CVS
PATHOLOGY

Modified NO: 3

كتابة: إبراهيم الشوابكة

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ARTERIOSCLEROSIS

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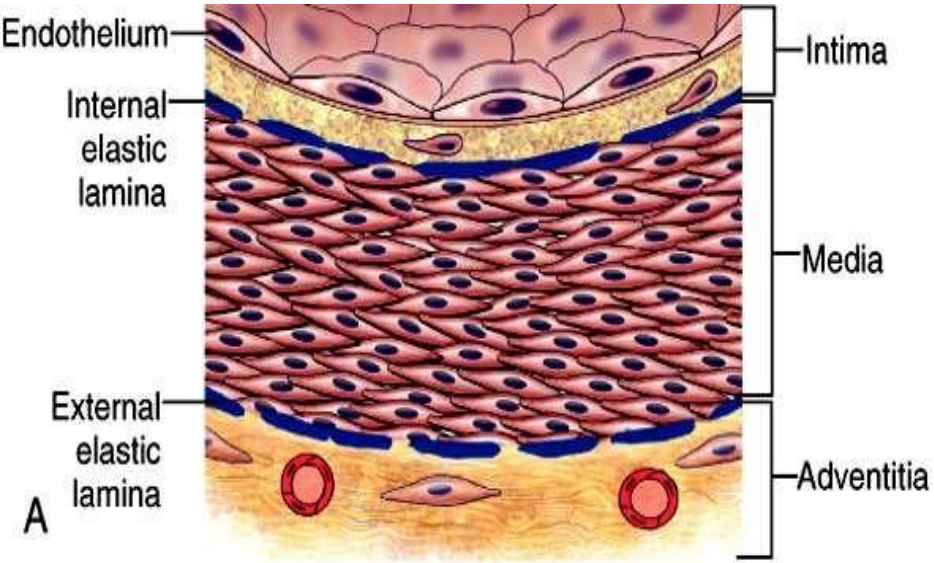
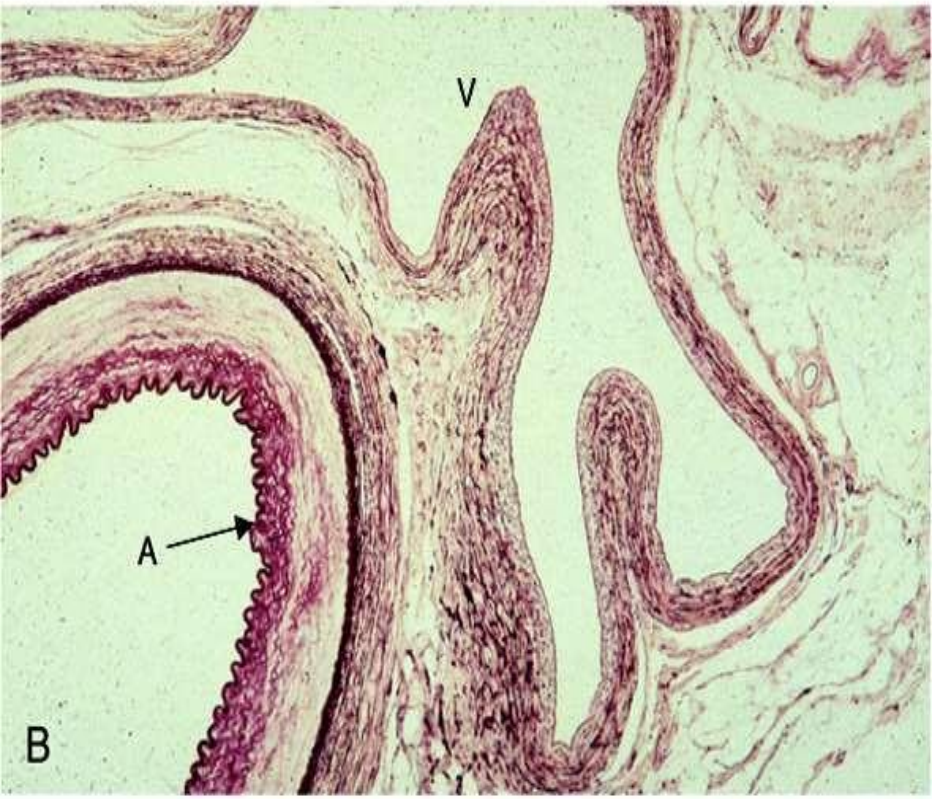
Color code

