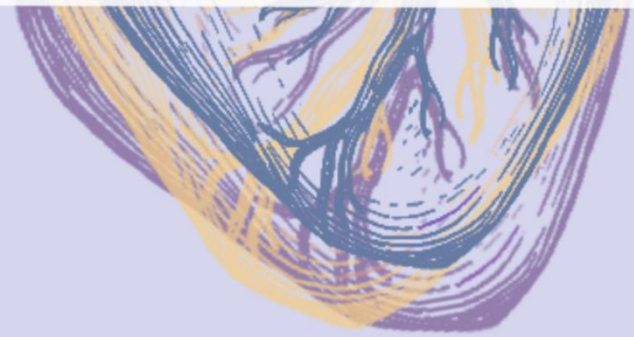
Cardio-Vascular System

6

Pathology



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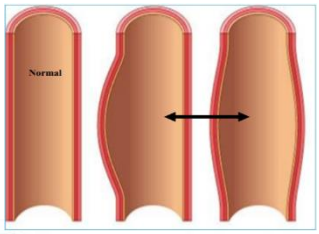
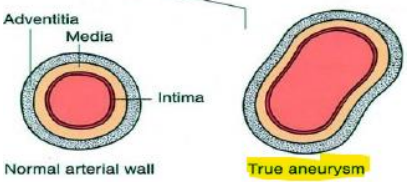
Aneurysms and dissections

ANEURYSMS



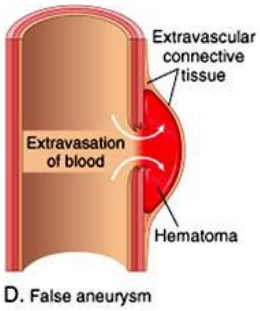
Definition: localized abnormal ***dilation*** of a vessel wall (artery/ vein), or the heart. The dilatation is permanent
we describe aneurysms as:

1. **"True" Aneurysm**
   - This description is used when **ALL THREE LAYERS** of the arterial wall or heart are affected **(intima, media and adventitia), and they are still intact.**



Aneurysms of this type include: Atherosclerotic, syphilitic, congenital aneurysms, ventricular aneurysms that follow transmural MI [MI affecting the full thickness of the heart]

2. **"False" Aneurysm (a.k.a. pseudo-aneurysm)**
   - Does not include the 3 layers of the vessel wall, instead there is **a breach** in the vascular wall leading to **an extravascular hematoma** communicating with the intravascular space **(a "pulsating hematoma"),**



- **Why is it called PSUEDO- aneurysm?**

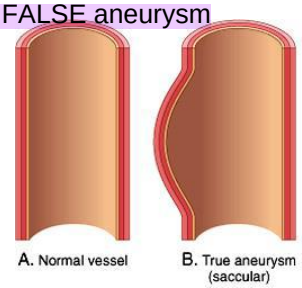
This hematoma will misleadingly resemble an aneurysm in the dilatation of the vessel's wall , meaning that the " external view" of both of them , would be the same , while actually in the false aneurysm , there is a tear through the wall that leads to blood extravasation and collection within the extravascular connective tissue.

Examples of false aneurysms:

1. post- myocardial infarction ventricular wall rupture, that has been contained within a pericardial adhesion.
2. Any event that leads to leakage from the vascular wall, for example a leak at the junction (anastomosis) of a vascular graft with a natural artery.<extra: **Vascular grafts** are **used on** damaged or diseased blood vessels, when surgeons need to redirect blood flow by replacing the **blood vessel**, oftentimes by using synthetic **grafts**>

⚠ The difference between true & false aneurysm:
True: The wall is intact (Intima,media,adventitia), but now the wall is upnormally dilated
False: There's a break in the wall (Rupture,Tear,Breach,Leak) through which blood is getting out of the vascular space
When you see any of these words (Rupture,Tear,Breach,Leak) You should know that this is a FALSE aneurysm

Aneurysms are classified according to their *macroscopic shape* and size into, (note the pictures aside):

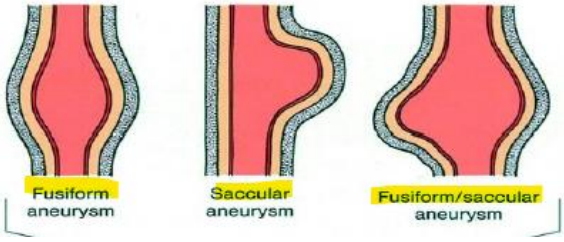


1-saccular aneurysms: they are spherical outpouchings that affect only a segment or a portion of the wall. They might also contain thrombi.

