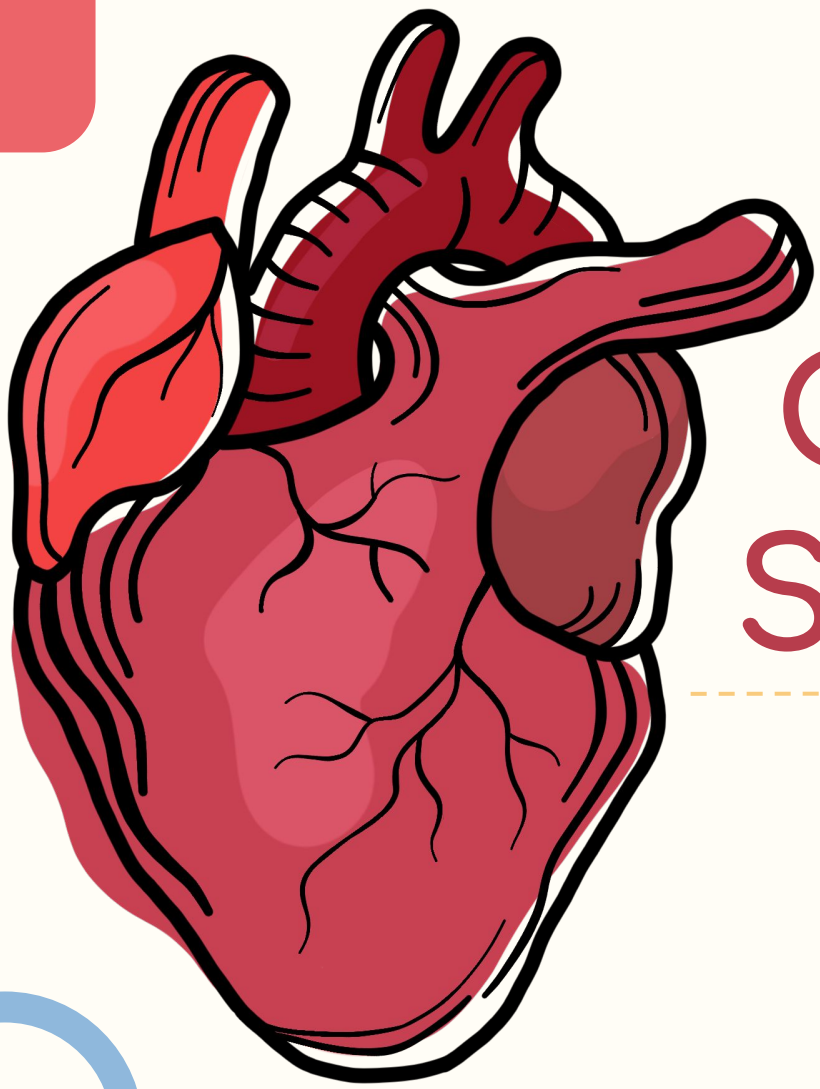
MED441
KING SAUD UNIVERSITY

CARDIAC441
SCIENCE



Cardiac Sciences

Arrhythmias

Revised & Reviewed by:
Abdulaziz Bahammam
Faye Wael Sendi

Main text
Important
Notes
Extra

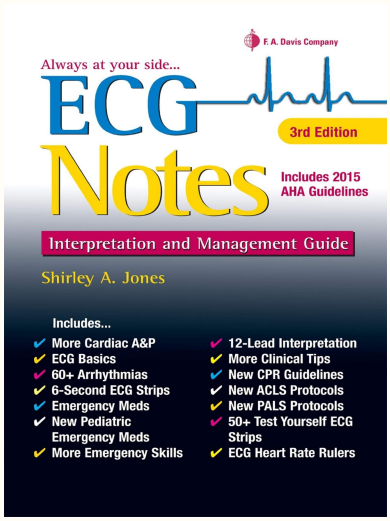
Editing File

We highly recommend to watch this video below before start studying & we suggest these 2 books if you want more details

