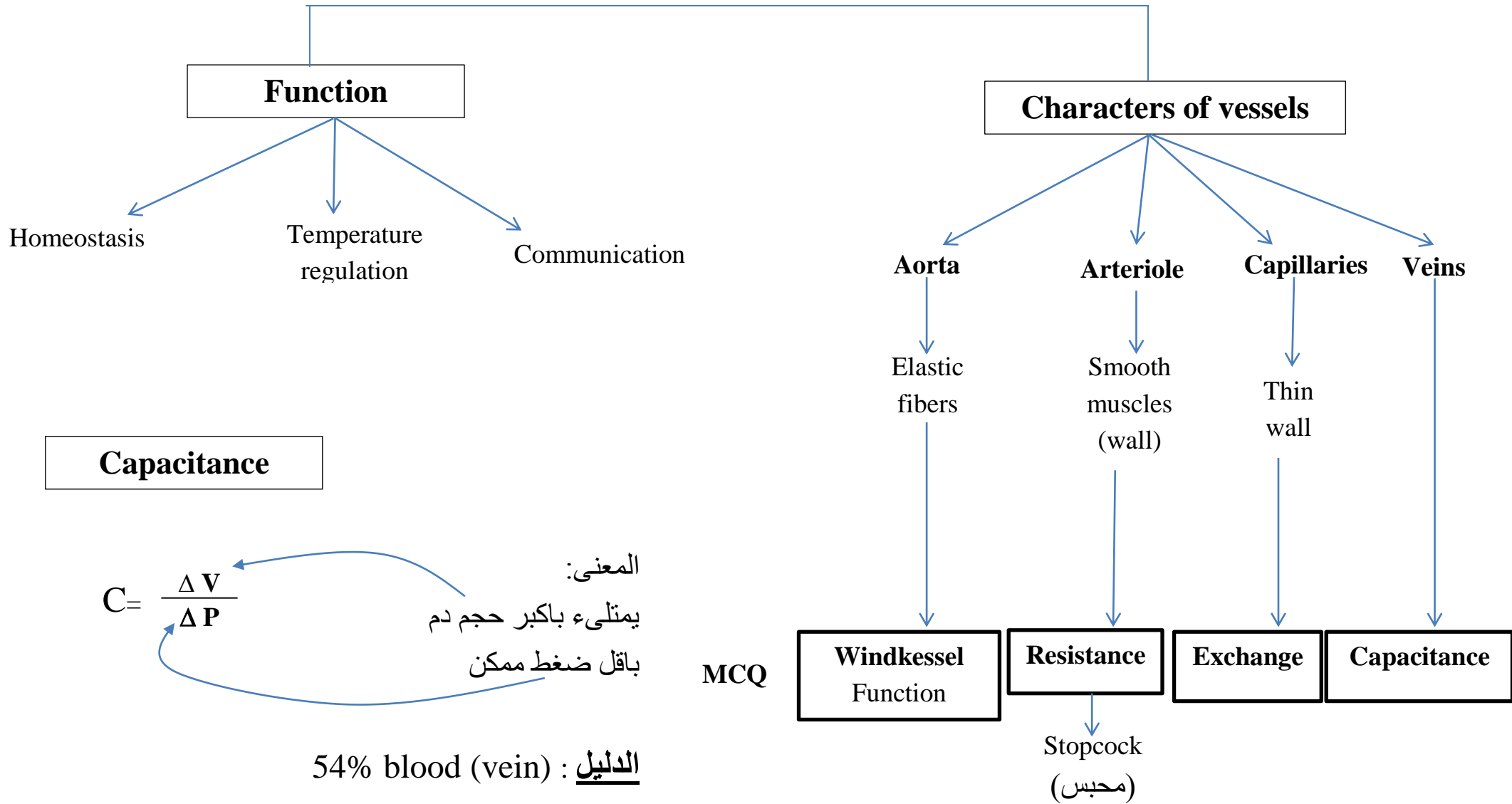
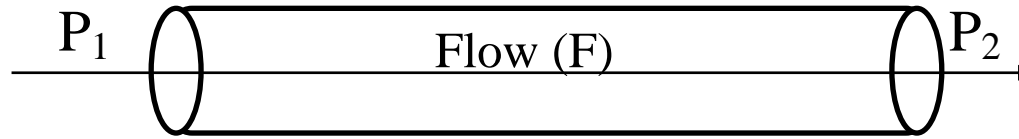


# د/ محمد فايز CVS



# د. محمد فايز CVS



$$F = \Delta P / R \rightarrow \text{Resistance}$$

**Intermittent**  
(LV  $\rightarrow$  Aorta)

**Types**

**Pulsatile**

Capillaries

**Steady**

Veins

**Rapid**

Aorta

**Slow**

Capill.

