

Cardiovascular System

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The cardiovascular system

- Subdivided into two functional parts:

1. Blood vascular system

2. Lymph vascular system

* النظام القلبي و الأوعية الدموية
① Blood vessels & heart ② lymph vessels
 & lymphatic ducts

Blood vascular system

- distributes nutrients, gases, hormones to all parts of the body
- collects wastes produced during cellular metabolism

④ - يجمع الـ Waste product الذي يُنتج من خلال الـ cellular metabolism

- consists of a continuum of **blood vessels**

④ قمت نسبة لـ Size & Composition

- * arteries

④ كل ما كنا اقرب لـ heart كان diameter كبير large in diameter
arterial Vessel
كل ما كنا بعيدا عن heart كان diameter صغير reduction for diameter & reduction for lumen
arterioles Small artery

- * arterioles

medium artery
large artery

- * capillaries network.

- * venules

- * veins

Circulation ⇒ artery circulation ⇒ large diameter
Small diameter
Proximal to the heart
large veins

- * a muscular pump (heart)

The blood vessel

Contain From 2 component

- ① Wall
- ② lumen

- **Vessel wall** → three major layers (**Tunics**):

1. Tunica intima (inner layer in vessels)

- * endothelium → simple squamous epithilium
 - * subendothelial layer [loose CT حوصلة loose CT]
 - * *internal elastic lamina (arteries & arterioles)*
- تكونه من
- ⊗ most of the epithilium
← epithilium اذا كان على الـ supporting by basment membran and connective tissue.
- arterials على مستوى large artery ← mainly على مستوى Wall the B.V. هو لا يرى في Tunica media هناك فاصل اقل Tunica intima في الـ

2. Tunica media

external elastic lamina (arteries) → عادة يرى في

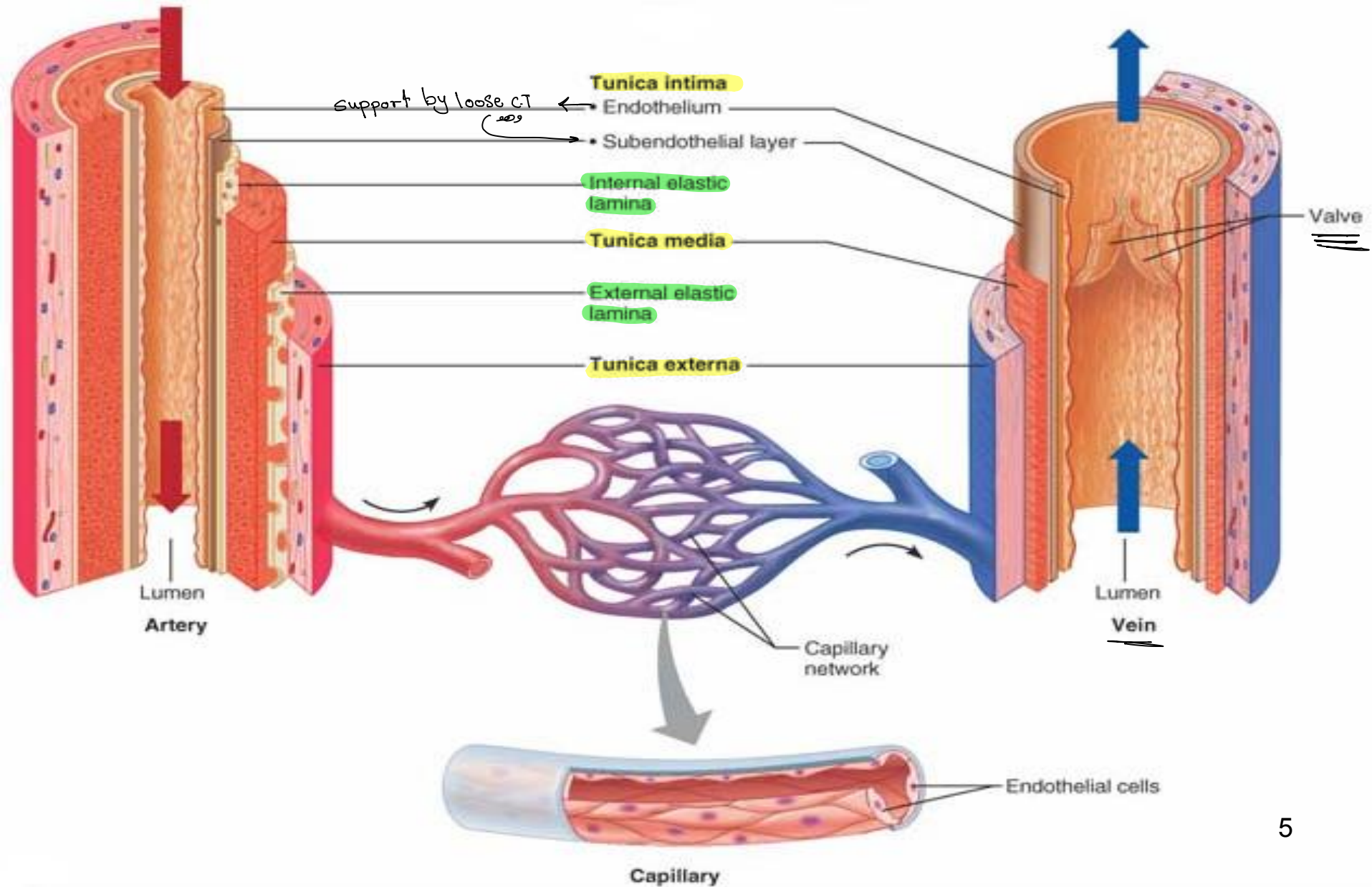
هذا عبارة عن border آخر موجود بينه Tunica adentitia و Tunica media

3. Tunica adventitia (tunica externa)

↳ outer most layer

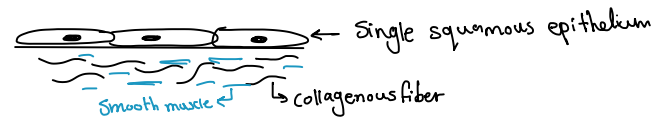
- **Lumen**

The vessel wall



The vessel wall

1. Tunica intima



- Inner lining comprising a **single layer of squamous epithelial cells** (endothelium) supported by a ^{Basement membrane} BM and delicate collagenous tissue (subendothelial layer) which may contain scattered smooth muscle

- Forms a smooth surface to reduce friction

لے بیس واد Blood و vessel wall

The vessel wall

2. Tunica media contain From ^{mainly} smooth muscle fiber and collagen and elastin

- Intermediate layer (largest layer & (thicker layer in arteries))
- Predominantly circularly arranged layers of smooth muscle fibers, with sheets of collagen and elastin in between
- Vasodilation and vasoconstriction
- Thicker in arteries than in veins

مرتباً بحل
circularly
بجانب القاطع حول
wall of the vessels

Tunica adventitia > thicker > هنا

* لا اى ال main component ال Tunica media هو smooth muscle fiber وانه هنا يتجى ال main function ال Vasodilation & vaso constriction

The vessel wall

3. Tunica adventitia

→ Support for B.V.
 anchoring it to surrounding tissue
 في جارة عس

- **Outer** layer of connective tissue
- Contains many collagen and a few elastic fibers that run longitudinally
 elastic & collagen *
 Tunica adventitia ⇒ longitudinally
- Strengthens the vessel wall and anchors it to surrounding tissue
 ⇒ Blood vessel ال مكانه ما تكونه
 Floting في ال Space (اي تقسمه في Surrounding tissue)
 يربطه
- Thicker in veins than in arteries
- May contain:

* vasa vasorum

* nervi vascularis

بظهرها في السرير
 deep
 section

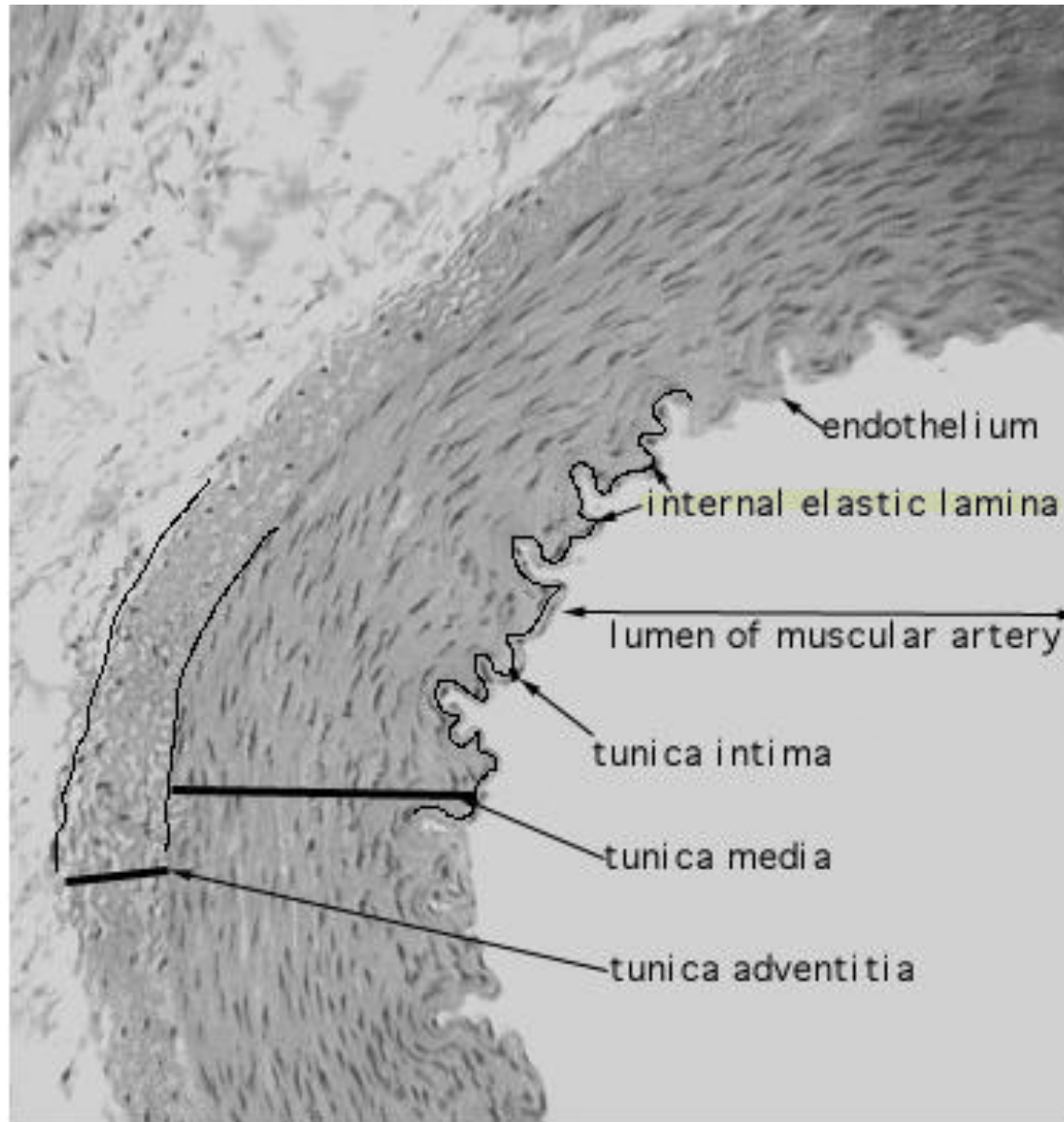
*
 Blood supply of the B.V wall it self
 لا ال B.V wall in the living tissue
 continuously
 Tunica adventitia
 *
 Nervus vasorum: the vasomotor autonomic nerves.

Vasa vasorum: small blood vessels which provide nutrition to the vessel wall (especially the large sized arteries & veins).
 Nervi vasorum: the vasomotor autonomic nerves.

The vessel wall



The vessel wall



Arteries

قائمة حسب -

Composition

- On the basis of size and characteristics of the tunica media → classified into:



main muscle fiber

& collagen & elastic

تختلف مع منطقة أخرى
size & Composition

قسموا الartery
for four main type.

ex: carotid coronary

①

– Large or Elastic arteries (Conducting Arteries)

②

– Medium or Muscular arteries

→ size medium.

– Small arteries and Arterioles

④

↓ size in the wall
↓ lumen

most common in the body

conducing artery elastic artery Tunica media elastic fiber

smooth muscle fiber

major component of artery

Arterioles

← تسمى بذلك ؟ لأنه بعد conducting no ال heart إلى small artery في media .

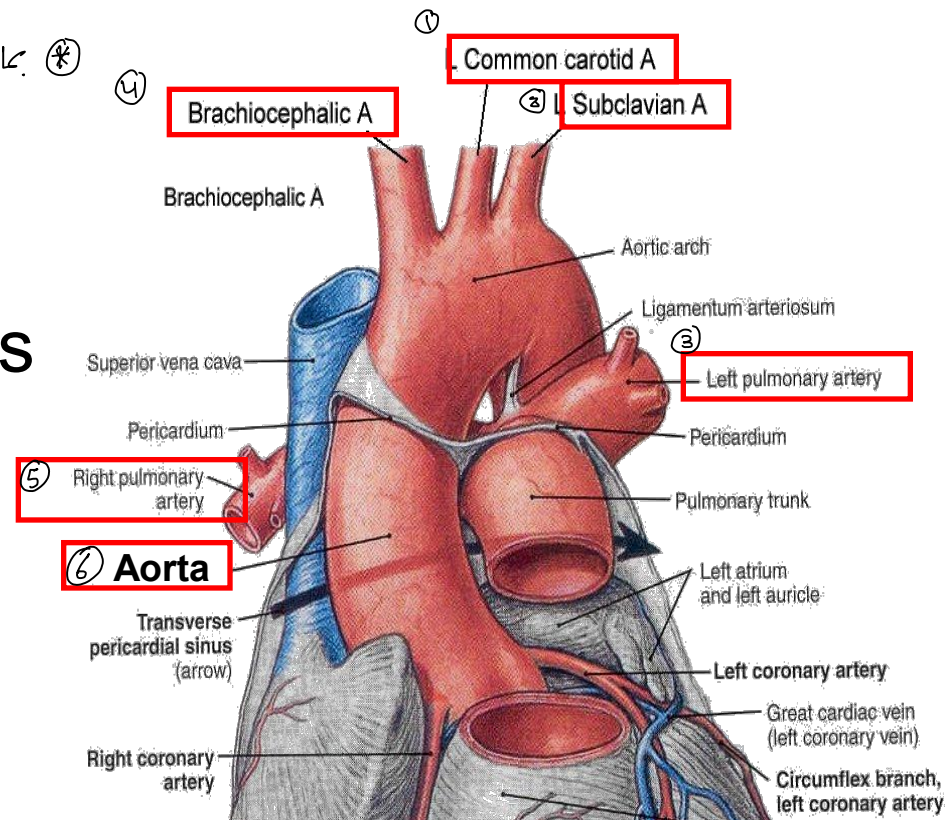
Elastic arteries (conducting artery).