~ Click on it ~

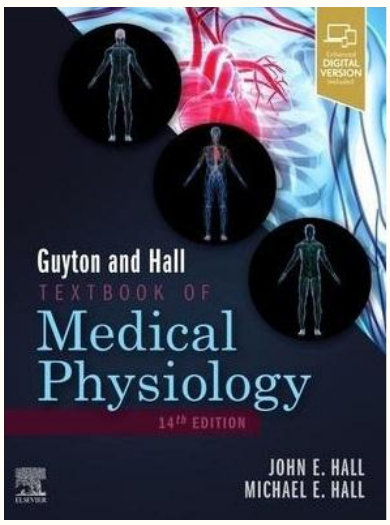
Cardiovascular | EKGs

by Ninja Nerd Lectures



ECG Notes: Interpretation and Management Guide 3rd Edition

by Shirley A. Jones



Guyton and Hall Textbook of Medical Physiology 14th Edition

by John E. HALL & Michael E. HALL

Chapter 13
Pages 157-168

Objectives

Describe sinus arrhythmias

Describe the main pathophysiological causes of cardiac arrhythmias

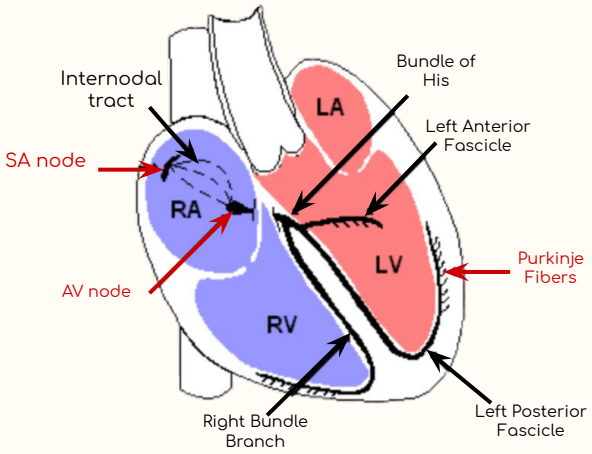
Explain the mechanism of cardiac block

Enumerate the common arrhythmias and describe the basic ECG changes

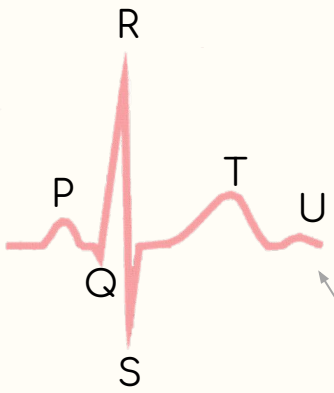
Explain the origin of an ectopic foci

The Normal Conduction System

SA node → Internodal tract → AV node → Bundle of His → Rt & Lt bundle → Purkinje fibers



Waveforms



- U wave is most often seen at slow heart rates and hypokalemia.
- Prominent U waves can be seen in hypokalemia (discussed in slide 14)

Interpretation

- Develop a systematic approach to read EKGs and use it every time
  - Rate
  - Rhythm
  - Axis
  - Hypertrophy
  - Ischemia

ECG/EKG Interpretation: Assessment of the morphology (appearance) of the waves and intervals on the ECG curve
بإختصار يعني نشوف معدل النبض سريع أو بطئ ، نشوف هل فيه P wave او لا ، هل المسافات متساوية او فيها اختلاف ، وهكذا لحد ما نقدر نشخص المرض

Heart rate

Rule of 300/ Divide 300 by the number of boxes between each QRS = rate

- Normal HR = 60-100 bpm
- Tachycardia = > 100 bpm
- Bradycardia = < 60 bpm

Counting large boxes for heart rate. The rate is 60 bpm.

Number of big boxes	Rate
1	300
2	150
3	100
4	75
5	60

Classification of Cardiac Arrhythmias

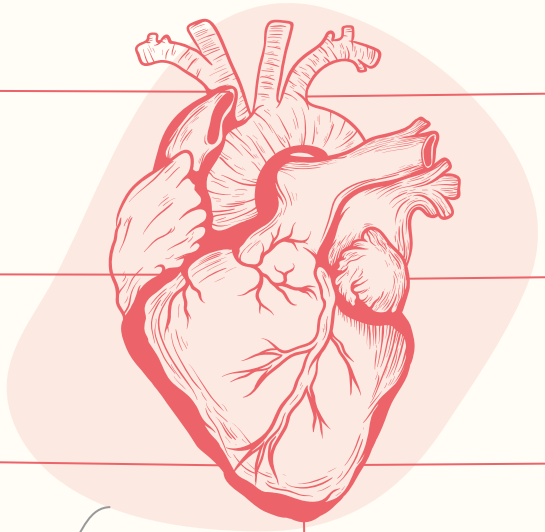
1	2	3	4	5
Heart rate above or below Normal (Tachy or Brady)	Regular or Irregular rhythm	Narrow or Broad (wide) QRS complex	Relation to P waves	Supra-ventricular or Ventricular