**Velocity  $\propto 1/CSA$**

**Vessels** Aorta (93 mmHg)  $\rightarrow$  Arteriole (32 mmHg)  
 $\rightarrow$  Capillaries  $\rightarrow$  veins (10 mmHg)  $\rightarrow$   
 Right atrium (0 mmHg)

**High Pressure**

Ventricles (Systole)

+

**A**orta  
 rteries  
 rterioles  
 rterial side of capillaries

**Low Pressure**

Atria + العكس

Pulmonary circulation

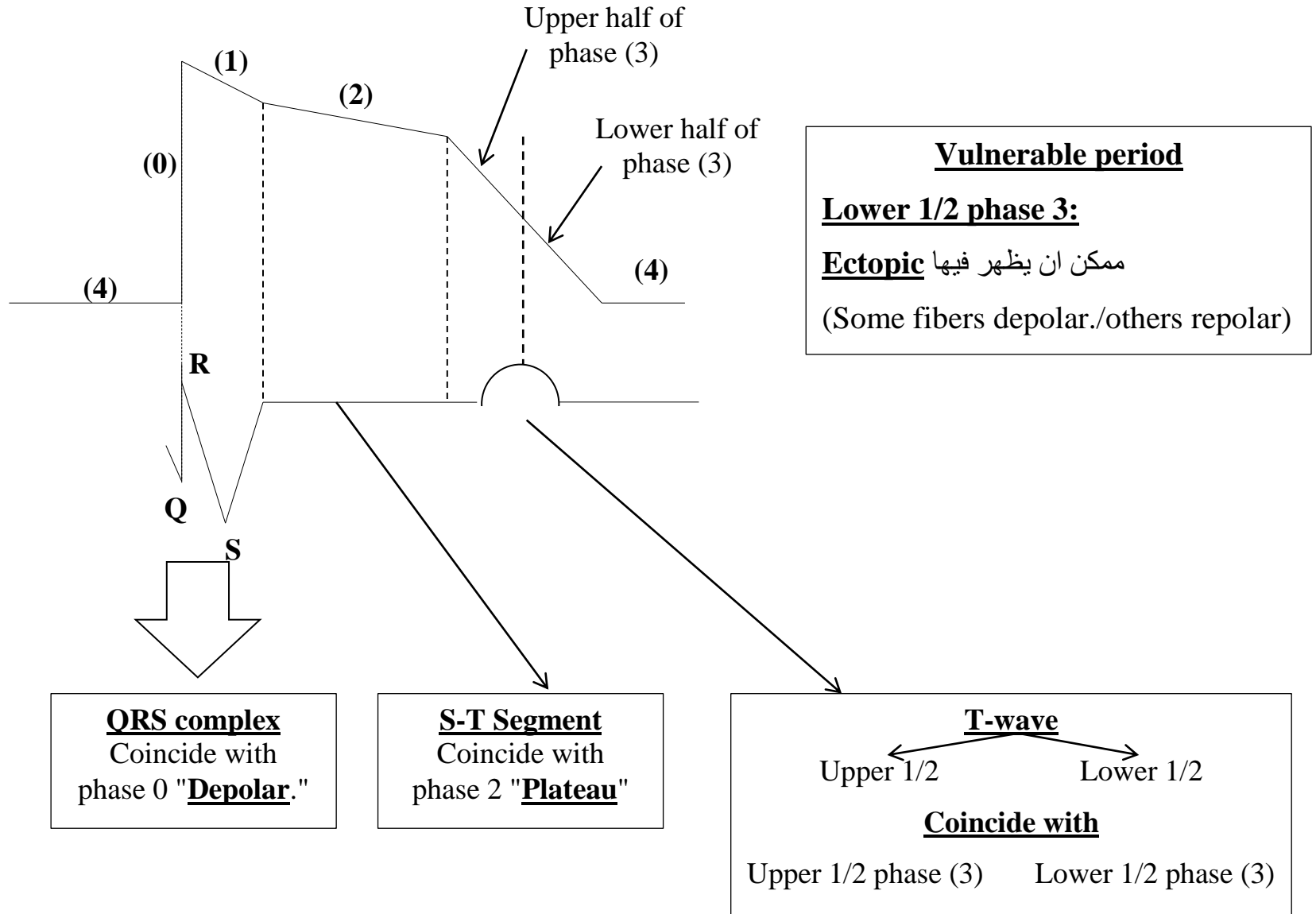
	Fast Response	Slow response
<b>Phase 4</b>	<b>Stable</b> ← RMP	→ <b>Unstable</b> (Prepotential)
Cause	$K^+$ efflux > $Na^+$ influx	= Diastolic depolarization <b>Early:</b> $Na^+$ influx } > $K^+$ efflux <b>Late:</b> $Ca^{++}$ influx (T-channels)
Value	-90 mV	- 55 mV
<b>Phase 0</b>	← Depolarisation →	
Cause	$Na^+$ influx (voltage gated $Na^+$ channels)	$Ca^{++}$ influx ( <b>L-type</b> $Ca^{++}$ channels)
Firing level	- 70 mV ( <b>Peak:</b> +30 mv)	- 45 mV ( <b>Peak:</b> +10 mV)
<b>Phase 1</b>	Open voltage gated $k^+$ channels	-----
<b>Phase 2</b> <b>(platau)</b>	<b>Early:</b> $ca^{++}$ Influx = $K^+$ efflux <b>Late:</b> $Na^+$ influx = $K^+$ efflux	-----
<b>Phase 3</b>	Open voltage gated $k^+$ channels	

