CARDIOVASCULAR SYSTEM

Objective

Students should be able to:

1. **Compare the histological structures of arteries and veins.**

2. **Relate the structure of different blood vessel walls to their function.**

3. **Examine the nutrient blood supply and the innervation of large blood vessels.**

4. **Compare the organisation and structure of exchange vessels in different tissues.**

The Heart

Into the right atrium comes blood from :

The systemic circulation.

From the right ventricle blood is pumped to the :

Lungs.

Into the left atrium blood comes from :

Lungs.

From the left ventricle blood is pumped to :

The systemic circulation.

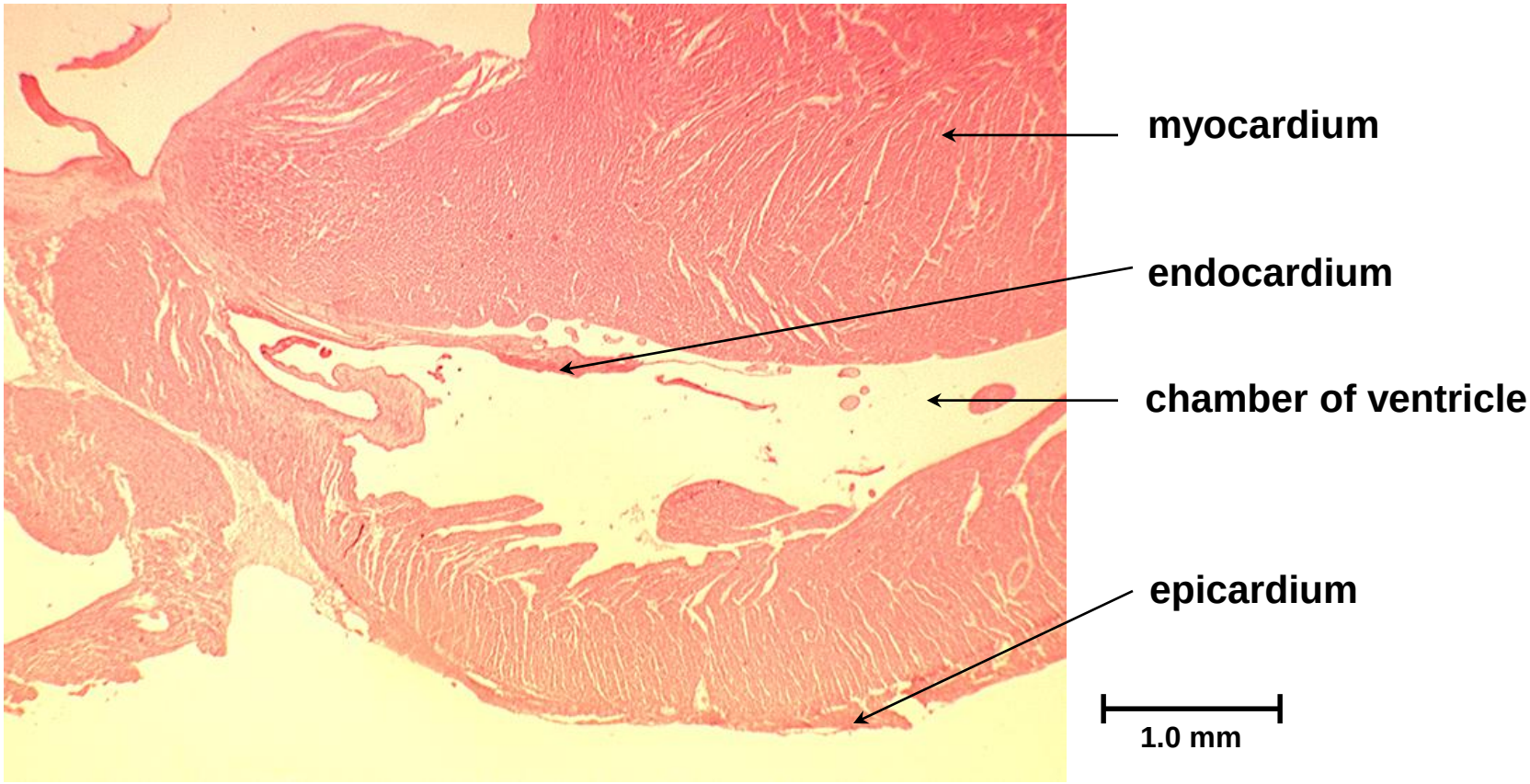
Demo slide section through wall of heart.

What three layers make up the wall of the heart?

Endocardium : lines atria and ventricles,forms valves.

Myocardium : the cardiac muscle.

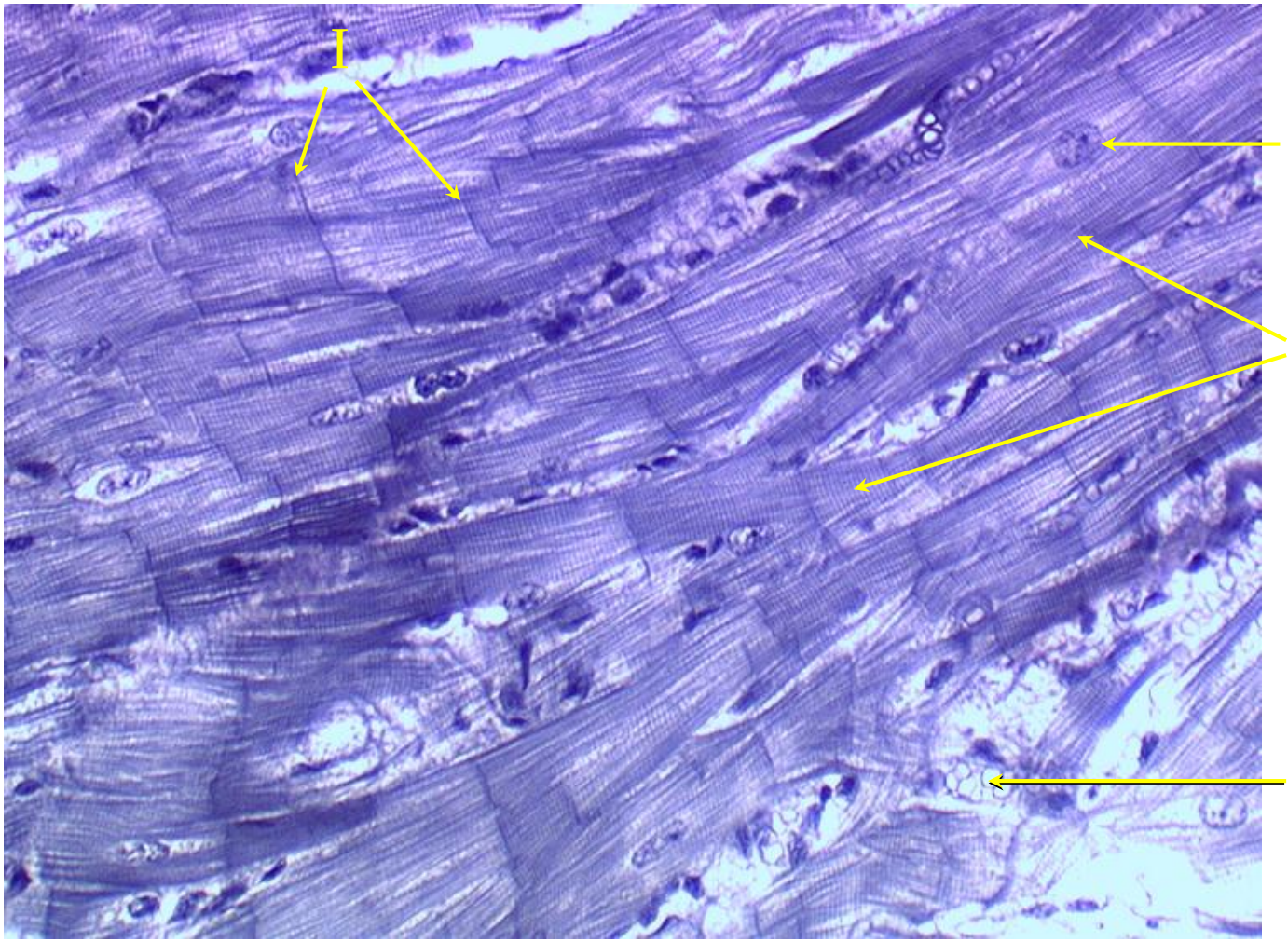
Epicardium : covers the external surface of the heart – serous membrane also called the visceral pericardium.



Cardiac muscle

Identify the principal features of cardiac muscle.

Intercalated discs, central nuclei (usually one but sometimes two) with perinuclear space, branched fibres, good blood supply.



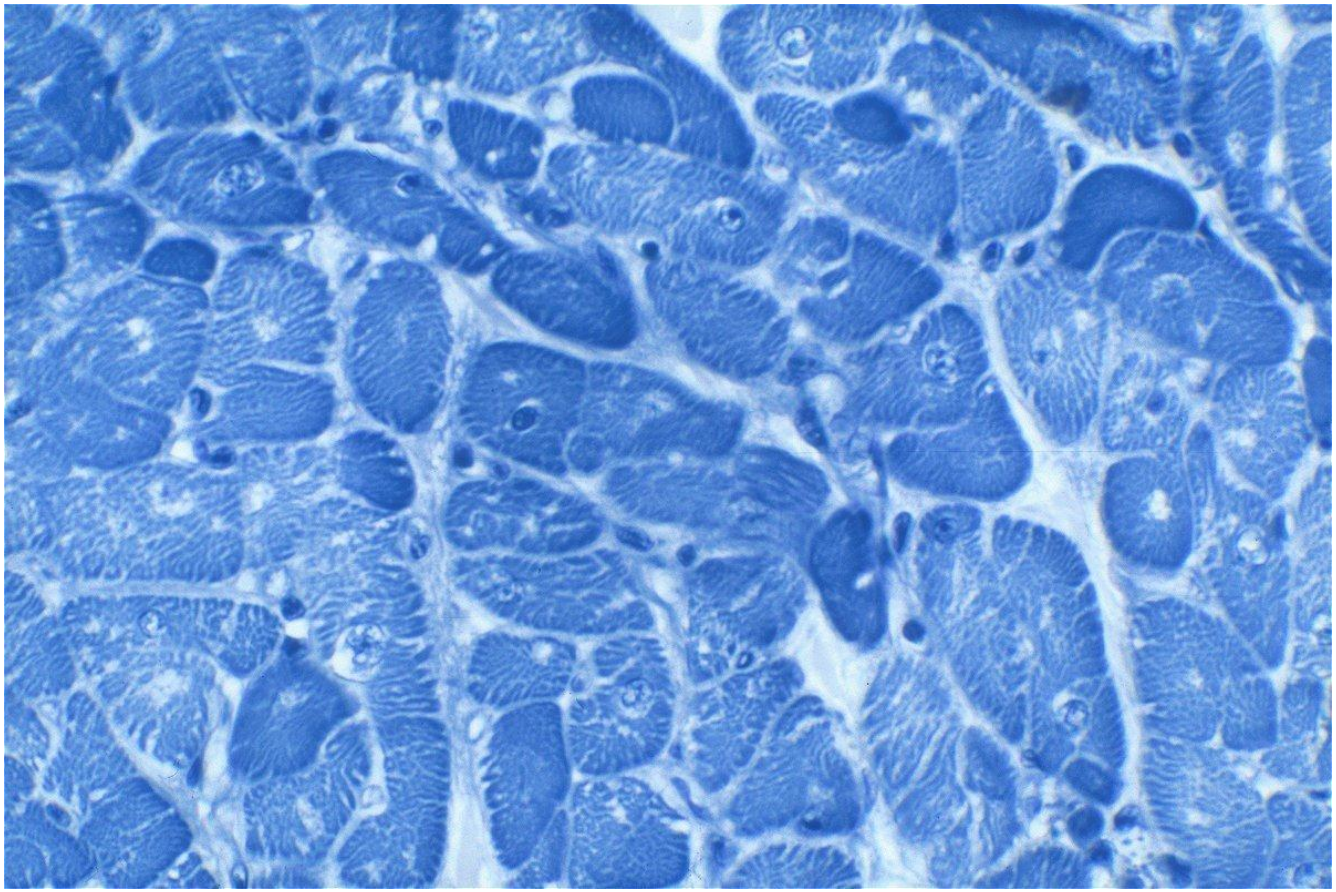
Cardiac muscle

List the structures that allow cardiac muscle to act as a functional syncytium.

Intercalated discs. Gap junctions.

Branched fibres – lateral junctions.

Rich vasculature.



TS section of fibres

Cardiac muscle

What type of cells make up Purkinje fibres?

Impulse conducting cardiac muscle cells.

They form the atrioventricular bundle and its branches in the walls of the ventricles.

Aorta elastic arteries

This slide shows a transverse section through the aorta.

Identify the layers of this structure at both low and high magnification.

Suggest why there appear to be two lumens in this structure?

The section was most likely cut at the divergence of the brachiocephalic trunk.

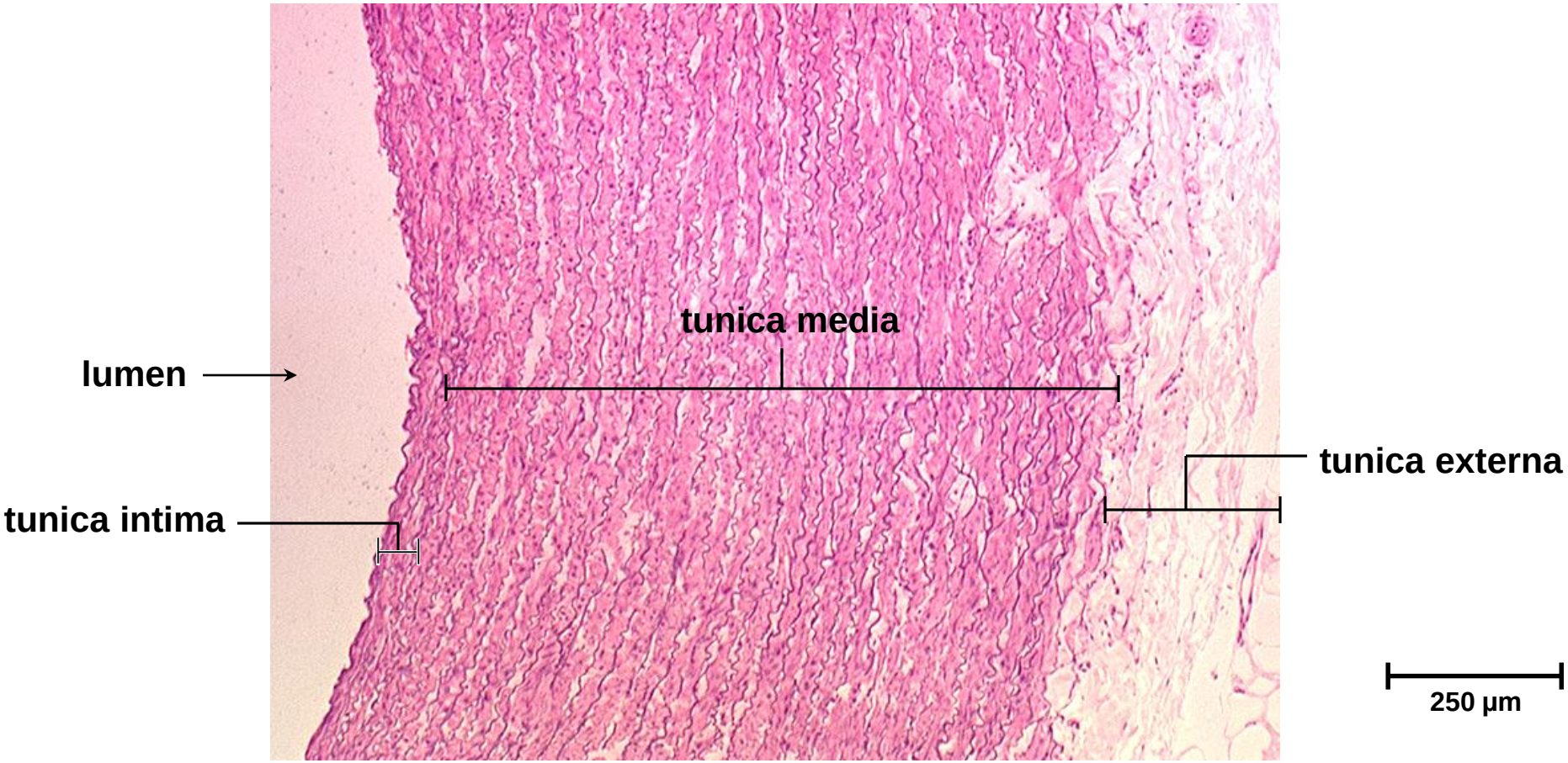
Aorta elastic arteries

Identify the layers of this structure.

