

# CH 20: The Cardiovascular System: Blood Vessels

## Key Concepts:

- ❶ Describe the histological similarities and differences of the blood vessels
- ❷ Explain the pattern and names of the major arteries and veins of the pulmonary & systemic circulations
- ❸ Describe the circulatory changes that occur at birth.

Developed by  
John Gallagher, MS, DVM



# The Circuits

## Pulmonary Circuit:

From the “Right Heart” to the Lungs

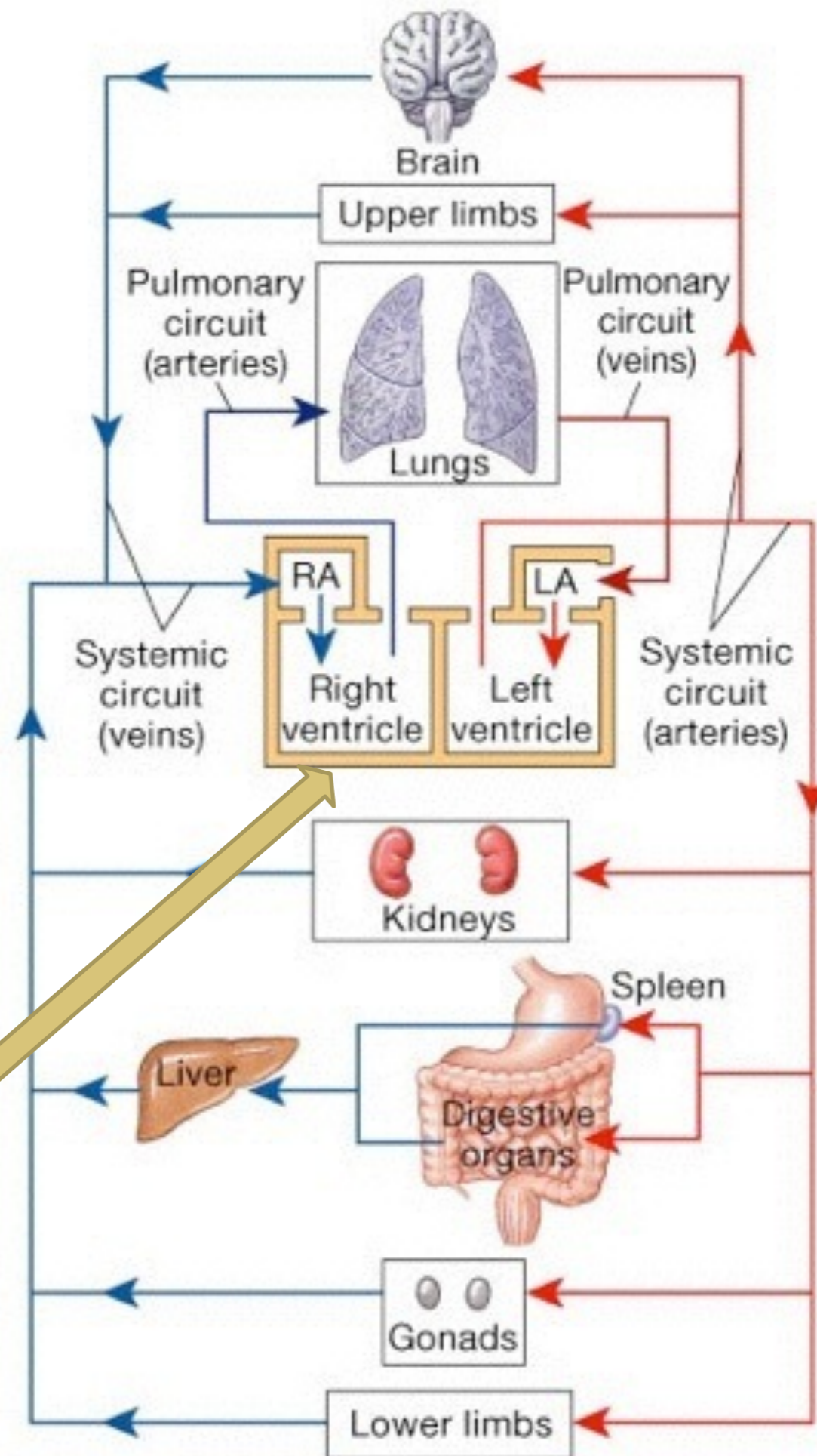
## Systemic Circuit:

From the “Left Heart” to Everywhere Else

65 -70% in veins (= blood reservoir); lumen is larger than in corresponding arteries

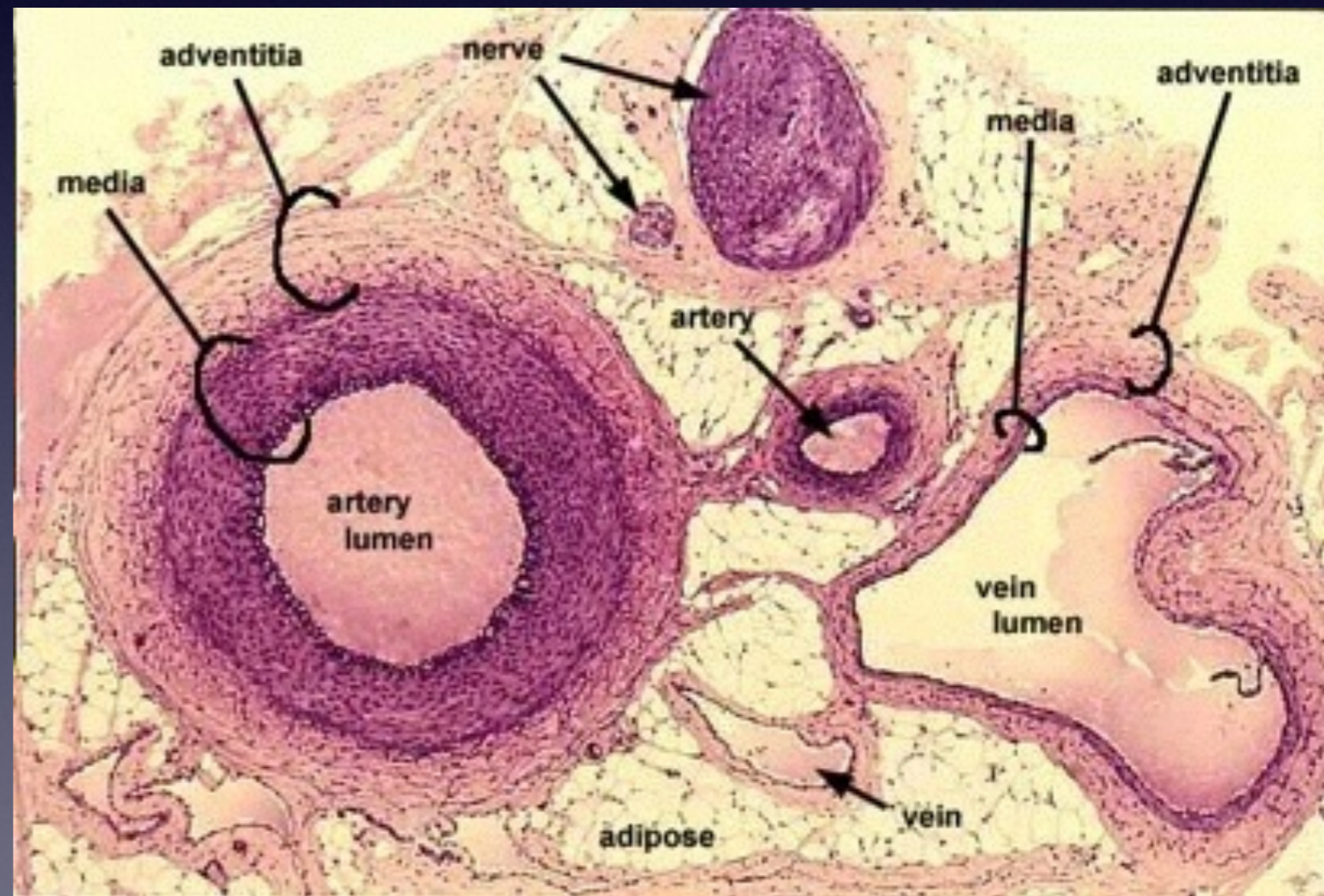
30-35% in heart, arteries and capillaries

N.B. The chambers pump the same VOLUME, approx 35 cc.



# Histology of Blood Vessels

1. Tunica interna or intima (endothelium + c.t.)
2. Tunica media (muscle + c.t.)  
Much more smooth muscle in arteries
3. Tunica externa or adventitia (thick layer of c.t.)
4. Vasa vasorum (p 588)



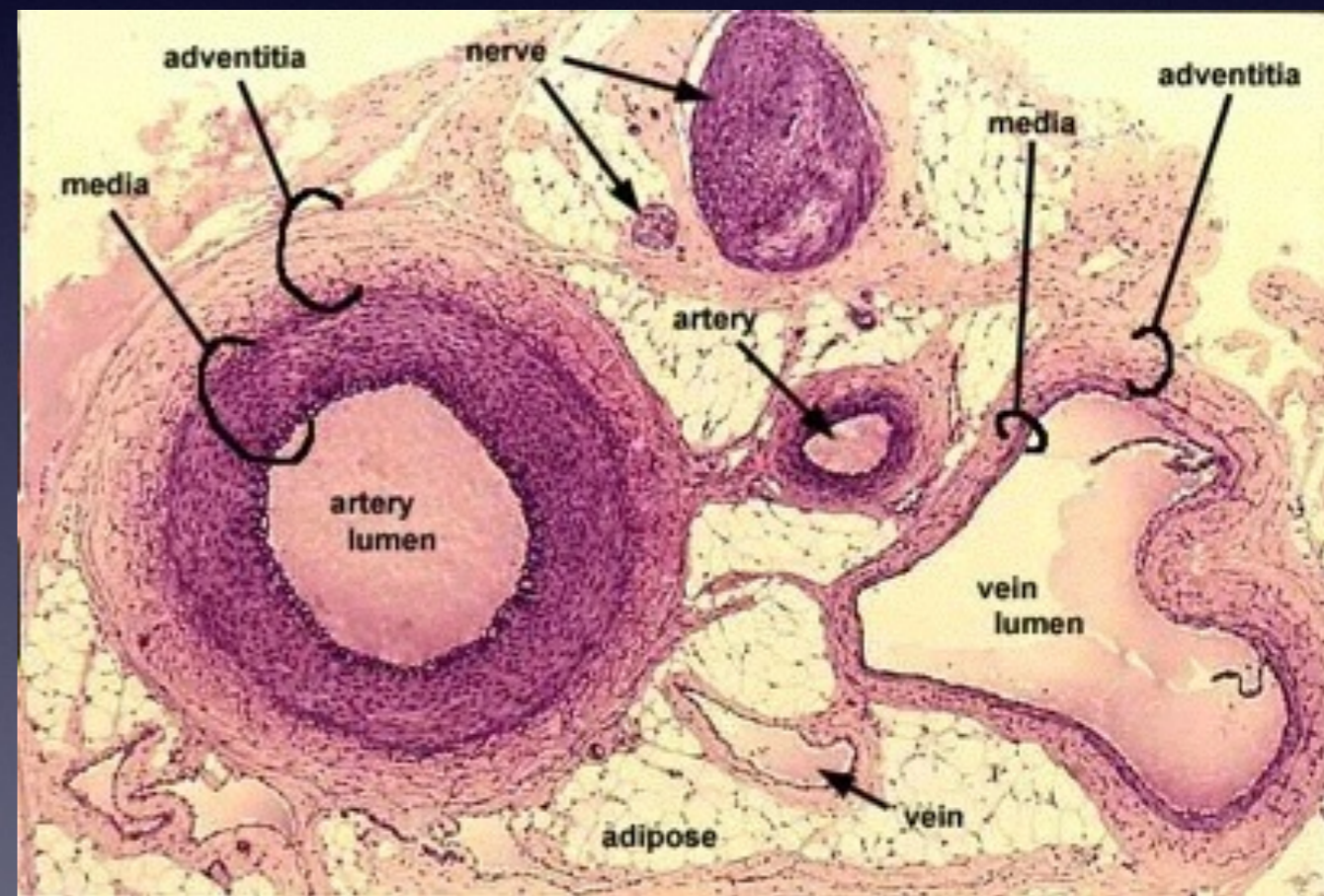
# Histology of Blood Vessels

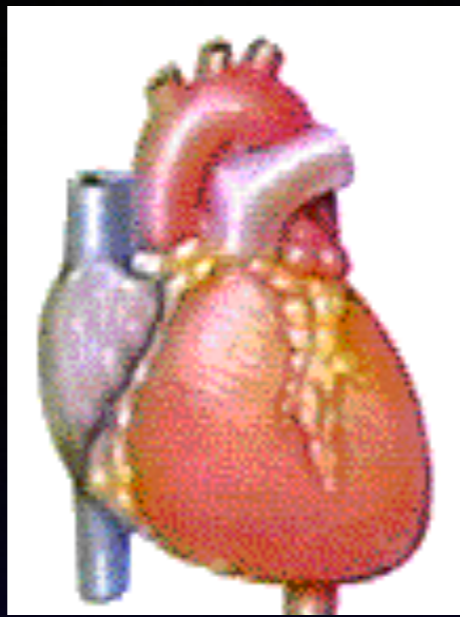
## Distinguishing Arteries from Veins:

- Artery walls thicker (more muscle and elastic fibers), smaller lumen
- Additional: internal & external elastic membranes

Artifacts when fixing slides:

- Arterial walls contract; endothelium cannot contract: pleated appearance
- Veins collapse in fixation



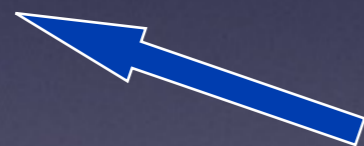


large vein

medium-sized vein



venules



capillaries



elastic arteries



muscular arteries



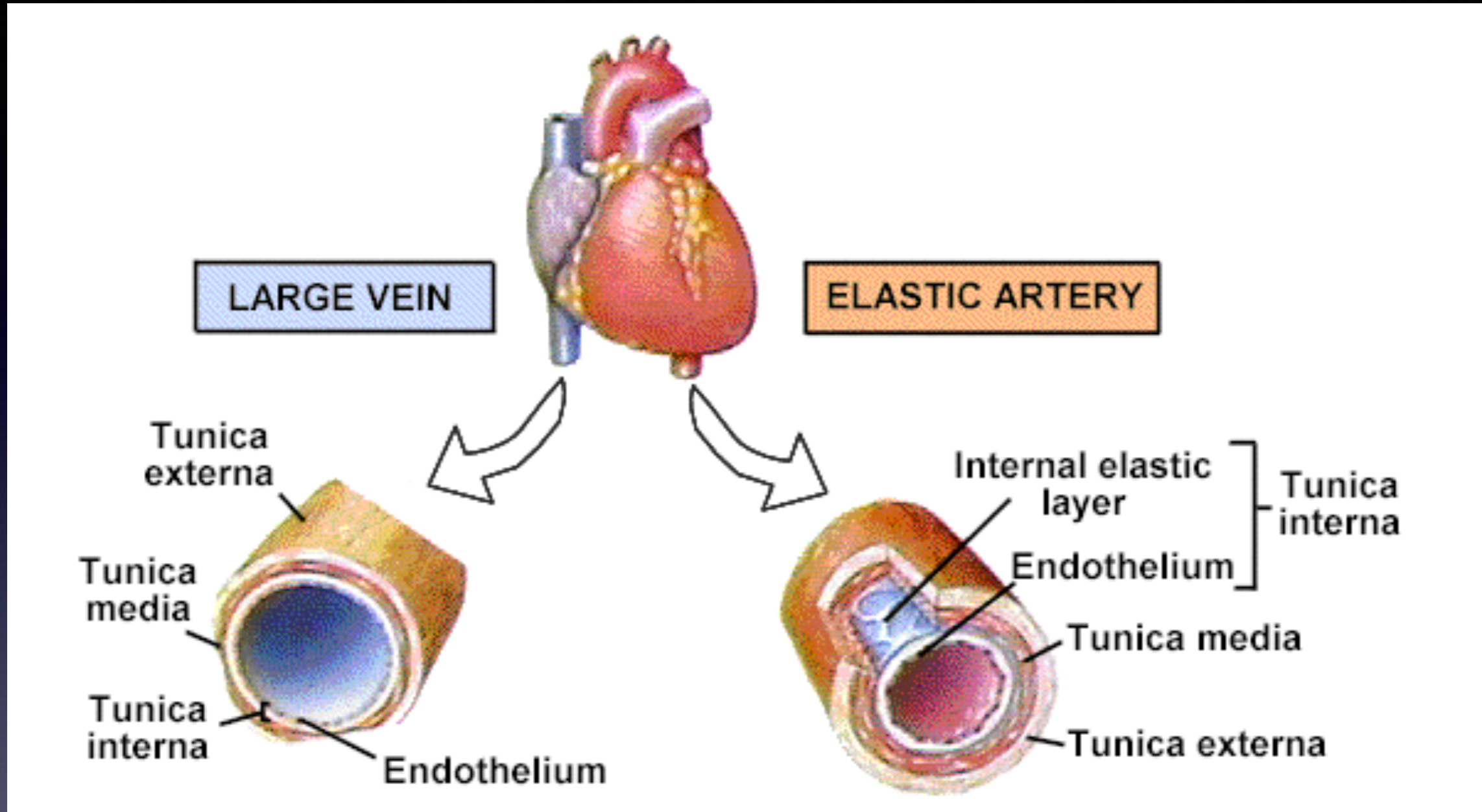
arterioles



Arteries – ALWAYS carry blood away from heart

Veins – ALWAYS return blood to heart,  
contain about 2/3 body's blood at any given time

lead  
high

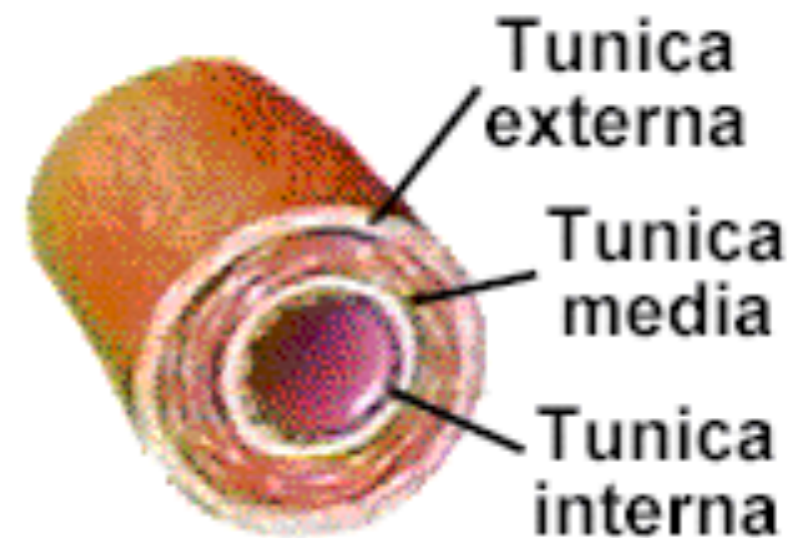
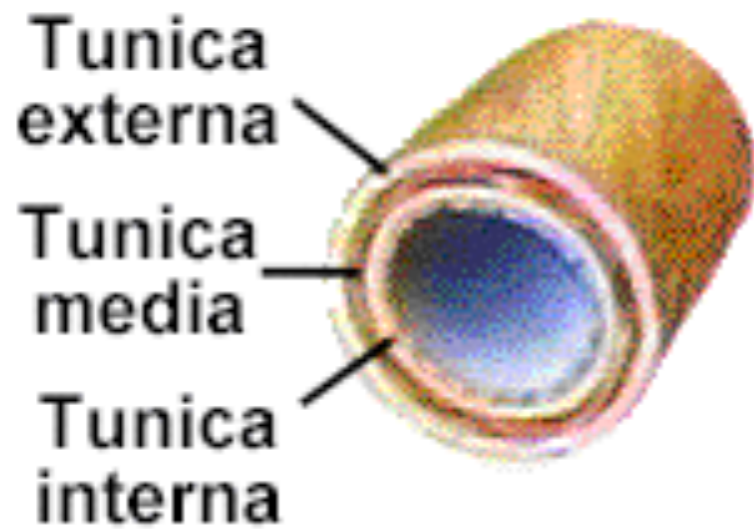


