

# CARDIOVASCULAR SYSTEM

SUBJECT : Pathology

LEC NO. : 2

DONE BY : Sadeel Alfaqeer

وَقُلْ رَبِّ زِدْنِي عِلْمًا



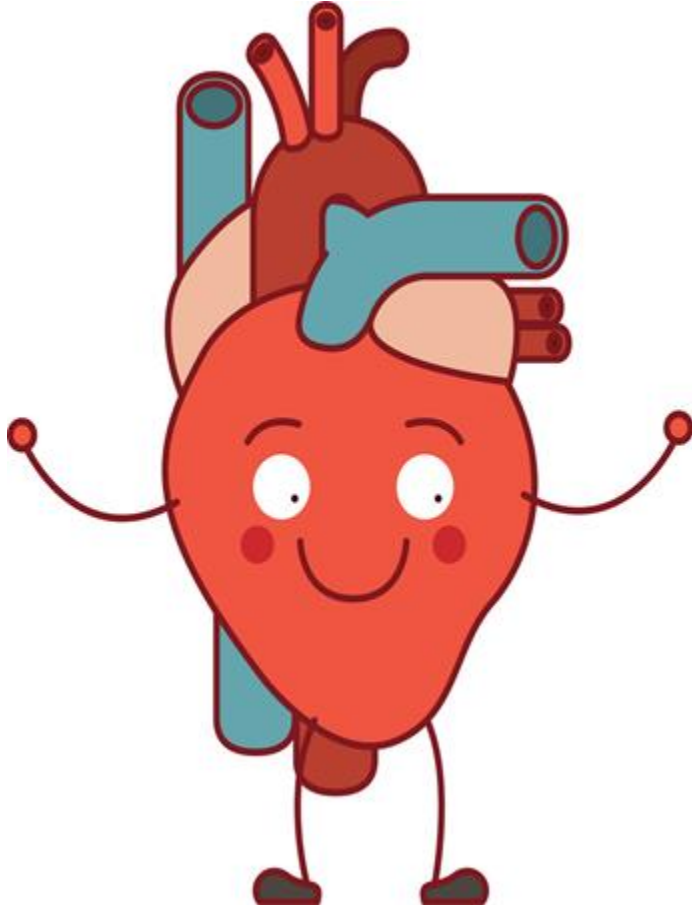
SCAN ME!

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ نَبْدَأُ



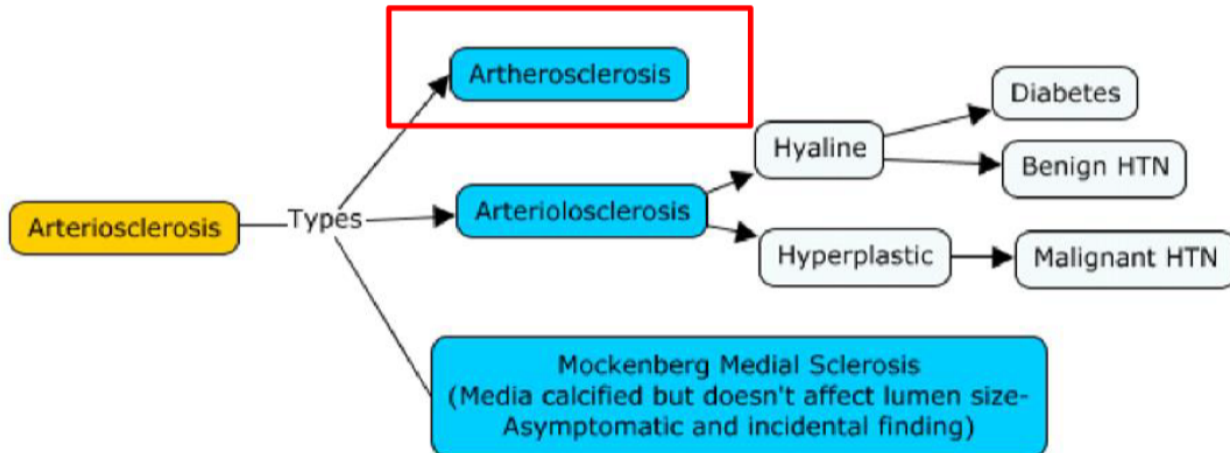
# Arteriosclerosis Cardiovascular Module 2024

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## تذكير احناوين؟

بلشنا المحاضرة الماضية بموضوع ال Arteriosclerosis و حكيينا انه عبارة عن hardning and thickning of the blood vessels & loss of elasticity ، قلنا انه عنا ٣ انواع ، ممكن تصير بال large & medium sized blood vessels بنسويه Atherosclerosis يلي هو disease of intima و هاد كان موضوع المحاضرة الماضية و يلي small blood vessels بنسويه arteriolosclerosis ، او ممكن يصير بال benign or malignant hypertension و كمان رح نحكي عنه بهاي المحاضرة ان شاء الله ، او النوع الأخير Mockenberg medial sclerosis بكون no clinical significant just calcification in media



# Pathogenesis of atherosclerosis

حكيينا البداية بتكون *injury, chronic EC injury* ، و  
حكيينا شو يلي ممكن يسبب ال *injury* بالمحاضرة الأولى

تذكروا *cracking not ulcer*

➤ **Starts with chronic EC injury:** resulting in increased endothelial permeability. Also, dysfunctional injured endothelial cells **express adhesion molecules, e.g., (VCAM-1)** that binds **monocytes & T cells**, followed by their migration into the intima.

➤ **Accumulation of the lipoproteins: LDL and oxidized forms of LDL** → *Permeability* لأننا عننا زيادة بال

➤ **When monocytes** migrate into the intima, they transform into macrophages & foam cells (**foam cells are macrophages engulfing oxidized LDL**)

يس migration ال smooth م ال media وسبرج لل intima  
From Monocytes

➤ **Factors released during this process induces SMC recruitment from media**

بالإضافة بصير express لل vWF بال sub endothelial collagen و adhesion and activation of platelet و ..... موجود

بسلاميد ١١ من المحاضرة الماضية



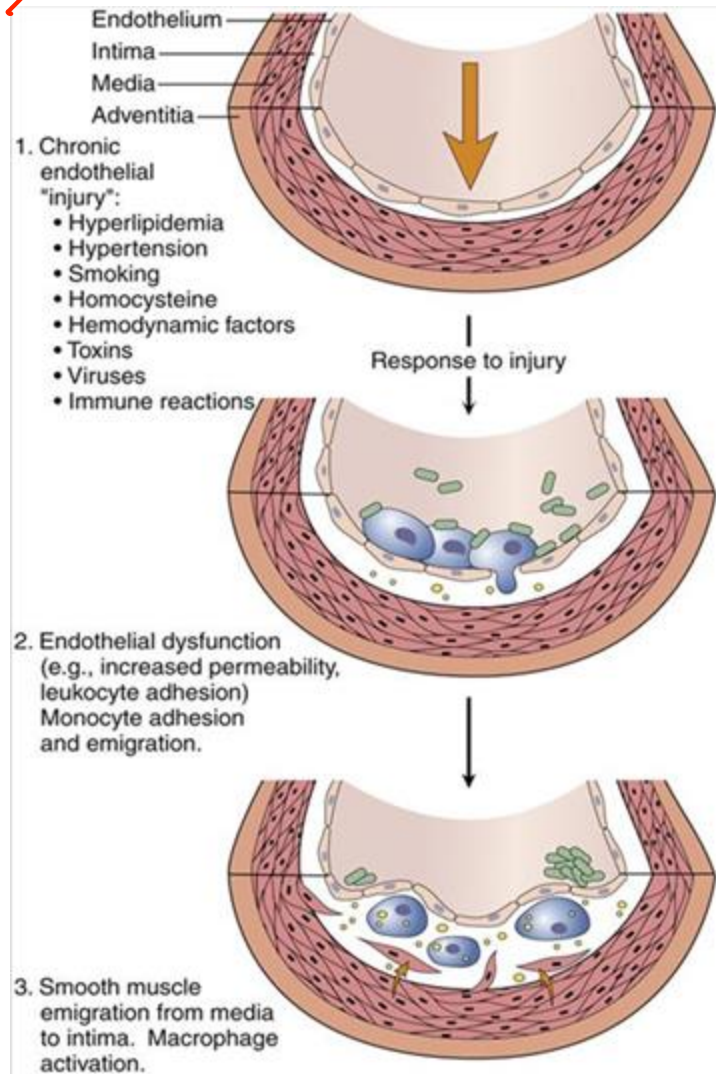
# Pathogenesis of atherosclerosis

- Lipid (oxidized LDL) accumulation in both cells macrophages & SMCs → **fatty streaks**  
*One of gross appearance of atherosclerosis in the early stages*  
*Patches ,atheroma ,plaques* لسما ما وصلنا لل
- Some of which die, releasing lipid & necrotic debris
- Activated macrophages produce **free radicles**, thus, aggravating LDL oxidation  
chemical mediator يعني ببلشوا يعطوا <sup>أكسدة</sup>
- The **activated T lymphocytes** elaborate **INF- $\gamma$** , which → **stimulate macrophages, ECs & SMCs** to release **growth factors GF**
- **GF** promote SMC proliferation & **ECM** synthesis (mainly collagen) → **stabilizes the atheroma, and produces a fibrous cap** covering the central core of lipid-laden cells & fatty debris  
حسينه المحاطرة للانسجة





بالوضع الطبيعي ال ECs المفروض تكون smooth ما فيها cracks



# Atherosclerosis

Evolution of arterial wall changes in the response to injury hypothesis.

1 Normal.

حكياناااه ، شايفين كله تكرر

2. Endothelial injury with adhesion of monocytes & platelets to sites where endothelial has been lost

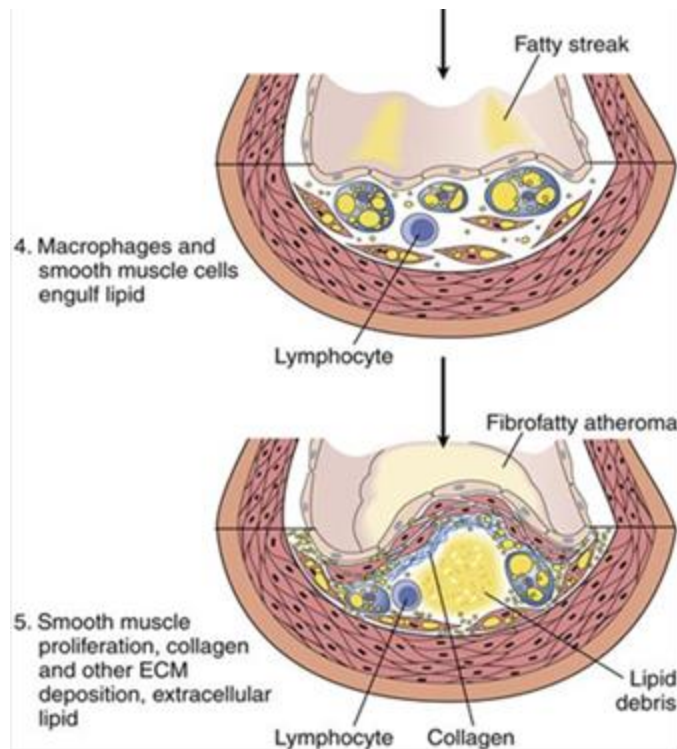
3. Migration of monocytes & smooth muscle cells (SMC) into intima.

