

6th Lecture

CARDIAC CYCLE-2

Physiology Team - 430

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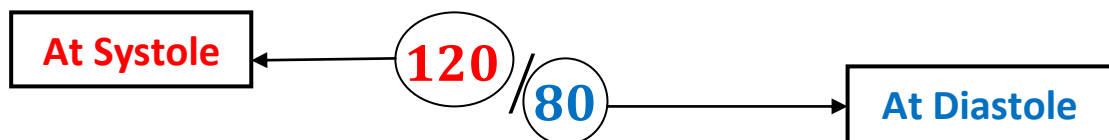
Reem Al jurayyad - Suliman AL-Shammari

Cardiac Catheterization : to measure the pressure and the amount of oxygen in each chamber of the heart

Catheter : is a tube that can be inserted into a body cavity, duct, or vessel

- **Right side of heart** : pass the tube through vein
(SVC → right atrium → right ventricle)
- **Left side of heart** : pass the tube through artery
(Femoral artery → Aorta → left ventricle → left atrium)

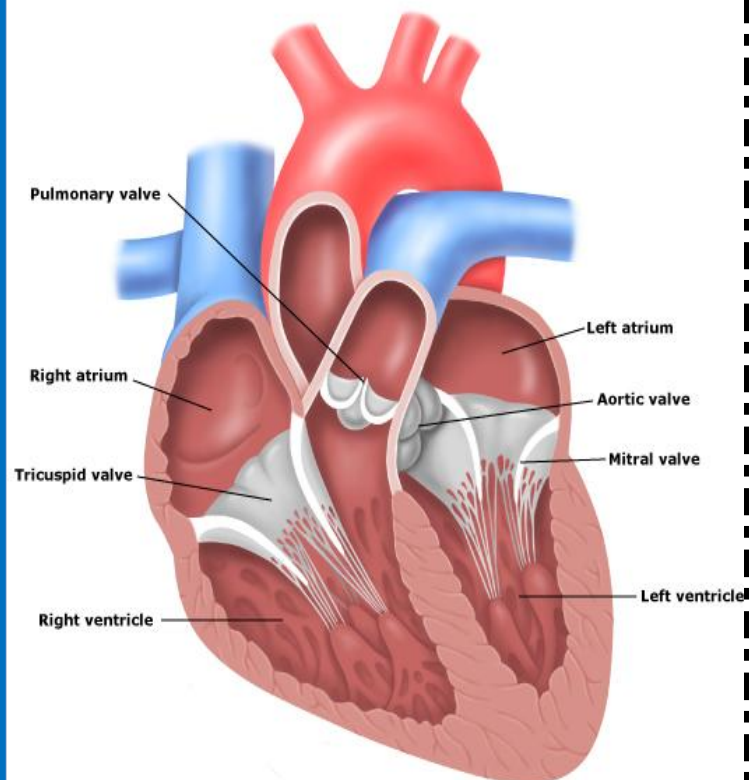
..... Pressure in heart chambers



- **Right atrium** : 0 → 4 mm hg
(some books : -2 → 4 mm hg)
- **Left atrium** : 8 mm hg
- **Aorta** : 120 / 80
- **Left ventricle** : 120 / 10
- **Pulmonary vein** : 25 / 10
- **Right ventricle** : 25 / 10

- Pressure in LV is **higher** than RV ,
Because LV is thicker than RV (5 times)

- LV and Aorta have the same pressure at systole (120) But they differ at diastole



How to measure the mean pressure :

$$\text{Mean pressure} = \text{Diastolic P} + \left[\frac{1}{3} \times (\text{systolic P} - \text{diastolic P}) \right]$$

