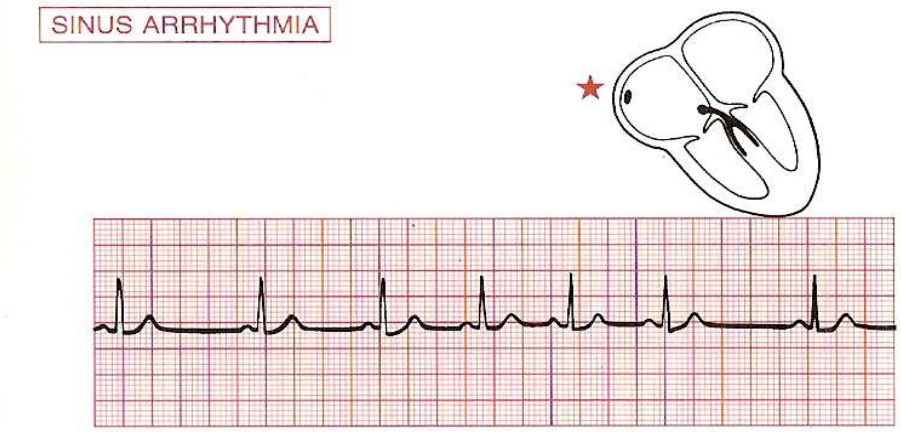
# CARDIOVASCULAR PHYSIOLOGY-OUTLINES

## The Cardiac Cycle – Abnormal ECG (Arrhythmias):

# I: Abnormal Sinus Rhythm

## 1. Respiratory Sinus Arrhythmia:

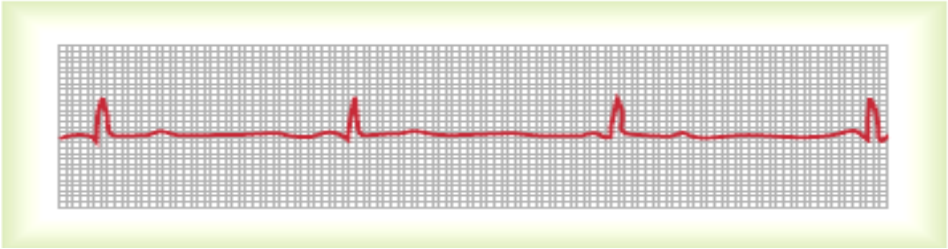
- HR varies 5% during respiratory cycle & up to 30% during deep respiration.
- HR normally ↑ in during inspiration & ↓ during expiration.
- ECG: Q-T & P-R intervals are shortened during inspiration & prolonged during expiration.




*Note:* One P wave per QRS complex
Constant PR interval
Progressive beat-to-beat change in R–R interval.

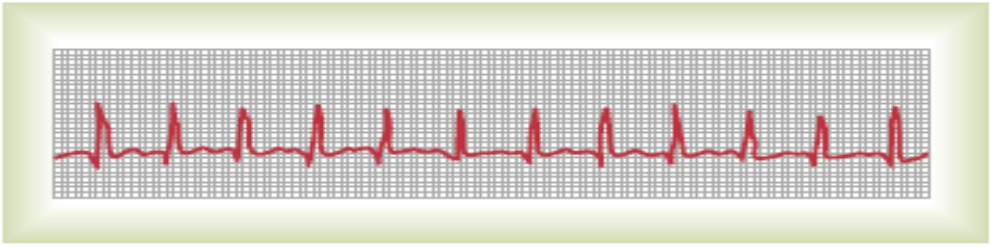
## 2. Sinus Bradycardia (Decreased Automaticity):

- Slow sinus rhythm (↓ HR) < 60 bpm.
- Physiologically associated with trained athletes & vagal stimulation (fainting attacks).
- Pathological causes: e.g. hypothermia, hypothyroidism (myxoedema), drugs (β-blockers), & is often seen immediately after a heart attack.



## 3. Sinus Tachycardia (Increased Automaticity):

- Fast sinus rhythm (↑ HR) > 100 bpm.
- Physiologically associated with exercise, fear, pain, & anxiety.
- Pathological causes: e.g. hypovolaemia (haemorrhage), anaemia, hypoxia, thyrotoxicosis, fever, drugs (salbutamol), & caffeine.
- ECG: Q-T & P-R intervals are shorter than N.