Tunica intima (interna) : consists of endothelial lining, sub endothelial connective tissue and internal elastic membrane.

Tunica media : consists of circular smooth muscle layer, elastic and collagen fibres and the external elastic membrane.

Tunica externa (adventitia) : outer covering.



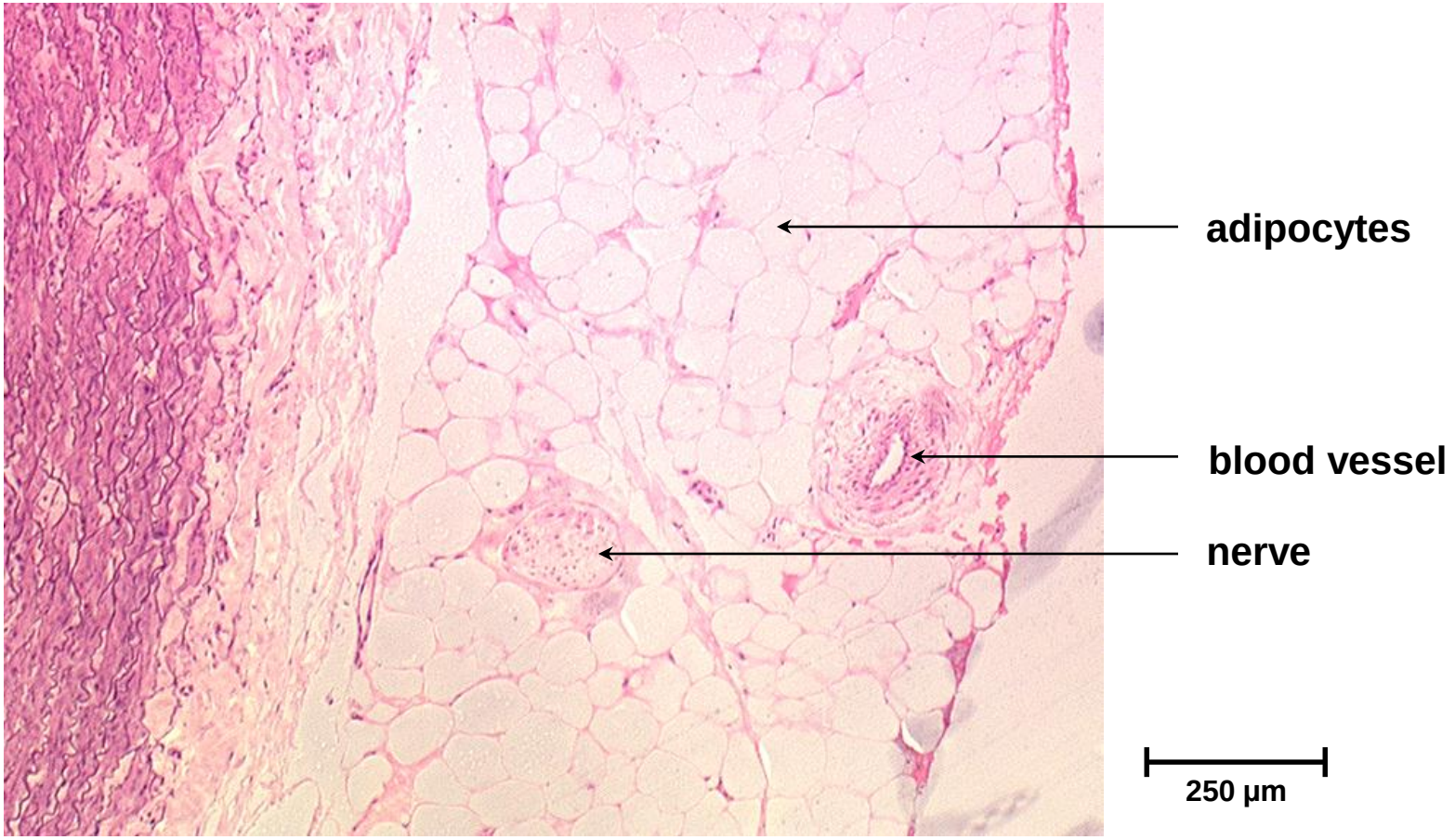
Aorta elastic arteries

What structures are present in the tunica adventitia?

Blood vessels – the vaso vasorum and autonomic nerves – the nervi vasorum.

What is their function?

They supply the wall of the blood vessel.



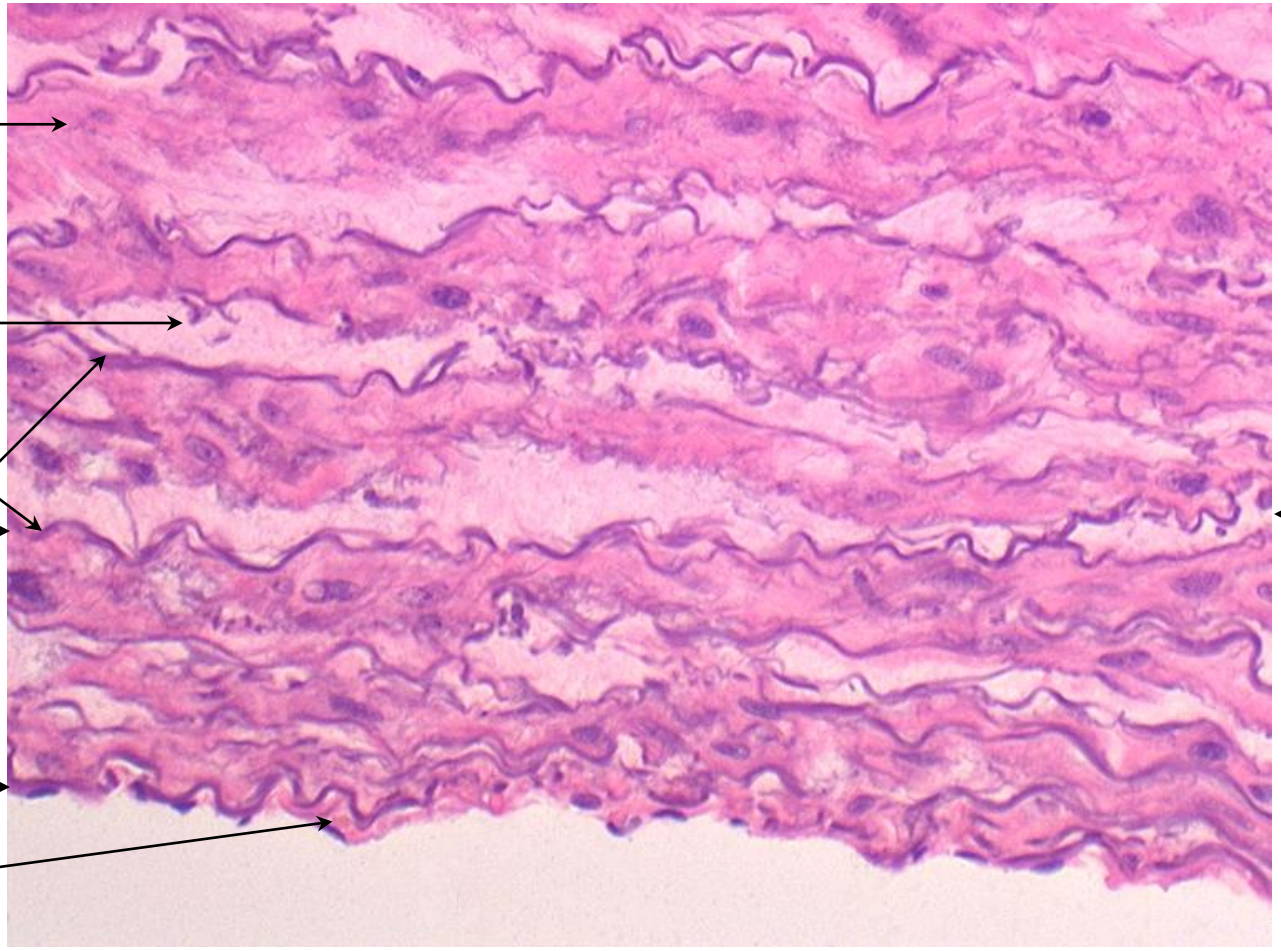
Aorta elastic arteries

Why are elastic fibres more prevalent in the aorta than in other arteries?

The elasticity of the tunica media sustains blood pressure (reduces fluctuations) between heart beats.

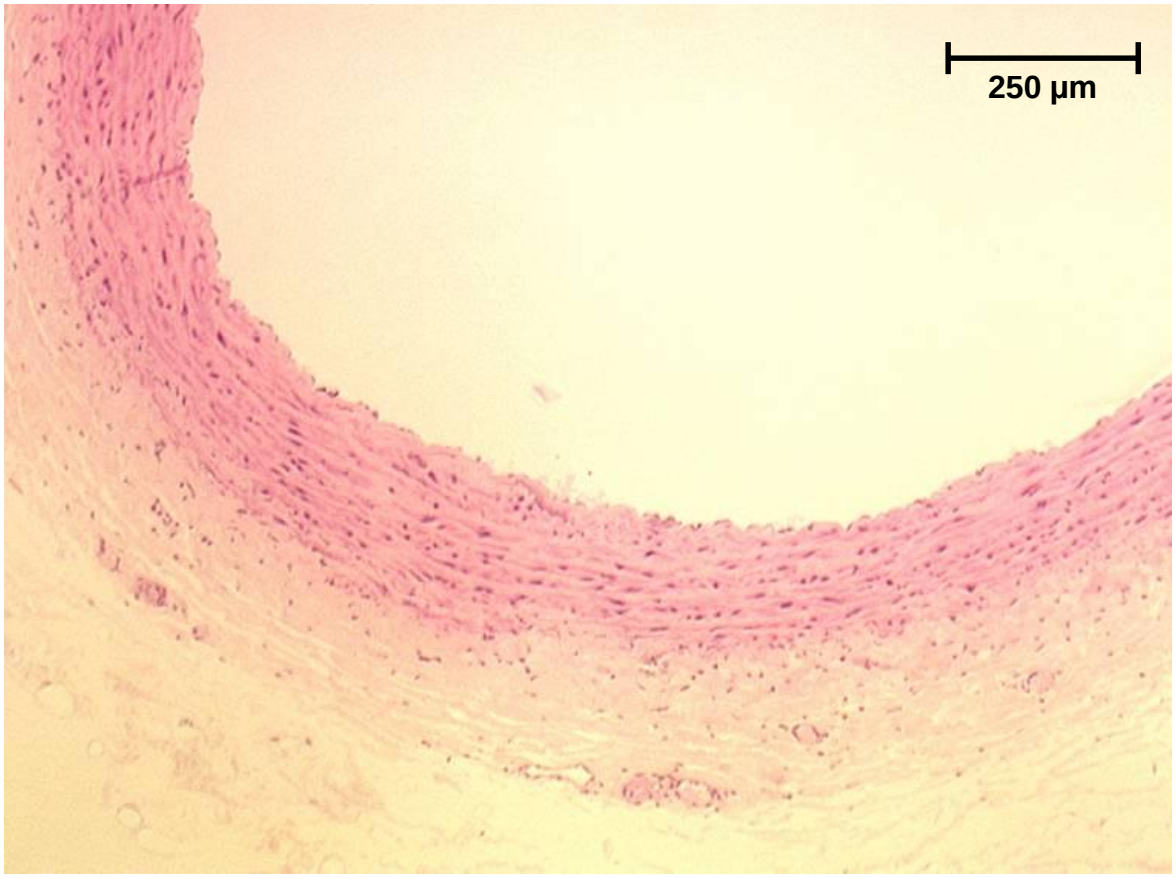
Systole : elastic walls stretched. Pressure converted to elastic tension.

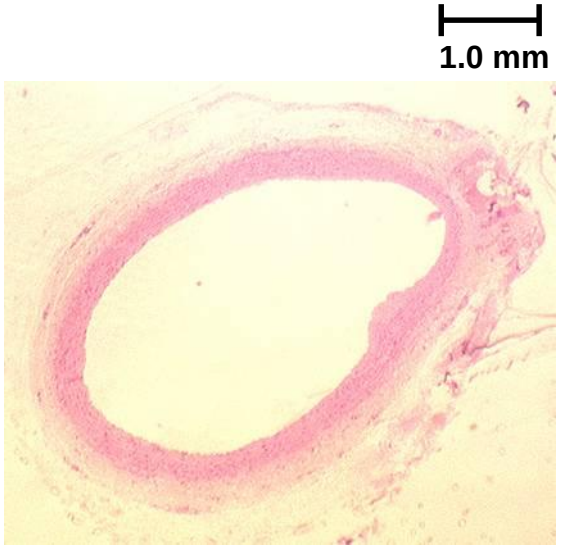
Diastole : elastic rebound in arterial wall maintains blood pressure.



Large veins

Compare with previous slide (aorta).

