

Normal Anatomy of the Extremity Veins

Veins

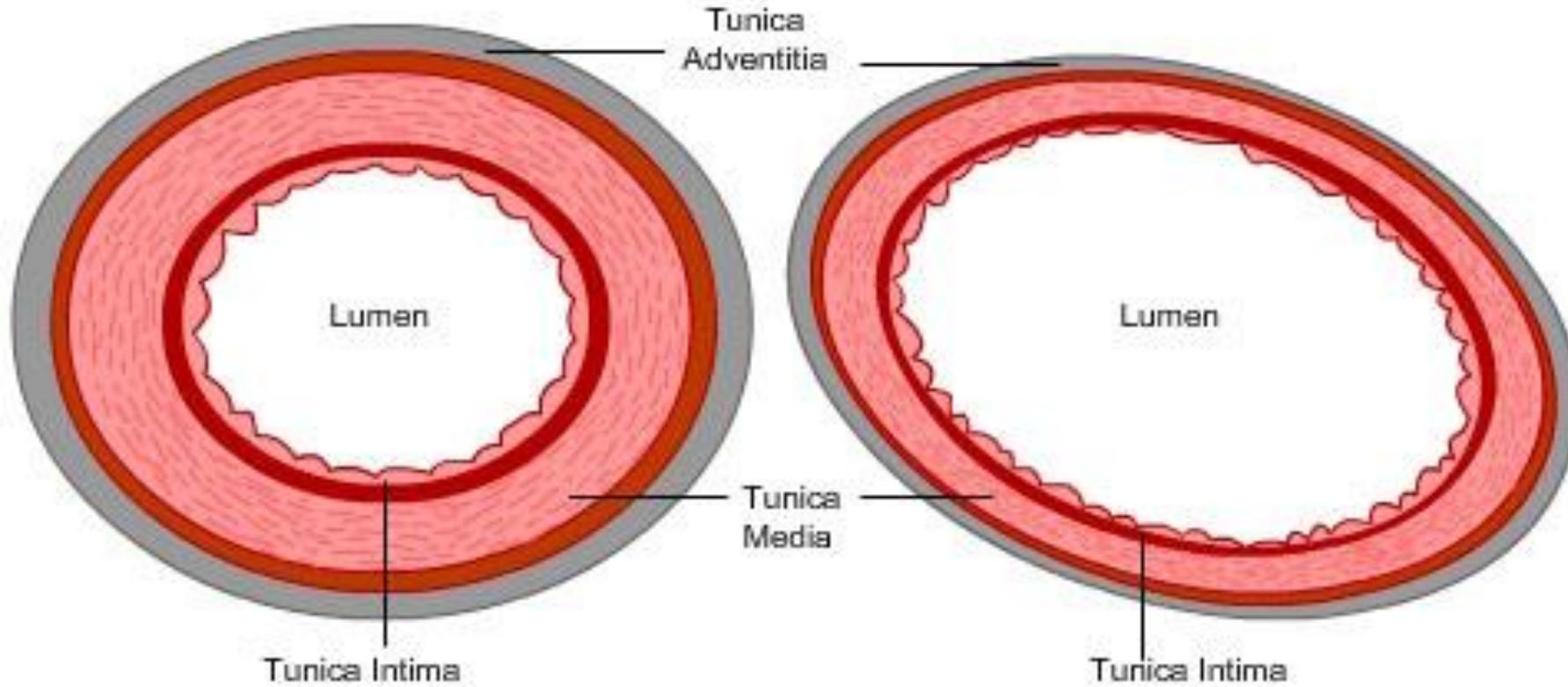
- Collapsible tubes that transport blood towards the heart from the capillaries
- Carries away waste products of cellular activity
- Starts at capillary level with an increase in size [venules (smallest); IVC (largest)]
- Compose of 3 layers or tunics
 - Tunica Adventitia – outermost
 - Tunica Media – middle
 - Tunica Intima - innermost

Venous Walls

- Tunica Adventitia – outermost layer
 - Thin layer of connective tissue
- Tunica Media – middle layer
 - Composed primarily of smooth muscle
 - Provides support and some resistance to dilatation
 - *** Histologic composition is the major difference between arteries and veins *****
 - Arteries have a thicker media as opposed to veins
- Tunica intima – inner layer
 - Endothelial cells that are one layer thick, provides “smoothness”