Superior & inferior  
vena cava and their  
tributaries

Pulmonary trunk & aorta  
and their major branches

**MEDIUM-SIZED VEIN**

**MUSCULAR ARTERY**

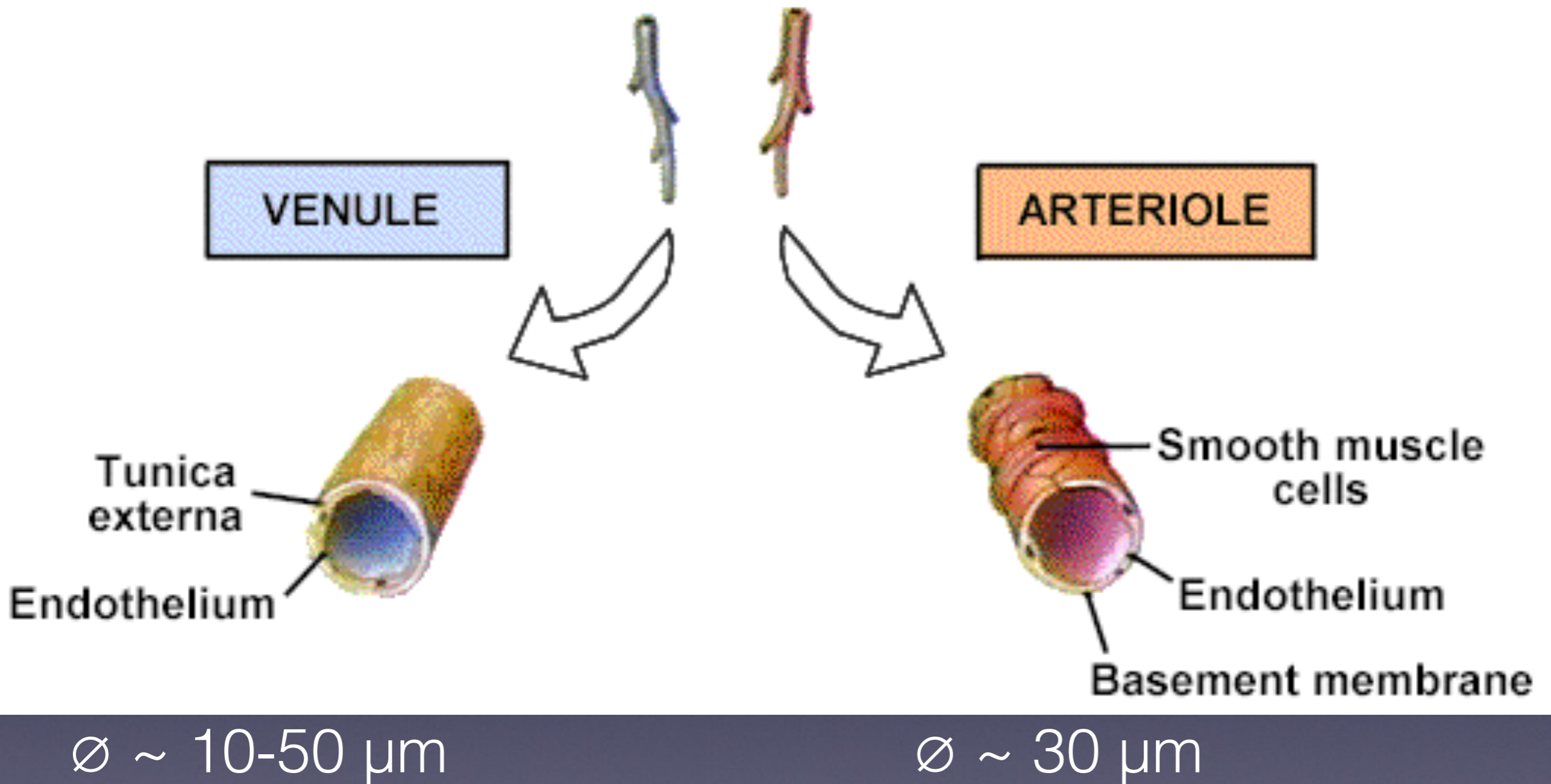


Ø 2 - 9 mm

Ø ~ 4 mm

External and internal jugular,  
brachial & femoral veins

External and internal  
carotids, brachial & femoral  
arteries







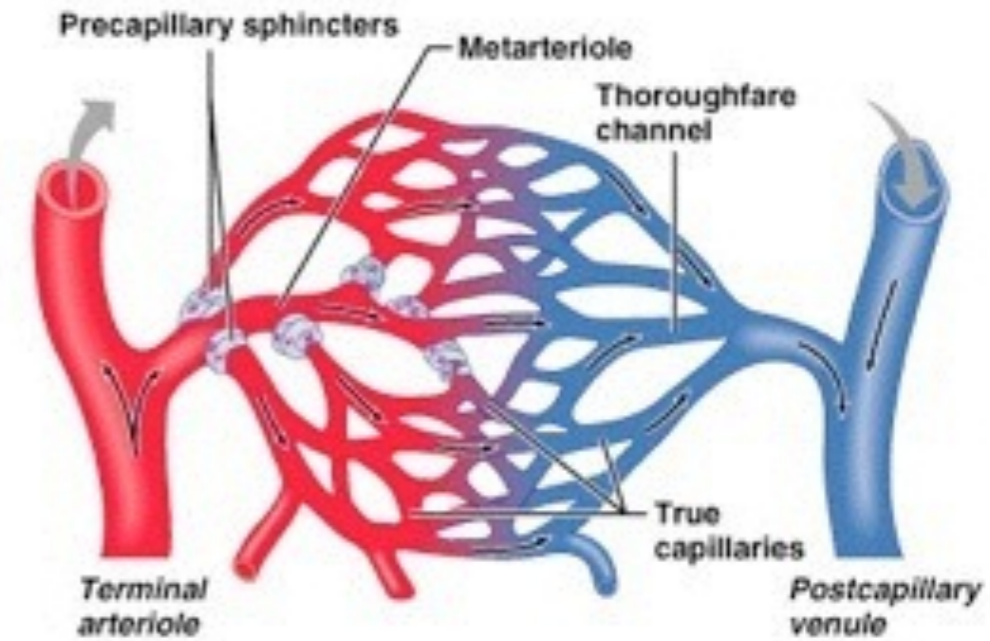
Remember: RBC  $\sim 7 \mu\text{m}$



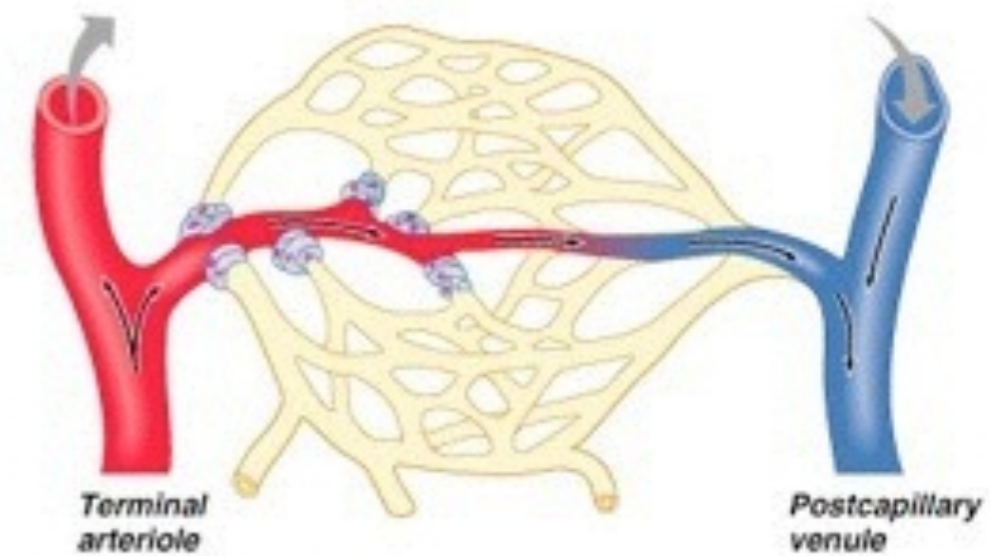
Fig 20.5

# Capillaries

-  The smallest
-  Only vessels that allow exchange
-  Diffusion or active transport
-  Precapillary Sphincters regulate flow and blood pressure



(a) Sphincters open

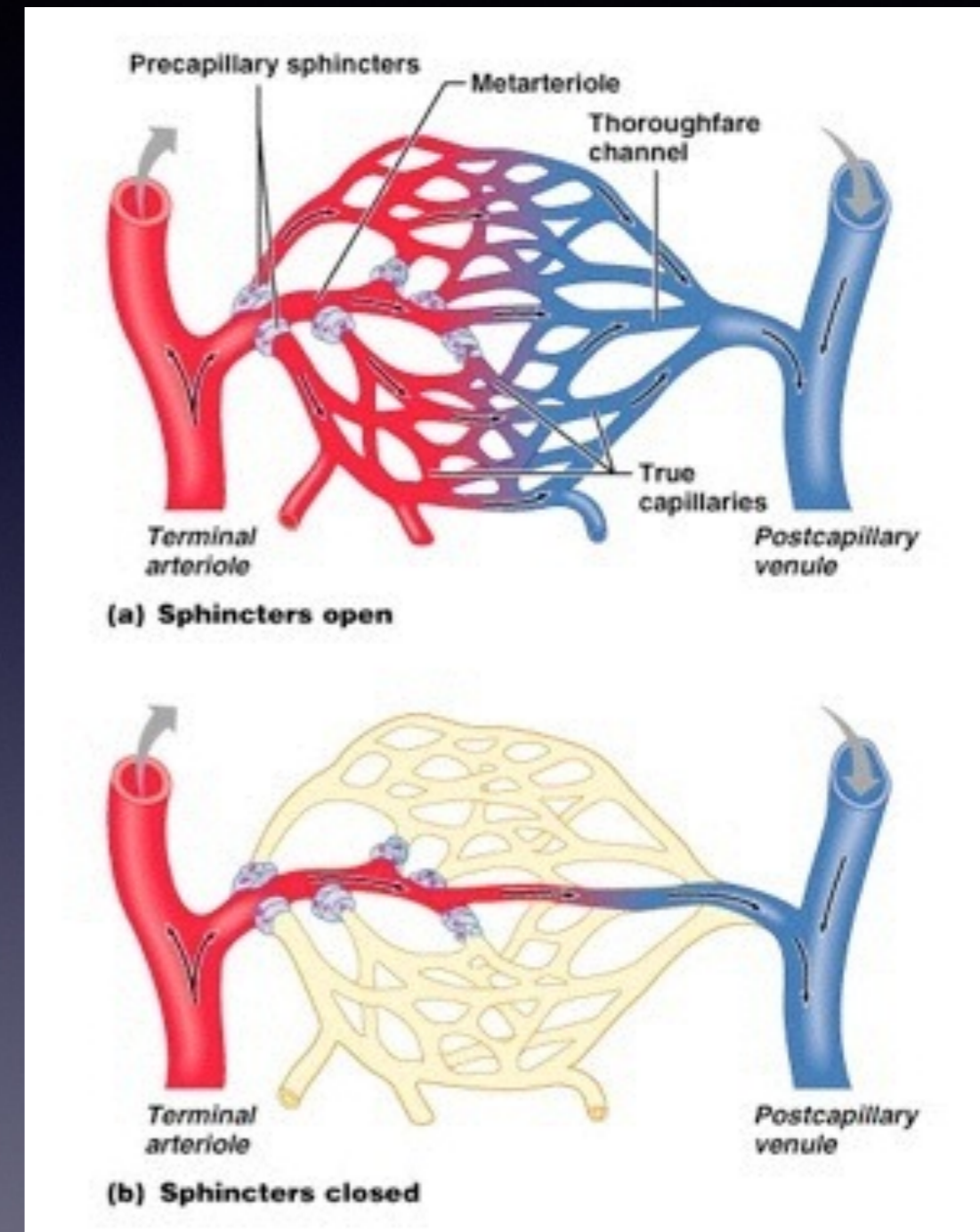


(b) Sphincters closed

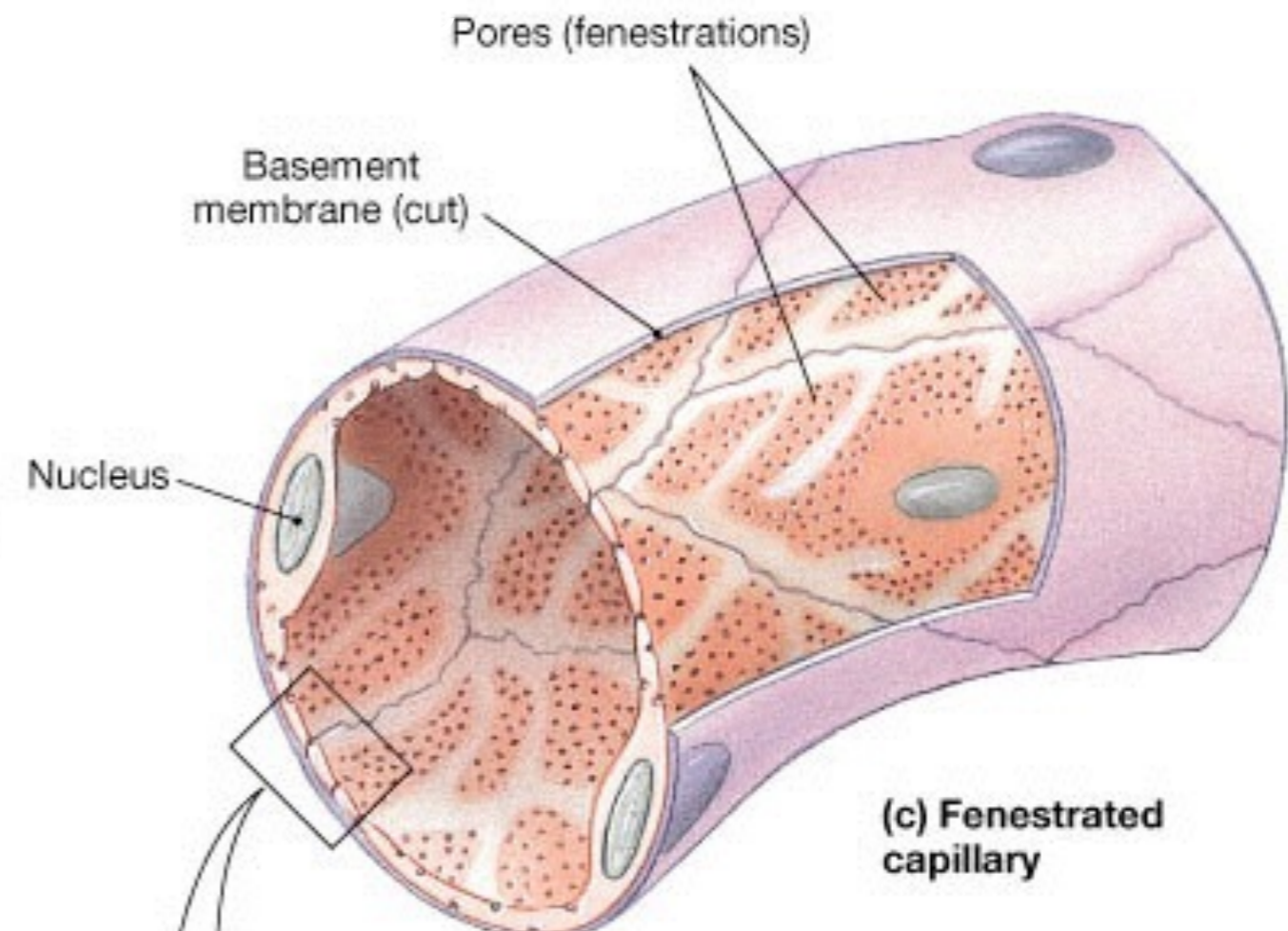
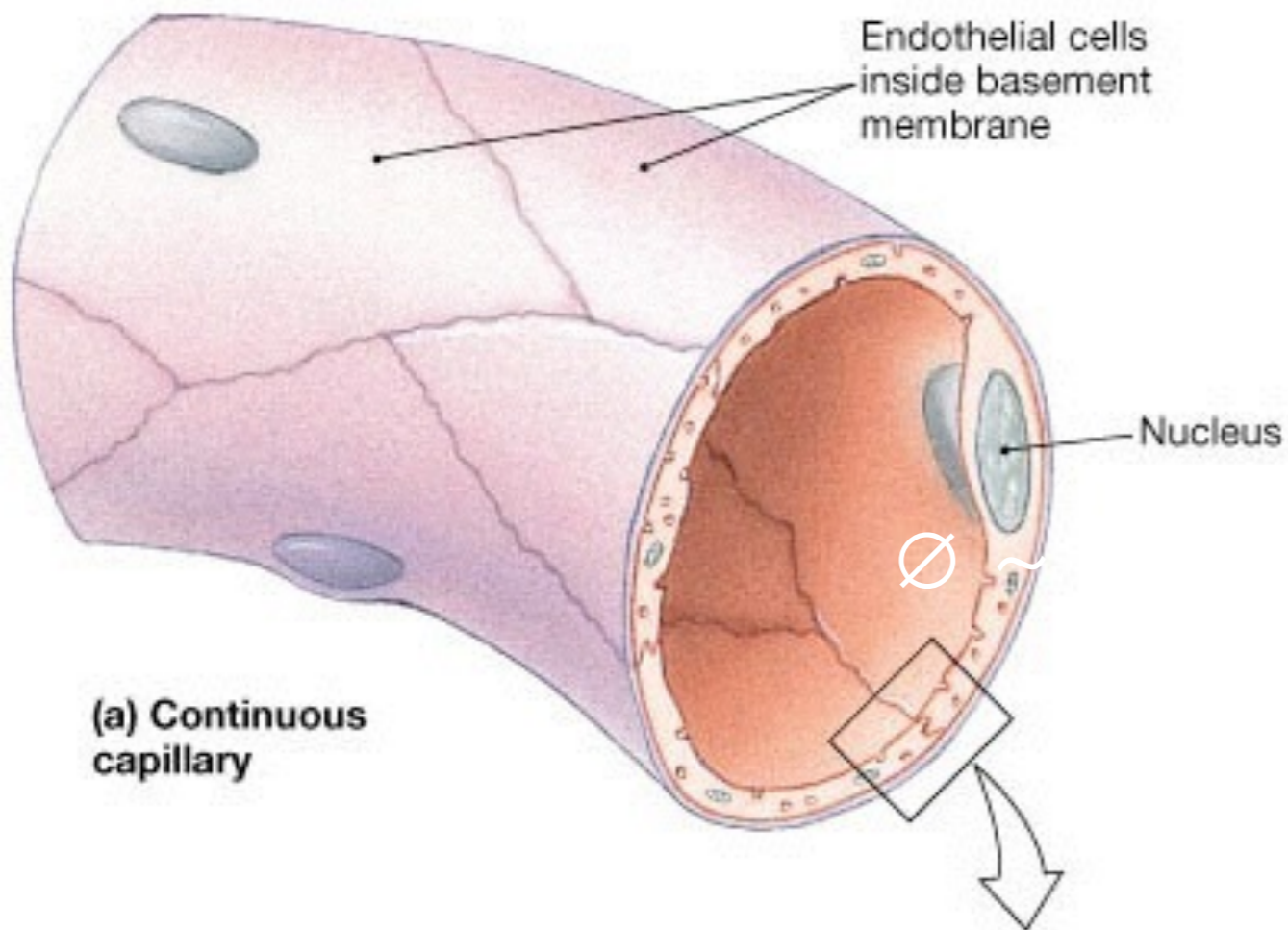
Fig 20.5