- Slides
- Doctor
- Additional info
- Important

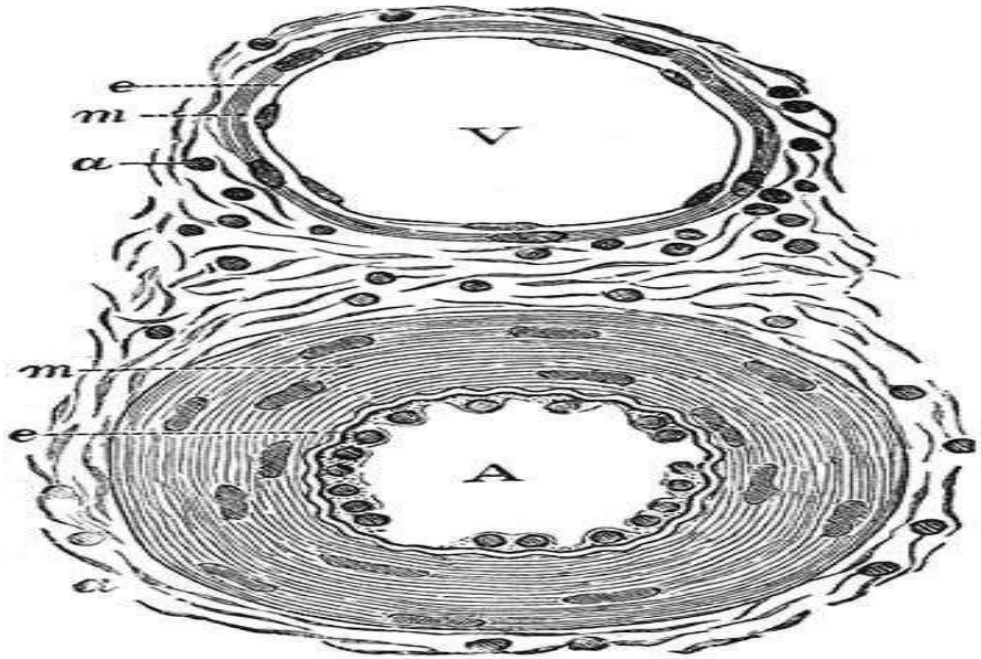




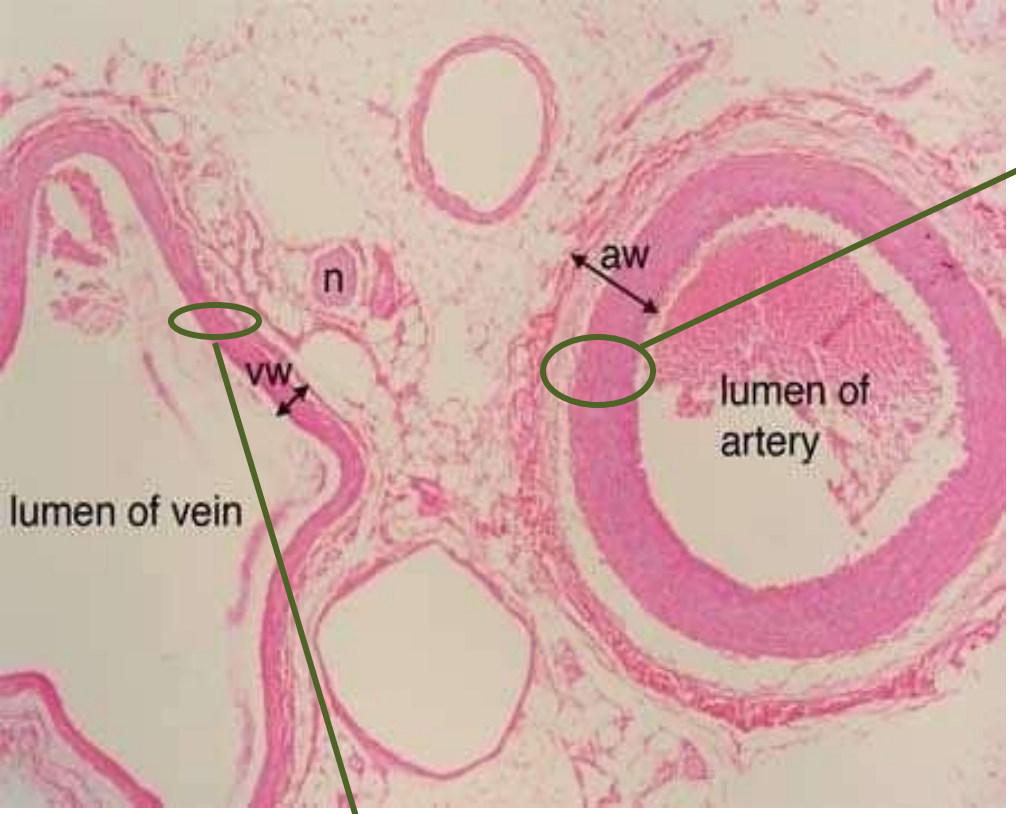
Arteries and veins are made up of three layers:

1) Tunica intima: The innermost layer, consisting of endothelial cells.
2) Tunica media: The middle layer, composed of smooth muscle cells.
3) Tunica adventitia: The outer layer, made up of connective tissue.

Arteries and veins share similar structural layers, but they differ in the thickness (arteries have **thicker tunica media**—> to support the function of the arteries in having higher contractility and elasticity)



Normal blood vessels
A=artery
V=vein



Arterial walls are thicker and more rigid compared to veins with a tube-like shape.

The wall of veins is thin and irregular, making them more prone to dilate or collapse.

في مساحة فاضية هون، خلّينا نستفيد شوي

أنت في شتات مستمر ما دُمت هاجرًا للقرآن
اعلم أنّه ما ضاقت بك الدّنيا إلا واتسعت بآية تقرؤها في كتاب الله، فالقرآن نعيم مُعجّل، وأُنسٌ يُذهِب كل بؤس، وسرورٌ يُزيل كل حزن هَمّ بك، وانشراحٌ يكشف كل ضيق أصابك.

🕊فَلَنا فِي القُرآنِ السَّلوىٰ،والمرتع الأحبّ

😃اسمعوا هذا البودكاست بس تكونوا فاضيين
كيف تتلذذ بالقرآن مع د أحمد العربي

ARTERIOSCLEROSIS

- **Arteriosclerosis ="hardening of the arteries"**
- **arterial wall thickening and loss of elasticity.**
- **Three patterns are recognized, with different clinical and pathologic consequences.**

1- Arteriolosclerosis
2- Mönckeberg medial calcific sclerosis
3- Atherosclerosis

1-Arteriolosclerosis

We'll cover this in hypertensive vascular diseases lecture

- **affects small arteries and arterioles**
- **associated with hypertension and/or diabetes mellitus**

