

Extra notes for lab- 1 histology

Slide 1 : cross section in the elastic artery (aortic arch , ascending aorta , descending aorta)

- twin of ascending aorta is the pulmonary trunk . Ascending aorta **represents** the cardiac output from the left ventricle.

-Elastic artery in this section is stained by H and E >> we cannot differentiate between the different components especially of the media (smooth muscle , collagen , elastic) because it is at low magnification .

- The main part in this section(aorta) is the media .

Slide 2 : here , at larger magnification . we can see that media contains nuclei of smooth muscles and the cytoplasm is located around the nucleus .

- We can't differentiate between collagen, elastic lamina and smooth muscle .

- Elastic lamina are in the form of wavy lines (cut crosswise)

- Using H and E, difficult to differentiate smooth muscle collagen and elastic .

- How can we define the smooth muscle ? they are around the nucleus.

* In the exam , the Doctor may points to the nucleus and ask you that this nucleus or cell (smooth muscle cell) produces the surrounding tissues ?

True >> collagen and elastic tissues are produced by smooth muscle cells

- Function of the elastic tissue (which is the major component of the media) :

1) expand during systole and recoil during diastole >> converts intermittent blood flow produced by left ventricle (intermittent because the blood is pumped only during systole) to continuous blood flow .

2) maintains the diastolic blood pressure

Slide 3 : another larger magnification

-We can see the nuclei of smooth muscle cells surrounded by cytoplasm.

-Also , we cannot differentiate between collagen and elastic

Slide 4 :

-Vasa vasorum : Blood vessels in the adventitia (vessel of the vessel).

-Function of vasa vasorum is to supply the adventitia with blood , nutrients and O₂ (because it can't be done by diffusion) .

-Vena cava which is large vein with thin wall needs vasa vasorum more than artery because the blood inside it is poorly oxygenated and contains little nutrients .

So , it depends on the thickness of vessels (+ve) and much more on the blood and nutrients inside these vessels (- ve) .

-Artery is riched by blood and nutriens >> little of vasa vasorum

-Elastic artery contains vasa vasorum more than muscular artery >> because elastic artery is thicker than muscular artery

-Large veins have less blood and nutrients >> more vasa vasorum

Slide 5 : here we used differential stain which is Masson's trichrome stain

-It stains elastic fibers black (we can see that black color is predominant in the media because elastic tissues is the major component of the media).

-It stains collagen bright green and stains smooth muscles red.

Slide 6 : this is at larger magnification .

- Black wavy lines are elastic laminae cut crosswise and in between there is little green (collagen) and red color (smooth muscles) .

-By this trichrome stain we make sure that the media is consist of 3 components and the major one is fenestrated elastic lamina (40-70 layers) .

-May be in the exam . which of these color is responsible for maintenance of diastolic blood pressure ? black color (elastic tissue)

-Which of these color responsible for production of these components ? red color (smooth muscles).

Slide 7:

-The media is mostly black (elastic tissue) while the adventitia is mostly green because its mostly collagen with some elastic fibers .

-Also here we see a small blood vessel which is vasa vasorum .

Slide 8 : here we used another differential stain (Van Gieson stain)

- Here it is not carefully stained

-It stains elastic laminae blue to black

-It stains smooth muscles yellow to brown

-It stains collagen red

Slide 9 : here we have it at higher magnification and carefully stained .

-We can see many elastic laminae (black color)

Slide 10 :

- Here we will compare medium sized artery and vein placed beside each other .

-Medium sized vein >> large lumen , then collapsed wall , the major and thickest layer is adventitia , media is less thick .

-Medium sized artery or muscular artery >> small lumen , thick wall , the major and thickest layer is media , adventitia is nearly equal or less than the media .

-We call these medium sized arteries **distributing arteries** :

- When smooth muscle constricts under the effect of sympathetic NS > constriction of lumen decreases blood flow or passing
- when smooth muscles relax or dilates > increase blood flow or passing .

-We call these medium sized vein **capacity veins** :

Accommodate large volume of blood under low pressure(compliant مطاوعة)

- Which makes it compliant (high expand , little recoil) ? presence of numerous collagen in the adventitia .

Slide 11 : at higher magnification

-We can recognize smooth muscle from the nucleus . each dot and it's surrounding represent a smooth muscle .

-Again , In the artery the adventitia is nearly equal or less than the media, while in the vein the adventitia has the major thickness .