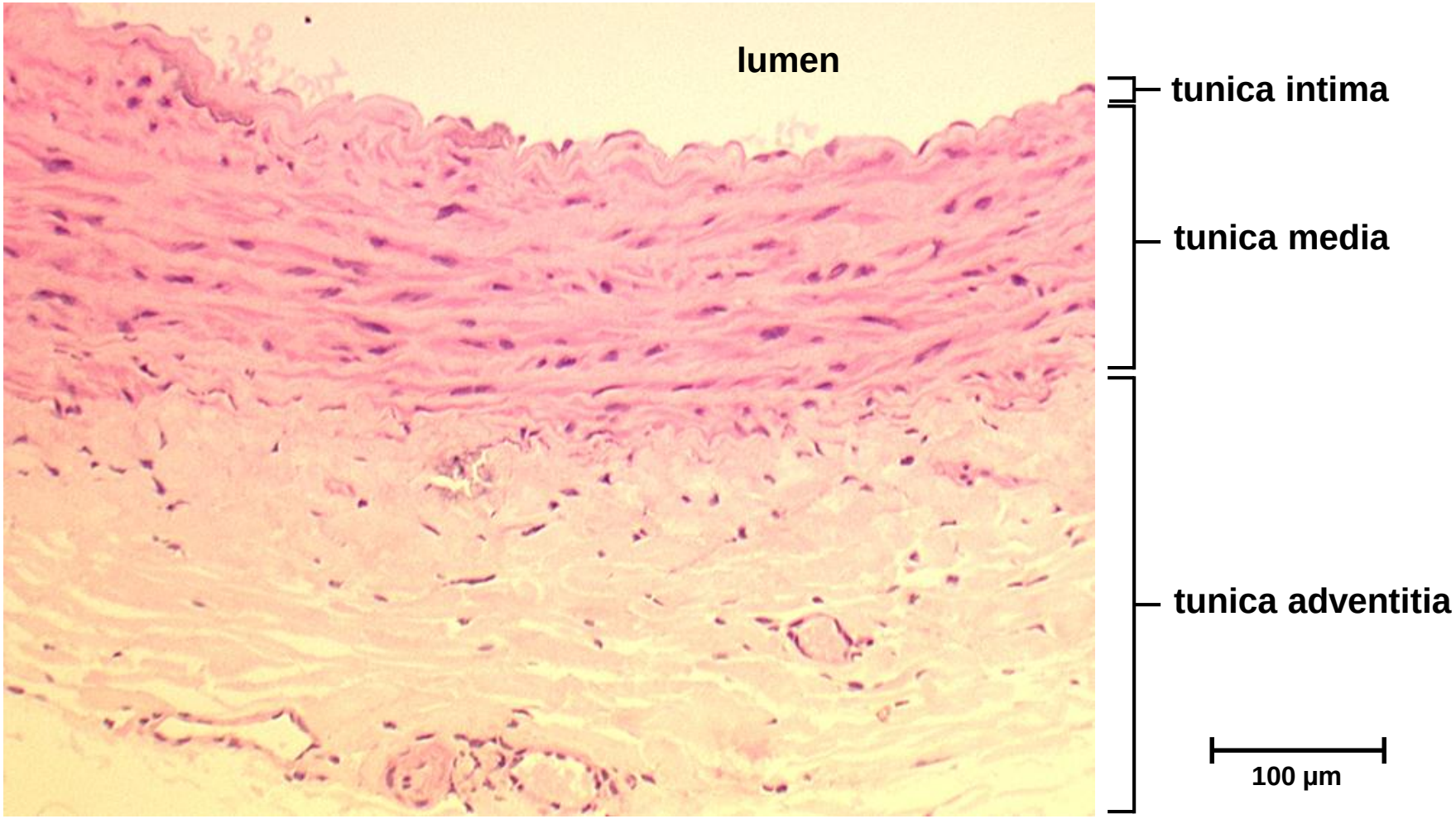




Large veins

Are the same layers present in both vessels?

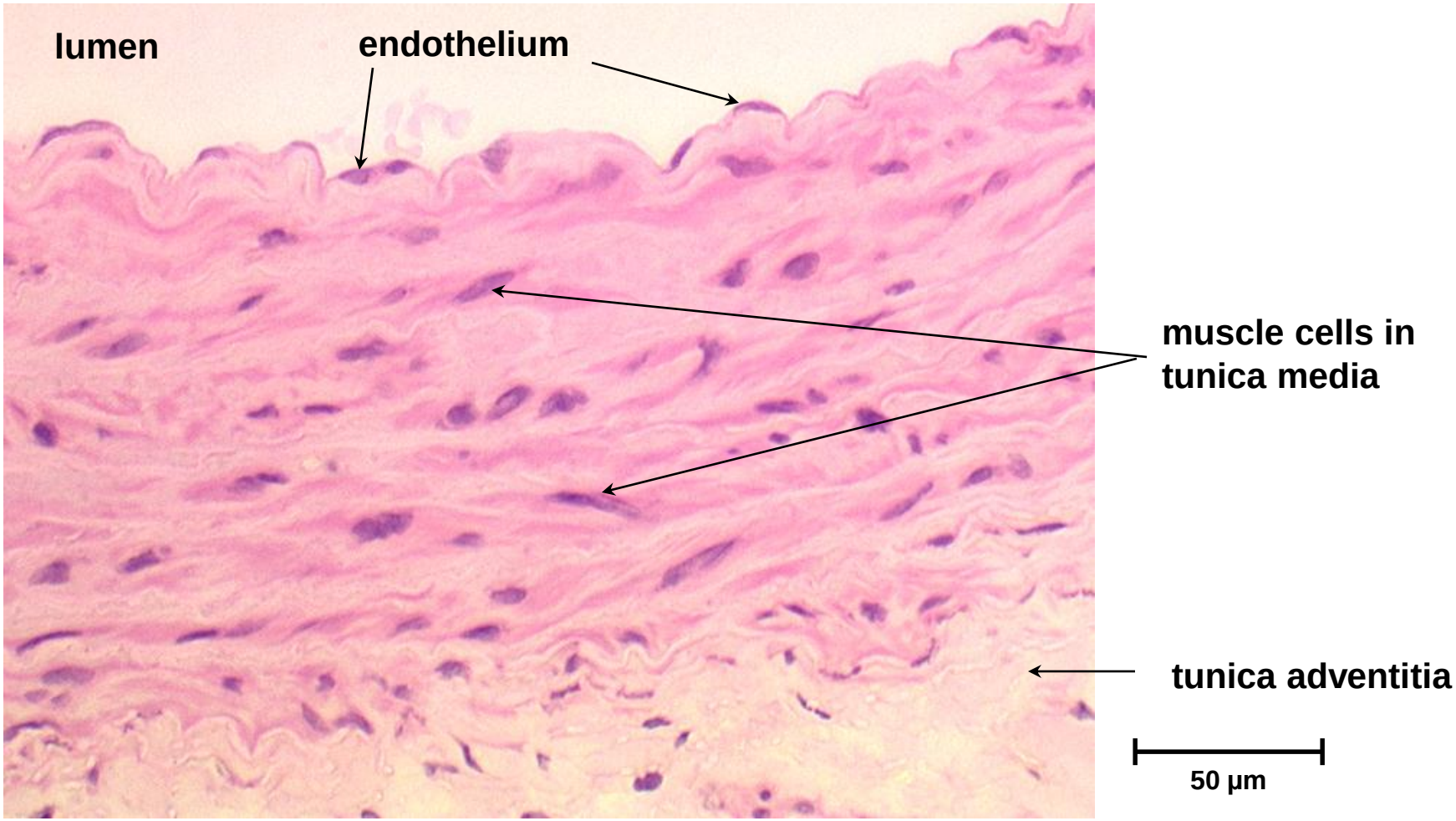
Yes.



Large veins

In which layer are most of the smooth muscle cells found?

In the tunica media; (walls of veins are thinner relative to the size of the lumen).

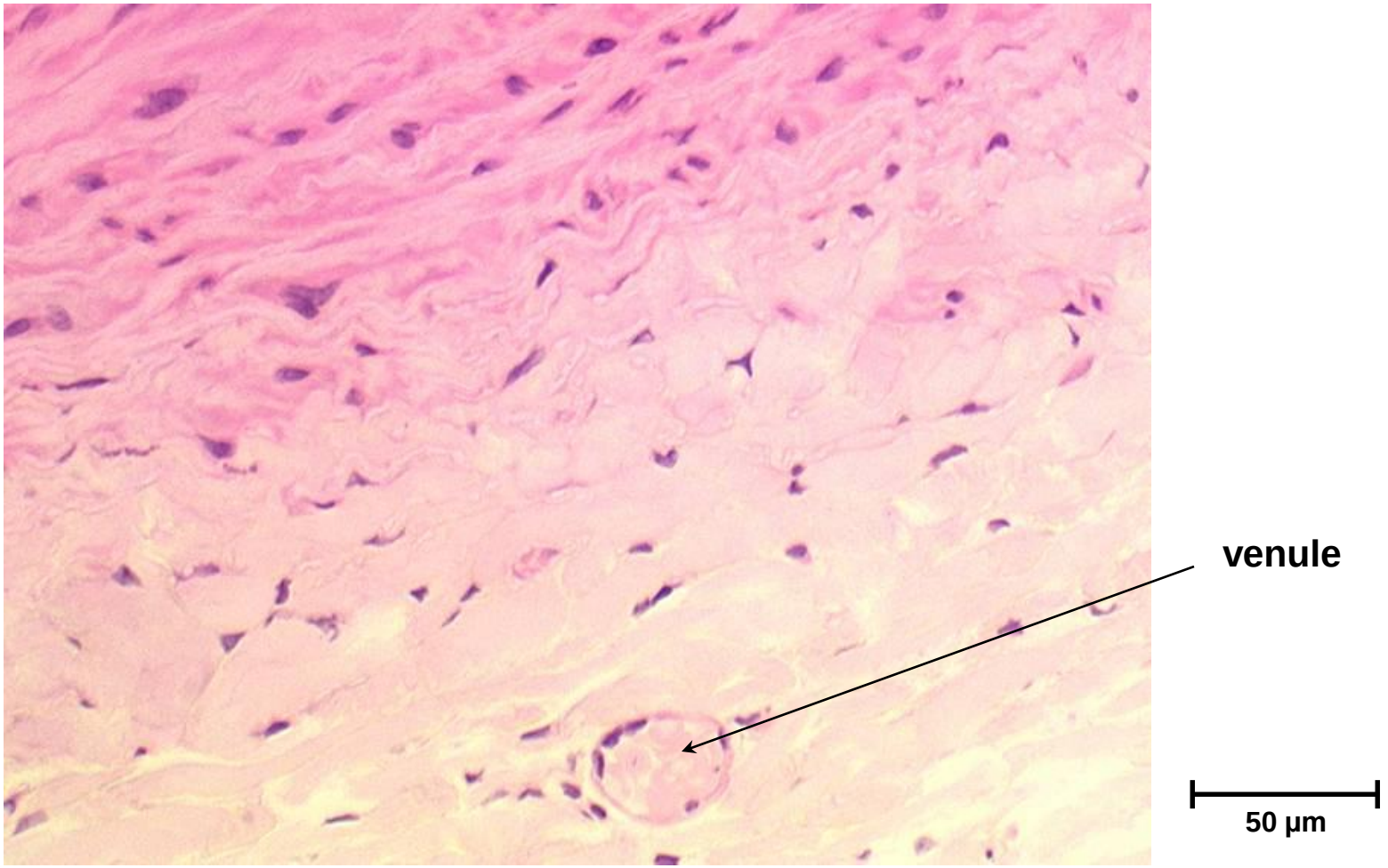


Large veins

Junction between tunica media and tunica adventitia.

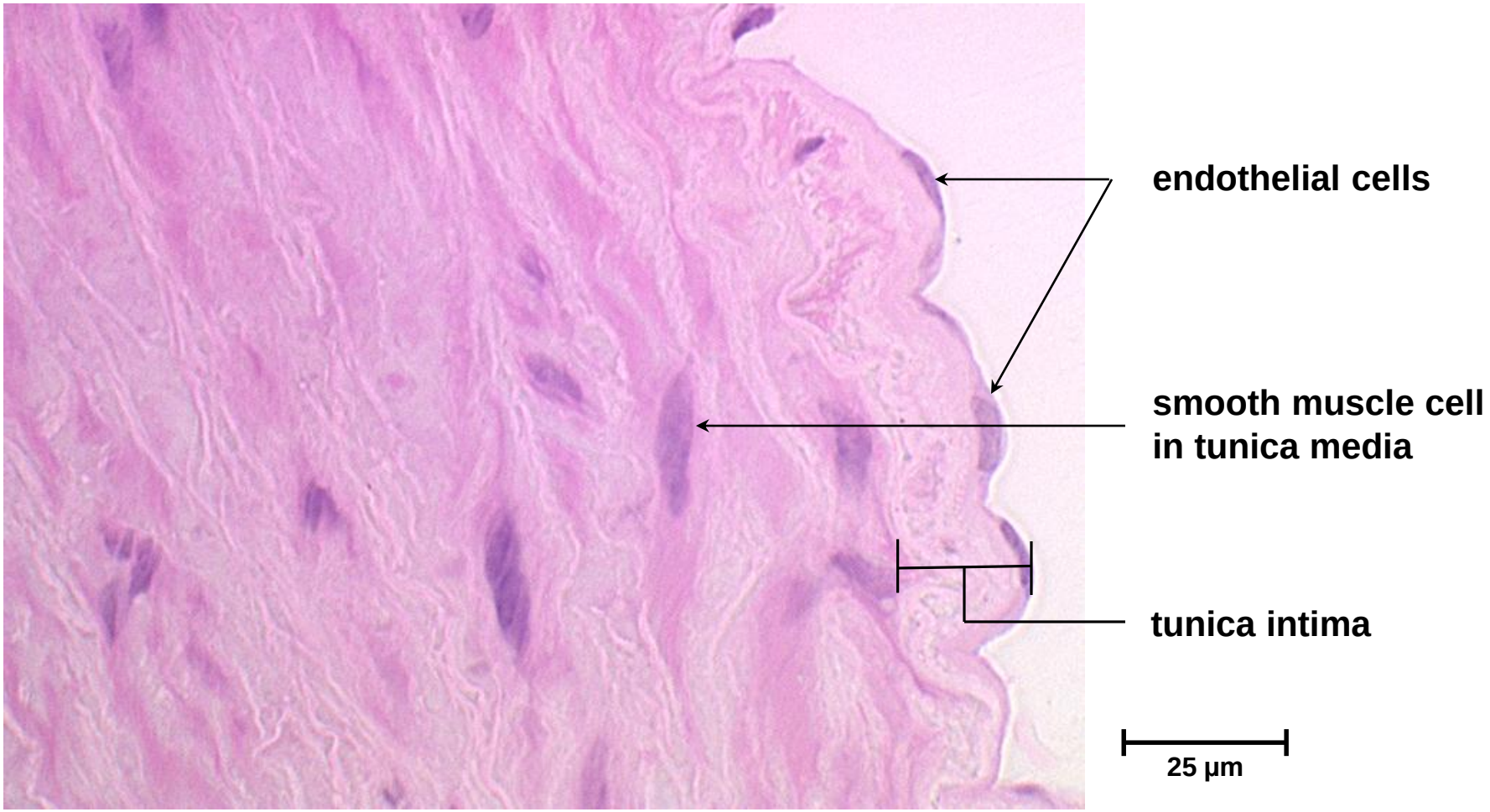
Dark pink staining muscle cells more numerous in tunica media.