هاد الفيديو بسهل عليكم موضوع ال pathogenesis ، احضروه ما بياخذ وقت

<https://youtu.be/N33JsBeziEY?si=LC6qUQyj4QhiG3Yg>



# Atherosclerosis



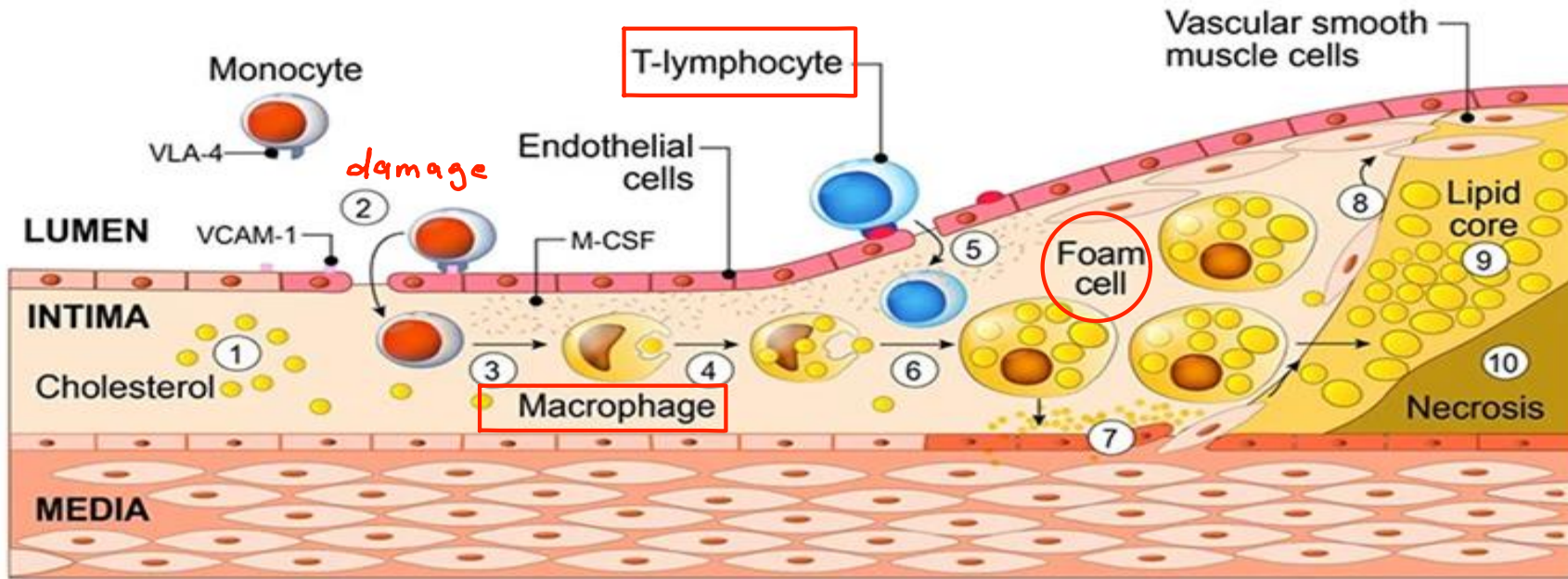
4. SMC proliferation in intima with extracellular matrix (ECM) elaboration

5. Well-developed atheromatous plaque



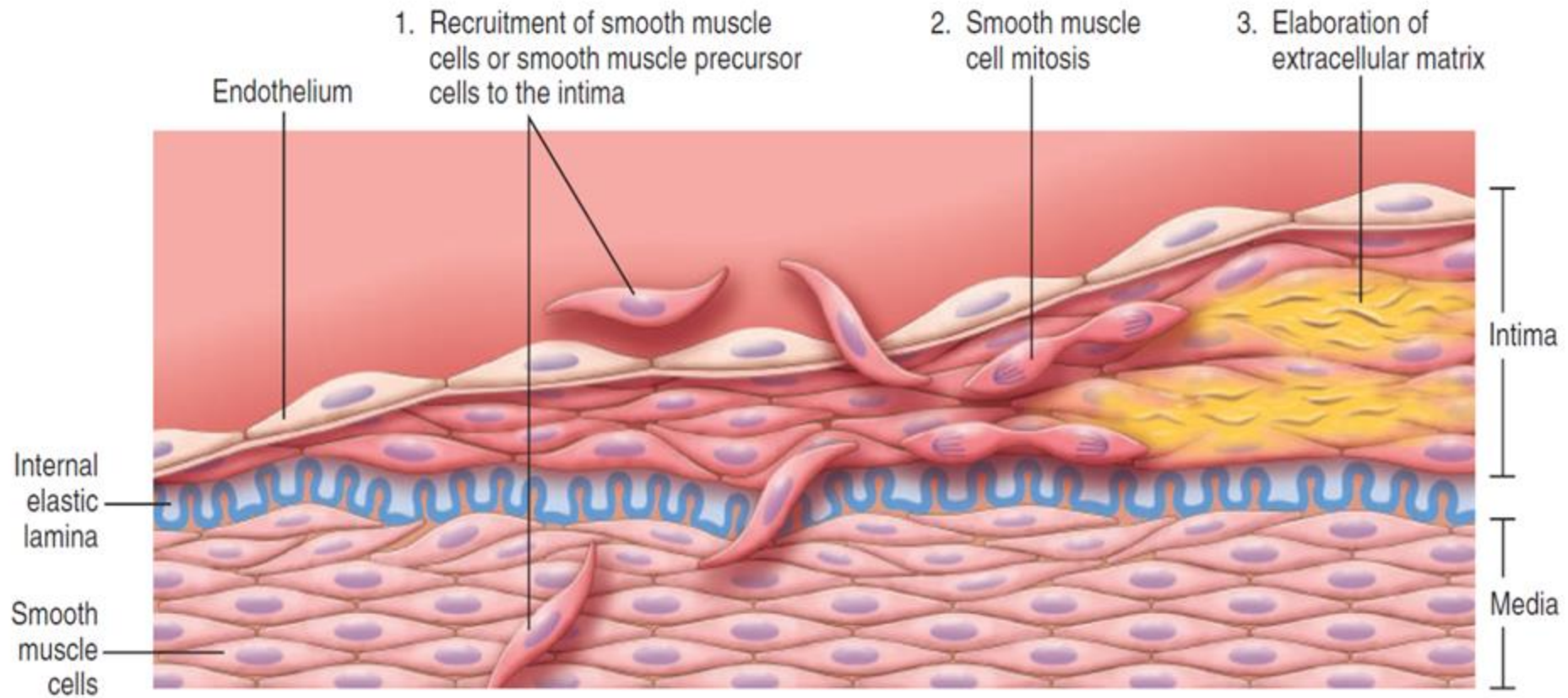
توضیح اسکلام

# Pathogenesis of atherosclerosis





# Pathogenesis of atherosclerosis



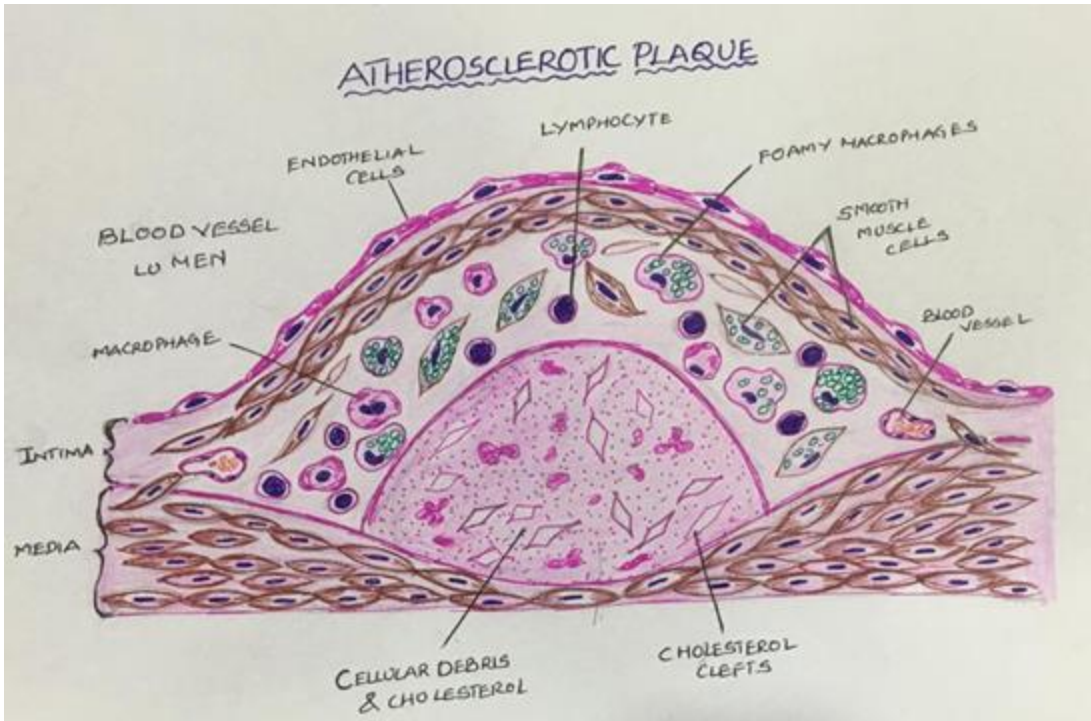
**Fig. 10.6** Stereotypical response to vascular injury. Schematic diagram of intimal thickening, emphasizing intimal smooth muscle cell migration and proliferation associated with extracellular matrix synthesis. Intimal smooth muscle cells may derive from the underlying media or may be recruited from circulating precursors; they are depicted in a color different from that of the medial smooth muscle cells, to emphasize their distinct phenotype.