# Capillaries

- ☒ Simple squamous epithelium; This kind of epithelium is sometimes called an 'endothelium' because it does not face the world outside the body
- ☒ Continuous, fenestrated, or sinusoids
  - ☒ Permit increasing exchange
- ☒ Capillary Beds (plexuses)

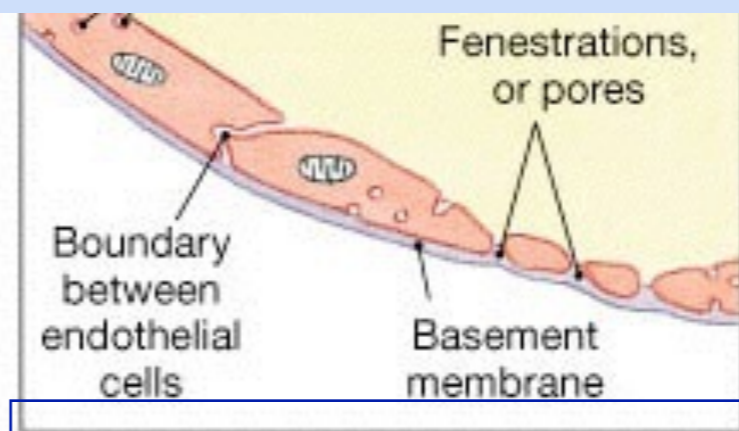
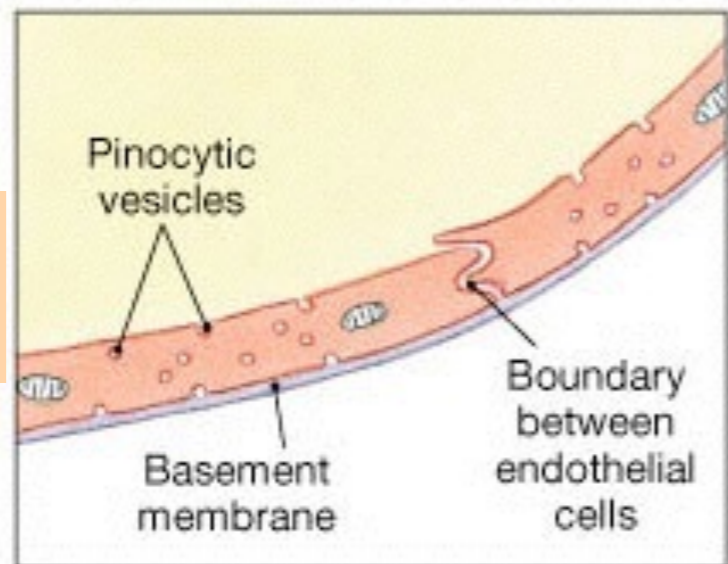


[Capillary flow](#)



Characterized by circular fenestrations or pores that penetrate the endothelium - permit exchange of larger molecules.

somewhat permeable



Most body regions

Intestinal mucosa, choroid plexus, endocrine glands, kidneys

# Sinusoids (AKA sinusoidal capillaries)



Resemble fenestrated capillaries, yet

1. Wider than typical capillaries
2. irregular shapes
3. have longer, larger pores
4. thinner (or no) basement membrane



Blood movement very slow



Exchange of larger molecules, i.e., proteins



Found in the liver, bone marrow, spleen



A lymphocyte traversing a fenestrated sinusoid.

# Veins

Postcapillary venule

Venule

Vein

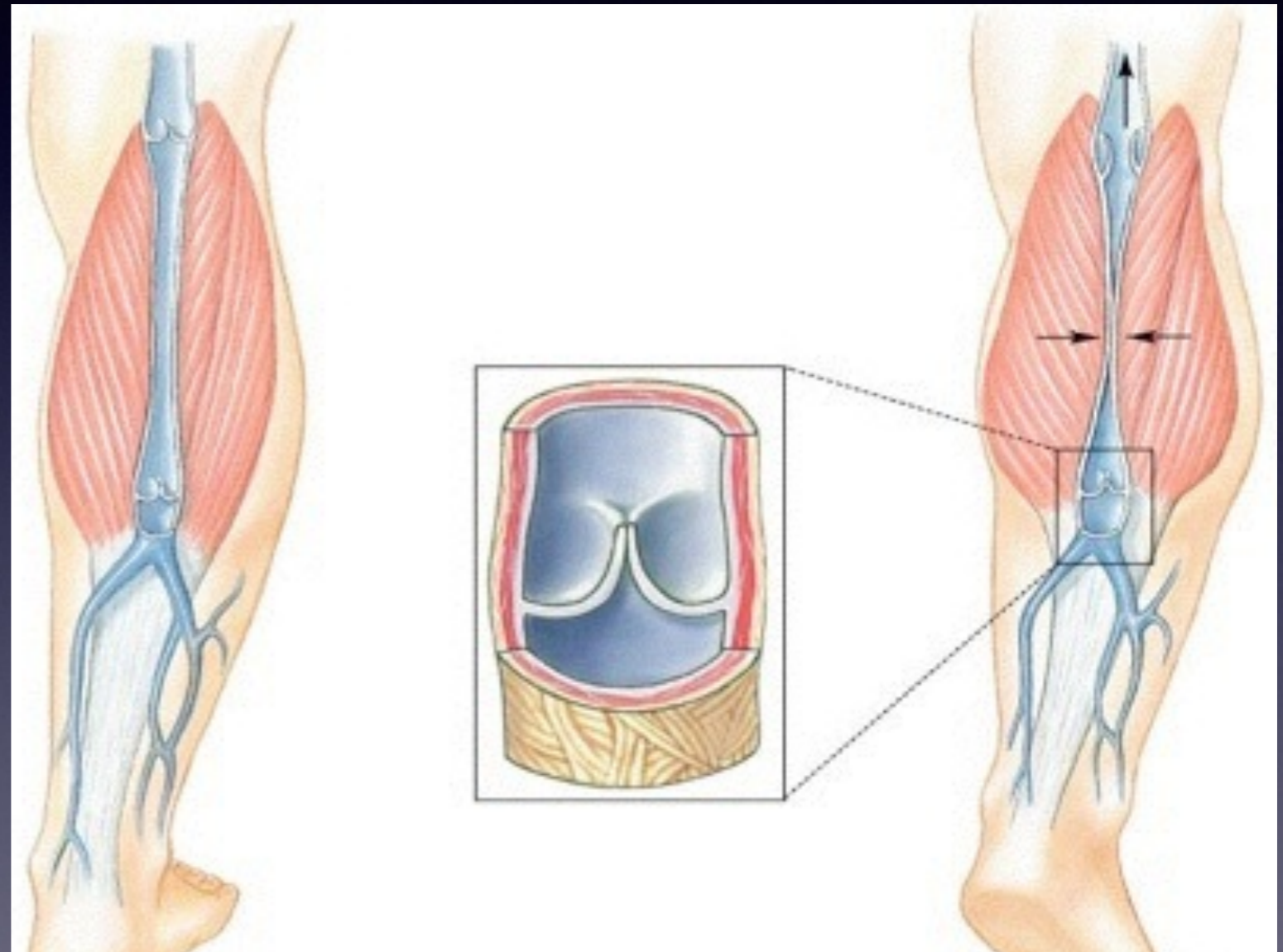
Thin wall

Large lumen

Low pressure

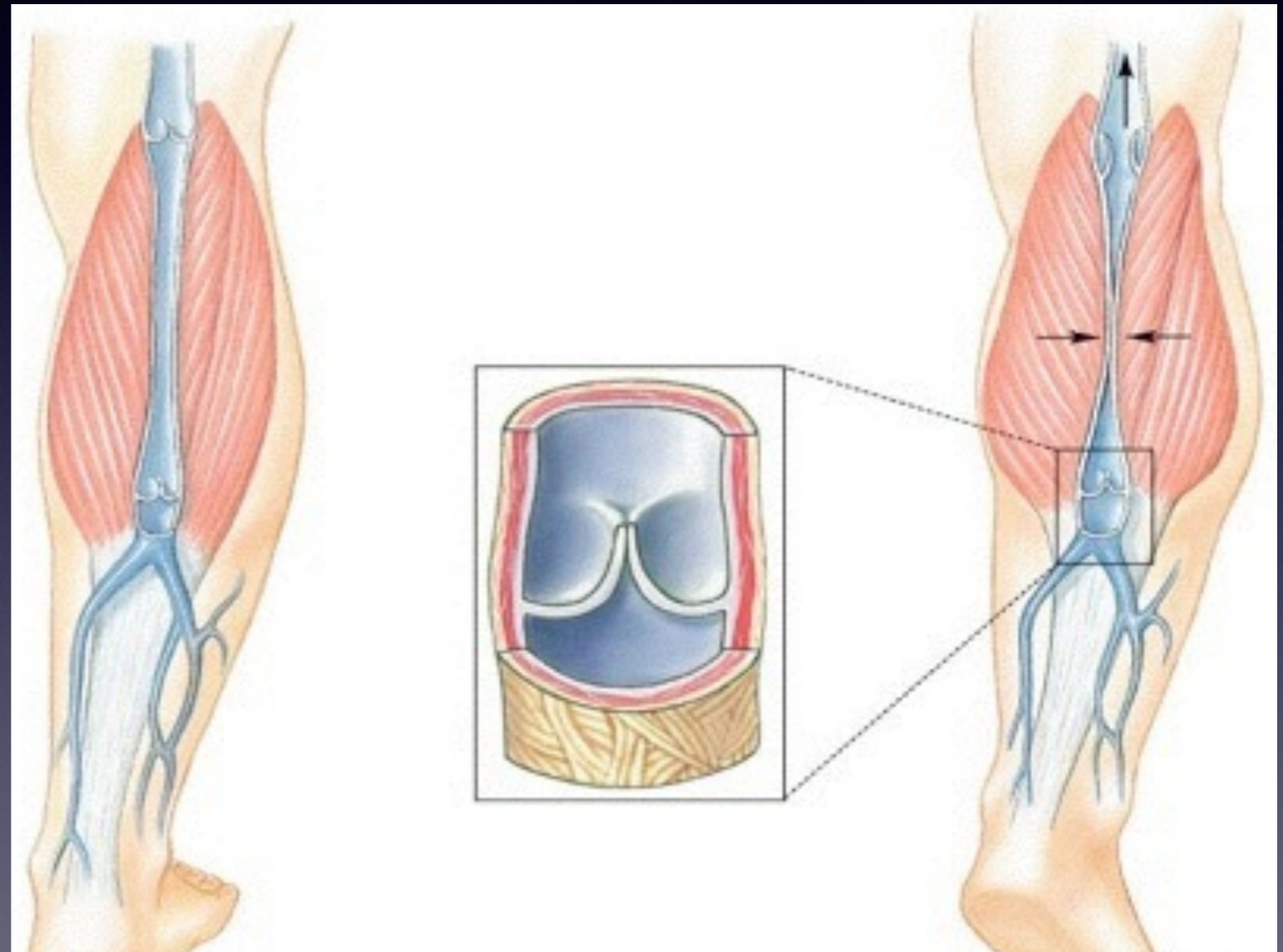
Low velocity

Valves

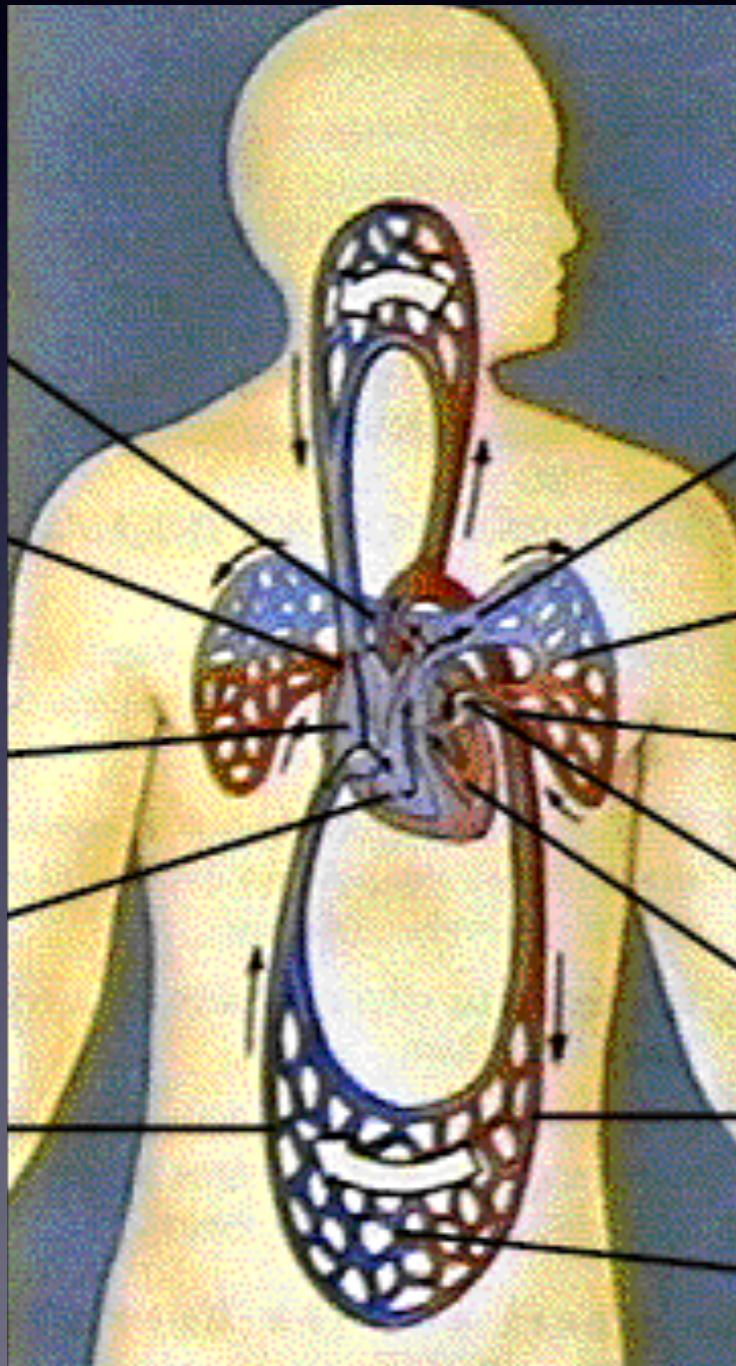


# Veins

Why are valves found in veins but not in arteries?

