats may have a different P-R interval.
Rhythm	PAC's occur early in the cycle and they usually do not have a complete compensatory pause.

Arrhythmias

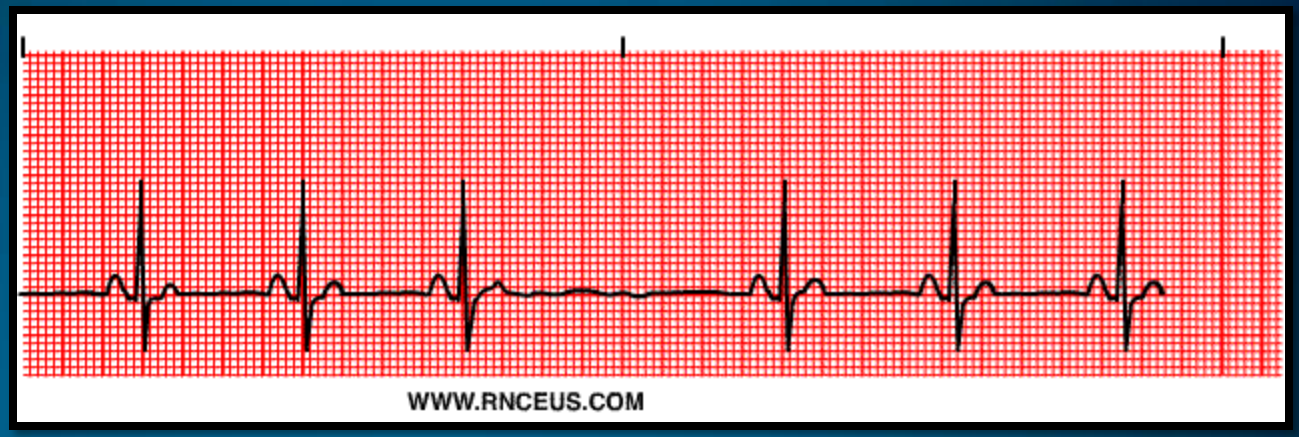
c. Sinus Arrest



Rate	Normal
P wave	When present they are normal
QRS	Normal
Conduction	Normal
Rhythm	The basic rhythm is regular. The length of the pause is not a multiple of the sinus interval.

Arrhythmias

d. Sinoatrial Block

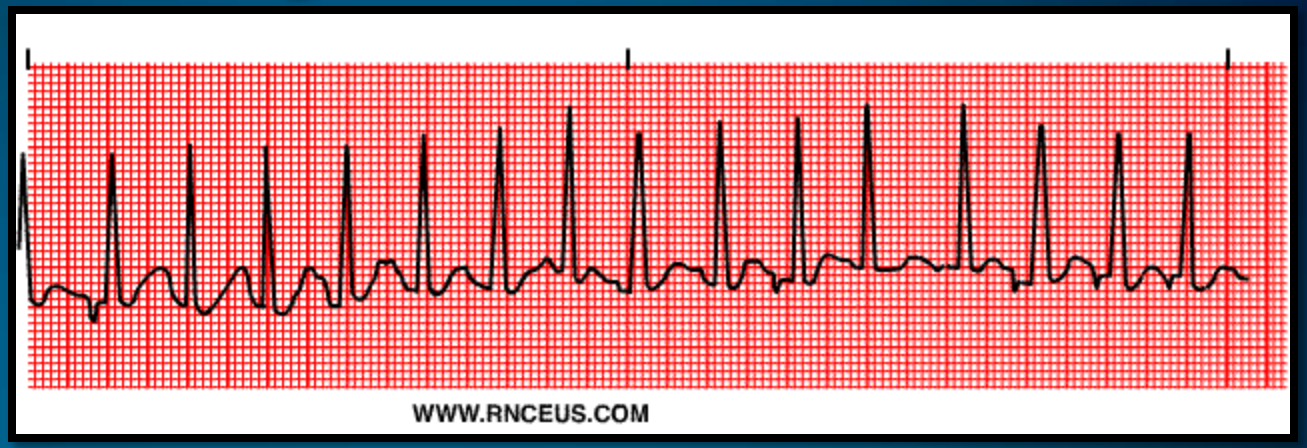


*In a type I SA block, the P-P interval shortens until one P wave is dropped.
*In a type II SA block, the P-P intervals are an exact multiple of the sinus cycle, and are regular before and after the dropped P wave.

Rate	Normal or bradycardia
P wave	When present P-waves are normal
QRS	Normal
Conduction	Normal
Rhythm	Basic rhythm is regular*.

Arrhythmias

e. Multifocal Atrial Tachycardia

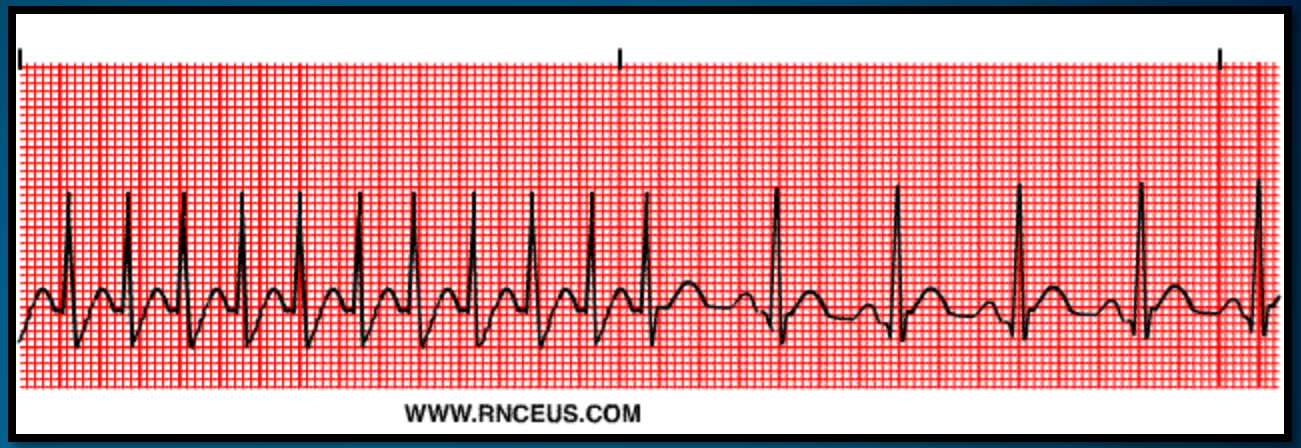


- Multifocal atrial tachycardia (MAT) may resemble atrial fibrillation or flutter.
- It almost always occurs in seriously ill, elderly individuals. COPD is the most common underlying cause.

Rate	100-250/bpm
P wave	Two or more ectopic P waves with different morphologies
QRS	Normal
Conduction	P-R intervals vary
Rhythm	Irregular

Arrhythmias

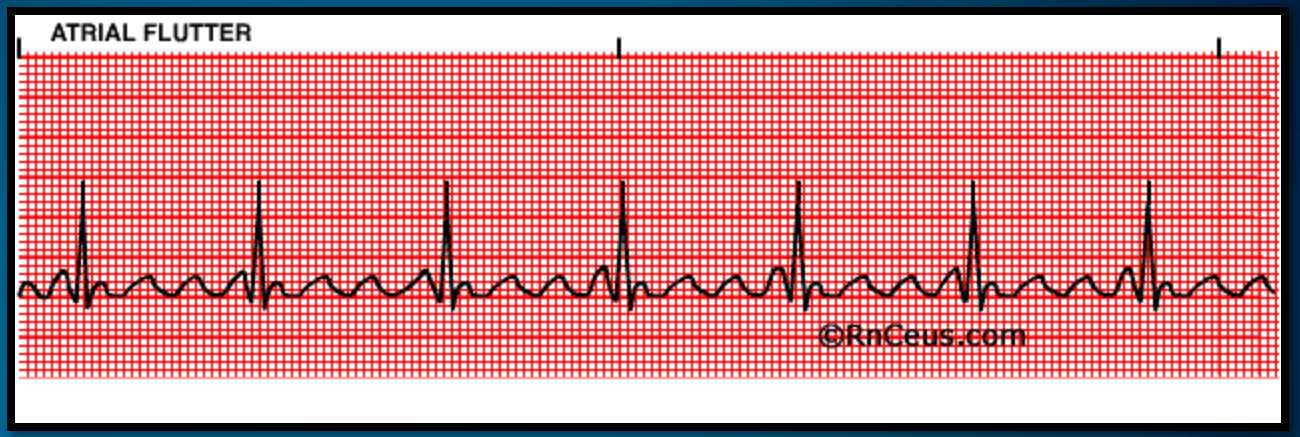
f. Paroxysmal Atrial Tachycardia



Rate	Atrial 160-250/min: may conduct to ventricles 1:1, or 2:1, 3:1, 4:1 into the presence of a block.
P wave	Morphology usually varies from sinus
QRS	Normal (unless associated with aberrant ventricular conduction).
Conduction	P-R interval depends on the status of AV conduction tissue and atrial rate: may be normal, abnormal, or not measurable.

Arrhythmias

g. Atrial Flutter



Rate	Atrial 250-350/min; ventricular conduction depends on the capability of the AV junction (usually rate of 150-175 bpm).
P wave	Not present; usually a "saw tooth" pattern is present.
QRS	Normal
Conduction	2:1 atrial to ventricular most common.
Rhythm	Usually regular, but can be irregular if the AV block varies.
Symptoms	Palpitations, rapid heart rate, chest pain, shortness of breath, lightheadedness, fatigue, and low blood pressure.

Arrhythmias

g. Atrial Flutter:

- Atrial flutter is the second most common tachyarrhythmia, after atrial fibrillation.

- It is usually confined to tissue of the right atrium, only rarely passing through the atrial septum to effect the left atrium.

- Atrial flutter almost always occurs in diseased hearts but it can occur in otherwise asymptomatic hearts.

- The incidence of atrial flutter increases with age and medical conditions including: congestive heart failure, rheumatic valve disease, congenital heart disease, lung disease such as emphysema, or high blood pressure. Surgery involving the right atrium can increase the risk of atrial flutter due to scar formation in the atrial wall or tricuspid annulus.