Causes of Cardiac Arrhythmias

1
Abnormal rhythmicity (automaticity) of the pacemaker

2
Shift of the pacemaker from the sinus node to another place in the heart

3
Blocks at different points during the spread of impulse through the heart



4
Abnormal pathways of impulse transmission through the heart

5
Spontaneous generation of spurious impulses in almost any part of the heart

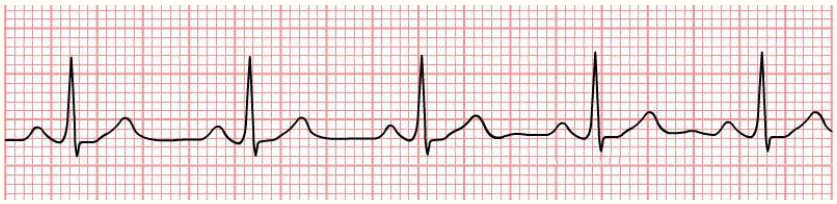
6
Trigger

7
Re-entry

The causes of the cardiac arrhythmias are usually one or a combination of the following abnormalities in the rhythmicity-conduction system of the heart

Normal Sinus Rhythm

- Regular
- Originating from SA node
- Single upright P-wave precedes every QRS complex
- P wave in same direction as QRS
- P-R interval is constant and within normal range
- P-P interval is constant



Abnormal Sinus Rhythm

Bradycardia

- Slow heart rate < 60 bpm

Causes:

- Parasympathetic stimulation
- Athlete people
- Sleep
- SA node problems
- Expiration

Tachycardia

- Fast heart rate > 100 bpm

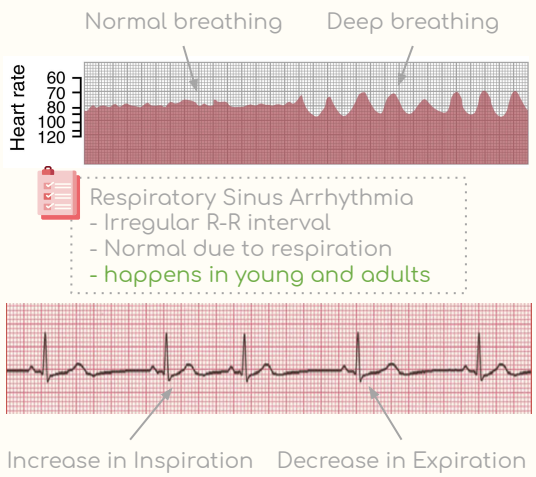
Causes:

- Increased body temperature
- Sympathetic stimulation
- Drugs: digitalis, β1 agonists
- Bleeding to compensate blood loss
- Inspiration

Sinus Arrhythmia

- Result from spillover of signals from the medullary respiratory center into the adjacent vasomotor center during inspiration and expiratory cycles of respiration

- The spillover signals cause alternate increase and decrease in the number of impulses transmitted through the sympathetic and vagus nerves to the heart



Common Types of Arrhythmias

Origin	SA node	Atria	AV node	Ventricles
Bradycardia	• Sinus Bradycardia • Sick Sinus Syndrome	-	• Conduction Blocks (1st,2nd, 3rd) • Junctional escape rhythm	• Ventricular escape rhythm
Tachycardia	• Sinus tachycardia	•Atrial Premature Beats •Atrial Flutter •Atrial Fibrillation •Paroxysmal SVT •Multifocal Atrial Tachycardia	-	• Ventricular premature Beats • Ventricular Tachycardia • Torsades de pointes • Ventricular Fibrillation

Differential Diagnosis of Tachycardia

Tachycardia	Narrow Complex	Wide Complex
Regular	• Sinus tachycardia • Supraventricular tachycardia • Atrial flutter	• Sinus tachycardia with aberrancy • Supraventricular tachycardia with aberrancy • Ventricular Tachycardia
Irregular	• Atrial Fibrillation • Atrial Flutter with variable conduction • Multifocal Atrial Tachycardia	• Atrial Fibrillation with aberrancy • Atrial Fibrillation with WPW • Ventricular Tachycardia

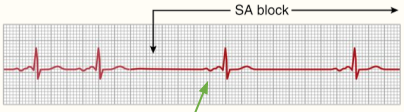
Abnormal Cardiac Rhythms

that Result From Impulse Conduction Block

1-Ischemia of the affected node
2-Compression of the affected node by scar or fibrosis
3-Inflammation of the affected node
4-Strong vagal stimulation

Blockade of the S-A node impulse before entering atrial muscle
-Cessation of P wave-

S-A BLOCK



- The AV node will be the pacemaker after SA block and these impulses are from AV node

When impulse from the S-A node is blocked

A-V BLOCK

Extra causes for A-V BLOCK from guyton:
5- Degeneration of the A-V conduction system, which is sometimes seen in older patients.
6- Medications such as digitalis or beta-adrenergic antagonists, can in some cases impair A-V conduction.