One of the effects of these diseases (HTN & DM) in the CVS is arteriolosclerosis

2- Mönckeberg medial calcific sclerosis

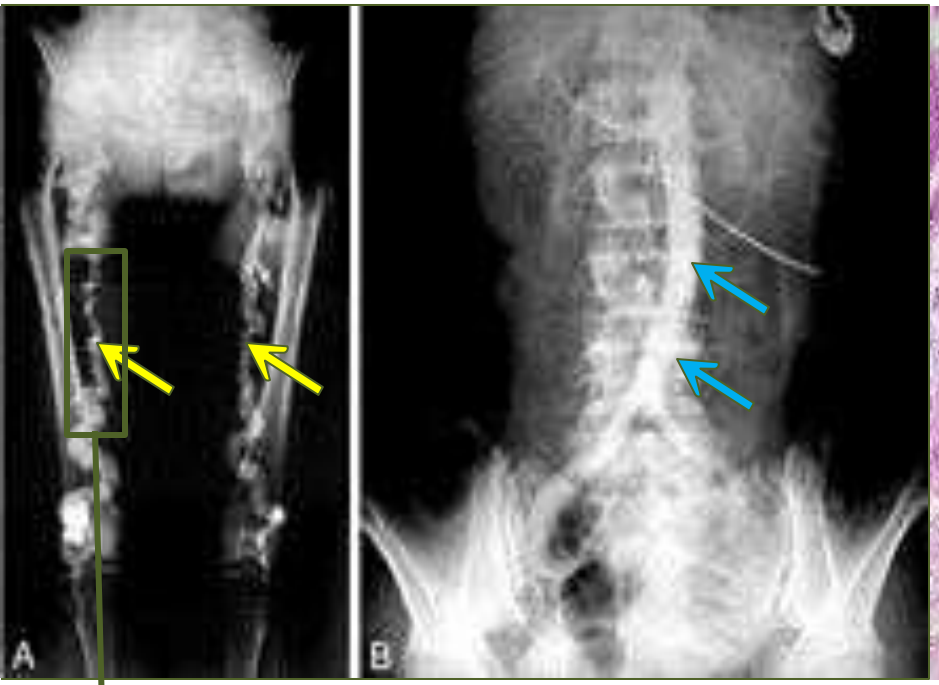
- **calcific deposits in muscular arteries**
- **typically in persons > age 50**
- **radiographically visible in (x-rays, etc…),** appears white due to the presence of calcium.
- **palpable vessels**
- Limited to tunica media**, do not encroach on vessel lumen and are usually not clinically significant,** unless other conditions, such as atherosclerosis, are present.

Let's break down the term "Mönckeberg medial calcific sclerosis"

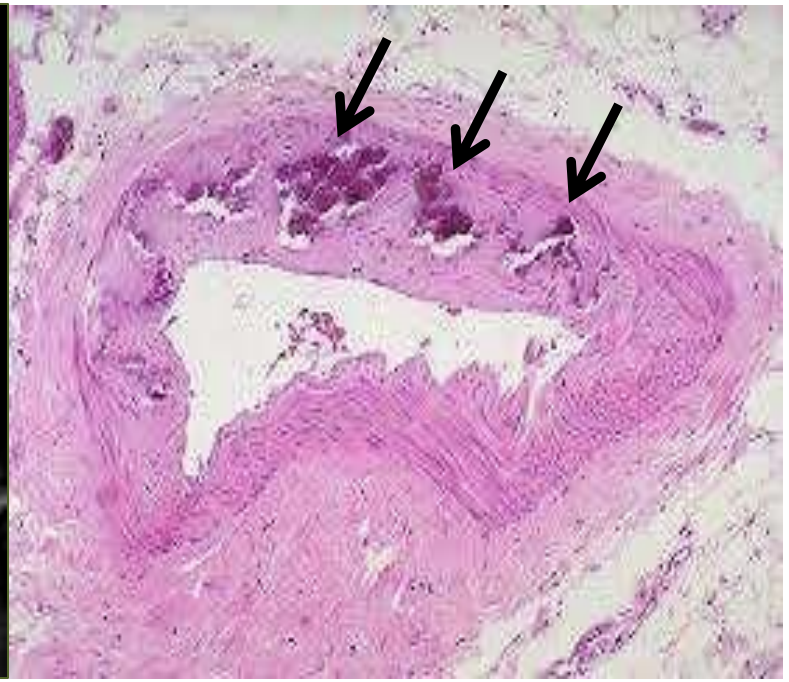
1) Mönckeberg: Refers to the scientist, Johann Mönckeberg, who first described this condition.

2) **Medial**: Refers to the middle layer of the blood vessel wall, called the **tunica media**, which is primarily affected.
3) **Calcific**: Refers to **calcium deposits**, which are the primary material causing this condition.
4) **Sclerosis:** Refers to the hardening or stiffening of the affected blood vessel due to the calcium buildup.

2-Mönckeberg medial calcific sclerosis



In X-Ray, whitish areas may be observed along the pathways of arteries due to the presence of calcium deposits.