Arrhythmias

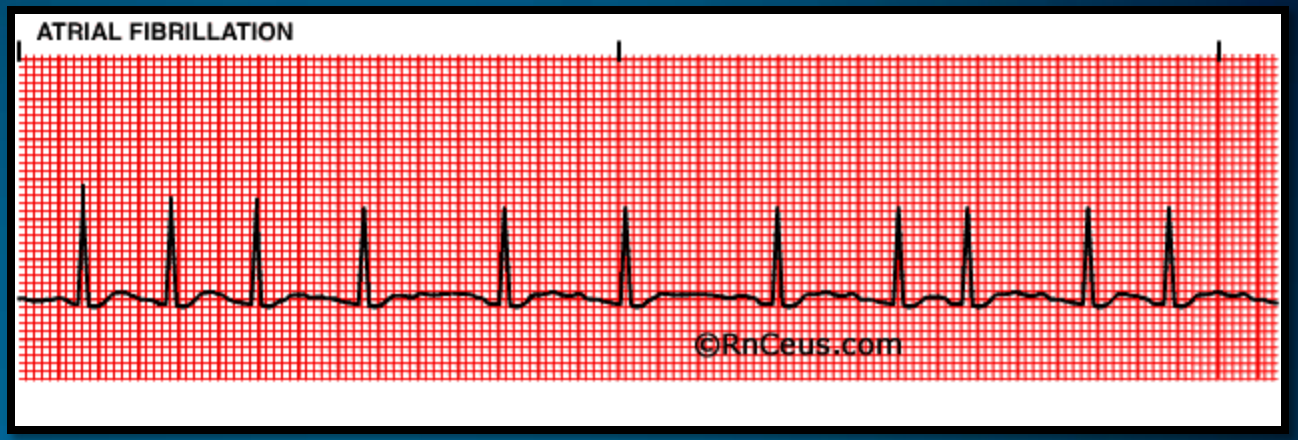
g. Atrial Flutter:

- Treatment depends on the level of hemodynamic compromise.

1. Synchronized electrical cardioversion is often used if: hypotensive, ischemic pain or severe CHF are present
2. Type I antiarrhythmics like quinidine or procainamide may convert the flutter
3. Diltiazem, verapamil, digitalis or beta-blocking agents may be used to slow ventricular rate.
4. Verapamil and beta-blockers can increase risk of bradycardia and CHF
5. Digoxin and other antiarrhythmic drugs can be used.
6. Catheter ablation is often the definative treatment for eliminating recurrence

Arrhythmias

h. Atrial Fibrillation



Rate	Atrial rate usually between 400-650/bpm.
P wave	Not present; wavy baseline is seen instead.
QRS	Usually normal, a wide QRS may indicate conduction by accessory pathway.
Conduction	Variable AV conduction; if untreated the ventricular response is usually rapid.
Rhythm	Irregularly irregular with abscence of P waves. (This is the hallmark of this dysrhythmia).
Symptoms	Palpitations, chest pain, dyspnea, fatigue, lightheadedness, or syncope.

Arrhythmias

h. Atrial Fibrillation:

- Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia.
- AF increases the risk hemodynamic impairment and thromboembolic events.
- It may occur paroxysmally, but it often becomes chronic.
- Signs of acute atrial fibrillation are: hypotension, myocardial ischemia, decreased perfusion of vital organs and acute congestive heart failure (CHF).
- Chronic atrial fibrillation increases the risk of atrial mural thrombus and embolus.
- Some conditions associated with atrial fibrillation are: mitral stenosis, lung disease, heart disease, sepsis, hyperthyroidism and cardiac surgery.

Arrhythmias

3. Junctional Dysrhythmias.

a. Premature Junctional Contractions
b. Junctional Tachycardia (SVT).
c. Junctional Escape Beats and Rhythm

Just Remember The Names!!

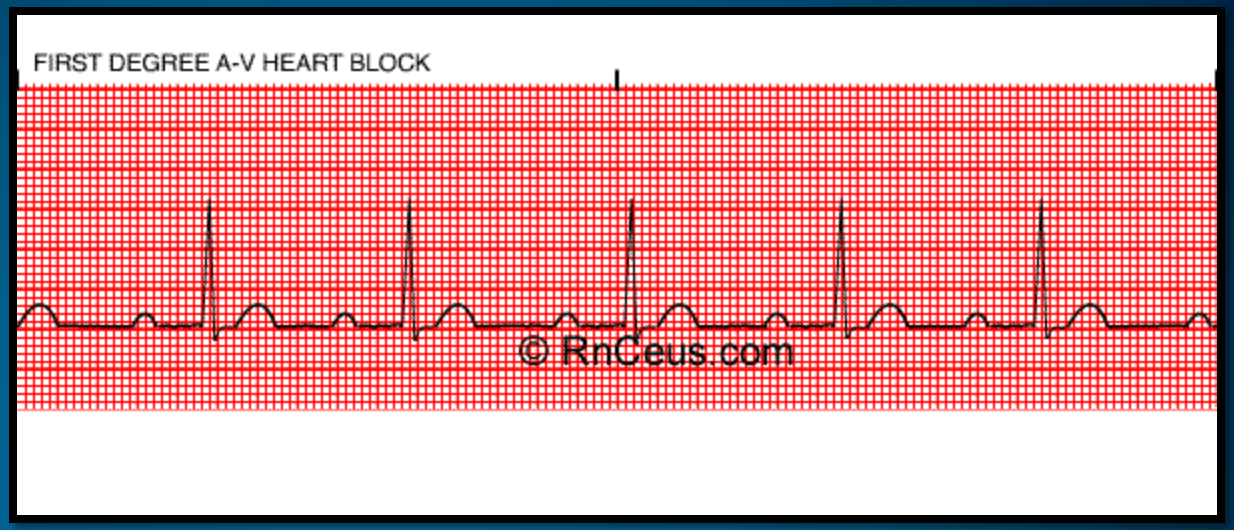
Arrhythmias

4. Blocks:

a. First Degree AV Block
b. Second Degree AV Block I
c. Second Degree AV Block II
d. Third Degree or Complete AV Block
e. Bundle Branch Block

Arrhythmias

a. First Degree AV Block



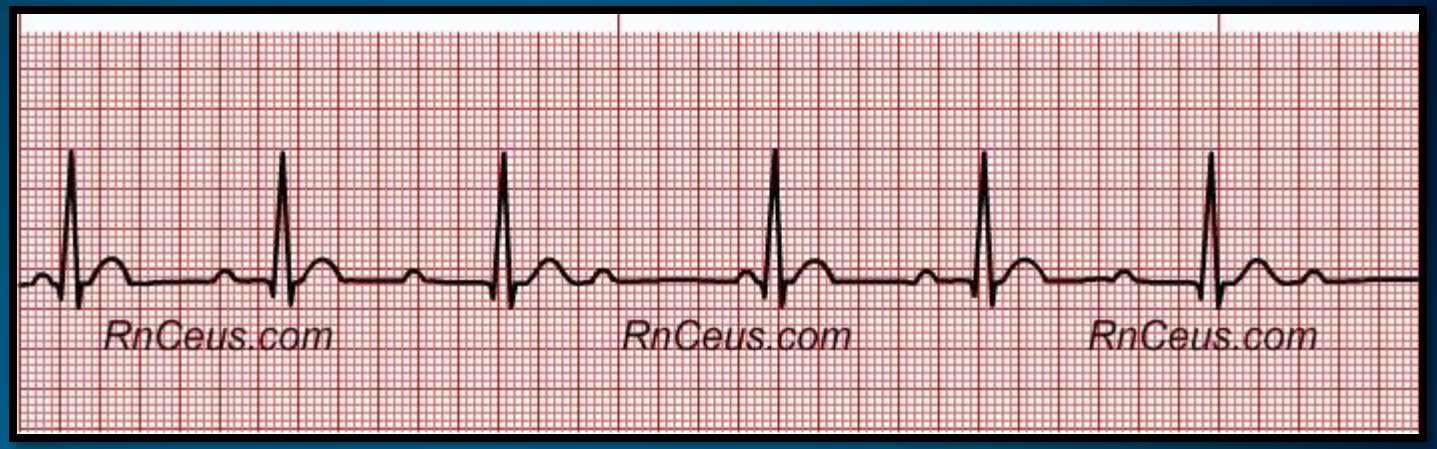
- This is the most common conduction disturbance. It occurs in both healthy and diseased hearts.
- First degree AV block can be due to:

inferior MI,
digitalis toxicity
hyperkalemia
increased vagal tone
acute rheumatic fever
myocarditis.

Rate	Variable
P wave	Normal
QRS	Normal
Conduction	Impulse originates in the SA node but has prolonged conduction in the AV junction; P-R interval is > 0.20 seconds.
Rhythm	Regular

Arrhythmias

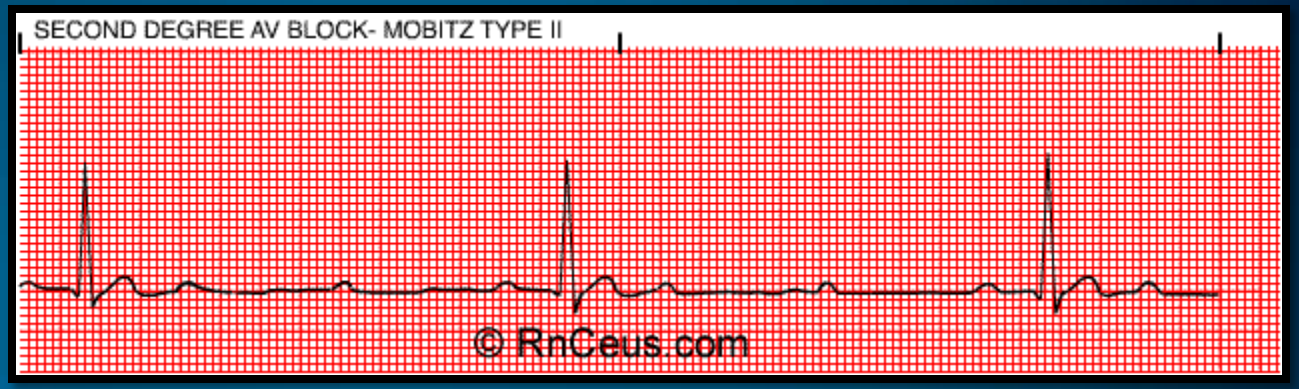
b. Second Degree AV Block (Mobitz type I, Wenkebach):



