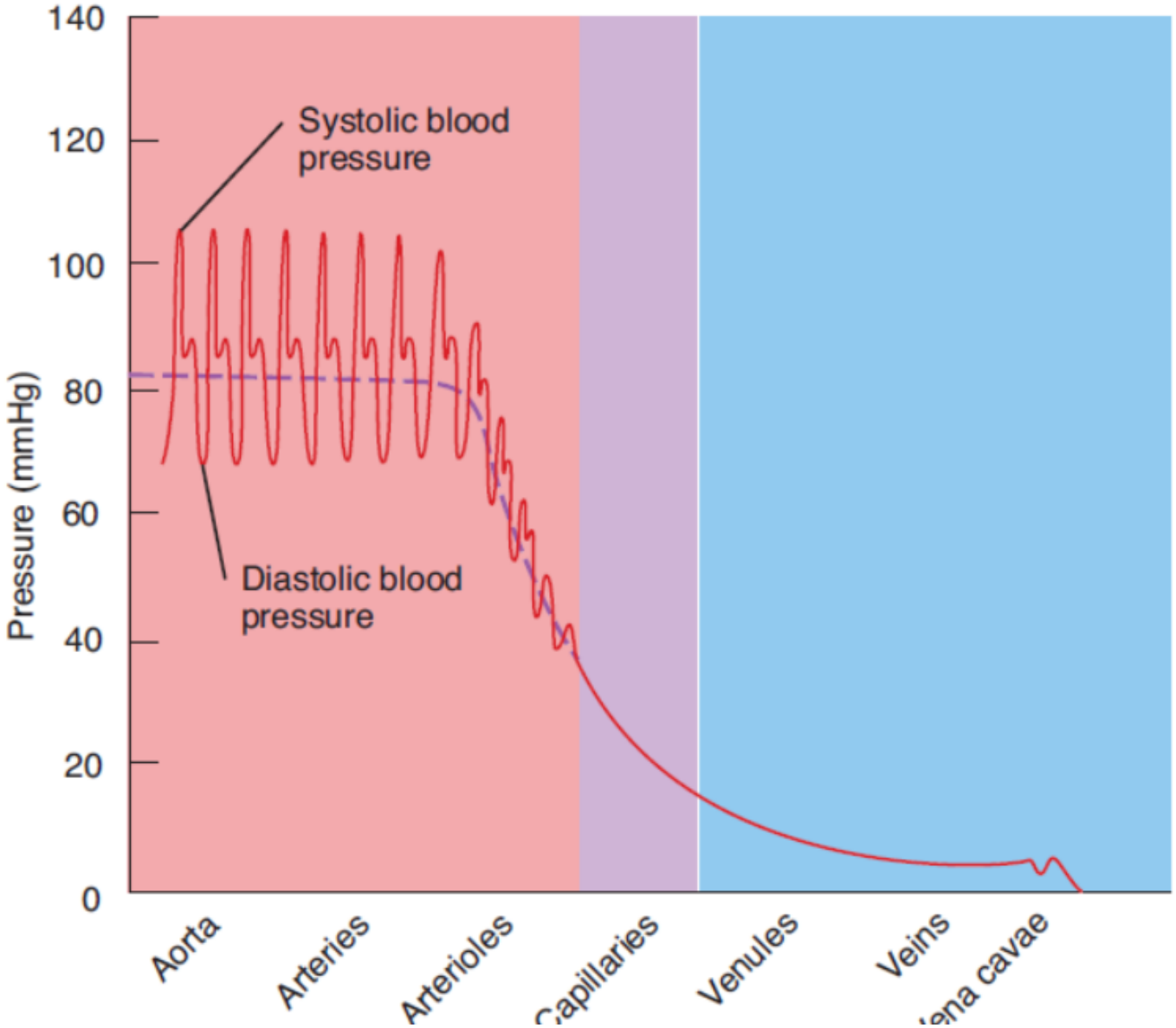
Arteries

Blood Pressure indicates the structure of blood vessels



High pressure

low pressure

Classification of Arteries

Large, elastic (conducting) arteries:

Aorta, Brachiocephalic, Common carotid, Subclavian, Common iliac and pulmonary trunk.

Medium sized, muscular arteries : femoral, brachial, radial……

Small sized, arterioles

Large arteries

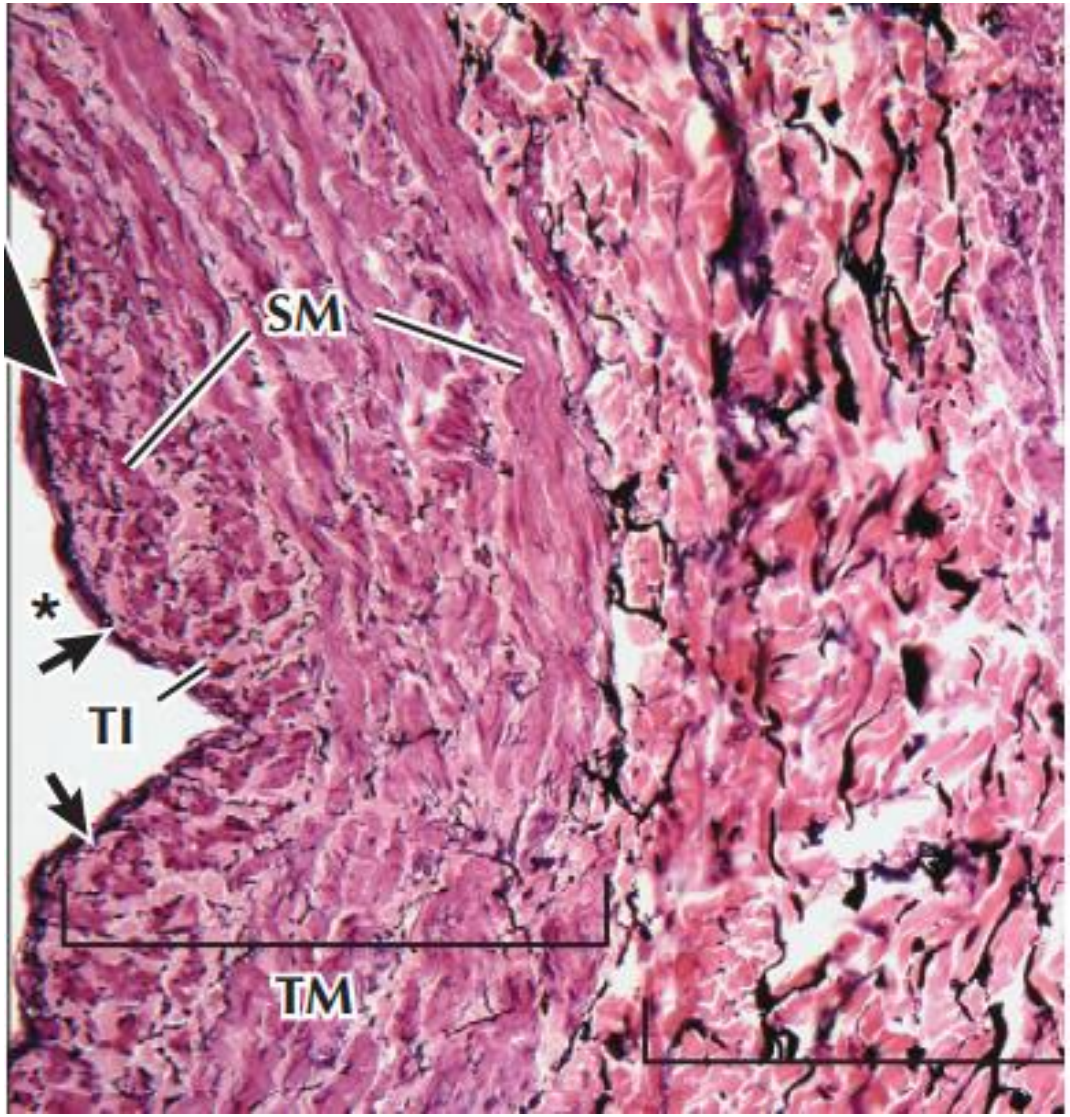
Elastic Arteries

Tunica intima

- **Simple squamous epithelium**, made of one layer of endothelial cells. The endothelium rests on a basal lamina

- **The subendothelial layer** of connective tissue consists of a delicate, interlacing network of collagen and elastic fibers.

- **The internal elastic lamina** is **indistinct** because the innermost elastic lamina of the media blends with adjacent laminae, without clear distinction between them



Elastic Arteries …Tunica media

Tunica media consists of many fenestrated lamella of elastin.

The number of elastic lamella increase with age (35-70).

The extracellular matrix is secreted by smooth muscles.

A fenestrated external elastic lamina is present; it allow diffusion of nutrient from the adventitia to the media.

Elastic Arteries Tunica adventitia

It is relatively thin.

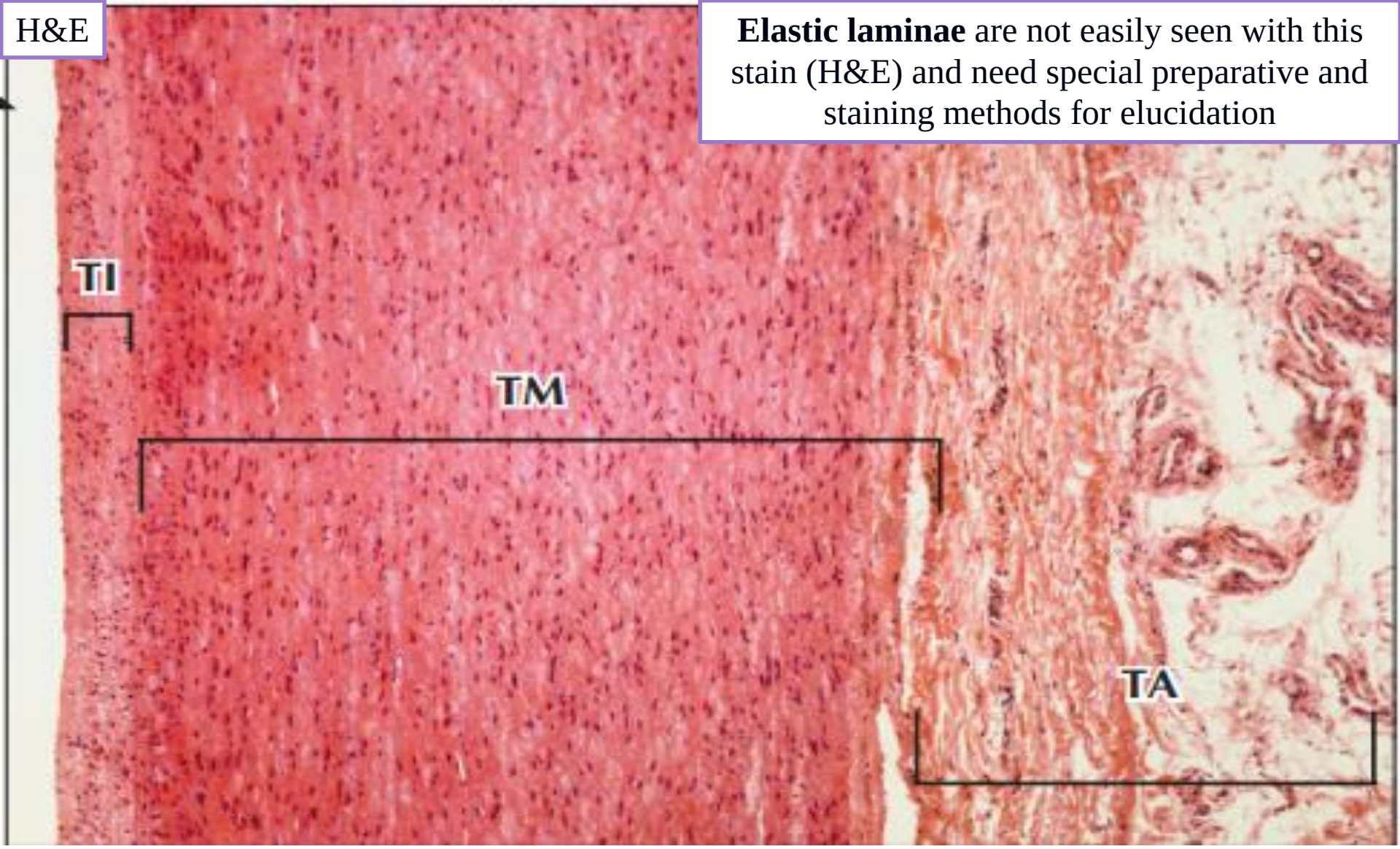
Composed of loose connective tissue.

