CUS Histology Summary - Mays Muamar

Histology of Cardiovascular System:-

Layers of the walls of heart chambers:

1] Endocardium [Internal]
- thin inner layer ⟶ endothelium
- middle myoelastic layer ⟶ smooth muscle fibers
  ⟶ connective tissue
- deep (subendocardial) layer ⟶ CT
  ↳ merges with myocardium ⟶ purkinje fibers

2] Myocardium
- thickest layer
- cardiac muscle + its fibers arranged spirally around each heart chamber
- thicker in ventricles (particullarly the LV)

- cardiac muscle fx:
  1. contraction ⟶ ordinary fibers
  2. conduction ⟶ conducting system
  3. secretion ⟶ ANP [Atrial Natriuretic Peptide]
     ↳ ↓ of ECF volume by ↑ renal sodium excretion [reduces edema]

- Purkinje fibers ⟶ modified cardiac muscle
  ⟶ pale-staining, larger than contractile muscles
  ⟶ ↓ peripheral myofibrils, ↑ glycogen

3] Epicardium
- simple squamous mesothelium
- supported by loose CT containing BVs & nerves
- epicardium ≈ visceral layer of pericardium
- reflected back as the parietal layer where large vessels enter & leave the heart
- serous mesothelial cells produce a lubricant fluid to prevent friction within pericardium

BV Classification & Structure:

1. Arteries	Transport blood away from heart	thick walls, narrow lumen
2. Veins	Return blood to the heart	thin walls, wide lumen, valves
3. Capillaries	Surround tissues for exchange	endothelial layer + basement membrane only

* Walls of BVs (except capillaries) contain smooth muscle & CT (in addition to endothelial lining).

↳ amount & arrangement of tissues in vessels depends on:
1. mechanical factors (BP)
2. metabolic factors (local needs of tissues)

Histological Structures & Characteristics of BVs

1] Tunica Intima (≈ endocardium)
- endothelium ⟶ simple squamous
  ⟶ smooth surface for blood flow

- sub-endothelial layer ⟶ loose CT

- internal elastic lamina [most external component]
  ↳ elastin + holes ⟶ better diffusion
  ↳ prevents complete occlusions of vessels during contraction

- endothelium ⟶ semipermeable barrier btwn blood & interstitial tissue fluid

  ⟶ vascular endothelial cells: squamous, polygonal, elongated, long axis in direction of blood flow

  ⟶ fx of endothelium:
  1. Selective permeability
  2. anti-thrombogenic
  3. WBC migration regulation
  4. Secretion of paracrine factors (dilation, constriction, cell growth)

2] Tunica Media
- smooth muscle fibers ⟶ circularly arranged
- elastin, collagen, proteoglycans, glycoproteins
- external elastic lamina ⟶ in arteries only, which is why veins collapse but arteries don't.

3] Tunica Adventitia
- ↓ elastic fibers
- continuous with the CT of the organ through which the vessel runs
- vasa vasorum ⟶ supply adventitia + periphery of media

  ↳ needed when vessel wall is too thick to be supplied by diffusion

  ↳ large veins have ↑ vasa vasorum than arteries

Arteries

large (elastic) - medium (muscular) - small (arterioles)

- large (elastic) → largest media
- medium (muscular) → largest adventitia
- small (arterioles) → smallest in all aspects

1] Large (elastic/conducting) arteries

- major role → "conduct" blood to smaller arteries
- elastic lamina in their media
- thick walls, wide lumen
- stretch to accomodate ↑ BV
  recoil to maintain BP in ↓ BV

① Common Carotid (head & neck)

② Common Iliac (LL & pelvis)