• لأنه يحتوي على large amount في Tunica media from elastic fiber

• Comprise the major distribution vessels

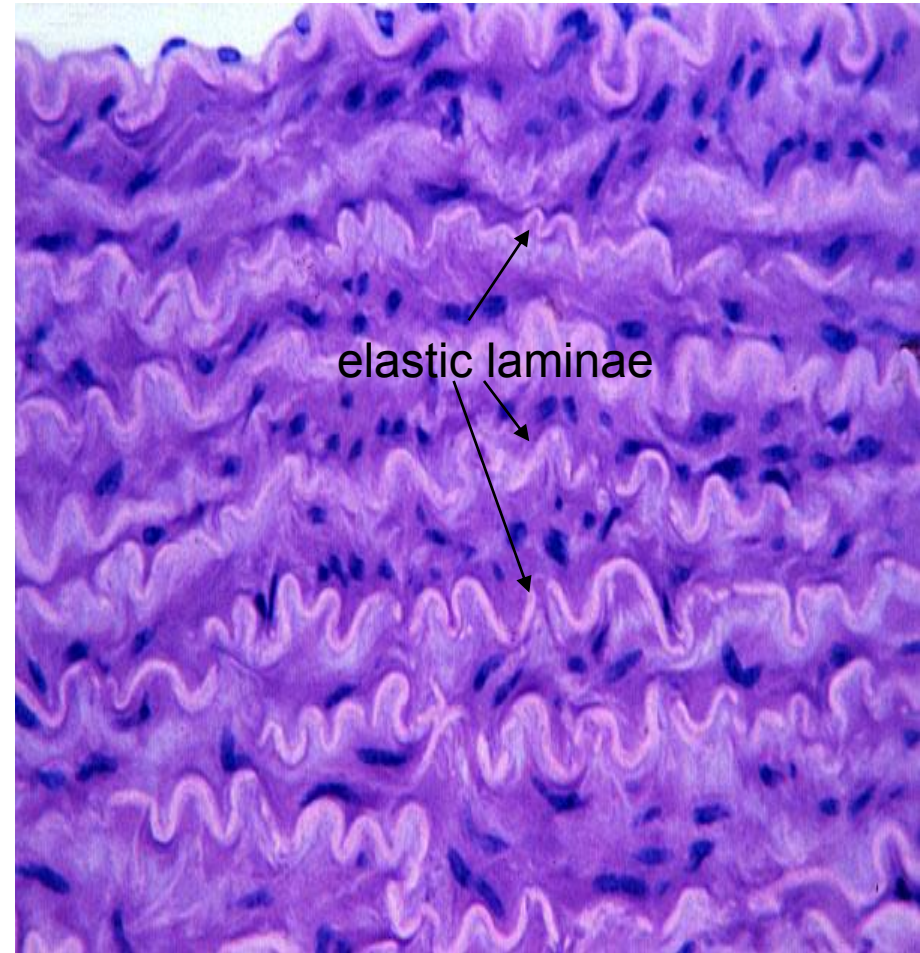
*) بما انها تحتوي على elastic فانه هي extend و flixable و تتوسع
 انها تحتوي على كمية كبيرة من الدم Blood
 ∴ so is distensible.

- Aorta
- Brachiocephalic trunk
- Common carotid arteries
- Subclavian arteries
- Most of the large pulmonary arterial vessels



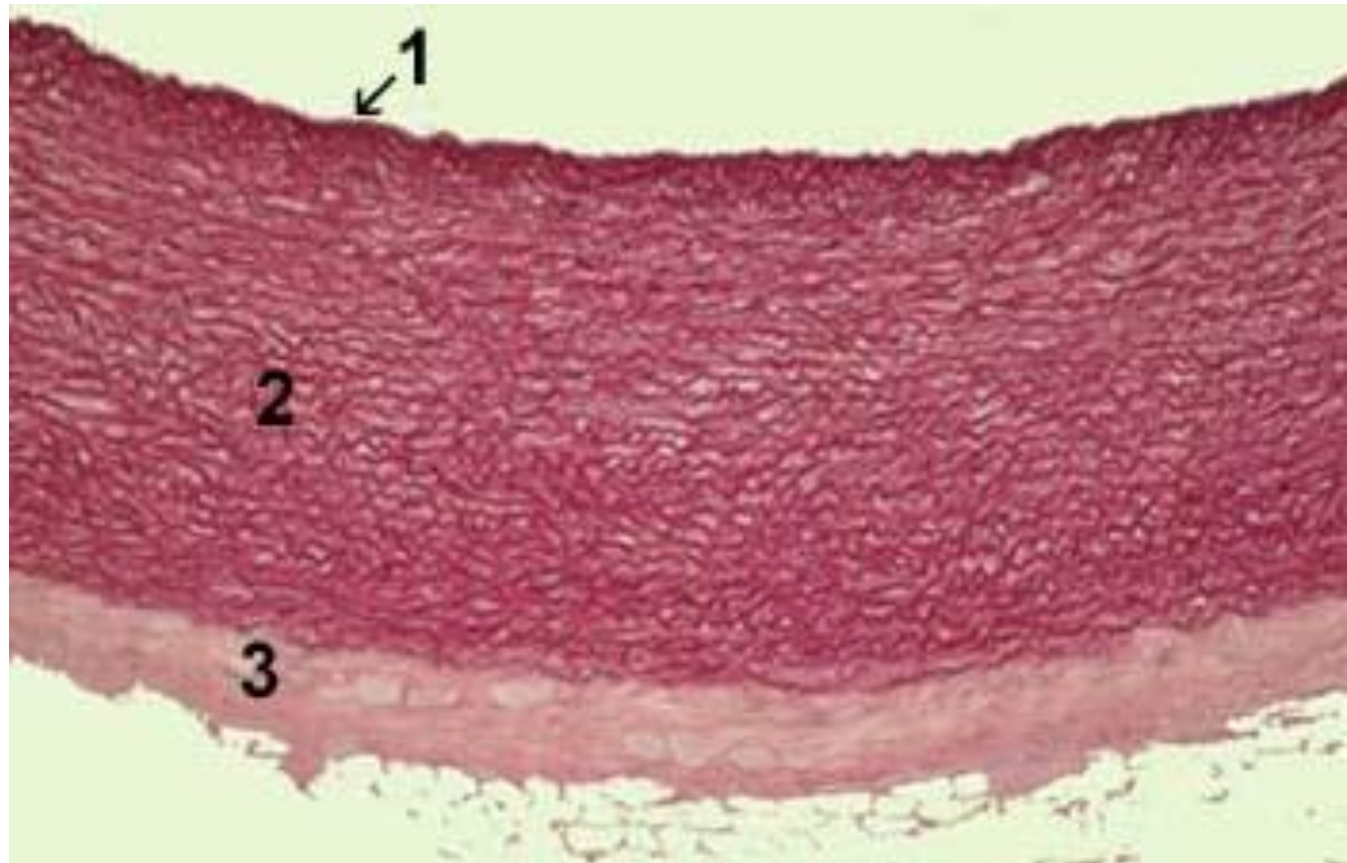
Elastic arteries

- Largest diameter
- Contain more elastin in their tunica media than any other vessel
- Are distensible^{قابل لتمدد}, serve to **conduct blood from** the heart to **smaller** arteries and **adjust blood pressure and flow**



Elastic arteries

- 1: Tunica intima
- 2: Tunica media
- 3: Tunica adventitia



Thin *Tunica Adventitia* : consists mainly of collagen fibers, some elastic fibers, fibroblasts, macrophages may also be present

Muscular arteries (medium size)

↳ most of the mid artery in body.

- Main distributing branches of the arterial tree e.g.
 - Radial arteries
 - Femoral arteries
 - Coronary arteries
 - Cerebral arteries
- Function to distribute blood to smaller arterial vessels and to various organs.