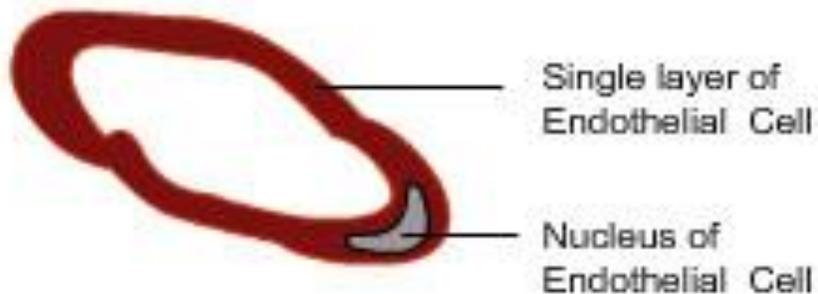
ARTERY

VEIN



- Media is thinner in veins
- Allows for compressibility and expansion

CAPILLARY



Valves

- Extensions of the intimal layer
- Allows for unidirectional blood flow to the heart
- Composed of 2 thin-walled cusps referred to as “Bicuspid valves”
- Valves are forced open by pressure below and closed via the pressure above
- Vein wall is slightly dilated at the level of each valve
 - Helps out with prompt valve closure
 - Downside: potential site for clot formation