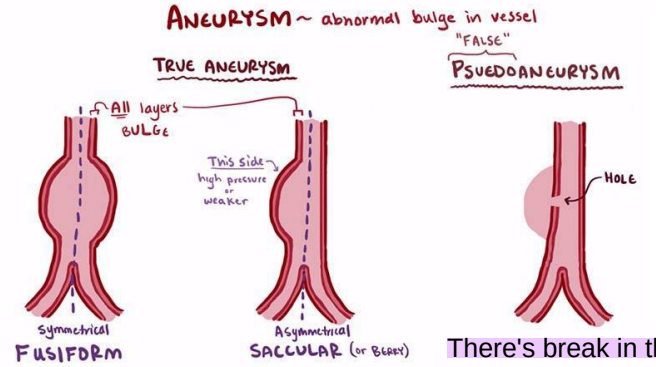
2-fusiform aneurysms: show diffuse, circumferential dilation of a long vascular segment. They vary in diameter and length and can involve extensive portions of the artery

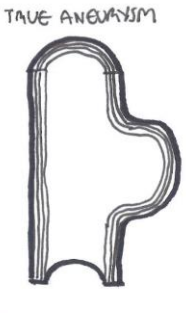
3- Fusiform/ saccular aneurysm: combination of the two morphological types.

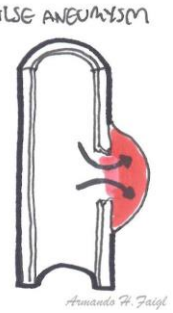
NOTE: *shape and size are NOT specific for any disease or clinical manifestations; it's purely a morphological description*

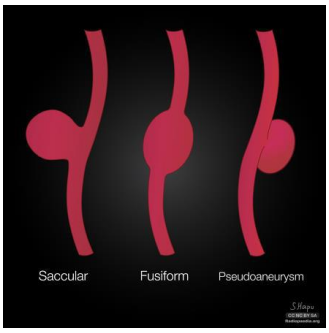


These pictures summarize types of aneurysms mentioned above:





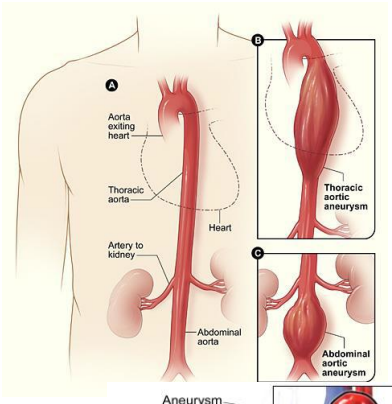




There's break in the wall

The wall is intact, but it's dilated whether only a sigment is dilated or the whole circumference of the artery is affected

AORTIC ANEURYSMS:



Any blood vessel in the body can be affected by an aneurysm, but the most significant one is that of the **AORTA**.

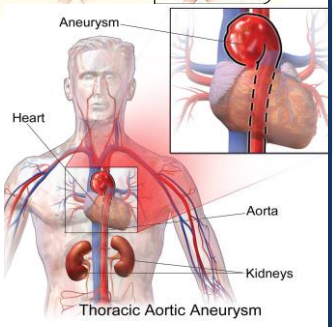
Also, any segment of the aorta can be affected – ascending ,aortic arch, descending thoracic or abdominal aorta and common iliacs.

abdominal aortic aneurysm are more prevalent

➲ The two most important causes of aortic aneurysms are

1. **Atherosclerosis:**

   .most common cause.



How does it cause that you may ask?

Well, Atherosclerotic intimal plaques compress the underlying media. This would compromise nutrients' and wastes' diffusion into and out of the arterial wall, leading to media degeneration and necrosis (it dies of hunger), and eventually thinning and weakening of the media of the blood vessel wall.

Weakness of blood vessels → may lead to dilation of the vessel

2. **Cystic medial degeneration of arterial media:** anything that leads to weakness and degeneration of the media

Causes of that include: trauma; congenital defects (e.g., *berry* aneurysms in the brain); hereditary defects in structural components of media (Marfan disease- will be discussed later in this sheet); infections (mycotic aneurysms); vasculitis.