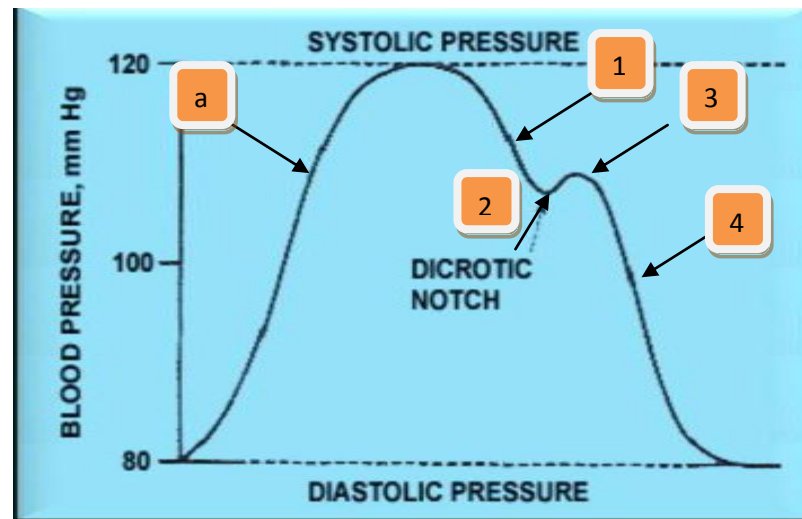
P = pressure

Pulse pressure = **Systolic P - Diastolic P**

Clinical significance of Aortic pressure changes:

- Aortic Stenosis : means → valves تضيق بالـ
- Shock or dehydration
- Aortic Regurgitation
- Hypertension
- Pregnancy

■ Aortic pressure : Two parts



a- Ascending or anacrotic limb: (With max ejection phase)

Aortic pressure \uparrow up to 120 mmHg

b. Descending or catacrotic limb : (Passes in 4 stages)

1. \downarrow Aortic pressure :

In Reduced Ejection phase

2. Dicrotic notch (incisura): Sudden drop in aortic press

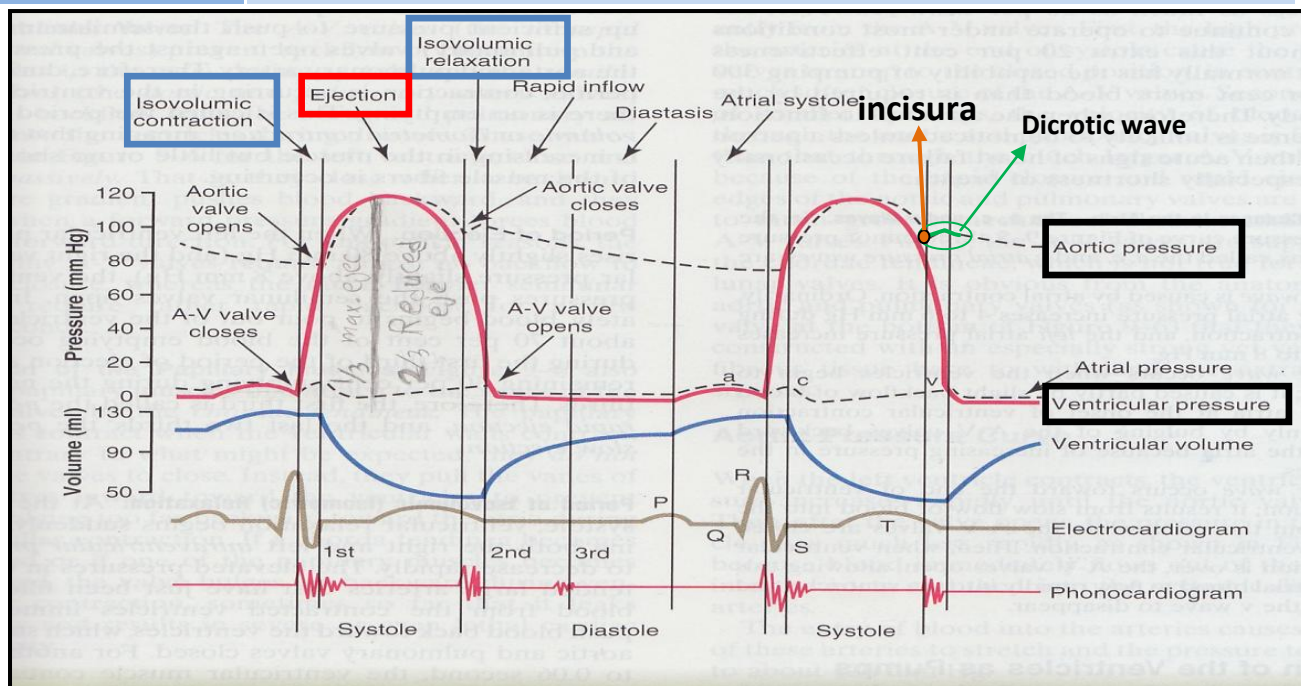
Due to sudden closure of aortic valve (At end of protodiastole phase)