PHILIPS

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L12-5/Vasc Art

FR 63Hz

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2D

68%

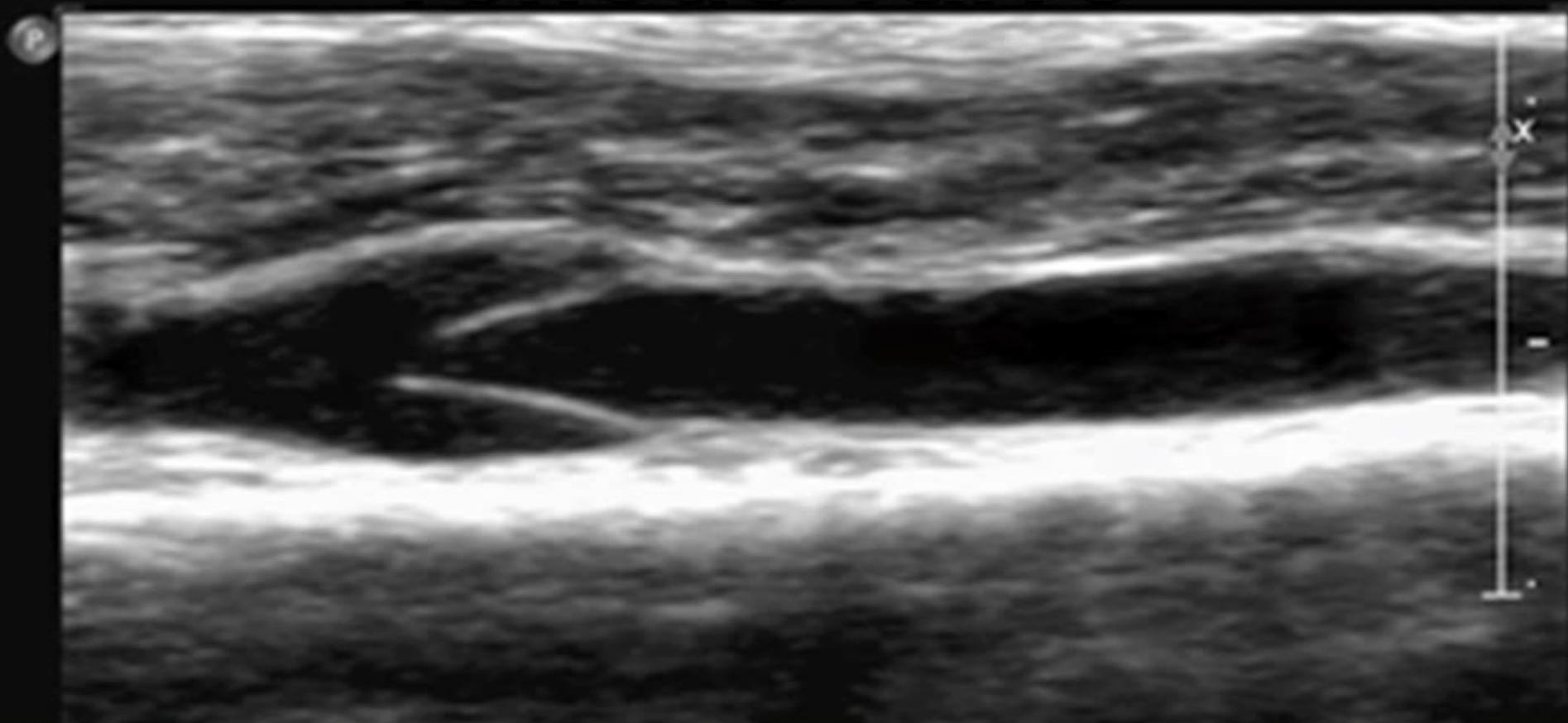
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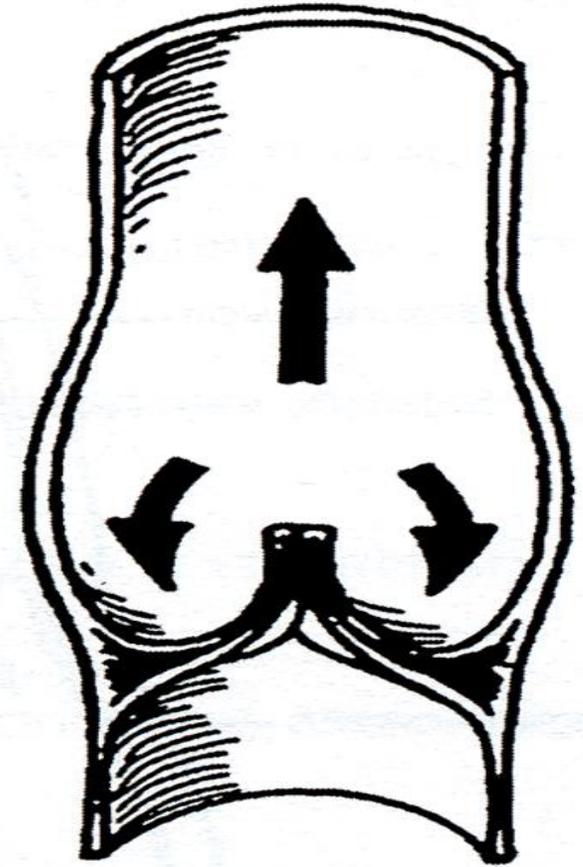
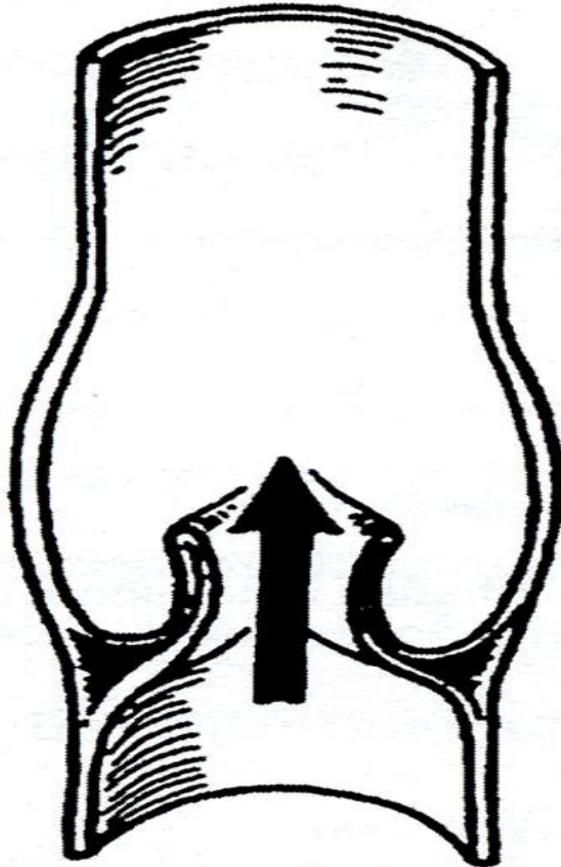
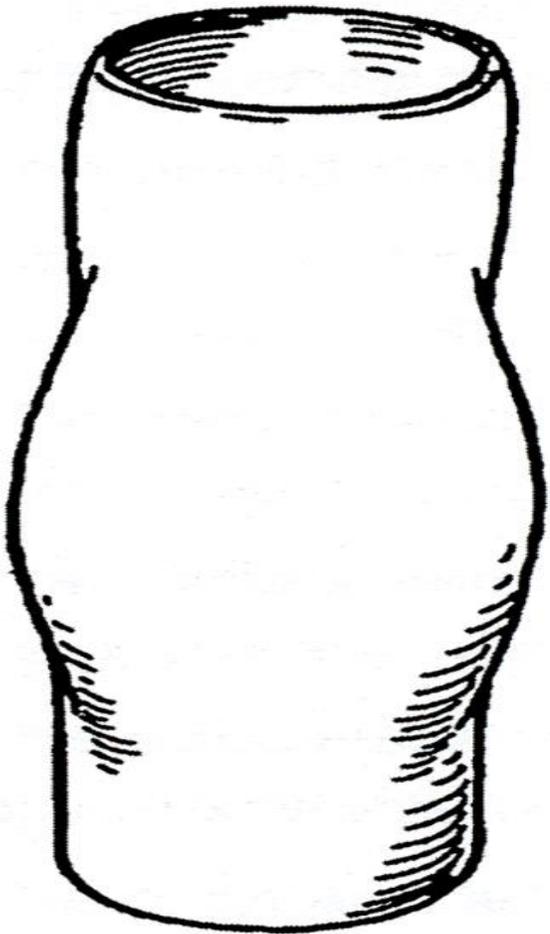
Res