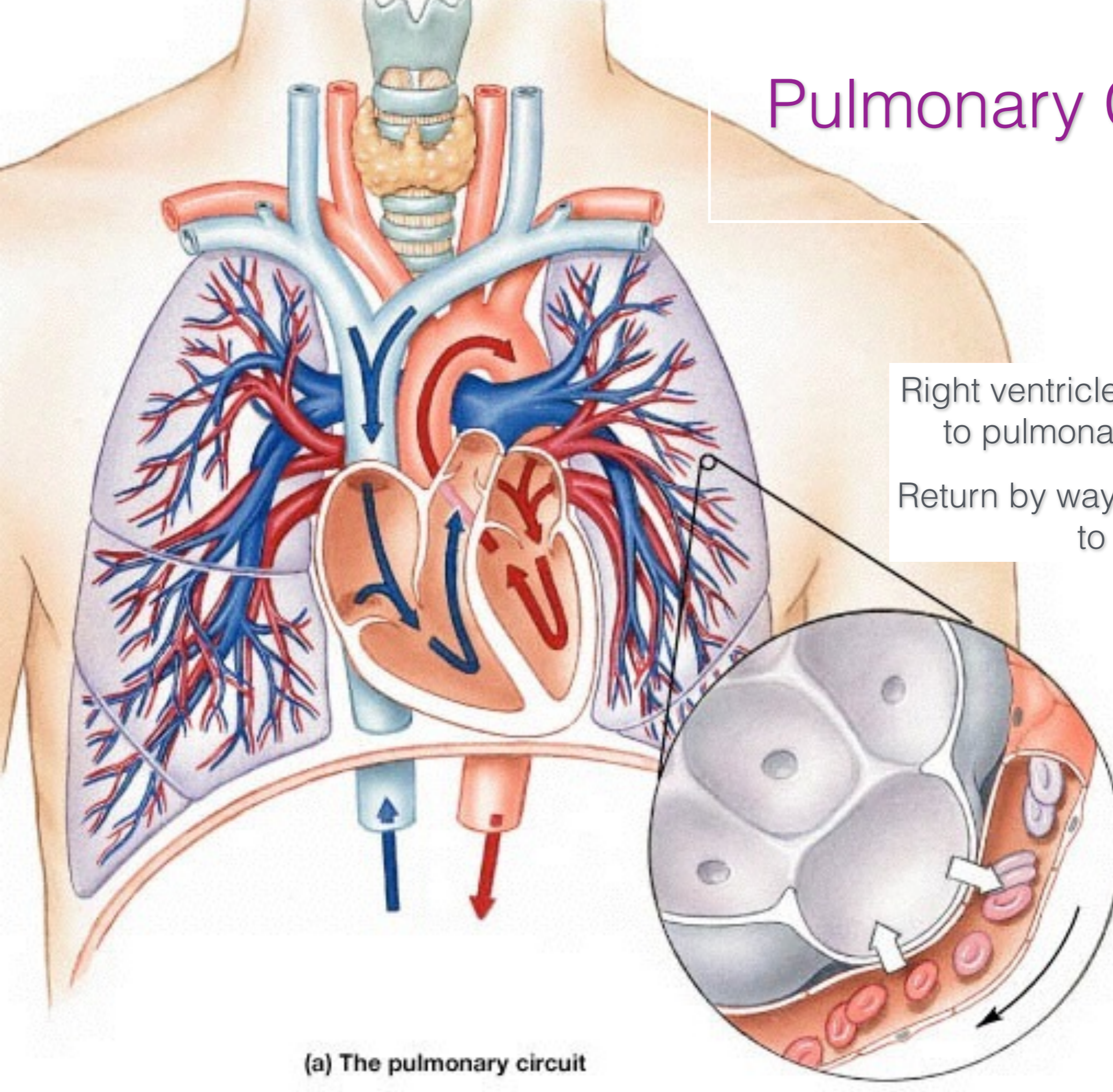


# Gross Anatomy of Circulatory System



Pulmonary &  
Systemic Circulations

# Pulmonary Circuit

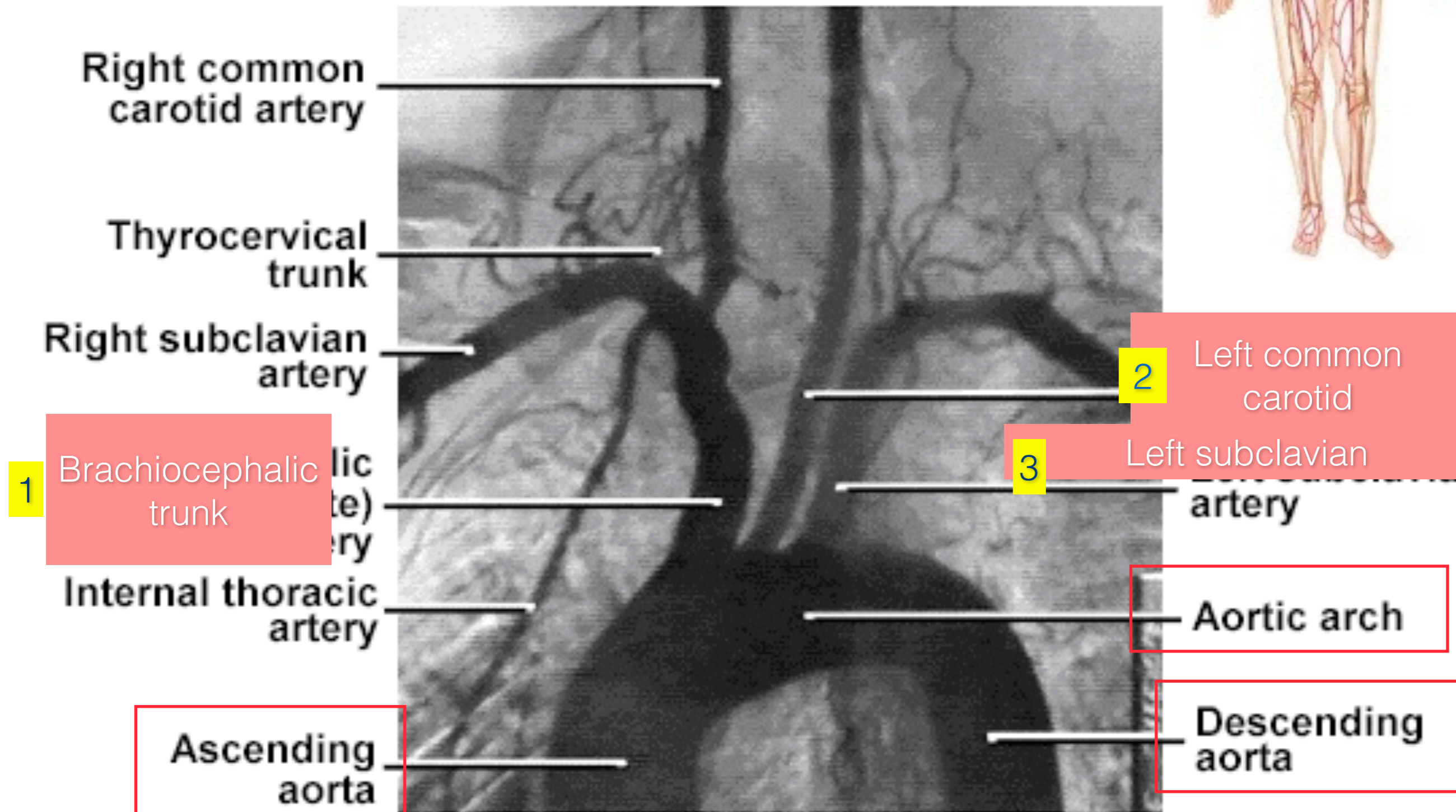
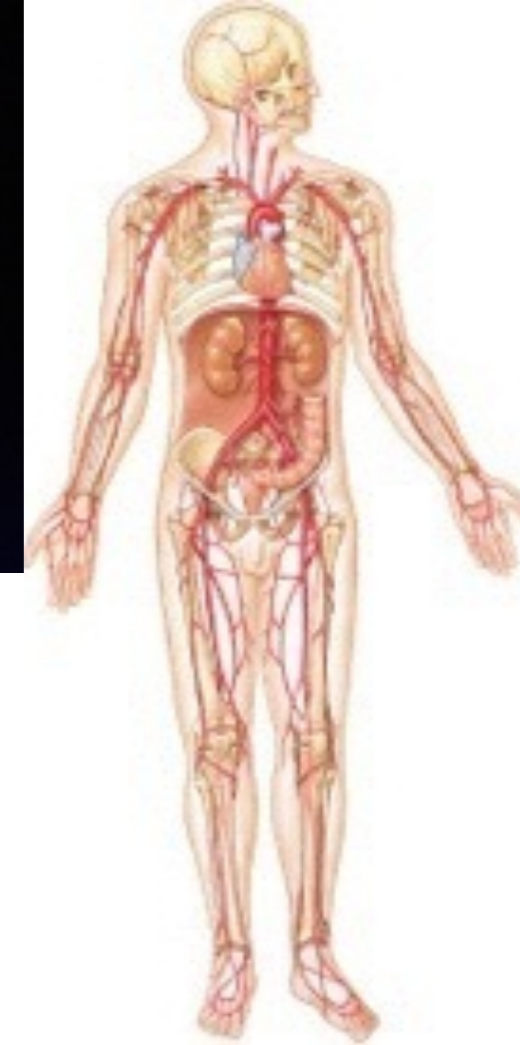


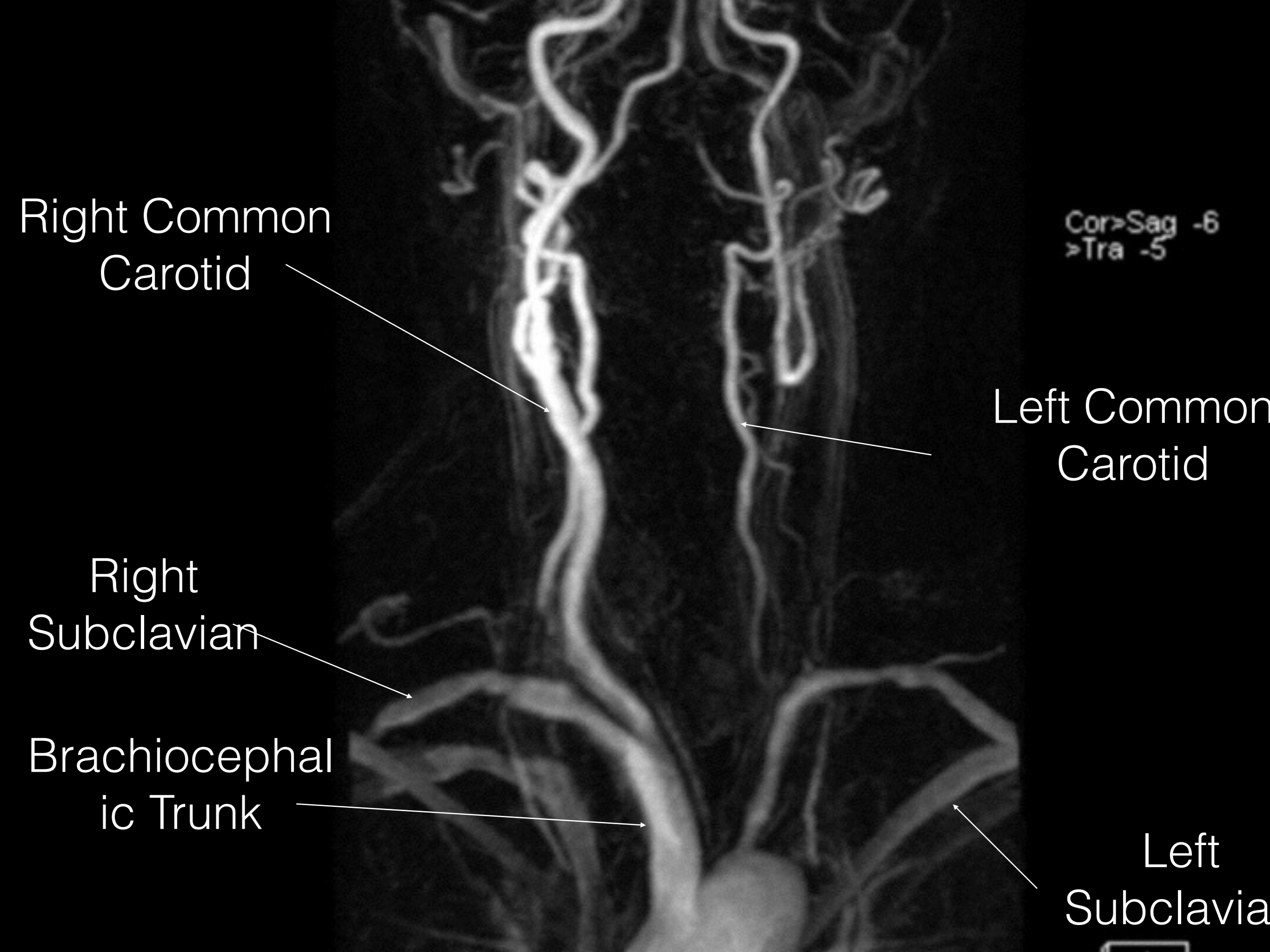
Right ventricle into pulmonary trunk  
to pulmonary arteries to lungs  
Return by way of 4 pulmonary veins  
to left atrium

(a) The pulmonary circuit



# Systemic Circulation





Cor>Sag -6  
>Tra -5

Right Common Carotid

Left Common Carotid

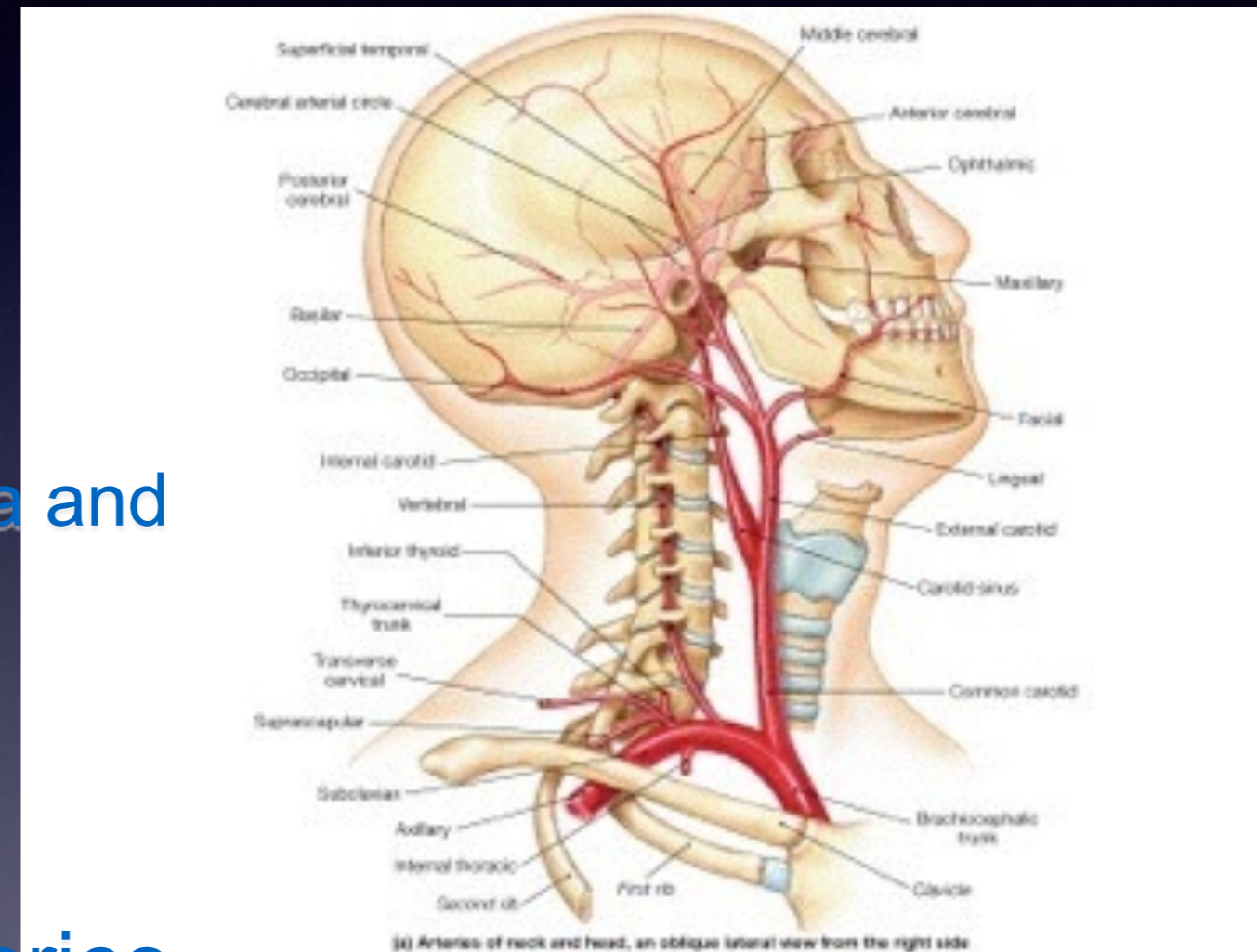
Right Subclavian

Brachiocephalic Trunk

Left Subclavian

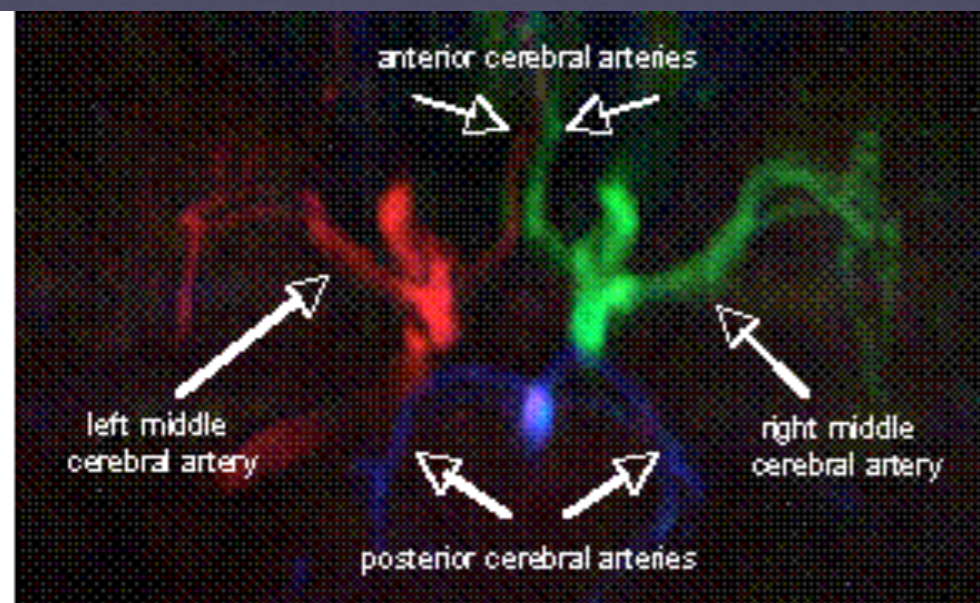
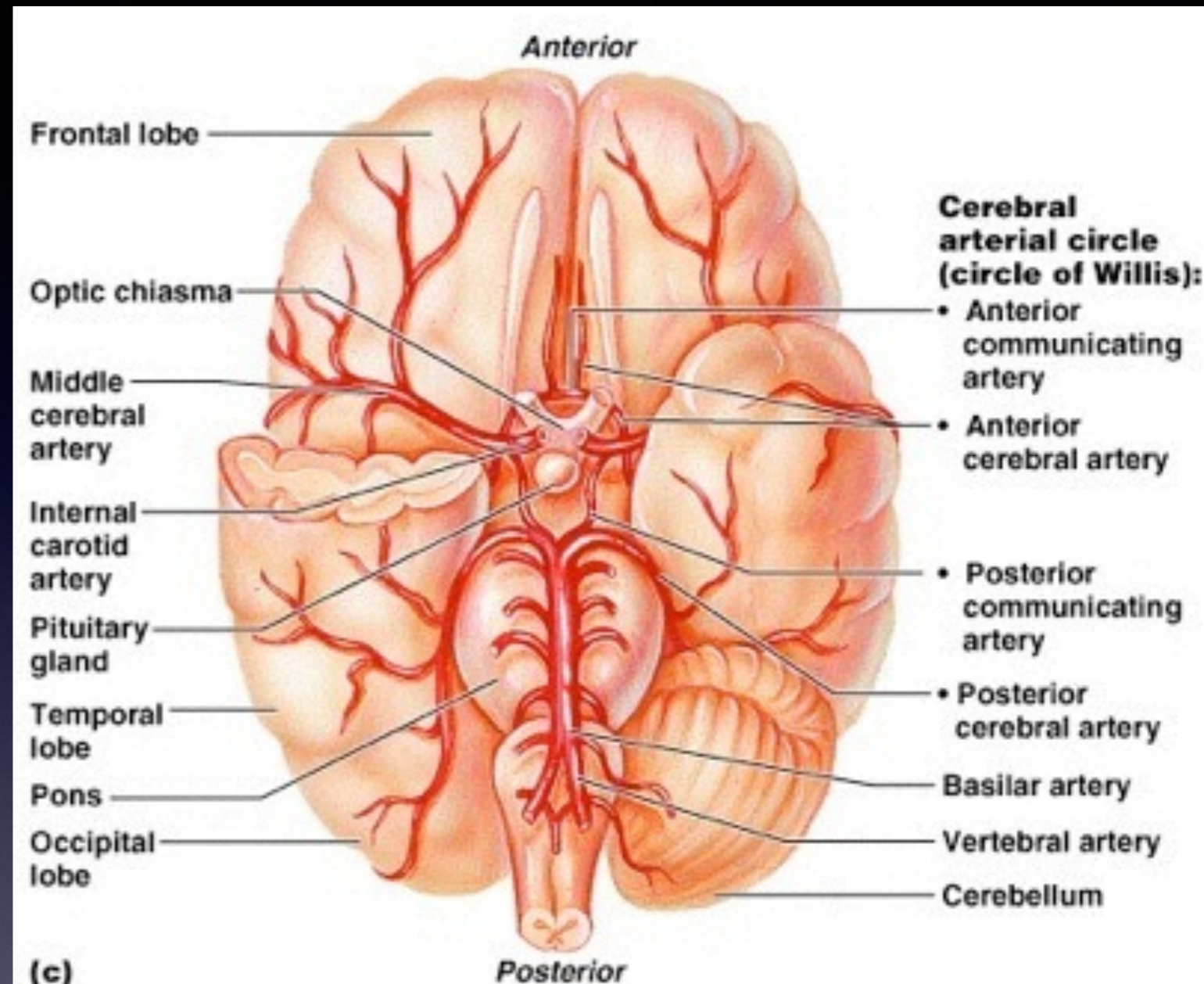
# Arteries to the Head