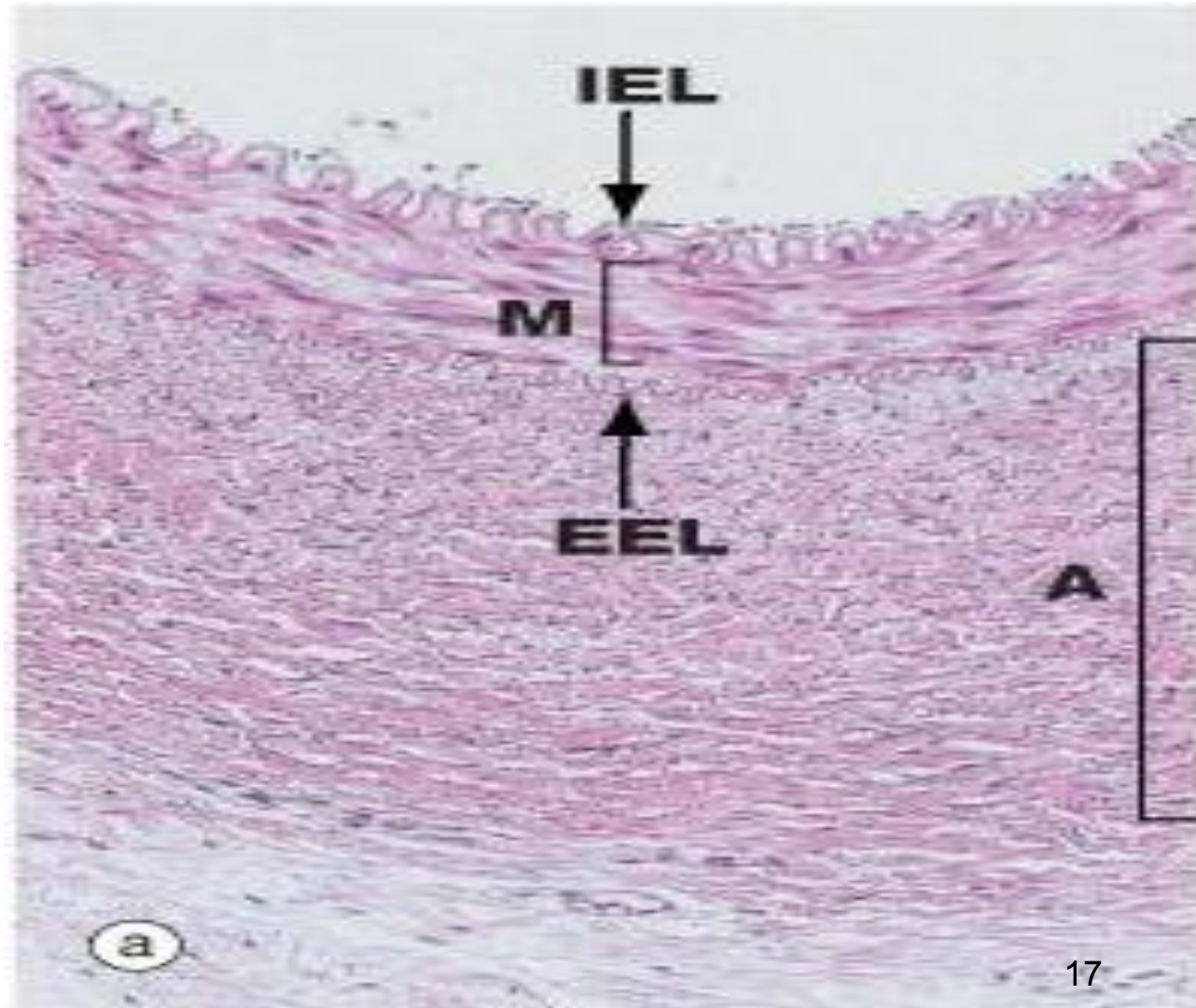
*large ~
↑ ↓ ↗*

Muscular arteries

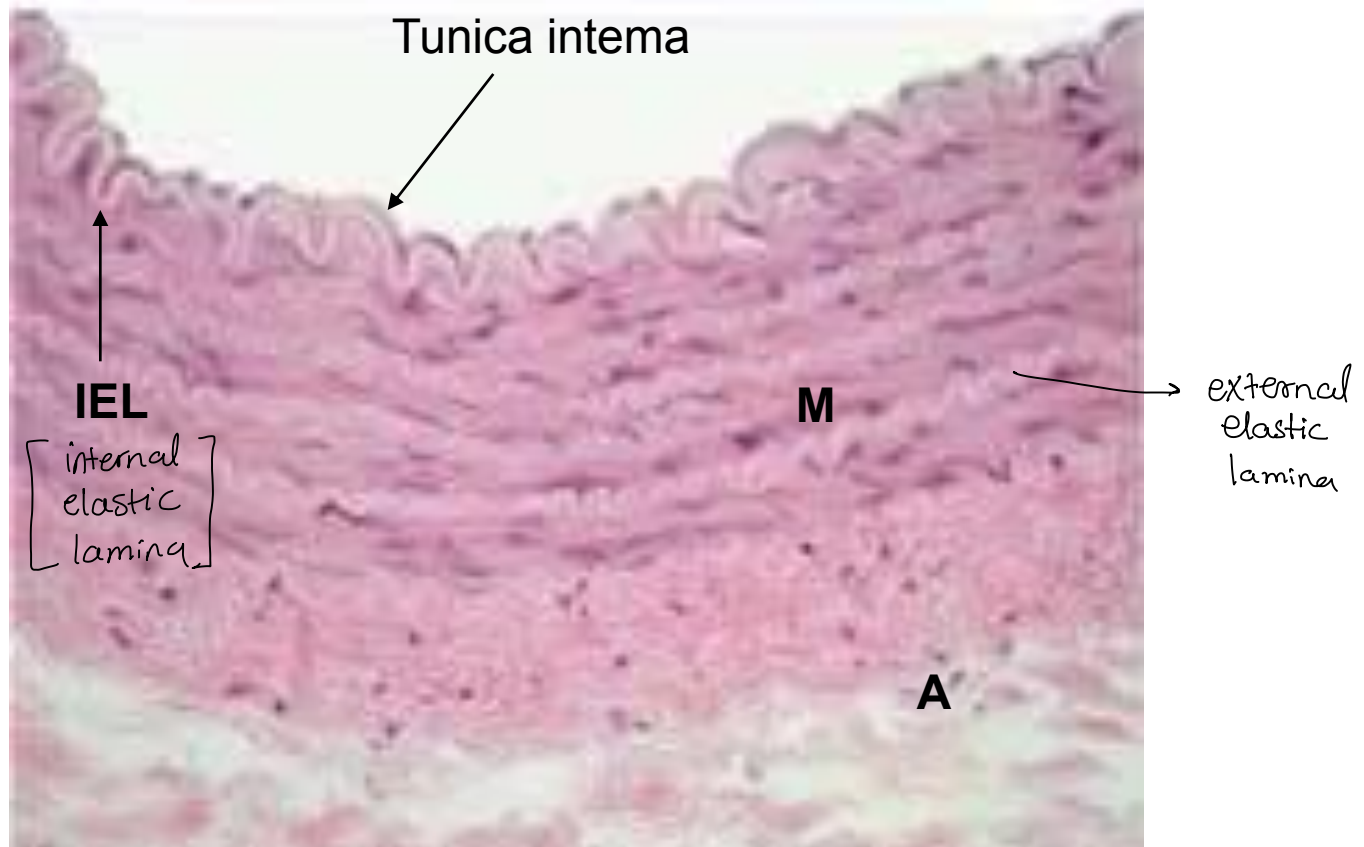
- Thickest tunica media of all vessels
- Tunica media contains relatively more ^① smooth muscle and ^② less elastic tissue than do elastic arteries
- ^{لأنه يحتوي على ألياف العضلات} [→] Active in vasoconstriction and less distensible
_{vaso dilation}
- Internal and external elastic lamina on each side of the tunica media
_{↳ intima & media ↳ media & adventitia}
- Tunica intima is usually very thin and not visible at low magnification
- Tunica adventitia is of variable thickness, composed of collagen and a variable amount of elastic tissue; may contain prominent vasa vasorum

Muscular arteries

IEL: internal elastic lamina
M: tunica media
EEL: external elastic lamina
A: tunica adventitia



Muscular arteries



Arterioles

② رتبة في muscular artery
 medium & large size
 size diameter → small size
 ① general classification & medium

- Small **muscular arteries** → large arterioles → small arterioles
- Gradual transition involving the ^①loss of IEL and ^②reduction in muscle layers ⊗ reduction in vessels → ↓ lumen → ↓ thickness of the wall
- Tunica media is mainly smooth muscle with a few scattered elastic fibers
- Function to redistribute blood flow to **capillaries** and to alter blood pressure by altering peripheral resistance to blood flow → by vaso dilation
vaso constriction

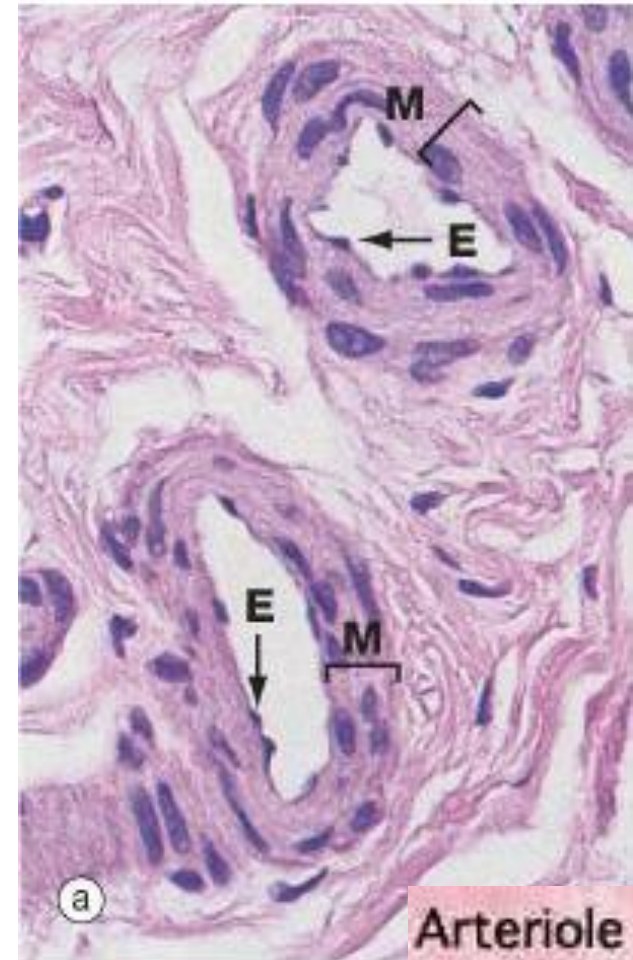
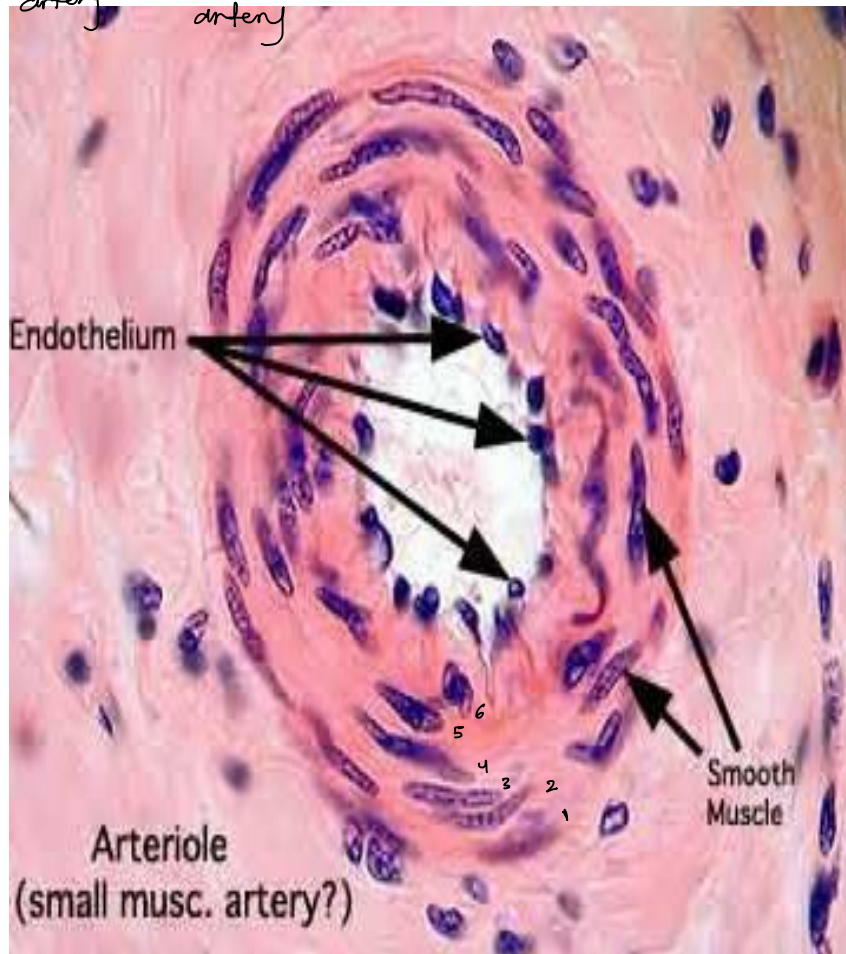
→ referred to as **peripheral resistance vessels**. ①

② هناك علاقة طرقة بين ال Blood pressure & resistance
 كلما زاد ال resistance كلما زاد ال B.p ، العكس

B.p = cardiac output ^(x) multiply by total peripheral resistance vessels ¹⁹
 عمة الدم التي يتطلع من القلب
 peripheral resistance ^{تحدد على مستوى ال arteriole}
 Blood داخل ال circulation ^{تحدد على مستوى ال arteriole}
 (المقاومة التي يواجهها ال Blood داخل ال circulation)

Arterioles

*) حينما انه هناك قِطْعٌ من muscular vessels إلى arteriole ولكن هذا القِطْعٌ من الضرورة يكون فاجعاً؛ أي ما حكيماً يكون large muscular artery ← medial muscular artery ← small muscular artery
arterioles



في هذا ال image ما تفرأ واحد من transmission صا، لذلك هناك كتابة
arteriole أو small muscular (ما تفرأ قترم)

صا دل بالاسم صا arteriole

*) الاسم المرتكز عليه لقيده هل هو small muscular arterioles صا smooth muscle layer اذا كانت 5 layer، أكثر tunica media

يقول انه muscular artery اذا كانه - smooth muscle layer tunica media كانه اقل منه 5 طبقات arteriol .
وبالتالي الصوره التي فيها ما قدرنا نزيد ما على طردي question mark يعني انه muscular artery لانه 6 طبقات .

Capillaries

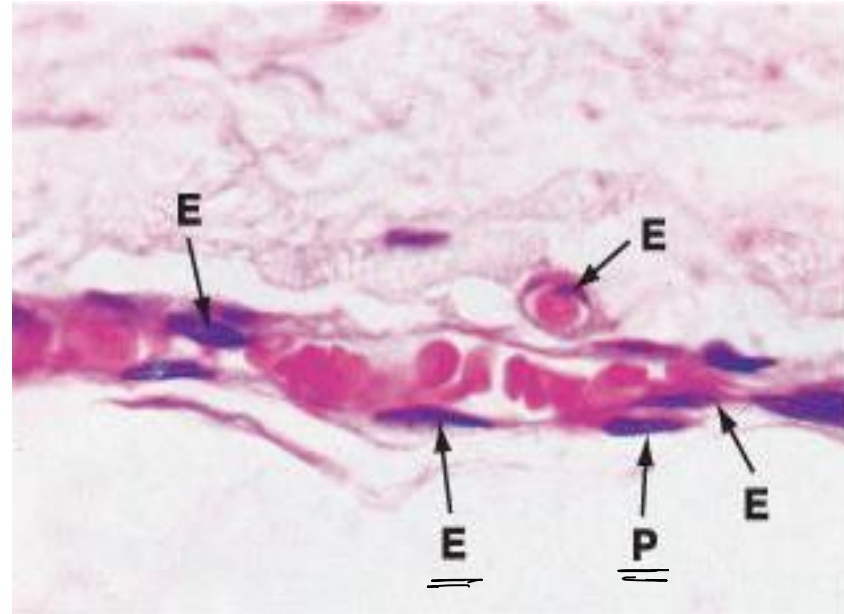
- Exchange of gases, fluids, nutrients and metabolic waste products
- Low rate of blood flow
- Large surface area
- Exceedingly thin walls

⊗ very very thin wall , very narrow lumen

capillary groups كذا يكون we have large surface area ← Rate of the Blood flow is slow

Capillaries

- Their walls consist of just a **thin tunica intima** capillary wall ال جداره هو رقيق، tunica intima
- Only a single layer of flattened endothelial cells (**E**) line the lumen supporting smooth muscle like cell، خلية عضلة ناعمة، endothelium، Tunica
- These cells are supported by **pericytes** (**P**), smooth muscle-like cells that stabilize the capillary wall Pericyte



Capillaries

له على الرغم من أنهم صغير جداً كثير الأهم الأهم many Function

• Functions:

1. **Permeability**; capillaries are exchange vessels

- **Intercellular junctions** (small pores): water and hydrophilic molecules

→ tight-junction between endothelial cells.