Contains few scattered smooth muscles.

Vasa vasorum are abundant and may extend to the media.

H&E

Elastic laminae are not easily seen with this stain (H&E) and need special preparative and staining methods for elucidation

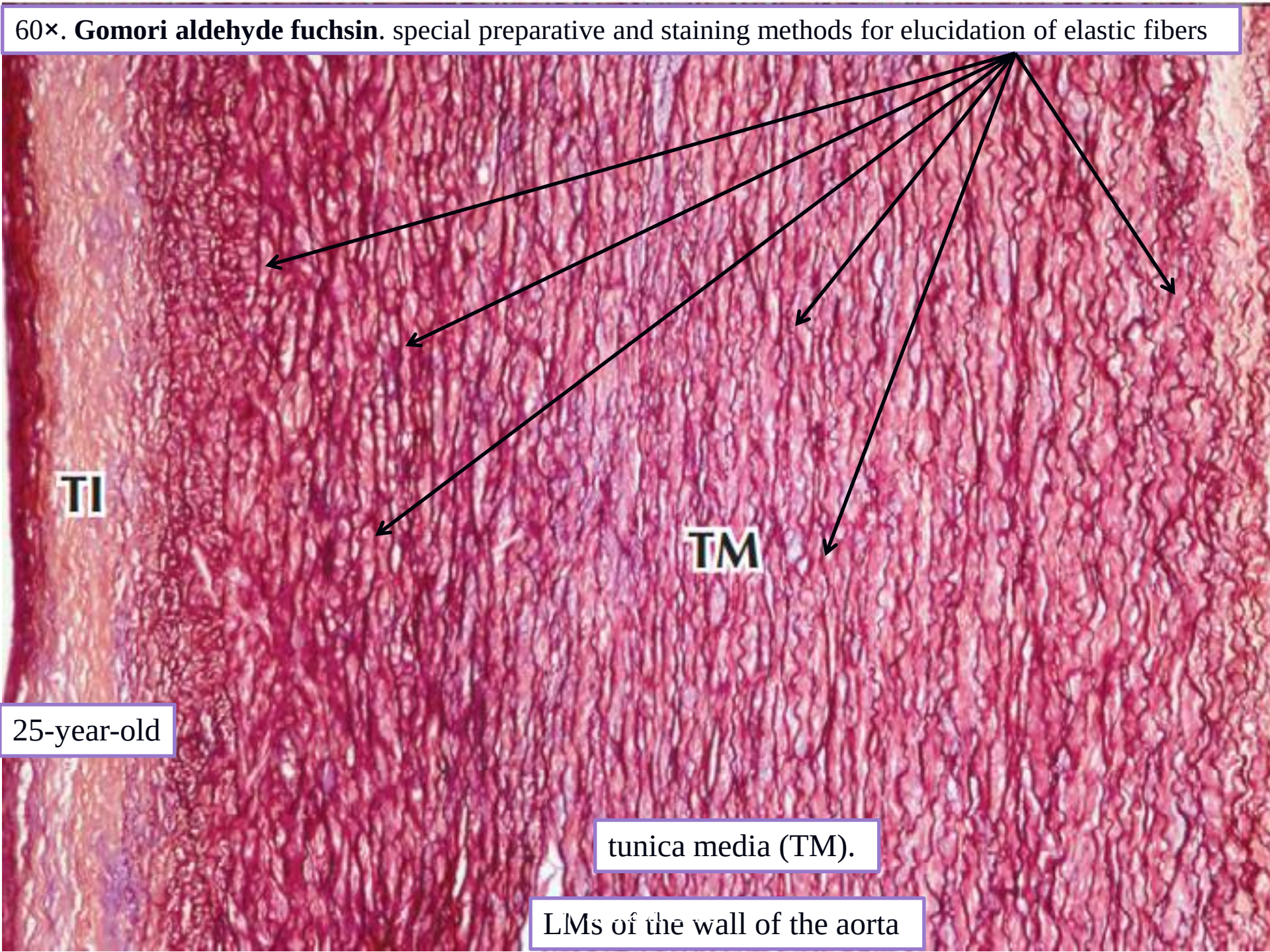


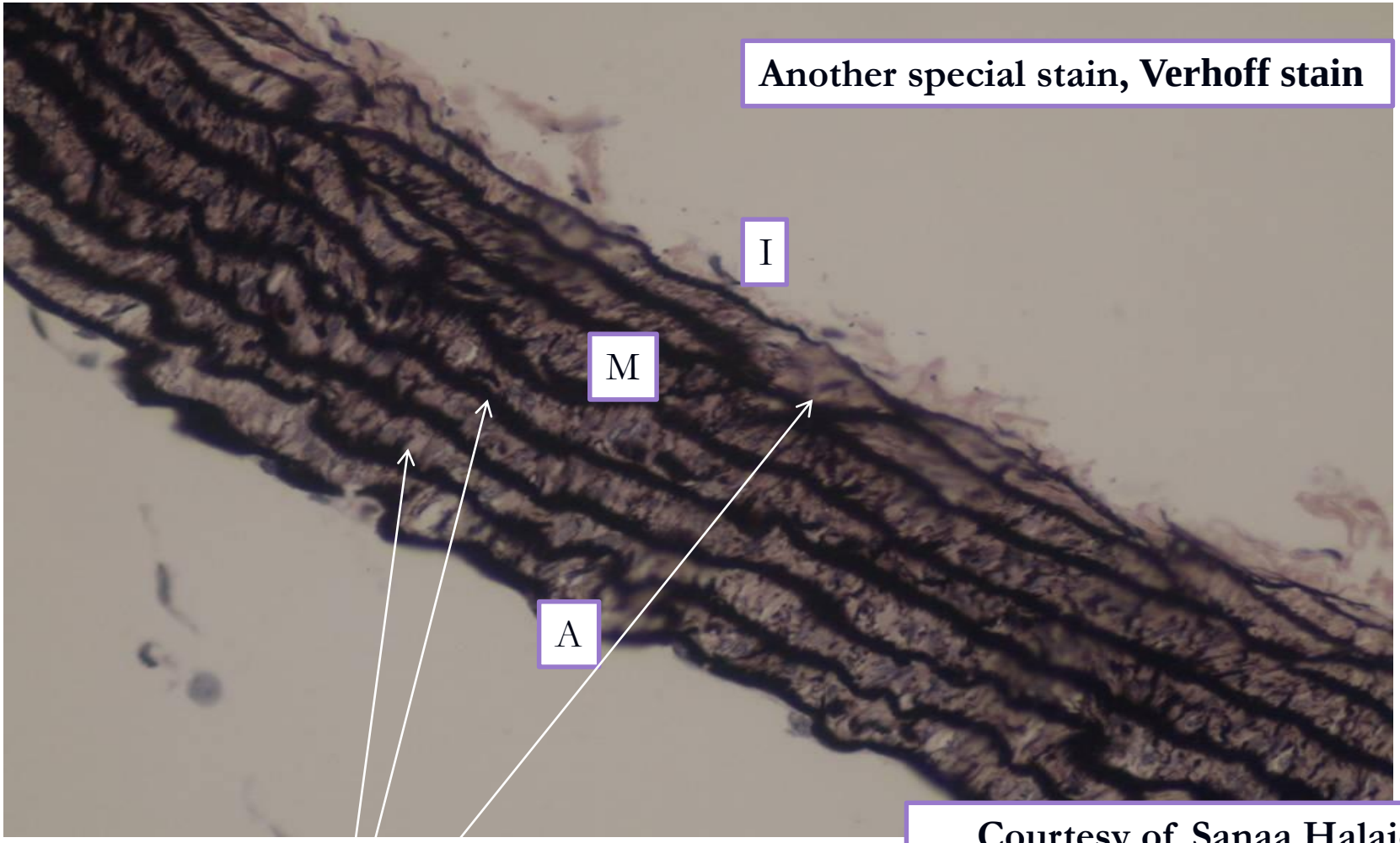
LM of part of the ***aortic wall***. The **intima (TI)** abuts the lumen (Left). A thick **media (TM)** and an outer **adventitia (TA)** are also shown. Nuclei in the media at this magnification are mostly those of smooth muscle cells. 60×. H&E

Look at the next slide where,

Gomori aldehyde fuchsin a special preparative and **staining methods have been used** for elucidation of