Repolariation

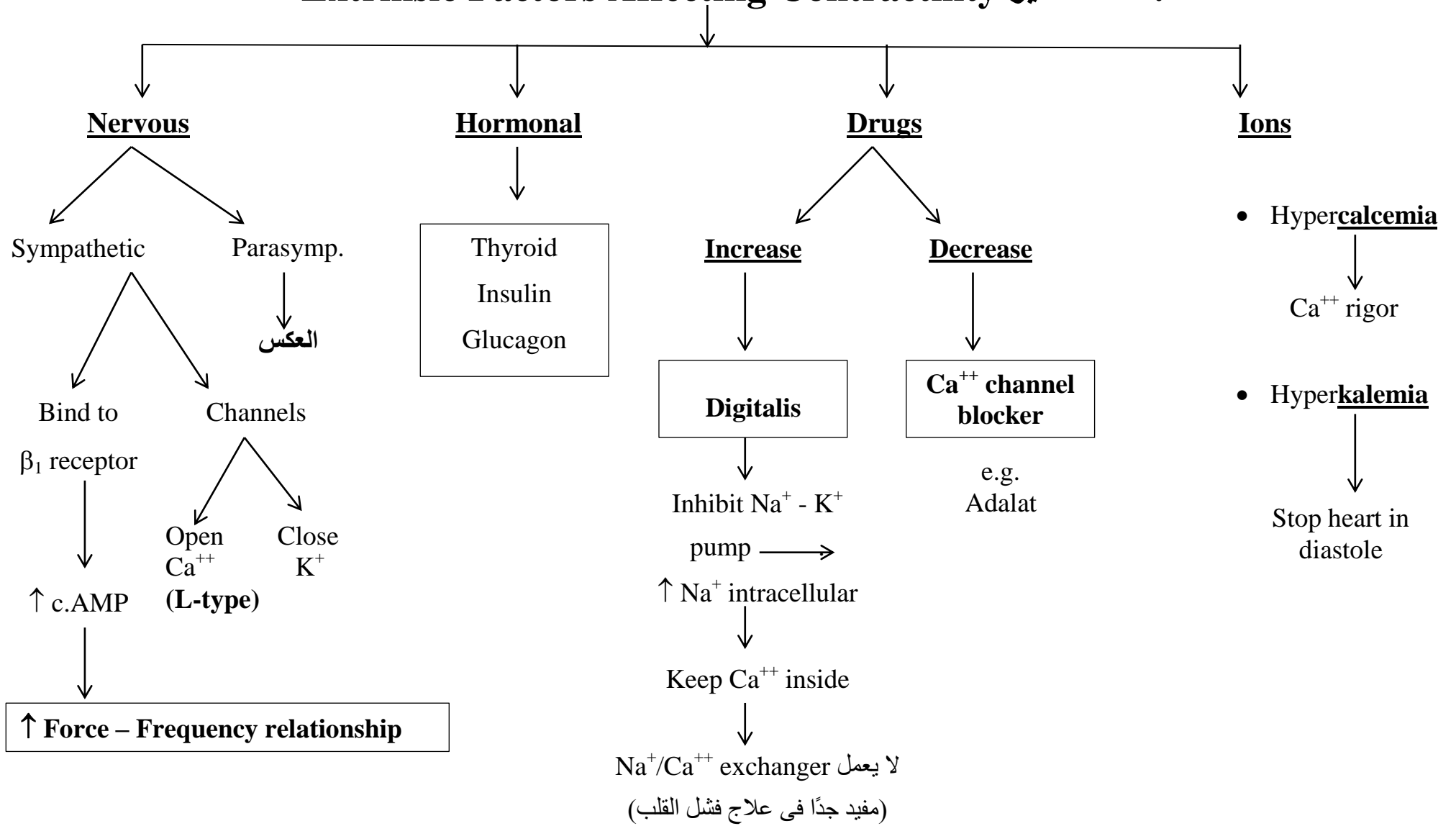
## Refractory Periods دكتور / محمد فايز

	<b>Fast Response</b>	<b>Slow response</b>
<b>Refractoriness</b>	Shorter	Longer → Start phase 4 (post repolar. Refractoriness)
<b><u>ARP</u> Time Significance</b>	Phases (0, 1, 2, upper 1/2 (3)) Safety against tetanisation	Phase (0) → 2/3 phase (3)  Voltage dependent refractoriness
<b><u>ARP</u> Time Significance</b>	Lower 1/2 (phase 3) Partial recovery of fast Na <sup>+</sup> channels	Late 1/3 phase (3) → start phase (4) Pathological importance of AVN (2)
<b><u>ERP</u> Time Significance</b>	ARP + 1 <sup>st</sup> 10 mv of RRP → 60 mv  As ARP + <b>cardioversion</b>  (الهدف الغانه حتى يرجع SAN لطبيعته) (2000-3000 volt) in V.F	—————
<b><u>Supernormal period</u></b>  Time Significance		Short at end of phase (3), start phase (4)  Propagated AP → ↑ excitability