# II: Conduction block

- Block of heart signals within the intra-cardiac conduction pathways.
- Commonly caused by ischemia.
- **Types of conduction block:**
  - Sinoatrial Block
  - Atrioventricular Block
    - Incomplete Atrioventricular Heart Block
    - Complete Atrioventricular Heart Block
  - Bundle Branch Block & Fascicular Block

## Atrioventricular Block:

- Conditions that either ↓ rate of impulse conduction in AV- node or AV-bundle, or block it entirely:
  1) Ischemia of A-V node or A-V bundle fibers.
  2) Compression of A-V bundle by scar tissue or by calcified portions of the heart.
  3) Inflammation of A-V node or A-V bundle.
  4) Extreme stimulation of heart by vagus n.

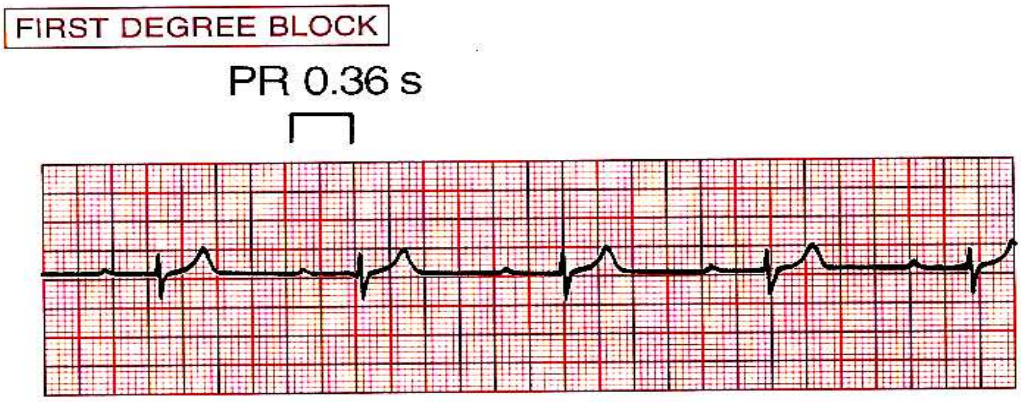
## Incomplete Atrioventricular Heart Block:

- Relatively common.
- **Two types:**

- First Degree Heart Block
- Second Degree Heart Block
  - **Wenckebach type 1**
  - **Mobitz type 2**
  - **2:1 type**

## a. First Degree Block:

- Normal waves & no of cycles per min.
- All atrial impulses pass through AV node, but takes longer time.
- Prolonged PR- interval in all cycles > 0.2 sec (N = 0.12-0.2 sec).




*Note:* One P wave per QRS complex
PR interval 0.36 s.