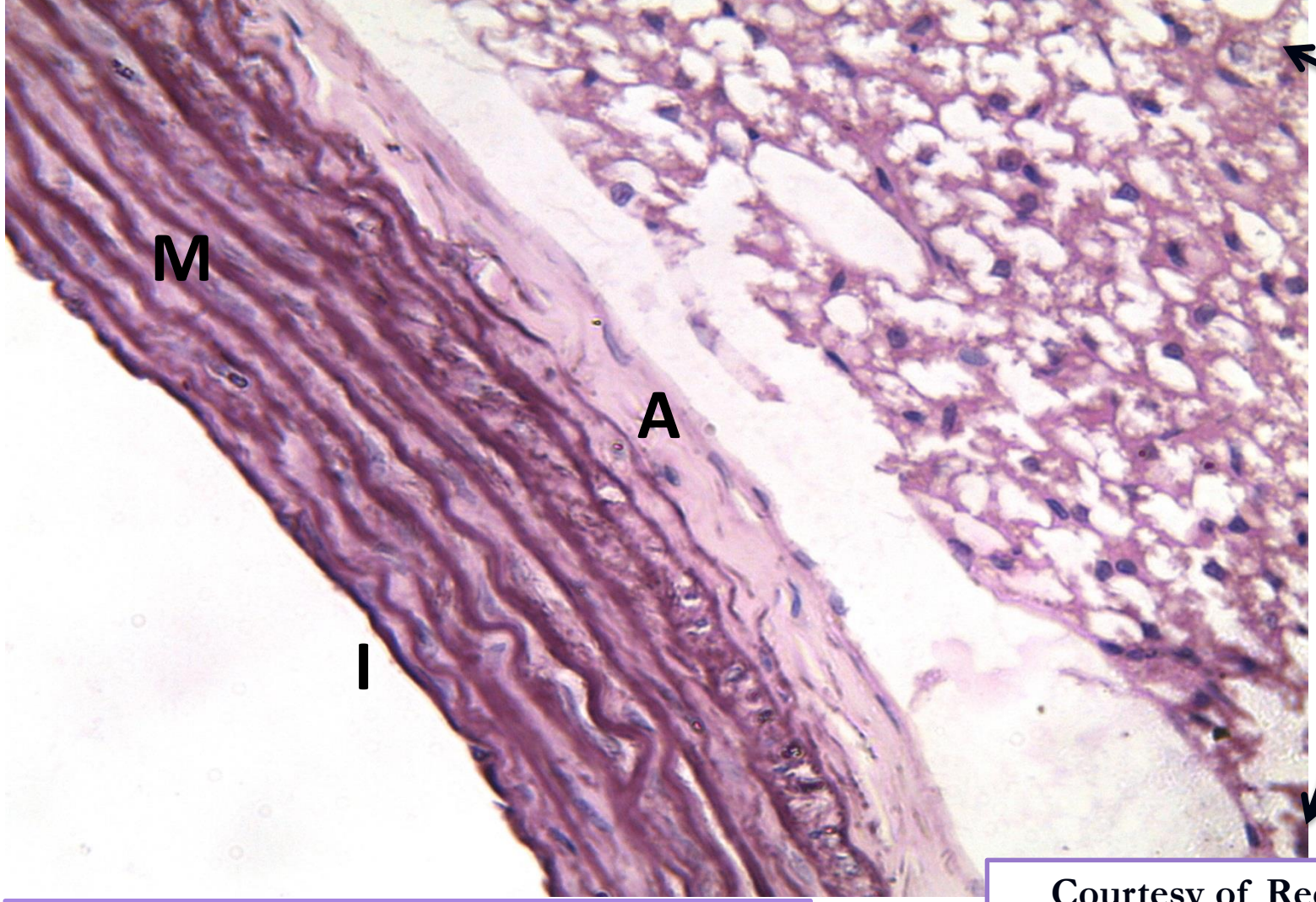
Elastic fibers


60×. **Gomori aldehyde fuchsin**. special preparative and staining methods for elucidation of elastic fibers
TI
TM
25-year-old
tunica media (TM).
LMs of the wall of the aorta



Transverse section of rat thoracic aorta stained with Verhoff stain. The darker elastic fibers are prominent tunica intima(I), tunica media (M), and tunica adventitia(A). X 400

**Courtesy of Sanaa Halaiqah.
Thesis material
supervised by Dr. Shatarat & Dr. Badran, 2017.
Dep. Anatomy and Histology
School of medicine
The University of Jordan**



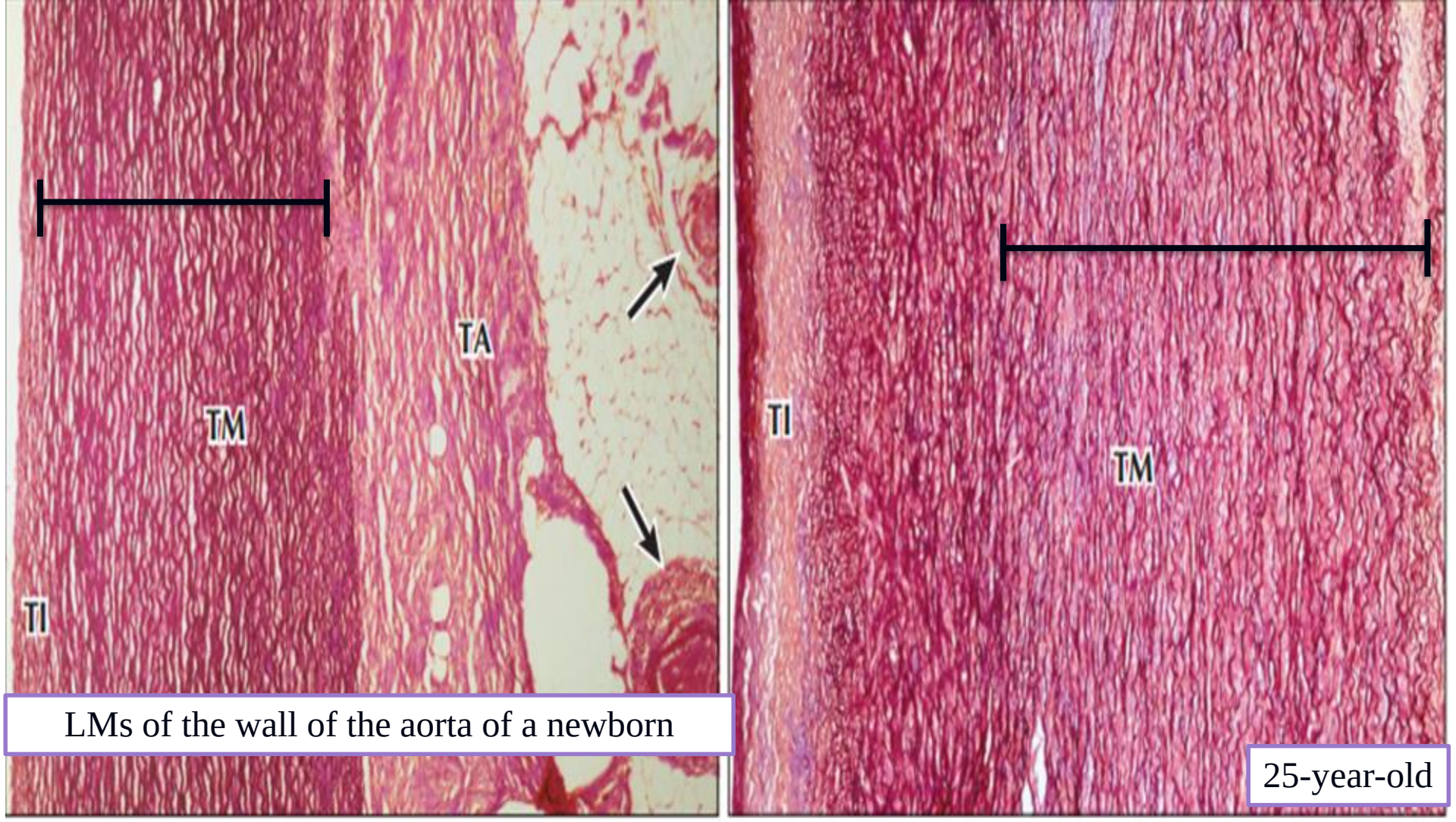
transverse section of the wall of thoracic aorta of rat, stained with **orcein stain** (×400) showing dark stained elastic fibers and normal tunical layers (tunica intima (I), tunica media (M) and tuica adventitia (A)). scale bar =50 µm.

Courtesy of Reema Al taweel.
Thesis material
supervised by Dr. Shatarat & Dr. Nafith Abu Tarboosh, 2018.
Dep. Anatomy and Histology
School of medicine
The University of Jordan

In the next slide you would see a comparison between a section of the aorta taken from a newborn and 25 -year-old

You can see that

The number of elastic laminae —the dark, wavy bands—increases with age



LMs of the wall of the aorta of a newborn

25-year-old

Comparative LMs of the wall of the aorta of a newborn (Left) and 25-year-old (Right). In both vessels, a relatively thin tunica intima (TI) merges with a prominent tunica media (TM). This stain specifically demonstrates elastic tissue, a prominent feature of these arteries. ***The number of elastic laminae —the dark, wavy bands—increases with ag***e. Vasa vasorum (arrows) occupy loose connective tissue of the adventitia (TA). 60×. Gomori aldehyde fuchsin.

Clinical correlations

The FBN1 gene

Responsible for making a protein

called **fibrillin-1**

This protein is transported out of cells into the extracellular matrix

In this matrix, molecules of fibrillin-1 attach (bind) to each other and to other proteins to form threadlike filaments

called microfibrils.

Microfibrils form

ELASTIC FIBERS

which enable the skin, ligaments, and **blood vessels to stretch**.
Microfibrils also provide support to more rigid tissues such as bones and the tissues that support the nerves, muscles, and lenses of the eyes.

Marfan's Syndrome and Aneurysms

- People with Marfan's Syndrome have defects in elastic fibers and elastic sheets often due to defect in FBN1 leading to insufficient functional fibrillin, one part of elastic microfibrils