A small venule is seen in the tunica adventitia.



Large veins

At high magnification the depth of the tunica intima can be seen.

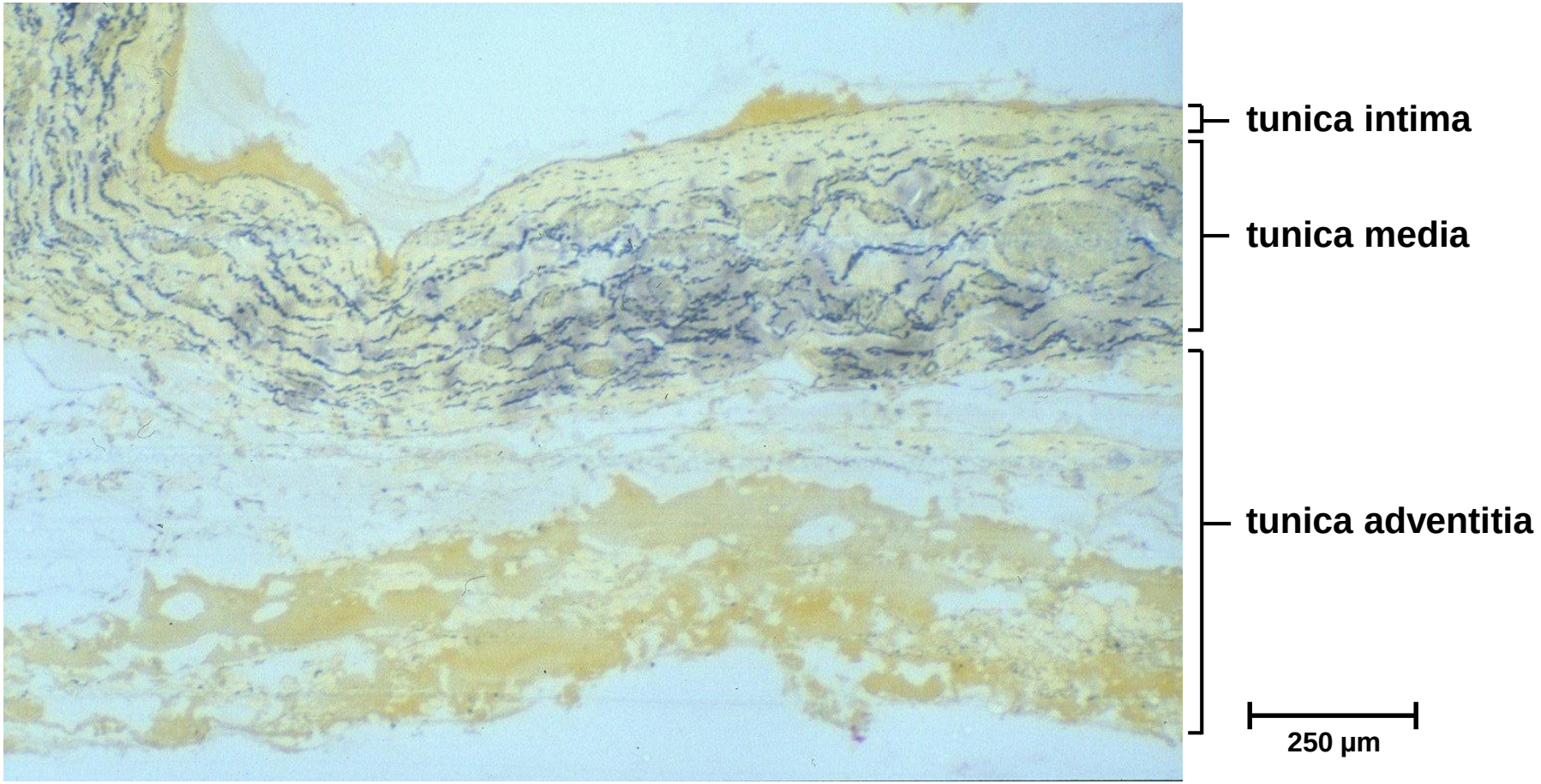


Large vein (Vena cava) elastic stain

In this section elastic tissue has been stained black.

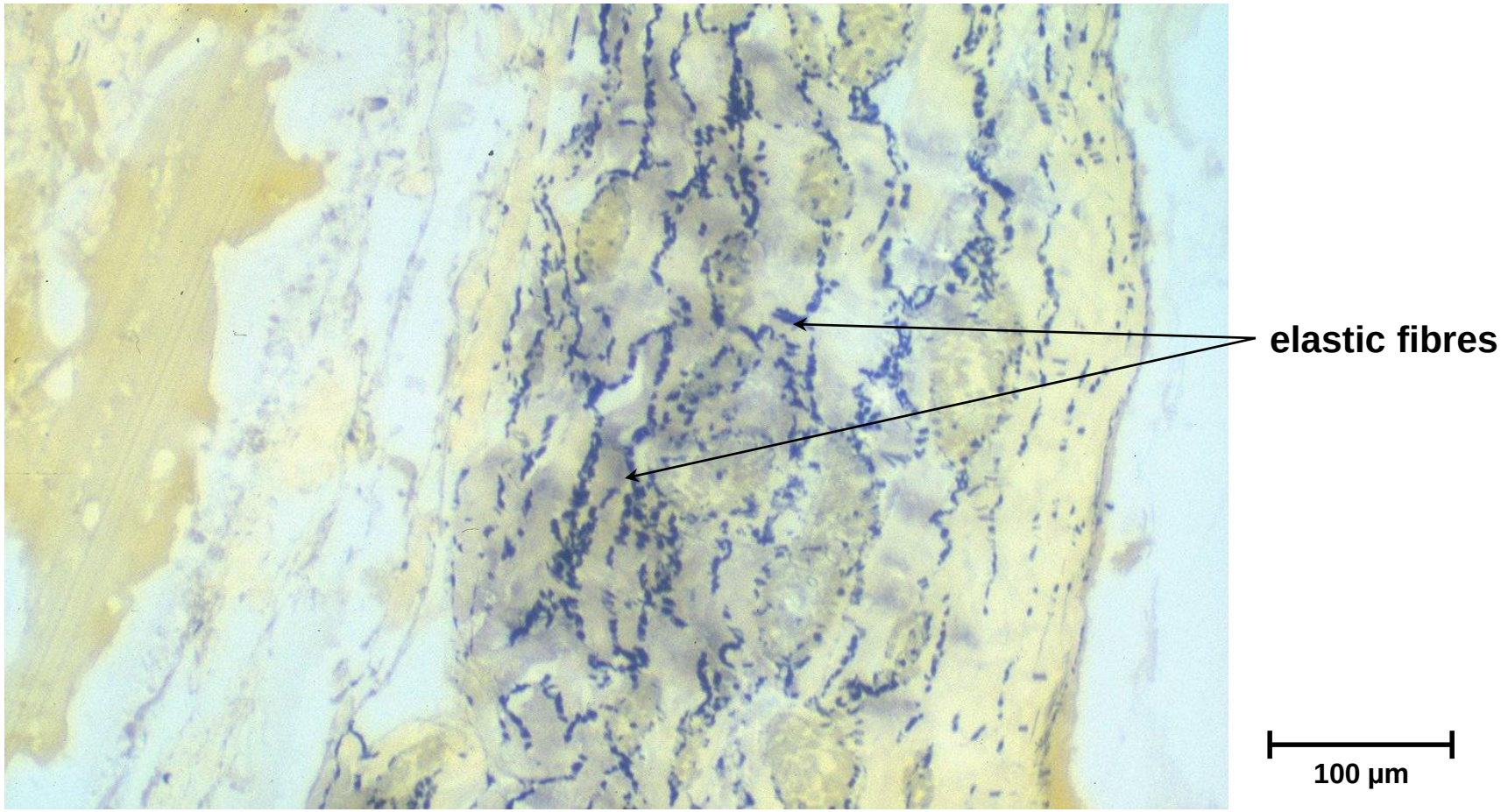
Which region has the most elastic tissue?

Tunica media.



Large vein (Vena cava) elastic stain

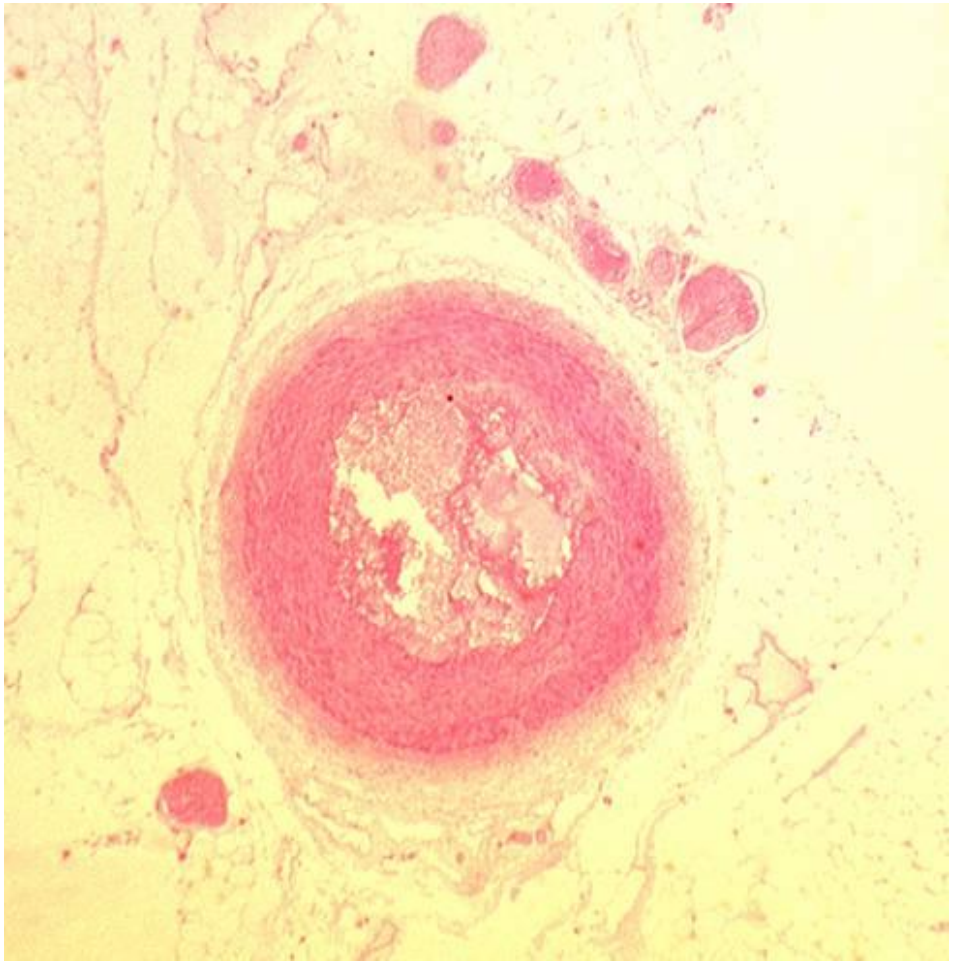
At higher magnification, elastic fibres can be seen.

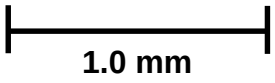


Muscular arteries

Muscular arteries are usually smaller diameter than elastic ones.

Autonomic regulation of these vessels produces changes in blood flow to organ systems.