1st° Block

Constant PR prolongation without drop beat

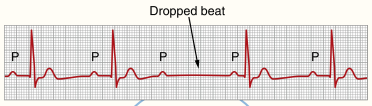
Note that, it will be:
- Prolong P-R interval more than (0.2 seconds)
- Benign, Asymptomatic
- Caused by Some drugs and old age
- No need for pacemaker

Also called (Wenckebach) and it's Normal, happens during sleep, no need for treatment

2nd° Block

P-R interval lasts more than 0.25 seconds

Note that,there will be:
- Only few impulses pass to the ventricles
- Atria beat faster than ventricles
- "dropped beat" of the ventricles. means (NO QRS & T waves)
- Higher dose of drugs (β and Ca Blockers and Digoxin) ,Old age and Ischemia (MI)



Types

Mobitz I
-Progressive PR prolongation
-Drop beat

Mobitz II
-Constant PR prolongation
-Drop beat

3rd° Block (complete)

Complete dissociation of P wave and QRS waves

Note that,there will be:
- Ventricle escape from the influence of S-A node
- Atrial rate is 100 beats/min
- Ventricular rate is 40 beats/min
- Stokes-Adams Syndrome: AV block comes and goes
- the patient needs a pacemaker
- Symptoms: syncope, dizziness.

- The Purkinje Fibers will be the pacemaker after AV block

This slide is only in girls' lecture

Premature Contractions

What?

Premature contractions, extrasystoles, or ectopic beat result from ectopic foci that generate abnormal cardiac impulses (pulse deficit)

What causes it ?

1-Ischemia
2-Irritation of cardiac muscle by calcified foci
3-Drugs like caffeine

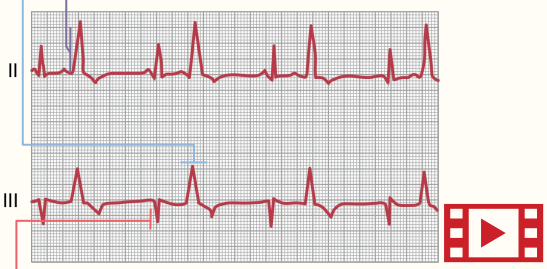
Ectopic foci can also cause premature contractions originate in:

1- The atria
2- A-V junction
3- The ventricles

Premature Ventricular Contractions (1)

Prolong QRS complex because the impulses are carried out with myocardial fibers with slower conduction rate than Purkinje fibers

Increase QRS complexes voltage because QRS wave from one ventricle can not neutralize the one from the other ventricle

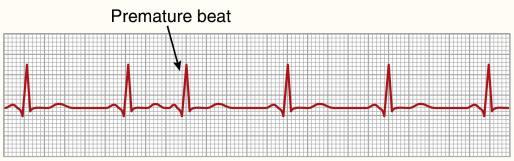


After PVCs, the T wave has an electrical potential of opposite polarity of that of the QRS because of the slow conduction in the myocardial fibers, the fibers that depolarizes first will repolarize first