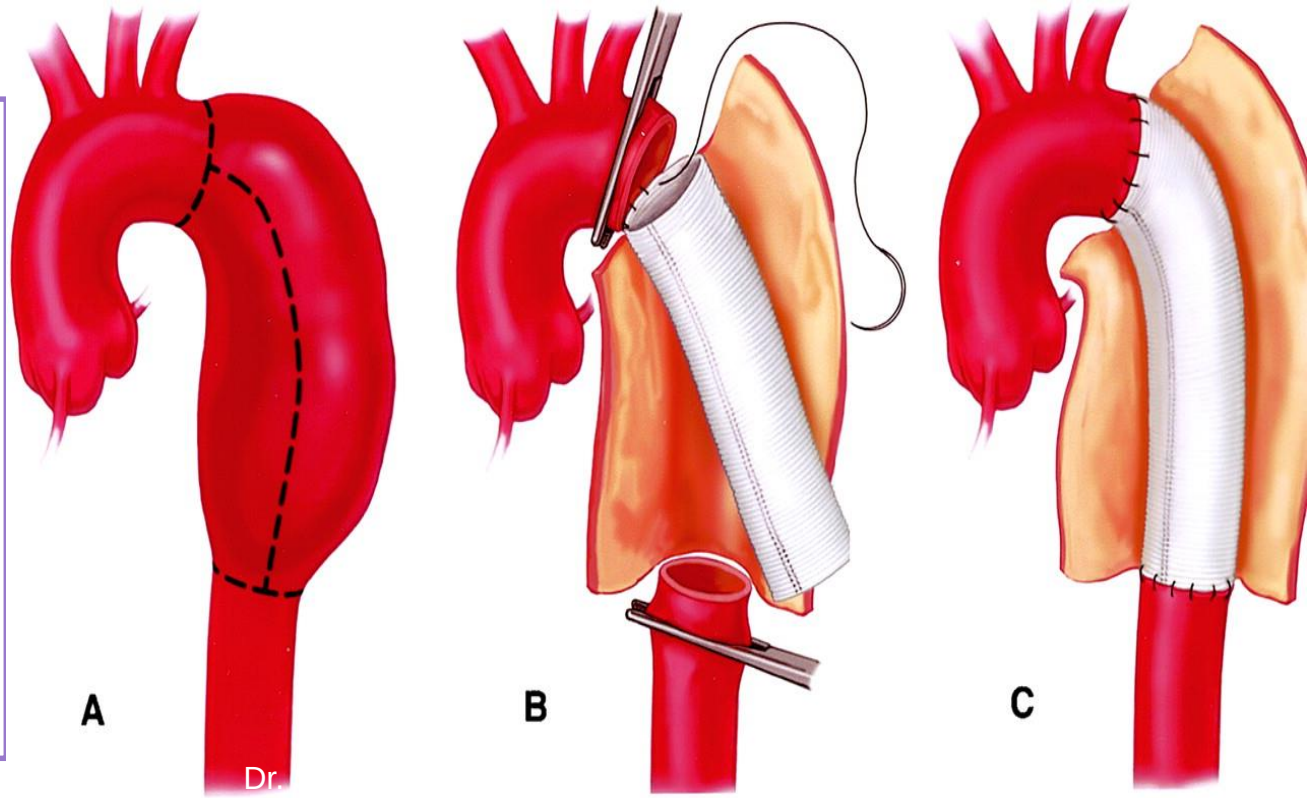
- Since the tunica media in large arteries has a thick elastic layer, people with Marfan's often have defects in their large arteries that may result in aortic aneurysms

An aneurysm

- is an abnormal localized dilation in the weakened wall of an artery.
- An aortic aneurysm occurs when the diameter of part of the aorta increases by 50% or more.
- A true aneurysm is a large bulge in the wall that consists of all three tunics.
- Rupture may lead to fatal bleeding in only a few minutes.
- Atherosclerosis is a major cause of most aortic aneurysms.

Read only

Infection, inflammation, syphilis, and the genetic connective tissue disorder **Marfan syndrome** also weaken arterial walls, and chronic hypertension induces susceptibility to aneurysms because elevated arterial pressures place undue stress on vessel walls

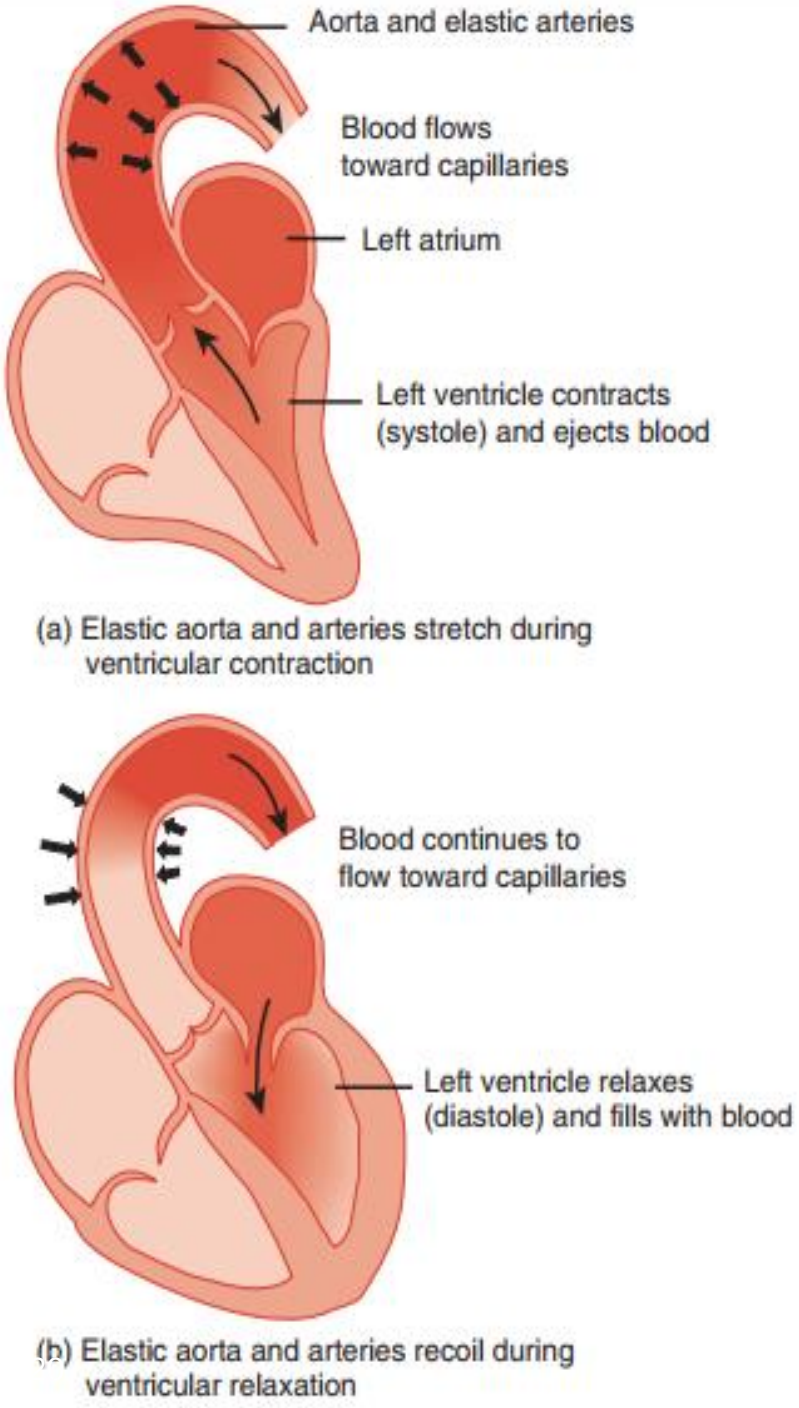


From a functional stand point, ***elastic arteries serve primarily as conduction tubes***; however, they also facilitate the continuous and uniform movement of blood along the tube Blood flow occurs as follows: The ventricles of the heart pump blood into the elastic arteries during systole (the contraction phase of the cardiac cycle).

The pressure generated by contraction of the ventricles moves the blood through the elastic arteries and along the arterial tree.

Simultaneously, it also causes the wall of the large elastic arteries to distend

The distension is limited by the network of collagenous fibers in the tunica media and tunica adventitia During diastole(there laxation phase of the cardiac cycle when no pressure is generated by the heart ,the recoil of the distended elastic arteries serves to maintain arterial blood pressure and the flow of blood within the vessels Initial elastic recoil forces bloodbothawayfromandbacktowardtheheart.T



Medium sized arteries

Muscular Arteries

Distributing arteries

Muscular Arteries , Tunica intima

thinner than in elastic arteries.

Sub endothelial CT contains few smooth muscles.

Prominent internal elastic lamina, which might be duplicated.

Processes from endothelium pass through fenestrae in IEL and form gap junction with smooth muscles in the media.

Muscular Arteries Tunica media

- Tunica media is composed mostly of smooth muscles.
- Smooth muscles are circularly arranged.
- The number of layers of smooth muscles is 4-40.
- Each smooth muscle has a basal lamina.
- Other components: type III collagen and chondroitin sulfate.
- External elastic lamina is seen in large muscular arteries.

Muscular Arteries, Tunica adventitia

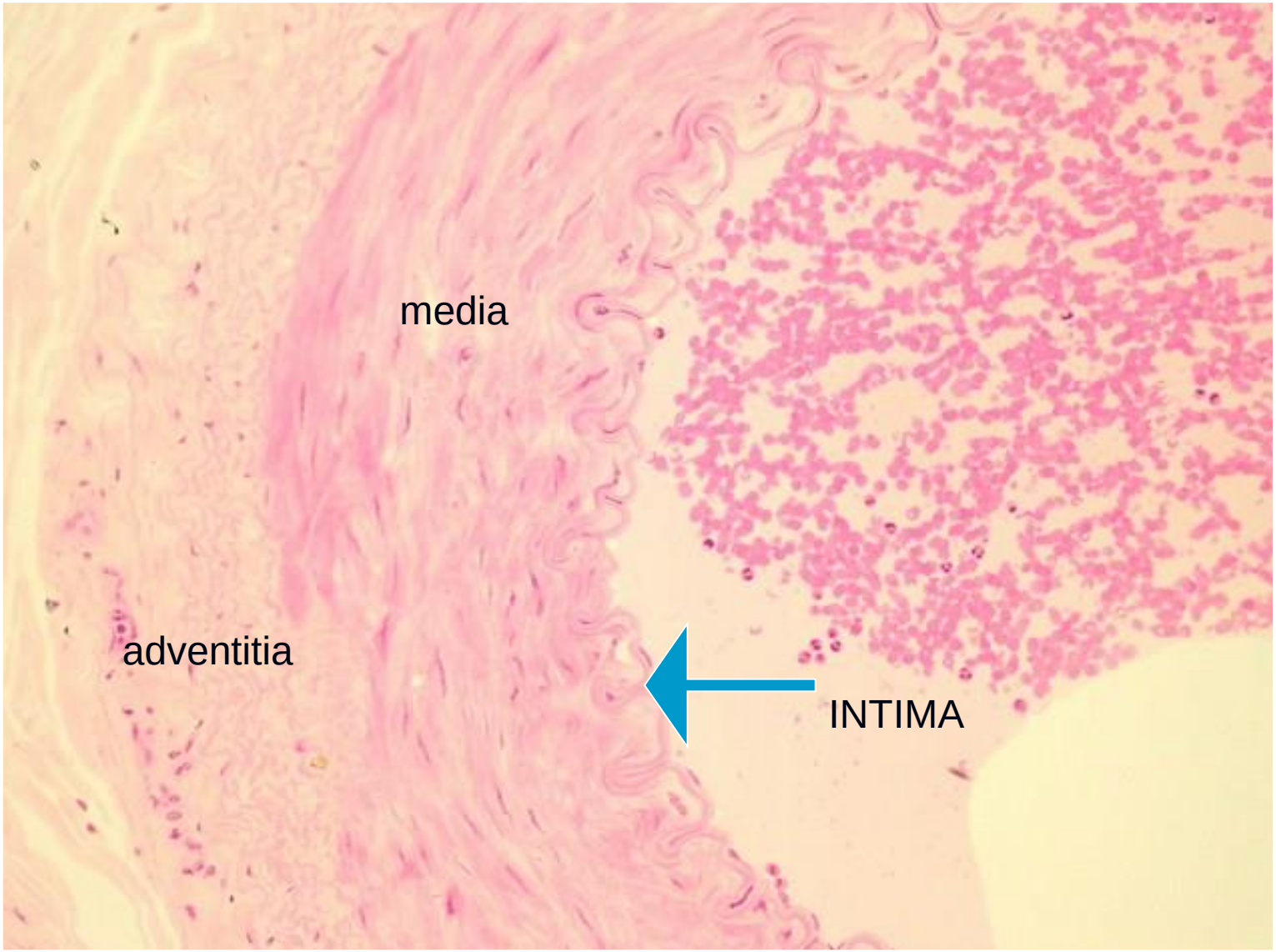
Tunica adventitia contains elastic and collagen fibres.