Slide 12 : at higher magnification of medium sized artery

-Small dots (nuclei of endothelium) > intima > little sub endothelial tissues > tortuous line (internal elastic lamina) .

- This line distinguishes muscular artery but may be seen in the veins .

This line also separates intima from media .

-Many smooth muscle layers (more than 10)

- ARTERIOL (1-4 LAYERS) , SMALL ARTERIOL (ONE LAYER)

- we can see little of adventitia

- external lamina is not clear . mostly when there is one or two layers of internal elastic lamina , external elastic lamina will be more layers

So, we say internal elastic lamina and external elastic laminae

Slide 13 : here at higher magnification .

-Typical medium(muscular) sized artery .

-Dots are nuclei of endothelium .

-Tortuous line is internal elastic lamina which is outer board of intima .

-Media is consist of numerous layers of smooth muscles > artery (never an arteriole) .

- The space between smooth muscle layers is much little , while in veins the space large due to the presence of collagen
- We can see outer board of the media which are external elastic laminae That's why we say typical because we can see both internal lamina and external laminae .
- Smooth muscles in the wall of artery r richly supplied by sympathetic NS

Slide 14 :

- Clear internal elastic lamina and unclear external elastic laminae , in between of them media and adventitia .

Slide 15 : same as previous slide but at higher magnification .

Slide 16 : muscular artery stained with Masson's trichrome .

- We can see both internal and external elastic laminae (many dense black layers) at each outer boarder of the intima and media of the muscular artery .

- Sometimes , internal elastic may be bifid > so we call laminae .
- Red color in the media > smooth muscles
- Green color in the media > collagen
- Little worm like black lines in the media > elastic fibers .

Slide 17 : we return back to the medium sized **vein**

- Intima is not clear
- Media is less thick
- Adventitia is more thick

* Both media and adventitia are filled with collagen

* Difference between collagen and elastic ?

Collagen > expand with little recoil (compliant property)

Elastic > expand and recoil

Slide 18 :

- We can see incomplete internal elastic lamina

-Media > consists of 3 layers of smooth muscles and collagen in between
-Adventitia > major layer , rich in collagen .

- Medium sized veins in the body stored about 65% of blood , because they diastole large volume of blood under low pressure (compliant).
- veins are more compliant than artery .

Slide 19 :

Arterioles and venules are similar to their parents , the muscular artery and vein respectively .

Large Venule

→ Large lumen , thin wall (while arteriole has small lumen , thick wall)
→ Post capillary venules are formed by the union of several capillaries .
→ Diameter is from 10- 50 . toward 50, will appear of smooth muscles in the wall .
→ Large venule >>> has incomplete layer of smooth muscles
→ Small vein >>> has complete layer of smooth muscles
→ Both small and large venules have same function , which is similar to capillaries > > > exchange of substances across the wall of venule . but the most important function is diapedesis (movement of WBCs from blood to tissues via wall of venules) .

Large arteriole

→ Arteriole could be small (one layer) or large (4-5)
→ Small lumen and thick wall .
→ We can see Internal elastic lamina (tortuous line) , but we can't see in small one .
→ We can see Media and adventitia .
→ Most important feature of arteriole that it's circular smooth muscles when contract >>> narrow lumen >>> increase resistance to the blood flow (not to prevent passing of blood to the tissues , but for production of pressure gradient from 93 to 37) . so we call it major resistance vessel

These smooth muscles are richly supplied by sympathetic innervations.

→ Pre capillary sphincter and met arterioles are poorly sympathetic ,
They are influenced by metabolites more than sympathetic innervations.

- Peripheral resistance maintains arterial blood pressure .
- Veins and arteries have a little resistance . the major one is small arterioles .
- Small arterioles is the major one that responsible for resistance because it is already contracted , but large arterioles contract during sympathetic innervations .
- Cardiac output depends on both blood flow and resistance .
- If patient comes to the hospital with extensive decrease in blood pressure 70/30 (shock , may be comma) , first we must ask for his history .
 - if he suffers from excessive loss of fluid and blood as in duodenal ulcer (here in duodenal ulcer we can't see the bleeding because it is internal , but can we use blood pressure as an indicator)
>>>>treated by giving him fluid and blood .
 - if he suffers from sensitivity to certain drug as penicillin , here the decrease in blood pressure is due excessive vasodilatation produced by anaphylactic reaction >>> excessive histamine >>> vasodilation >>> decrease blood pressure . treated by anti-histamine drugs or drugs act as vasoconstriction .

Slide 20 : large arteriole at higher magnification .