- Causes: drugs, caffeine, smoking, lack of sleep, emotional irritations

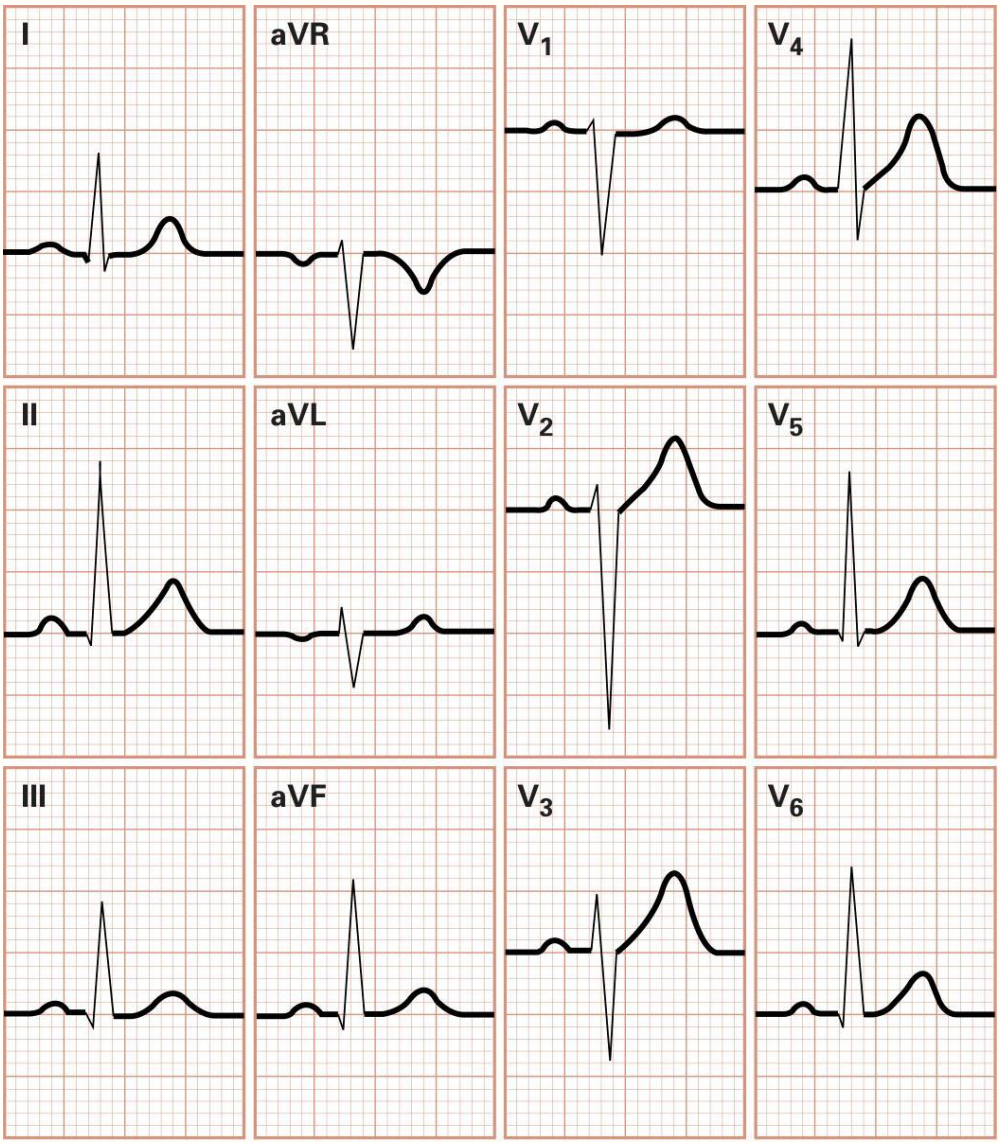
Premature Atrial Contractions

- Short P-R interval depending on how far the ectopic foci from the AV node
- Pulse deficit if there is no time for the ventricles to fill with blood
- The time between the premature contraction and the succeeding (التالية) beat is increased (Compensatory pause)

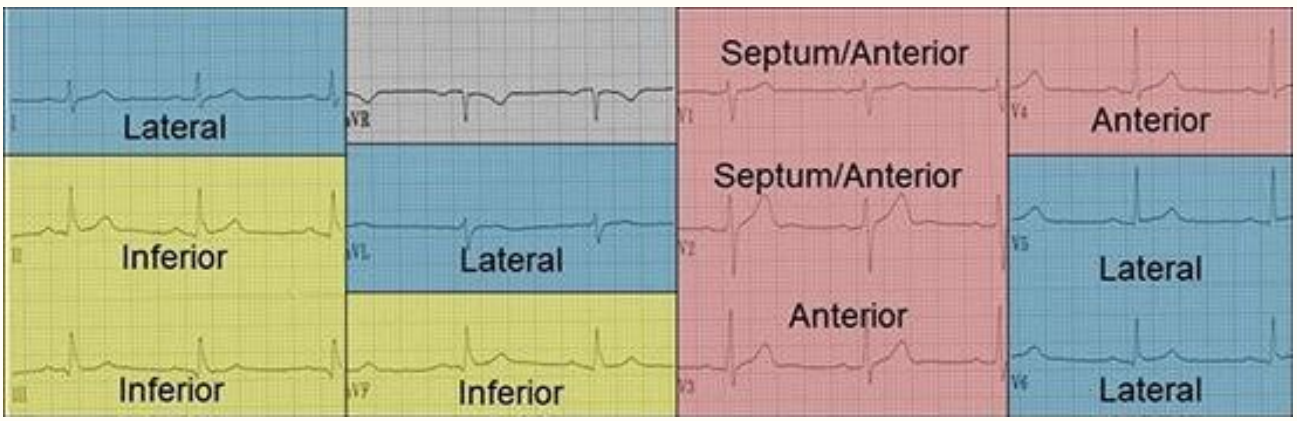


(1)-Normally,septum and endocardial areas of the ventricular muscle depolarize first and repolarize the last because,the septum and other endocardial areas have a longer period of contraction than do most of the external surfaces.
BUT,in PVCs the role change completely and the fibers that depolarizes first will repolarizes first due to the slow conduction of myocardial fibers in the ventricles!
That's why the QRS complex voltage will increase (taller),and the polarity of T wave will be opposite to the QRS complex.