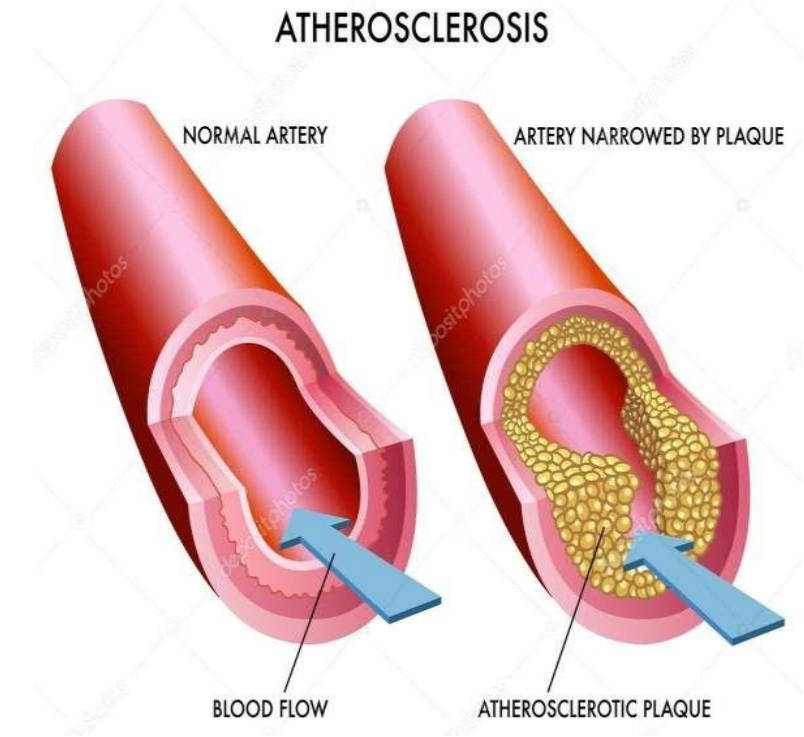


In H&E staining, calcium deposits typically appear as dark blue or purple due to the affinity of the hematoxylin stain for the calcium salts.

3- The third pattern ,**atherosclerosis (تصلب الشرايين)**, is the most important and most frequent one.

- characterized by **intimal** lesions ,that can be referred to as atheroma, atherosclerotic plaque, and atheromatous plaque.

- atheromatous plaque is a raised lesion with a yellowish material, consisting of fat -> specifically cholesterol -> specifically LDL (the bad cholesterol), which accumulates in the intima, leading to its expansion and narrowing of the vessel lumen.



- Greek word "gruel" ,"hardening,"

- most frequent and clinically important pattern of arteriosclerosis

- characterized by intimal lesions =atheromas (a.k.a. atherosclerotic plaques)

- atheromatous plaque = raised lesion with a core of lipid (cholesterol and cholesterol esters) covered by a firm, white fibrous cap

Atherosclerosis- Pathogenesis

The pathogenesis of atherosclerosis is primarily related to two factors:

1) **LDL accumulation**
2) **Inflammation** in the intima which is composed of endothelial cells.
The intima becomes inflamed as a response to the accumulated LDL, leading to thickening of the arterial walls.

- **not fully understood**
- **? inflammatory process in endothelial cells of vessel wall associated with retained low- density lipoprotein (LDL) particles→ ? a cause, an effect, or both, of underlying inflammatory process**

Dr said it isn't important to know which one causes the other.
You just need to know that both factors are involved in the pathogenesis of atherosclerosis.

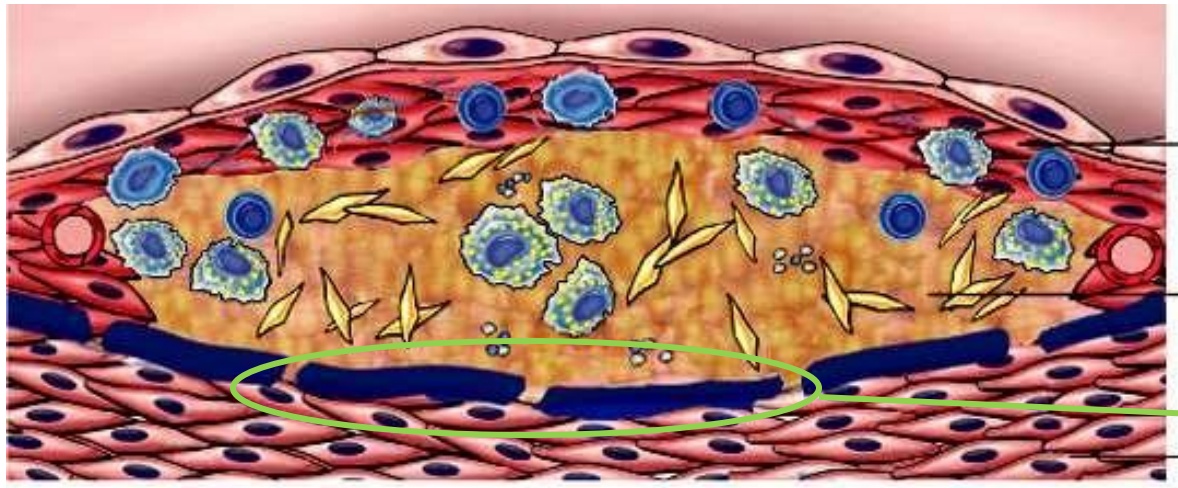
The major components of a well-developed intimal atheromatous plaque

The atheroma is composed of two distinct parts:

1) **Fibrous cap .**
2) **Necrotic or lipid center.**

In atherosclerosis, the normal intima is altered, containing yellowish areas that are not present in healthy intima leading to the narrowing of the lumen.