- **Fenestrae** (large pores): macromolecules : in pinocytotic vesicles

عارة متواجدة في

يتكون
عن طريق

أحياناً

2. Antithrombogenic function

① normal endothelial cell → release of nitric oxid & vasodilation factor like endothelin
 ② في المقابل لو الـ endothelial injury بغيرها thrombogenic or coagulate property.
 Stress → injury → anti coagulation عن طريق
 coagulation → thrombation
 or thrombation

Capillaries

- Functions:

3. Metabolic functions:

a. Activation: ^{on renin} conversion of angiotensin I to angiotensin II

b. Inactivation: ^{on capillary} conversion of bradykinin, serotonin, prostaglandins, thrombin to biologically inert compounds
_{normal endothelium} ^{غالباً في}

c. production of vasoactive factors like endothelins and nitric oxide (NO)

d. Lipolysis ⇒ ^{① في} adipose tissue عن طريق fatty acid تدخل من الدم
 Kilomicon ^② من الدم ^③ VLDL ^④ fatty acid ^⑤ Blood ^⑥ تدخل
 Lipoprotein ^⑦ enzyme ^⑧ storage ^⑨ adipose ^⑩ tissue
 Lipase ^⑪ ^⑫ for triglyceride
 F.A ^⑬ ^⑭ ^⑮ ^⑯ ^⑰ ^⑱ ^⑲ ^⑳ ^㉑ ^㉒ ^㉓ ^㉔ ^㉕ ^㉖ ^㉗ ^㉘ ^㉙ ^㉚ ^㉛ ^㉜ ^㉝ ^㉞ ^㉟ ^㊱ ^㊲ ^㊳ ^㊴ ^㊵ ^㊶ ^㊷ ^㊸ ^㊹ ^㊺ ^㊻ ^㊼ ^㊽ ^㊾ ^㊿ ¹ ² ³ ⁴ ⁵ ⁶ ⁷ ⁸ ⁹ ¹⁰ ¹¹ ¹² ¹³ ¹⁴ ¹⁵ ¹⁶ ¹⁷ ¹⁸ ¹⁹ ²⁰ ²¹ ²² ²³ ²⁴ ²⁵ ²⁶ ²⁷ ²⁸ ²⁹ ³⁰ ³¹ ³² ³³ ³⁴ ³⁵ ³⁶ ³⁷ ³⁸ ³⁹ ⁴⁰ ⁴¹ ⁴² ⁴³ ⁴⁴ ⁴⁵ ⁴⁶ ⁴⁷ ⁴⁸ ⁴⁹ ⁵⁰ ⁵¹ ⁵² ⁵³ ⁵⁴ ⁵⁵ ⁵⁶ ⁵⁷ ⁵⁸ ⁵⁹ ⁶⁰ ⁶¹ ⁶² ⁶³ ⁶⁴ ⁶⁵ ⁶⁶ ⁶⁷ ⁶⁸ ⁶⁹ ⁷⁰ ⁷¹ ⁷² ⁷³ ⁷⁴ ⁷⁵ ⁷⁶ ⁷⁷ ⁷⁸ ⁷⁹ ⁸⁰ ⁸¹ ⁸² ⁸³ ⁸⁴ ⁸⁵ ⁸⁶ ⁸⁷ ⁸⁸ ⁸⁹ ⁹⁰ ⁹¹ ⁹² ⁹³ ⁹⁴ ⁹⁵ ⁹⁶ ⁹⁷ ⁹⁸ ⁹⁹ ¹⁰⁰ ¹⁰¹ ¹⁰² ¹⁰³ ¹⁰⁴ ¹⁰⁵ ¹⁰⁶ ¹⁰⁷ ¹⁰⁸ ¹⁰⁹ ¹¹⁰ ¹¹¹ ¹¹² ¹¹³ ¹¹⁴ ¹¹⁵ ¹¹⁶ ¹¹⁷ ¹¹⁸ ¹¹⁹ ¹²⁰ ¹²¹ ¹²² ¹²³ ¹²⁴ ¹²⁵ ¹²⁶ ¹²⁷ ¹²⁸ ¹²⁹ ¹³⁰ ¹³¹ ¹³² ¹³³ ¹³⁴ ¹³⁵ ¹³⁶ ¹³⁷ ¹³⁸ ¹³⁹ ¹⁴⁰ ¹⁴¹ ¹⁴² ¹⁴³ ¹⁴⁴ ¹⁴⁵ ¹⁴⁶ ¹⁴⁷ ¹⁴⁸ ¹⁴⁹ ¹⁵⁰ ¹⁵¹ ¹⁵² ¹⁵³ ¹⁵⁴ ¹⁵⁵ ¹⁵⁶ ¹⁵⁷ ¹⁵⁸ ¹⁵⁹ ¹⁶⁰ ¹⁶¹ ¹⁶² ¹⁶³ ¹⁶⁴ ¹⁶⁵ ¹⁶⁶ ¹⁶⁷ ¹⁶⁸ ¹⁶⁹ ¹⁷⁰ ¹⁷¹ ¹⁷² ¹⁷³ ¹⁷⁴ ¹⁷⁵ ¹⁷⁶ ¹⁷⁷ ¹⁷⁸ ¹⁷⁹ ¹⁸⁰ ¹⁸¹ ¹⁸² ¹⁸³ ¹⁸⁴ ¹⁸⁵ ¹⁸⁶ ¹⁸⁷ ¹⁸⁸ ¹⁸⁹ ¹⁹⁰ ¹⁹¹ ¹⁹² ¹⁹³ ¹⁹⁴ ¹⁹⁵ ¹⁹⁶ ¹⁹⁷ ¹⁹⁸ ¹⁹⁹ ²⁰⁰ ²⁰¹ ²⁰² ²⁰³ ²⁰⁴ ²⁰⁵ ²⁰⁶ ²⁰⁷ ²⁰⁸ ²⁰⁹ ²¹⁰ ²¹¹ ²¹² ²¹³ ²¹⁴ ²¹⁵ ²¹⁶ ²¹⁷ ²¹⁸ ²¹⁹ ²²⁰ ²²¹ ²²² ²²³ ²²⁴ ²²⁵ ²²⁶ ²²⁷ ²²⁸ ²²⁹ ²³⁰ ²³¹ ²³² ²³³ ²³⁴ ²³⁵ ²³⁶ ²³⁷ ²³⁸ ²³⁹ ²⁴⁰ ²⁴¹ ²⁴² ²⁴³ ²⁴⁴ ²⁴⁵ ²⁴⁶ ²⁴⁷ ²⁴⁸ ²⁴⁹ ²⁵⁰ ²⁵¹ ²⁵² ²⁵³ ²⁵⁴ ²⁵⁵ ²⁵⁶ ²⁵⁷ ²⁵⁸ ²⁵⁹ ²⁶⁰ ²⁶¹ ²⁶² ²⁶³ ²⁶⁴ ²⁶⁵ ²⁶⁶ ²⁶⁷ ²⁶⁸ ²⁶⁹ ²⁷⁰ ²⁷¹ ²⁷² ²⁷³ ²⁷⁴ ²⁷⁵ ²⁷⁶ ²⁷⁷ ²⁷⁸ ²⁷⁹ ²⁸⁰ ²⁸¹ ²⁸² ²⁸³ ²⁸⁴ ²⁸⁵ ²⁸⁶ ²⁸⁷ ²⁸⁸ ²⁸⁹ ²⁹⁰ ²⁹¹ ²⁹² ²⁹³ ²⁹⁴ ²⁹⁵ ²⁹⁶ ²⁹⁷ ²⁹⁸ ²⁹⁹ ³⁰⁰ ³⁰¹ ³⁰² ³⁰³ ³⁰⁴ ³⁰⁵ ³⁰⁶ ³⁰⁷ ³⁰⁸ ³⁰⁹ ³¹⁰ ³¹¹ ³¹² ³¹³ ³¹⁴ ³¹⁵ ³¹⁶ ³¹⁷ ³¹⁸ ³¹⁹ ³²⁰ ³²¹ ³²² ³²³ ³²⁴ ³²⁵ ³²⁶ ³²⁷ ³²⁸ ³²⁹ ³³⁰ ³³¹ ³³² ³³³ ³³⁴ ³³⁵ ³³⁶ ³³⁷ ³³⁸ ³³⁹ ³⁴⁰ ³⁴¹ ³⁴² ³⁴³ ³⁴⁴ ³⁴⁵ ³⁴⁶ ³⁴⁷ ³⁴⁸ ³⁴⁹ ³⁵⁰ ³⁵¹ ³⁵² ³⁵³ ³⁵⁴ ³⁵⁵ ³⁵⁶ ³⁵⁷ ³⁵⁸ ³⁵⁹ ³⁶⁰ ³⁶¹ ³⁶² ³⁶³ ³⁶⁴ ³⁶⁵ ³⁶⁶ ³⁶⁷ ³⁶⁸ ³⁶⁹ ³⁷⁰ ³⁷¹ ³⁷² ³⁷³ ³⁷⁴ ³⁷⁵ ³⁷⁶ ³⁷⁷ ³⁷⁸ ³⁷⁹ ³⁸⁰ ³⁸¹ ³⁸² ³⁸³ ³⁸⁴ ³⁸⁵ ³⁸⁶ ³⁸⁷ ³⁸⁸ ³⁸⁹ ³⁹⁰ ³⁹¹ ³⁹² ³⁹³ ³⁹⁴ ³⁹⁵ ³⁹⁶ ³⁹⁷ ³⁹⁸ ³⁹⁹ ⁴⁰⁰ ⁴⁰¹ ⁴⁰² ⁴⁰³ ⁴⁰⁴ ⁴⁰⁵ ⁴⁰⁶ ⁴⁰⁷ ⁴⁰⁸ ⁴⁰⁹ ⁴¹⁰ ⁴¹¹ ⁴¹² ⁴¹³ ⁴¹⁴ ⁴¹⁵ ⁴¹⁶ ⁴¹⁷ ⁴¹⁸ ⁴¹⁹ ⁴²⁰ ⁴²¹ ⁴²² ⁴²³ ⁴²⁴ ⁴²⁵ ⁴²⁶ ⁴²⁷ ⁴²⁸ ⁴²⁹ ⁴³⁰ ⁴³¹ ⁴³² ⁴³³ ⁴³⁴ ⁴³⁵ ⁴³⁶ ⁴³⁷ ⁴³⁸ ⁴³⁹ ⁴⁴⁰ ⁴⁴¹ ⁴⁴² ⁴⁴³ ⁴⁴⁴ ⁴⁴⁵ ⁴⁴⁶ ⁴⁴⁷ ⁴⁴⁸ ⁴⁴⁹ ⁴⁵⁰ ⁴⁵¹ ⁴⁵² ⁴⁵³ ⁴⁵⁴ ⁴⁵⁵ ⁴⁵⁶ ⁴⁵⁷ ⁴⁵⁸ ⁴⁵⁹ ⁴⁶⁰ ⁴⁶¹ ⁴⁶² ⁴⁶³ ⁴⁶⁴ ⁴⁶⁵ ⁴⁶⁶ ⁴⁶⁷ ⁴⁶⁸ ⁴⁶⁹ ⁴⁷⁰ ⁴⁷¹ ⁴⁷² ⁴⁷³ ⁴⁷⁴ ⁴⁷⁵ ⁴⁷⁶ ⁴⁷⁷ ⁴⁷⁸ ⁴⁷⁹ ⁴⁸⁰ ⁴⁸¹ ⁴⁸² ⁴⁸³ ⁴⁸⁴ ⁴⁸⁵ ⁴⁸⁶ ⁴⁸⁷ ⁴⁸⁸ ⁴⁸⁹ ⁴⁹⁰ ⁴⁹¹ ⁴⁹² ⁴⁹³ ⁴⁹⁴ ⁴⁹⁵ ⁴⁹⁶ ⁴⁹⁷ ⁴⁹⁸ ⁴⁹⁹ ⁵⁰⁰ ⁵⁰¹ ⁵⁰² ⁵⁰³ ⁵⁰⁴ ⁵⁰⁵ ⁵⁰⁶ ⁵⁰⁷ ⁵⁰⁸ ⁵⁰⁹ ⁵¹⁰ ⁵¹¹ ⁵¹² ⁵¹³ ⁵¹⁴ ⁵¹⁵ ⁵¹⁶ ⁵¹⁷ ⁵¹⁸ ⁵¹⁹ ⁵²⁰ ⁵²¹ ⁵²² ⁵²³ ⁵²⁴ ⁵²⁵ ⁵²⁶ ⁵²⁷ ⁵²⁸ ⁵²⁹ ⁵³⁰ ⁵³¹ ⁵³² ⁵³³ ⁵³⁴ ⁵³⁵ ⁵³⁶ ⁵³⁷ ⁵³⁸ ⁵³⁹ ⁵⁴⁰ ⁵⁴¹ ⁵⁴² ⁵⁴³ ⁵⁴⁴ ⁵⁴⁵ ⁵⁴⁶ ⁵⁴⁷ ⁵⁴⁸ ⁵⁴⁹ ⁵⁵⁰ ⁵⁵¹ ⁵⁵² ⁵⁵³ ⁵⁵⁴ ⁵⁵⁵ ⁵⁵⁶ ⁵⁵⁷ ⁵⁵⁸ ⁵⁵⁹ ⁵⁶⁰ ⁵⁶¹ ⁵⁶² ⁵⁶³ ⁵⁶⁴ ⁵⁶⁵ ⁵⁶⁶ ⁵⁶⁷ ⁵⁶⁸ ⁵⁶⁹ ⁵⁷⁰ ⁵⁷¹ ⁵⁷² ⁵⁷³ ⁵⁷⁴ ⁵⁷⁵ ⁵⁷⁶ ⁵⁷⁷ ⁵⁷⁸ ⁵⁷⁹ ⁵⁸⁰ ⁵⁸¹ ⁵⁸² ⁵⁸³ ⁵⁸⁴ ⁵⁸⁵ ⁵⁸⁶ ⁵⁸⁷ ⁵⁸⁸ ⁵⁸⁹ ⁵⁹⁰ ⁵⁹¹ ⁵⁹² ⁵⁹³ ⁵⁹⁴ ⁵⁹⁵ ⁵⁹⁶ ⁵⁹⁷ ⁵⁹⁸ ⁵⁹⁹ ⁶⁰⁰ ⁶⁰¹ ⁶⁰² ⁶⁰³ ⁶⁰⁴ ⁶⁰⁵ ⁶⁰⁶ ⁶⁰⁷ ⁶⁰⁸ ⁶⁰⁹ ⁶¹⁰ ⁶¹¹ ⁶¹² ⁶¹³ ⁶¹⁴ ⁶¹⁵ ⁶¹⁶ ⁶¹⁷ ⁶¹⁸ ⁶¹⁹ ⁶²⁰ ⁶²¹ ⁶²² ⁶²³ ⁶²⁴ ⁶²⁵ ⁶²⁶ ⁶²⁷ ⁶²⁸ ⁶²⁹ ⁶³⁰ ⁶³¹ ⁶³² ⁶³³ ⁶³⁴ ⁶³⁵ ⁶³⁶ ⁶³⁷ ⁶³⁸ ⁶³⁹ ⁶⁴⁰ ⁶⁴¹ ⁶⁴² ⁶⁴³ ⁶⁴⁴ ⁶⁴⁵ ⁶⁴⁶ ⁶⁴⁷ ⁶⁴⁸ ⁶⁴⁹ ⁶⁵⁰ ⁶⁵¹ ⁶⁵² ⁶⁵³ ⁶⁵⁴ ⁶⁵⁵ ⁶⁵⁶ ⁶⁵⁷ ⁶⁵⁸ ⁶⁵⁹ ⁶⁶⁰ ⁶⁶¹ ⁶⁶² ⁶⁶³ ⁶⁶⁴ ⁶⁶⁵ ⁶⁶⁶ ⁶⁶⁷ ⁶⁶⁸ ⁶⁶⁹ ⁶⁷⁰ ⁶⁷¹ ⁶⁷² ⁶⁷³ ⁶⁷⁴ ⁶⁷⁵ ⁶⁷⁶ ⁶⁷⁷ ⁶⁷⁸ ⁶⁷⁹ ⁶⁸⁰ ⁶⁸¹ ⁶⁸² ⁶⁸³ ⁶⁸⁴ ⁶⁸⁵ ⁶⁸⁶ ⁶⁸⁷ ⁶⁸⁸ ⁶⁸⁹ ⁶⁹⁰ ⁶⁹¹ ⁶⁹² ⁶⁹³ ⁶⁹⁴ ⁶⁹⁵ ⁶⁹⁶ ⁶⁹⁷ ⁶⁹⁸ ⁶⁹⁹ ⁷⁰⁰ ⁷⁰¹ ⁷⁰² ⁷⁰³ ⁷⁰⁴ ⁷⁰⁵ ⁷⁰⁶ ⁷⁰⁷ ⁷⁰⁸ ⁷⁰⁹ ⁷¹⁰ ⁷¹¹ ⁷¹² ⁷¹³ ⁷¹⁴ ⁷¹⁵ ⁷¹⁶ ⁷¹⁷ ⁷¹⁸ ⁷¹⁹ ⁷²⁰ ⁷²¹ ⁷²² ⁷²³ ⁷²⁴ ⁷²⁵ ⁷²⁶ ⁷²⁷ ⁷²⁸ ⁷²⁹ ⁷³⁰ ⁷³¹ ⁷³² ⁷³³ ⁷³⁴ ⁷³⁵ ⁷³⁶ ⁷³⁷ ⁷³⁸ ⁷³⁹ ⁷⁴⁰ ⁷⁴¹ ⁷⁴² ⁷⁴³ ⁷⁴⁴ ⁷⁴⁵ ⁷⁴⁶ ⁷⁴⁷ ⁷⁴⁸ ⁷⁴⁹ ⁷⁵⁰ ⁷⁵¹ ⁷⁵² ⁷⁵³ ⁷⁵⁴ ⁷⁵⁵ ⁷⁵⁶ ⁷⁵⁷ ⁷⁵⁸ ⁷⁵⁹ ⁷⁶⁰ ⁷⁶¹ ⁷⁶² ⁷⁶³ ⁷⁶⁴ ⁷⁶⁵ ⁷⁶⁶ ⁷⁶⁷ ⁷⁶⁸ ⁷⁶⁹ ⁷⁷⁰ ⁷⁷¹ ⁷⁷² ⁷⁷³ ⁷⁷⁴ ⁷⁷⁵ ⁷⁷⁶ ⁷⁷⁷ ⁷⁷⁸ ⁷⁷⁹ ⁷⁸⁰ ⁷⁸¹ ⁷⁸² ⁷⁸³ ⁷⁸⁴ ⁷⁸⁵ ⁷⁸⁶ ⁷⁸⁷ ⁷⁸⁸ ⁷⁸⁹ ⁷⁹⁰ ⁷⁹¹ ⁷⁹² ⁷⁹³ ⁷⁹⁴ ⁷⁹⁵ ⁷⁹⁶ ⁷⁹⁷ ⁷⁹⁸ ⁷⁹⁹ ⁸⁰⁰ ⁸⁰¹ ⁸⁰² ⁸⁰³ ⁸⁰⁴ ⁸⁰⁵ ⁸⁰⁶ ⁸⁰⁷ ⁸⁰⁸ ⁸⁰⁹ ⁸¹⁰ ⁸¹¹ ⁸¹² ⁸¹³ ⁸¹⁴ ⁸¹⁵ ⁸¹⁶ ⁸¹⁷ ⁸¹⁸ ⁸¹⁹ ⁸²⁰ ⁸²¹ ⁸²² ⁸²³ ⁸²⁴ ⁸²⁵ ⁸²⁶ ⁸²⁷ ⁸²⁸ ⁸²⁹ ⁸³⁰ ⁸³¹ ⁸³² ⁸³³ ⁸³⁴ ⁸³⁵ ⁸³⁶ ⁸³⁷ ⁸³⁸ ⁸³⁹ ⁸⁴⁰ ⁸⁴¹ ⁸⁴² ⁸⁴³ ⁸⁴⁴ ⁸⁴⁵ ⁸⁴⁶ ⁸⁴⁷ ⁸⁴⁸ ⁸⁴⁹ ⁸⁵⁰ ⁸⁵¹ ⁸⁵² ⁸⁵³ ⁸⁵⁴ ⁸⁵⁵ ⁸⁵⁶ ⁸⁵⁷ ⁸⁵⁸ ⁸⁵⁹ ⁸⁶⁰ ⁸⁶¹ ⁸⁶² ⁸⁶³ ⁸⁶⁴ ⁸⁶⁵ ⁸⁶⁶ ⁸⁶⁷ ⁸⁶⁸ ⁸⁶⁹ ⁸⁷⁰ ⁸⁷¹ ⁸⁷² ⁸⁷³ ⁸⁷⁴ ⁸⁷⁵ ⁸⁷⁶ ⁸⁷⁷ ⁸⁷⁸ ⁸⁷⁹ ⁸⁸⁰ ⁸⁸¹ ⁸⁸² ⁸⁸³ ⁸⁸⁴ ⁸⁸⁵ ⁸⁸⁶ ⁸⁸⁷ ⁸⁸⁸ ⁸⁸⁹ ⁸⁹⁰ ⁸⁹¹ ⁸⁹² ⁸⁹³ ⁸⁹⁴ ⁸⁹⁵ ⁸⁹⁶ ⁸⁹⁷ ⁸⁹⁸ ⁸⁹⁹ ⁹⁰⁰ ⁹⁰¹ ⁹⁰² ⁹⁰³ ⁹⁰⁴ ⁹⁰⁵ ⁹⁰⁶ ⁹⁰⁷ ⁹⁰⁸ ⁹⁰⁹ ⁹¹⁰ ⁹¹¹ ⁹¹² ⁹¹³ ⁹¹⁴ ⁹¹⁵ ⁹¹⁶ ⁹¹⁷ ⁹¹⁸ ⁹¹⁹ ⁹²⁰ ⁹²¹ ⁹²² ⁹²³ ⁹²⁴ ⁹²⁵ ⁹²⁶ ⁹²⁷ ⁹²⁸ ⁹²⁹ ⁹³⁰ ⁹³¹ ⁹³² ⁹³³ ⁹³⁴ ⁹³⁵ ⁹³⁶ ⁹³⁷ ⁹³⁸ ⁹³⁹ ⁹⁴⁰ ⁹⁴¹ ⁹⁴² ⁹⁴³ ⁹⁴⁴ ⁹⁴⁵ ⁹⁴⁶ ⁹⁴⁷ ⁹⁴⁸ ⁹⁴⁹ ⁹⁵⁰ ⁹⁵¹ ⁹⁵² ⁹⁵³ ⁹⁵⁴ ⁹⁵⁵ ⁹⁵⁶ ⁹⁵⁷ ⁹⁵⁸ ⁹⁵⁹ ⁹⁶⁰ ⁹⁶¹ ⁹⁶² ⁹⁶³ ⁹⁶⁴ ⁹⁶⁵ ⁹⁶⁶ ⁹⁶⁷ ⁹⁶⁸ ⁹⁶⁹ ⁹⁷⁰ ⁹⁷¹ ⁹⁷² ⁹⁷³ ⁹⁷⁴ ⁹⁷⁵ ⁹⁷⁶ ⁹⁷⁷ ⁹⁷⁸ ⁹⁷⁹ ⁹⁸⁰ ⁹⁸¹ ⁹⁸² ⁹⁸³ ⁹⁸⁴ ⁹⁸⁵ ⁹⁸⁶ ⁹⁸⁷ ⁹⁸⁸ ⁹⁸⁹ ⁹⁹⁰ ⁹⁹¹ ⁹⁹² ⁹⁹³ ⁹⁹⁴ ⁹⁹⁵ ⁹⁹⁶ ⁹⁹⁷ ⁹⁹⁸ ⁹⁹⁹ ¹⁰⁰⁰