Rate	Variable
P wave	Normal morphology with constant P-P interval
QRS	Normal
Conduction	The P-R interval is progressively longer until one P wave is blocked; the cycle begins again following the blocked P wave.
Rhythm	Irregular

Arrhythmias

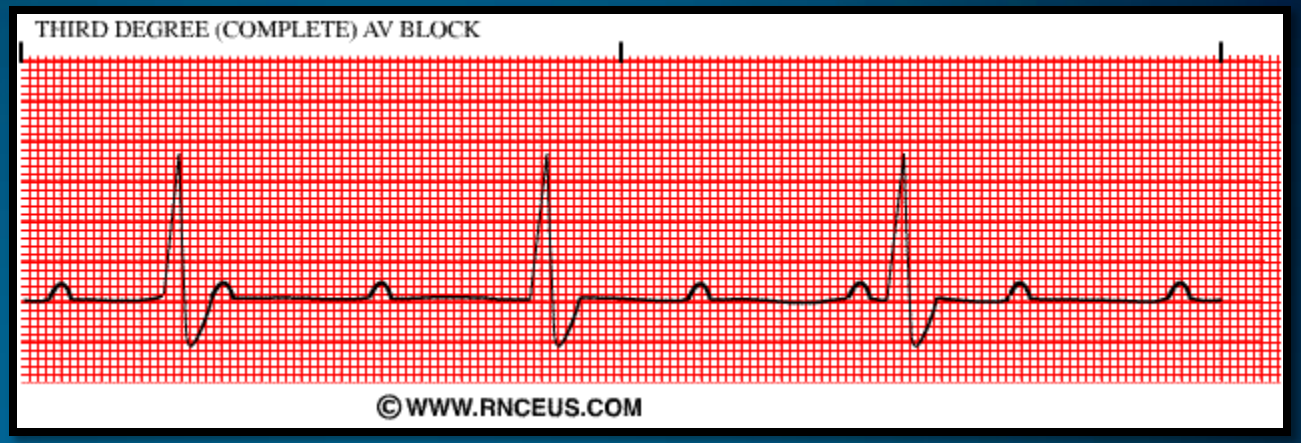
c. Second Degree AV Block (Mobitz type II)



Rate	Variable
P wave	Normal with constant P-P intervals
QRS	Usually widened because this is usually associated with a bundle branch block.
Conduction	P-R interval may be normal or prolonged, but it is constant until one P wave is not conducted to the ventricles.
Rhythm	Usually regular when AV conduction ratios are constant

Arrhythmias

d. Third Degree AV Block or Complete AV Block:

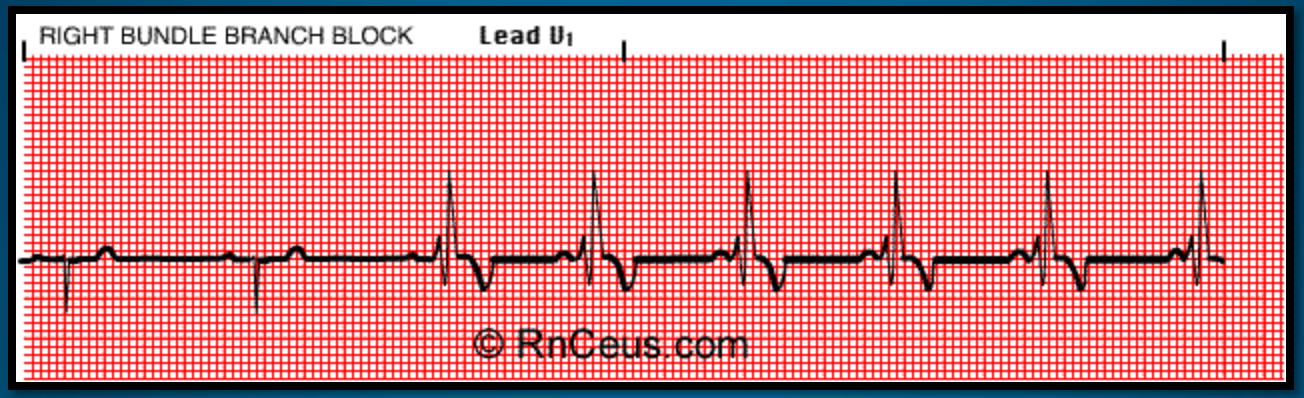


- Treatment is: Pacing

Rate	Atrial rate is usually normal; ventricular rate is usually less than 70/bpm. The atrial rate is always faster than the ventricular rate.
P wave	Normal with constant P-P intervals, but not "married" to the QRS complexes.
QRS	May be normal or widened depending on where the escape pacemaker is located in the conduction system
Conduction	Atrial and ventricular activities are unrelated due to the complete blocking of the atrial impulses to the ventricles.
Rhythm	Irregular

Arrhythmias

e. Bundle branch Block: Right and Left

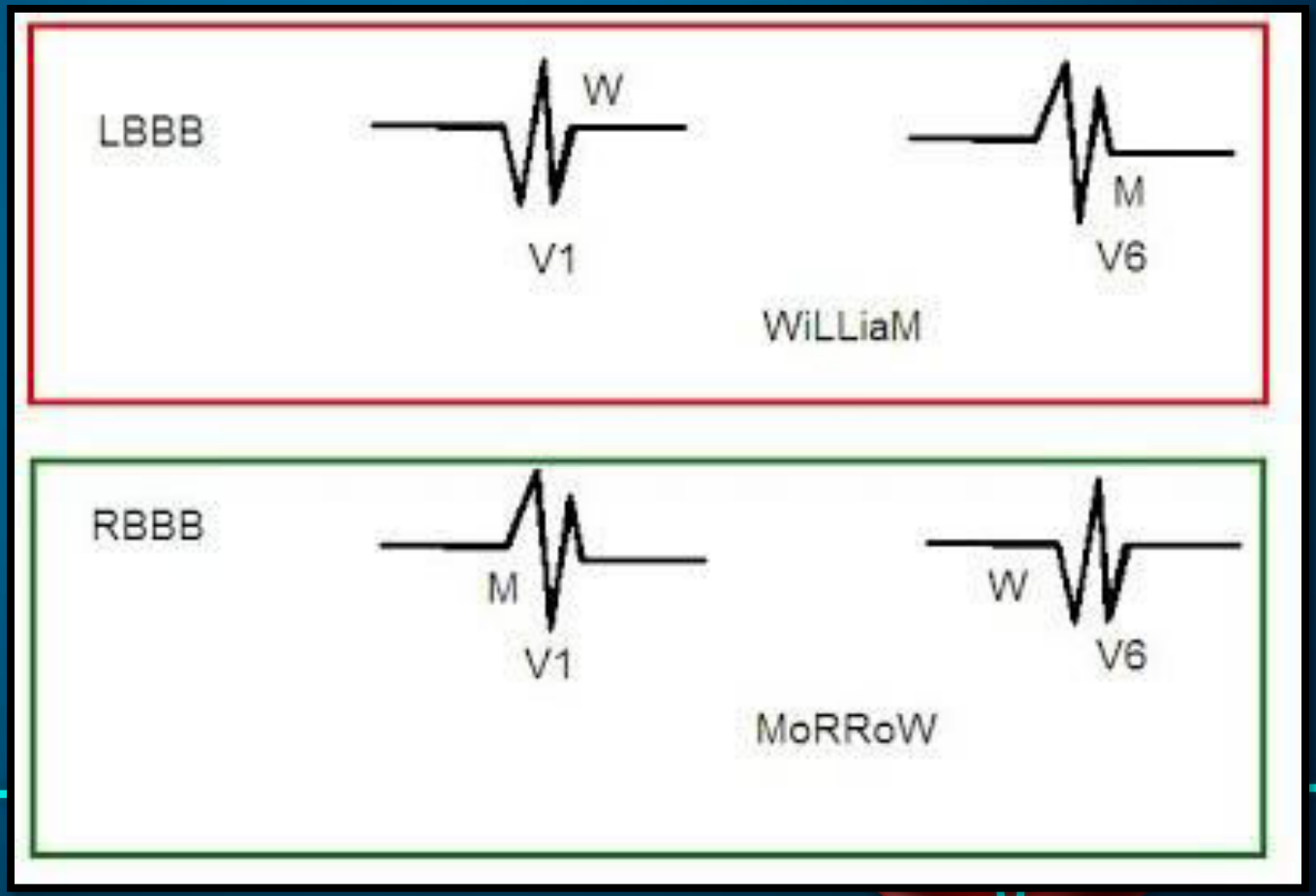


Rate	Variable
P wave	Normal if the underlying rhythm is sinus
QRS	Wide; > 0.12 seconds
Conduction	This block occurs in the right or left bundle branches or in both. The ventricle that is supplied by the blocked bundle is depolarized abnormally.
Rhythm	Regular or irregular depending on the underlying rhythm.