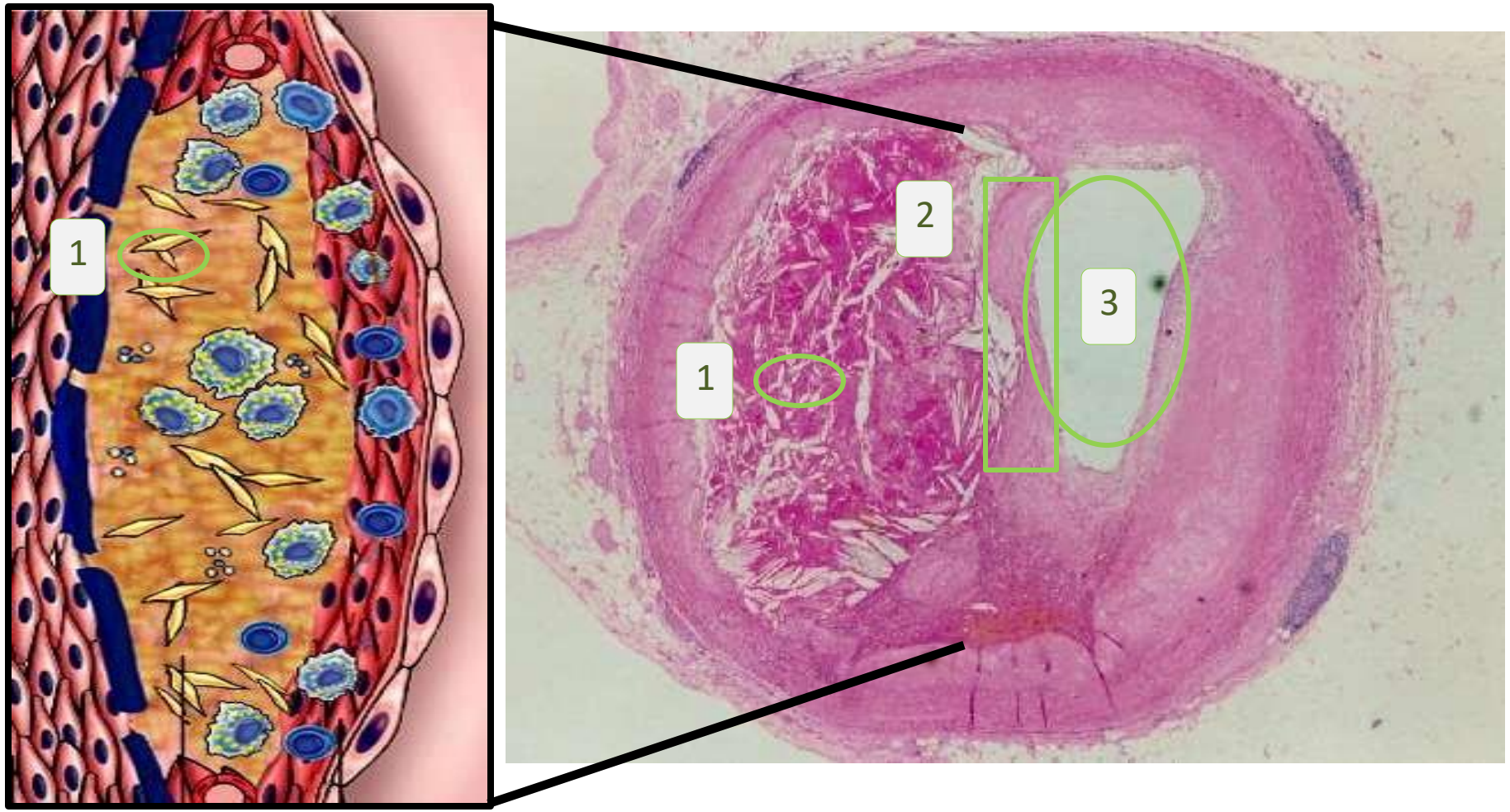
- In the coronary arteries, this narrowing can result in ischemic heart disease.
- In the brain, it can lead to stroke or transient ischemic attacks (TIAs).



Unfortunately, we have to memorize the components of each part.