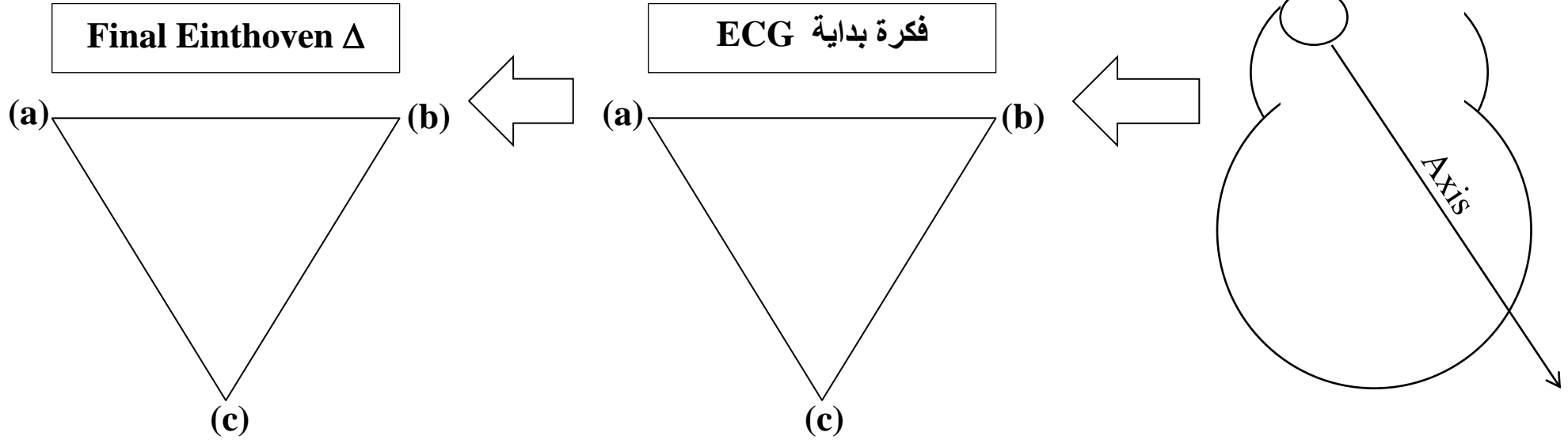
## د. محمد فايز Relation between Fast response, ECG