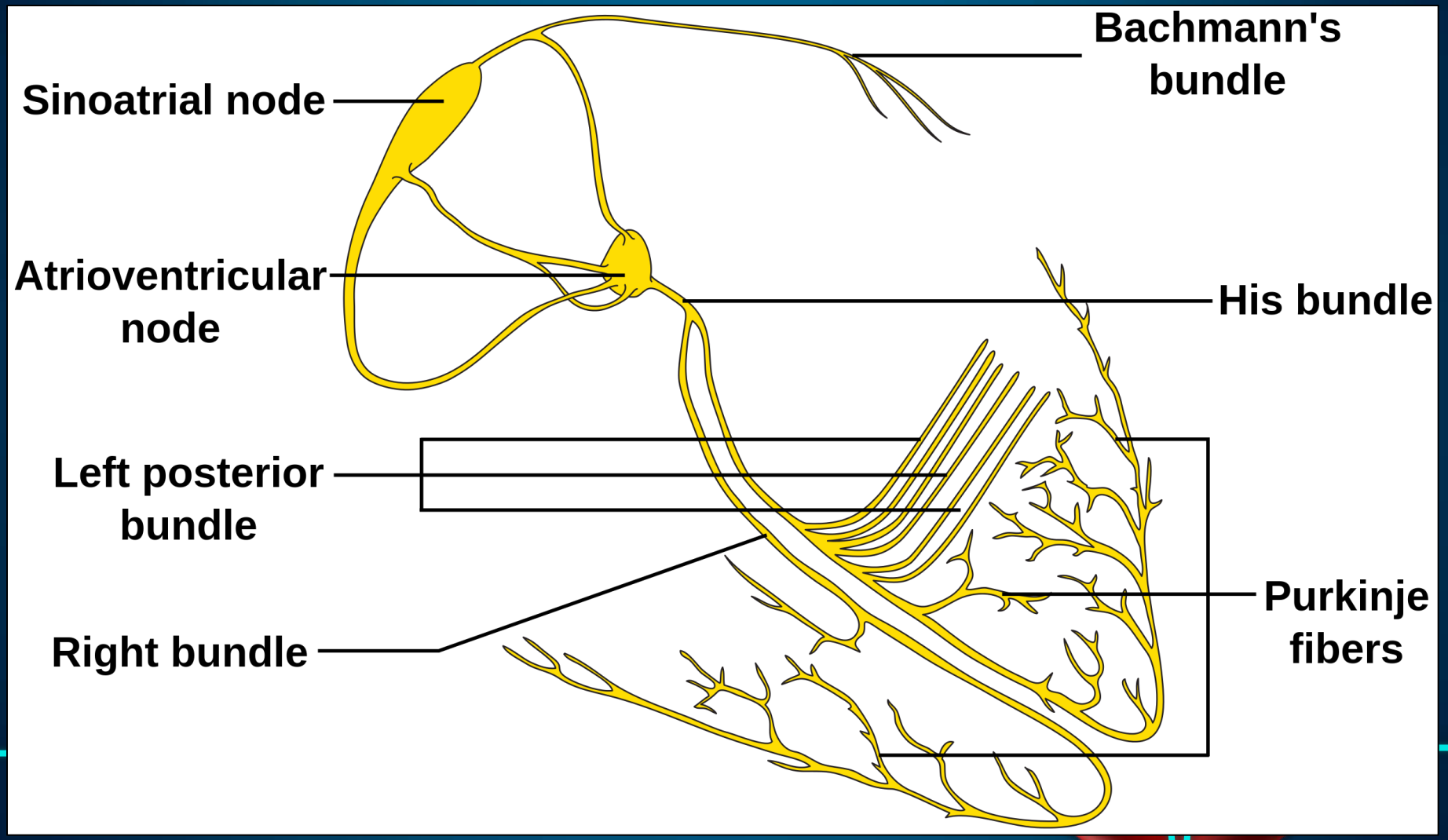
Arrhythmias

e. Bundle branch Block: Right and Left

WiLLiaM
MoRRoW



Arrhythmias



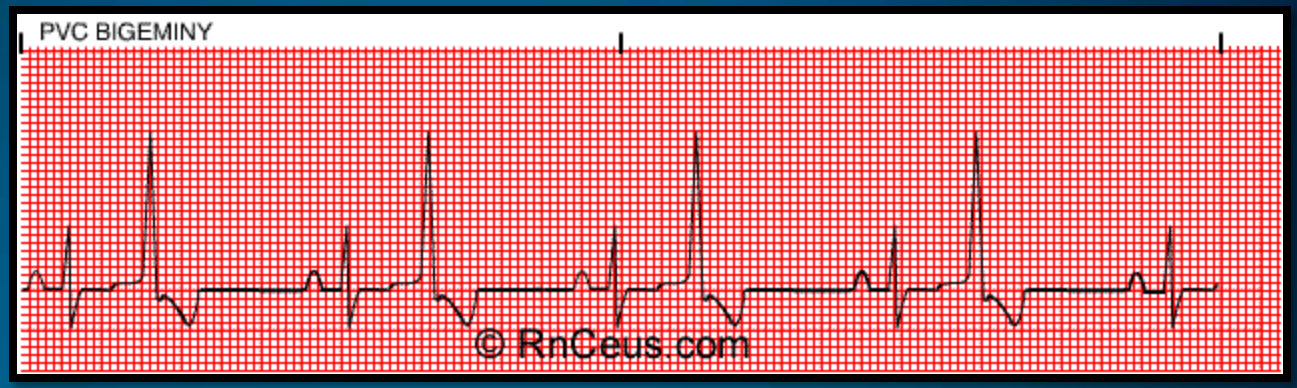
Arrhythmias

5. Ventricular Dysrhythmias:

a. Premature Ventricular Contractions
b. Ventricular Tachycardia
c. Torsade de Pointes
d. Ventricular Fibrillation
e. Idioventricular Rhythm
f. Asystole/Ventricular Standstill

Arrhythmias

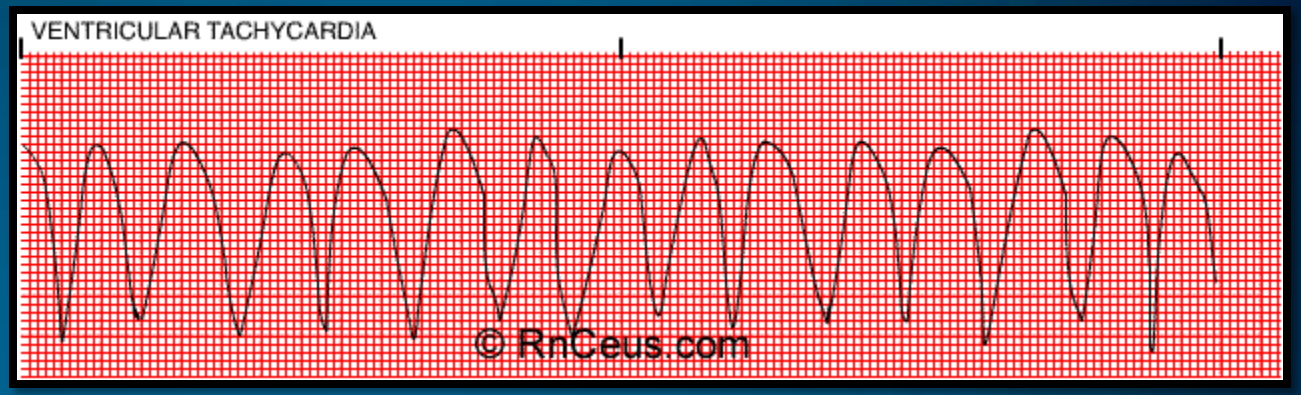
a. Premature Ventricular Contractions:



Rate	variable
P wave	usually obscured by the QRS, PST or T wave of the PVC
QRS	wide > 0.12 seconds; morphology is bizarre with the ST segment and the T wave opposite in polarity. May be multifocal and exhibit different morphologies.
Conduction	the impulse originates below the branching portion of the Bundle of His; full compensatory pause is characteristic.
Rhythm	irregular. PVC's may occur in singles, couplets or triplets; or in bigeminy, trigeminy or quadrigeminy.

Arrhythmias

2. Ventricular Tachycardia:



Rate	Usually between 100 to 220/bpm, but can be as rapid as 250/bpm
P wave	Obscured if present and are unrelated to the QRS complexes.
QRS	Wide and bizarre morphology
Conduction	As with PVCs
Rhythm	Three or more ventricular beats in a row; may be regular or irregular.

Arrhythmias

2. Ventricular Tachycardia:

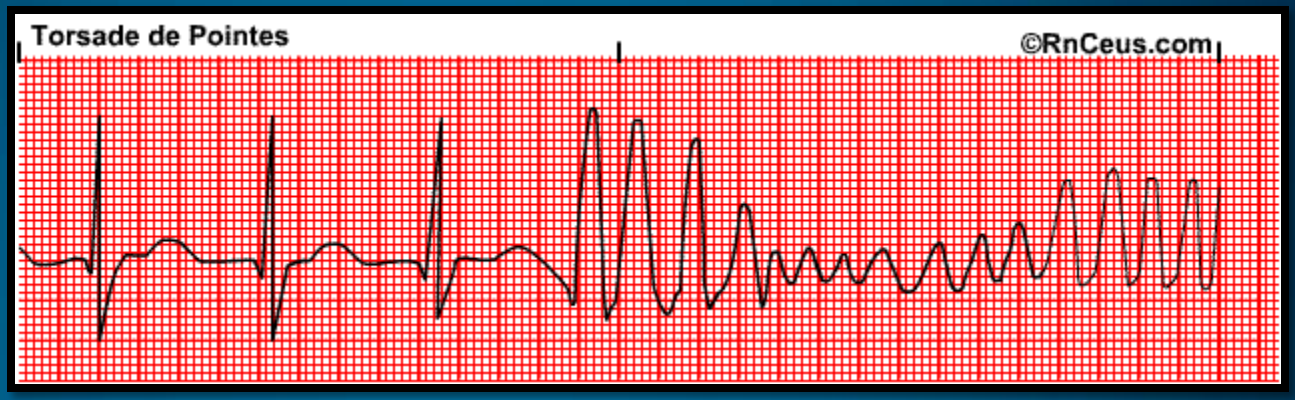
- Ventricular tachycardia almost always occurs in diseased hearts.
- Some common causes are:

CAD, acute MI, digitalis toxicity, CHF, ventricular aneurysms.

- Patients are often symptomatic with this dysrhythmia.
- Ventricular tachycardia can quickly deteriorate into ventricular fibrillation.
- Electrical countershock is the intervention of choice if the patient is symptomatic and rapidly deteriorating.
- Some pharmacological interventions include amiodarone and lidocaine.

Arrhythmias

3. Torsade de Pointes:



Rate	Usually between 150 to 220/bpm,
P wave	Obscured if present
QRS	Wide and bizarre morphology
Conduction	As with PVCs
Rhythm	Irregular

Arrhythmias

3. Torsade de Pointes:

- Paroxysmal – (starting and stopping suddenly)
- Hallmark of this rhythm is the upward and downward deflection of the QRS complexes around the baseline. The term Torsade de Pointes means "twisting about the points."