② وكما لو كان الـ fatty acid يفرغ من جدار القلب
 adipocyte عن طريق استهلاكها لبروتينات في القلب
 في حالة الجوع أو fasting لن يتم lipolysis
 ↳ degradation for adipose tissue. 24

Capillaries

- 3 **Types:** dependant on spaces or pores that are the present between the endothelial cells within the endothelium and within the basal lamina

1. Continuous capillaries

basal lamina - pores لا فيها opening في endothelium، pores لا فيها في البسم
 small molecule لا passage لا
 (tight) endothelial cells only بين
 junction

found in muscles, CT, exocrine glands, and nervous tissue

Connective tissue

2. Fenestrated capillaries

found in ^①kidney, ^②intestines, and ^③endocrine glands

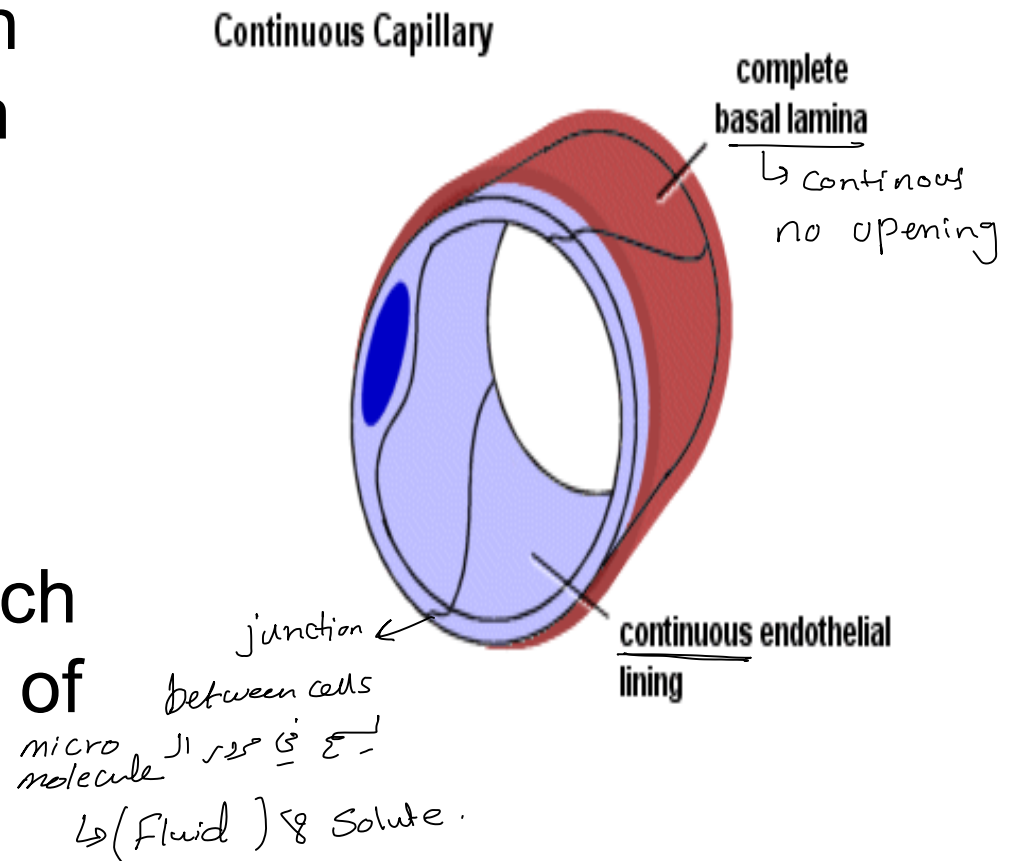
3. Discontinuous sinusoidal capillaries

endothelium - opening & pores لا فيها continuous لا
 basal lamina - Capillary

found mainly in liver, bone marrow, and spleen

Continuous capillaries

- Endothelial cells form a continuous lining, with tight junction between adjacent cells
- The tight junctions leave gaps to form intercellular clefts which allow limited passage of fluids and solutes