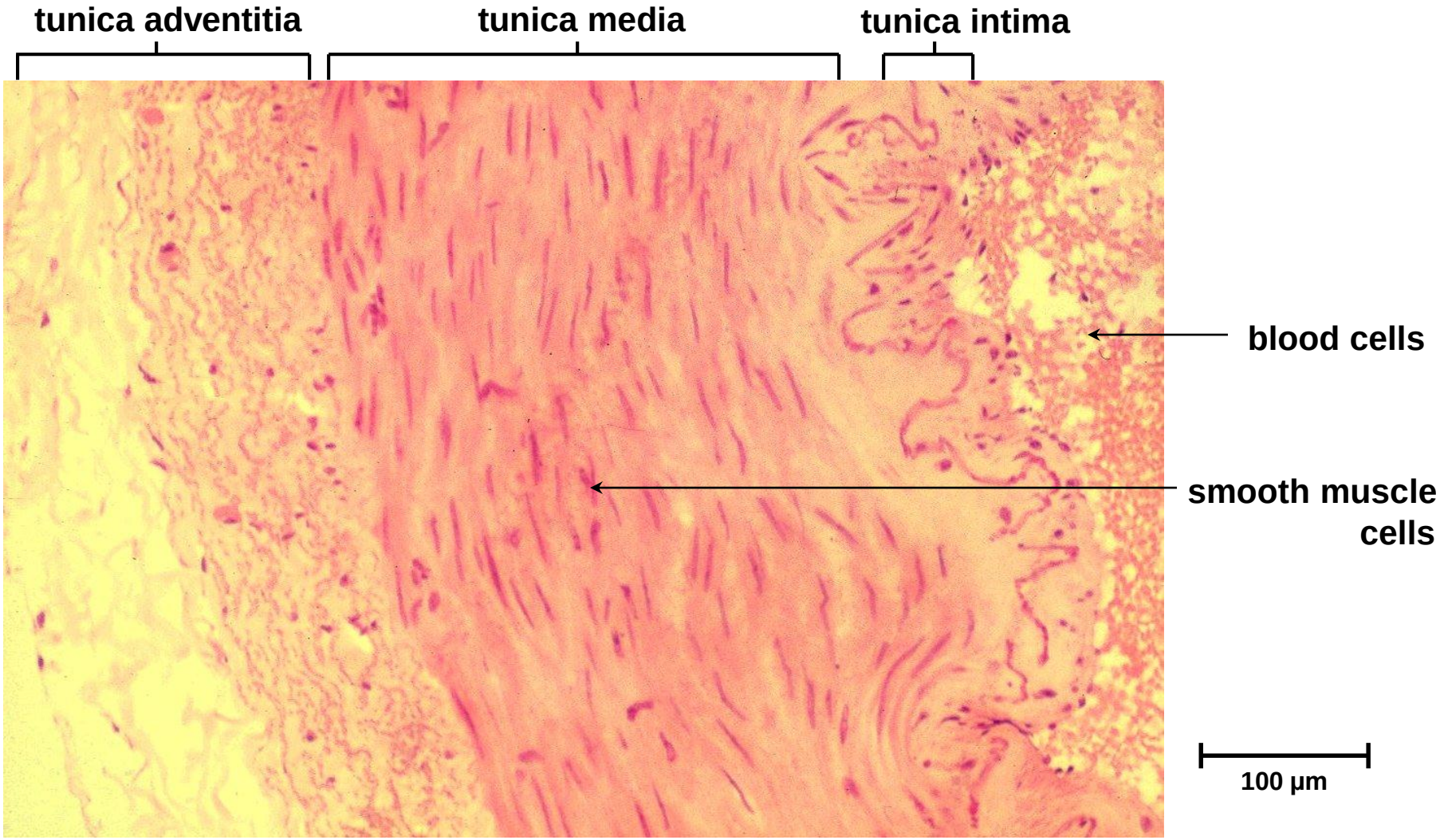




Muscular arteries

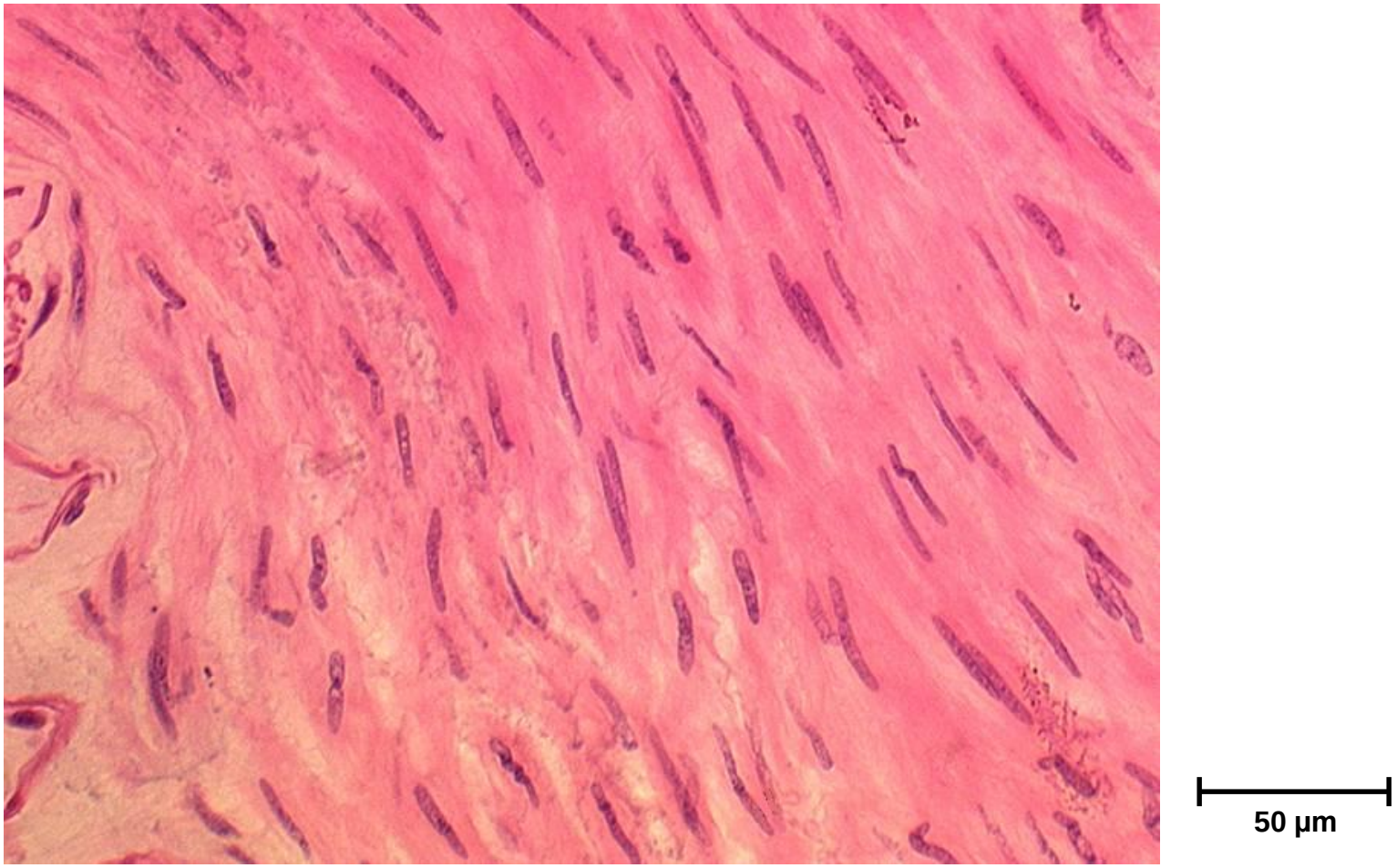
How does the structure of a muscular artery relate to its compliance?

Thicker musculature - lower compliance.



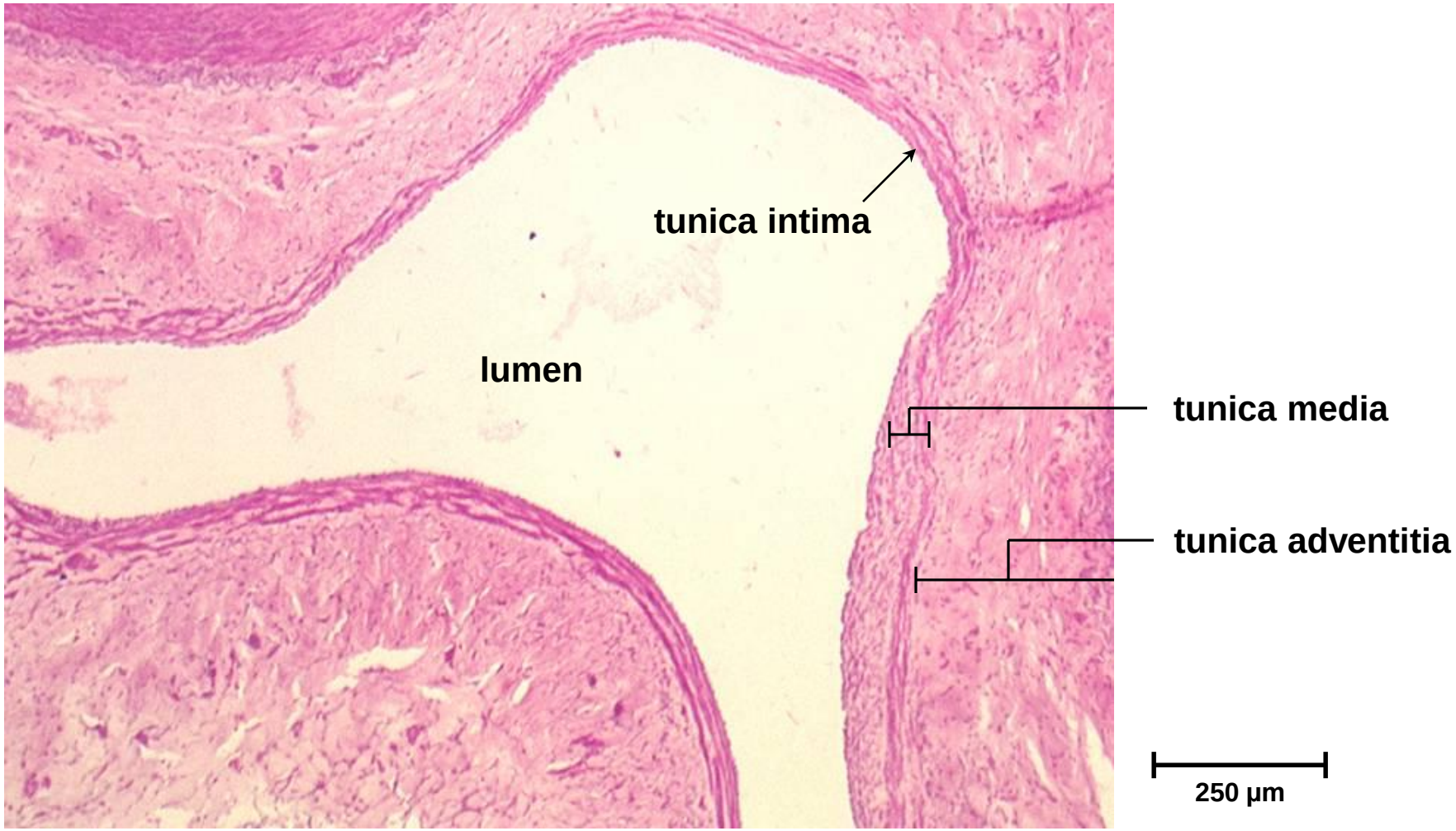
Muscular arteries

The smooth muscle cells in the tunica media



Femoral vein

The three layers tunica intima, tunica media and tunica adventitia can be identified. The thickest layer is the tunica adventitia.

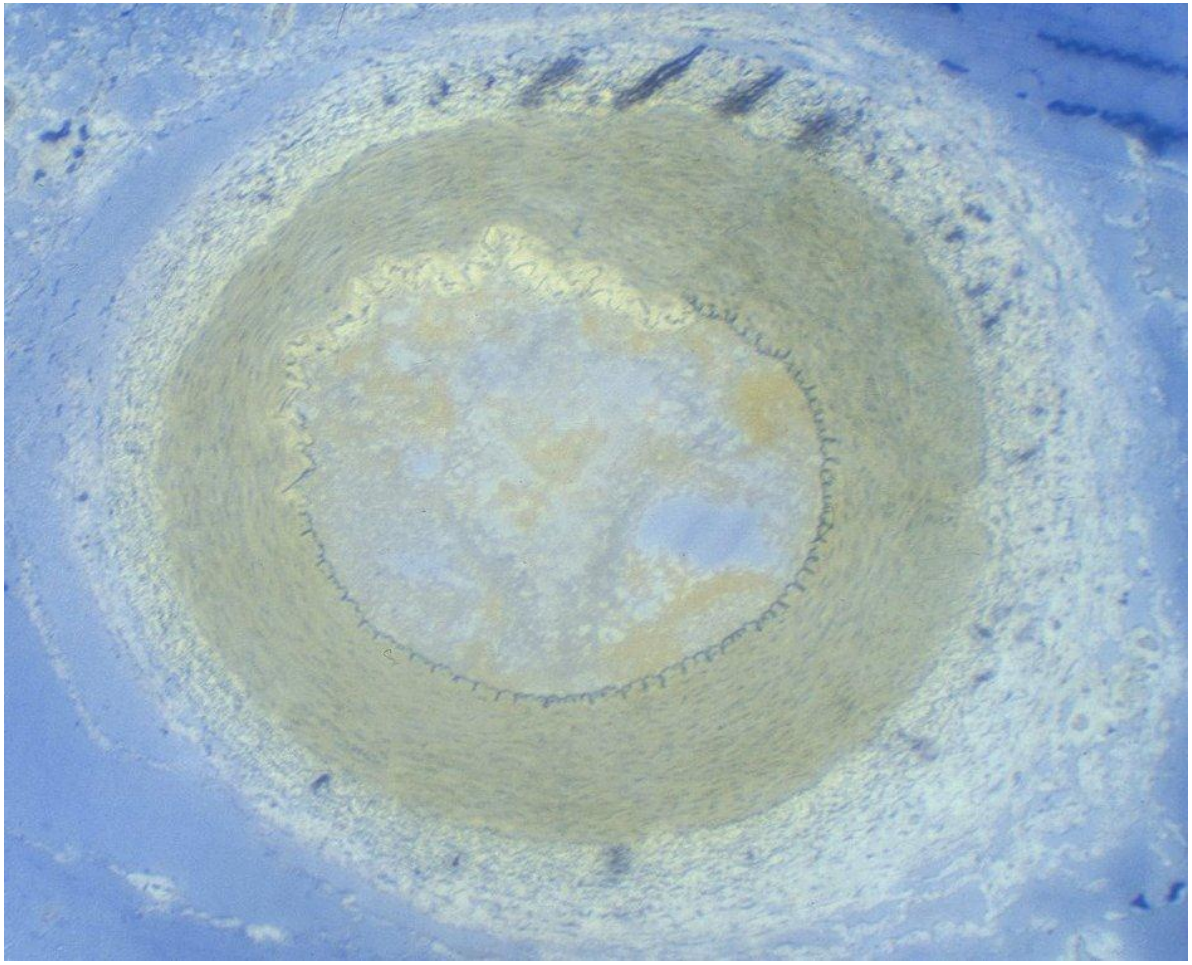


Femoral vein

Identify the layer of endothelial cells lining the vein.

Muscular artery (elastic stain)

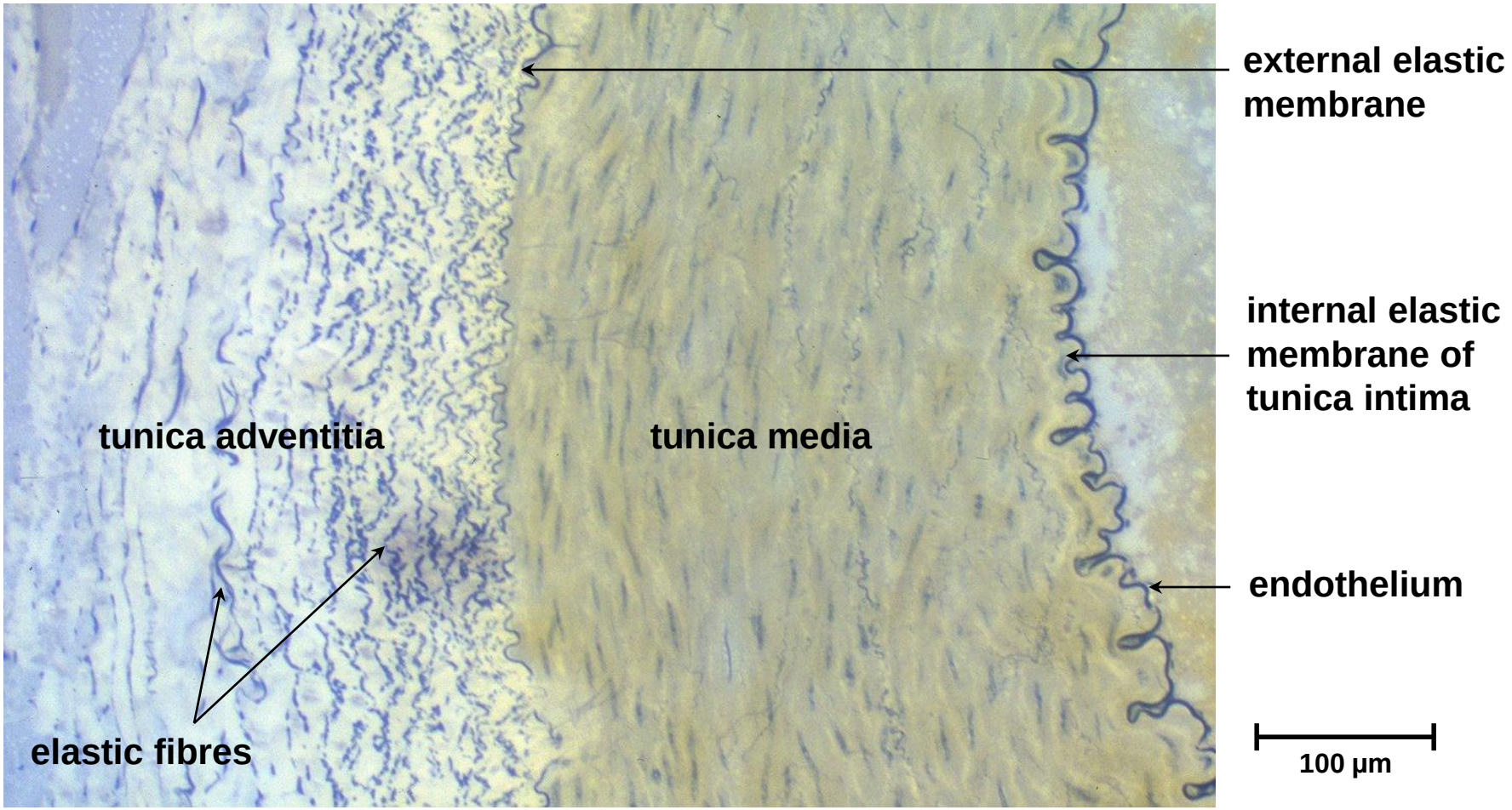
Muscular artery stained to show elastic fibres.