③ Aorta + largest main branches
- Tunica Intima → thin
  - ↳ endothelium
  - ↳ subendothelium
    [smooth muscle, elastic fibers, collagen]
  - ↳ Internal elastic lamina
    present but indistinct → merges with elastic membranes in tunica media
- Tunica media → v. thick
  - ↳ main component: 40-60 concentrically arranged elastic laminae
  - ↳ elastic lamina, fibroblasts, elastic fibers, collagen, ↓ smooth muscle cells.
- Tunica adventitia → thin
  - ↳ mainly: collagen
  - ↳ vasa vasorum, nerves, elastic fibers, fibroblasts

2] Medium (muscular/distributing) arteries

- Distribute blood to organs
- Regulate BP by contracting/relaxing
- ↑ smooth muscle in media
- thick wall, narrow lumen
  ↓
  need to be able to: ① pump blood
  ② Withstand arterial BP
- Tunica Intima → thin
  - ↳ endothelium: simple squamous on basal lamina
  - ↳ subendothelium
  - ↳ Internal elastic lamina: prominent
- Tunica Media → thick
  - ↳ up to 40 concentric layers
  - ↳ reticular + elastic fibers
  - ↳ ICM: proteoglycans + glycoproteins
  - ↳ external elastic lamina
- Tunica Adventitia → thick
  - ↳ 1/2 thickness of media
  - ↳ collagen, elastin, fibroblasts, adipose cells, nerves

① Ulnar Artery ② Radial Artery

3] Arterioles

- Indicate beginning of an organs microvasculature
- Only 1 or 2 smooth muscle layers
- Lumens as wide as the wall is thick
- Sub-endothelial layer is very thin
- elastic lamina is absent
- media → circularly arranged smooth muscle cells
- adventitia is v. thin
- they are the major determinants of systemic BP

Veins

1] Inferior Vena Cava

- very wide lumen with many valves
- Tunica Intima
  - ↳ endothelium
  - ↳ sub-endothelium → thick
  - ↳ Internal elastic lamina → absent
- Tunica Media → thin
  - ↳ ↓ circular smooth muscle cells ↑ CT
  - ↳ no external elastic lamina
- Tunica Adventitia → most thick
  - ↳ longitudinal smooth muscle bundles
  - ↳ ↑ vasa vasorum & lymphatics
  - ↳ valves (endothelium + core of CT)

Medium Sized Artery vs. Medium Sized Vein

Wall	thick	↑	↓	thin
lumen	narrow	↓	↑	wide
Intima	thicker	↑	↓	thinner
Media	thicker	↑	↓	thinner
I. elastic lamina	present	✓	✗	absent
Adventitia	thinner	↓	↑	thicker
Valves	absent	✗	✓	present

Capillaries

* Simple layer of endothelial cells ⟶ rolled up as a tube ⟶ surrounded by BM
* Nuclei ⟶ oval & bulge into lumen of capillaries
* ↓ diameter ⟶ allows for transit of blood only one at a time
* surrounded by pericytes ⟶ present along capillary walls
* has only tunica intima
* grouped into 3 histologic types ⟶ depending on continuity of endothelial cells & their BM (appearance under the microscope)
  1. continuous
  2. fenestrated
  3. discontinuous

1] Continuous Capillaries

- Tight junctions ⟶ continuity + well-regulated metabolic exchange
- m.c found in: muscle, CT, lungs, exocrine glands, nervous tissue, skin
- least permeable ⟶ inf x can't get in

2] Fenestrated Capillaries

- Rapid diffusion ⟶ but with control
- "sieve-like" structure
- penetrated by fenestrations
  ↳ some are covered by thin diaphragms of proteoglycans
- BM ⟶ continuous & covers fenestrations
- m.c in: kidneys, intestines, endocrine glands [organs with rapid interchange of substances btwn tissues & blood]

3] Discontinuous [sinusoidal] capillaries

- maximal exchange of macromolecules
- easier movement of cells btwn tissues & blood
- large perforations without diaphragms
- discontinuous membranes } slow blood flow
- ↑↑ diameter
- large intercellular clefts
- liver, bone marrow, spleen