- 4 layers of smooth muscles .
- Internal elastic lamina and adventitia .

Slide 21 : superficial vein (long saphenous)

- From foot to the end of thigh . during standing >>> compression on the wall of vein >>> become weak .
- compensatory mechanism :
 - 1) smooth muscle in media and collagen in between reinforce the wall (when they contract cause constriction of the lumen) .

2) more important and for further reinforcing , there is a longitudinal smooth muscles in the adventitia (when they contract , constriction of the lumen will not be occur).

- superficial vein has valves and longitudinal muscles in the adventitia .

Slide 22 :

Media >>> smooth muscles and collagen .

Adventitia >>> longitudinal smooth muscles cut crosswise .

Slide 23 : at higher magnification

Media >>> smooth muscles and collagen .

Slide 24 : at higher magnification

Adventitia >>> longitudinal smooth muscles cut crosswise .

Green color >>> collagen

Slide 25 : microcirculation

-Arterioles >>> capillary >>> venules

-Capillary has very simple structure .

-We can see nucleus of endothelium surrounded by little cytoplasm

-We can't see the basal lamina

-3 types : fenestrated , continuous and discontinuous capillaries.

-Has 2 ends : arterial (37 mm Hg) and venous (17 mm Hg)

Old theory : at the beginning >>> more filtration than reabsorption ,
at the end >>> more reabsorption than filtration .

- Pre capillary sphincter is responsible for determining when filtration and reabsorption occur .
- When it opened >>> blood flow from arterioles to the capillaries >>> increase blood pressure inside capillaries >>> filtration occur at both ends .
- When it closed >>> less blood reach the capillaries >>> decrease blood pressure inside capillaries >>> reabsorption occur at both ends .

- There are two major forces , blood pressure (driving force by hydrostatic BP) and colloid osmotic pressure (withdrawing force)
- There is a very little plasma proteins in tissues because there is no filtration for them .

Slide 26 :

Venules , they have thin wall .

Slide 27 : cardiac muscle

Differs from skeletal muscle by the branching fibers

Slide 28 :

- we see the muscle fibers branching and this character is not found in skeletal muscles
- In cardiac muscle >>> the fiber consists of group of cells
- skeletal muscle >>> the fiber consist of one cell .
- Group of cells joined together by intercalated disc .
- The most important component of intercalated disc is gap junction.
- Gap junction >>> functional syncytium
- The nucleus of cardiac muscle is single and central placed , while in skeletal muscle it is multinucleated and peripheral placed.

Slide 29 :

- Single nucleus central placed
- fiber consists of many cells

Slide 30 :

-This is a cross section of the cardiac muscle fibers , the cells that appear without a nucleus are cut at their sides that's why their nuclei don't appear (its located at the center).

Slide 31 : intercalated disc with special stain

-We can see branches and lines crosswise which they are intercalated disc . if we look closely we can see cross striations (found in both

skeletal and cardiac muscles) indicates there is fibril >> filaments >> actin and myosin .

- Filaments arranged in the form of sacromere . board of sacromere z-z
- Intercalated discs have desmosomes that connect cell membranes to each other (separate cells from each other) . it also have gap junctions (area of low electrical resistance) and they permit flow of ions (electrical current) between cells .

Slide 32 : same as the previous slide

Slide 33 : same as the previous slide

Slide 34 : purkinje fibers

- Cardiac muscle has two main parts :
contractile >>> muscle contraction .
conductive >>> modified or specialized cardiac muscle fibers called purkinje fibers) .
- purkinje fibers are various in size .
- The heart has a conductive system for cardiac impulse (action potential): SA node ,AV node , AV bundle ,right and left branches of AV bundles (from which the Purkinje fibers branch), Purkinje fibers .
- Purkinje fiber is the largest and fastest part of conductive system .

Slide 35 : at higher magnification

- purkinje fibers are located beneath the endocardium .
- We can see the nucleus and it might be binecleated .
- Stained densely at peripheral and slightly at center .
- Larger and thicker than the normal cardiac muscle .
- most important characteristic is that it has little fibrils (fibers >fibrils> filaments actin and myosin) located at the peripheral and lots of glycogen >>> that's why it stained densely at peripheral .

- desmosomes and gap junction are present .
- T tubules are not present .
- purkinje fibers are numerous in intervenricular septum beneath the endocardium and near to the lumen .
- it's function >>> rapid conduction of action potential to the wall of ventricles .

* Slide 36 and Slide 37 are same as the previous slide .