The most common type of aortic aneurysms are**Abdominal Aorta Aneurysms (= AAA):**

General info:

- More common in men
- rarely seen age < 50 (So it's a disease of adults)

Pathogenesis:

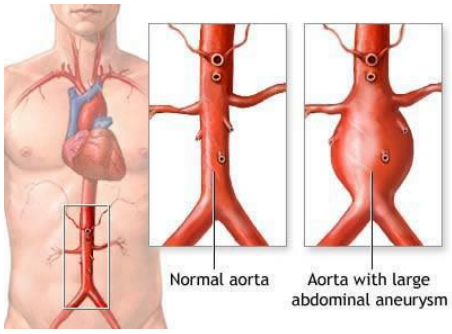
- **Atherosclerotic** aneurysms in most cases

- We have other contributors to **AAA development**, examples include:

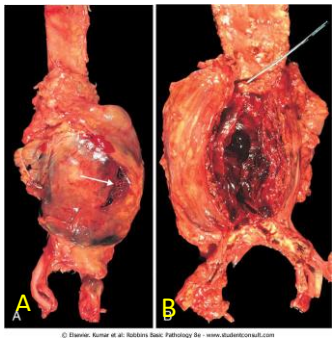
1. **1-Hereditary defects in structural components of the aorta:** (e.g., **Marfan disease** by defective fibrillin production that affects elastic tissue synthesis and maintenance)

2. **2-An altered balance of collagen degradation and synthesis** mediated by local inflammatory infiltrates, because of the effect of destructive proteolytic enzymes (e.g. vasculitis)

Morphology of AAA:



- Usually **below renal arteries** and **above** bifurcation of aorta into common iliac arteries - notice the picture aside.
- can be saccular or fusiform *REMEMBER: the morphology has no connection with a specific disease*
- May be as large as 15 cm in diameter, and as long as 25 cm!
- **Microscopically:** as atherosclerosis is the main cause of AAA; we may see evidence of atherosclerotic plaques, advanced lesions of atherosclerosis and thinning of media .
- frequently contains a laminated mural ***thrombus.***

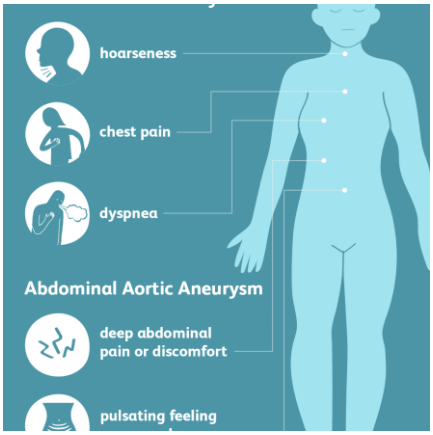


Have a look at this picture. Here, two complications of aortic aneurysms are seen:

A: shows a RUPTURE in the wall of the aorta

B: shows a large MURAL THROMBUS in the lumen of the aorta

Symptoms of aortic aneurysms: . depend mainly on the location of aortic aneurysm.



Thoracic aortic aneurysm: <extra: remember the anatomical relations>

- Hoarseness, Chest pain and Dyspnea

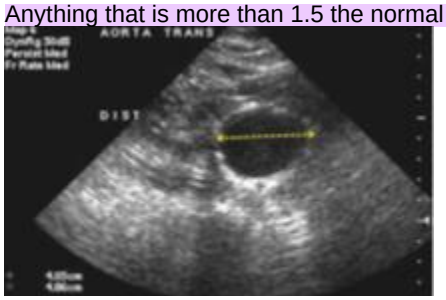
Abdominal Aortic Aneurysm:

- Deep abdominal pain or discomfort or back pain
- Pulsating feeling in the abdomen

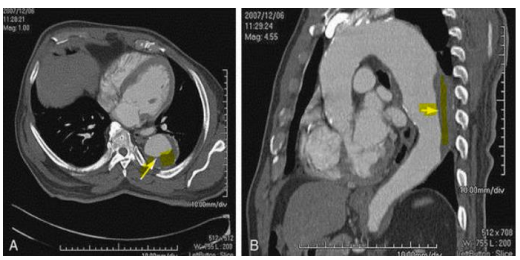
However, many aneurysms are ASYMPTOMTIC

Clinical assessment of AAA: History, physical examination and also ***radiology:***