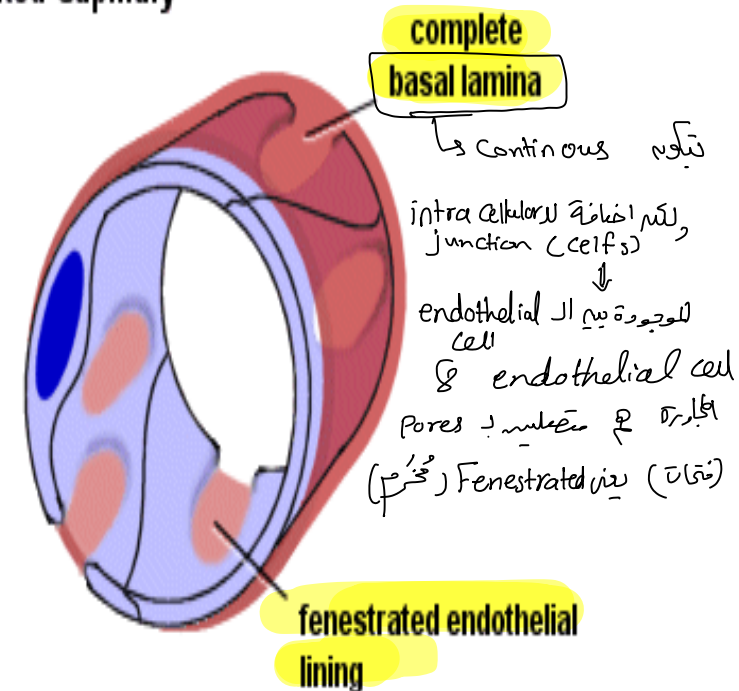


Fenestrated capillaries

- Contain numerous pores (fenestrations) that allow better passage of molecules

هذا النوع من الـ Capillary يسمح بدخول الجزيئات الأكبر عبر هذه الـ pores

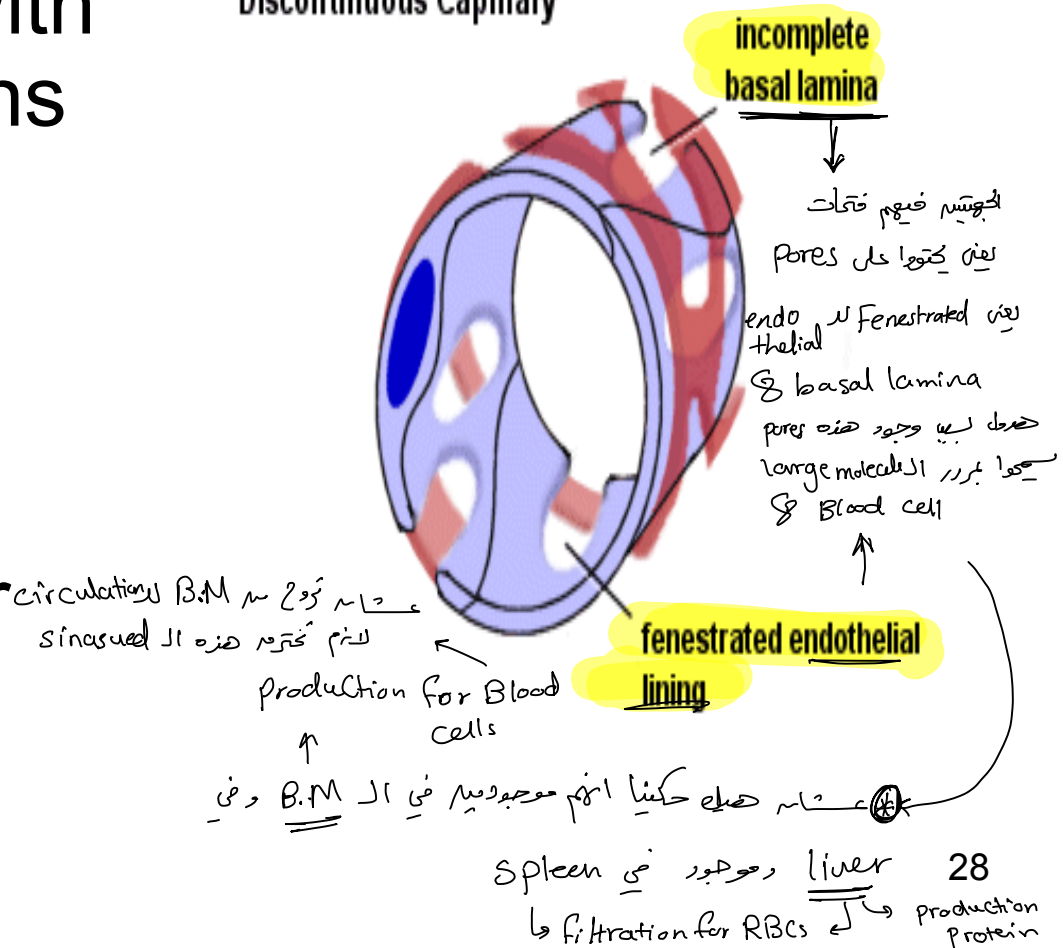
Fenestrated Capillary



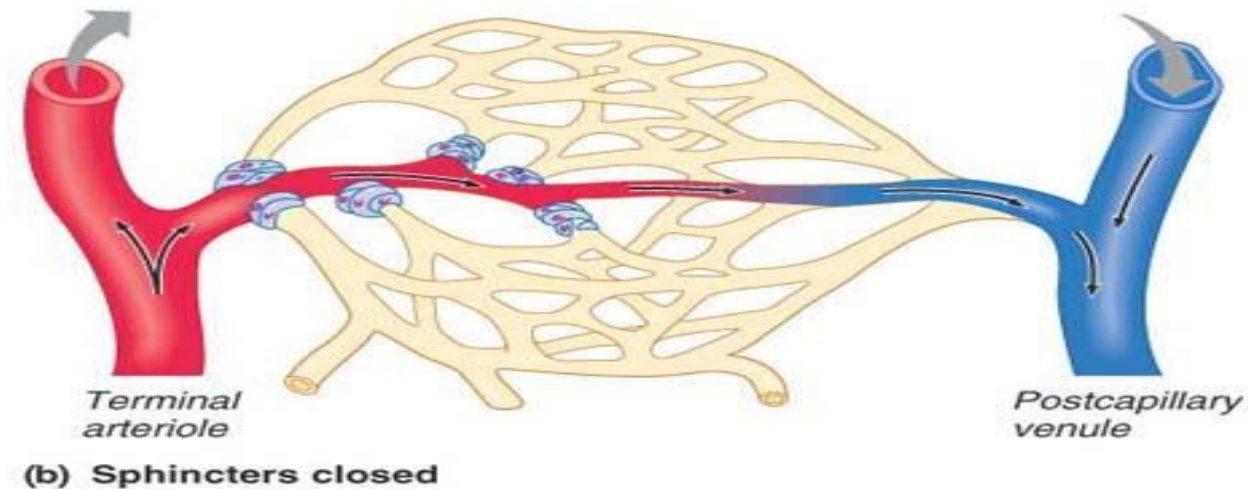
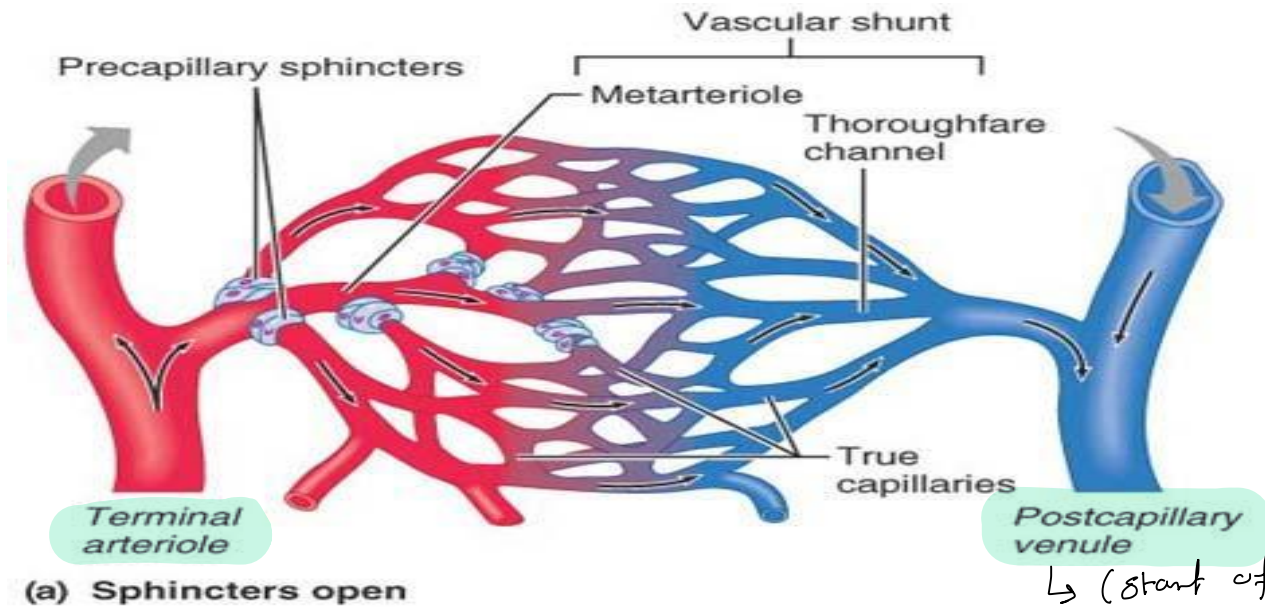
Sinusoidal (discontinuous) capillaries

- Fenestrated endothelial cells with fewer tight junctions and larger intercellular clefts
- Allow passage of large molecules or even blood cells

Discontinuous Capillary



Capillary beds



Arteriovenous Anastomoses

لأنه يمكننا أن نلاحظ أن الدم الarterial في venule عن طريق capillary
ولكنه أحياناً يمكن أن يكون هناك اتصال مباشرة بين الarterial وvenule في ventricular circulation ← normal communication وهذا يؤدي إلى تكون glomus

- Direct communication between arterial and venous circulation

- **Glomus** (plural: **Glomera**)

- Complex structures

في حالة هذا الcommunication ميسر في
arterioles في tunica media الarterioles
smooth muscle fiber
تكون hypertrophy وhyperplasia وهاذا هو

- Arterioles and venules are continuous

⊗ شغلة مهنة -

- Arterioles acquire a thick concentric layer

⊗ الhyperplasia للوجود هي

of smooth muscle cells

normal لكنه يمكن أن يصبح فيها pathological
تكون في tumor لكونه
glomus tumor (or) glomangioma ⇒ Very painful
فingers peels كونه جفن الجرح

- Found mainly in fingerpads, fingernail beds, and ears

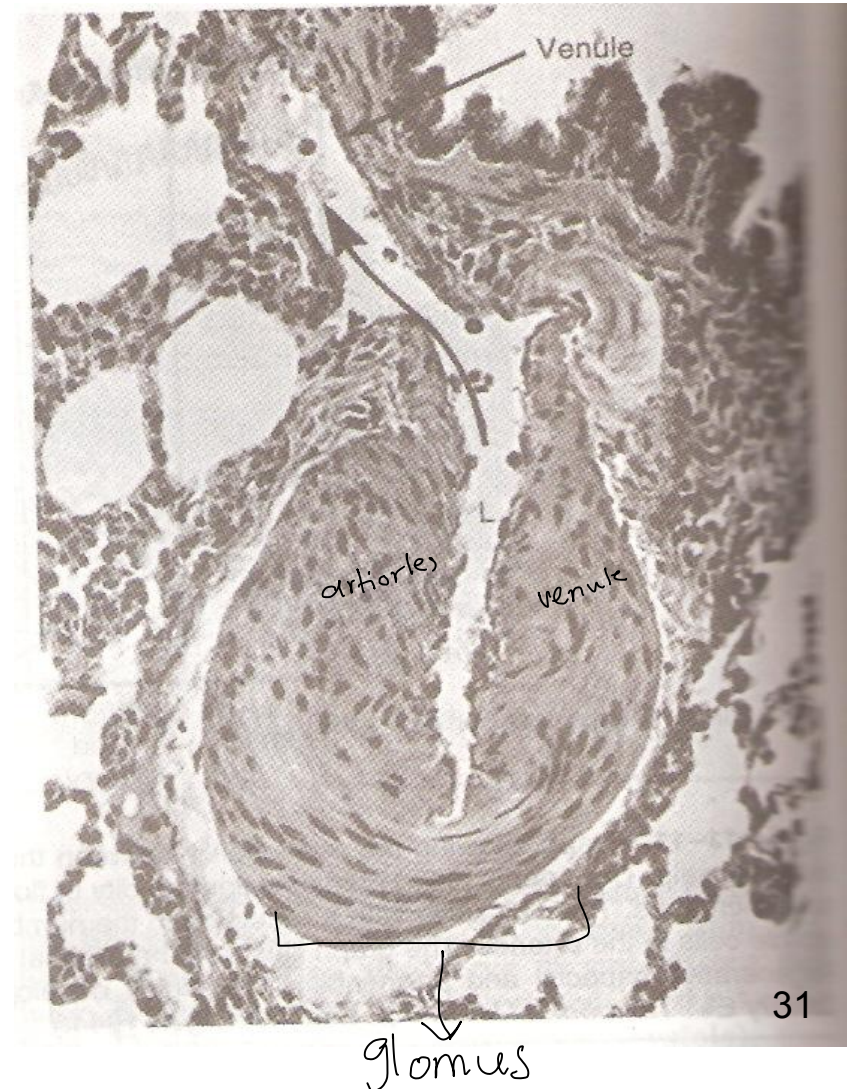
① موجودة في

② fingers peels

③

Glomus

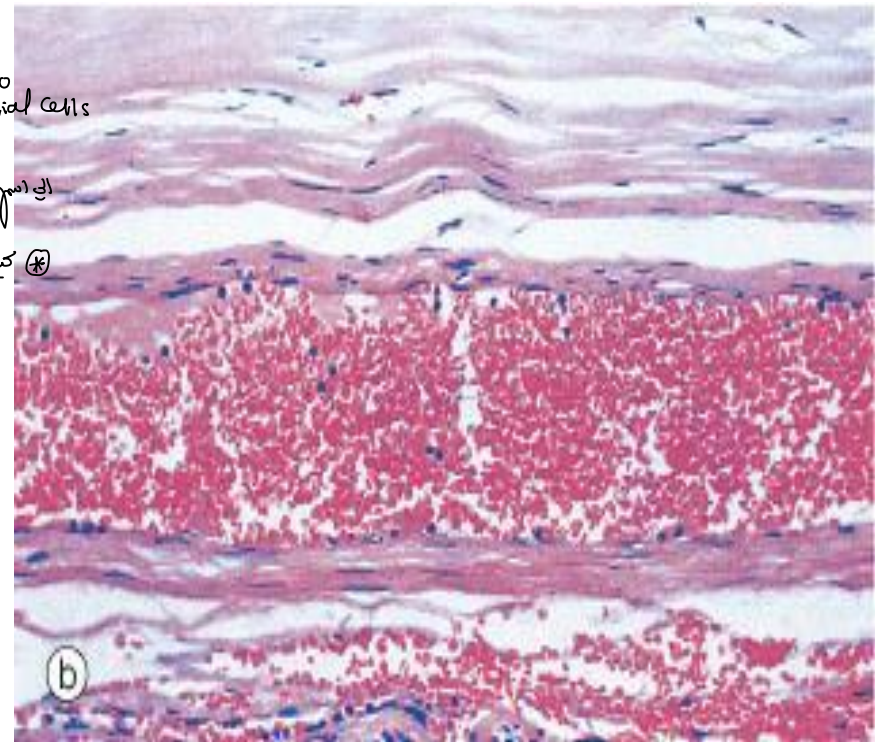
- The glomera have an important role in regulating the blood pressure and controlling the circulation as in:
 - menstruation
 - erection
 - thermoregulation