The Normal 12-Lead ECG



Location of MI by ECG Leads

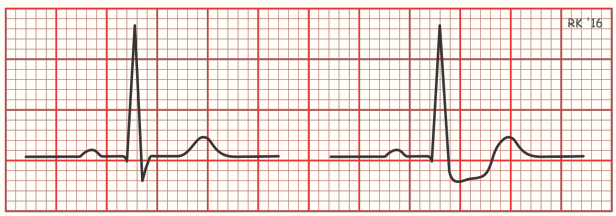


- Inferior: RCA — Right Coronary Artery
- Anterior: LAD — Left Anterior Descending Artery
- Lateral: LCX — Left Circumflex Artery

Ischemia and the ECG

- One of the common uses of the ECG is in acute assessment of chest pain
- Cause : restriction of blood flow to the myocardium, either:
  - Reversible: angina pectoris
  - Irreversible: myocardial infarction
- Ischemia ➡ Injury ➡ Infarction

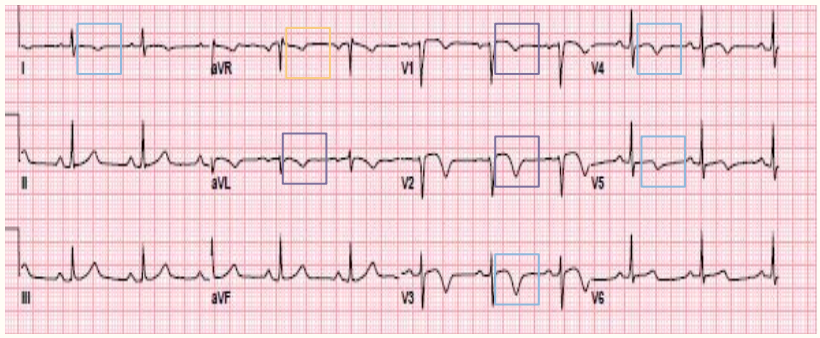
Inverted T wave



Normal ST Depression

Reversible Ischemia

- Inverted T wave
- ST segment depression



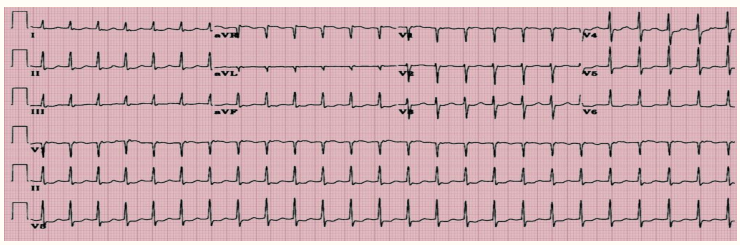
- Inverted T wave in leads I, II, V3-V6 is Abnormal

- Inverted T wave in aVR is Normal , when it's upright it will be Abnormal

- Inverted T wave is variable in leads III, aVL, aVF, V1, V2

AVRT–Narrow complex

- Tachycardia
- Regular rhythm
- SVT



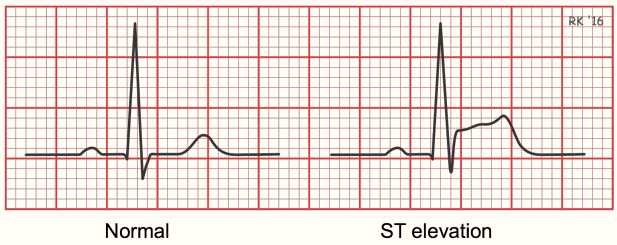
Ventricular Tachycardia

- Regular rhythm
- Wide QRS complex
- No P wave
- Caused by: Ischemia, Electrolytes abnormalities