# د. محمد فايز Extrinsic Factors Affecting Contractility



## د. محمد فايز Einthoven Triangle



تم تغيير ٣ نقاط

**∴ Final Einthoven Δ:**

a) Rt arm. }  
 b) Lt arm } معظم الوصلات  
 c) Lt foot } شمال

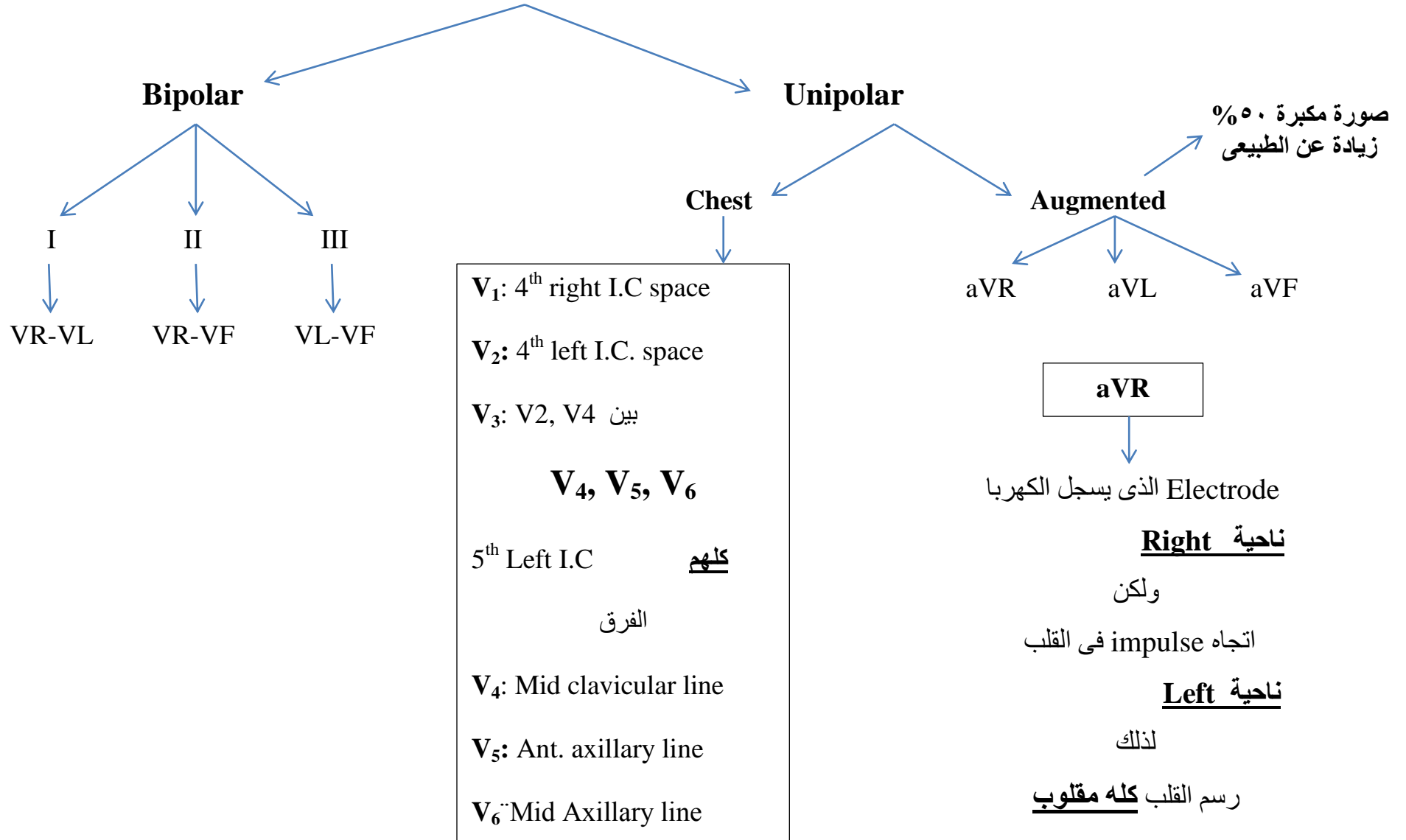
يمكن تسجيل كهرباء الناتجة من القلب  
لأنه يقع على ابعاد متساوية من ٣ نقاط:

a) Rt shoulder.  
 b) Lt shoulder.  
 c) Symphysis pubis.

أساس فكرة رسم القلب:  
 Axis of heart is directed  
 downward, to left

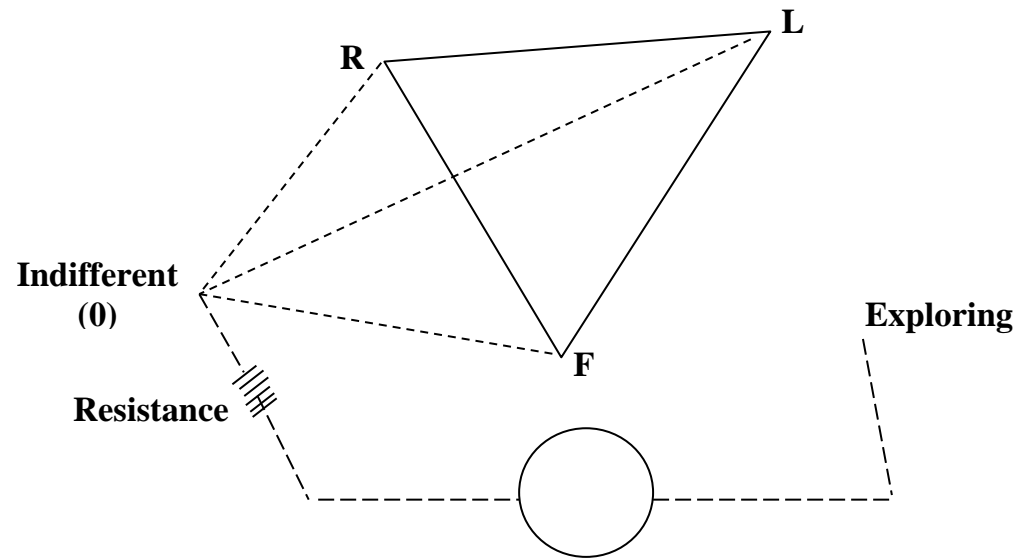
**∴ Einthoven Δ**  
معظم الوصلات ناحية الشمال

# د. محمد فايز ECG Leads





## Unipolar Lead



Unipolar lead معناها أسجل الكهربيا عند نقطة واحدة (Exploring) أما النقطة الأخرى (In different) تساوى صفر