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venous valve



Valves



Valves

- Valves of the lower extremities are susceptible to disease due to the effects of:
 - Venous thrombosis
 - Increased venous pressure from gravity
 - Increased intra-abdominal pressure
 - Venous obstruction

Superior Vena Cava

- Returns blood to the heart from the superior portion of the body
- Formed by the junction of the innominate veins (both right and left innominate)
- Begins near the sternum and ends in the superior portion of the right atrium
- Does not contain any valves
- Approximately 7 cm in length

Innominate Veins

- Also known as *Brachiocephalic* veins
- Formed by the internal jugular and subclavian veins
 - Does not contain any valves
 - Both the right and left brachiocephalic veins form the Superior Vena Cava

Inferior Vena Cava

- Returns blood to the right atrium from the organs below the diaphragm
- Formed by the junction of the right and left common iliac veins
- Enters the inferior portion of the right atrium
- Contains 1 valve at the entrance of the right atrium

Lower Extremity

- Venous system divided into 3 systems:
 - Deep system
 - Superficial system
 - Communicating or Perforating veins
- Since blood travels cephalad, we will begin with the foot and work our way up the leg

Deep Veins

- **Deep Digital Veins**

- Plantar digital and Dorsal digital veins join to form 4 Metatarsal Veins

- **Metatarsal Veins**

- Connected by perforators to the Dorsal Veins to form the Deep Plantar Venous Arch

- **Peroneal Veins**

- Paired veins that course along the lateral aspect of the leg near the fibula
 - Carries blood cephalad to the tibioperoneal trunk
 - Forms the common peroneal trunk

Posterior Tibial Veins

- Paired veins formed by plantar veins
- Course posterior to the tibia
- Carries blood cephalad to the tibioperoneal trunk
- Drains blood from the posterior aspect of the leg
- Tibioperoneal Trunk
 - Where the Common Tibial Trunk and the Common Peroneal Trunk converges

Anterior Tibial Veins

- Paired veins formed by the Dorsalis Pedis veins
- Lies lateral to the tibia (medial to the fibula)
- Drains blood from the front of the leg
- Joins with the tibioperoneal trunk veins to form the popliteal vein just below the level of the knee

Popliteal Vein

- Formed by the anterior tibial and the tibioperoneal trunk just below the knee
- **Gastrocnemius Muscular Vein**
 - Paired veins that drain the “muscle mass” of the calf
 - Drains into the popliteal vein
 - Resembles a “dumbbell” shape

Soleal Sinusoids

- Thin walled “reservoirs” that lie within the soleal muscle
- Drains into the Posterior Tibial and Peroneal Veins
- “Spindle Shaped” veins important for the “muscle pump” of the calf

****** Frequent site of Thrombus ******



Superficial Femoral

- This vein is part of the “DEEP” system, do not let the name confuse you
- A continuation of the popliteal vein
- Becomes the Superficial Femoral Vein (SFV) when it passes through the adductor hiatus, also known as adductor canal or Hunter’s canal