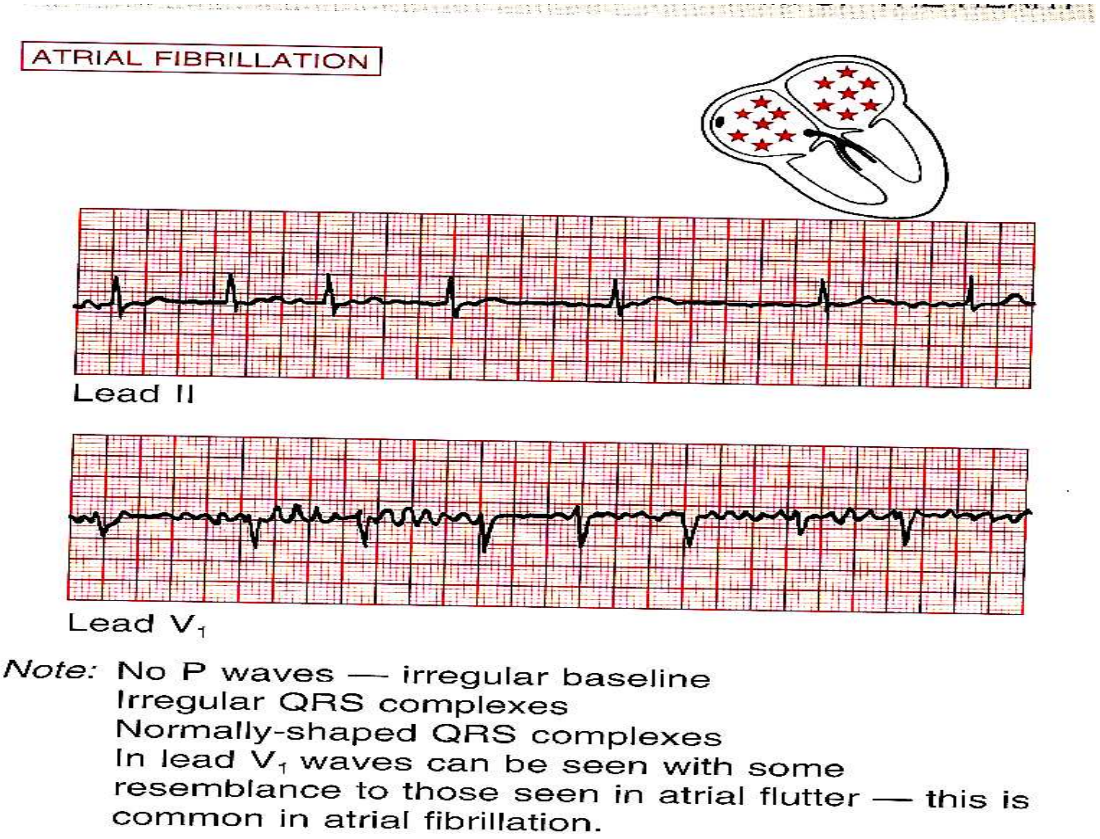
**Note:** - 1st degree heart block may be seen in normal people.
- It is may be a sign of coronary artery disease, acute myocardial infarction, acute rheumatic carditis, digitalis toxicity or electrolyte disturbances.
- No specific action needed.

# III: Re-entry Rhythm

## Atrial fibrillation:

- Caused by numerous wavelets of depolarization (> one ectopic focus) spreading throughout the atria simultaneously.
- Generate absence of coordinated atrial contraction (IRREGULAR atrial impulses from 400-600 bpm).
- ECG:

- P waves absent & replaced by fine oscillating baseline f (fibrillation) waves.
- Irregular ventricular rhythm (100-180 bpm)
- QRS complexes normal shape but irregular in rhythm, due to irregular passage of impulses through AV node.




- **Causes:**
  - Ischaemic heart disease.
  - Hypertensive heart disease.
  - Rheumatic heart disease.
  - Thyotoxicosis.
  - Cardiomyopathy.
  - Post-cardiac surgery.
  - Chronic pulmonary disease.
  - Alcohol misuse.
  - Idiopathic (ione)

# IV: Effect of Electrolyte Abnormalities

## Potassium level changes:

### ❑ Hyperkalemia (↑ K level):

- ECG: tall, wide, peaked T waves with the disappearance of the ST segment.
  - QRS complex may be widened.
  - o Tall T- wave.

**N.B.** Abnormal magnesium levels causes similar effects.

### ❑ Hypokalemia (↓ K level):

- ECG: T wave flattening, & appearance of a hump on the end of the T wave called a 'U' wave.
  - o Small T- wave.
  - o U- wave.

## Calcium level changes:

### ❑ Hypercalcemia (↑ Ca level):

- ECG:
  - o Short QT- interval.

### ❑ Hypocalcemia (↓ Ca level):

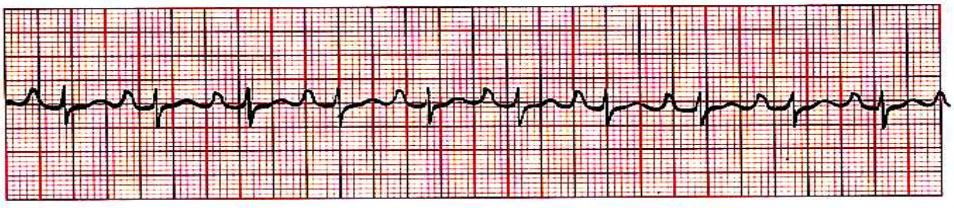
- ECG:
  - o Prolonged QT- interval.