Ground substance contains dermatan sulfate and heparan sulfate.

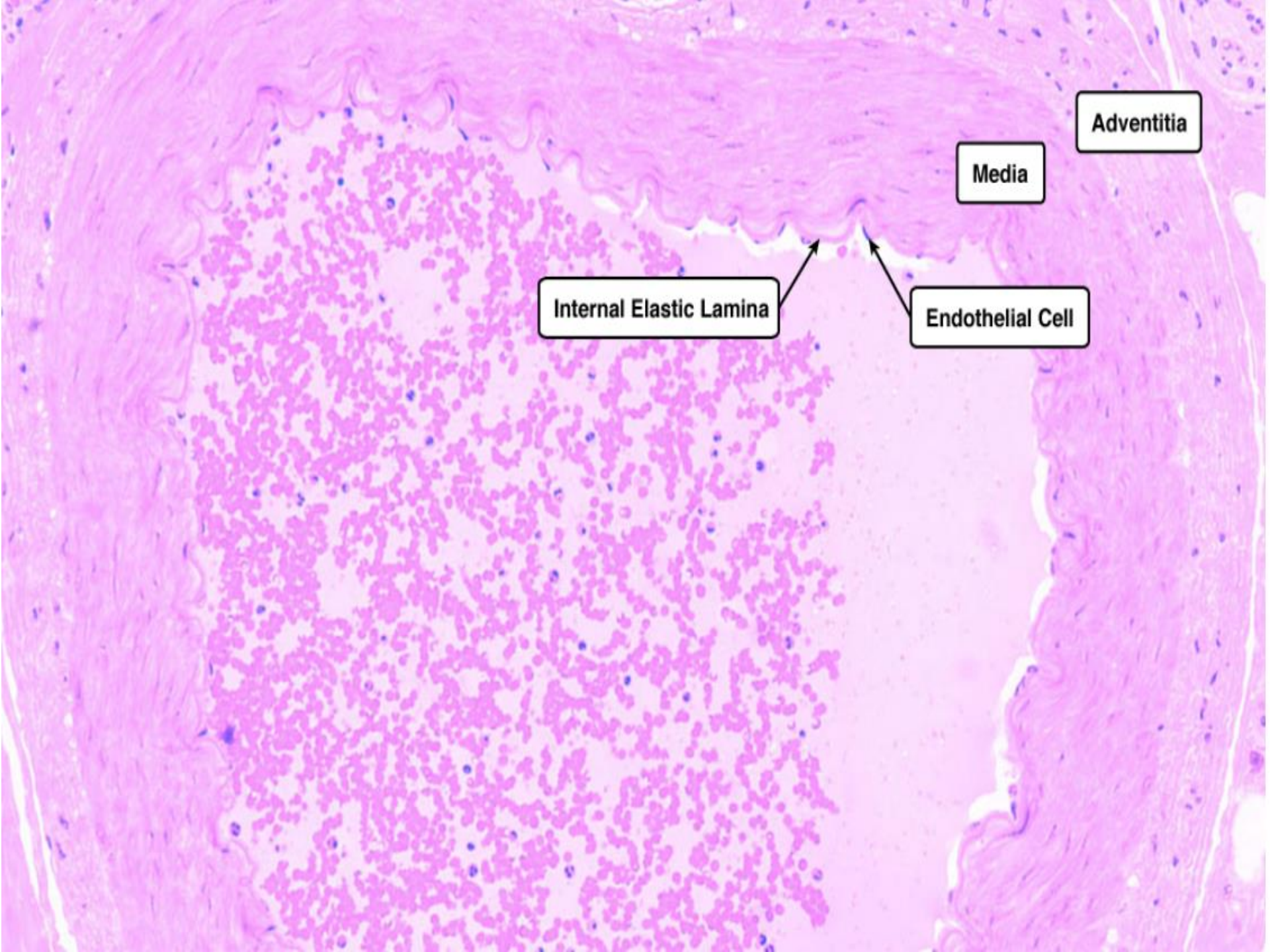
Occasional longitudinal smooth muscles are seen.

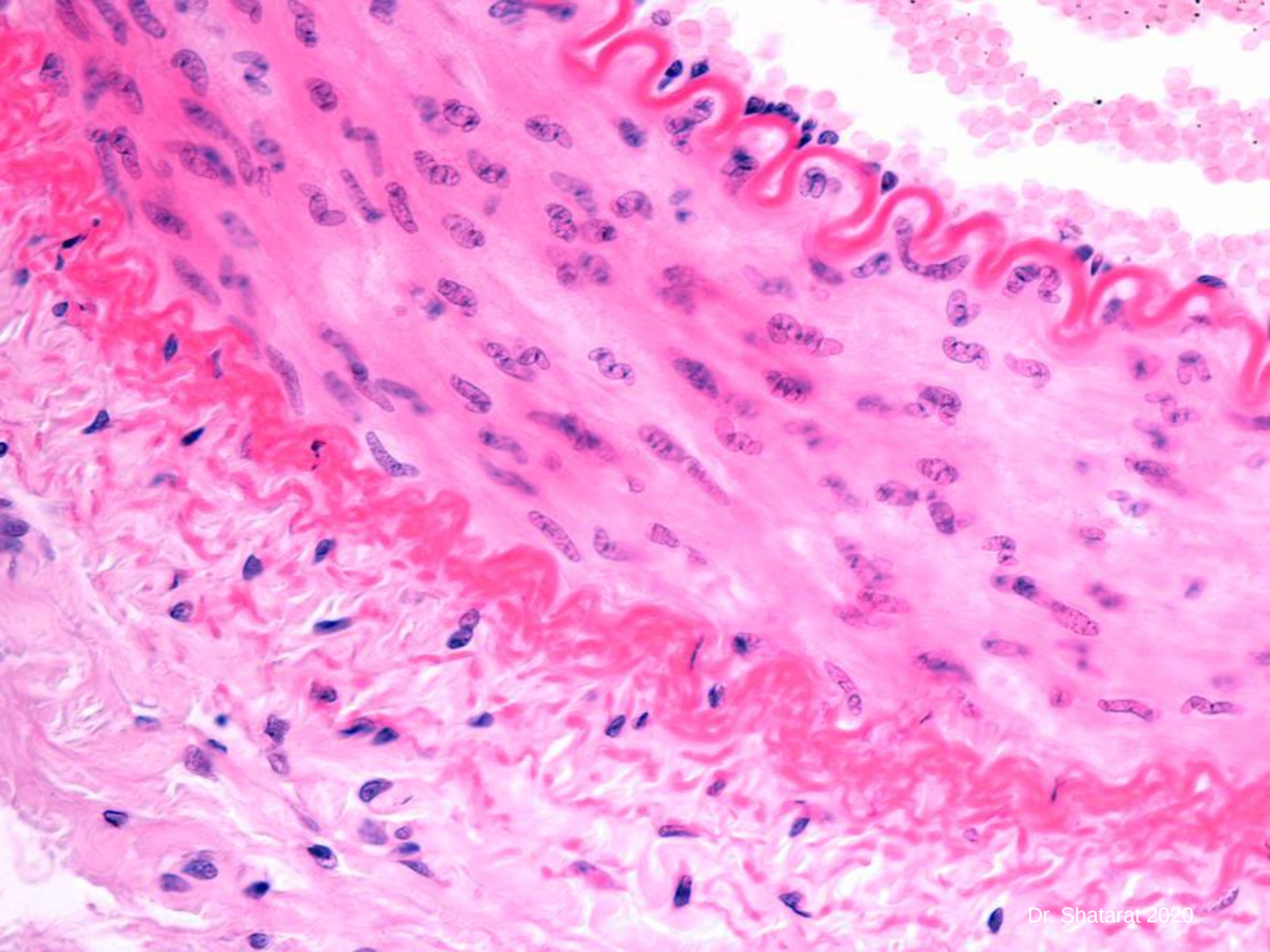
Contains vasa vasorum and unmyelinated nerve fibres.