Muscular artery (elastic stain)

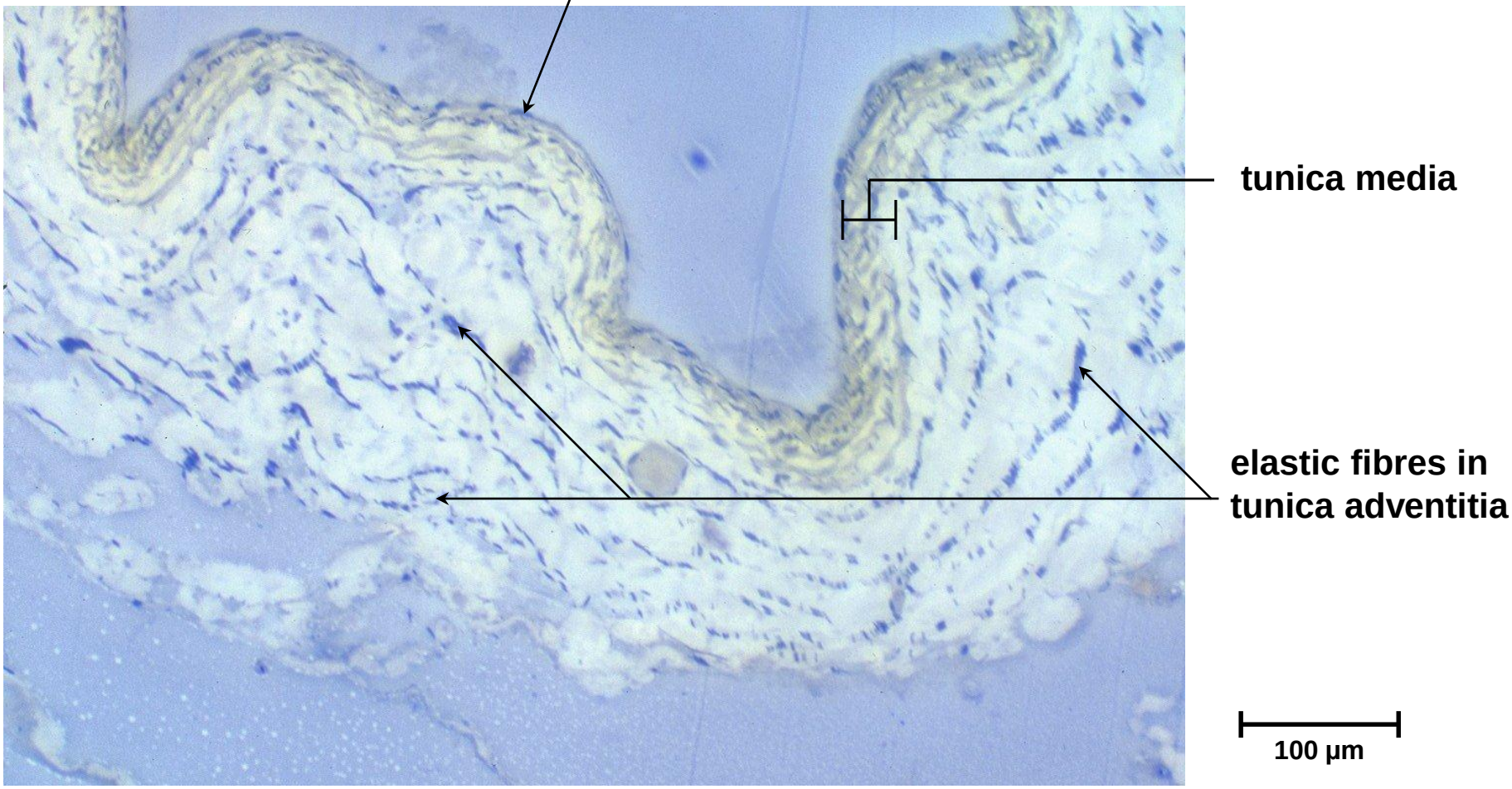
The internal elastic membrane of the tunica intima can be seen. Also the external elastic membrane at the base of the tunica media.

The tunica adventitia has the most elastic fibres (stained black) and is of a similar thickness to the tunica media.



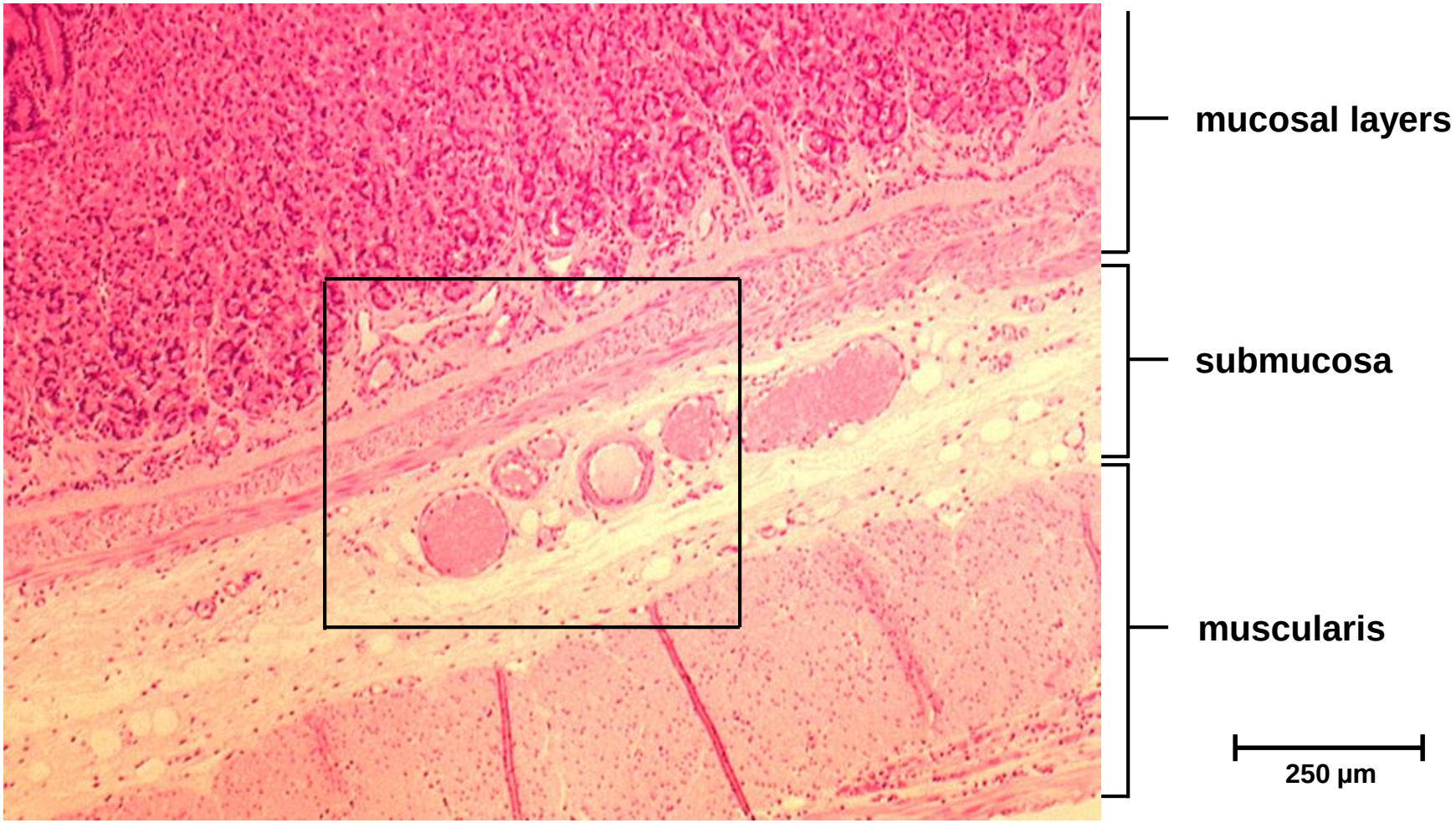
Companion vein (elastic stain)

Again with the companion vein most of the elastic fibres are staining up in the tunica adventitia, which is the thickest layer.



Arterioles and venules (stomach submucosa)

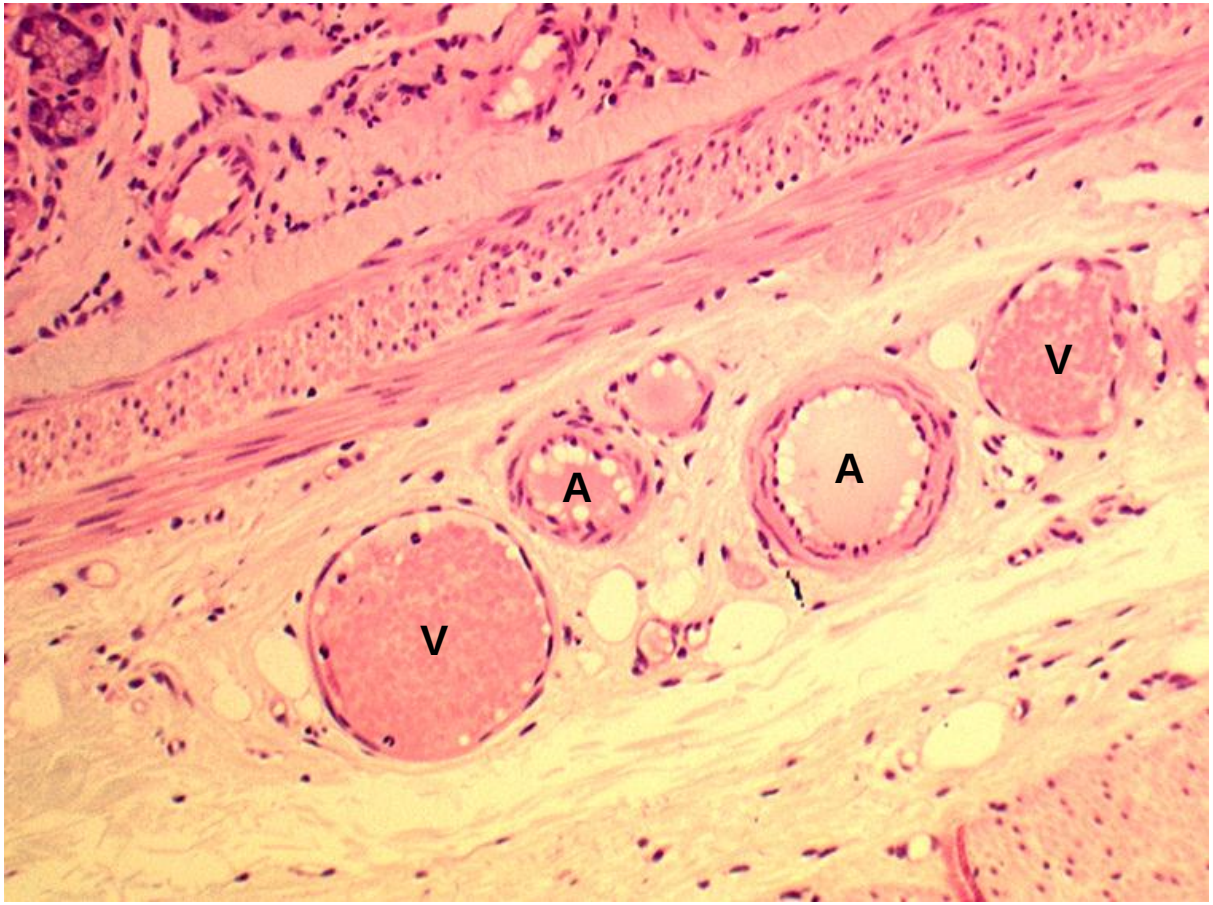
In this section of the stomach; identify the submucosa and locate arterioles and venules.



Arterioles and venules (stomach submucosa)

Why is the lumen of the arteriole smaller than that of the venule?

Compliance.



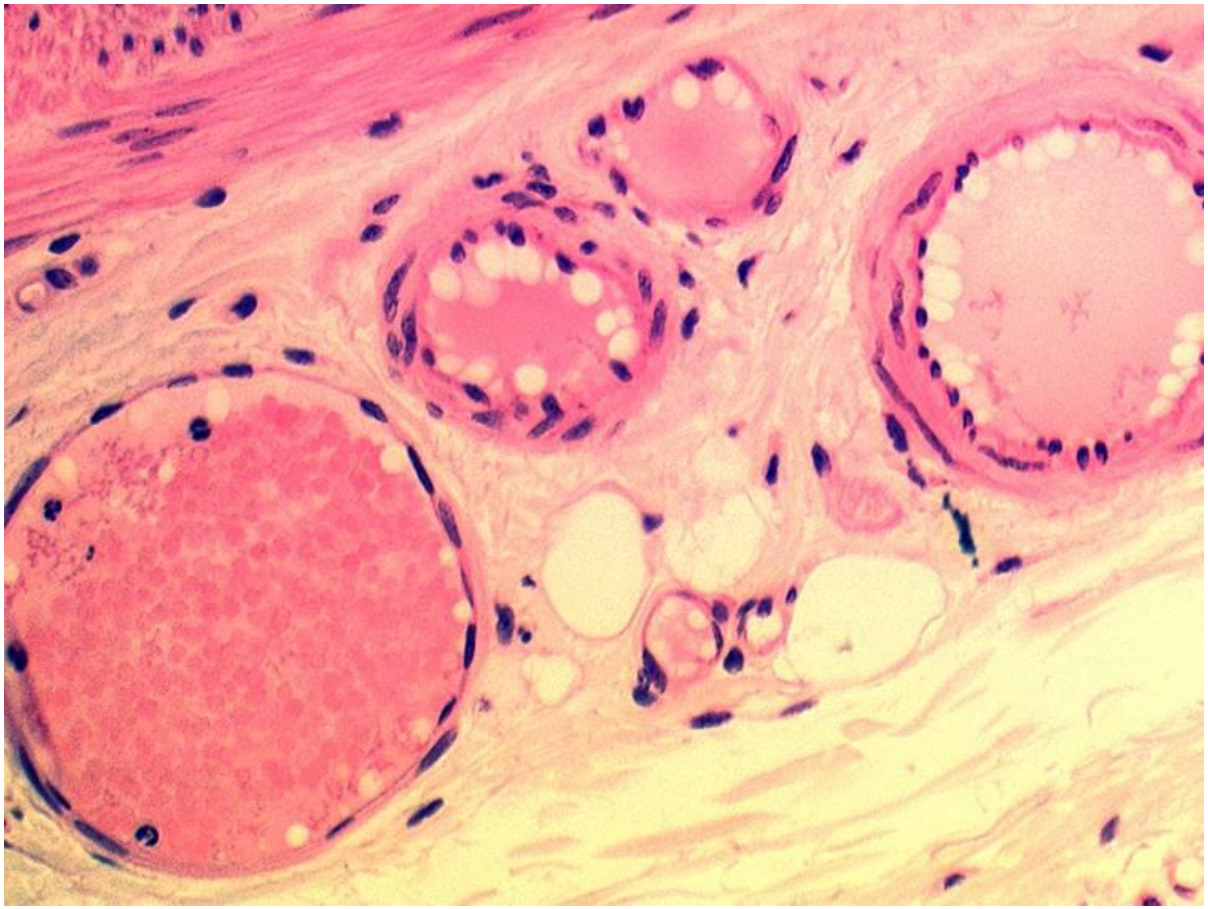
A : arteriole

V : venule

Arterioles and venules (stomach submucosa)

The walls of the arterioles have distinct layers of smooth muscle and regulate the blood flow through the capillary bed.