Venules

*) عبر صلبه بيلي غناد venous Circulation ويبأ حنا عه طيعر ال venules اولا جزء مر ال vein اسمع

- **Postcapillary venules** → vary vary متباين
thin wall جدار رقيق
consist entirely of tunica intima (تunica intima) تتكون عاده من
endothelium around (endothelial cells) + smooth muscle like cells
which a few pericytes ← pores مر ال large number
collect
- Extremely porous
- Larger venules have one or two layers of smooth muscle cells (a scanty tunica media) and a thin adventitia

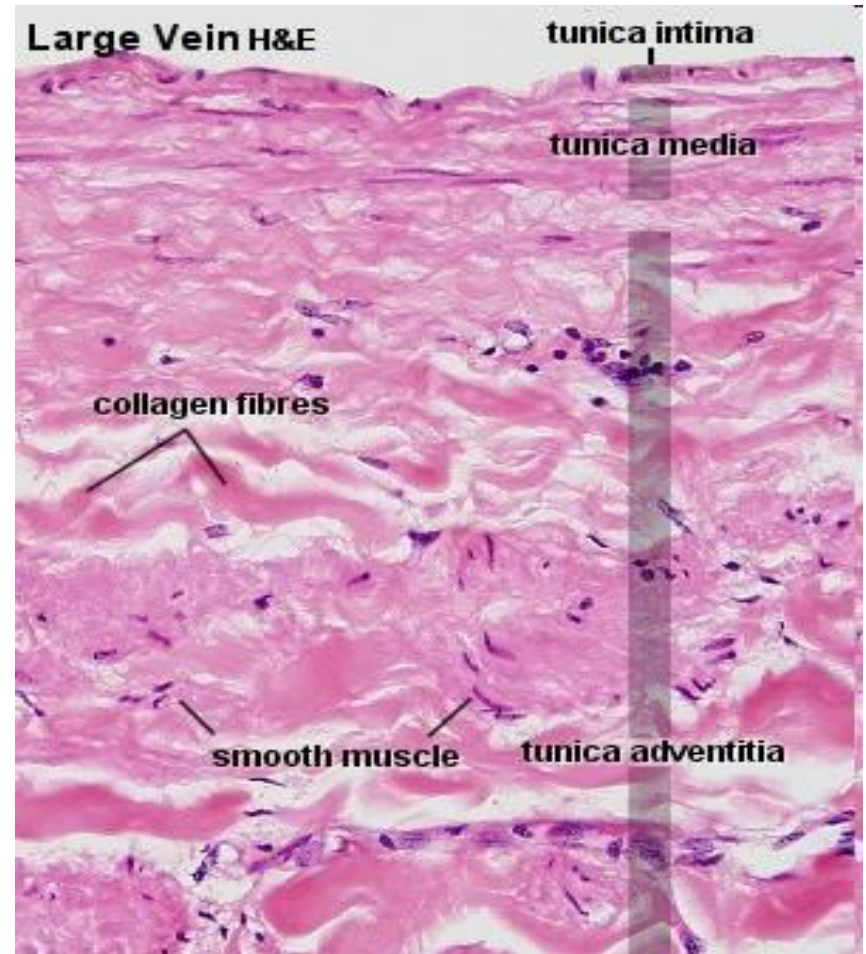


Veins

usually 8-



- Relatively **thin walls** and **large lumen**
- Poorly developed tunica media, with less prominent muscular and elastic features
- **Adventitia** is the **thickest** layer and contains smooth muscle
- **Capacitance vessels**
(**blood reservoir**) → Contain 65 – 70% of the total blood volume



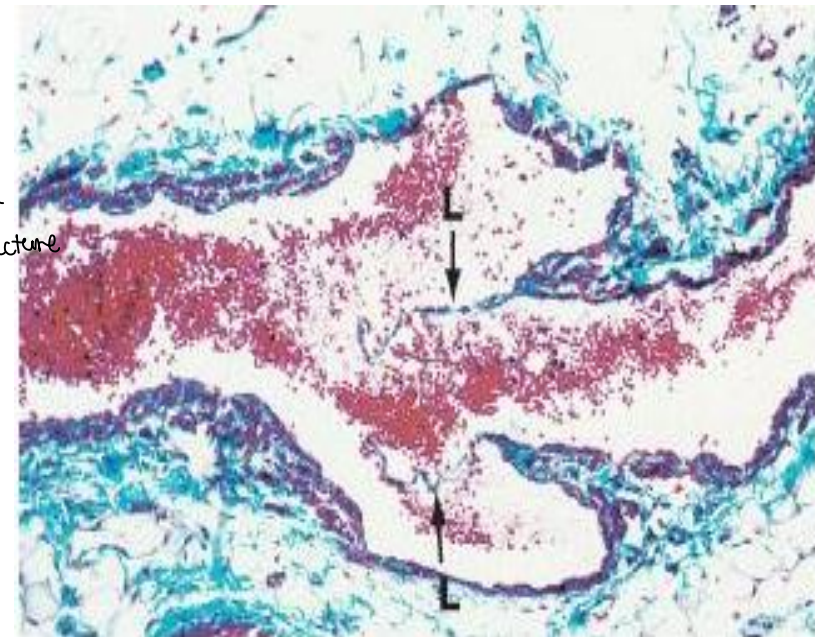
↳ the blood vessels that contain most of the blood and that can readily accommodate changes in the blood volume

Venous valves

- Develop from projections of the tunica intima

④ Flow of the Blood in the veins into the heart against gravity $\Rightarrow$ therefore spiral structure in vein is valves.

- Similar in structure and function to the cardiac



semilunar valves

↑
Projection from tunica intima
↓
endothelium
↑
Projection from tunica intima
↓
endothelium

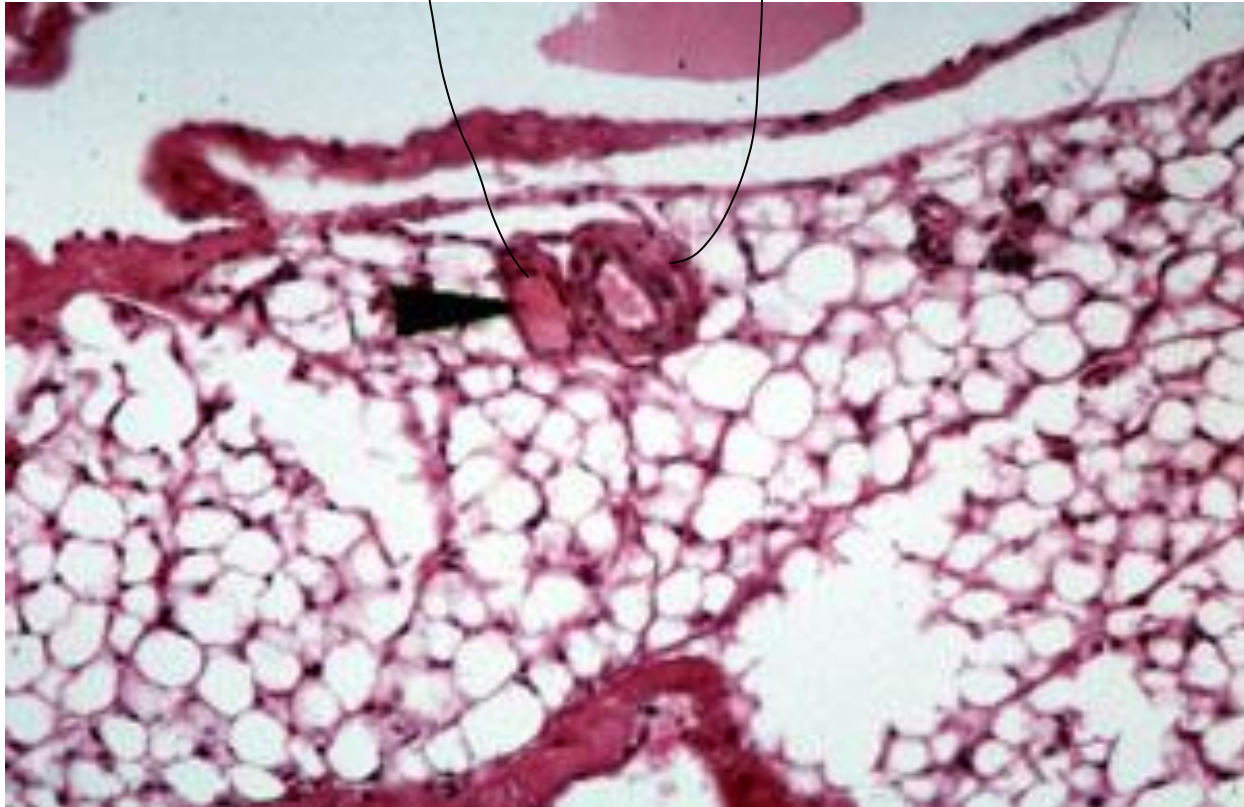
→ aortic valve
→ pulmonary valve.

extensions
↑
Projection from tunica intima
↓
endothelium
↑
Projection from tunica intima
↓
endothelium

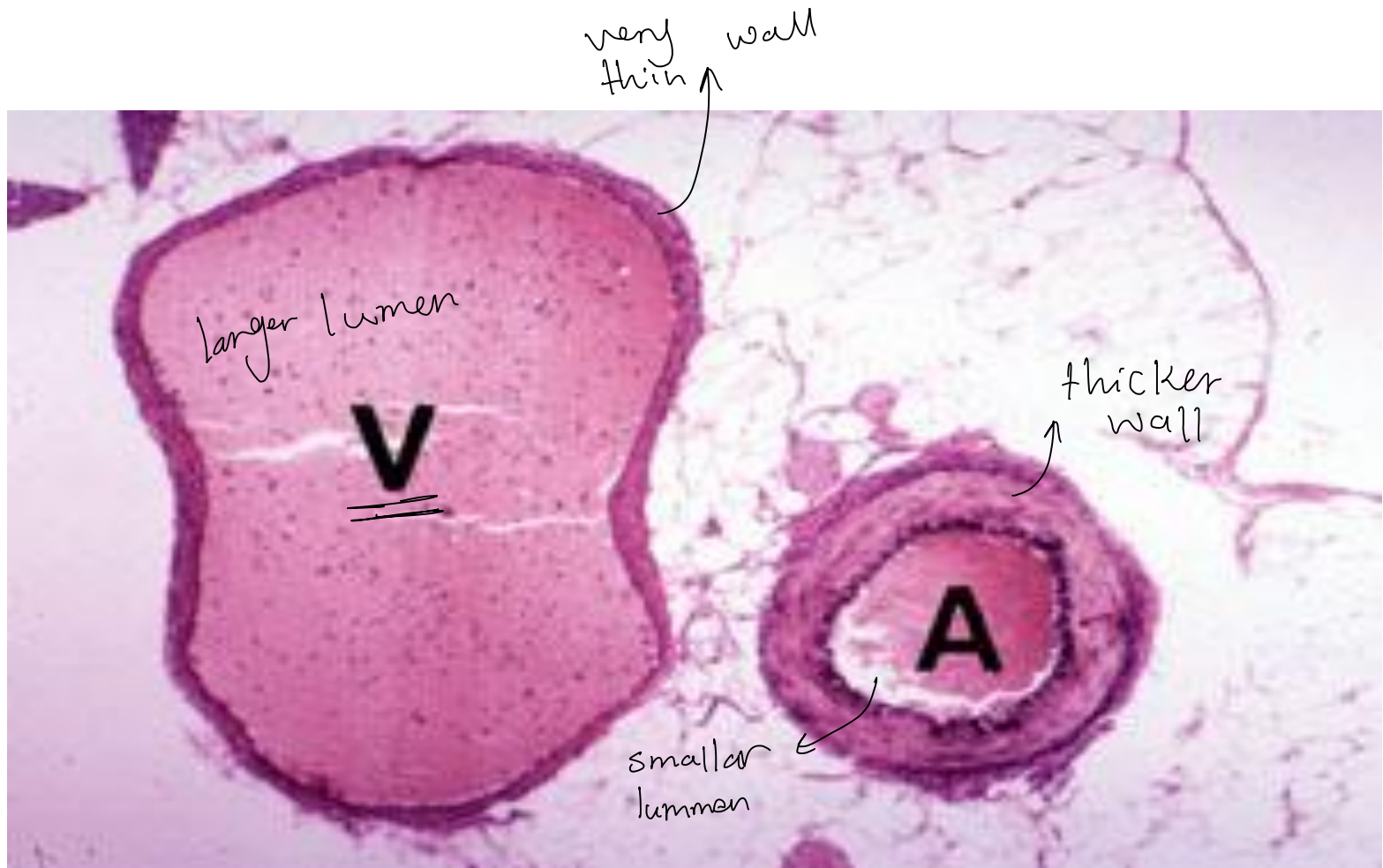
Venule & Arteriole

ملاحظة: في بعض الأحيان

venule
[lumen larger
than arteriol]
arteriol (thick wall)