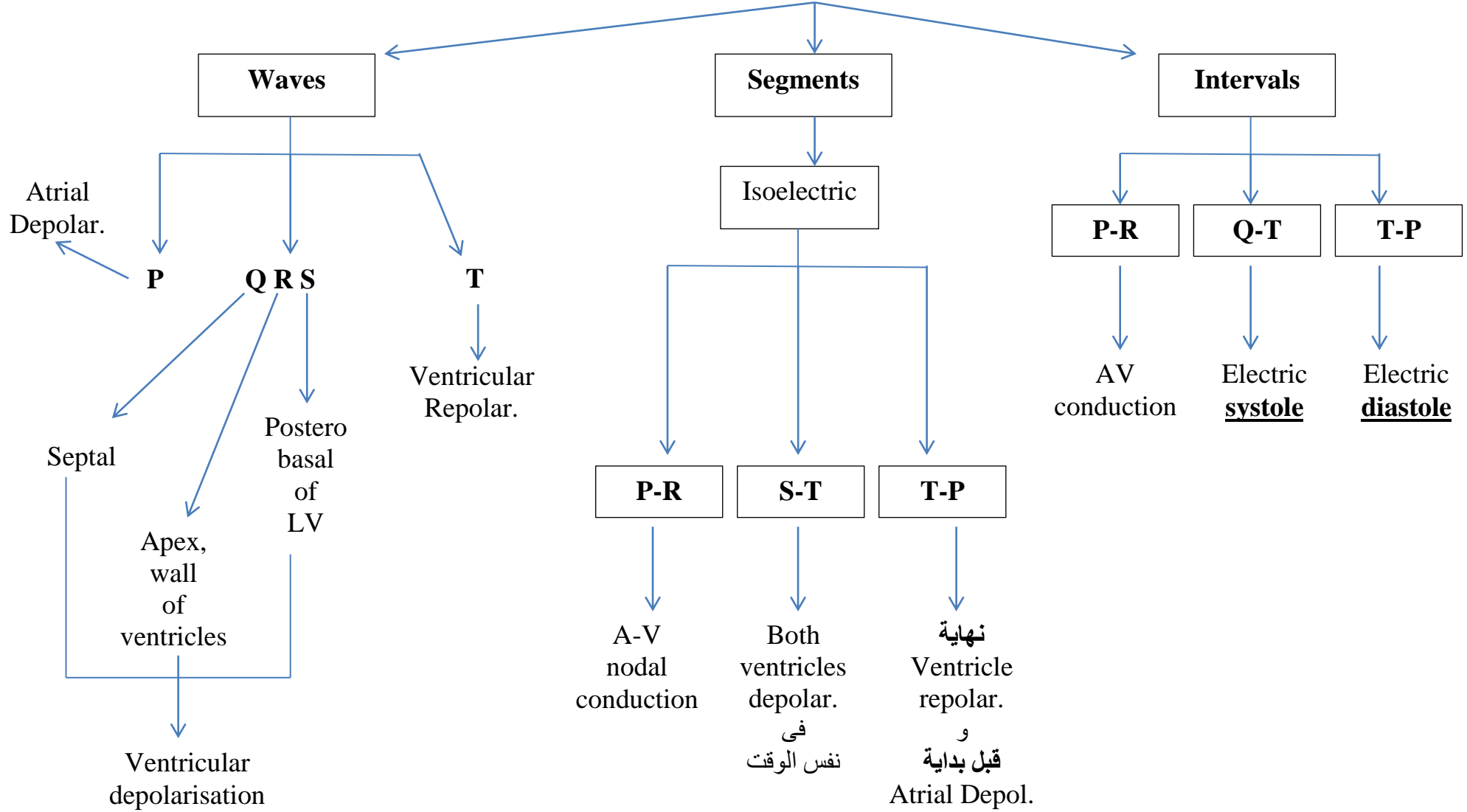
$$\underline{\text{Indifferent} = (R - L) + (L - F) + (F - R) = 0}$$