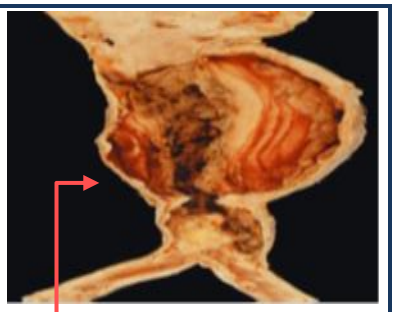
1)This Ultrasound shows us the diameter of aorta. Diameter is an **important prognostic** measurement in aortic aneurysms.
Anything that is more than 1.5 the normal is considered aneurysm



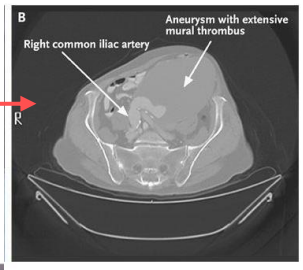
2) This CT image shows an aneurysmal descending thoracic aorta with considerable mural thrombus (notice the yellow arrows pointing at mural thrombus). CT scans help with following up the patient's status

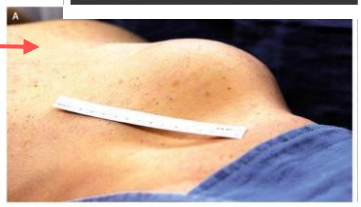


Clinical consequences of AAA:



- **Rupture**→massive hemorrhage, it is the most serious complication. Diameter of the aneurysm is directly proportional to its risk of rupture, mainly those of size (≥5 cm) are very risky.
  - ↳ mortality for **un**ruptured aneurysms =5%. Comparatively, rupture mortality rate > 50%
- **Obstruction** of downstream vessel leads to **ischemic** injury of downstream tissues.
- **Embolism**→mural thrombus
- **Compression** on adjacent structures, especially on large size aortic aneurysms (e.g. ureter or vertebrae may be compressed leading to many symptoms)
- **Abdominal mass** (often pulsating)





MYCOTIC ANEURYSMS:

Infection of a major artery that weakens its wall leads to wall weakening and abnormal wall dilation

can originate from:

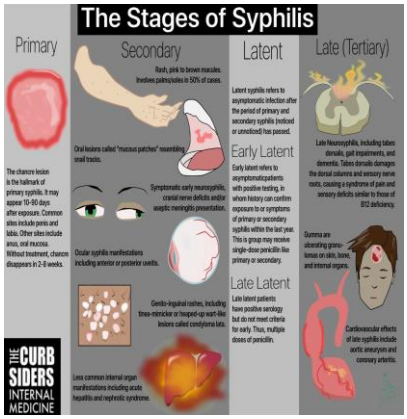
(1) Embolization of a septic thrombus (like what happens in infective endocarditis)

(2) Extension of adjacent suppurative process

(3) Circulating organisms in the bloodstream that infect arterial wall

SYPHILITIC ANEURYSM:

- A rare complication (due to early recognition and treatment of syphilis by antibiotics)
- It appears in the Tertiary stage of syphilis as it can cause "obliterative end-arteritis of **vasa vasorum** of aorta"→ this will lead to ischemic medial injury→weakening of blood vessels→aneurysmal dilation
- Most affected parts of aorta are **ascending aorta** and **aortic annulus** < extra: remember annulus is a fibrous ring at the aortic orifice>, and this will eventually cause valvular insufficiency and aortic valve regurgitation.



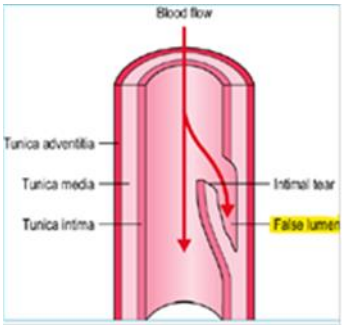
Syphilis is a sexually transmitted disease that is caused by the spirochete "T. pallidum". It has 3 stages: primary, secondary and latent (tertiary).