Small Vein & Muscular Artery



The Heart

- The heart wall can be viewed as a three-layered structure:
 - a. Inner layer = **endocardium**
 - b. Middle Layer = **myocardium**
 - c. Outer layer = **epicardium**
↓
most

The Heart

- **The endocardium** ⇒ simple squamous epithelium (as endothelium vessels).
 & mesothelium in cavities
 - thin layer consists of **endothelium** on the surface with underlying **subendothelial layer**
 - Basement membran (قاع الغشاء) *
 - Supporting by connective tissue.
- **The myocardium**
 - the **thickest** layer and consists of cardiac muscle with connective tissue in between, blood vessels and nerves.
 - (C.T.)
 - conducting nerve (Purkinje system) (نظام بركة)
 - Specialized cells (خلايا متخصصة)
 - ↳ rapidly changing myocyte.
- **The subendocardial layer**
 - connective tissue between the endocardium and myocardium
 - contains nerves and the impulse-conducting system (**Purkinje fibers**)

endothelium

subendocardial layer

CT

Cardiac muscle

↳ myo cardium

myo cardium ⇒ many branches
from myo cytes
~ intercalated disc
fibers transmission for impuls

sub endocardial

heart muscle

PF: purkinje fiber, CM: cardiac muscle

MF: myofibril

ICD

nucleus

ICD

PF

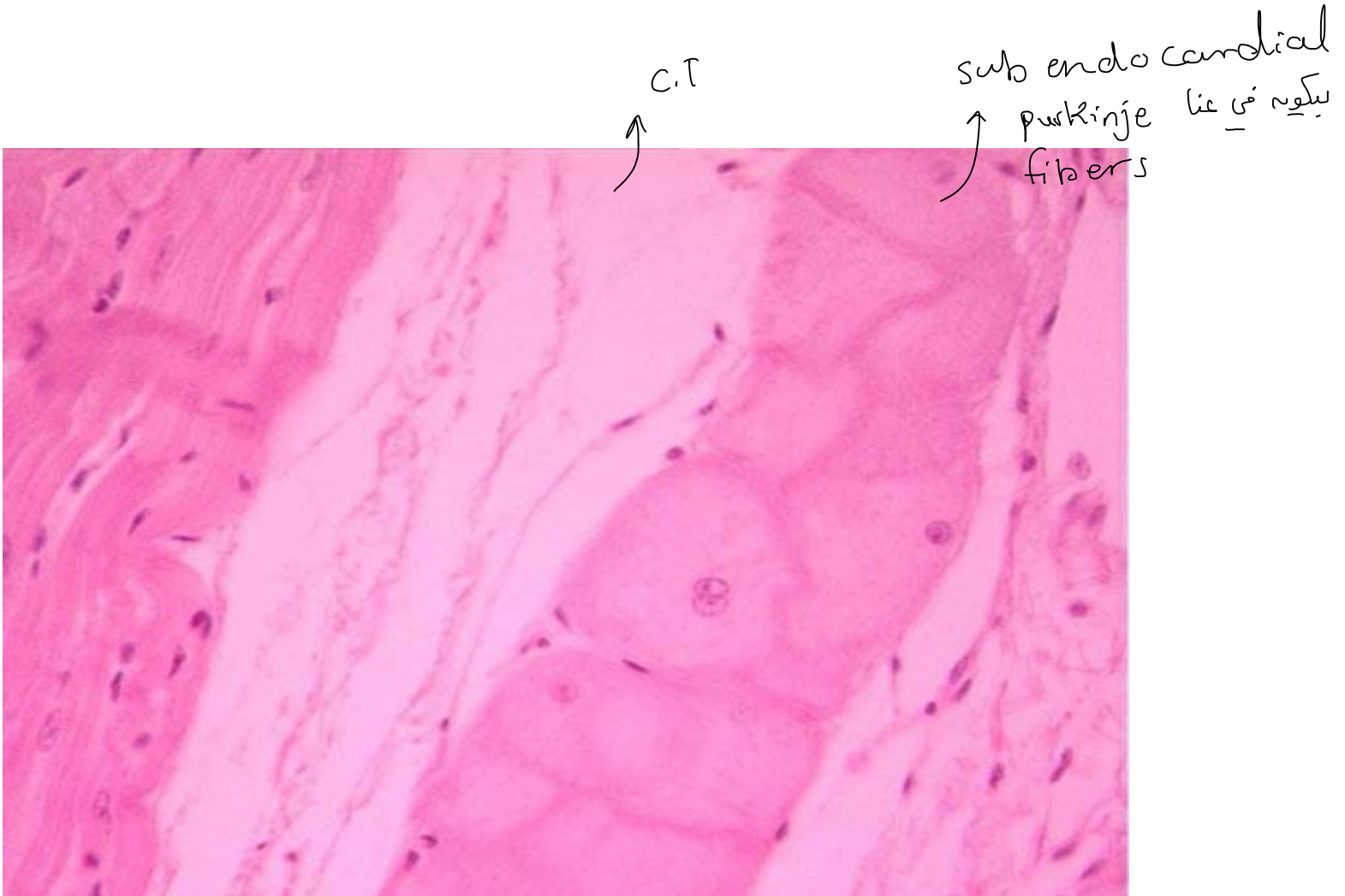
MF

CM

MF

39

The Heart



The Heart

- The **epicardium**

- **outer layer** consists of **connective tissue**

- contain large blood vessels (coronary & large blood vessels) and nerves

↳ contain very amount from adipose tissue

⇒

myocardial = $\frac{1}{2}$ الـ $\frac{1}{2}$ الـ Small B.V

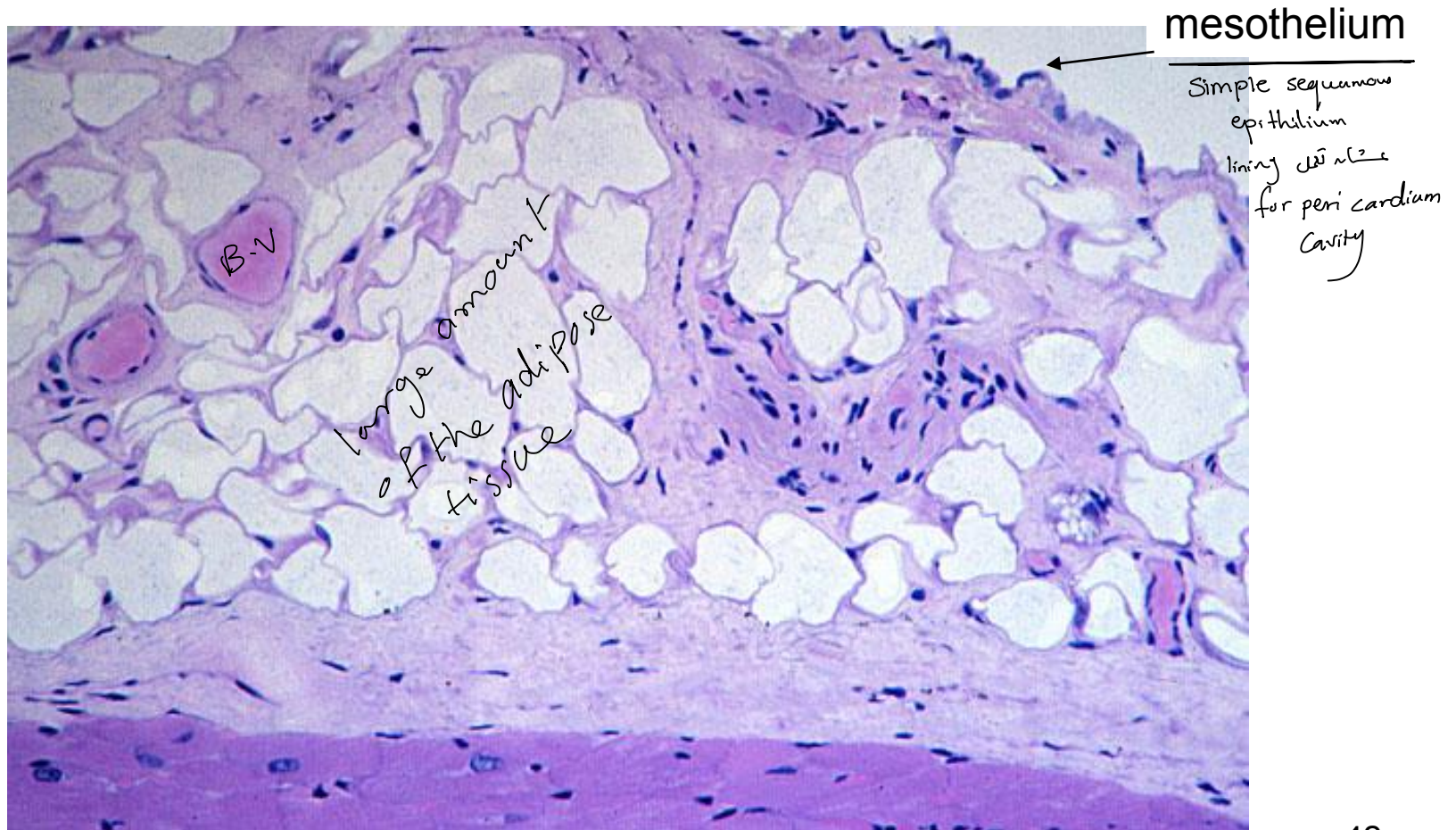
medium muscular artery & coronary vessels

- large amount of adipose tissue

- covered on its outer edge by a mesothelium which lines the pericardial cavity

lining الـ

The epicardium



Lymph vascular system

- ① ^{يجمع} Collects fluid from tissues and returns it to the blood vascular system. ② ^{اعادتها}

- Consists of
 - blind-ended capillaries (lymphatic capillaries) connected to venous vessels

أجزاء
صغيرة
أكبر
→ lymphatic vessels → lymphatic duct

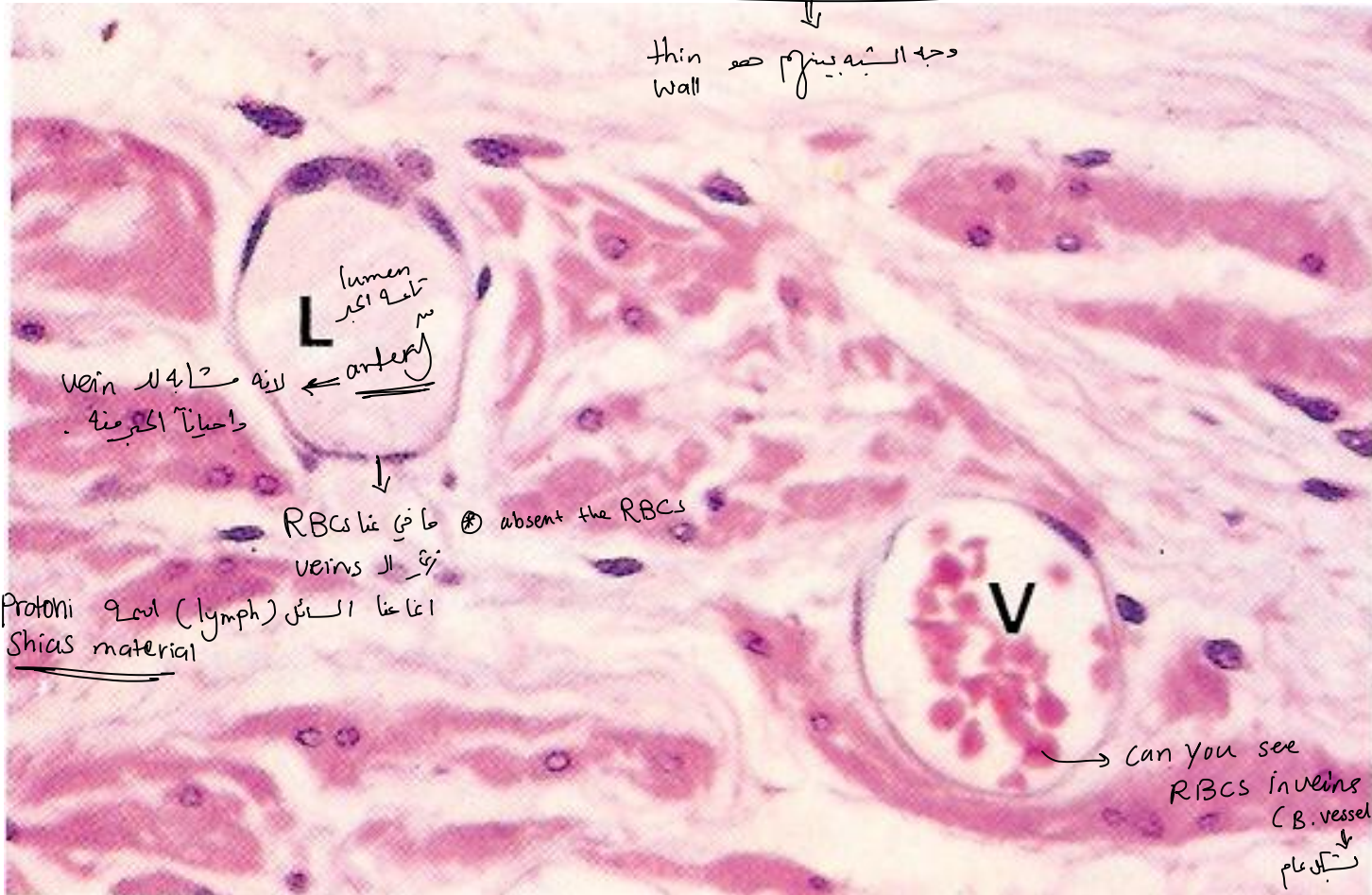
→ lymphatic capillary

→ lymphatic ducts

Small lymphatic vessel & venule

Small or veins
venules
الحد غير يسبوا ال
tunica intima or endothelium
تكونه من

thin wall
دجة البنية رقيقة



Medium sized lymphatic vessel