لا توجد نقطة في جسمك، الكهربيا عندها تساوى صفر

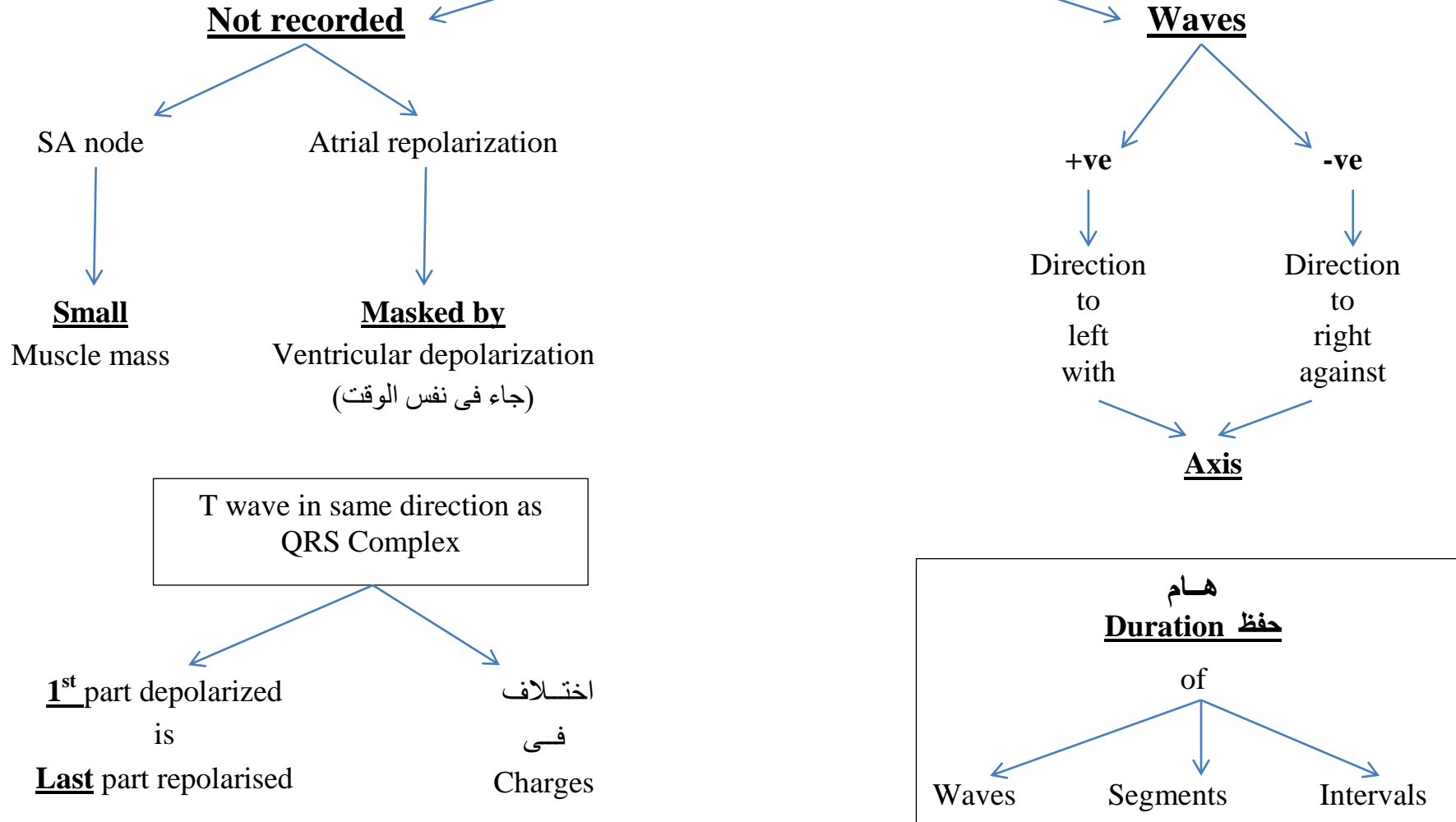
It can be applied only by high resistance (5000 ohm) to be indifferent

Exploring electrode   
 ↗ Limb (unipolar Limb Lead)   
 ↘ Chest (unipolar chest Lead)

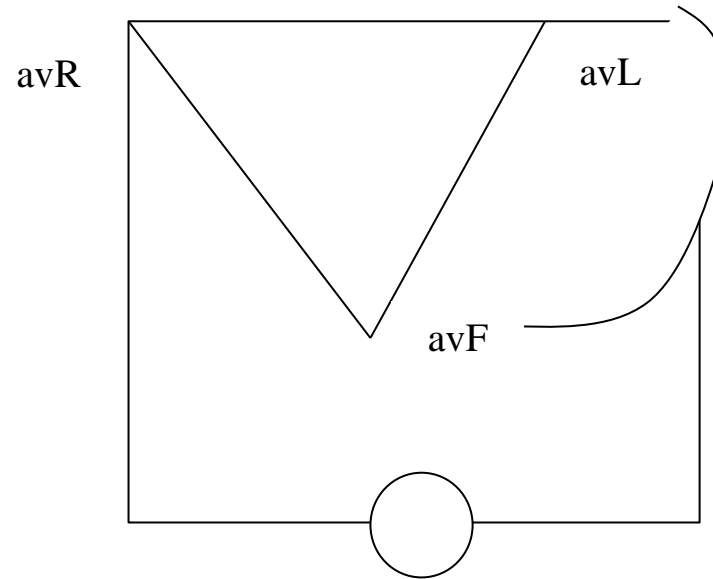
# د. محمد فايز Normal ECG



# ECG Notes د. محمد فايز



**Proof: Augmented Unipolar Leads = 50% ↑ Unipolar Lead** د. محمد فايز



$$avR = VR - \left( \frac{VL + VF}{2} \right)$$

$$\therefore 2 avR = 2 VR - (VL + VF)$$

$$\Delta VR + VL + VF = \text{Zero (Kirchhoff's 2<sup>nd</sup> law)}$$

$$\therefore (VL + VF) = -VR$$

$$\therefore 2 avR = 2 VR - (-VR) = 3 VR$$

$$\therefore \underline{avR = 3/2 VR}$$

د. محمد فايز Notes on ECG

	Atrium		Ventricle	
	Endocardium	Epicardium	Endocardium	Epicardium
Depolarised	1 <sup>st</sup>	Last	1 <sup>st</sup>	Last
Repolarised	1 <sup>st</sup>	Last	Last	1 <sup>st</sup>