The discontinuous blue line represents the **internal elastic lamina.**

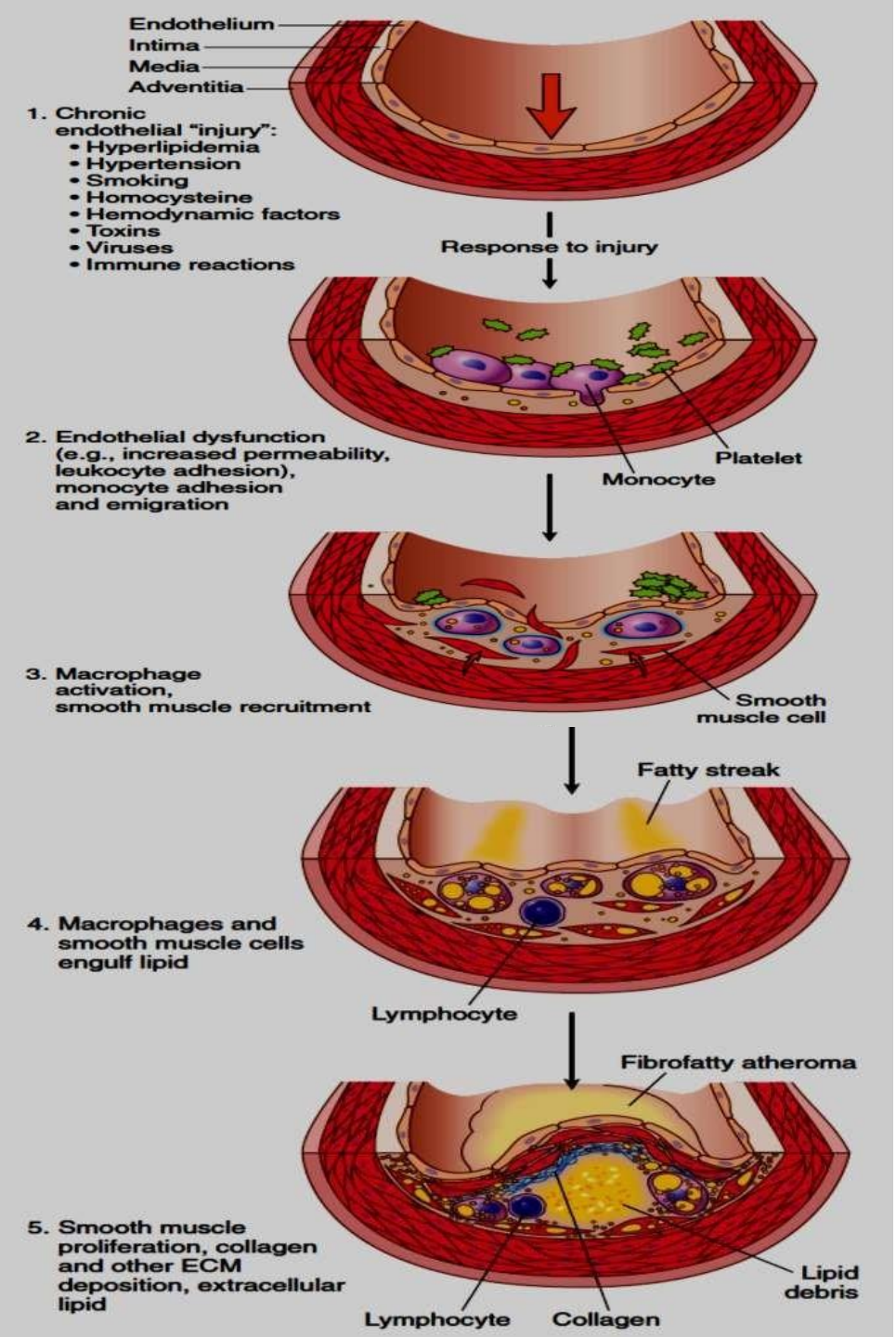
Atheromatous plaque



(1) refers to a needle-like structure, which is a yellowish **crystal of cholesterol** which appears white because the cholesterol dissolves during preparation, leaving its shape intact.

(2) refers to the **fibrous cap.**

(3) refers to the **remaining lumen.**



The formation of an atheromatous plaque is a slow and dynamic process that gradually narrows the lumen of the affected vessel.

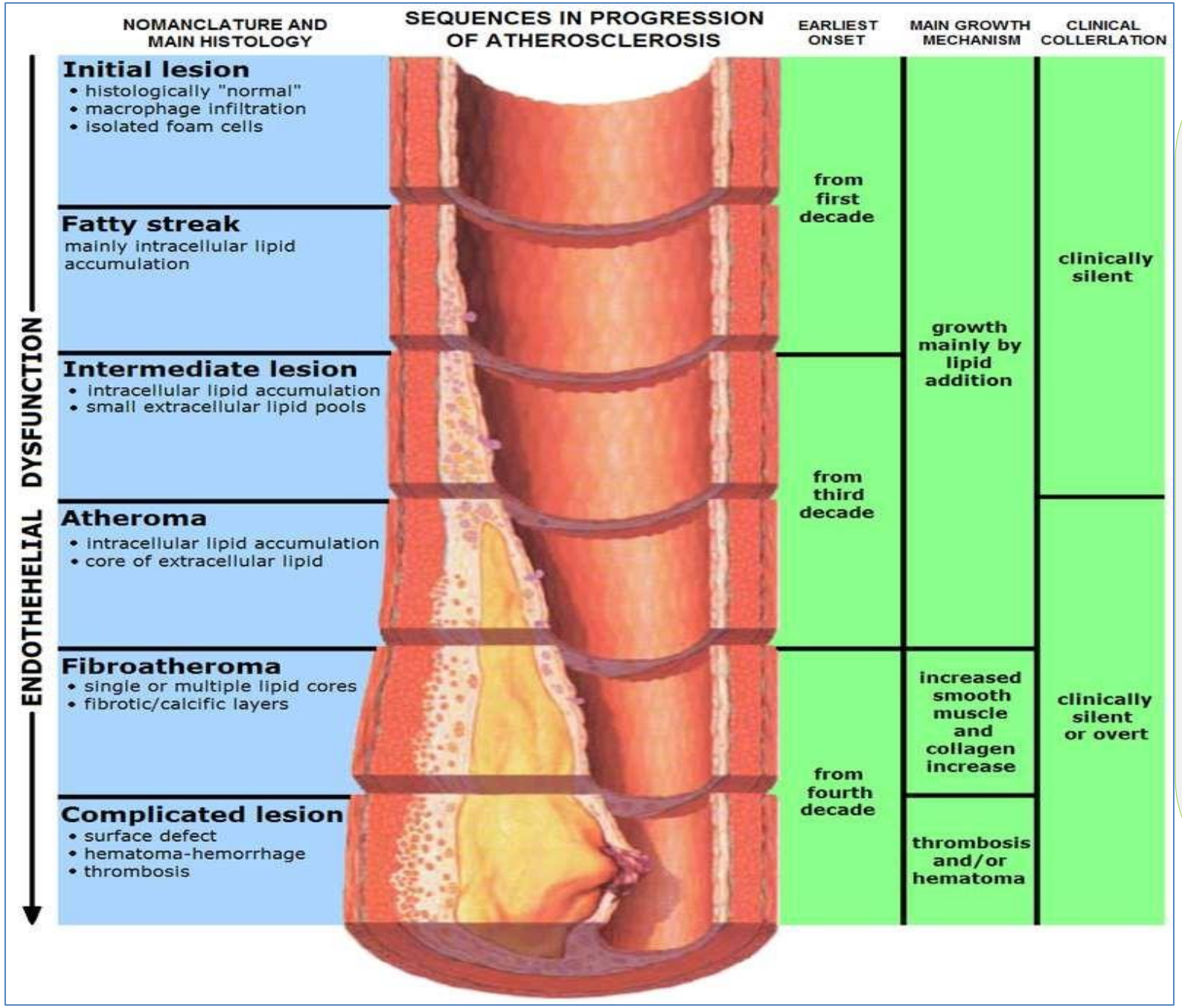
In the first lecture, we discussed how the vascular wall responds to injury involving:

1) Recruitment of macrophages and other **inflammatory cells.**

2) Increased permeability of **endothelial cells.**

These changes are due to invasion of inflammatory cells from the lumen and migration of smooth muscle cells from the tunica media to reach the intima, inducing the production of extracellular proteins.

With further progression, a well-formed atheroma develops.