3. Dicrotic wave:

Slight \uparrow in aortic pressure **Due** to elastic recoil of aorta

4. Slow \downarrow aortic press: up to 80 mmHg

Due to continued flow of blood from aorta \rightarrow systemic circulation



■ Left Ventricular and Aortic Pressure curve :

1- During isovolumic contraction : (after "closure of A-V valve" and before "opening of aortic valve" :)

Ventricular pressure increases until **80mm Hg** then Aortic valve opens

2- During Ejection : **Both** ventricular and Aortic pressures will be **increased** BUT ventricular pressure is higher than aortic pressure.

End of "Reduced Ejection" : **Both** ventricular and Aortic pressures will be **decreased** BUT Aortic pressure will be higher than ventricular pressure.(this will continue until the Aortic valve closes)

3- During isovolumic relaxation : (after "closure of Aortic valve" and before "opening of A-V valve")

Ventricular pressure still on being decreased until the A-V valve opens then the ventricle should be completely filled with blood to lead to **the isovolumic contraction** again

Aortic pressure will be slightly **increased (dicrotic wave)**. Δ then **decrease** until Aortic valve opens again

Dicrotic notch (incisura) : occurs in the closure of Aortic valve

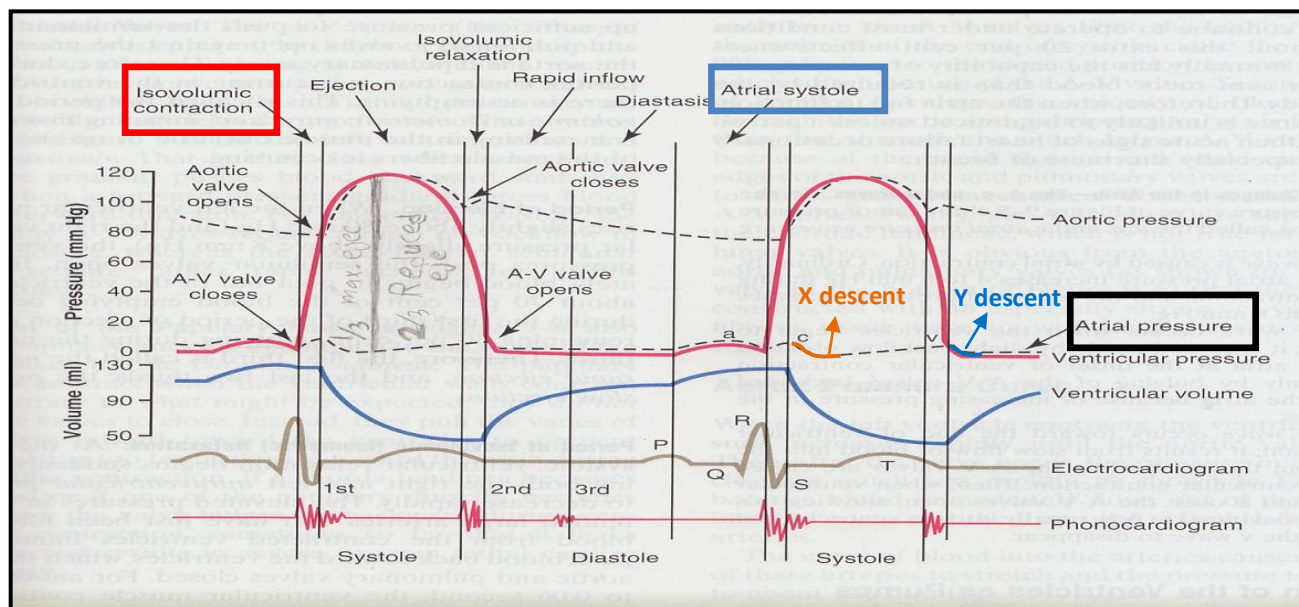
Δ : Explained in the end

End of Reduced Ejection : Aortic pressure will be higher than ventricular pressure Because muscle of ventricle will be relaxed but Blood continues flowing (**Why ?**) Because of the **Inertia**

When the Pressure changed in **right Atrium** will reflect on **internal jugular vein** (Right side of neck) because there is no valve between them . So, we can **record waves** from it, called the jugular venous pulse .