# Pathogenesis of atherosclerosis

## Summary

انتبهوا انه في عنا **arteries** لأنه زي ما بنعرف اي شي يكبر بالجسم بعمل **Angiogenesis** و هاي ال **plaque** ممكن تكبر كثير و تسكر ال **blood vessel**



A plaques have three principal components;

- ✓ **Cells** = SMCs + macrophages + T lymphocytes cells;
- ✓ **ECM** = collagen + elastic fibers
- ✓ **Lipids**: mainly oxidized LDL

**AND COMPOSED MAINLY OF**

- (1) **Fibrous cap** (SMCs & collagen).
- (2) **Necrotic core**, deep to the fibrous cap containing lipids + foam cells + debris from dead cells

وبعير تكسير ال **elastic fibers** حشانه هيلك بنفقد ال **elasticity**

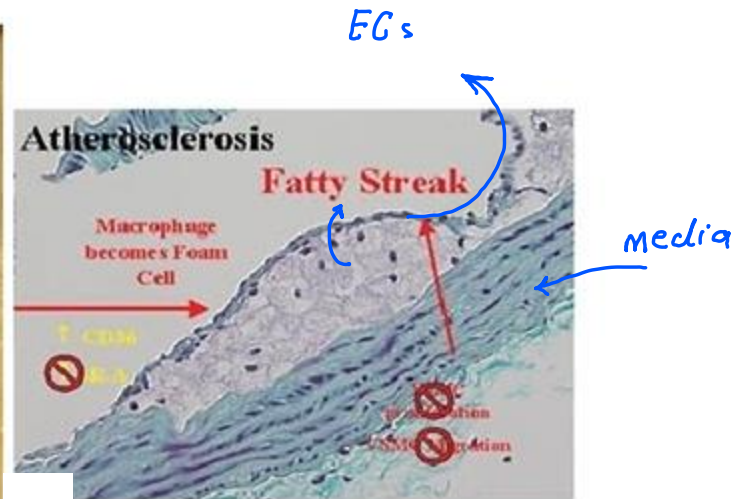
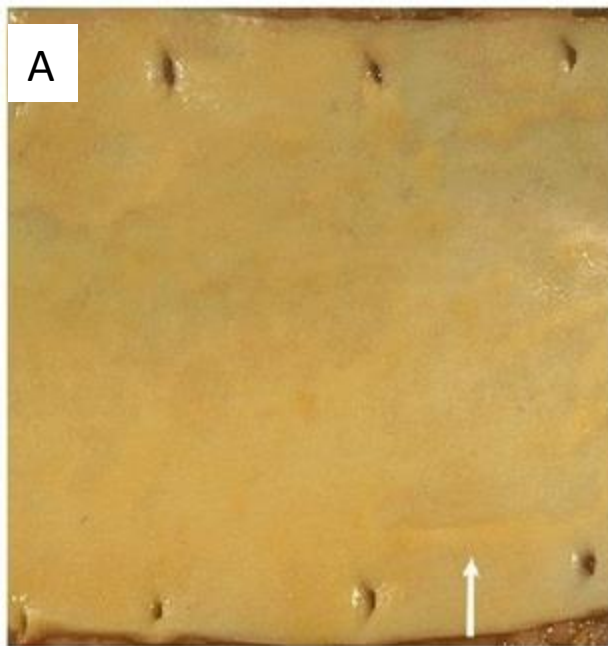
هاي ال **core** بتعمل **pressure effect** على ال **smooth muscle** و الطبقة يلي تحتها و بصير **loss of elasticity and atrophy of a** **smooth muscle** بهاي المنطقة عشان هيك هاي المنطقة **media** رح تضعف من الشريان و تسبب واحدة من ال **complication** رح نحكي عنها اسماها **aneurysm** كأنه بالون منفوخ نتيجة ال **inflammatory process** وتراكم الدهون

# MORPHOLOGY OF ATHEROMAS

## Fatty Streaks

حکینا بتصیر بال early stages

### Fatty streak



**A. Grossly, the fatty streaks** are multiple, minute **yellow flat spots**

**B. Histology, fatty streaks** are composed of **lipid-filled foam cells only**

مكونة من

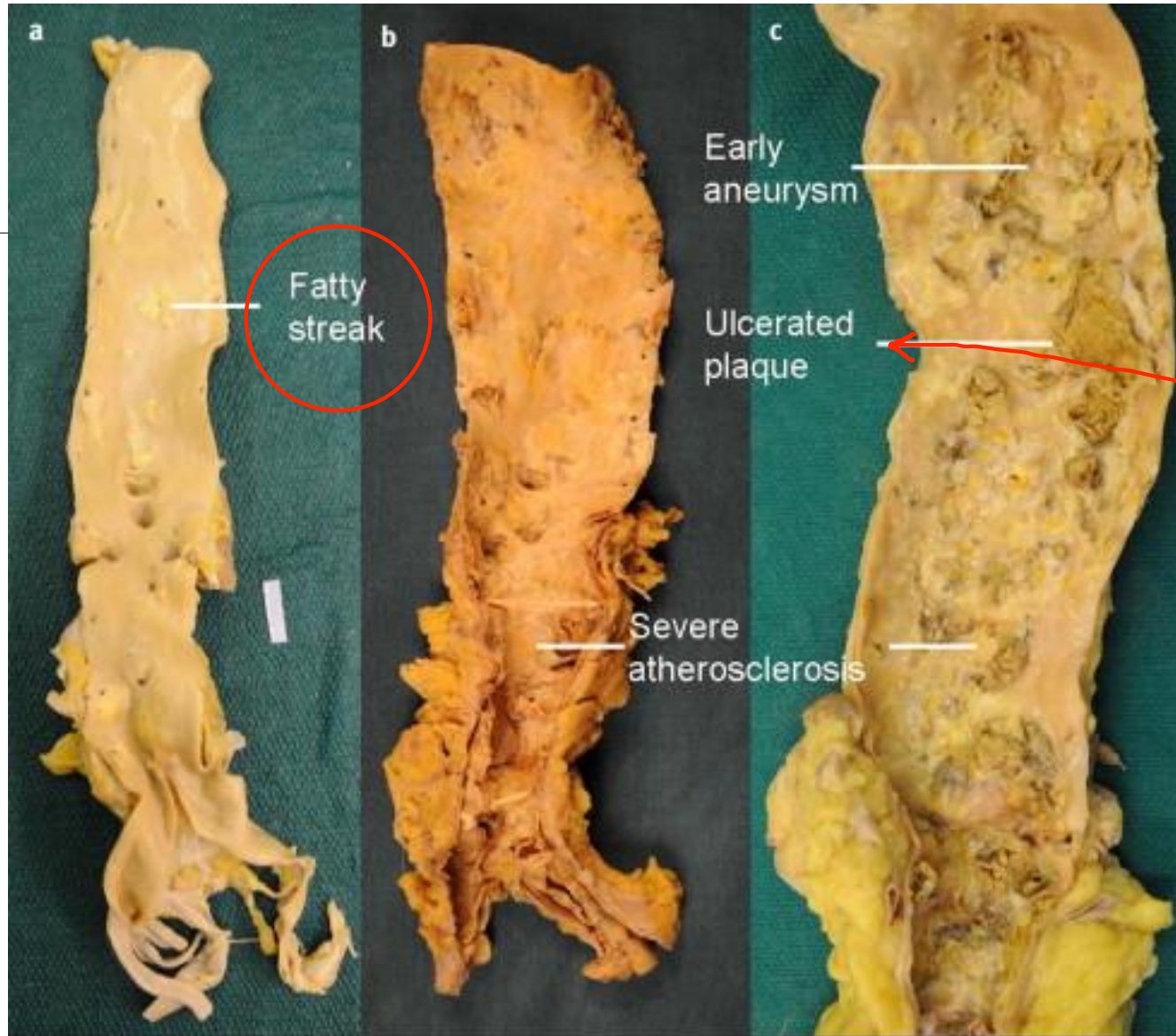
طیب هل هی مضره ؟ لا مو مضره ، لكن لو صار تجمعات و inflammatory reaction





هون صار يتكون عندي atherosclerosis plaque

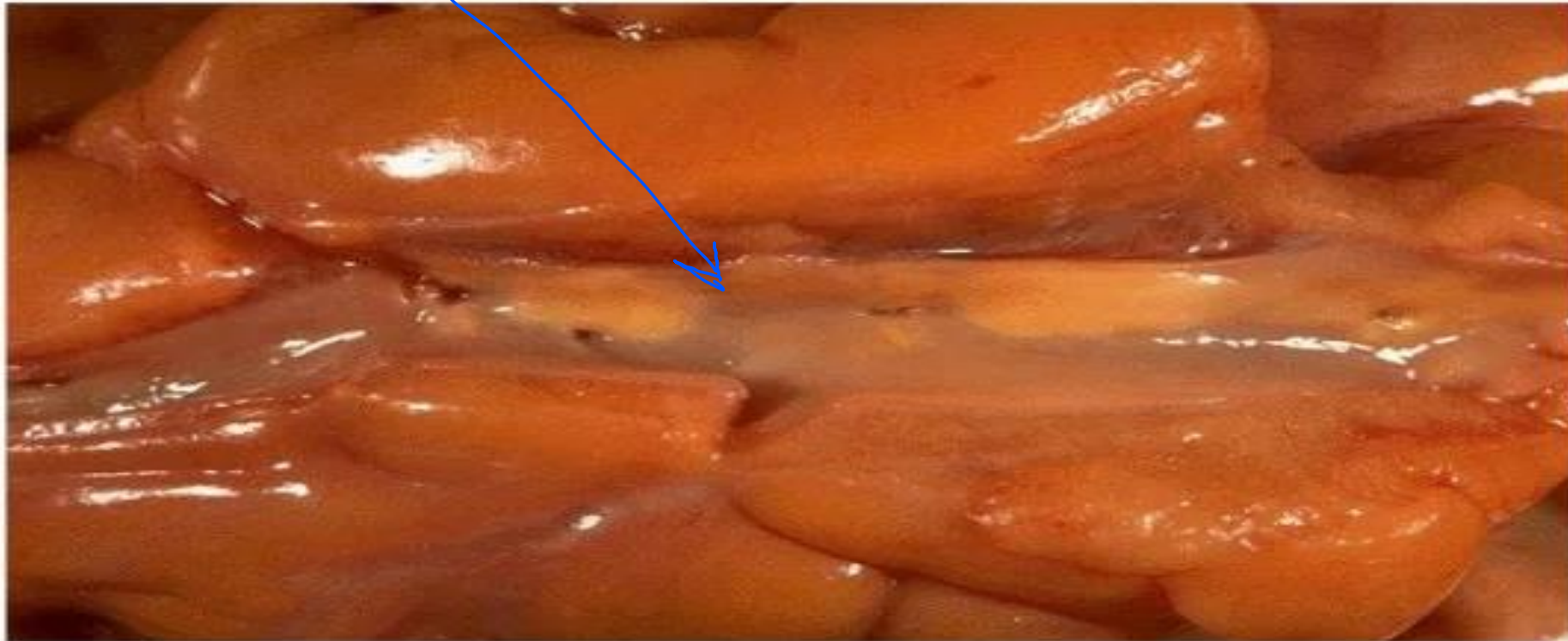
هون عنا ال Aorta ، ليش لونها أصفر ؟  
لأنه عملناها fixation بال formalin