The thin walls of venules may have a few smooth muscle cells.



Arterioles and venules

Identify which of these structures contributes

a) most and

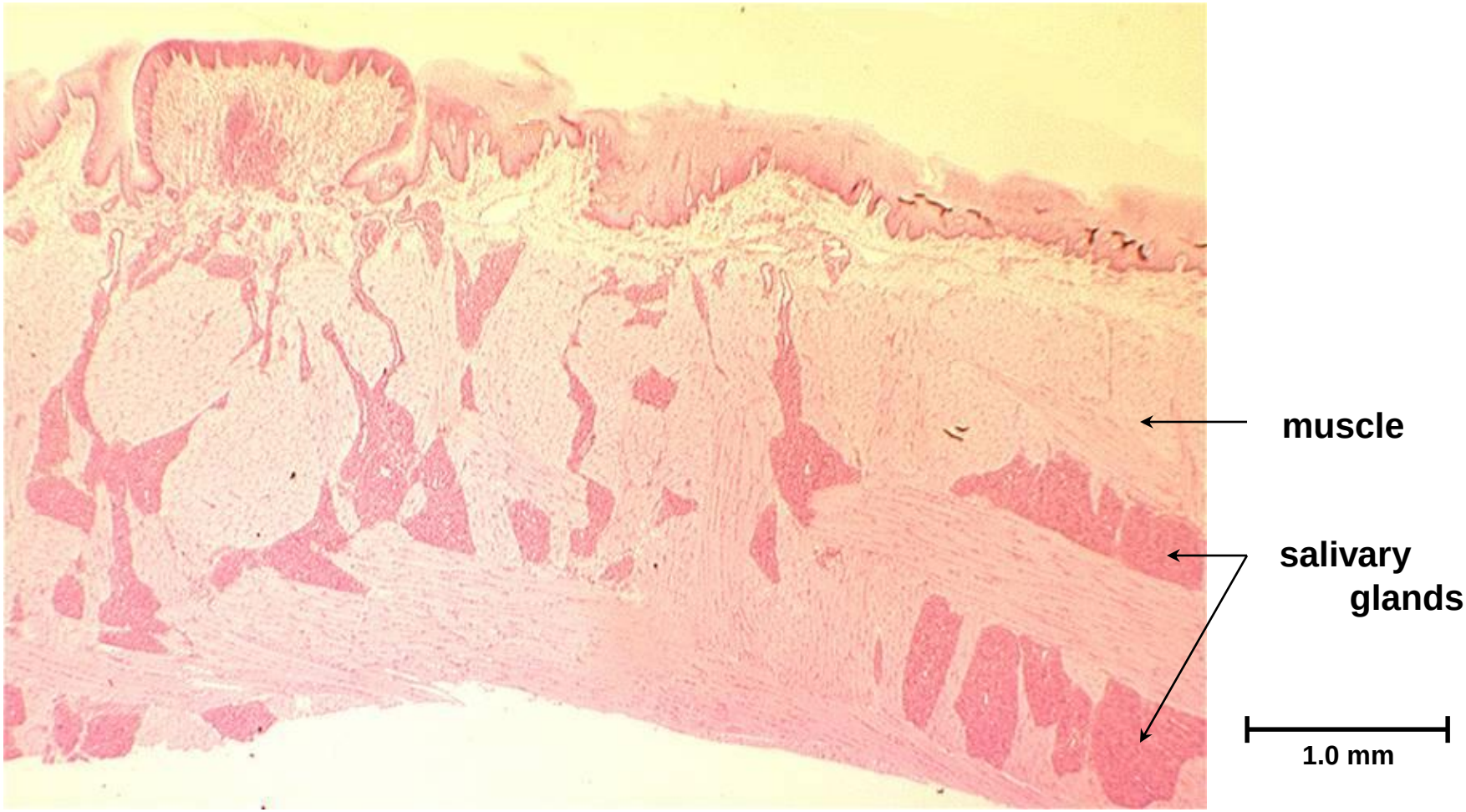
b) least to peripheral resistance:

Elastic artery	**arteriole**	**capillary**	**vein**	**venule**
	a		**b**	

Skeletal muscle

Capillaries in the skeletal muscle of the tongue.

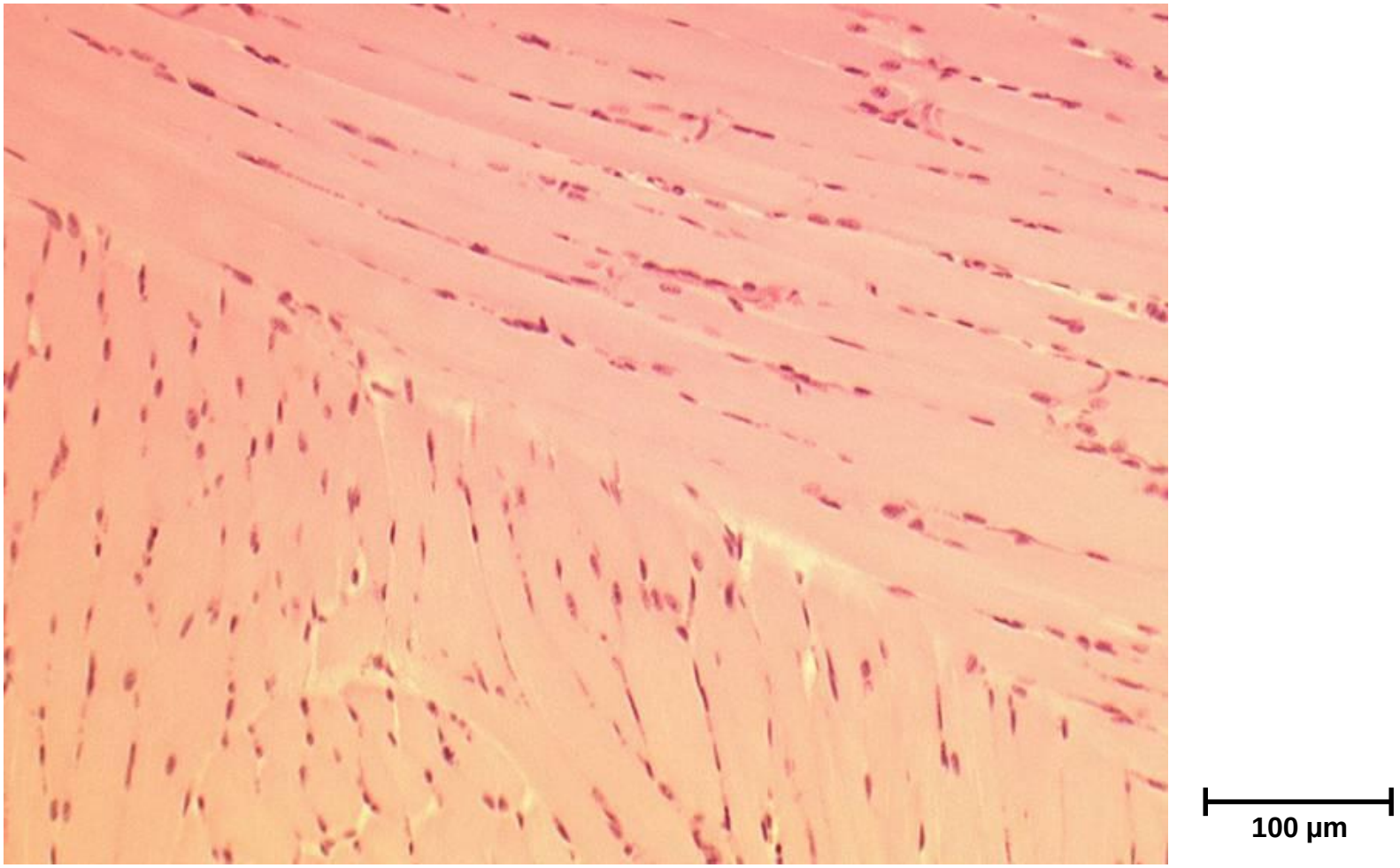
Low magnification view showing surface papillae, striated muscle layers and glandular units.



Skeletal muscle

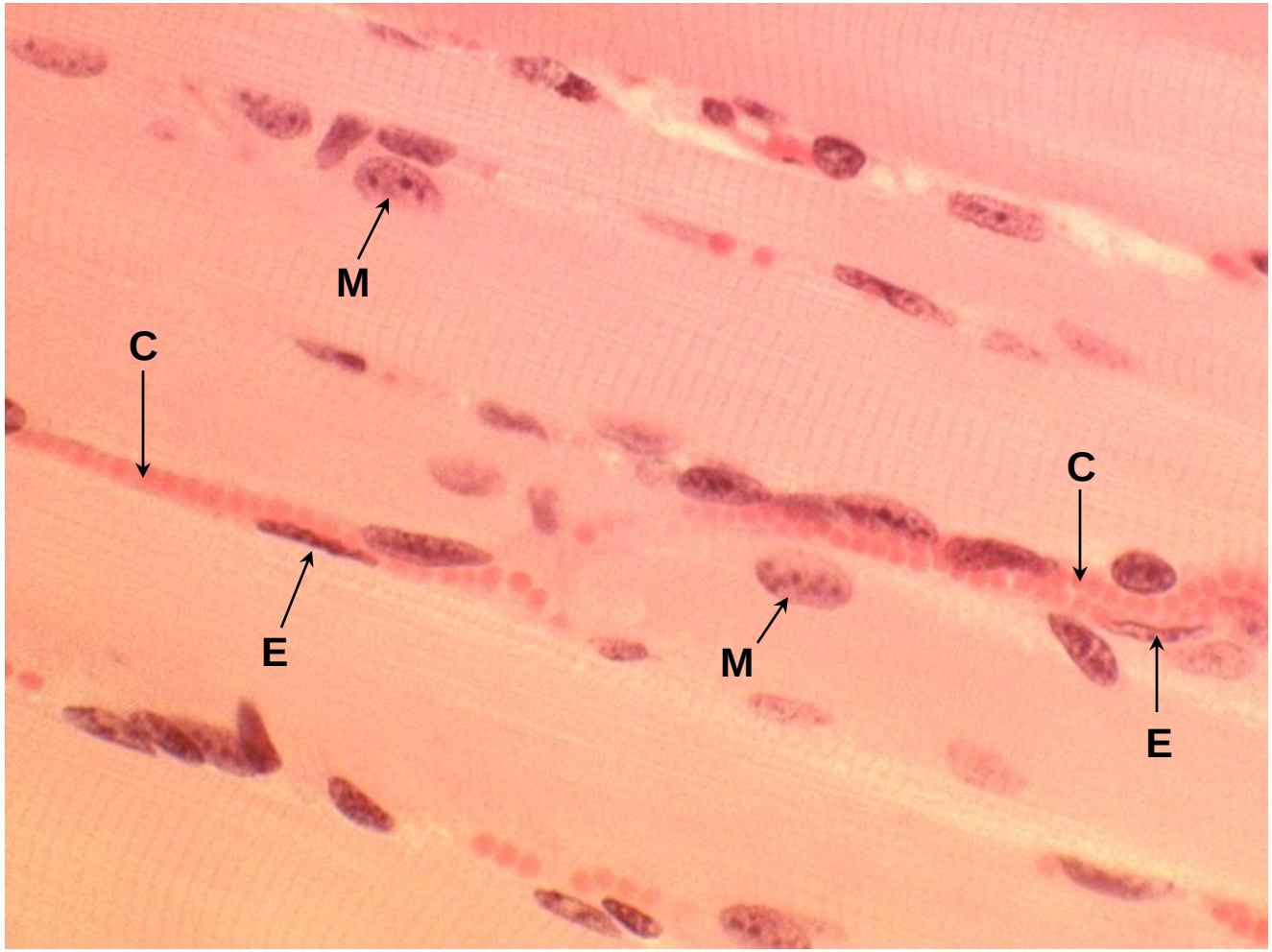
The striated muscle fibres of the tongue run in many directions.

Sections of tongue muscle provide good examples of capillaries cut in longitudinal and in transverse section.



Skeletal muscle

At high magnification the individual blood cells can be resolved in the capillaries.