We have :

- **3 upward waves (a , c and v)**
- **2 downward waves (x and y)**



■ Atrial Pressure curve :

1- During Atrial systole : blood will go down to ventricles and up to jugular vein . also , Pressure goes up to the jugular vein . So, we will see **a wave**

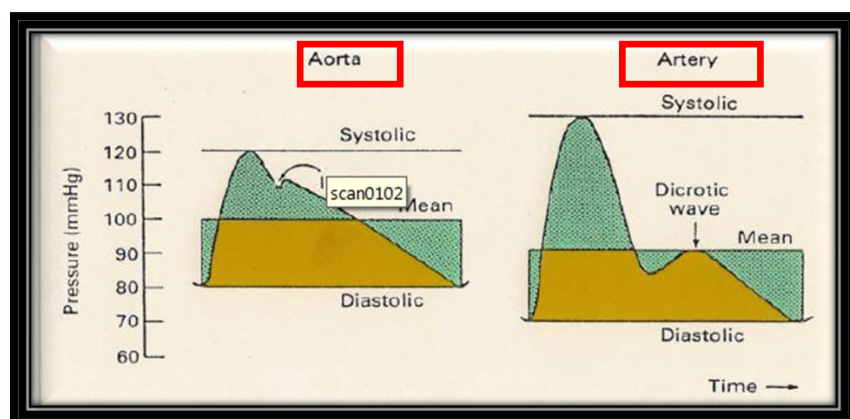
2- During Atrial diastole : (A-V valves closed) blood fills the atrium and the pressure will be increased . So, we will see **v wave**

■ **After the peak of v wave** the rapid filling happens. we will see **y descent** (or wave)

3- During isovolumic contraction : All valve closed and pressure in ventricles will go up that causes **bulging** of A-V valves in atrial cavity. This will increase the pressure in the atrium , causing **c wave**.

■ **After Bulging** : ventricles will be in rapid ejection phase that cause downward displacement of A-V valves . So, we will see **x descent** (or wave)

■ **Arterial** pressure changes (110-130/70-90)



Systolic pressure : 110- 130 mmHg

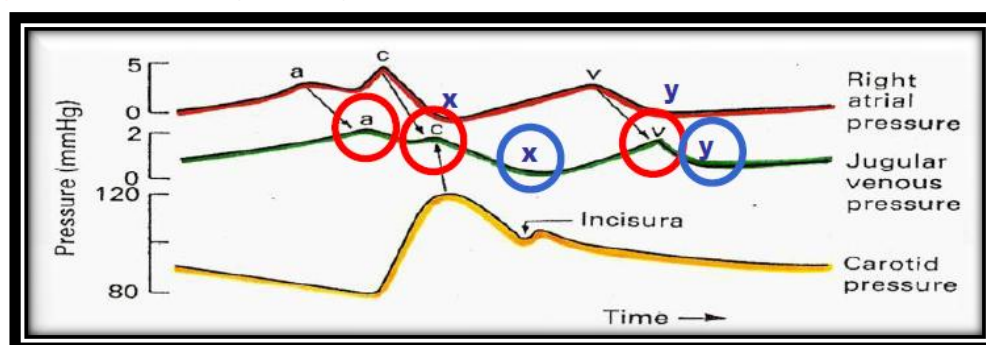
Diastolic pressure : 70-90 mmHg

Note that : pressure values here are higher than aortic values , that's why the curve is sharper

■ **Pulmonary** pressure changes : (25-30/4-12)

Similar to aortic press changes but with **difference in magnitude**

■ **Jugular venous** pulse pressure :