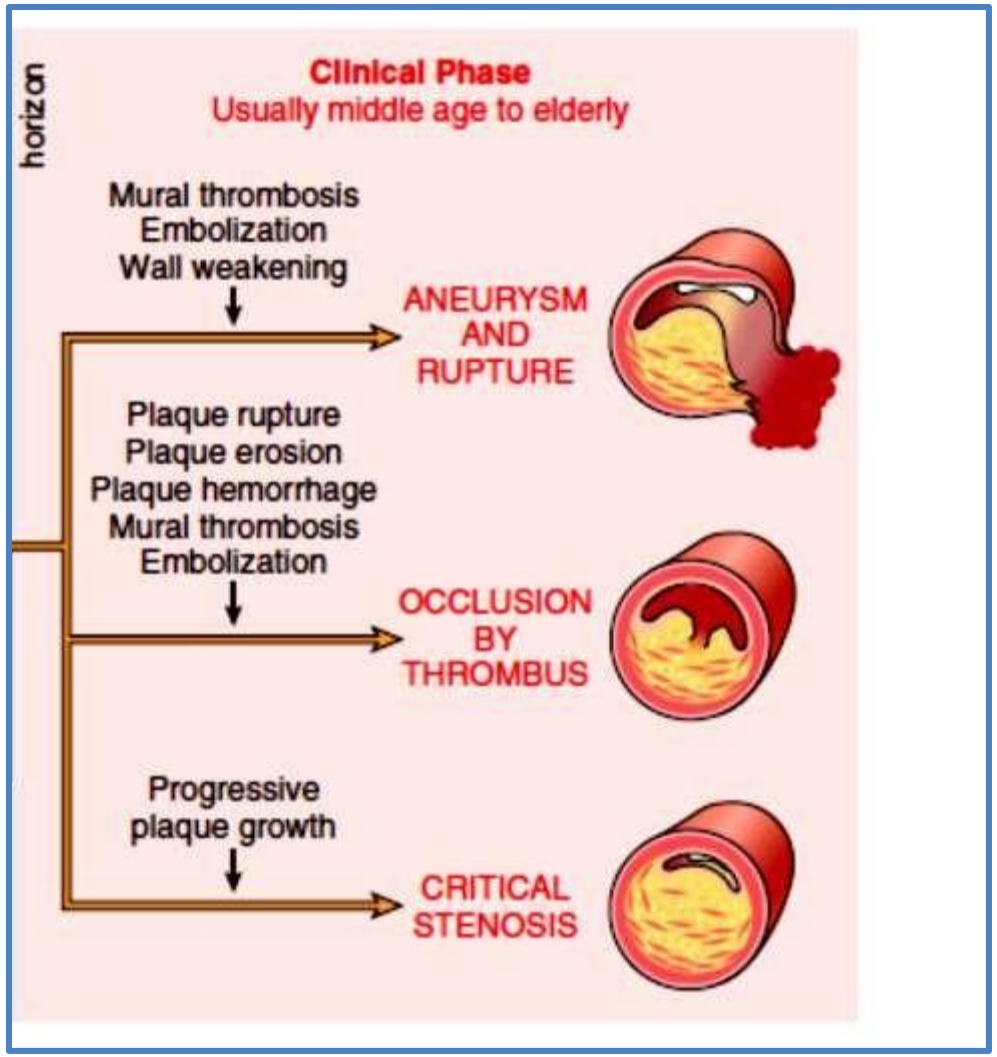
Chronological Events of Atherosclerosis
الأثر الزمني لتصلّب الشرايين

A we said earlier ,the process is slow and progressive.

Atherosclerosis begins as a clinically silent process (**asymptomatic**) at the first decade.

At the fourth decade, the disease progresses into complicated lesions, including atheromatous plaques ,these lesions become clinically **symptomatic**, causing conditions such as ischemic heart disease & stroke.
And becoming crucial to control and manage.

Atherosclerosis: progression



Complications:

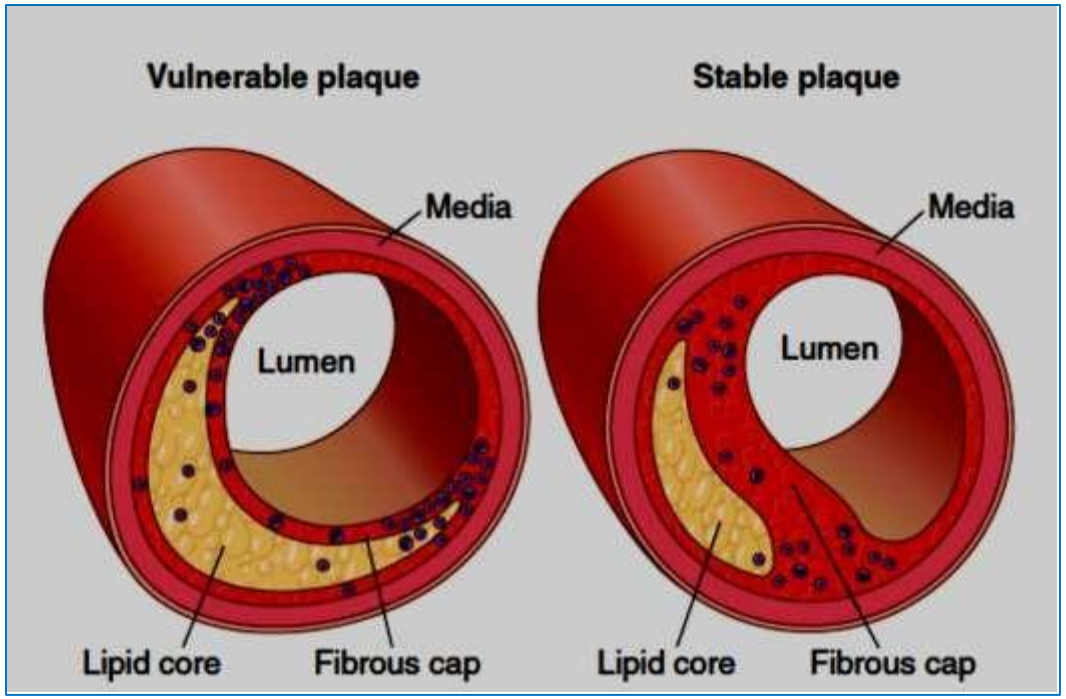
1) The weakened vessel wall due to the atheroma may dilate abnormally, forming an **aneurysm** & leading to wall rupture at the end (will be covered).