mass like lesion ،  
ممکن بمراحل متقدمة يتشكل عندي  
ulcerated plaques

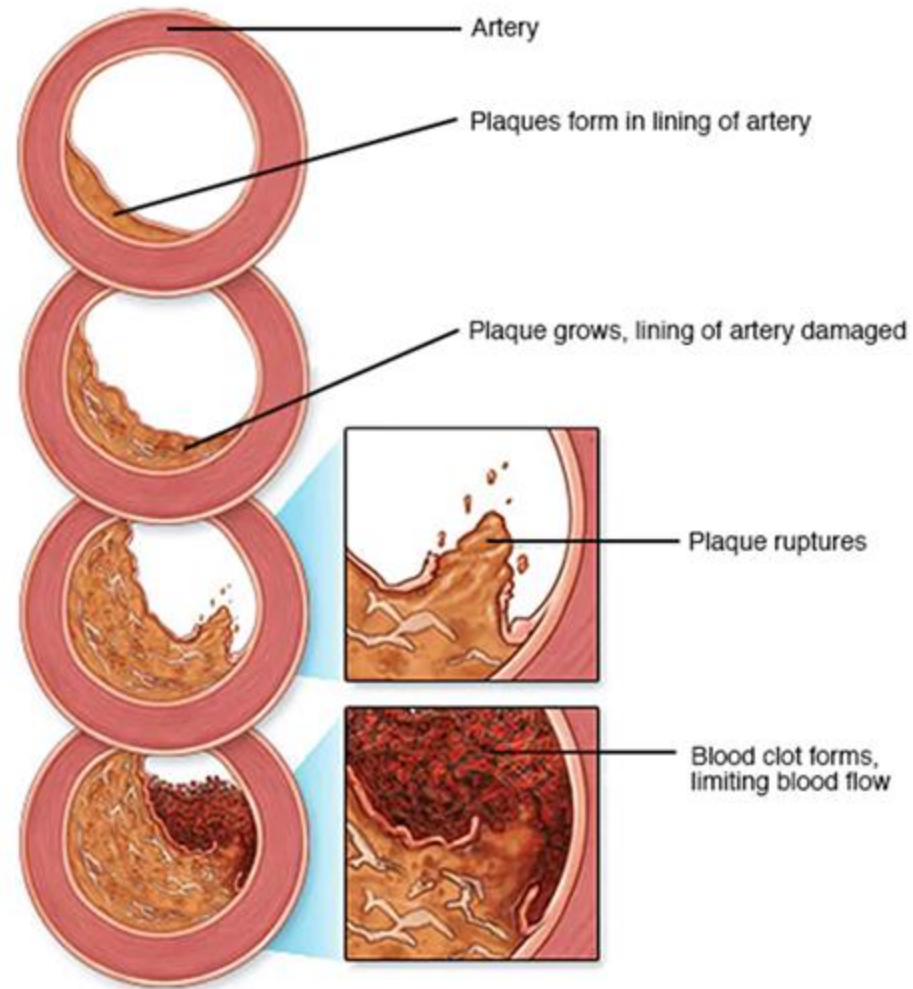


# Fatty Streaks, Coronary Artery with Increased Fat





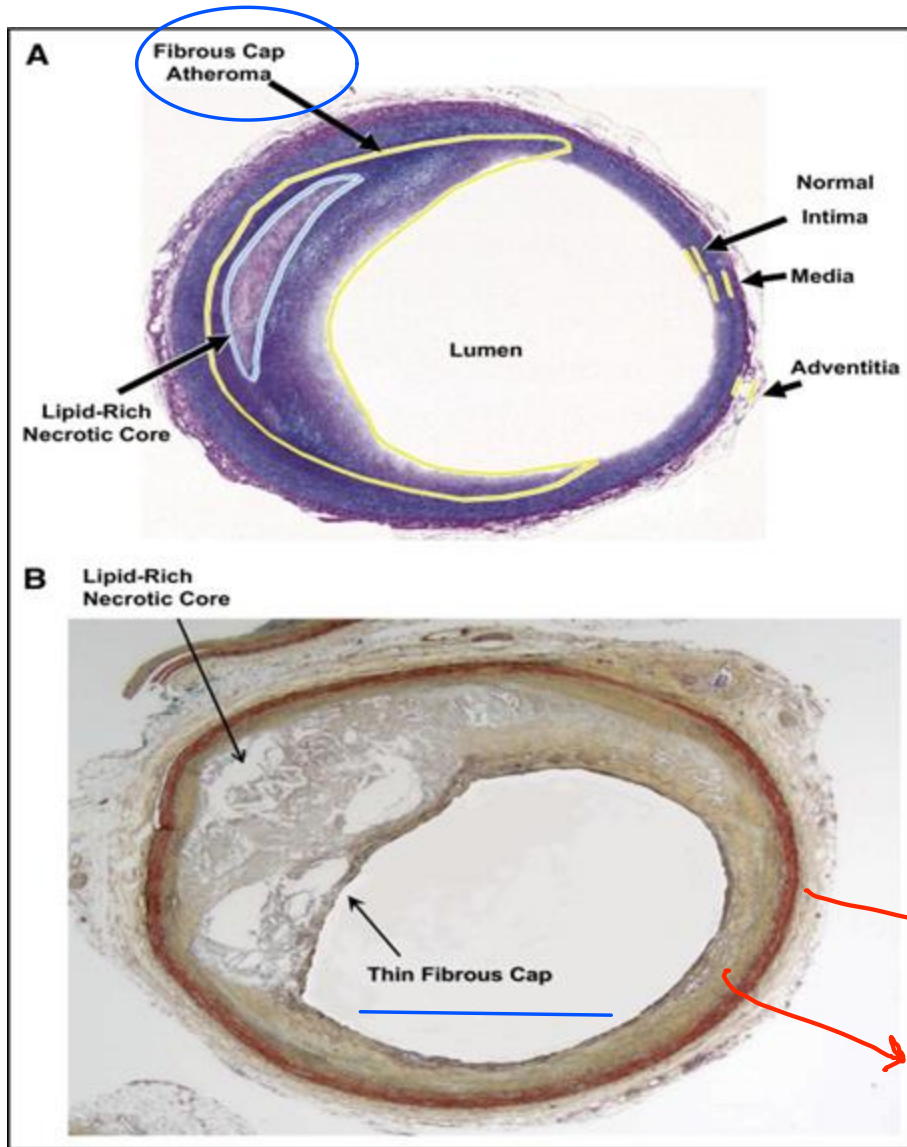
# Pathogenesis of atherosclerosis



Rupture of the fibrous cap → superimposed thrombus → leads to catastrophic consequences (sudden occlusion of the vessel or thromboembolism)

مجرد ما صار rupture لل cap بصير عنا ulceration ، وتتجمع الصفائح و احنا بنعرف انه الصفائح بتتجمع لما يصير عنا injury و تلتصق على ال ECs بسبب





# Atheromas: histology

→ media  
→ intima





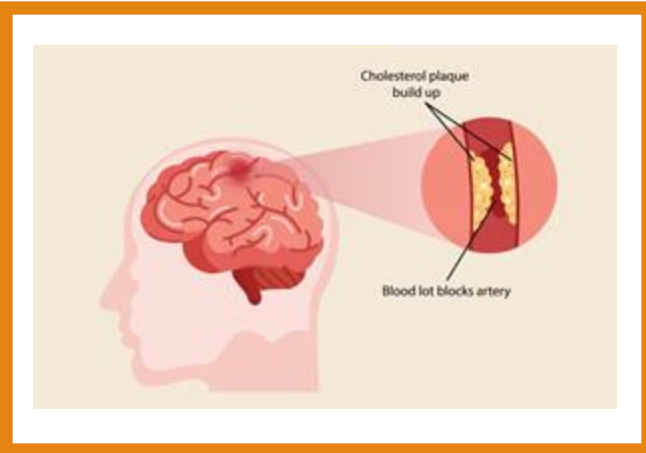
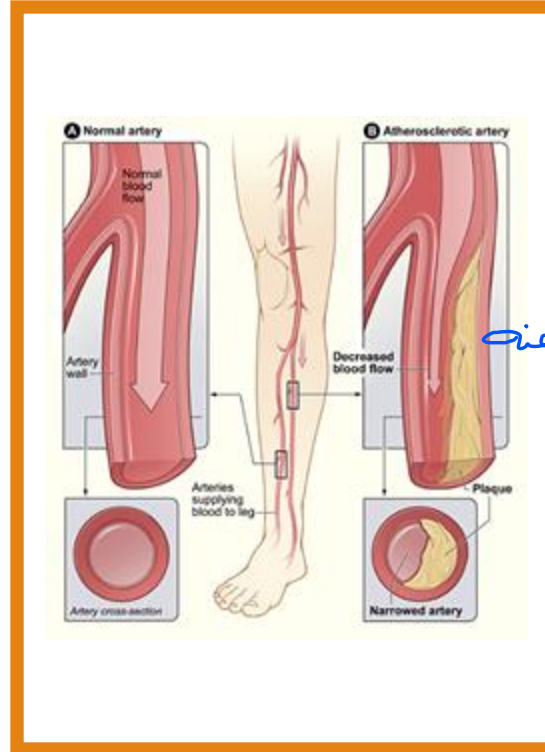
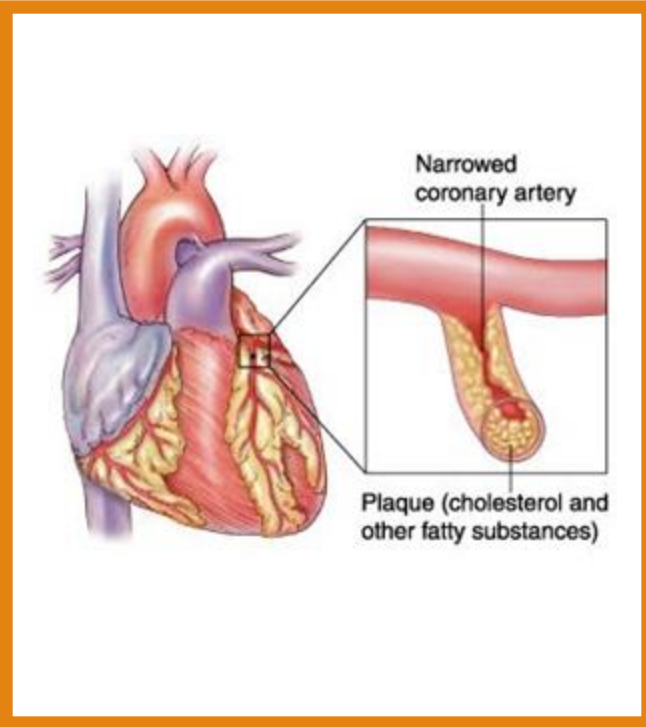
# Atherosclerosis (Vessels involved)

Most common vessels involved by atherosclerosis are:

ال atherosclerosis ما بتصير بكل ال arteries ، هالأرح نحكي عن  
ال most common arteries يلي بصير فيهم تصلب

1. Coronary arteries (IHD) Ischemic heart disease
2. Infrarenal abdominal aorta (aneurysms) تنسد الشرايين يلي بتغذي الأقدام فمممكن تعمل غرغرينا
3. Popliteal arteries (gangrene)
4. Internal carotid arteries (stroke)
5. The vessels of the circle of Willis (stroke)

عادةً ال atheroma بتتكون at the site of branch ، من الأماكن  
يلي بتفرع منها الشريان و ليكن ال aorta مثلاً ،



الاختلاف بينهم يعتمد على المكونات الموجودة عند كل وحدة

عرضة انه يصير فيها *complications* اكثر ، لأنه كل ما كانت ال *cap* رفيعة كلما زادت احتمالية حدوث ال *rupture* وال *ulceration* و لما يصير *rupture* لل *fibrous cap* رح تصير مكوناتها الداخلية *direct contact* مع ال *blood* بالتالي بتكون عندي *thrombus* طبعاً هاي الحالة *fatal* ممكن تكون لأنه رح يصير تسكير لل *blood vessel* ويكون *suddenly*

# Types of Plaque

بكون هش و *easily rupture an ulcerated*

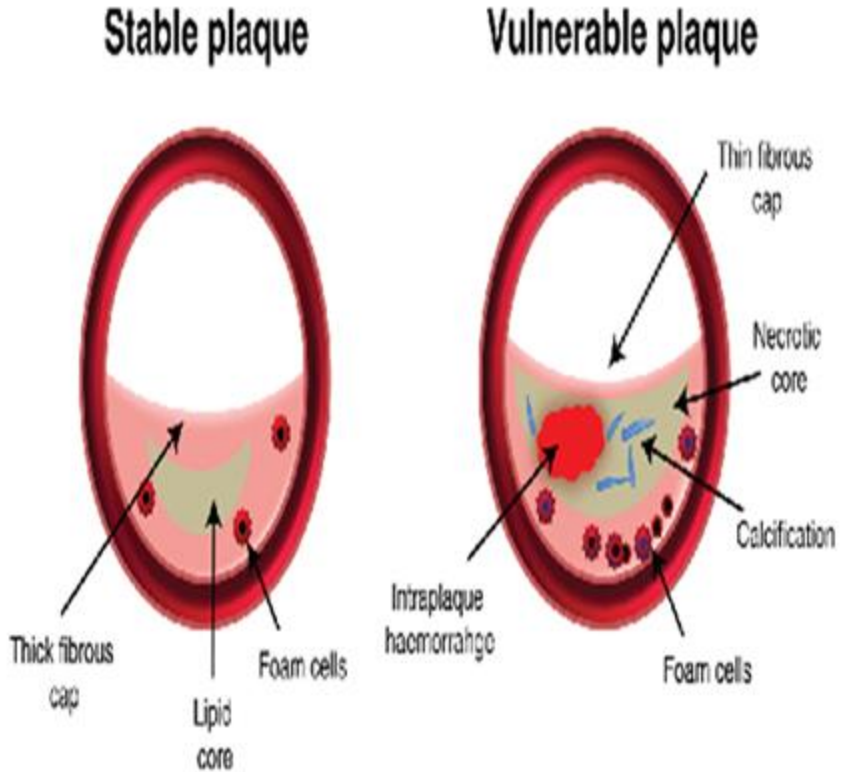
**Vulnerable plaques:** leads to dramatic and fatal ischemic complications

- Large numbers of foam cells and abundant extracellular lipid
- Thin fibrous caps
- Clusters of inflammatory cells.