Consider it V-tach if it doesn't respond to antiarrythmic therapy or treatments

► Caused by:

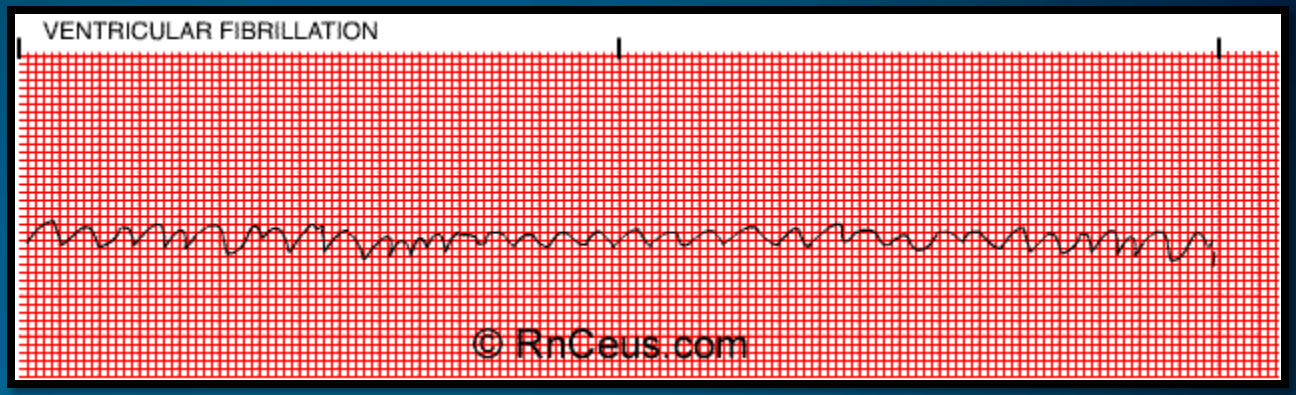
- drugs which lengthen the QT interval such as quinidine
- electrolyte imbalances, particularly hypokalemia
- myocardial ischemia

► Treatment:

- Synchronized cardioversion is indicated when the patient is unstable.
- IV magnesium
- IV Potassium to correct an electrolyte imbalance
- Overdrive pacing

Arrhythmias

4. Ventricular Fibrillation:



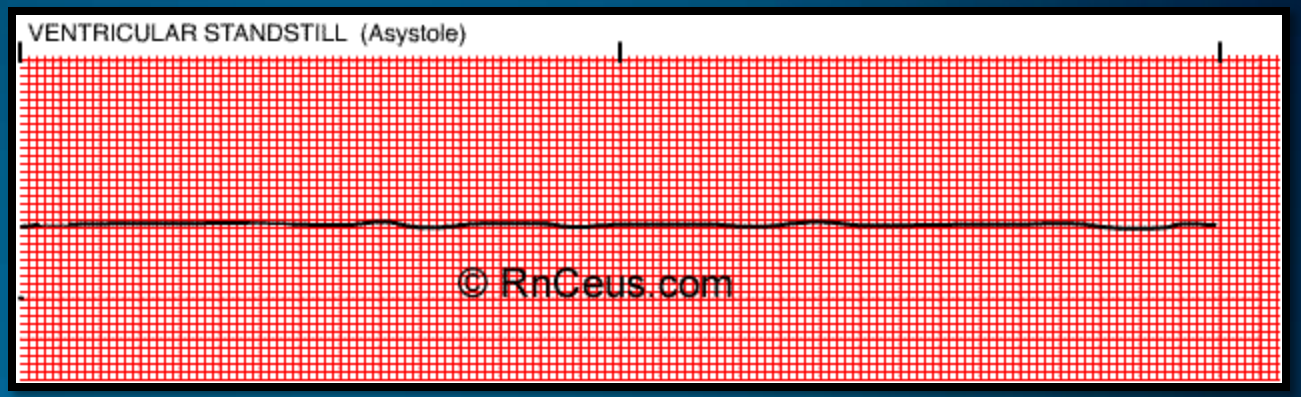
- This dysrhythmia results in the absence of cardiac output.
- Almost always occurs with serious heart disease, especially acute MI.
- The course of treatment for ventricular fibrillation includes:
  - immediate defibrillation and ACLS protocols.
  - Identification and treatment of the underlying cause is also needed.

Rate	Unattainable
P wave	May be present, but obscured by ventricular waves
QRS	Not apparent
Conduction	Chaotic electrical activity
Rhythm	Chaotic electrical activity

The Most Common Cause of Cardiac Arrest!!

Arrhythmias

5. Asystole/ Ventricular Standstill:



- **Interventions include:**

CPR, 100% oxygen,
IV
Intubation
Transcutaneous pacing
Epinephrine 1.0 mg., IV push, q3-5 minutes
Atropine

Rate	**None**
P wave	**May be seen, but there is no ventricular response**
QRS	**None**
Conduction	**None**
Rhythm	**None**

OUTLINE

- ECG Basics. ✓
- The normal ECG. ✓
- How to read an ECG. ✓
- Most common Arrhythmias. ✓
- Assessment.

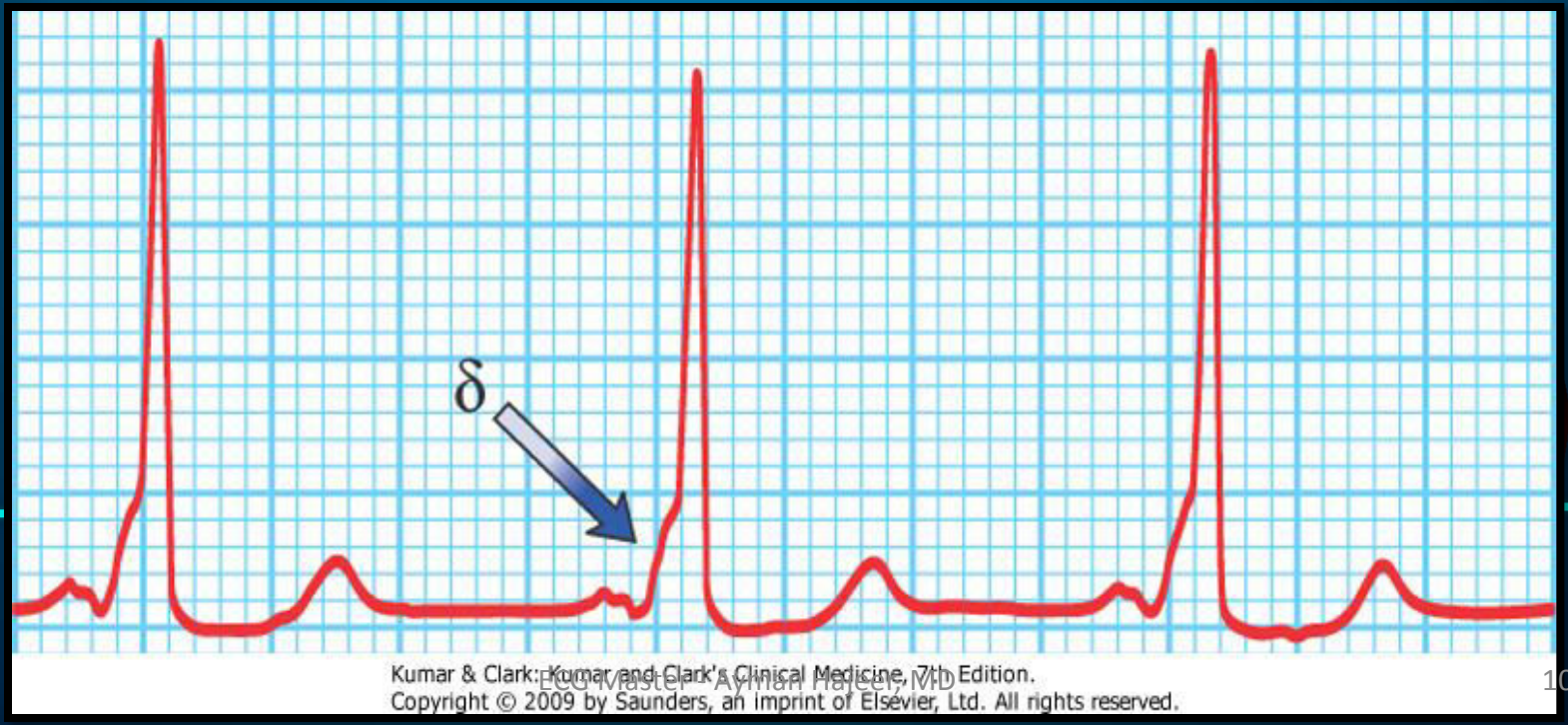
ECG Master

Special Topics

1. STEMI.
2. Pericarditis.
3. WPW Syndrome.

WPW Syndrome

- Wolff-Parkinson-White (WPW) Syndrome was first reported in 1930.
- Electrically active muscle fibers bridge the atria and ventricles - and cause pre-excitation of the ventricles. This accessory pathway is able to conduct faster than the AV node.
- EKG characteristics are seen only after a rhythm conversion from PSVT to NSR:
  - PR interval is shorter
  - the upstroke of the QRS wave is slurred; this is known as a delta wave.
  - 12 lead ECG is essential as delta wave may not show up in all leads.

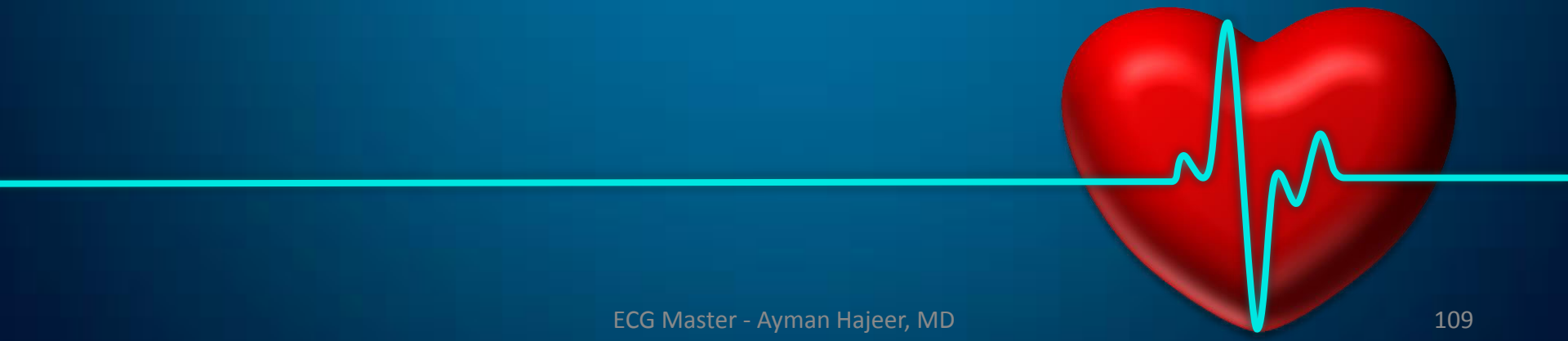


Pericarditis

- Inflammation of the pericardium (e.g. following viral infection) produces characteristic chest pain (retrosternal, pleuritic, worse on lying flat, relieved by sitting forward), tachycardia and dyspnoea.