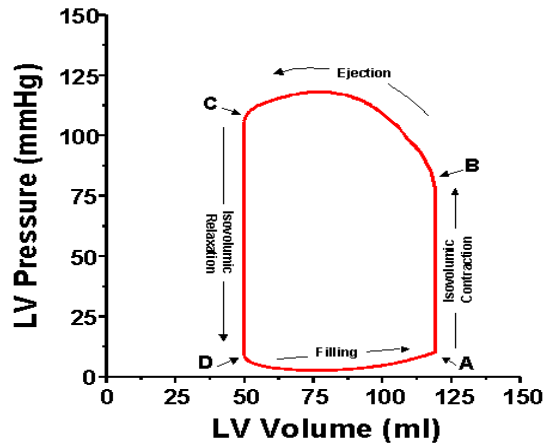
Premature atrial contractions **not** followed by compensatory pause

Premature ventricular contractions **followed by compensatory pause**

## د. محمد فايز Cardiac Cycle

	Atrial systole	Isovol. contraction	Maximum ejection	Reduced ejection	Proto diastolic	Iso vol. relaxation	Rapid filling	Slow filling
<b>Atrial Pr.</b>	↑	↑	↓	Increased (VR)			↓	No change
<b>Ventricle Vol.</b>	↑	Constant	↓	↓	↓	Constant	↑	↑ <u>Slow</u>
<b>Ventricle Press.</b>	↓	↑	↓	↓	↓	↓	↓	↑ <u>Slight</u>
<b>Aortic Press.</b>	↓	↓	↑	↓	↑	↑ بداية ثم يقل	↓	↓
<b>CBF</b>	↓	↓	↑	↓	↓	↑	↓	↓
<b>Valves</b>	<u>Open</u> (A-V) <u>Close</u> <u>Semi</u> <u>lunar</u>	<u>All closed</u>	<u>Open</u> : Semilunar <u>Close</u> : A-V valves			<u>All closed</u>	<u>Open</u> : A-V <u>Closed</u> : Semilunar	
<b>Heart sounds</b>	4 <sup>th</sup>	1 <sup>st</sup>	1 <sup>st</sup>	-	-	2 <sup>nd</sup>	3 <sup>rd</sup>	-
<b>ECG</b>	P-wave before (0.02 sec)	* Q-wave before (0.02 sec) * QRS	ST segment T بداية	1 <sup>st</sup> 1/2 T-wave		End T-wave TP segment بداية	T-P segment	

## د. محمد فايز LV Pressure Volume Loop



### Significance

1. Area under curve = SW

$$= \underline{\underline{SV \times MAP}}$$

2. BC represents SV

3. DA represents ventr. Filling.

4. RV pressure volume loop (as LV)

(Systolic RV pressure: 25 mmHg)

5. Heart failure:

Contractility curve (Shirt to Rt)

Points				
	A	B	C	D
Valves	MVC	AVO	AVC	MVO
Lines				
	AB	BC	CD	DA
Phase of c. cycle	Isovolumetric contraction	<u>Rapid, Reduced</u> ejection	Isovolumetric relaxation	Rapid, slow filling
Ventricular volume	Constant	↓	Constant	↑
Ventricular pressure	↑	<u>Rapid ejection</u> ↑ (80-120 mmHg) <u>Reduced ejection</u> يقل	↓ ↓ ↓	<u>Rapid filling</u> يقل حتى يصل صفر <u>Slow filling</u> ↑ up to (5-8 mmHg)

# د. محمد فايز Heart Sounds

## Audible by stethoscope

1<sup>st</sup>  
↓

**L**ub  
long  
low pitch

Cause of S<sub>1</sub>

↓

**V**asculo-haemic  
vibrations

↙ A-V valve closure  
↘ Muscle itself

2<sup>nd</sup>  
↓

**S**hort  
semilunar valve closure  
second

Costo sternal junction

↓

Pulmonary

Left intercostal space

↓

Aortic

## Audible by phonocardiogram

3<sup>rd</sup>  
↓

Rapid filling

4<sup>th</sup>  
↓

Atrial systole

Very low pitch

**A**ugmented 3<sup>rd</sup>, 4<sup>th</sup> sounds  
audible by stethoscope

Gallop rhythm

(تسمع الصوت كأنه خطوات  
رجل الحصان وهنا يحدث في  
LV failure)