بكون *more stable* لأنه أقوى

**Stable Plaques:** leads to chronic ischemia

- Minimal lipid accumulation
- Dense collagen, thick fibrous cap
- Minimal inflammation
- The factors involved to promote either a vulnerable plaque or a stable plaque are not clear yet, however, the major differences between a vulnerable and stable plaque are that vulnerable plaques have a "rich-lipid core" and a "thin fibrous cap" in comparison with the "thick fibrous cap" and the "poor lipid"
- Whereas stabilized atherosclerotic lesions progress slowly, vulnerable plaques suddenly rupture and cause thrombosis, resulting in acute coronary syndrome (ACS).



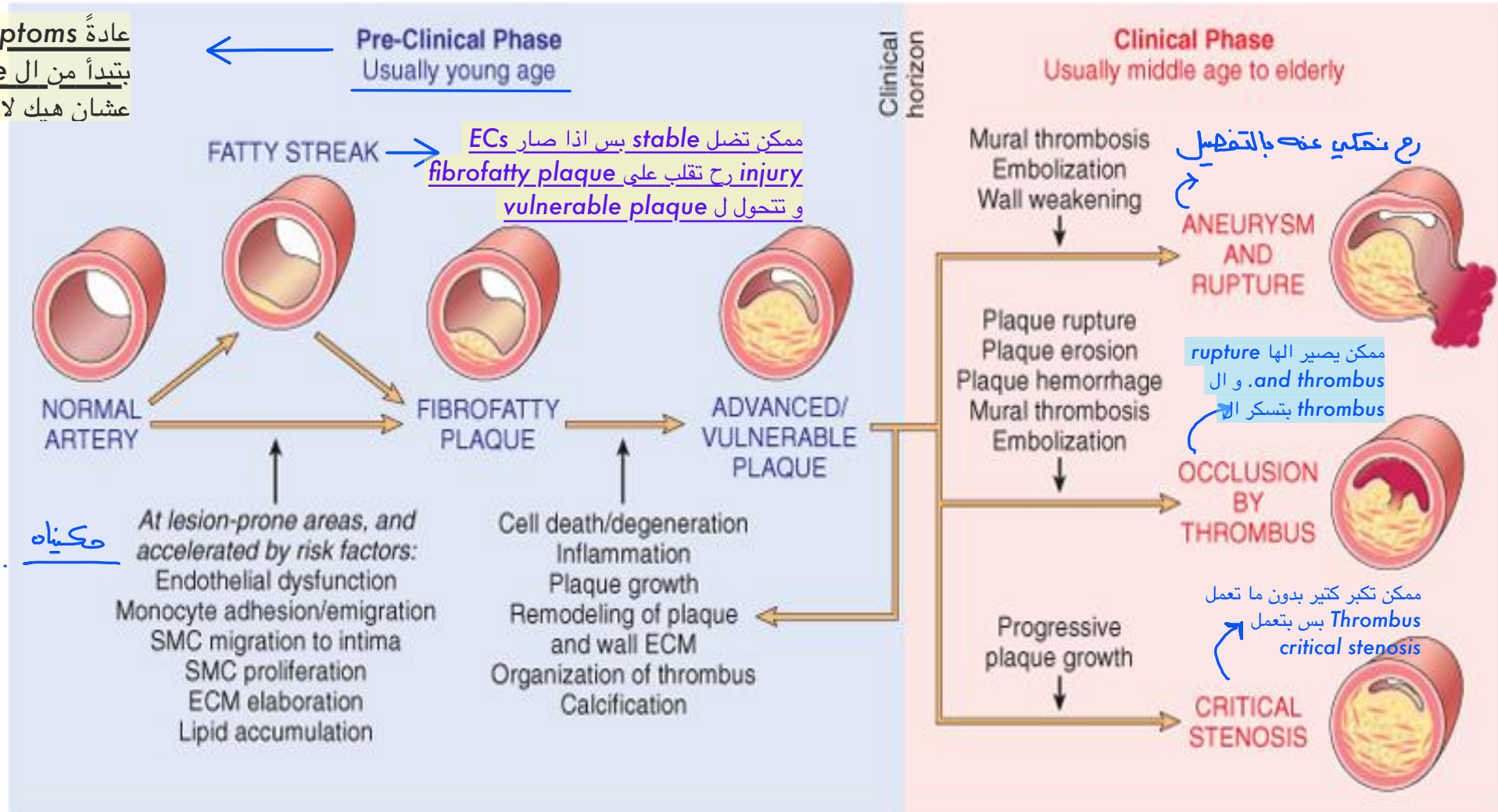
من اسمها هي *stable* ف بتكون اقل عرضة انها تكون *thrombus* ، بس مشكلتهم انهم ماخذين حيز بال *blood vessel* بقللوا من قطر ال *blood supply* و يعملوا *chronic ischemia* لكن المريض مش عرضة انه يصير *rupture* و خثرة و تسكر زي ال *vulnerable*



كل اشبي بعيد بعضه ، برضو هون معلومات مكررة 😊😊

# Natural history, morphologic features, main pathogenic events, & clinical complications of atherosclerosis.

عادةً no symptoms و بتبدأ من ال young age ، عشان هيك لازم نهتم بصحتنا





# Effects and complications of atherosclerotic plaques

رُهم نَقَطَاتِ  
↓

- **Narrowing**, or even complete occlusion of the arterial lumen, by progressively enlarging plaque causing ischemic injury. حكيينا انه لما يصير rupture و تلتقي مكونات ال cap مع الدم رح يصير عنا thrombus لأنه مكونات ال plaque بتكون very highly thrombogenic ، و بس يصير thrombus ، اما انها بتسكر ال lumen completely or partially او انها تنتقل لمكان تاني بالجسم يعني thrombo embolism و هاد ال embolism ممكن يكون من الخثرة نفسها او من مكونات ال plaque
- **Ulceration, fissuring, erosion or rupture**, of the plaques fibrous cap exposes the bloodstream to highly thrombogenic substances and causes **thrombus formation**.

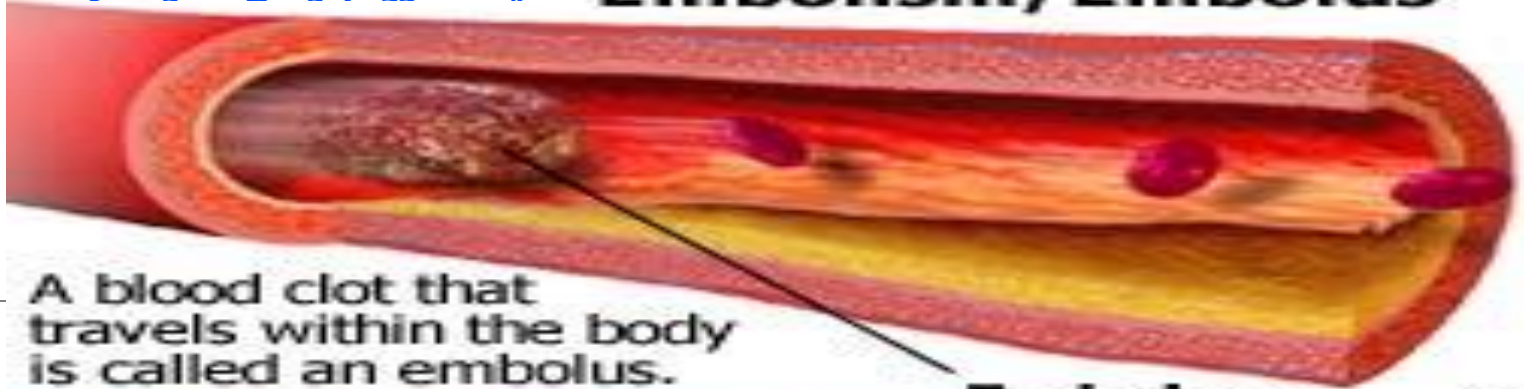
**Such thrombi can:** (I) occlude the lumen, partially or completely (II) dislodged, resulting in systemic thromboembolism.

Note: If the patient survives the initial vascular occlusion, the thrombi may become organized & incorporated into the growing plaque. يعني ال plaque رح يكبر شوي، صح ال thrombus ذابت ولكن ذابت و دخلت جوا ال plaque يلي تحتها