muscular artery

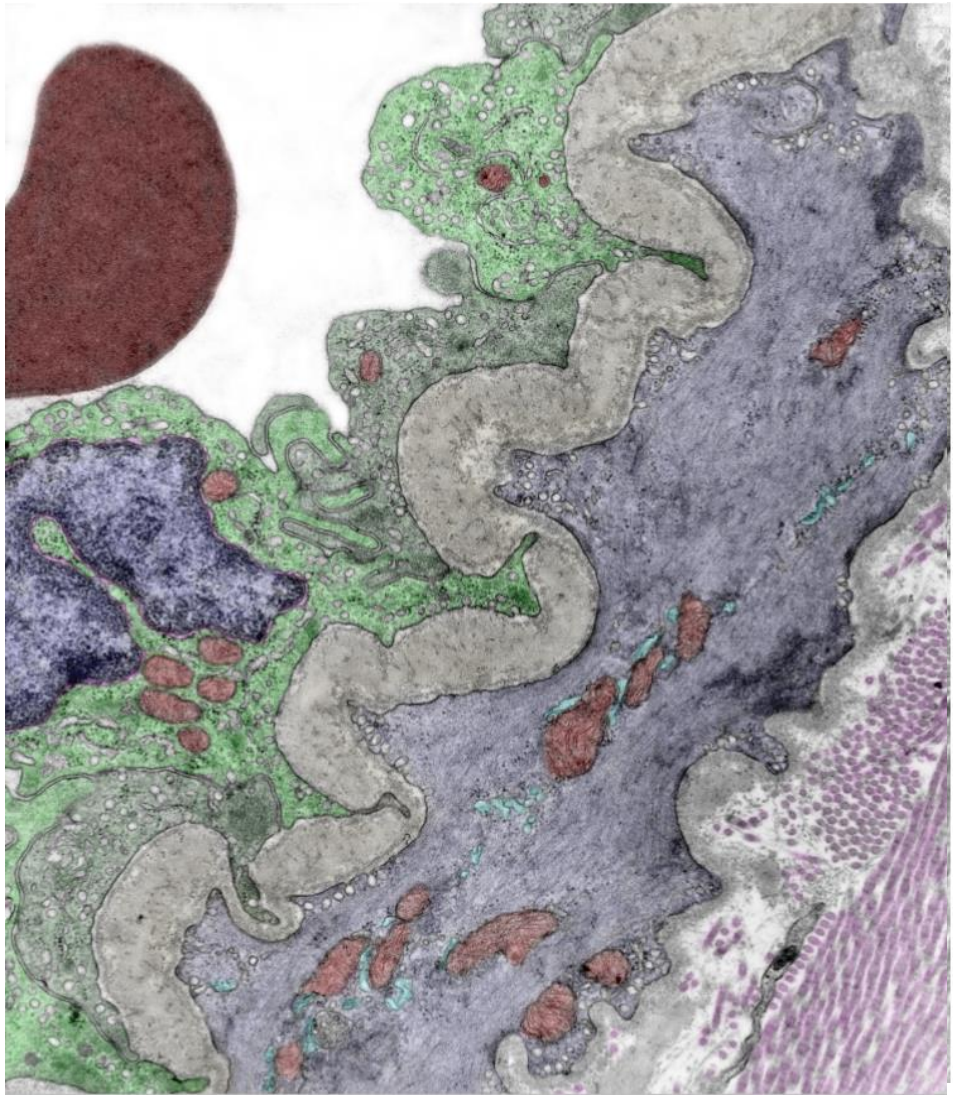


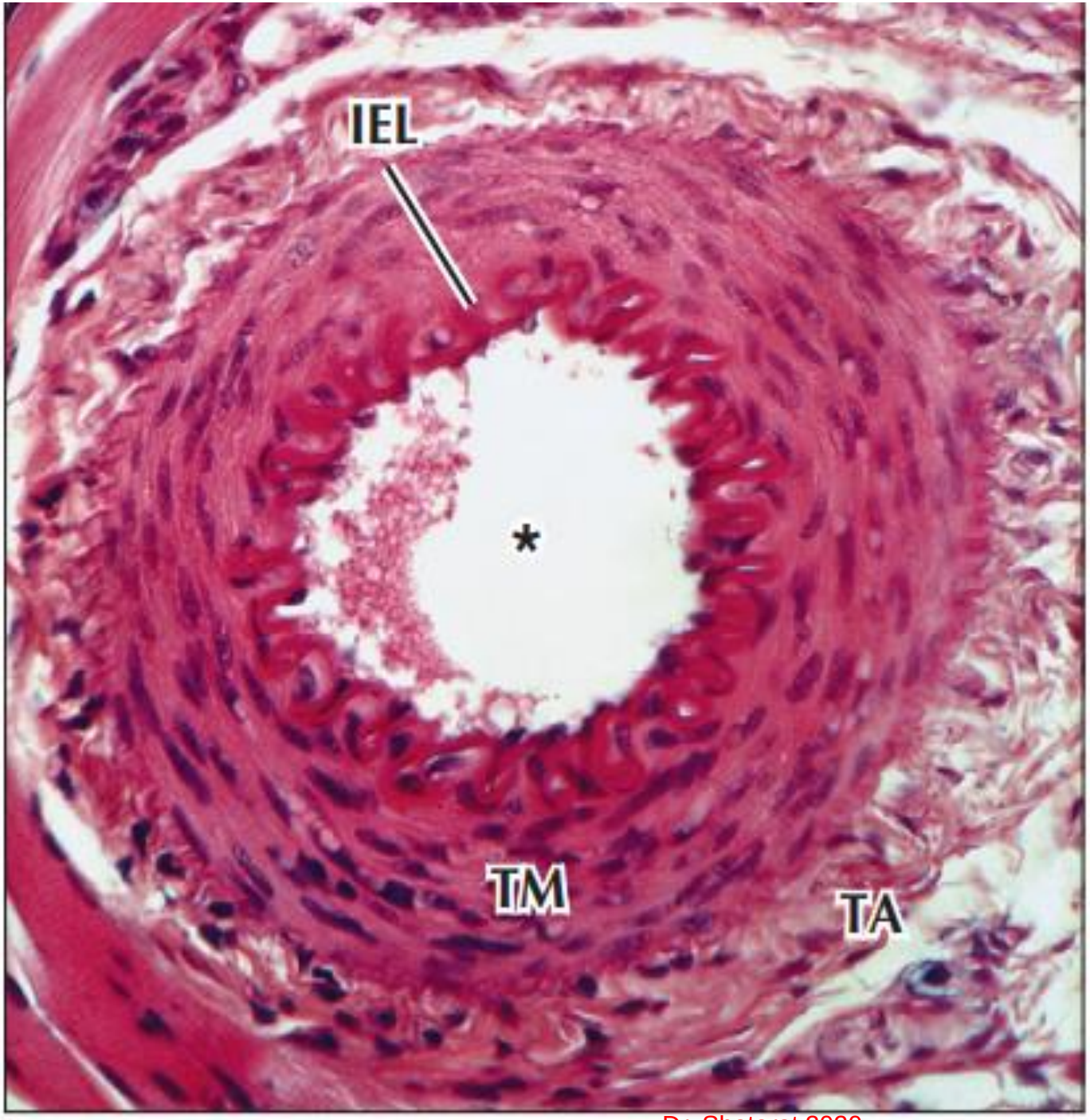
H& E


Adventitia
Media
Internal Elastic Lamina
Endothelial Cell

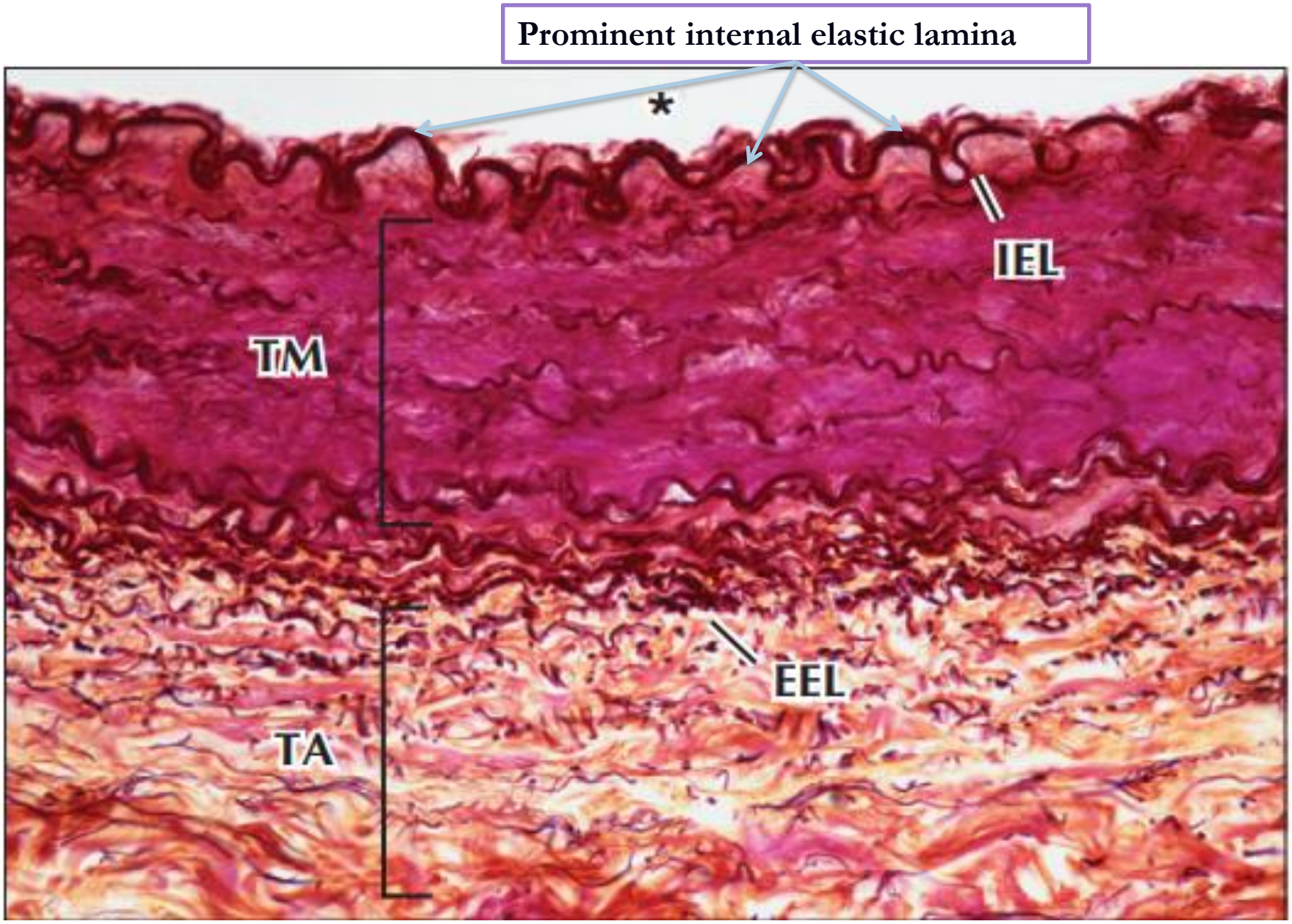

Dr. Shatarat 2020

- Endothelium (green)
- Internal Elastic Lamina (tan)
- Tunica Media (light blue)
- Caveolae - large number of small invaginations of the plasma membrane of the smooth muscle cells
- Part of a red blood cell (dark red)





LM of the wall of a muscular artery.
In **this partly constricted artery,** the lumen (*) caliber is small relative to the muscular wall thickness.
A prominent internal elastic lamina (IEL) looks corrugated. Several layers of circular smooth muscle occupy the media (TM); loose connective tissue, the adventitia (TA). 240×.
H&E.



LMs of the wall of a muscular artery 320×. Gomori aldehyde fuchsin

Small sized arteries

Arterioles

Arterioles

Their diameter is < 0.1 mm.

They control the peripheral resistance and regulate flow to capillaries.

IEL may be present.

Tunica media is 1-3 layers of smooth muscles.

No EEL.

Tunica adventitia is small.

Vascular Resistance

As noted earlier, vascular resistance is the opposition to blood flow due to friction between blood and the walls of blood vessels.

Vascular resistance depends on
(1) Size of the blood vessel lumen
(2) Blood viscosity
(3) Total blood vessel length.

- Size of the lumen. The smaller the lumen of a blood vessel, the greater its resistance to blood flow.