- There may be an associated pericardial friction rub or evidence of a pericardial effusion.

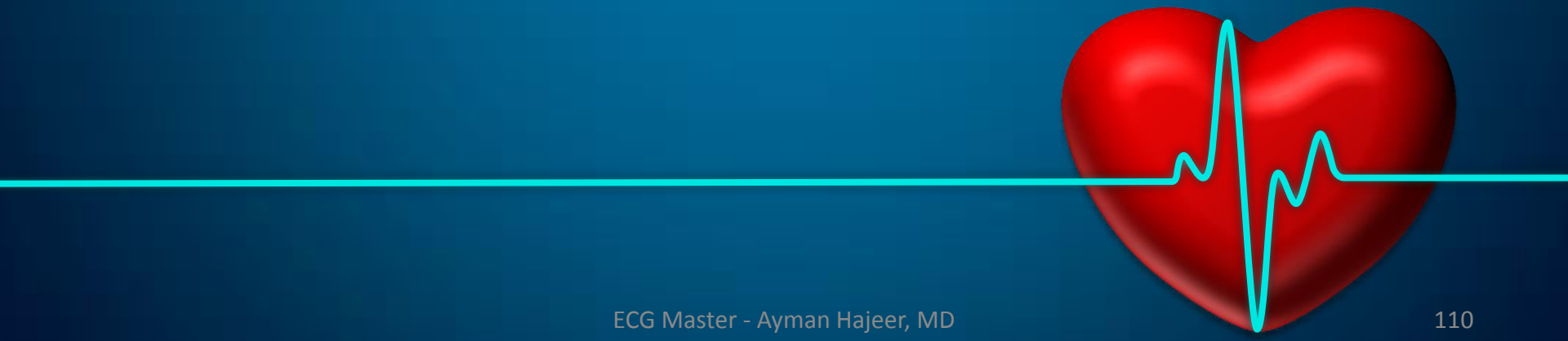
- Widespread ST segment changes occur due to involvement of the underlying epicardium (i.e. myopericarditis).



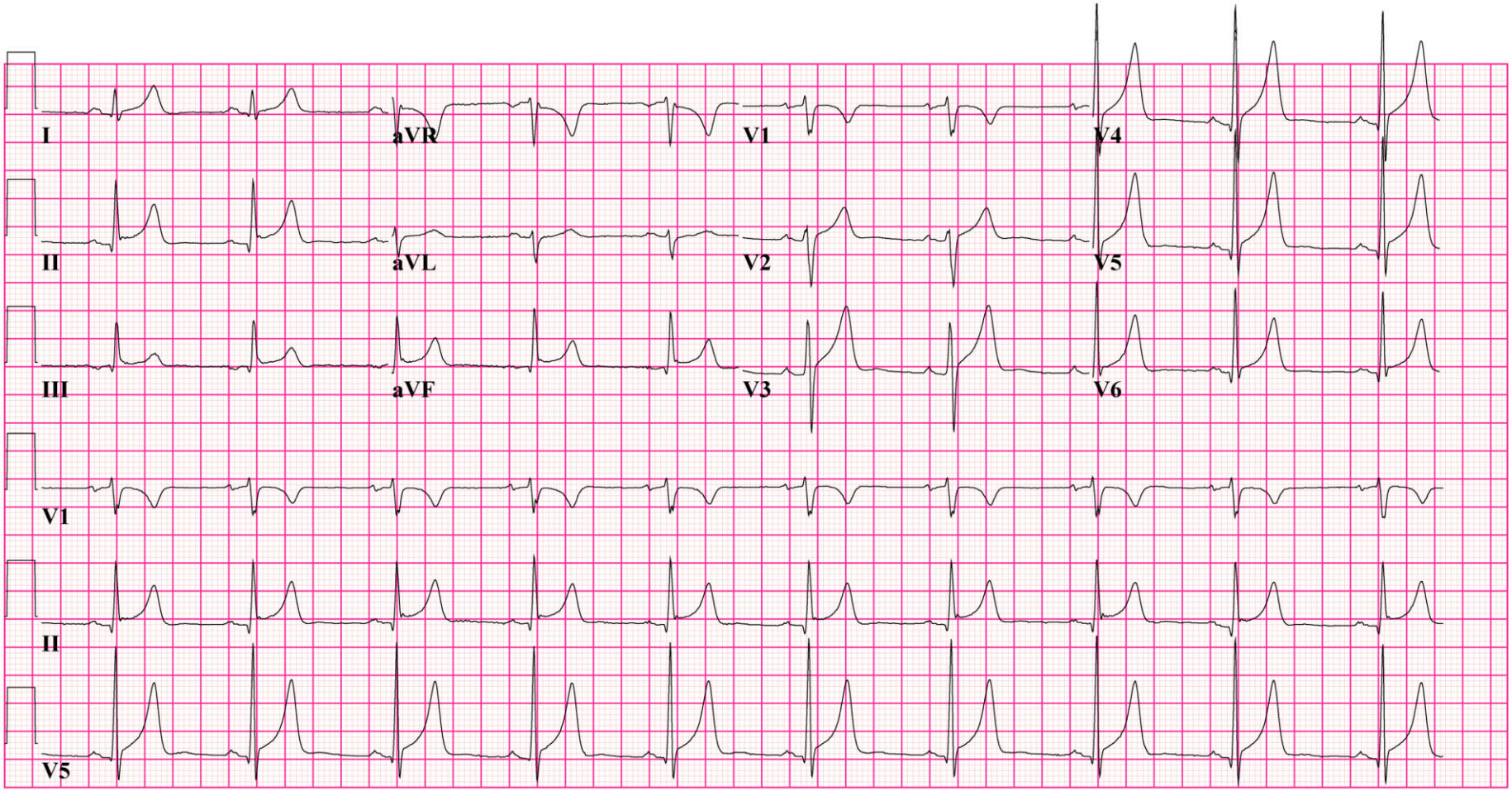
Pericarditis

► How To Recognise Pericarditis on the ECG ?

- Widespread concave **ST elevation** and **PR depression** throughout most of the limb leads (I, II, III, aVL, aVF) and precordial leads (V2-6).
- **Reciprocal ST depression and PR elevation in lead aVR** (± V1).
- **Sinus tachycardia** is also common in acute pericarditis due to pain and/or pericardial effusion.