- Common carotid (2)
- Vertebral Artery (2)
  - Through the transverse foramina and foramen magnum
  - and converge as the
- Basilar artery (1)
- The carotids and basilar arteries converge on the Circle of Willis (AKA Cerebral Arterial Circle)

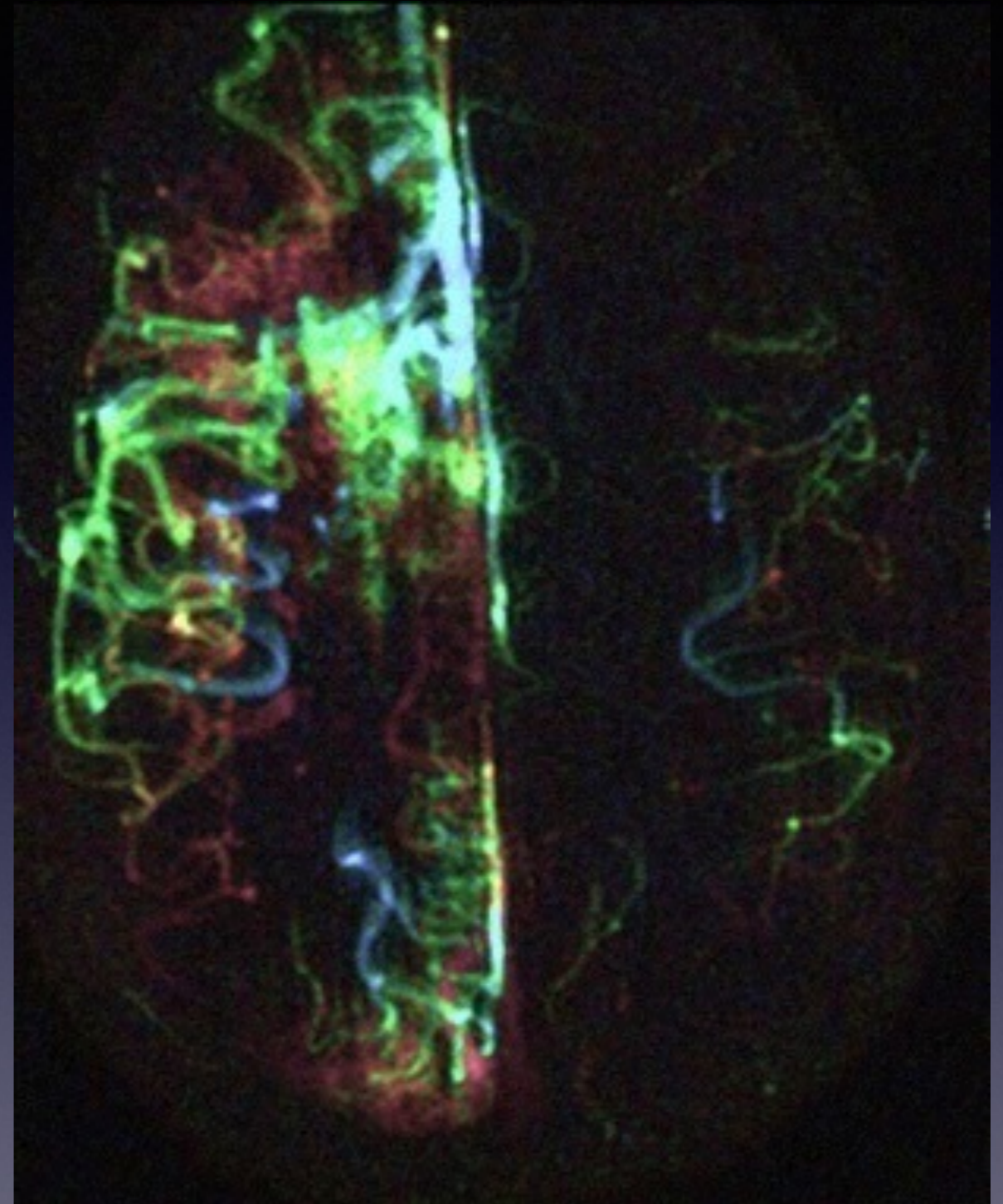


# Circle of Willis = Cerebral Arterial Circle

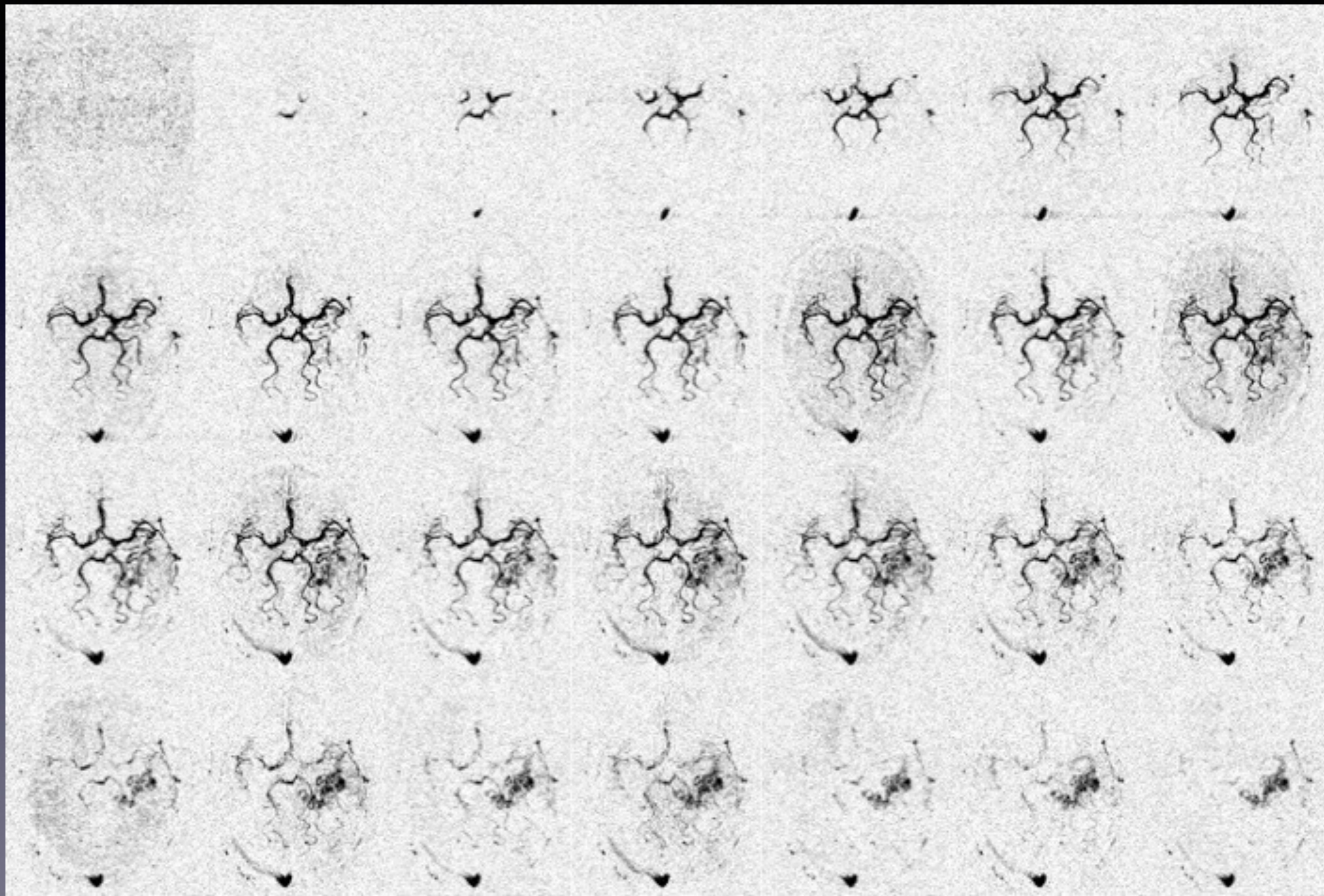
- = Ring of vessels surrounding pituitary gland - supplies cerebrum and cerebellum
- Brain can receive blood from carotid or basilar aa.
- Collateral circulation
  - (significance?)



Arteriovenous malformations (AVM) are masses of abnormal blood vessels which grow in the brain.

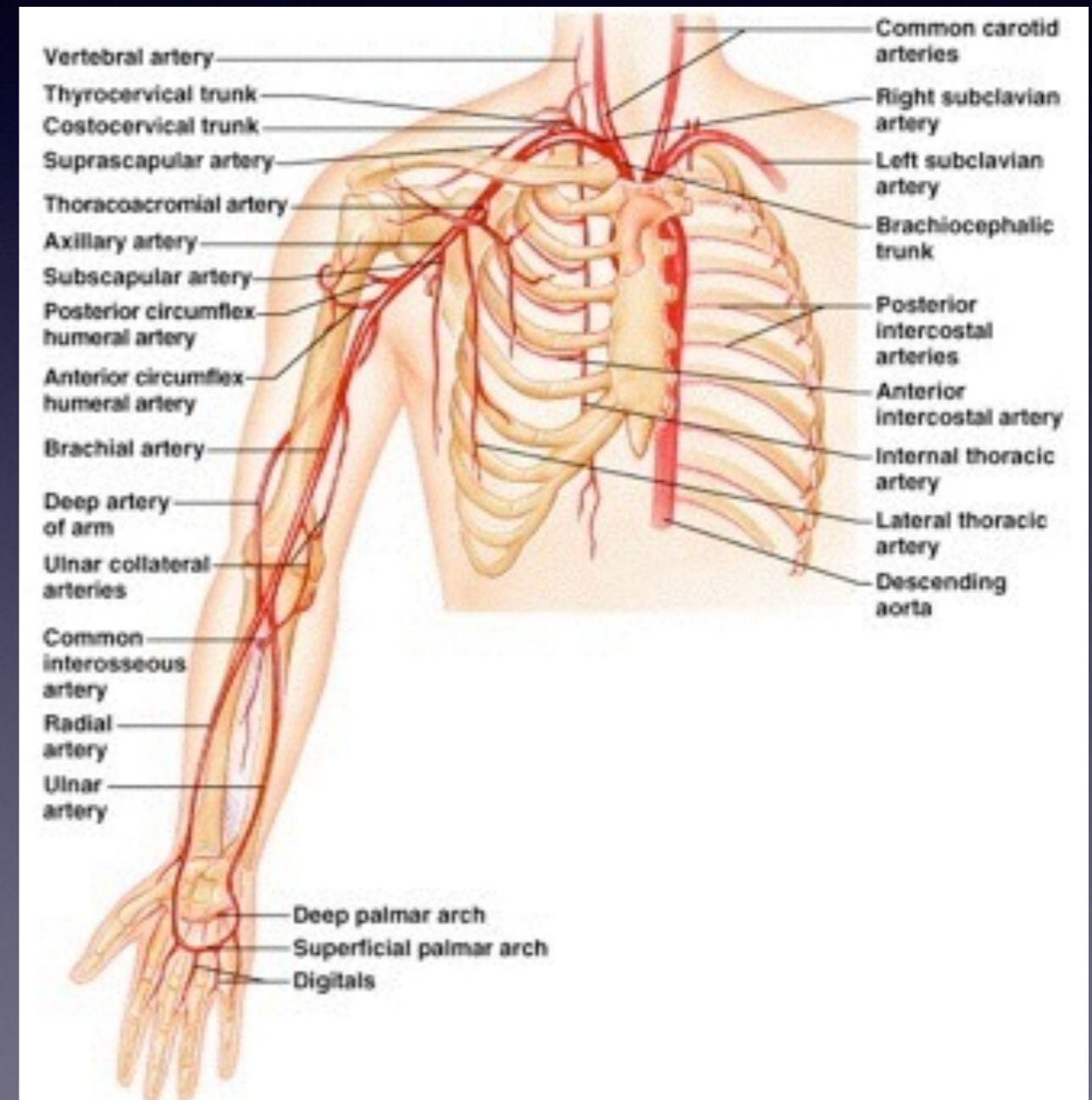


# Dynamic angiogram

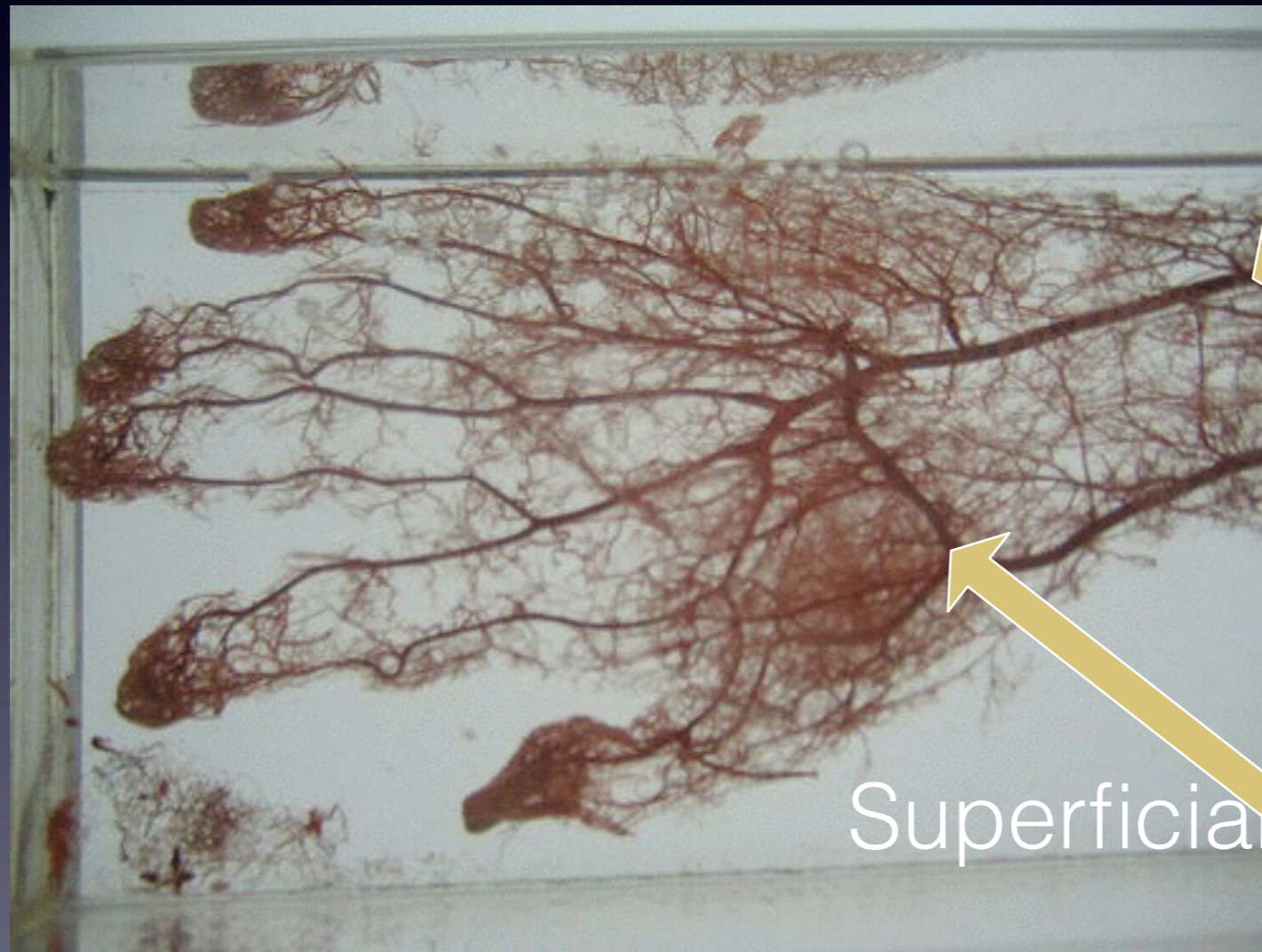


# Arteries of the Arm

- Difference Between Right and Left??
- Subclavian
- Axillary
- Brachial
  - Radial
  - Ulnar