## V: Abnormalities of waves and intervals

# Abnormalities of P–Wave

| | Too Tall > 2.5mm Peaked (tented) | Too Wide > 0.08 sec & notched (bifid; double summit) | Inverted, pointed & usually <0.1 sec wide | Absent |
|---|---|---|---|---|
| Cause | RA hypertrophy | LA hypertrophy or dilatation | Retrograde spread from AV-node to A<br>➢ AV Junction rhythm - normal in aVR.<br>➢ Coronary sinus rhythm - lead II,III, and aVF<br>➢ LA rhythm - leads II,III ,aVF -arm lead reversal | ➢ Atrial fibrillation.<br>➢ Atrial flutter.<br>➢ Hyperkalaemia.<br>➢ Sinus arrest & sinoatrial block. |
| Called | **P-Pulmonale** | **P-Mitrate** | **P-Nodale** | **Absent** |

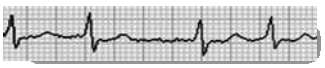
RIGHT ATRIAL HYPERTROPHY



LEFT ATRIAL HYPERTROPHY

# QRS- COMPLEX INTERVAL

| ≤ 0.10 s | 0.10-0.12 s | > 0.12 s |
|---|---|---|
| Normal | Incomplete bundle branch block | Bundle branch block<br>PVC<br>Ventricular rhythm |

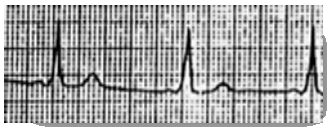


Incomplete bundle branch block

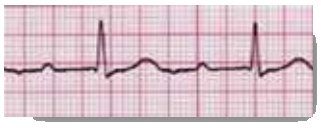
3rd degree AV block with ventricular escape rhythm

# PR- INTERVAL

| < 0.12 s | 0.12-0.20 s | > 0.20 s |
|---|---|---|
| High catecholamine states<br>Wolff-Parkinson-White | Normal | AV nodal blocks |



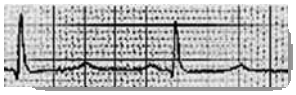
Wolff-Parkinson-White



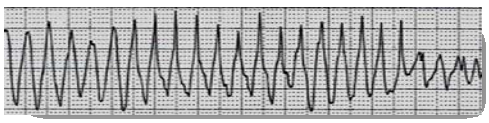
1st Degree AV Block

# QT- INTERVALS

| < 0.44 s | > 0.44 s |
|---|---|
| Normal | Long QT |



Long QT



Torsades de Pointes

- Prolonged QT can be very dangerous
- It may predispose an individual to a type of ventricular tachycardia called Torsades de Pointes
- Causes include drugs, electrolyte abnormalities, CNS disease, post-MI, & congenital heart disease.

# Questions to answer in order to identify an unknown arrhythmia:

**Q1. The rate? Is it slow (<60 bpm) or fast (>100 bpm)?**

Slow → ? sinus bradycardia, sinus arrest, or conduction block

Fast → ? increased/abnormal automaticity or reentry

**Q2. The rhythm? Is it irregular?**

Irregular → ? atrial fibrillation, 2nd degree AV block, multifocal atrial tachycardia, or atrial flutter with variable AV block

**Q3. The QRS complex? Is it narrow or wide?**

Narrow → Rhythm must originate from the AV node or above

Wide → Rhythm may originate from anywhere

**Q4. Are there P waves?**

Absent P waves → ? atrial fibrillation, ventricular tachycardia, or rhythms originating from the AV node

**Q5. What is the relationship between the P waves and QRS complexes?**

More P waves than QRS complexes → ? 2nd or 3rd degree AV block

More QRS complexes than P waves → ? an accelerated junctional or ventricular rhythm

**Q6. Is the onset/termination of the rhythm abrupt or gradual?**

Abrupt → ? reentrant rhythm

Gradual → ? altered automaticity