- **Intra-plaque hemorrhage**

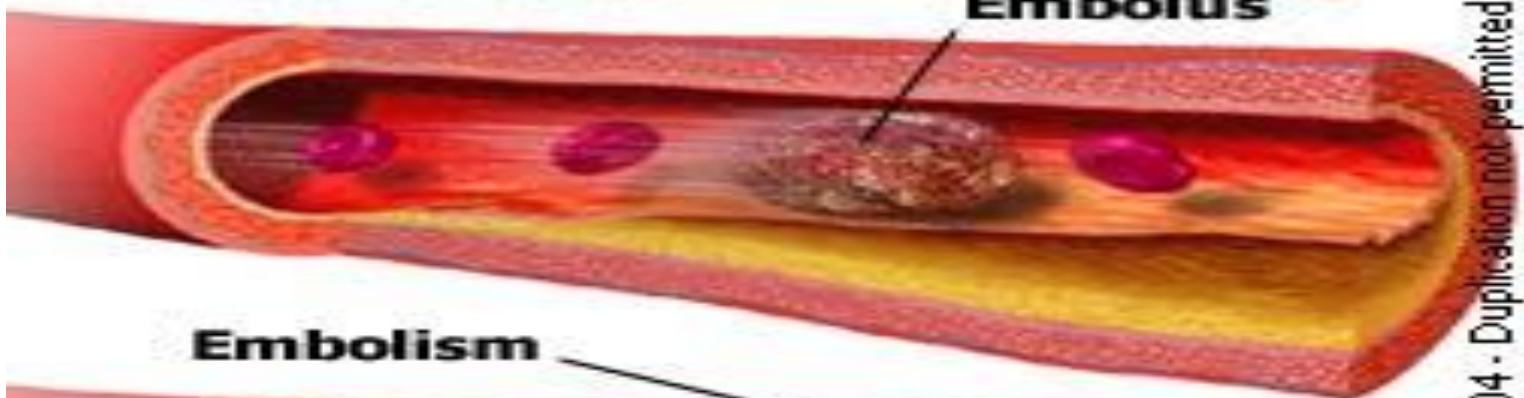


# Embolism/ Embolus

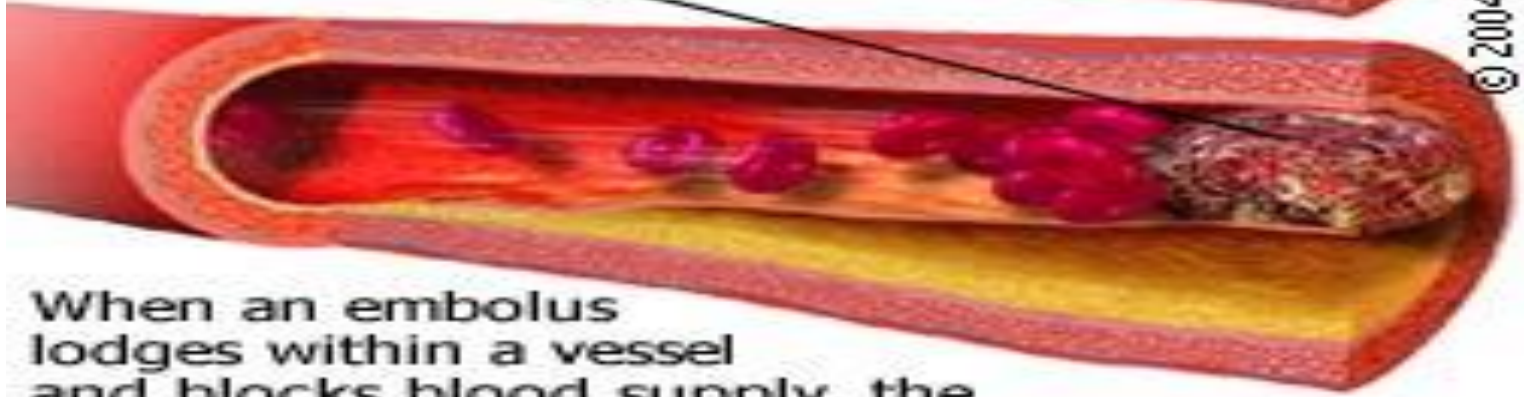


A blood clot that travels within the body is called an embolus.

**Embolus**



**Embolism**

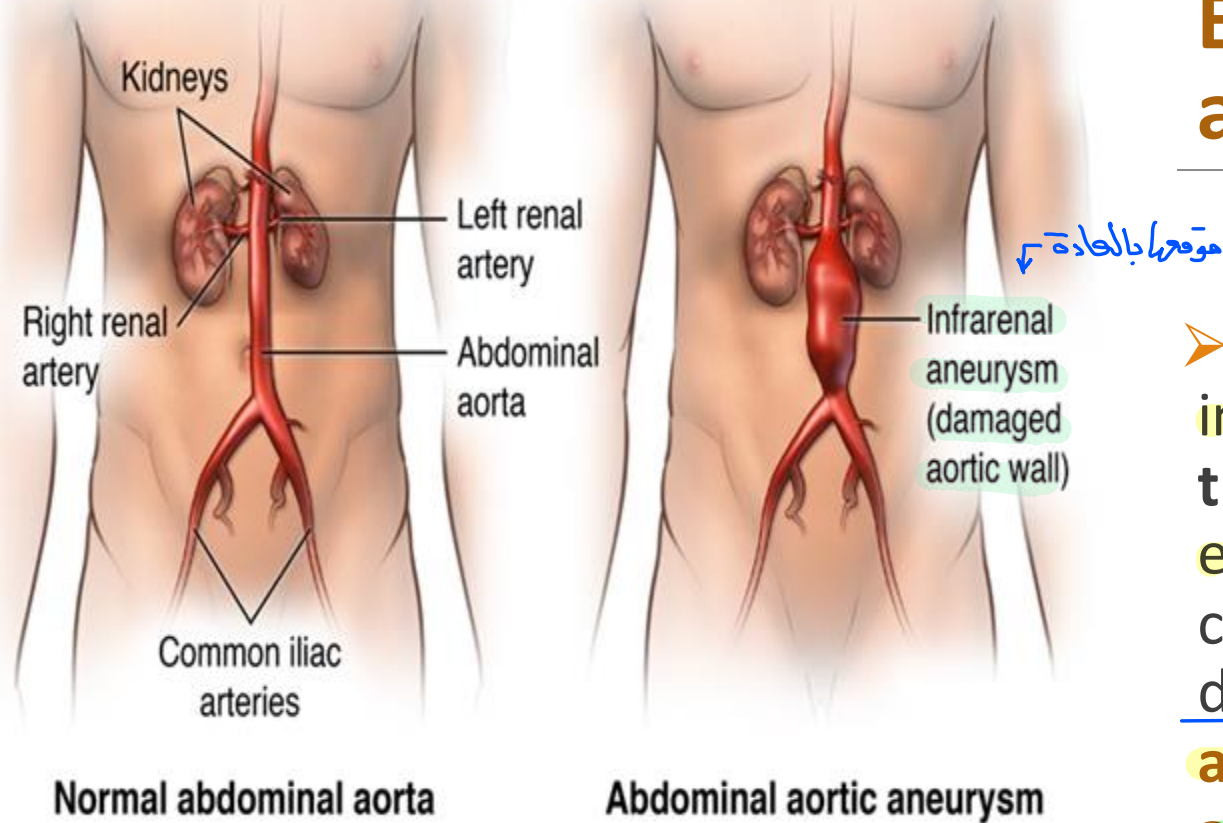


When an embolus lodges within a vessel and blocks blood supply, the condition is called an embolism.

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## Effects and complications of atherosclerotic plaques



- **Aneurysm formation: atheroma induce pressure or ischemic atrophy of the underlying media, with loss of elastic tissue in large arteries, this causes weakness of the arterial wall & development of atheromatous aneurysms (commonest type of aneurysm) that may rupture.**

↪ The complication



# Clinical Consequences of Atherosclerotic Disease

رح نفضّل فيهم بالمحاضرات القادمة ان شاء الله

حسب ال Organ

✓ Signs and symptoms related to ischemia in the heart, brain, kidneys, and lower extremities

✓ Myocardial infarction (heart attack), cerebral infarction (stroke), aortic aneurysms, and peripheral vascular disease (gangrene of extremities) → <sup>الأخطار</sup> *diy gangrene* عادة

✓ **Atheroembolism:** ruptured plaque can discharge debris into the blood, producing microemboli composed of plaque contents. embolism ممكن تكون جاية من حكيها ، انه ال

✓ Outcomes depends on **size of the affected vessel, size and stability of the plaques**

↓  
Stable or vulnerable?



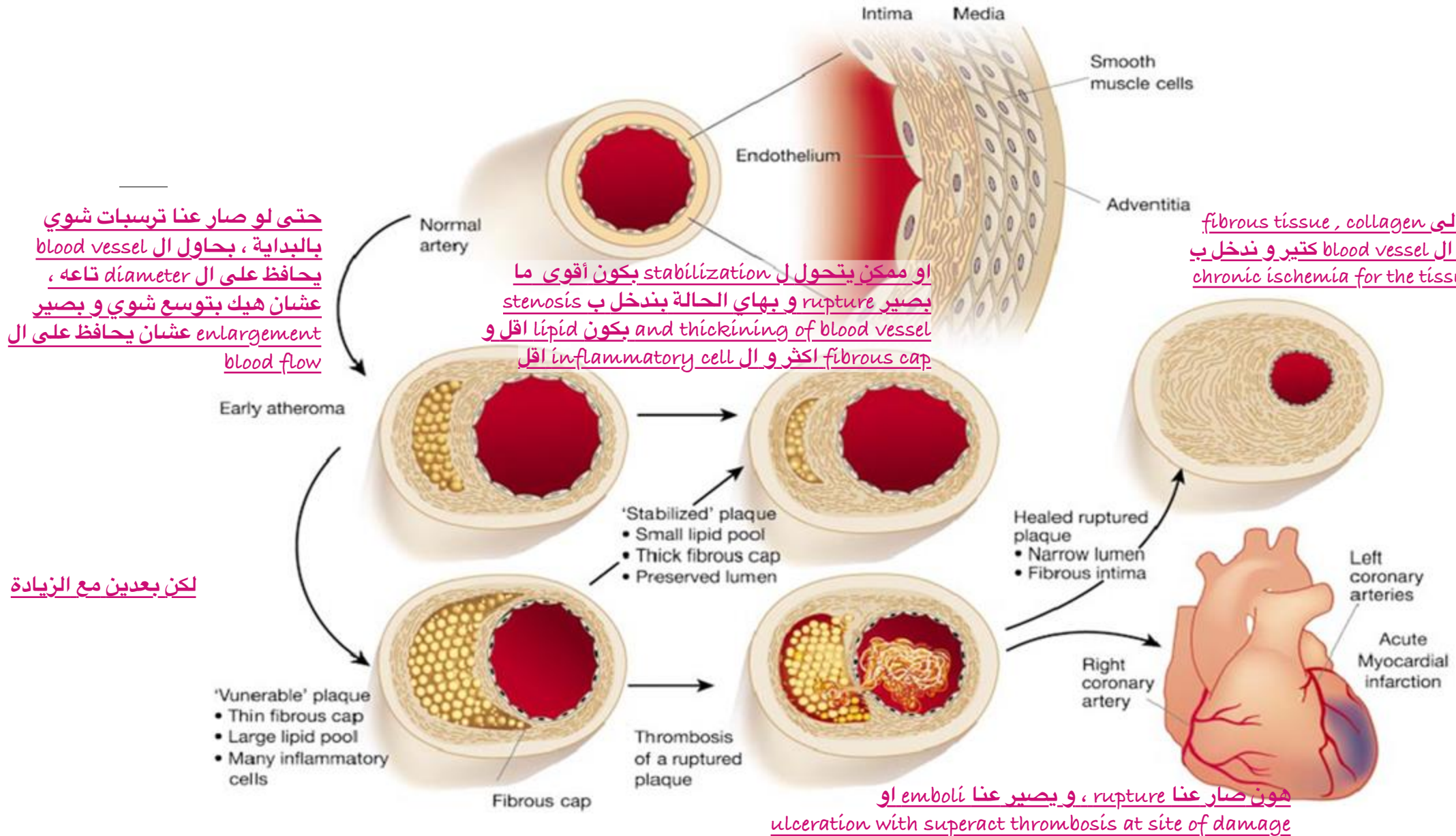
# Atherosclerotic Stenosis

مرات بال **early stages** ال **media** و لأنها **elastic** بتحاول تعمل **stretching** عشان تزيد ال **vessel circumference** ، اول ما يكون عندي **plaque** صغيرة بالشريان

- **At early stages:** remodeling of the media tends to preserve the luminal diameter by increasing the vessel circumference. بعدين بصير عنا stenosis بصير عنا damage and remodelling mechanism
- **Critical stenosis:** chronic occlusion limits flow so severely that tissue demand exceeds supply.
- **Arterial remodeling** is currently being recognized as an important determinant in vascular pathology in which narrowing of the lumen is the predominant feature. Not only expansive remodeling (enlargement), but also constrictive remodeling (shrinkage) is observed. بالبدائية بصير enlargement لكن بعدين بصير shrinkage
- **What is Remodeling in atherosclerosis?**
- Vascular remodeling is an active process of structural change that involves changes in at least four cellular processes: cell growth, cell death, cell migration, and the synthesis or degradation of extracellular matrix. بتصير تغيرات هياي التغيرات تحدث نتيجة انه ال blood vessel يلي صار فيه هاد التغيير بتحاول يعمل positive remodeling mechanism in order to preserve blood flow
- With development of atherosclerotic plaque, outward remodeling may preserve size of lumen. However, necessary degradation of matrix by metalloproteinases may increase risk of plaque rupture. Healing process after plaque rupture may result in inward remodeling. preserve blood flow
- Mechanisms involved in arterial remodeling include fibrosis, hyperplasia of the arterial intima and media, changes in vascular collagen and elastin, endothelial dysfunction, and arterial calcification. Migration and proliferation of vascular smooth muscle cells (VSMCs) contribute to thickening of the arterial intima.