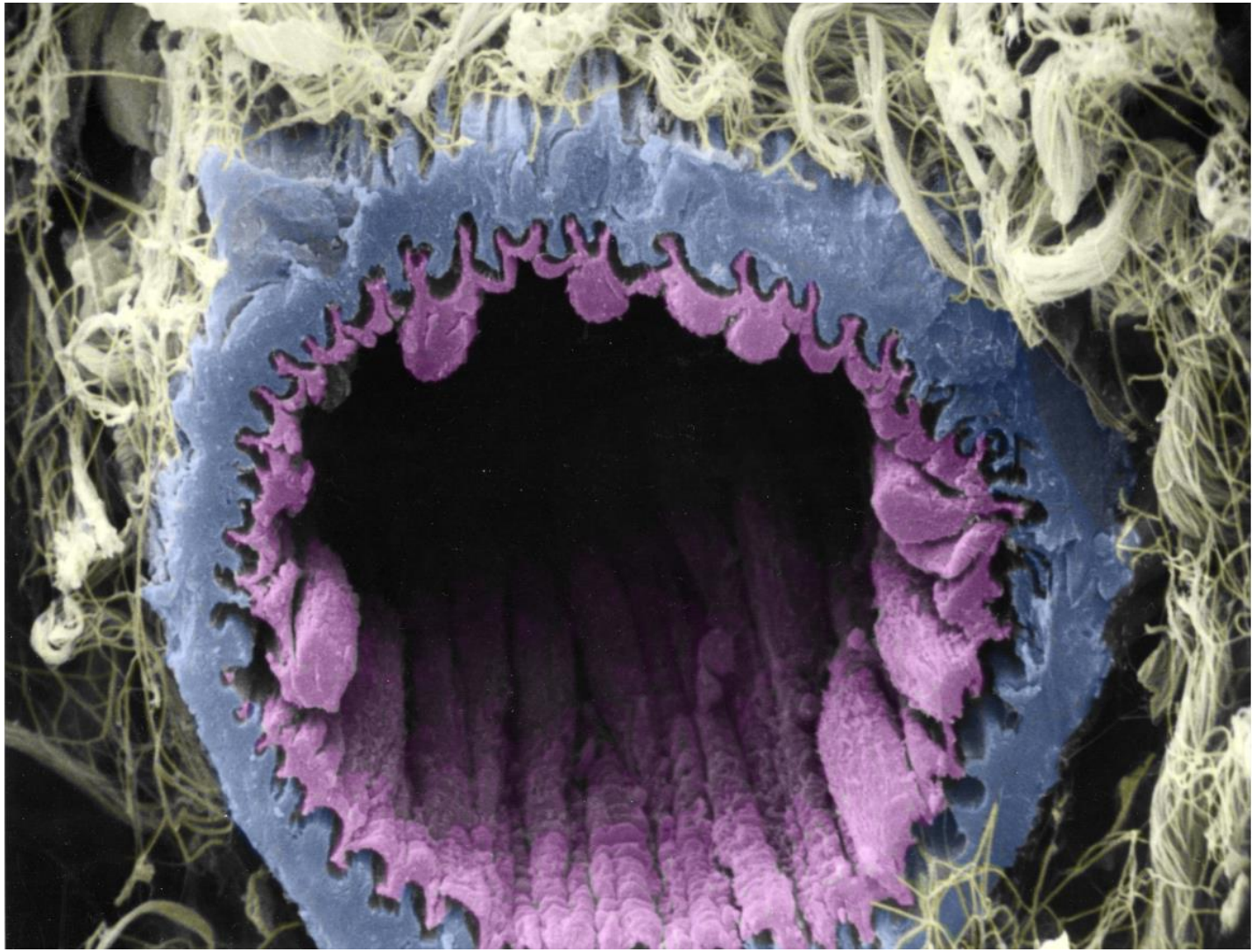
The smaller the diameter of the blood vessel, the greater the resistance it offers to blood flow.

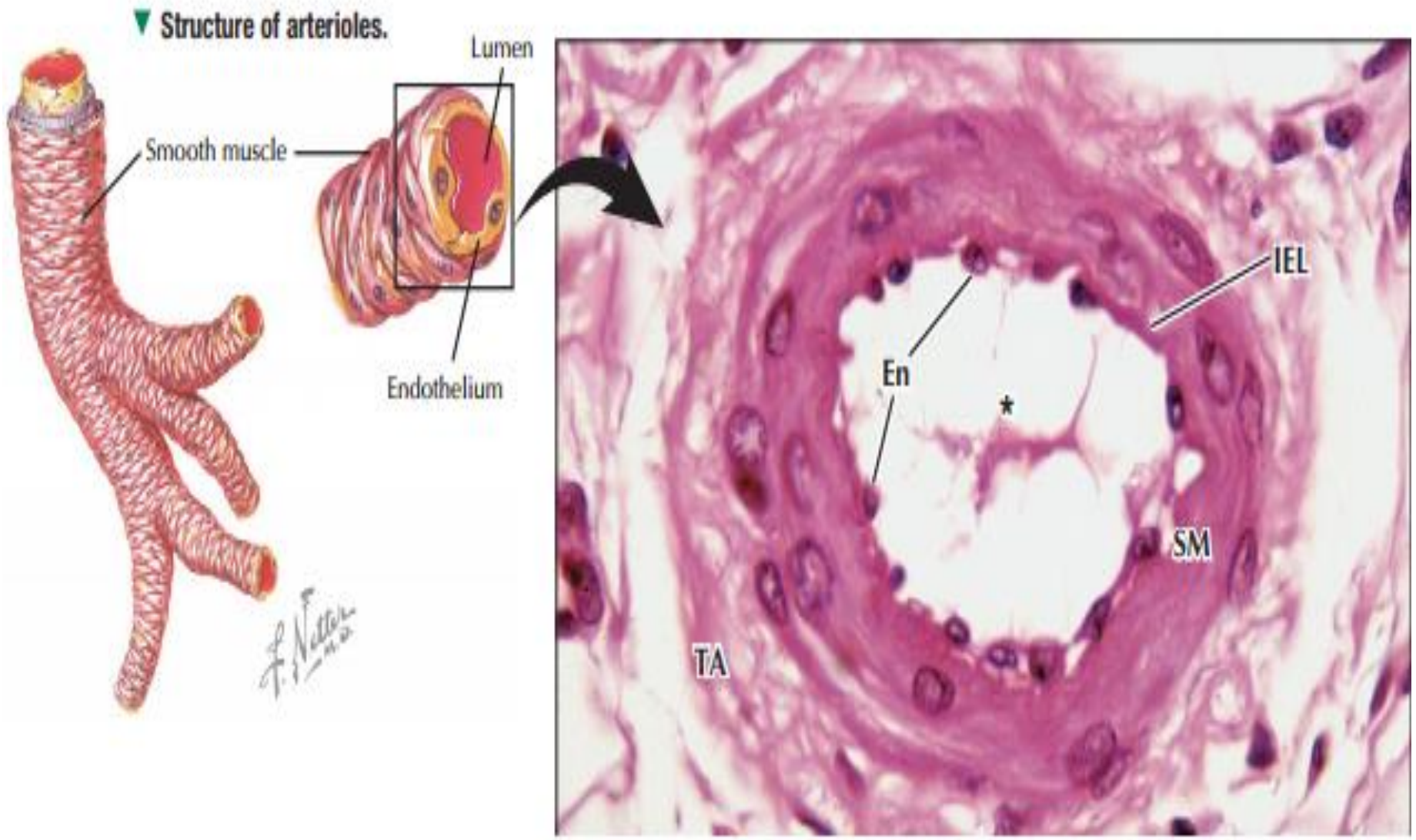
For example, if the diameter of a blood vessel decreases by one-half, its resistance to blood flow ***increases 16 times***.

Vasoconstriction narrows the lumen, and vasodilation widens it.

Normally, moment-to-moment fluctuations in blood flow through a given tissue are due to vasoconstriction and vasodilation of the tissue's arterioles. As arterioles dilate, resistance decreases, and blood pressure falls. As arterioles constrict, resistance increases, and blood pressure rises.

- Endothelium (purple)
- Internal Elastic Lamina (blue, inner surface)
- Tunica Media (blue)
- Tunica Adventitia (yellow) -





LM of an arteriole in transverse section. Tightly arranged smooth muscle cells (SM) are oriented more or less circularly relative to the lumen (*). Their contraction causes the internal elastic lamina (IEL) to appear corrugated and endothelial cell (En) nuclei to bulge into the lumen. The adventitia (TA) contains connective tissue cells (mostly fibroblasts) and collagen fibers. 720×. H&E.

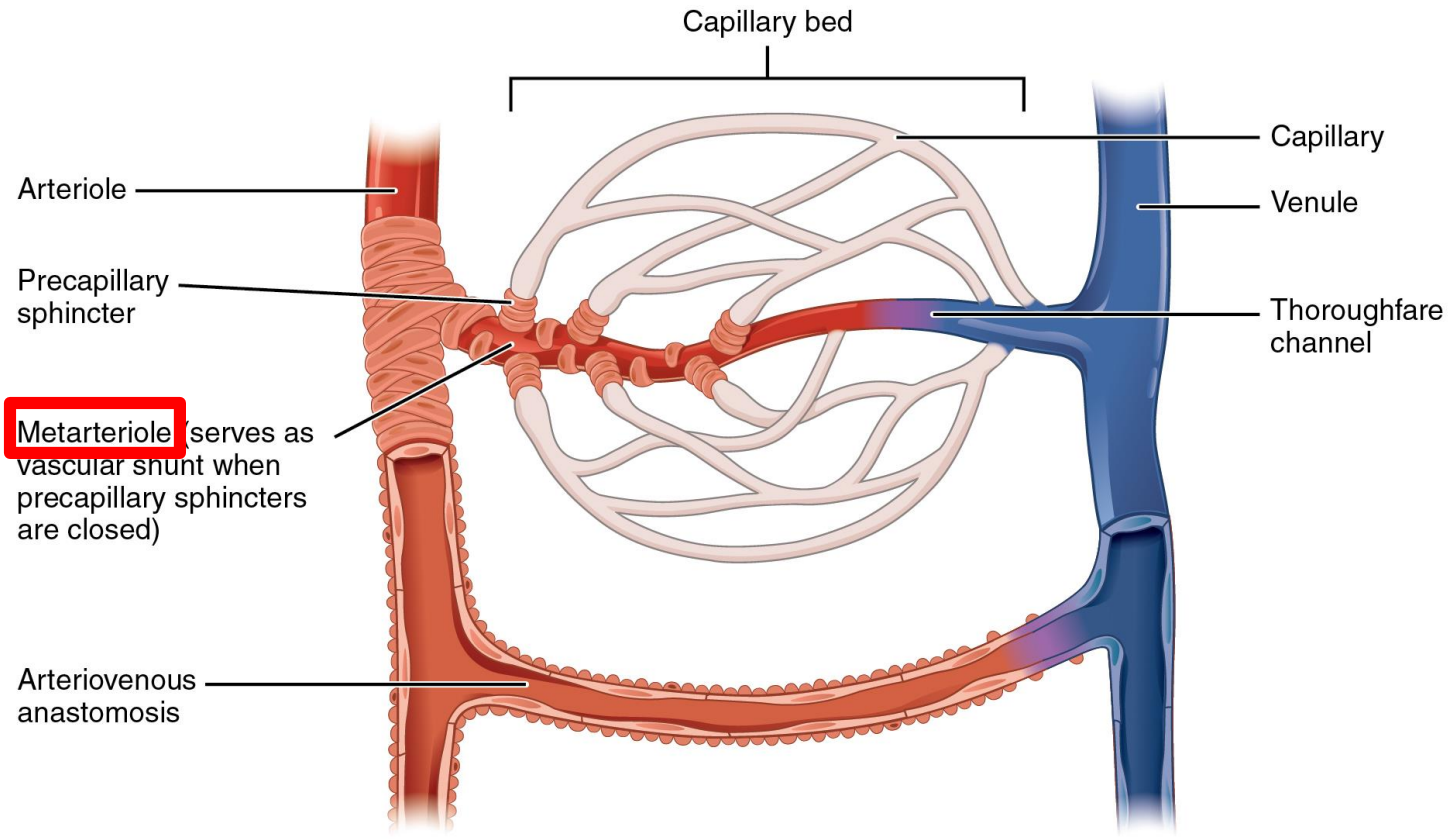
Metarterioles

They directly supply capillary beds.