Myocardial Infarction

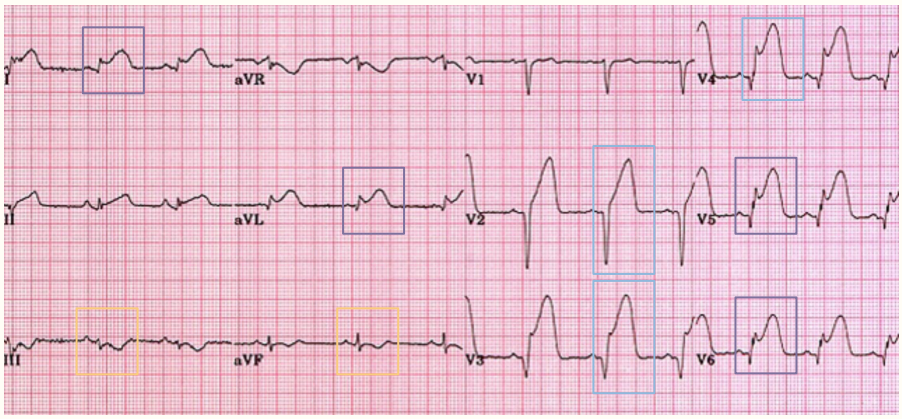
- Complete loss of blood supply to the myocardium resulting in necrosis or death of tissue
  - ST segment elevation
  - Deep Q wave

STEMI : ST-Elevation Myocardial Infarction



Antero-Lateral MI

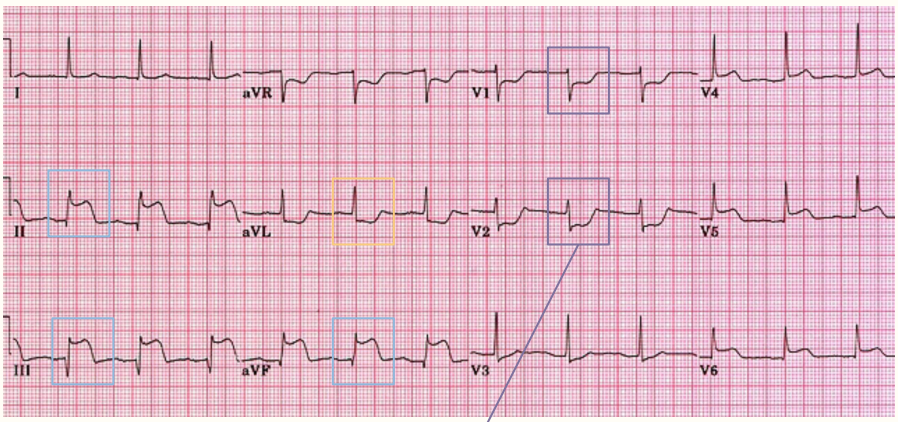
- Anterior
- Lateral
- Reciprocal Changes



- ST elevation in leads V2-V6, I, aVL
- Reciprocal ST depression in leads III, aVF

- Occlusion of the Left Anterior Descending Artery (LAD)

- Inferior
- Posterior
- Reciprocal Changes



Infero-Posterior MI

- ST elevation in leads II, III, aVF
- Reciprocal ST depression in aVL

- Occlusion of the Right Coronary Artery (RCA)

STEMI in Lead III

Inverted Lead V2

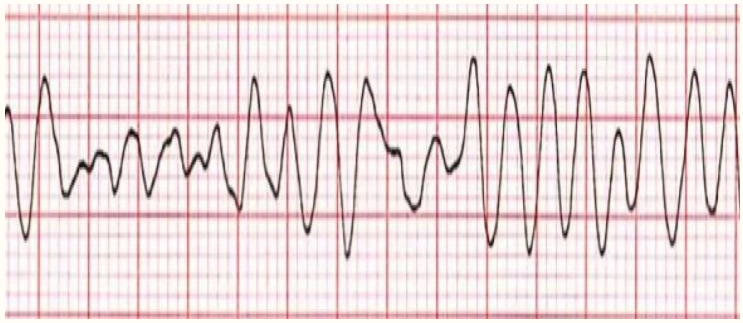
Diagnosis may require a 15-lead ECG because a standard 12-lead does not look directly at the Posterior wall.

aVL is the only lead truly reciprocal to the inferior wall, It is thus a sensitive marker for inferior infarction

Ventricular Fibrillation

- The most serious of all arrhythmias
- Cause : impulses stimulate one part of the ventricles, then another, then itself, many parts contract at the same time while other parts relax (circus movement) ➡ Tachycardia, Irregular rhythm, Broad QRS complex, No P wave
- Causes : sudden electrical shock, ischemia
- Treatment: DC shock

Interpretation	
Rate	Chaotic & Rapid
Rhythm	Irregular
P wave	N/A
PR interval	N/A
QRS complex	Broad



Note the chaotic & irregular rhythm with no identifiable waves

Atrial Fibrillation

- Cause/same mechanism as ventricular fibrillation, it can occur only in atria without affecting the ventricles
- It occurs more frequently in patients with enlarged heart
- The atria do not pump if they are fibrillating
- The efficiency of ventricles pumping/filling is decreased 20-30%
- No P wave, or high frequency of low voltage P wave
- Treatment : DC shock
- A person can live for years with atrial fibrillation