حتى لو صار عنا ترسبات شوي  
 بالبداية ، بحاول ال blood vessel  
 يحافظ على ال diameter تاعه ،  
 عشان هيك بتوسع شوي و بصير  
 enlargement عشان يحافظ على ال  
 blood flow

لكن بعدين مع الزيادة

او ممكن يتحول ل stabilization يكون أقوى ما  
 بصير rupture و بهاي الحالة بندخل ب stenosis  
 and thickening of blood vessel يكون lipid اقل و  
 inflammatory cell اكثر و ال fibrous cap اقل

ممكن كل ال plaque تتحول الى fibrous tissue , collagen  
 organized و يقللوا من قطر ال blood vessel كثير و ندخل ب  
 chronic ischemia for the tissue that are supply by this  
 vessel

هون صار عنا rupture ، و بصير عنا emboli او  
 ulceration with superact thrombosis at site of damage



# Prevention of atherosclerosis

نمنعها او نقتل من نسبة حدوثها خصوصاً عند الأشخاص يلي بكونوا  
at risk عن طريق الاجراءات الآتية :

## Primary prevention programs:

Aim to delay atheromatous plaque formation in persons who have not yet suffered a serious complication. These involve cessation of cigarette smoking + control of hypertension + weight loss + exercise, & lowering total & LDL blood cholesterol levels while increasing HDL

لو الشخص كان high risk عنده genetics مثلاً او عنده ischemic heart disease or stroke  
بنحتاج لعلاج زي الأسبرين وال statins يلي بتقلل من الكوليسترول و ال triglyceride  
(رج نحكي عنهم بالفارما )

## Secondary prevention programs:

It aims to prevent recurrence of IHD or stroke in symptomatic patients, involving medications (aspirin antiplatelet agent), statins, & beta-blockers (to limit cardiac demand).

## What is the gold standard diagnostic test for atherosclerosis?

It is invasive coronary angiography (ICA) has remained the gold standard upon which other diagnostic tests are measured.

عادة الأطباء لما يشكوا بواحد عنده symptoms of ischemic heart disease يعملوا coronary angiography قسطرة ، حتى  
يشوفوا مدى تضيق ال coronary blood vessel



و أخيراً خلاصنا من أول pattern 😭😭 ، طويل بس سهل ان شاء الله ، اغلبه تكرر معلومات

# Arteriosclerosis

نبدأ بال second pattern

Arteriosclerosis is hardening of arterial wall

## Three patterns

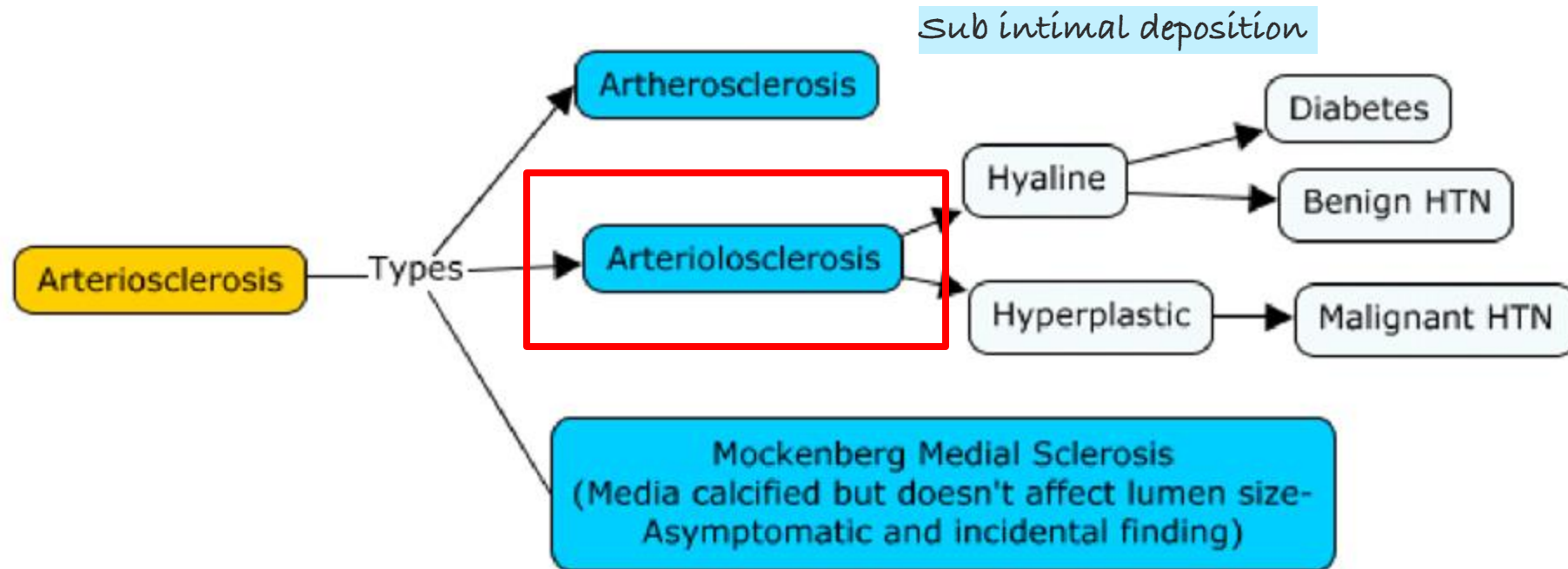
### 1. Atherosclerosis

1. Arteriolosclerosis - thickening of small vessels. Wall thickens due to protein deposition (hyaline arteriolosclerosis) or hyperplasia of smooth muscle (hyperplastic arteriolosclerosis)

### 1. Monckeberg medial sclerosis



# Arteriosclerosis



*Artherosclerosis*





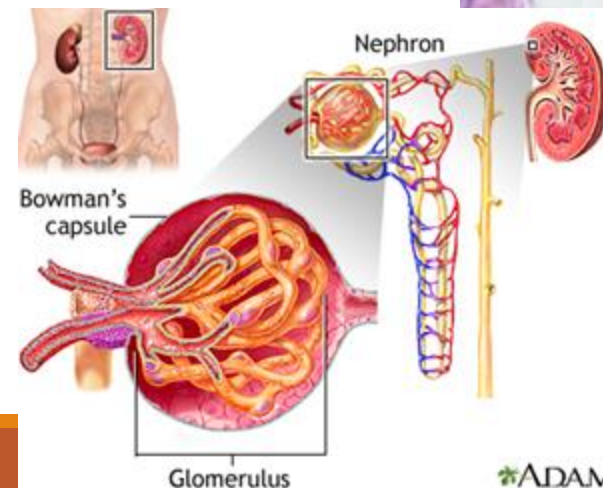
# Arteriolarosclerosis

## 1. Hyaline arteriolarosclerosis:

- Seen in benign hypertension and DM.
- Pink hyaline thickening of the arteriolar walls, and luminal narrowing
- In the kidneys: narrowing leads to diffuse vascular compromise and nephrosclerosis (glomerular scarring).
- Seen in elderly patients (normo- or hypertensive)
- Common in diabetic microangiopathy



The arteriolar wall is thickened with pink hyaline material



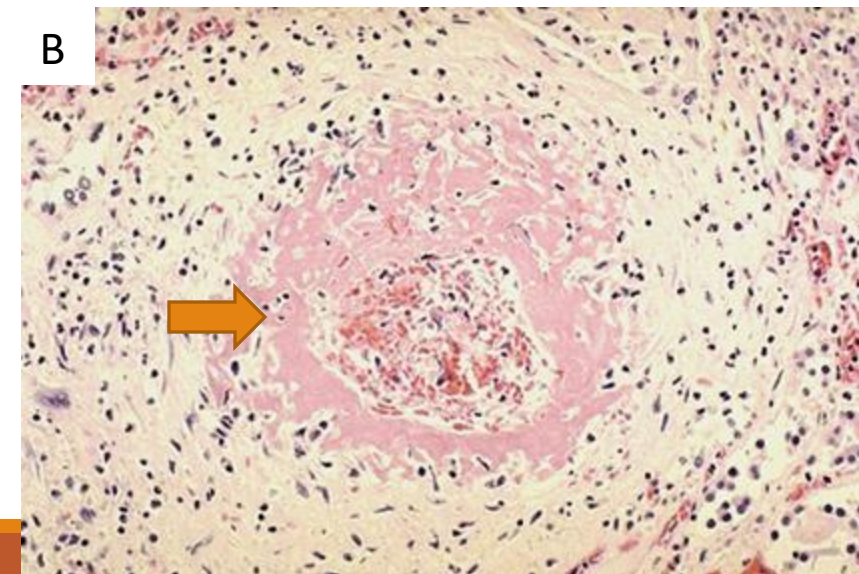
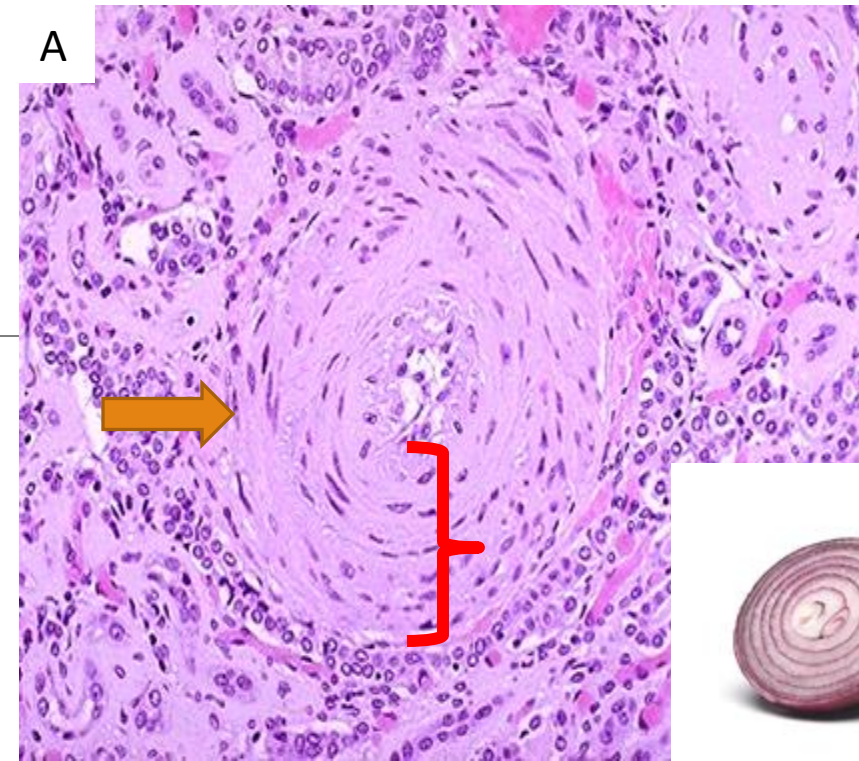