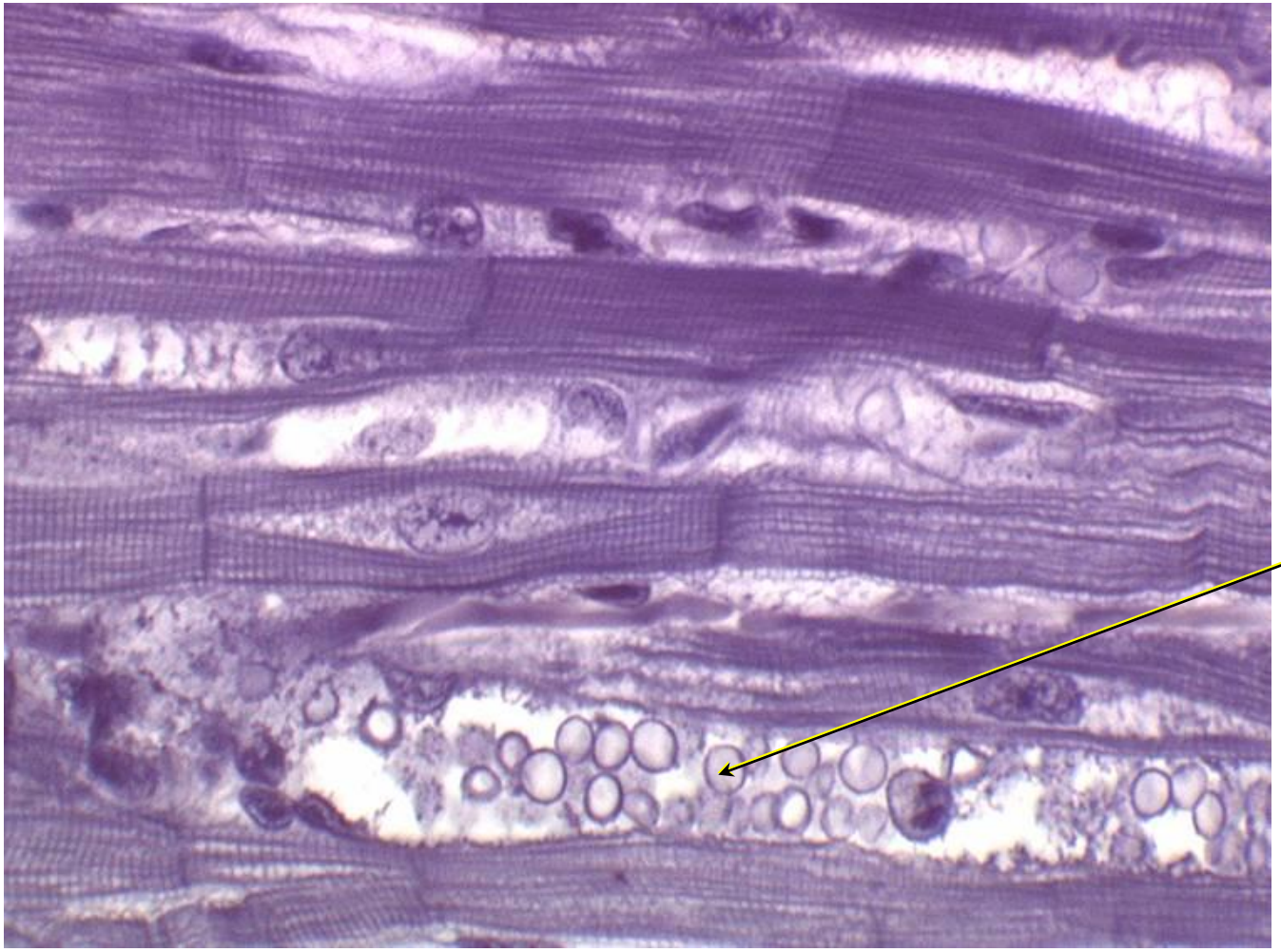
C : capillaries

E : endothelial cells

M : muscle nuclei

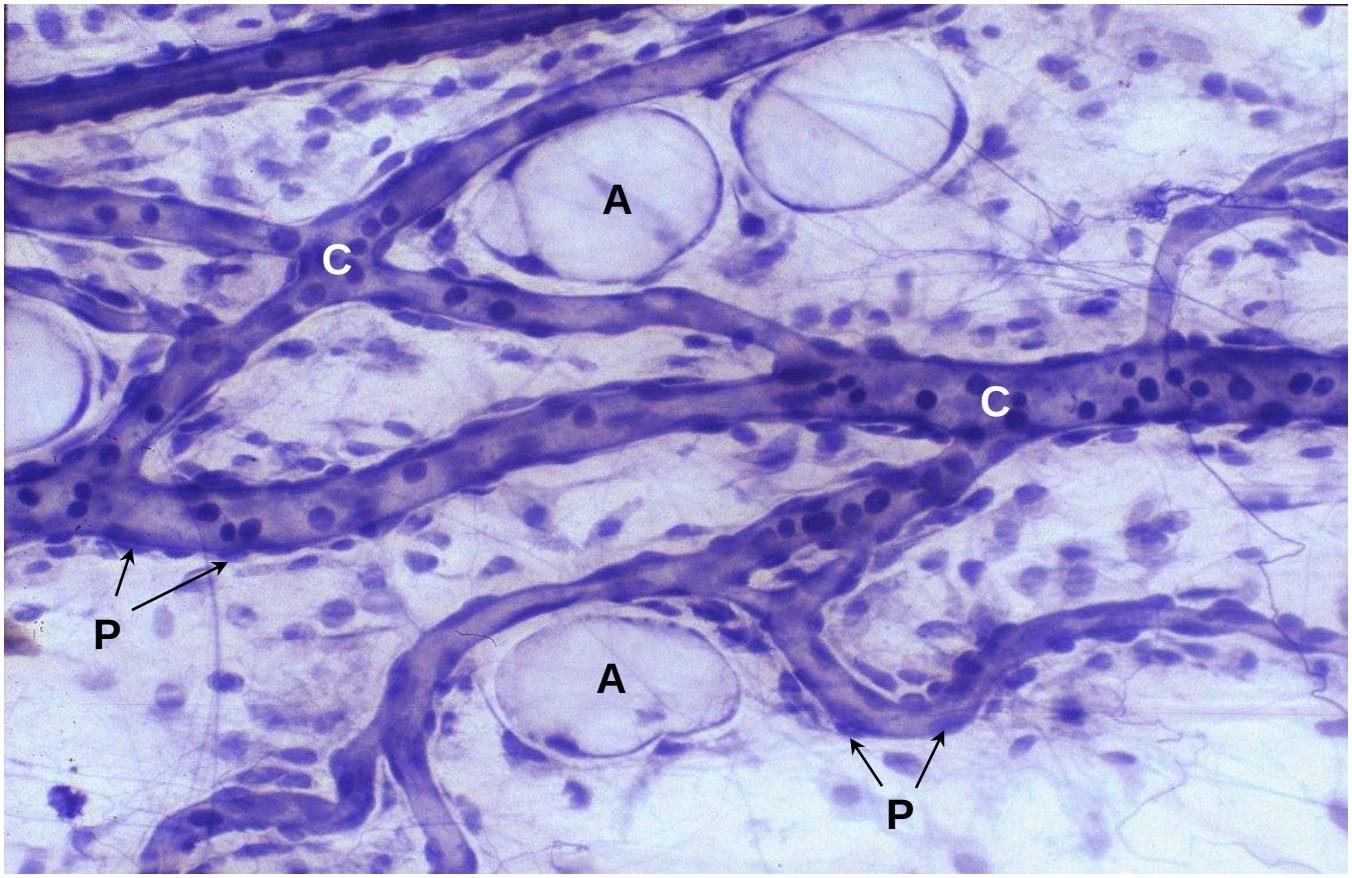
Cardiac muscle

Capillaries in cardiac muscle.



Loose connective tissue (spread)

Capillaries in loose (areolar) connective tissue.
This slide is a spread preparation.



C : capillaries

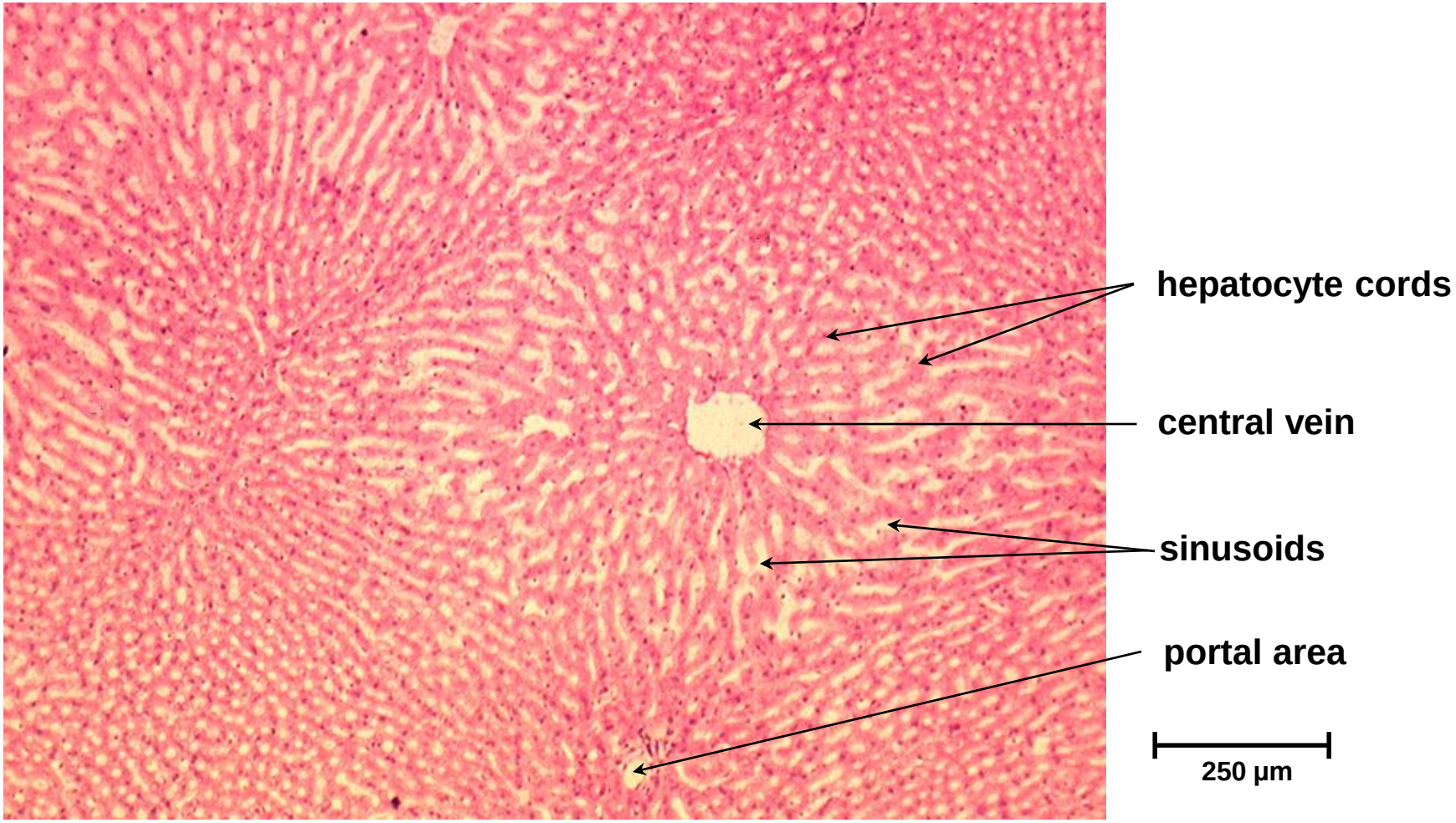
P : pericytes

A : adipocytes

Adult liver

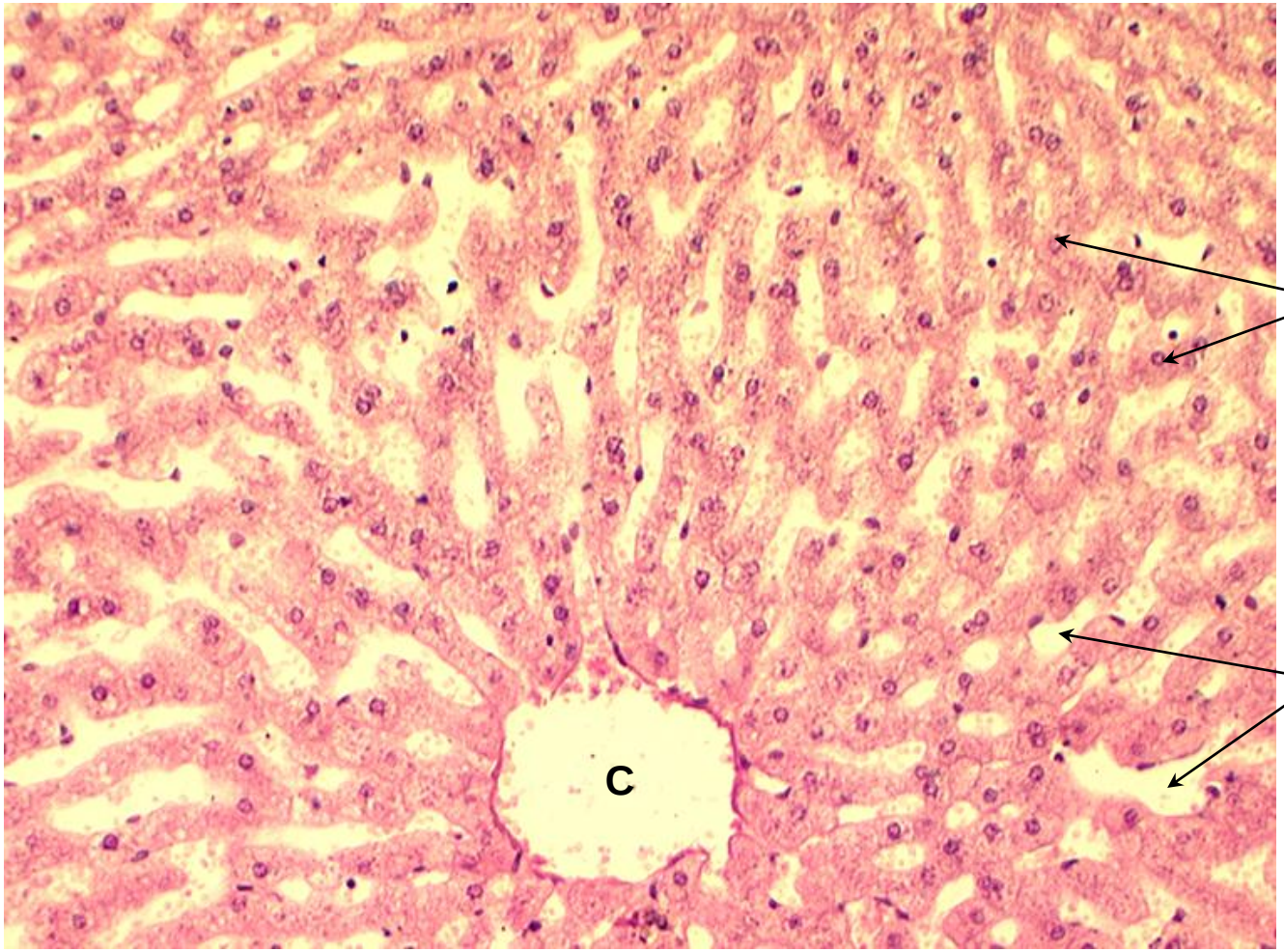
Sinusoids in liver lobules.

Hepatocytes form cords of cells with at least one surface against a sinusoid.



Adult liver

Sinusoids in liver lobules.



Capillaries and sinusoids

State three differences between sinusoids and capillaries.

1 . Sinusoids usually larger and more varied shape than capillaries.
2. Sinusoids may be fenestrated, have gaps and pores in the endothelium.
3. They have a discontinuous basal lamina.

What structures connect individual endothelial cells?

Gap or tight junctions.

Capillaries and sinusoids

What is an arteriovenous anastamosis?

A by-pass of the capillary bed between an arteriole and a venule.

How do capillaries resist collapse?

Arteriole blood pressure maintains capillary shape.

In which vessels are valves found, and why?

In some veins. Particularly those draining the limbs.

They prevent backflow and back pressure.