Is syphilitic aneurysm an example of mycotic aneurysm? NO, because there's no microorganism in the wall of the artery, it's just an inflammation that lead to this problem. So this is just a normal aneurysm, not mycotic aneurysm

DISSECTION:

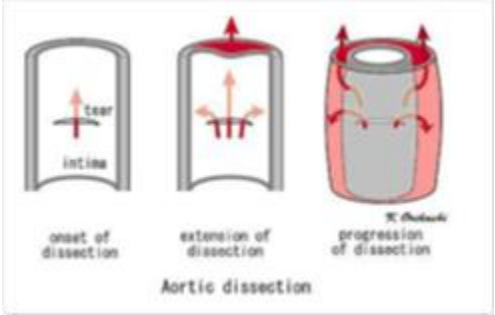
Extravasation of blood through an intimal tear, that enters the wall of artery (inside the layers) as a hematoma dissecting its layers.

- ✓ often but not always aneurysmal i.e. the wall of the affected artery is originally dilated and abnormal
- ✓ Both true and false aneurysms as well as dissections ***can rupture***, often with catastrophic consequences!



AORTIC DISSECTION:

- A catastrophic event whereby blood dissects apart the media to form a blood-filled channel within the aortic wall
- Complications are :
  - massive hemorrhage
  - cardiac tamponade (in case of hemorrhage into the pericardial sac)
- All parts of it can be affected



Aortic Dissection progression:

i. Onset of dissection: an intimal tear in the vessel's wall will allows blood to move to the inside of the media (extravasation)

ii. From there, high pressure found in arteries pushes blood in many directions, so blood starts to collect there

ii. With progression of the defect, the blood will fill the FALSE lumen formed within the media by the dissection, ending with blood collecting in the wrong place out of the normal blood stream

Causes of aortic dissection:

(1) Hypertension is the major risk factor→ pressure-related mechanical and/or ischemic injury of the arterial wall.

(2) Inherited or acquired connective tissue disorders causing abnormal vascular ECM (e.g., Marfan syndrome, Ehlers-Danlos syndrome, vitamin C deficiency, copper metabolic defects)

Marfan syndrome: The most common among inherited or acquired connective tissue disorders associated with aortic dissection. Caused by Autosomal dominant defect of **fibrillin; which is an ECM scaffolding protein required for normal elastic fibers deposition during synthesis .

Manifestations of Marfan syndrome include:

- skeletal abnormalities (elongated axial bones)
- ocular findings (lens subluxation) <extra: lens not working properly>
- cardiovascular manifestations including aortic dissiction

Aortic dissection manifestations:

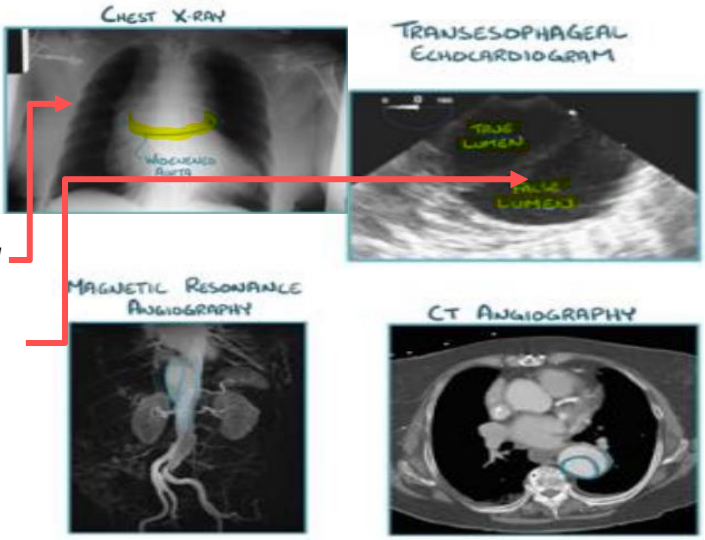
- ✓ Sharp chest/ back pain
- ✓ Weak pulses in downstream arteries
- ✓ If it ruptures into the pericardium →cardiac tamponade
- ✓ Blood pressure difference between Rt & Lt arms in cases of proximal aortic dissection lesions
- ✓ Hypotension; due to the internal hemorrhage that is taking place. And consequently, **shock.**

Diagnosis and clinical assessment of aortic dissection:

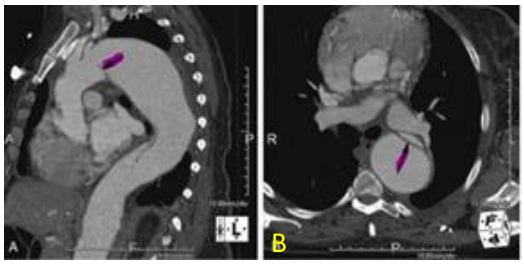
Again, proper history taking, physical examination and ***Radiology***

Many X-rays may guide you in diagnosis. shown to the right:

- *Chest X-ray: the shadow of the heart is large and there is widening of aortic shadow*
- *Transesophageal echocardiogram; helps you to assess the presence of false lumen*
- *CT angiography*
- *Magnetic resonance angiography*



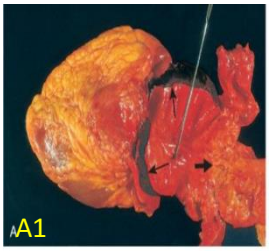
- *Sagittal (A) and axial (B)* ***contrast-enhanced CT*** *images; showing aortic dissections indicated by the purple arrows. Notice the obvious false lumen in pic B*

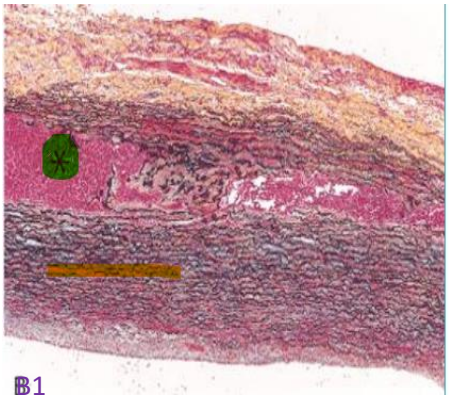


morphology:

A1→ macroscopic morphology

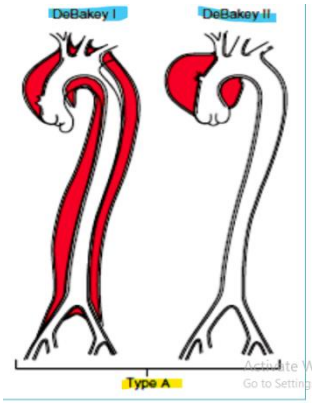
B1→ MICROSCOPICLLY, using some special stains including silver stain that shows elastic fibers in black lines inside the media < notice orange signed area in the picture >





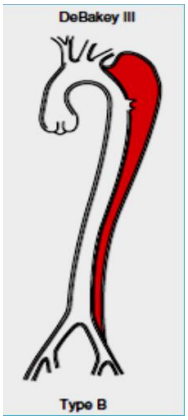
Greenly signed area, illustrates a defect in the media< we see no black lines as the normal situation, instead blood filling the dissected portion is seen here

Aortic dissections types:

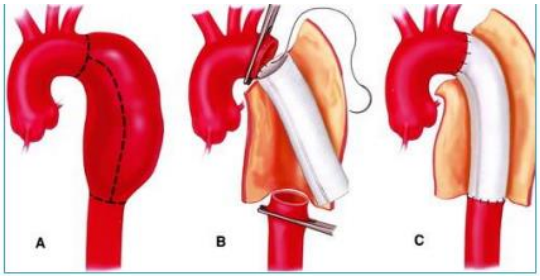


1. Type A dissections:
   - More common
   - More dangerous
   - Proximal to the takeoff of major aortic branches
   - Involve either ascending aorta only or both ascending and descending aorta (these are types I and II of DeBakey classification; which is another way to classify aortic dissections)

2. type B dissections
   - Occur distal to the takeoff of major aortic branches
   - Does not involve ascending aorta
   - usually beginning distal to the subclavian artery
   - Also called DeBakeytype III



- Previously, aortic dissection was typically fatal, but prognosis has markedly improved due to Rapid diagnosis and institution of:
  1. antihypertensive therapy.
  2. surgical procedures involving plication of aorta, wall reconstruction with synthetic graft.



"لا يترك الناس شيئا من أمر دينهم لاستصلاح دُنْيَاهُمْ، إلاَّ فَتَحَ اللهُ عَلَيهِمْ ما هو أضر منه"