# Arteriolosclerosis

de novo ممکن rapid increase of blood pressure لأنه بصير  
يعني فجأة ما عنده previous history of HTN او ممکن عنده

## 2. Hyperplastic arteriolosclerosis :

- Seen in severe (malignant) hypertension.
- Onionskin concentric, laminated thickening of walls and luminal narrowing (figure A)
- The laminations consist of smooth muscle cells and thickened, reduplicated BM (Media)
- In malignant hypertension: accompanied by fibrinoid deposits and vessel wall necrosis (**necrotizing arteriolitis**), prominent in the kidney (figure B)



# Arteriosclerosis

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Arteriosclerosis is **hardening of arterial wall**

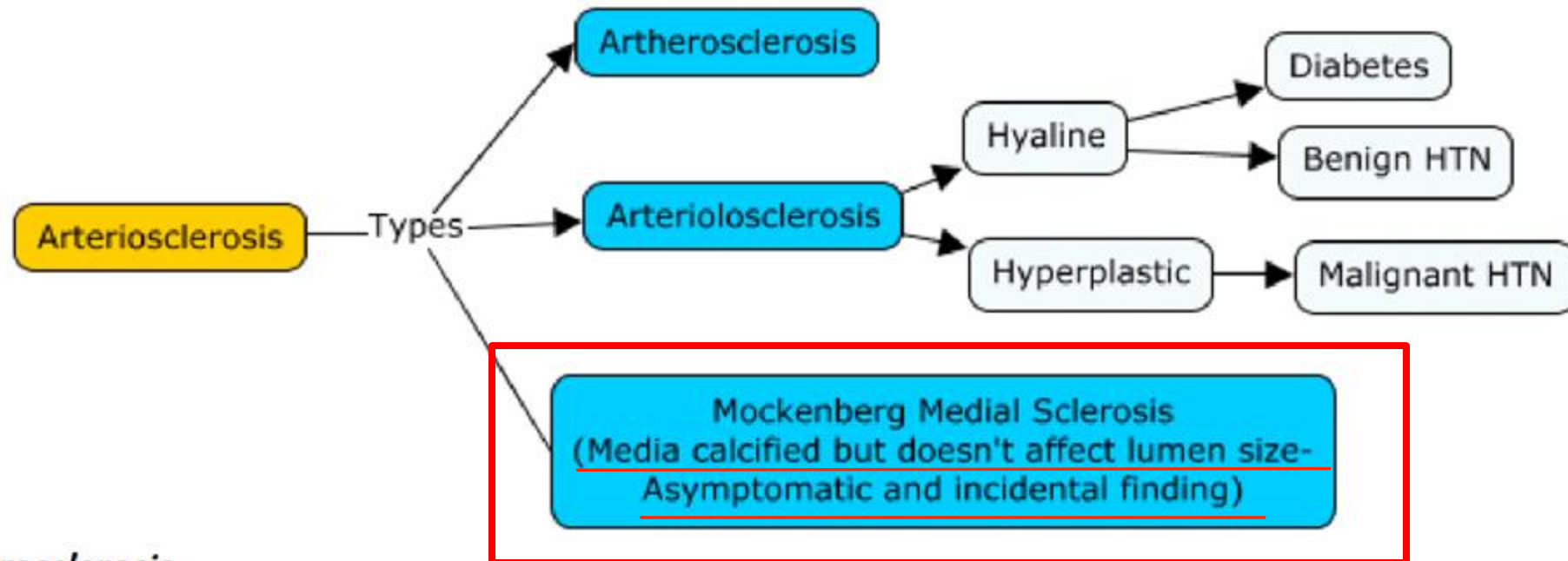
## Three patterns

1. Atherosclerosis
2. Arteriolosclerosis

1. **Monckeberg medial sclerosis - calcification of media. Not very clinically significant**



# Arteriosclerosis



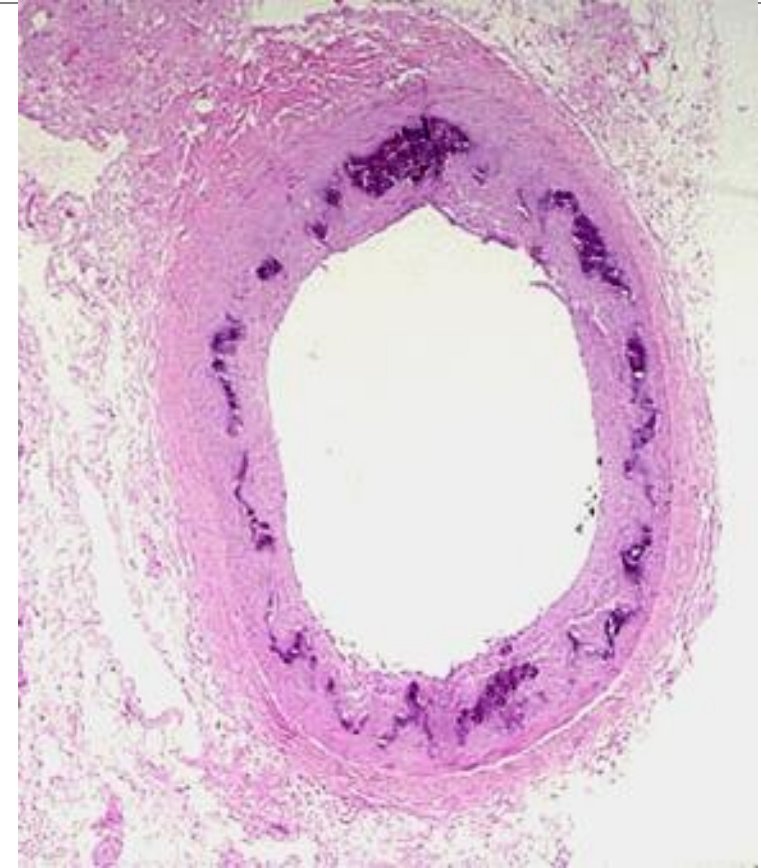
*Artherosclerosis*



# Monckeberg medial sclerosis

## Monckeberg medial sclerosis:

- ❑ Calcified deposits in muscular arteries
- ❑ Seen in adults (older than 50 years)
- ❑ Not clinically significant

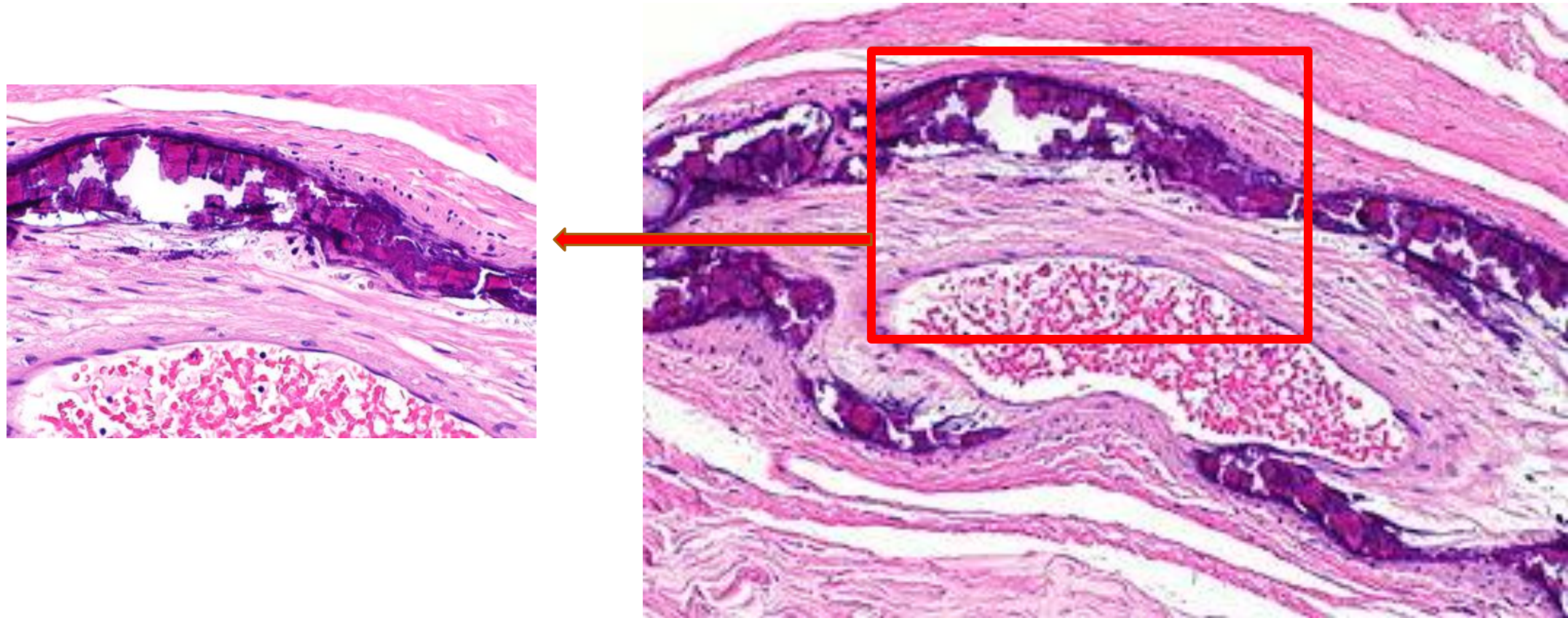


Monckeberg medial sclerosis





# Monckeberg medial sclerosis





شرح المادة لدفعة وريد

الدكتورة دعاء

Pathology-CVS

شرح خارجي

Medical club

Dr.sameh ghazi

Dr.MO.alrakabi

Subject	Medical club	Sameh ghazi	Other videos
Atherosclerosis Lec 1+2	-	video	Dr.doaa -vein video 1 video 2
Ischemic heart disease Lec 3+4	Video 1 Video 2	MI	Dr.MO. al.rakabi video 1 video 2

ضفنا لكم على خانة ال Guidance جداول بتحتوي  
على فيديوهات بتساعدكم بفهم مواضيع الباتو بشكل أكبر  
ولتسهل عليكم الحفظ بتلاقوهم من  
(رفعة حياة.. CVS.. باتو.. Guidance)

# ختاماً ، ما ننسى الدعاء لأهلنا و إخواننا المجاهدين الصابرين في غزة

اللهم انصرا إخواننا المجاهدين في غزة  
اللهم افتح للمجاهدين الأبواب، وأزل عنهم الصعاب  
بقولك يا وهاب اللهم اربط على قلوبهم وثبت أقدامهم وانصرهم وزلزل الأرض من تحت أعدائهم يا عزيز يا قهار  
اللهم سد رميهم وصوب رأيهم واجعل لهم من كل ضيق فرجا

اللهم آمين

"اللهم قد طال أمد بلائهم :  
اللهم أظهر أمنهم ..  
وأزل كربهم ..  
وفزج همهم ..  
وعجل بنصرهم"