The smooth muscle layer in the media is incomplete.

Each smooth muscle encircles the endothelium.

They act as sphincters.


Capillary bed
Capillary
Arteriole
Venule
Precapillary sphincter
Thoroughfare channel
Metarteriole (serves as vascular shunt when precapillary sphincters are closed)
Arteriovenous anastomosis

Veins

Venules and Small Veins

Read only

Their walls are similar to capillaries.

Venules (post capillary) have thin endothelium surrounded by pericyte and reticular fibres.

In larger venules, pericytes are replaced by scattered smooth muscles.

In small veins, smooth muscles form a continuous layer.

The endothelium in venules of lymphoid organs is rather cuboidal (HEV) and functions in lymphocyte segregation and recognition.

Medium Veins

Read only

Less than 1 cm in diameter.

Drain most of the body.

Occasionally the endothelium is surrounded by elastic fibres but ***no*** IEL.

Tunica media: Smooth muscles are loosely organized with collagen fibres and fibroblasts in between.

Tunica adventitia: collagen and elastic bundles are longitudinally arranged with few smooth muscles.

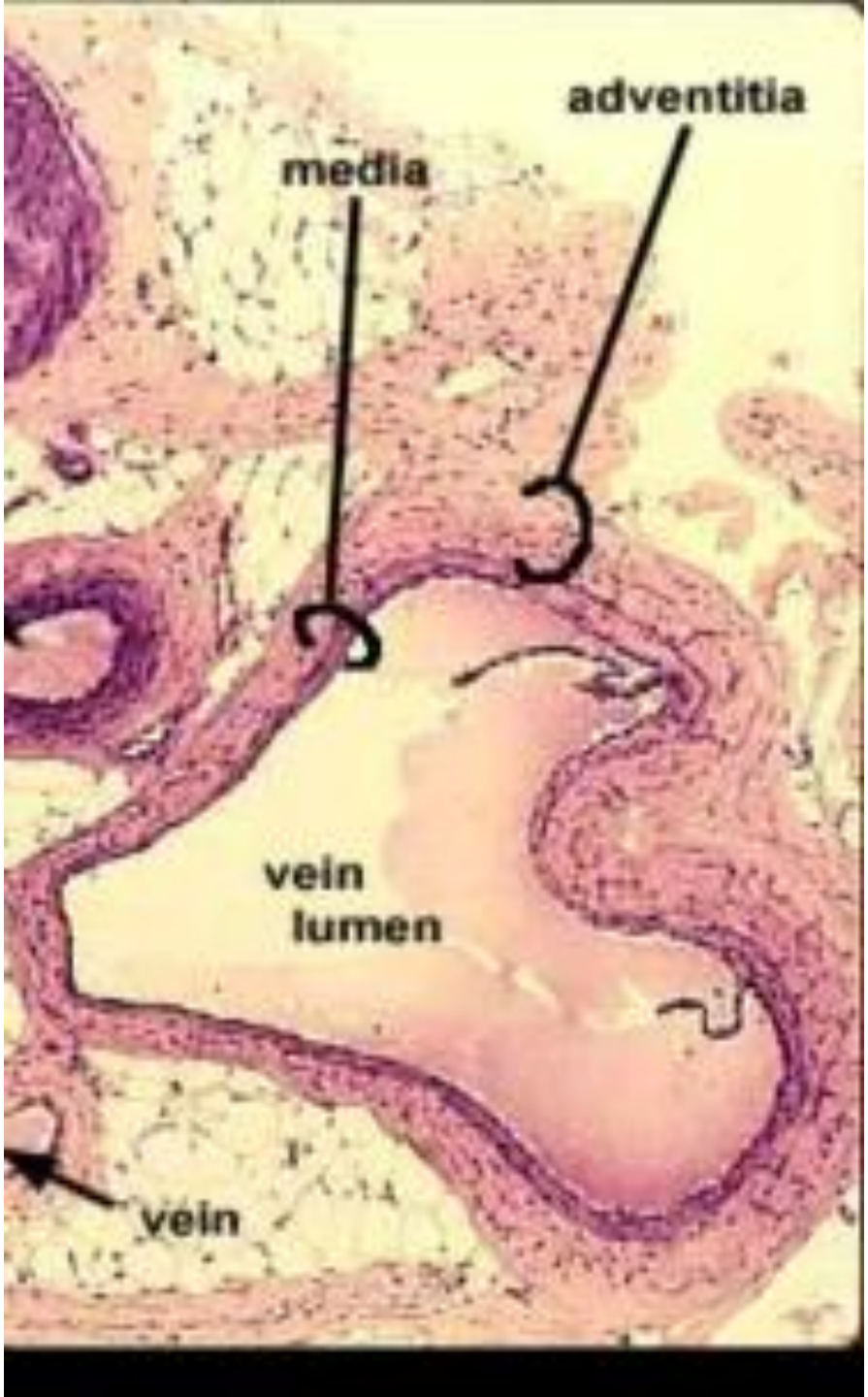
Large Veins

Include: SVC, IVC and veins forming them and their major tributaries, pulmonary and portal veins

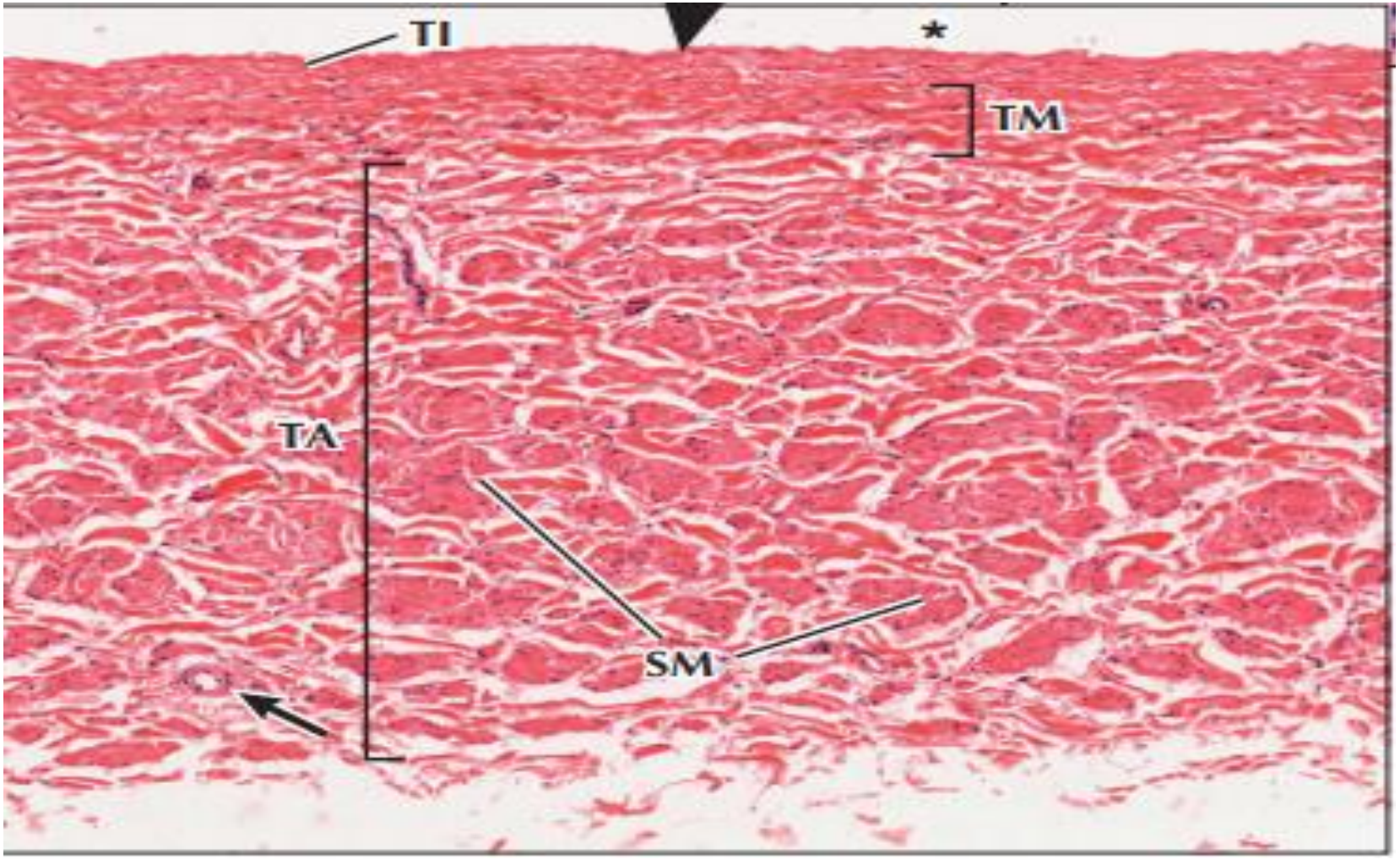
Tunica intima: similar to medium veins but with thick subendothelial tissue.

Tunica media: poorly develop in most of the large veins.

Tunica adventitia: well developed.



Tunica adventitia: well developed



LM of the wall of the inferior vena cava. The lumen (*) is lined by an attenuated intima (TI). A few layers of circular smooth muscle cells occupy the thin media (TM). The adventitia (TA), the thickest layer, contains longitudinal bundles of smooth muscle (SM) interspersed with collagen fibers, as well as vasa vasorum (arrow). 55×. H&E

Special Features of Certain Veins

Cerebral, meningeal veins, dural venous sinuses, retinal veins, penile erectile tissue and veins of the bones: **have no definite media**.

Veins of the gravid uterus, umbilical vein, some mesenteric veins and limbs are **rich in smooth muscles**.

Adventitia of SVC, IVC and pulmonary veins contain cardiac muscle close to the heart.

THE END

انتهى بحمد الله

Thanks to **Dr. Darwaish Badran** for his valuable Contribution to this lecture