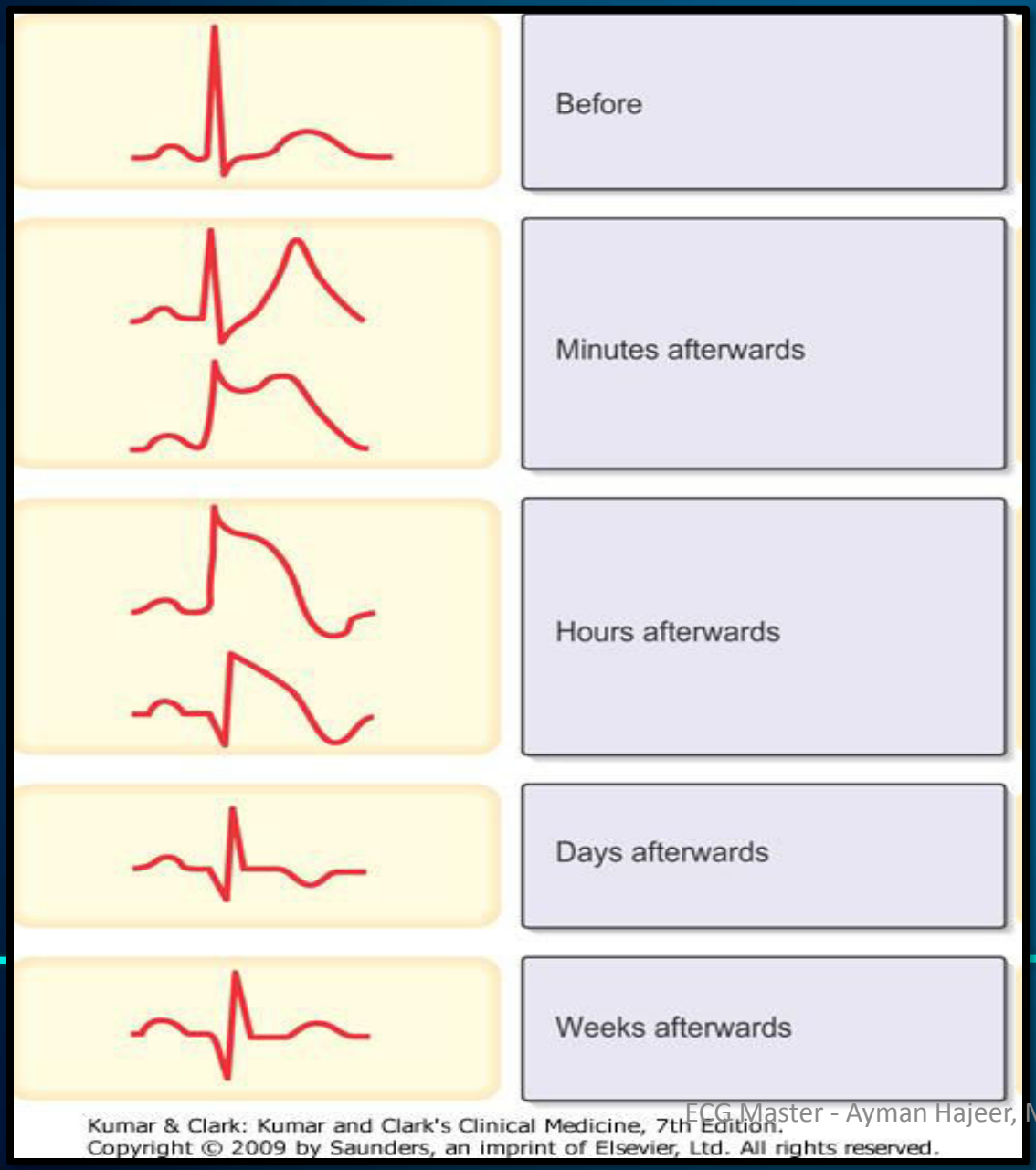


Wide spread ST elevation seen in Acute Pericarditis



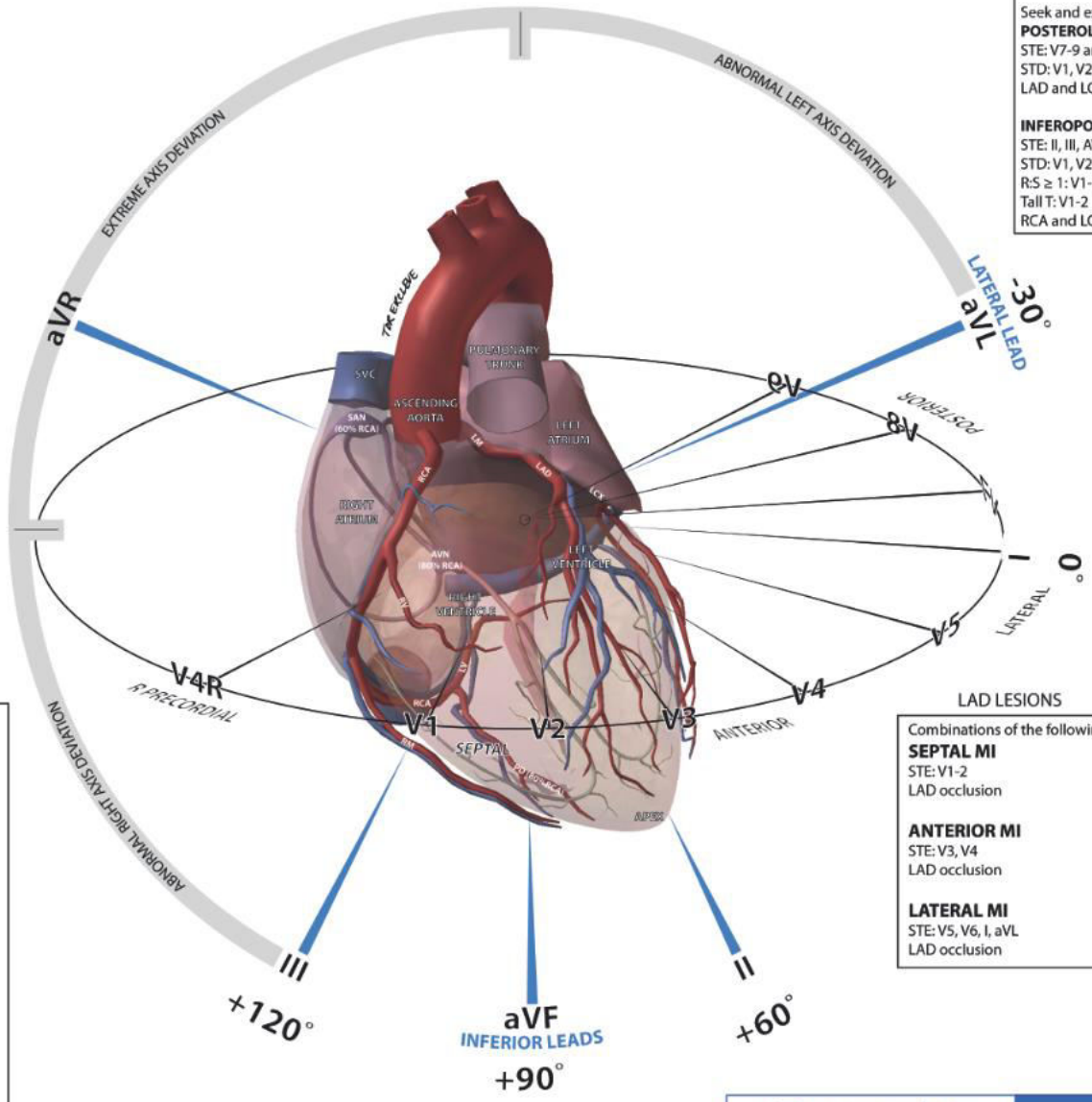
Pericarditis

STEMI (ST Elevation MI)



ECG evolution of myocardial infarction (STEMI).

AMI ECG, ANATOMY AND PATHOLOGY



LCX LESIONS ±

POSTERIOR MI
STE: V7-9
STD: V1-2 (reciprocal STE)
R:S ≥ 1: V1-2
Tall T: V1-2
RCA and LCX occlusion

Seek and exclude
POSTEROLATERAL MI
STE: V7-9 and I, aVL, V5-6
STD: V1, V2
LAD and LCX occlusion

INFEROPOSTERIOR MI
STE: II, III, AVF and V7-9
STD: V1, V2 (reciprocal STE)
R:S ≥ 1: V1-2
Tall T: V1-2
RCA and LCX occlusion

RCA 'TYPE' LESIONS ±

INFERIOR MI
STE: II, III, aVF
STD: aVL (reciprocal STE)
RCA occlusion distal to RV
58% of MI

Seek and exclude
INFERIOR AND RV MI
STE: II, III, aVF and V1, V4R
RCA occlusion proximal to RV
40% of Inferior MI
Increased mortality risk

INFEROLATERAL MI
STE: II, III, AVF and I, aVL, V5, V6 ± V4R
LAD and LCX occlusion
in a L dominant system

INFEROPOSTERIOR MI
STE: II, III, AVF and V7-9
STD: V1, V2 (reciprocal STE)
R:S ≥ 1: V1-2
Tall T: V1-2
RCA and LCX occlusion