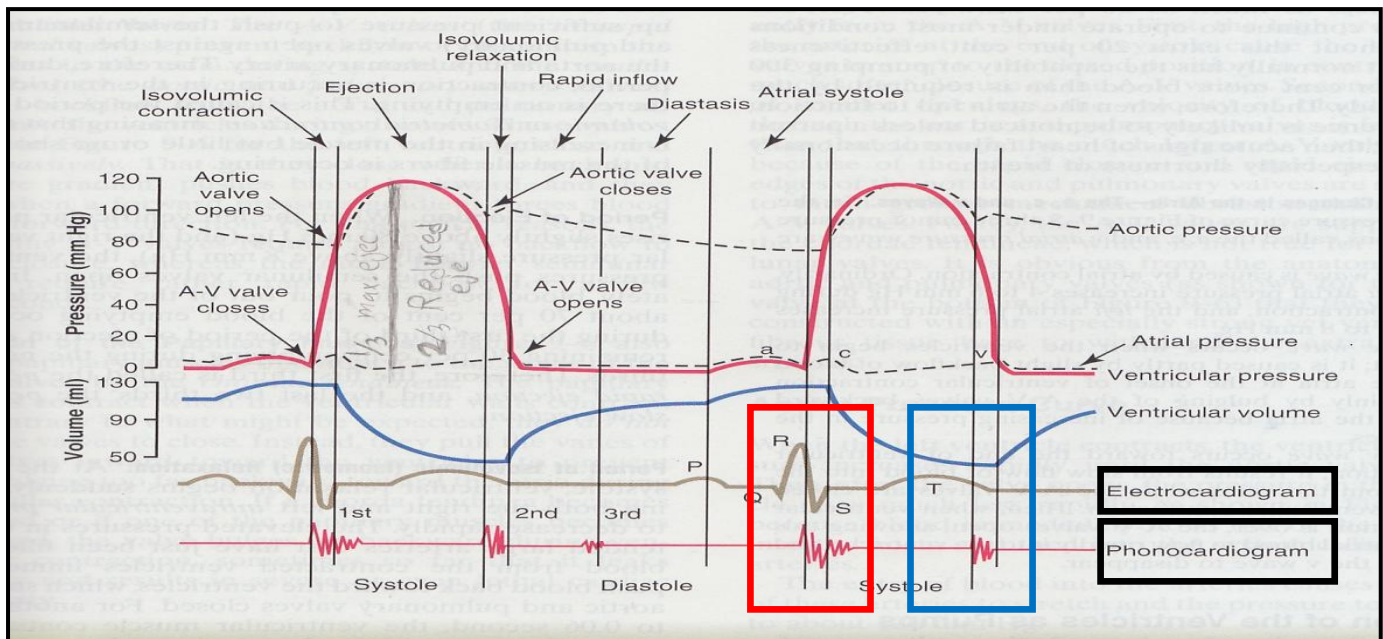


(Recording the **same waves** in the atrial pressure)

Waves revision :

- Atrial contraction cause **a wave**
- Isovolumic contraction cause **c wave (Bulging)**
- 'a-c' interval: Indicates time of conduction of excitation waves through AV node & bundle
(Measured from the start of 'a' wave to start of 'c' wave)
- Rapid Ejection cause **x wave**
- Atrial relaxation cause **v wave**
- Rapid filling cause **y wave**

- Electrical phenomenon occurs before mechanical event (Ex : depolarization then contraction)



- Compared between ECG and Phonocardiogram :

1st heart sound : (At the beginning of systolic ventricles when A-V valves are closed)

In ECG : at the **end of QRS complex** (Depolarization)

Why ? because Electrical event happens before mechanical (contraction)

2nd heart sound : (At the beginning of diastolic ventricles when Semilunar valves are closed)

In ECG : **after T wave** (Repolarization)

Why because Electrical event happens before mechanical (relaxation)

- Right ventricle's pressure curve like Left ventricle's
- Left Atrial's pressure curve like Right Atrial's
- Pulmonary vein's pressure curve like Aortic's



■ More explanation on How **dicrotic wave** occurred : :

1st phase : ventricles pressure will be higher than Aortic pressure . So, blood will go to Aorta

2nd Phase : Aortic pressure will be higher . So, Blood goes back to ventricle But Aortic valve closed . therefore blood reflects back . This will be cause dicrotic wave

Good Luck