# The Hand



Ulnar  
Artery

Superficial Palmar Arch

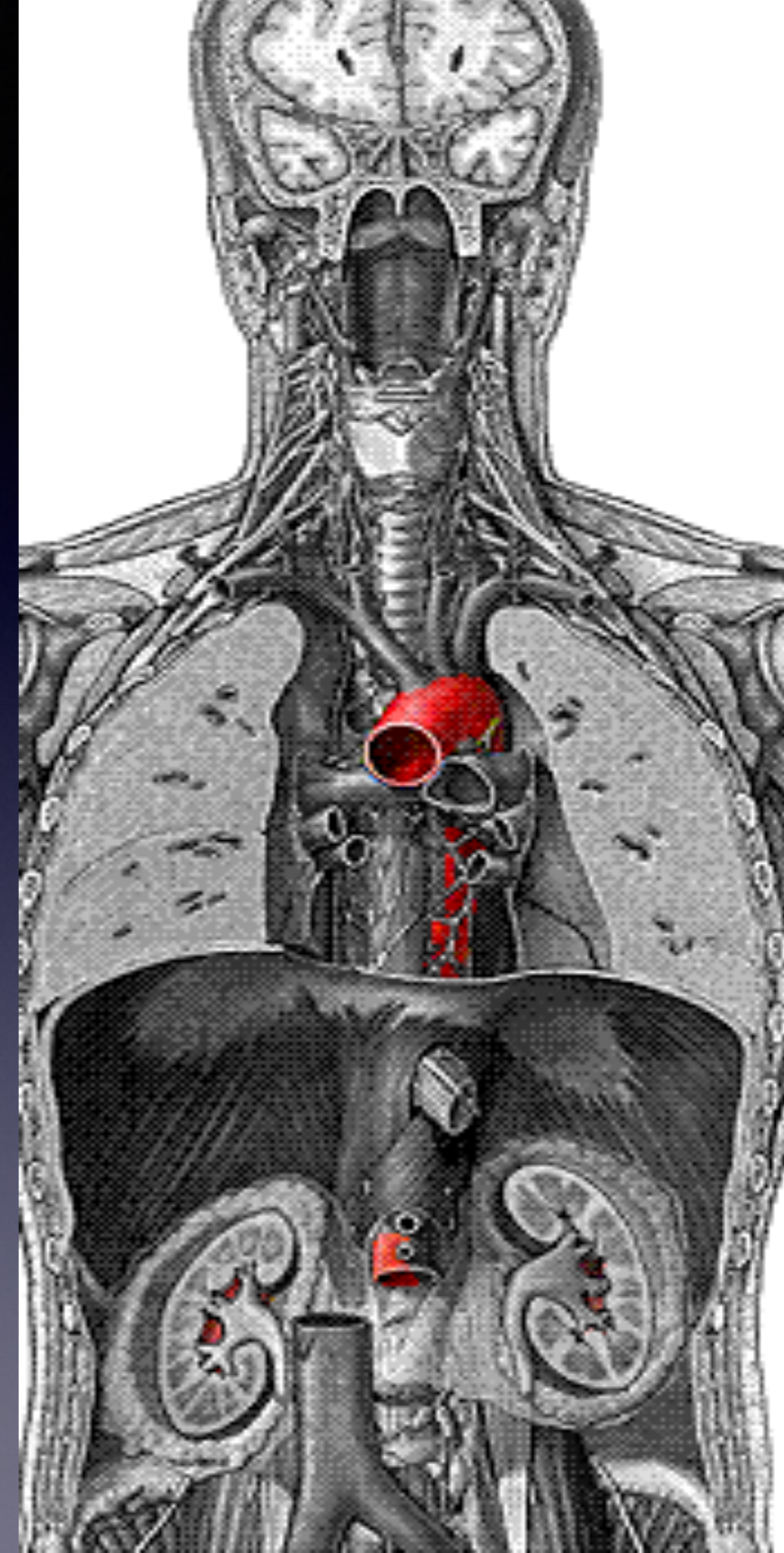
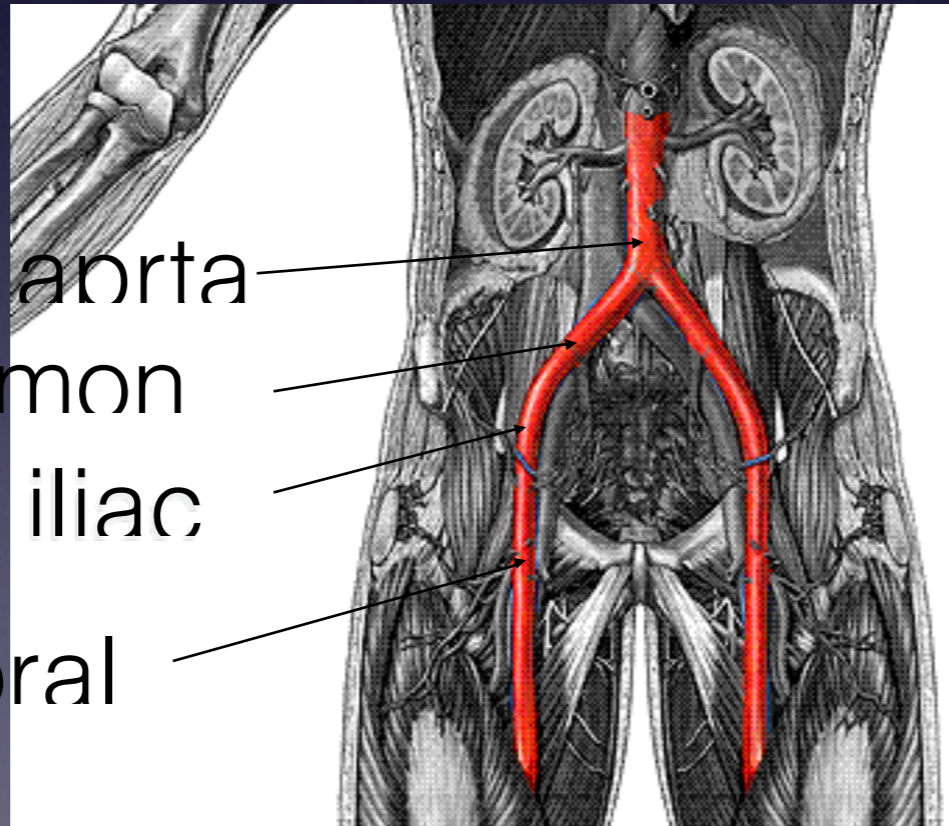
Body Worlds



# Descending aorta

Thoracic aorta  
Abdominal aorta

Abdominal aorta  
Common  
External iliac  
Femoral



# Descending Aorta - Thoracic Area

Bronchial arteries - supply bronchi and lungs

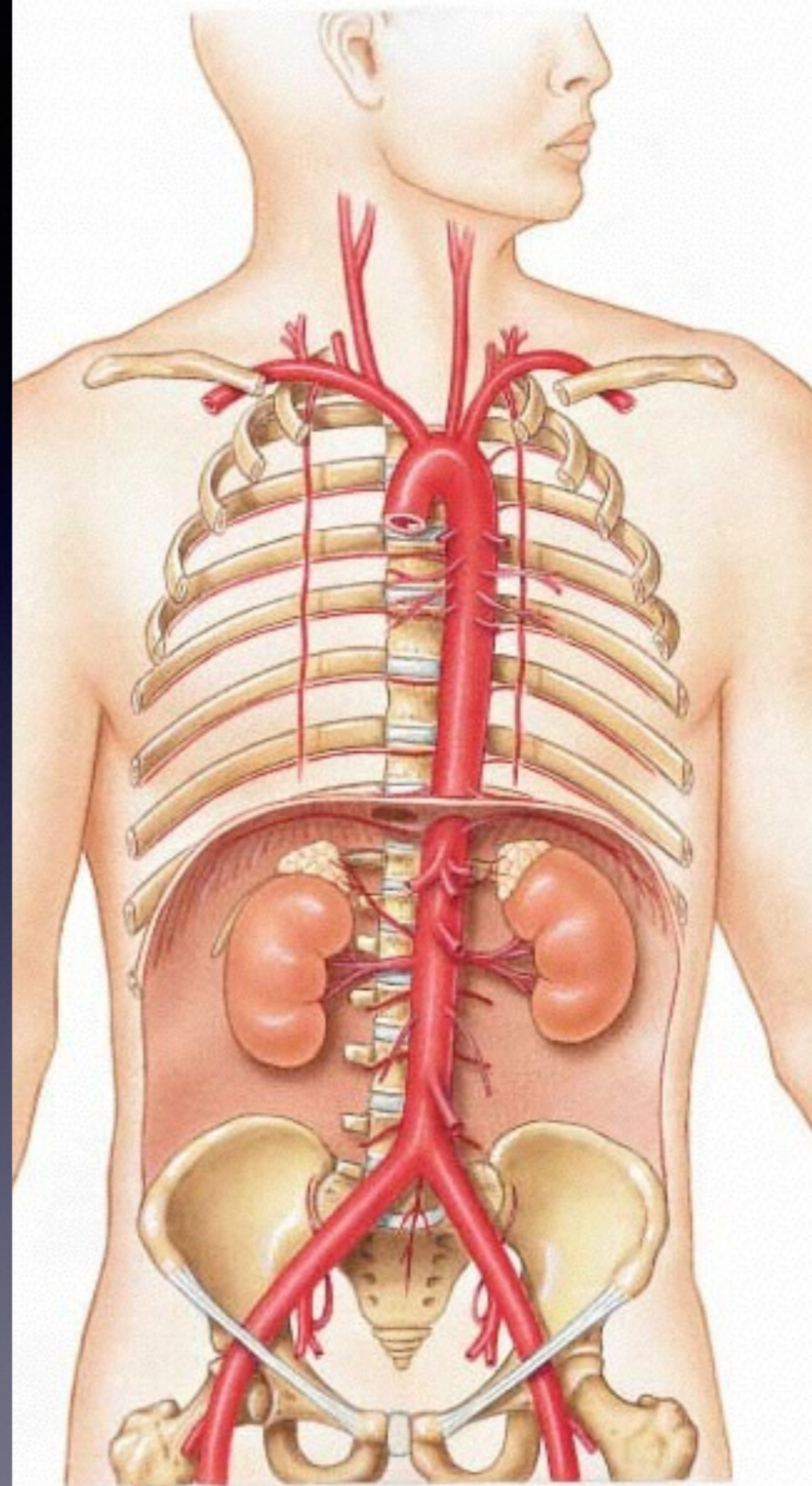
Pericardial arteries - supply pericardium

Mediastinal arteries - supply mediastinal structures

Esophageal arteries - supply esophagus

Paired intercostal arteries - thoracic wall

Superior phrenic arteries - supply diaphragm



# Descending Aorta: Abdominal Area

Celiac trunk - 3 branches – to liver, gallbladder, esophagus, stomach, duodenum, pancreas, and spleen

Superior mesenteric – to pancreas and duodenum, small intestine and colon

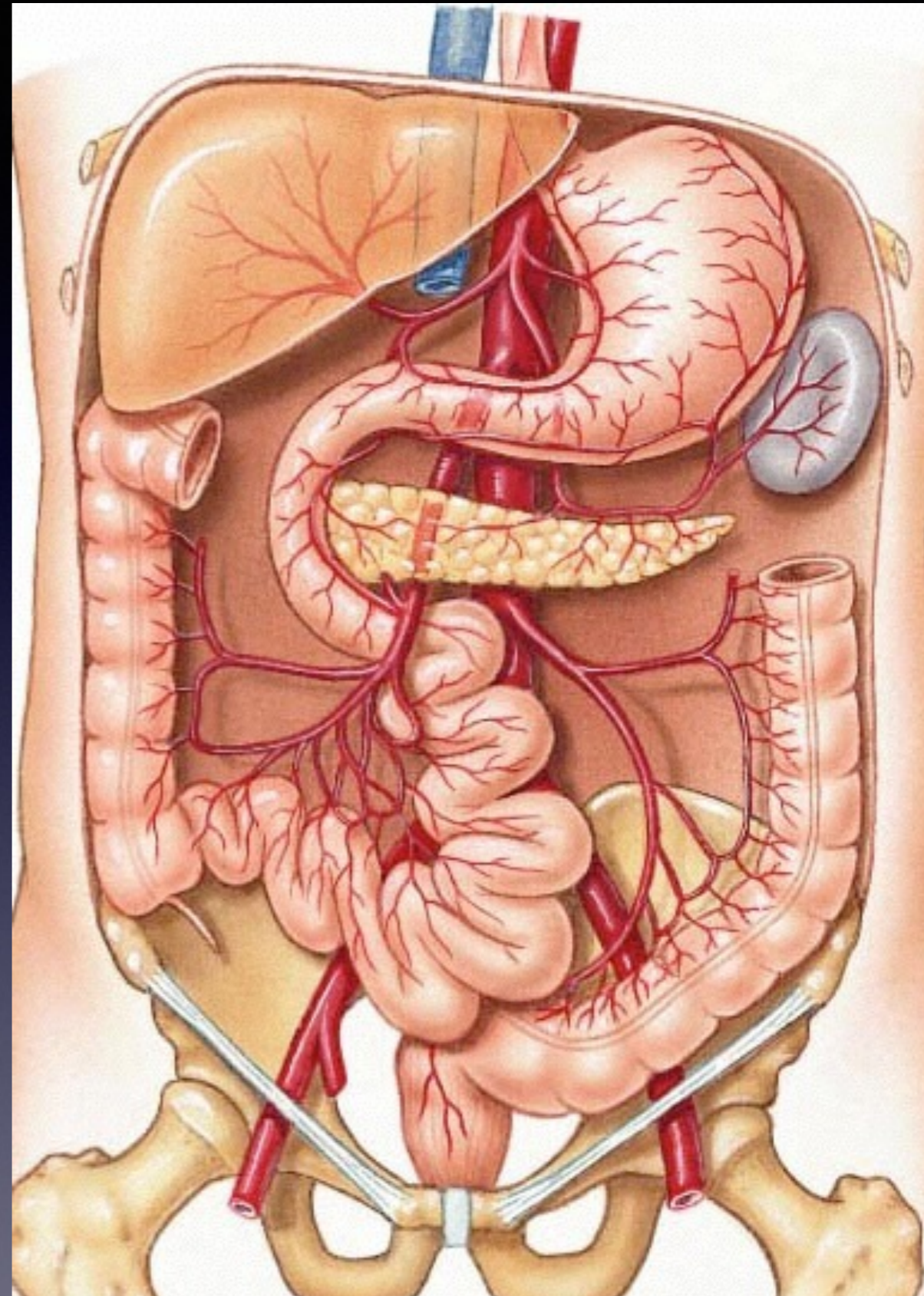
Paired suprarenal - to adrenal glands

Paired renal – to kidneys

Paired gonadal – to testes or ovaries

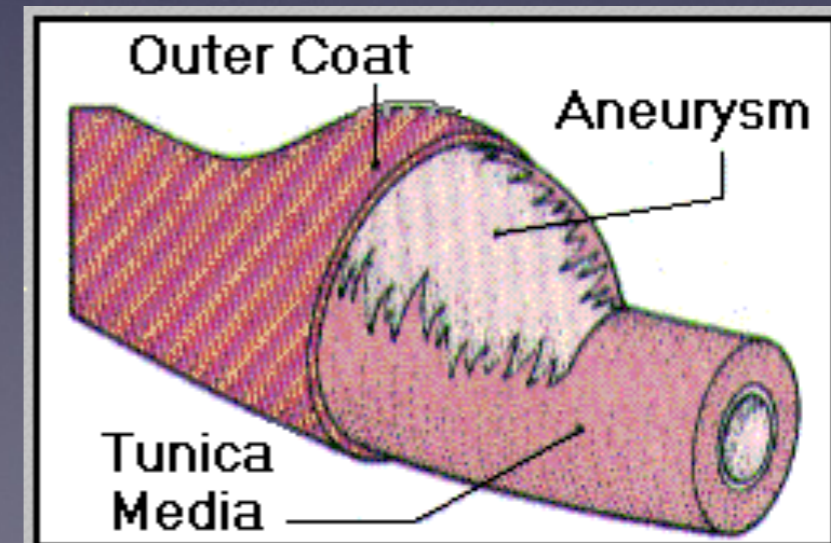
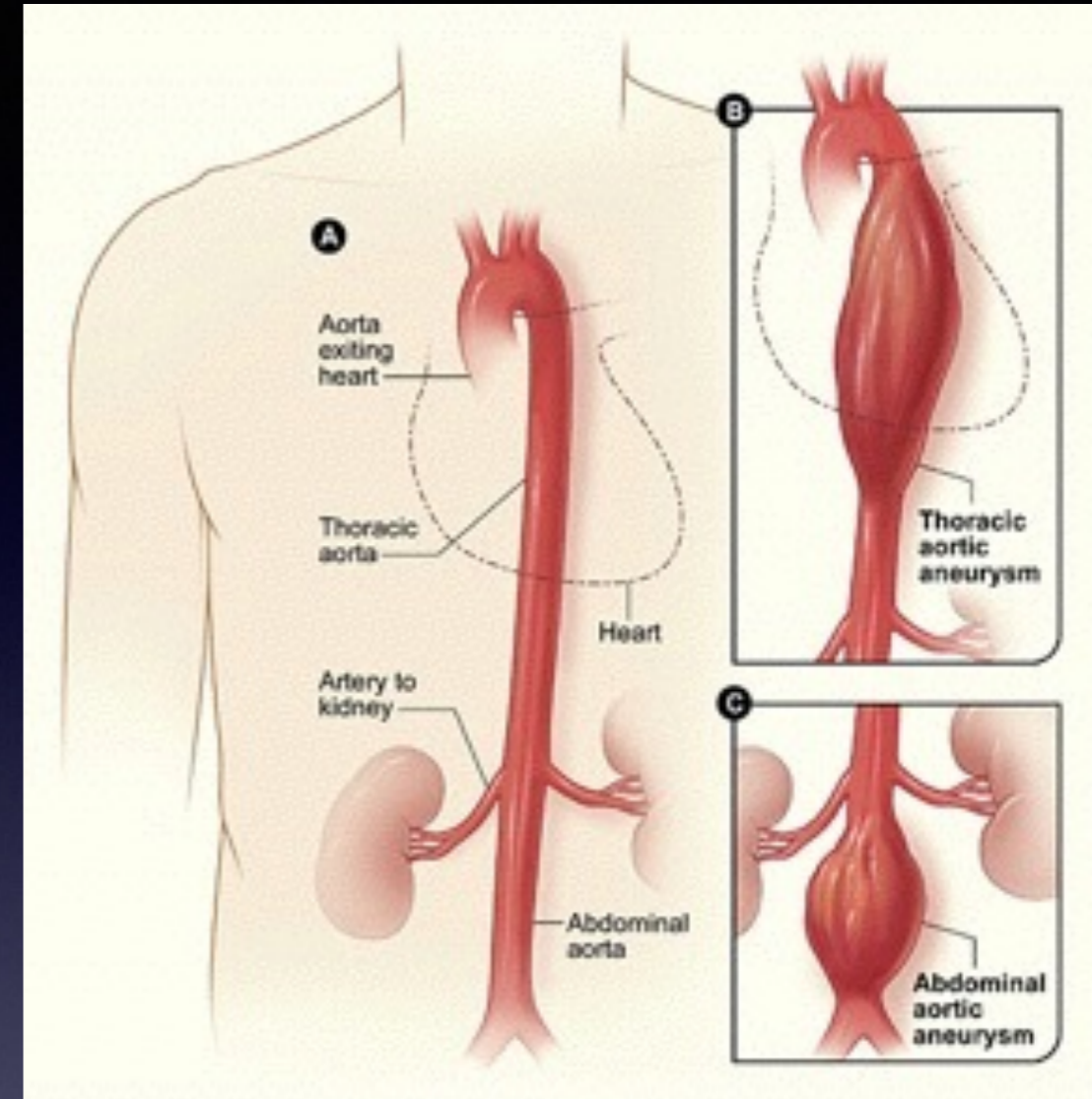
Inferior mesenteric – to terminal colon and rectum