Interpretation	
Rate	> 350 bpm
Rhythm	Irregular
P wave	Chaotic appearance
PR interval	N/A
QRS complex	Narrow

Note the 'fibrillatory waves' or 'f' waves

Atrial Flutter

- A single large wave travels around and around in the atria
- The atria contracts at high rate (250 bpm)
- Because one area of the atria is contracted and another one is relaxed, the amount of blood pumped by the atria is slight
- The refractory period of the AV node causes 2-3 beats of atria for one single ventricular beat ; 2:1 or 2:3 rhythm

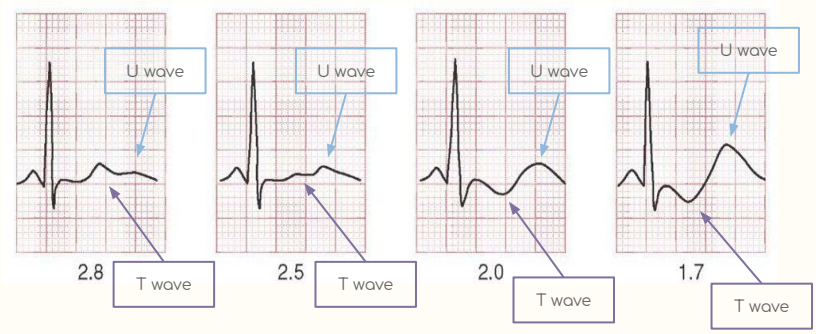
Interpretation	
Rate	250-350 bpm
Rhythm	Regular
P wave	Saw-tooth appearance
PR interval	N/A
QRS complex	Narrow

Note the 'Flutter' or 'F' waves they look like a 'saw tooth'

The source of the U wave is unknown but it may be caused by the late repolarization of the Purkinje fibers

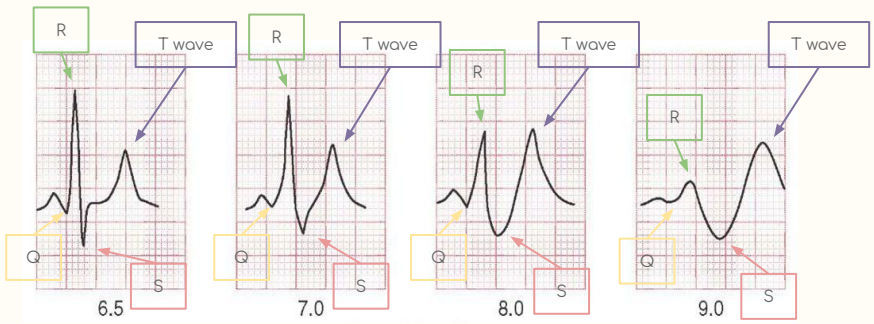
Hypokalemia

Flat T wave



Hyperkalemia

Tall peaked T wave



Summary

SCAN ME

Click HERE

Or

Scan the code for the amazing summary that include the important rhythms in this lecture

QUIZ

Q1/ This rhythm called ?

A/ Normal sinus rhythm
B/ Sinus tachycardia
C/ Sinus bradycardia
D/ First degree AV block

Q2/ Which one of the following conditions will cause a sinus bradycardia ?

A/ Sympathetic NS
B/ Parasympathetic NS
C/ Fever
D/ Bleeding

Q3/ After SA node got blocked or damaged which node will be the pacemaker ?

A/ Purkinje Fibers
B/ Bundle of His
C/ AV node
D/ Internodal tract

Q4/ Which AV block have a progressive PR prolongation with drop beat ?

A/ First degree AV block
B/ Mobitz I
C/ Mobitz II
D/ Complete heart block

Q5/ Patient has sawtooth waves in ECG test, which one is most likely he has ?

A/ Atrial flutter
B/ Atrial fibrillation
C/ Ventricular flutter
D/ Ventricular fibrillation

Q6/ This ECG shows ?

A/ Atrial flutter
B/ Atrial fibrillation
C/ Ventricular flutter
D/ Ventricular fibrillation

Click HERE for more questions done by Qbank team!

Answers : 1-A 2-B 3-C 4-B 5-A 6-D

Time to see by yourself

- 1nd° Block
- 2nd° Block I
- 2nd° Block II
- 3nd° Block
- Ventricular Fibrillation
- Atrial Fibrillation
- Atrial Flutter
- Premature Ventricular Contraction
- Premature Atrial Contraction

CARDIAC441
SCIENCE

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