LAD LESIONS

Combinations of the following
SEPTAL MI
STE: V1-2
LAD occlusion

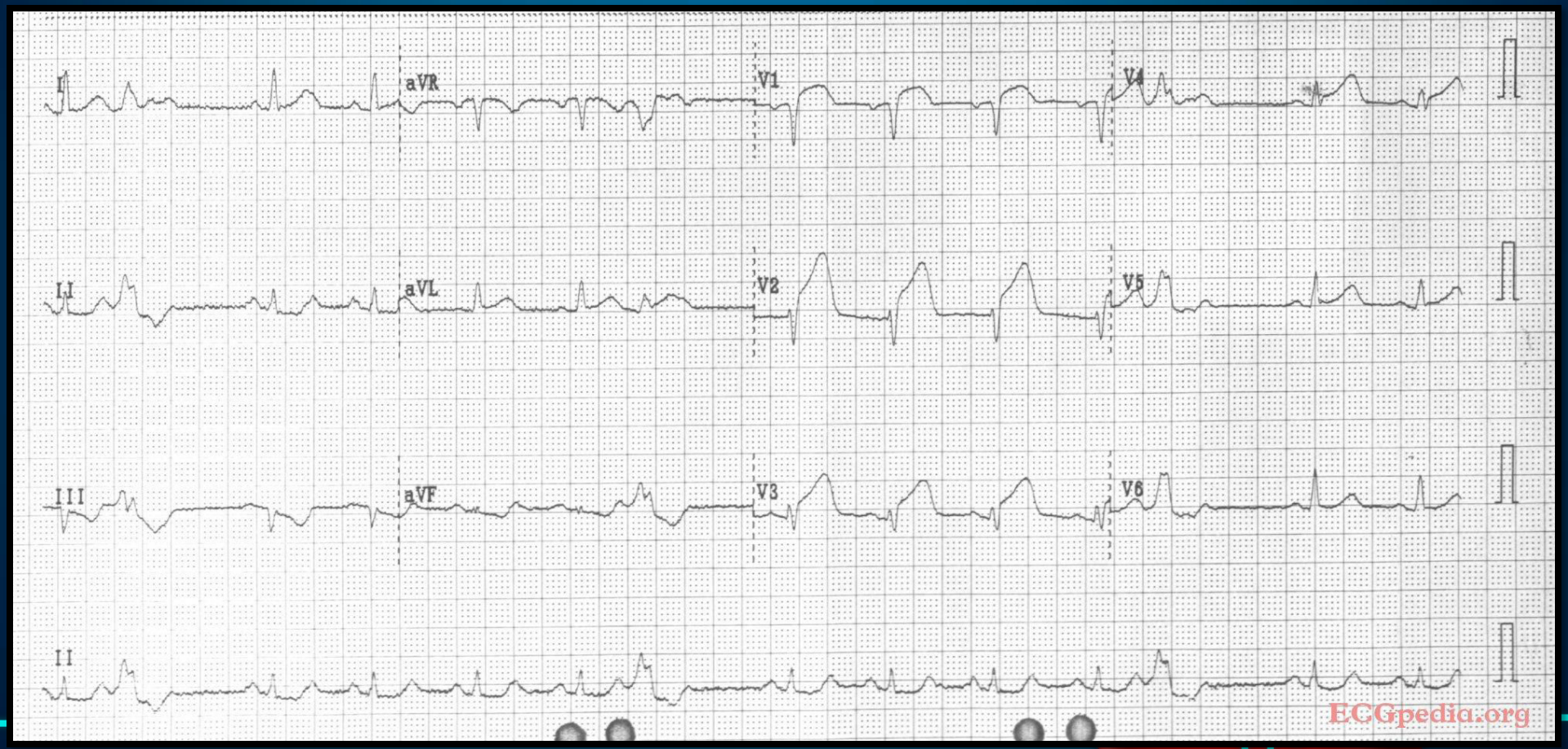
ANTERIOR MI
STE: V3, V4
LAD occlusion

LATERAL MI
STE: V5, V6, I, aVL
LAD occlusion

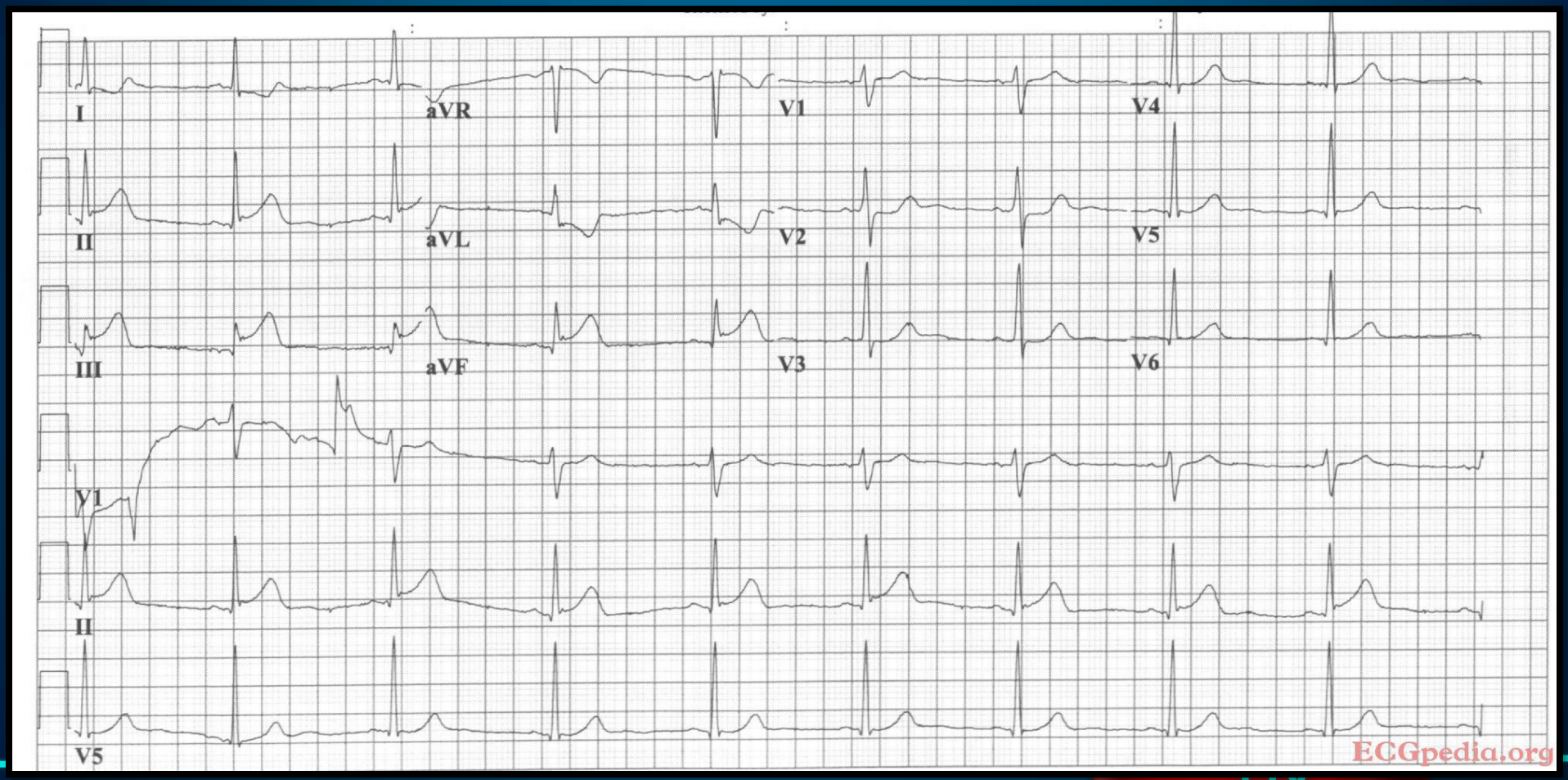
Location of the MI and the coronary artery affected

localisation	ST elevation	Reciprocal ST depression	coronary artery
Anterior MI	V1-V6	None	LAD
Septal MI	V1-V4, disappearance of septum Q in leads V5,V6	none	LAD-septal branches
Lateral MI	I, aVL, V5, V6	II,III, aVF	LCX or MO
Inferior MI	II, III, aVF	I, aVL	RCA (80%) or RCX (20%)
Posterior MI	V7, V8, V9	high R in V1-V3 with ST depression V1-V3 > 2mm (mirror view)	RCX
Right Ventricle MI	V1, V4R	I, aVL	RCA
Atrial MI	PTa in I,V5,V6	PTa in I,II, or III	RCA

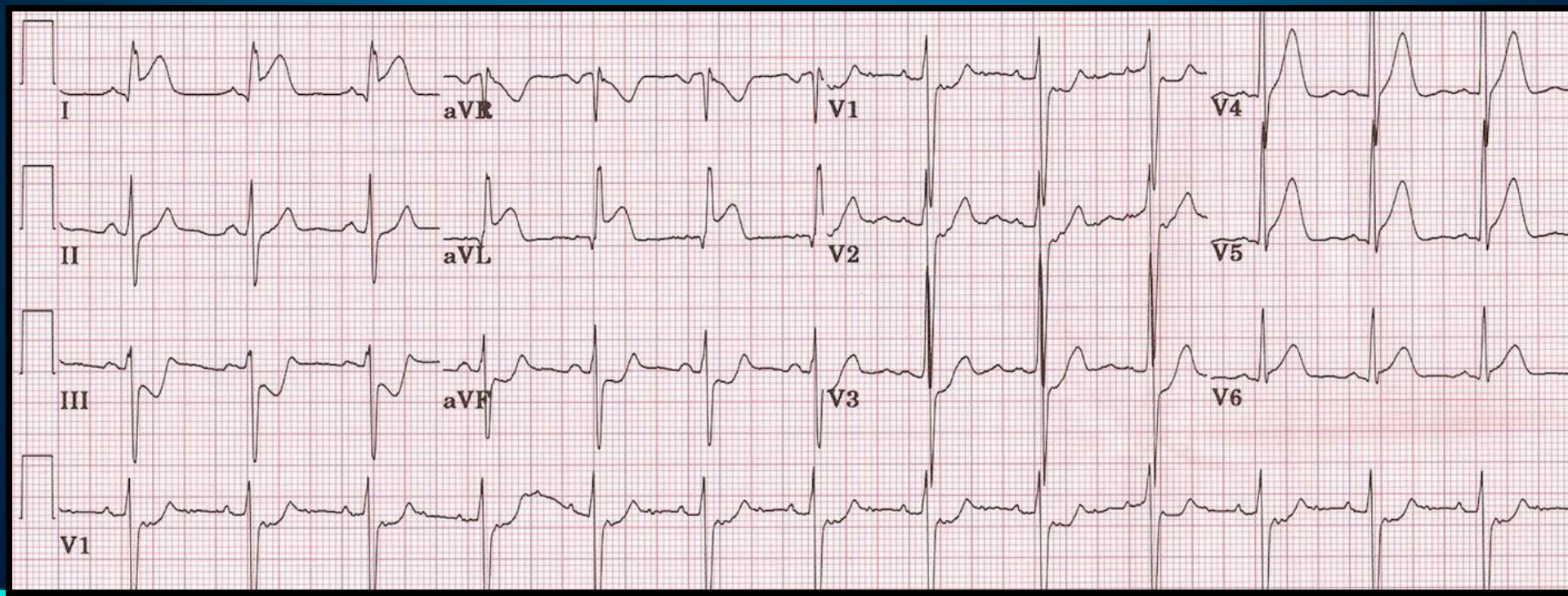
Example 1: Anterior MI



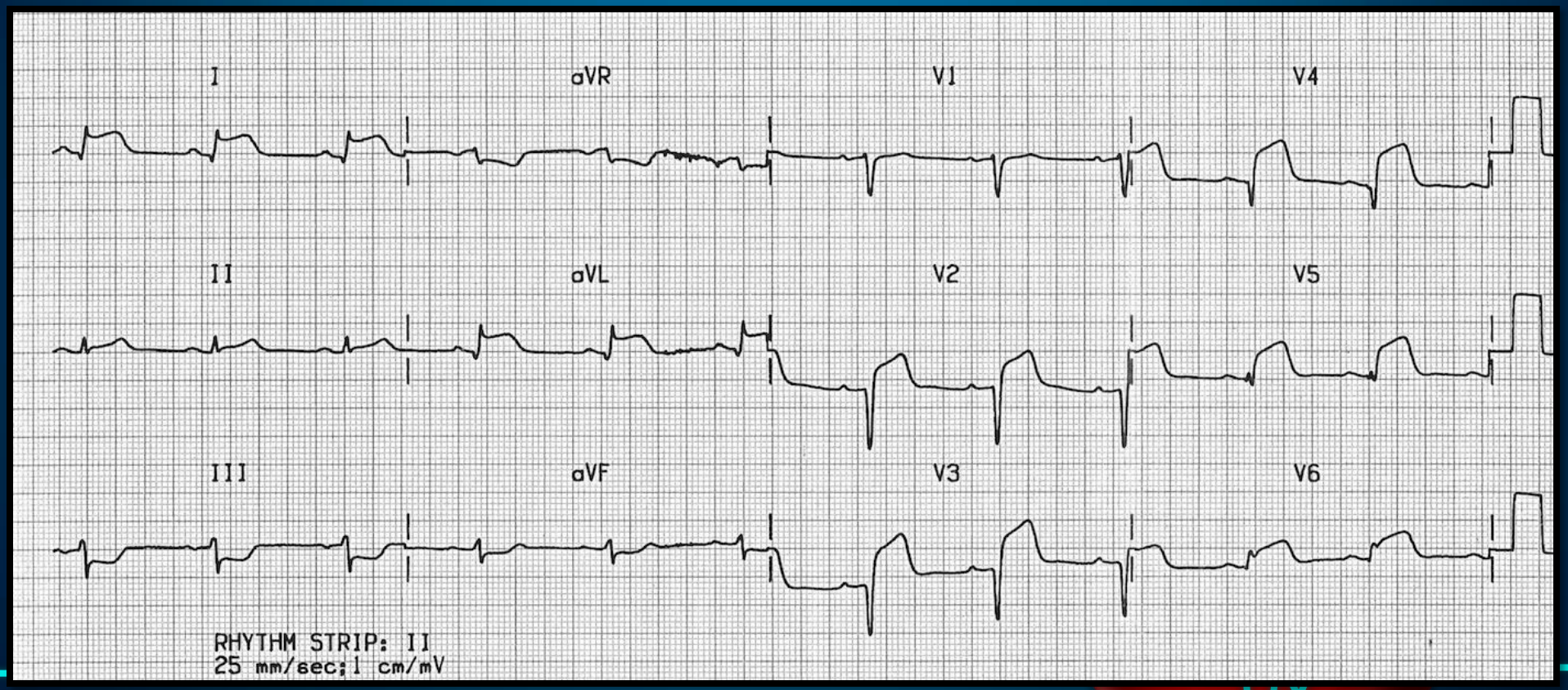
Example 2: Inferior MI



Example 3: Lateral MI



Example 4: Anterolateral MI



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