Paired lumbar – to body wall



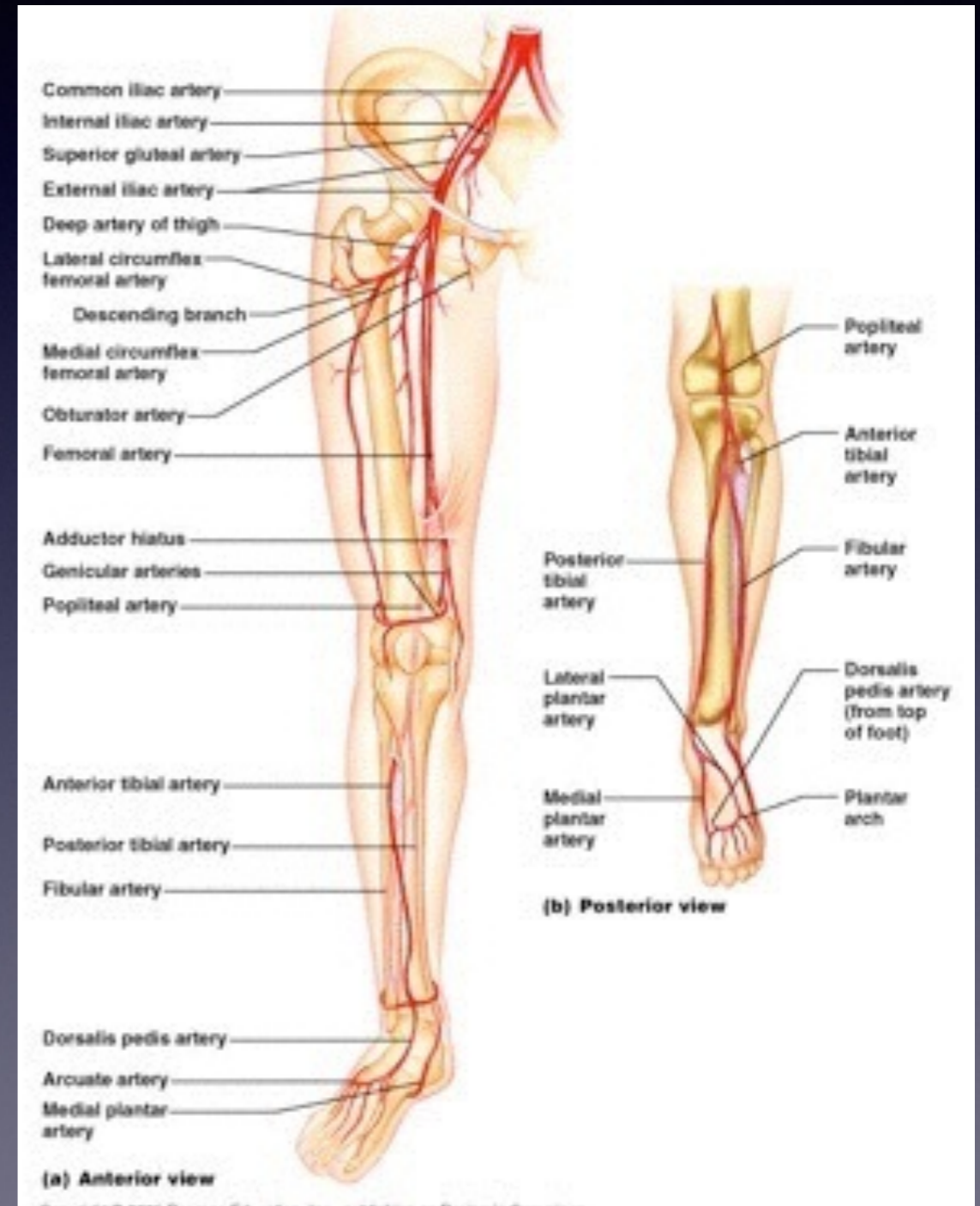
# Aortic Aneurysm

- ❏ An aneurysm is a bulging or ballooning of an artery.
- ❏ Often asymptomatic if it grows slowly
- ❏ Weakness in the C.T. wall of the aorta
- ❏ Rupture = ?
- ❏ Treatment is synthetic support of the aorta



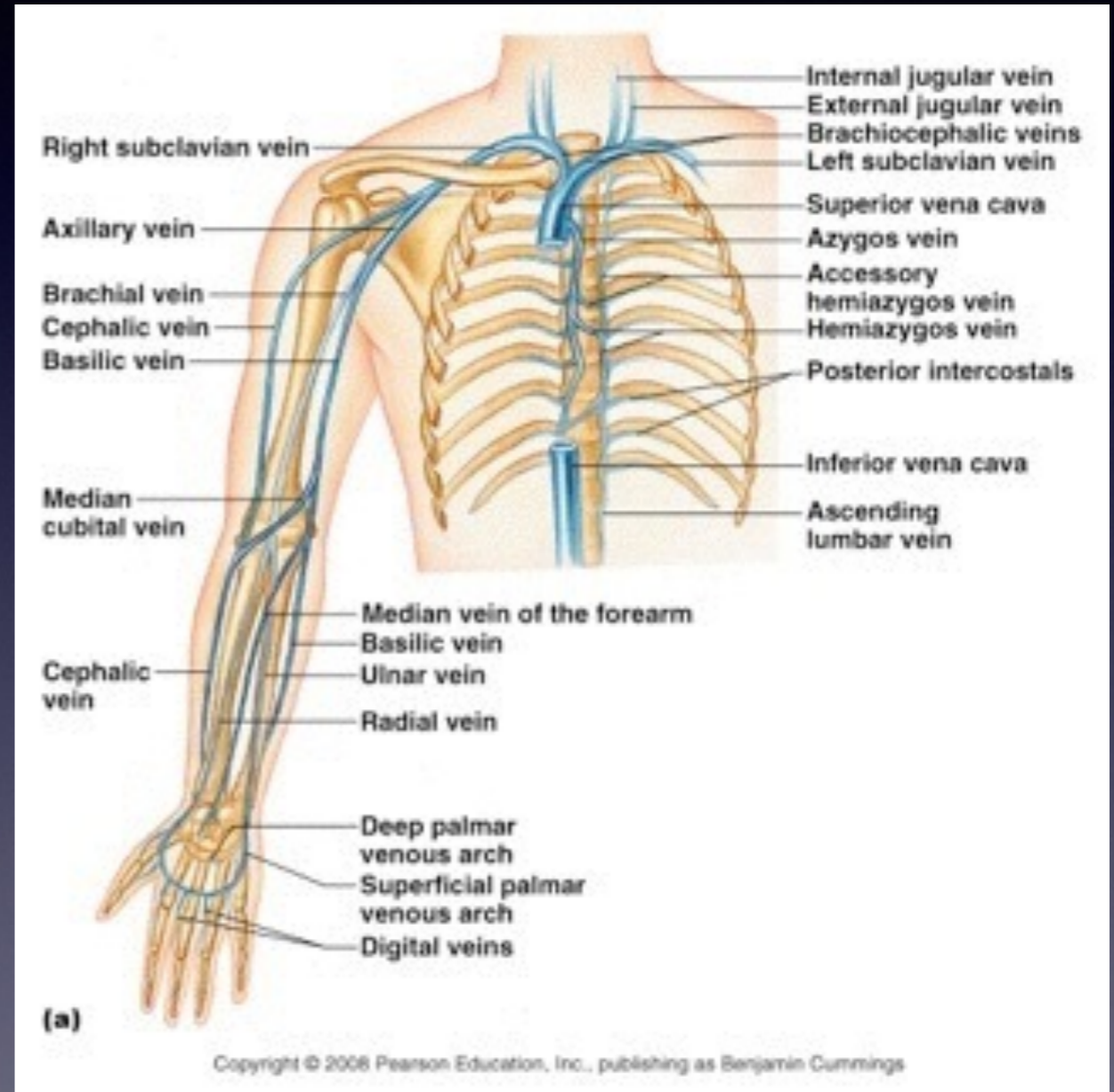
# Circulation of the Leg

- ❏ Common Iliac A. and V.
- ❏ External Iliac A. & V.
- ❏ Femoral A. & V.
- ❏ Popliteal A. & V.
- ❏ Anterior Tibial
- ❏ Posterior Tibial
- ❏ Dorsal Pedal A.
- ❏ Pulse checking
- ❏ Great Saphenous V.
- ❏ Used for coronary bypasses
- ❏ Longest vessel



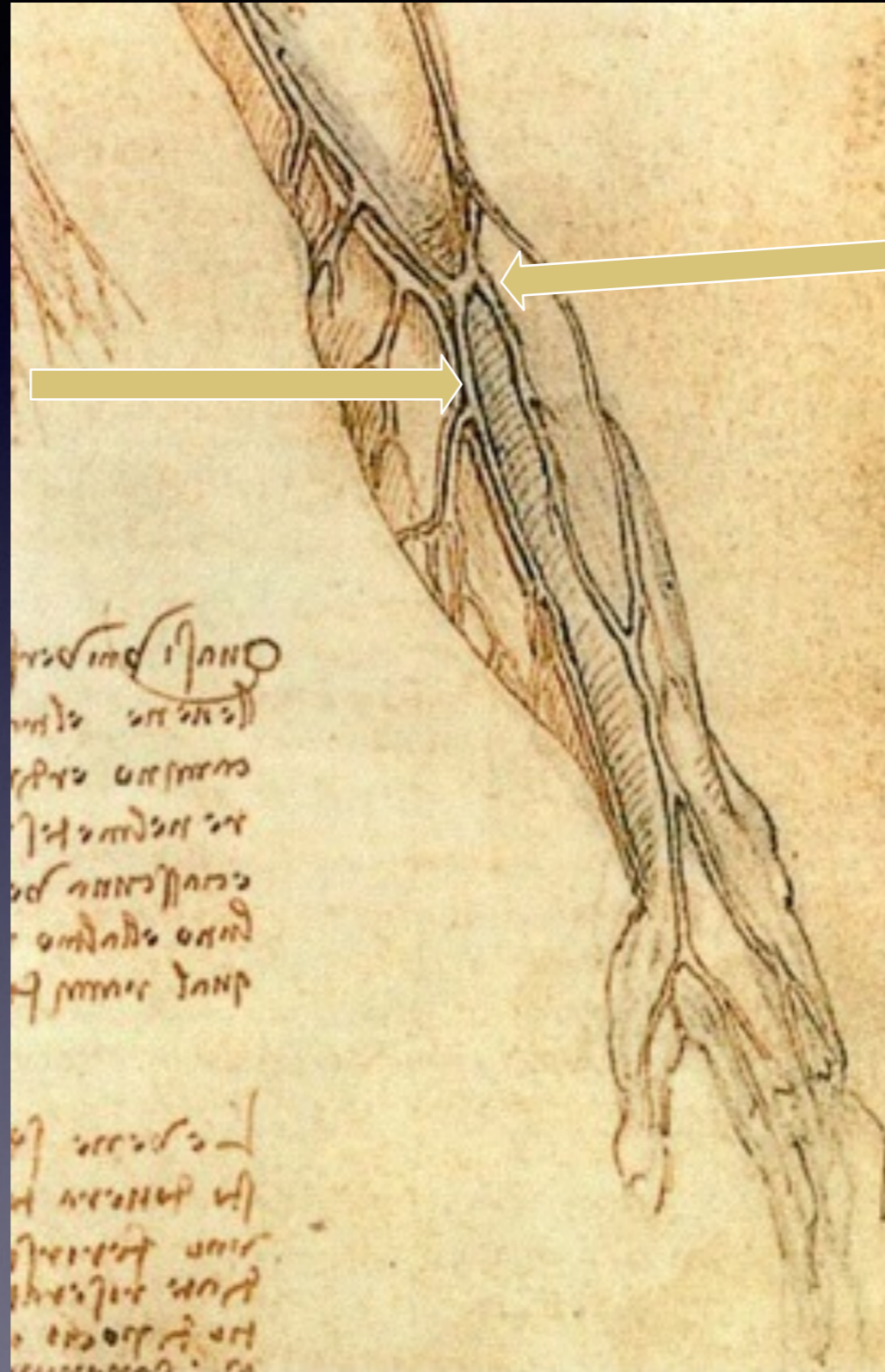
# Venous Circulation

- ☒ Mostly parallels arterial circulation
- ☒ Veins are more superficial in limbs
- ☒ Major exception in the abdomen
- ☒ Portal Circulation



# Useful Superficial Veins

Cephalic v.



Median cubital v.

See Fig. 20.19

# Normal Blood Flow: From artery to capillary bed to vein and back to heart

## Portal Systems

3 exceptions: from artery to capillary to artery (or venule) to capillary to vein



Hypophysis



Liver



In kidney nephrons

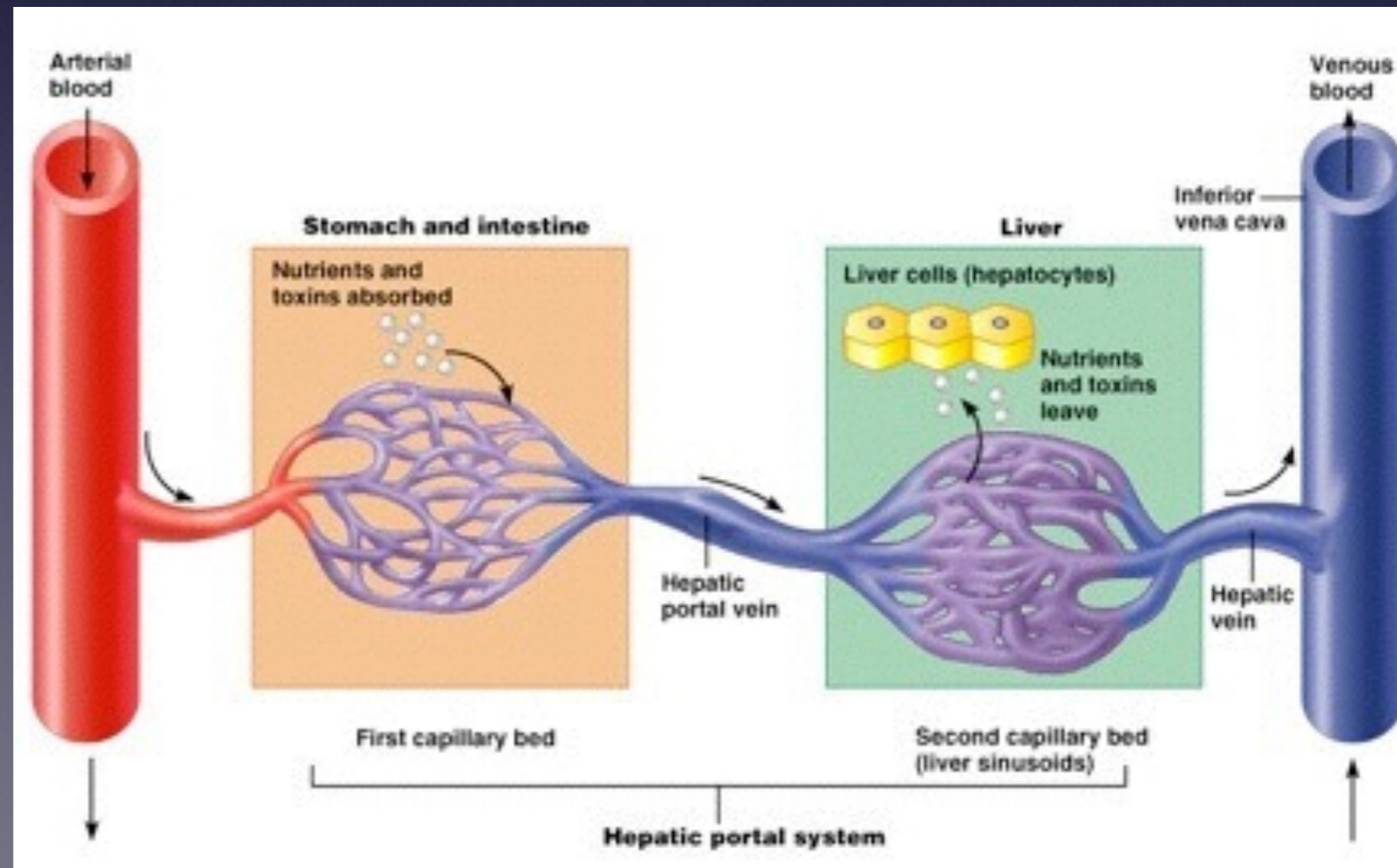


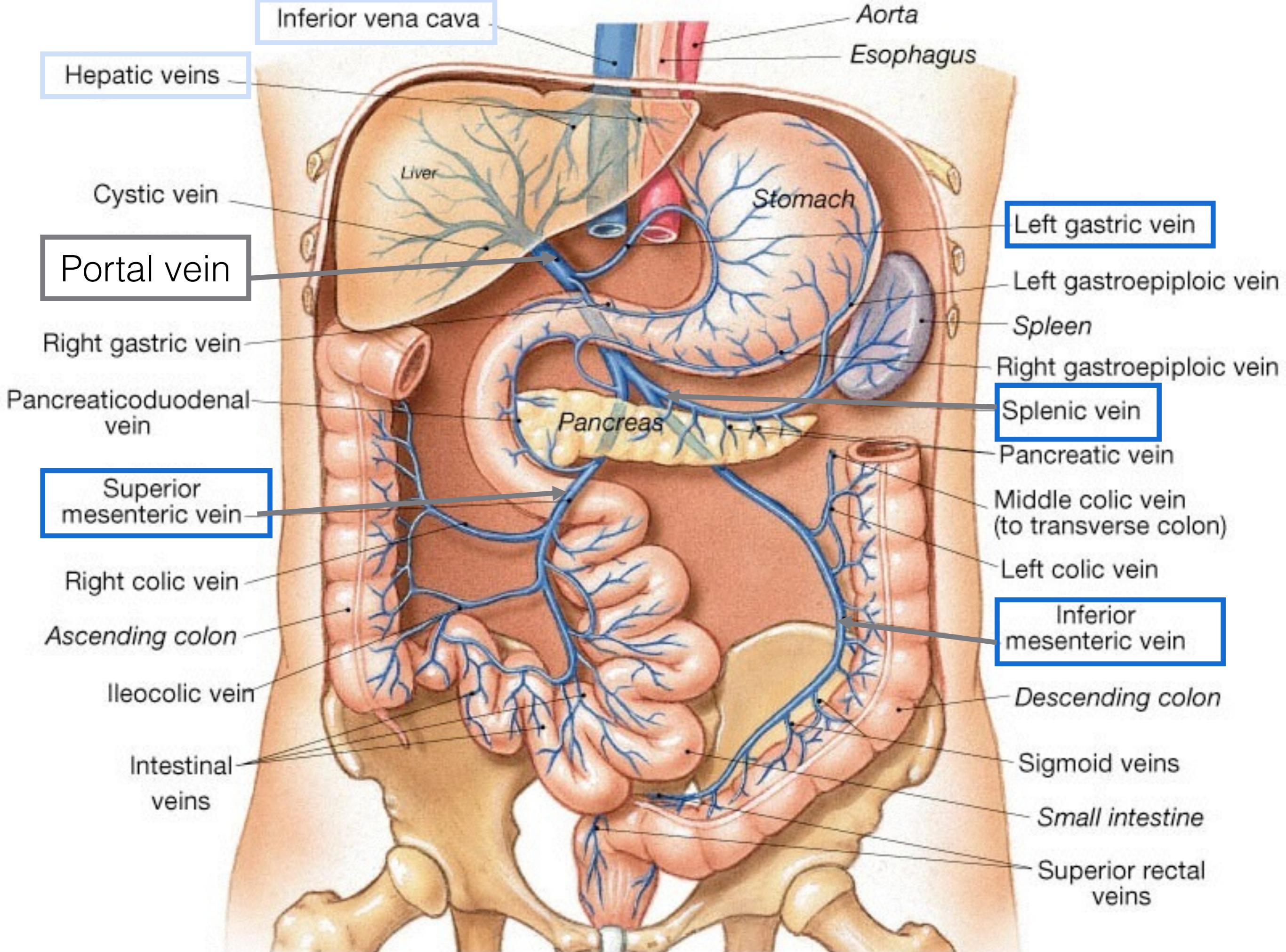


# Portal Circulation

- Venous return from the intestine is carried to the liver via the Portal Vein
- Most nutrients (not fat) are carried by the portal vein
- Portal vein enters the liver at the hilus

Fig. 20.22 (a)





# Varicose Veins

- Page 562
- ↑ BP in legs
  - Venous dilation
  - Breakdown of c.t.
- Pooling
- May be painful and/or thrombogenic



# Fetal circulation

During fetal life, all oxygen and nutrition comes not from the intestine and lungs, but from the placenta.