2) Inflammation and endothelial cells injury within the atheroma make the vessel wall more prone to develop **thrombosis**.
Thrombus formation **superimposed** on the atheroma can lead to **arterial occlusion** and **complete loss of blood flow**.

This thrombus can now **rupture** and **release its contents** into the bloodstream causing **embolization** (part of the atheroma itself could also rupture and move with this embolus)

3) Atheromatous plaque can undergo progression & **further plaque growth** leading to **critical stenosis** which is a severe narrowing of the lumen that significantly **reduces blood supply** (will be covered in the ischemic heart diseases lecture).

Vulnerable vs stable plaque



Thick fat core
Thin fibrous cap
More inflammation

Thin fat core
Thick fibrous cap
less inflammation

Not all atheromas have the same risk of complications, they differ:

1) **Vulnerable plaque** formed by a thin fibrous cap and a thick lipid core, making it more prone to develop complications.

2) **Stable plaque** has a thicker fibrous cap and a thinner lipid core, making it less prone to develop complications.

Risk Factors for Atherosclerosis

Major Risks	Lesser, Uncertain, or Non-quantitated Risks
Non-modifiable (non-controllable)	**Obsesity**
Increasing age	**Physical inactivity**
Male gender	**Stress ("type A personality)**
Family history	**Postmenopausal estrogen deficiency**
Genetic abnormalities	**High carbohydrate intake**
	Lipoprotein(a)
Potentially modifiable (Controllable)	**Hardened (trans)unsaturated fat intake**
Hyperlipidemia	
Hypertension	**Chlamydia pneumoniae infection**
Cigarette smoking	
Diabetes	
C-reactive protein (inflammation)	

- Risk factors for atherosclerosis are divided into major risk factors (which have strong evidence linking them to the development of atherosclerosis) and non-quantifiable risk factors (which have less evidence-based association).

- Major risk factors are classified into:

1) **Non-modifiable factors**
2) **Modifiable factors** (we can modify them using some medications or through lifestyle changes such as quitting smoking for e.g)

- CRP is an indicator of inflammation in the body. While CRP itself does not cause atherosclerosis.

1-age

- **ages 40 to 60, incidence of MI in men increases 5 x**
- **Death rates from IHD rise with each decade**

2-Gender

- **Premenopausal* → protected against atherosclerosis compared with age-matched men.**
- **After menopause→ incidence of atherosclerosis- related diseases increases**
- *** unless they are otherwise predisposed by diabetes, hyperlipidemia, or severe hypertension.**

3-Genetics

- **familial predisposition is multifactorial.**
- **Either :**

1- familial clustering of other risk factors

- e.g. HTN or DM or :

2- well-defined genetic derangements in lipoprotein metabolism

- e.g. familial hypercholesterolemia

Additional Risk Factors for atherosclerosis

- 20% of cardiovascular events occur in the absence of identifiable risk factors:

- **Hyperhomocystinemia**
- **Metabolic syndrome**
- **Lipoprotein a levels**
- **Factors Affecting Hemostasis (**Elevated levels of procoagulants….)
- **Others:**

-lack of exercise

-competitive, stressful lifestyle ("type A" personality)

-obesity

-High carbohydrate intake

Test your self:

1. How does inflammation within an atheroma contribute to thrombosis?
A) It strengthens the vessel wall
B) It makes the vessel wall more prone to thrombosis
C) It reduces the risk of arterial occlusion
D) It prevents plaque formation

2. What can occur if a plaque ruptures and releases its contents into the bloodstream?
A) Thrombosis
B) Embolization
C) Aneurysm
D) Stenosis

3. All are true regarding atherosclerosis **except**:
A) Consists of a soft necrotic center surrounded by a white fibrous cap
B) Due to formation of an atheromatous plaque in the vessel's intima
C) Hyperlipidemia is a major non-modifiable risk factor
D) The lower abdominal aorta is mostly affected
E) Premenopausal women are protected more than their counterpart aged men

4. All are true regarding Monckeberg medial calcification sclerosis **except**:
A) Affects muscular arteries
B) Occurs mostly in children
C) Radiologically visible on X-ray
D) Does not encroach on the vessel lumen
E) Not significant

Ans:
1 -> B
2 -> B
3 -> C
4 -> B

أحداث الطّوفان..

تركت لكلّ واحدٍ رسالته، فمنّا من أخذ الرّسالة بقوُةٍ بدأ بها ولَم يلتفت، ومِنّا مَن أخذ جزءًا وترك الآخر مُهمَلًا، وهناك من التَفَت كأنّه غريبٌ عنها، وهناك مَن مزّق الرّسالة ومَضىٰ، كُلّ واحد سيقف يومًا، يسأل عمّا رأىٰ، وفَهِمَ، وفَعَل.

Additional sources

1) Atherosclerosis - pathophysiology
2) Coronary atherosclerosis animation
3) Robbins Basic Pathology 10th edition / page 369

VERSIONS	SLIDE #	BEFORE CORRECTION	AFTER CORRECTION
V1→ V2			
V2→V3			

امسح الرمز و شاركنا بأفكارك لتحسين أدائنا!!