The fetus has different circulatory pathways to accommodate these different needs.

These pathways must change AT the time of birth.

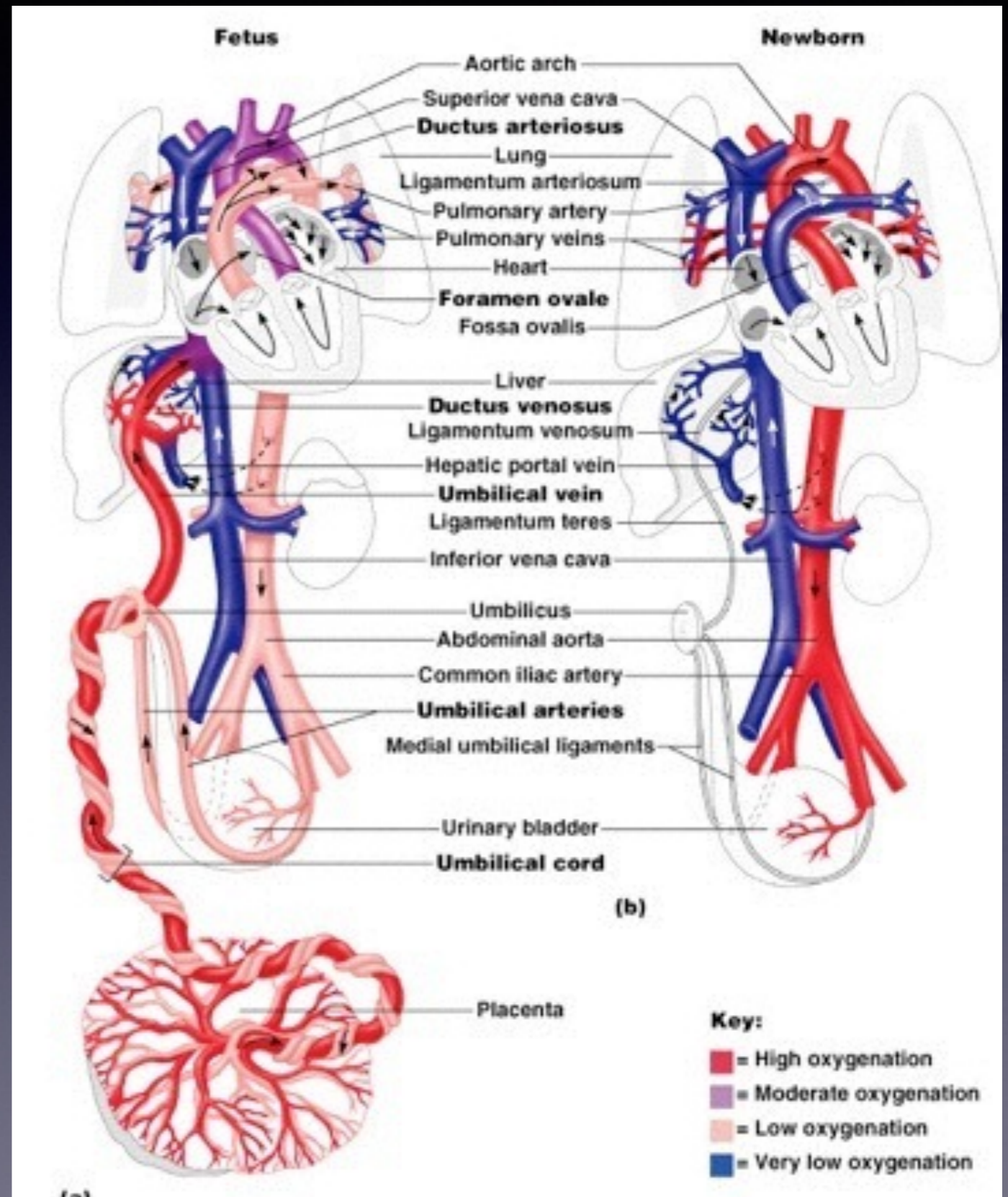


Figure 20.25

# Circulation Changes AT Birth

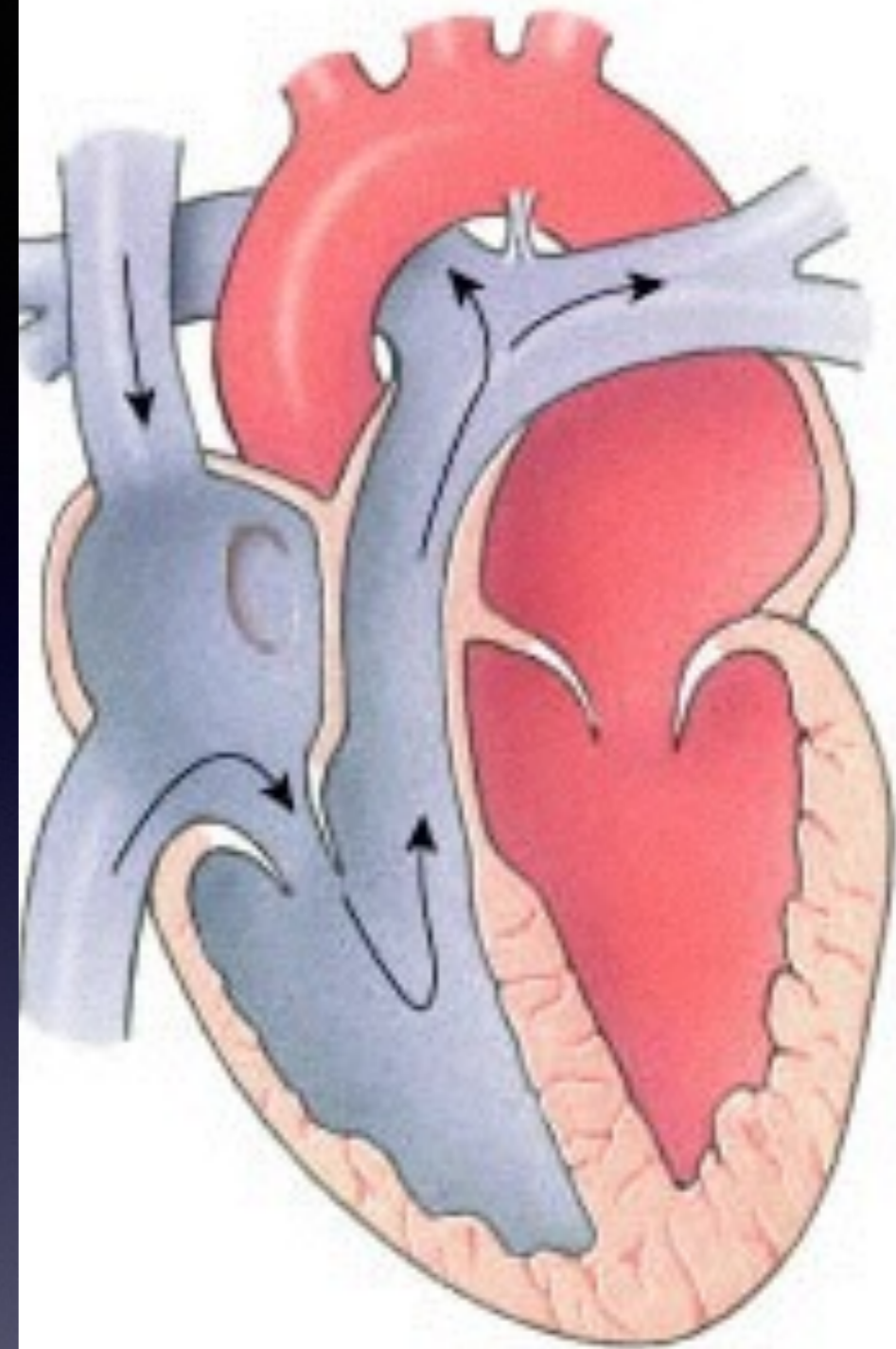
No blood coming from placenta

Ductus venosus becomes ligamentum venosus (=ligamentum teres)

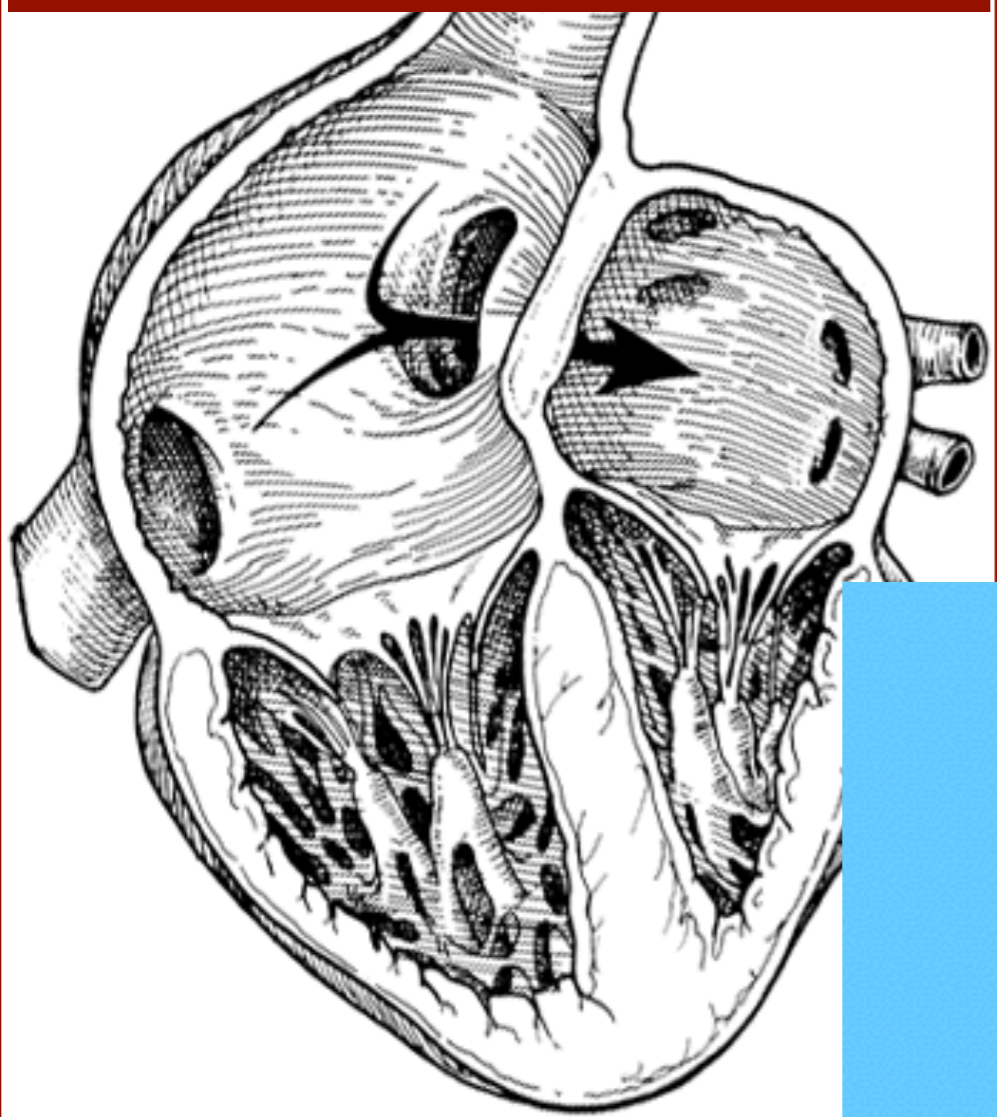
Foramen ovale closes & becomes fossa ovale

Ductus arteriosus closes and becomes ligamentum arteriosum

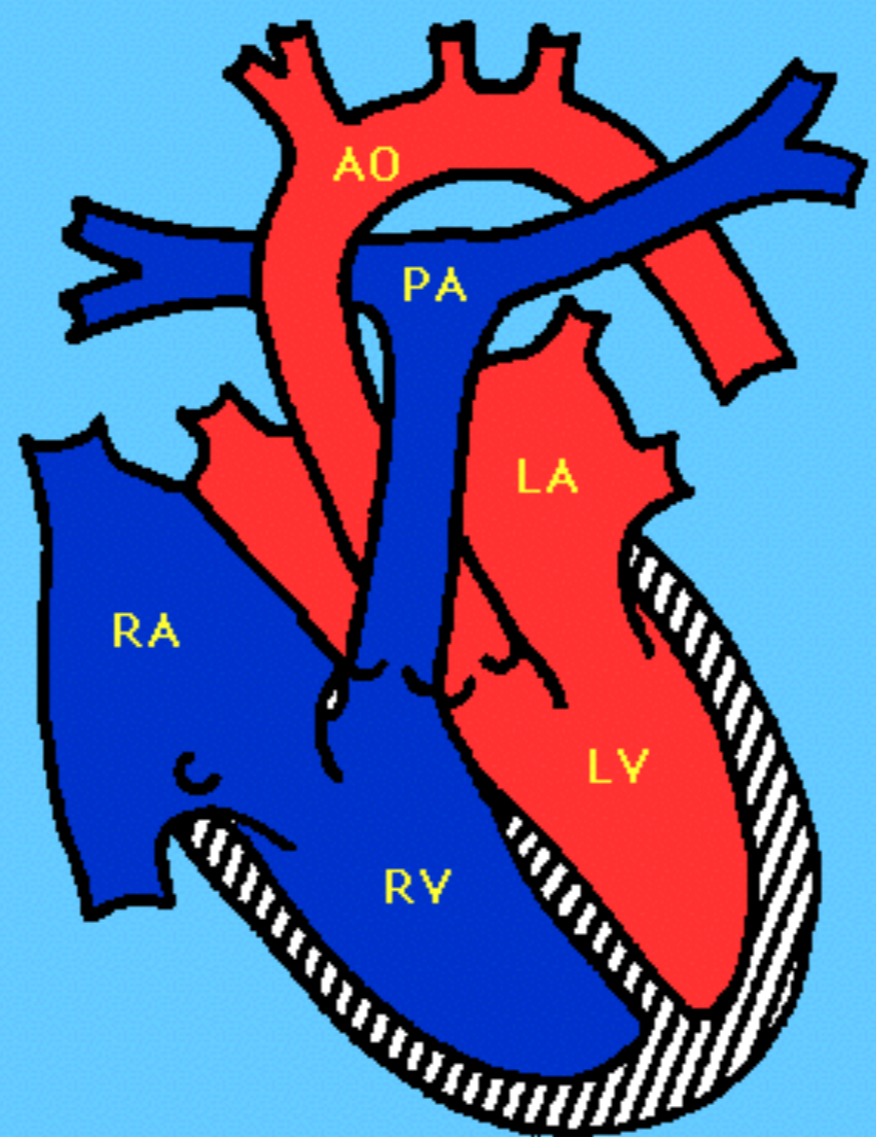
Umbilical vein and arteries degenerate



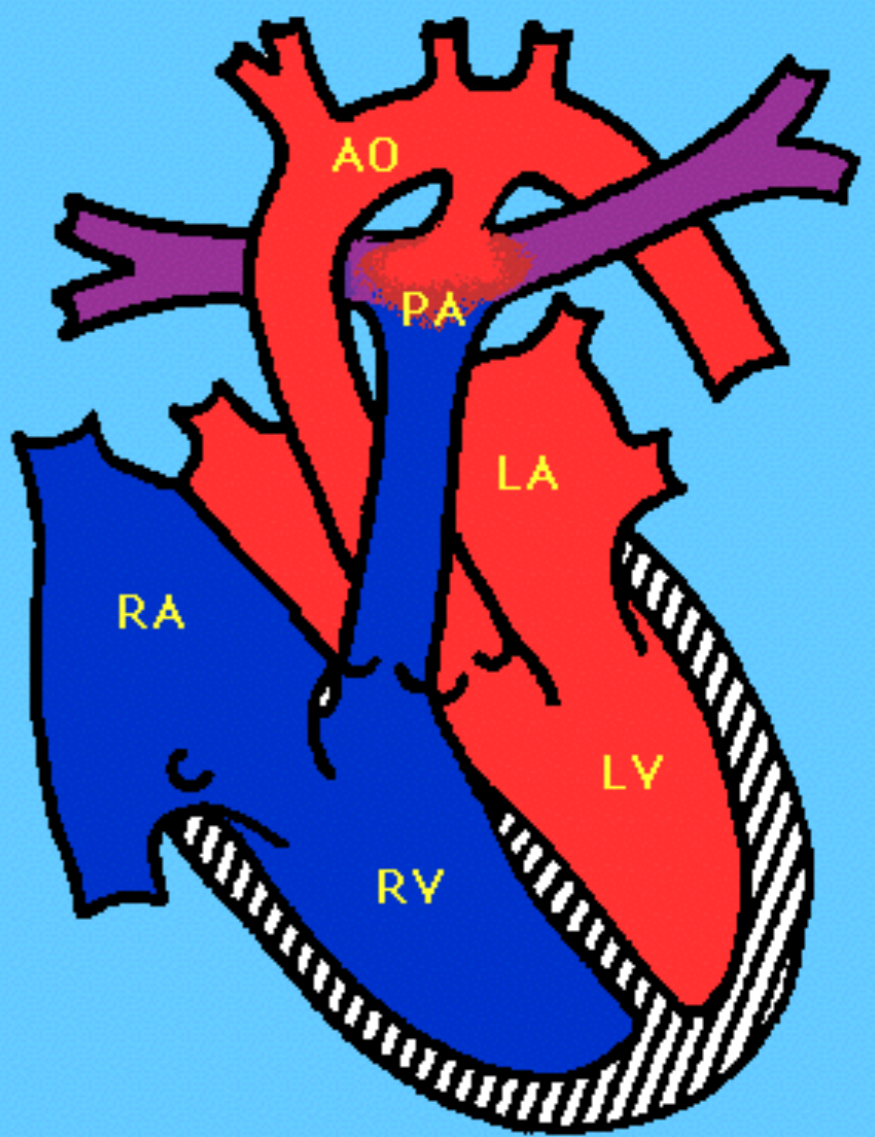
# Patent foramen ovale



## Patent Ductus Arteriosus



Normal



Patent Ductus Arteriosus