Common Femoral

- A continuation of the superficial femoral vein
- Formed by the SFV and Deep Femoral Vein (Profunda Femoris)
- Becomes the Common Femoral Vein (CFV) when it approaches the inguinal ligament
- Lies in the femoral triangle (Scarpa's triangle) medial to the Common Femoral Artery

External Iliac

- A continuation of the CFV
- Becomes the External Iliac Vein when it passed through the inguinal ligament
- Joins with the Internal Iliac Vein to form the Common Iliac Vein

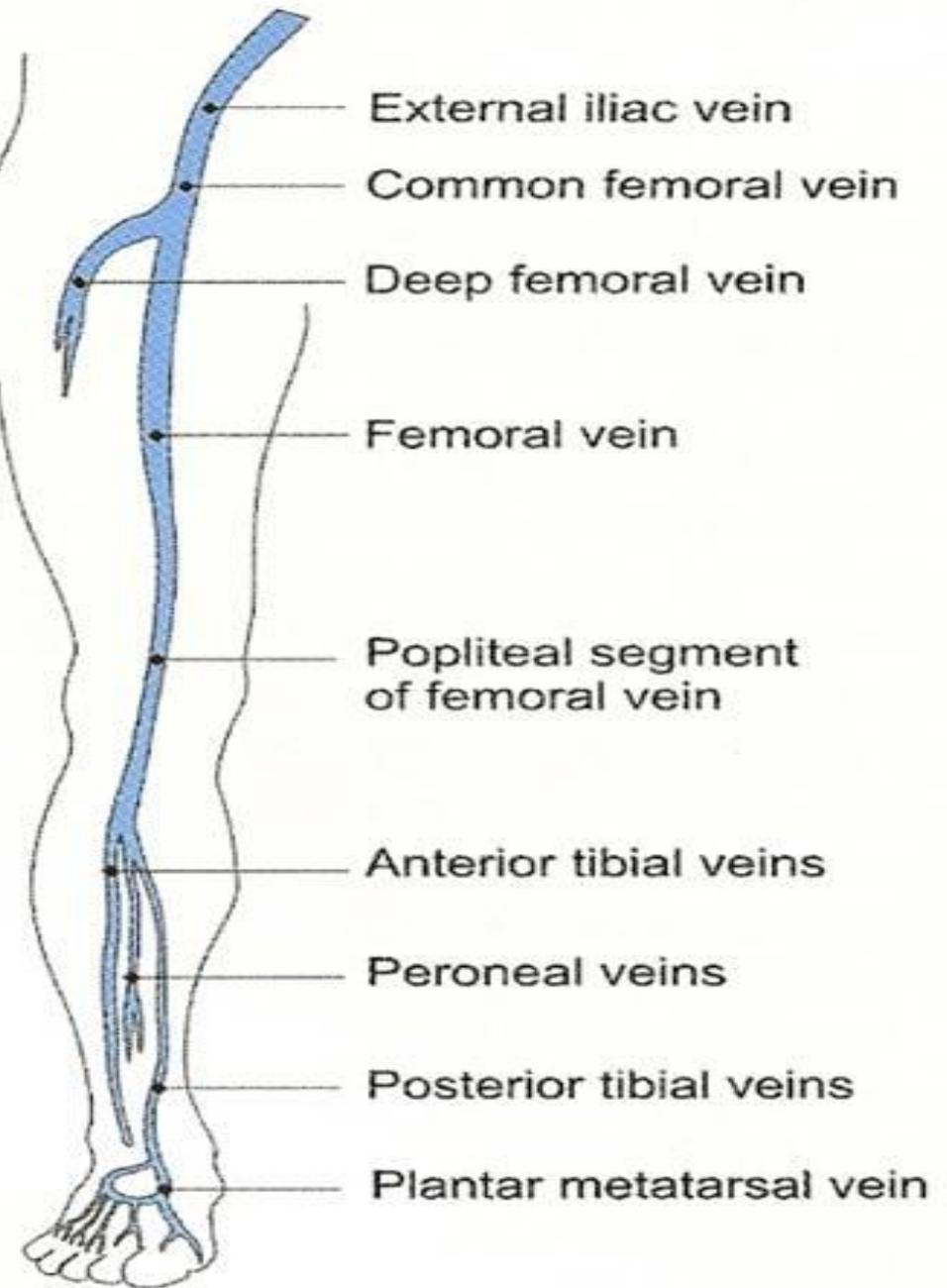
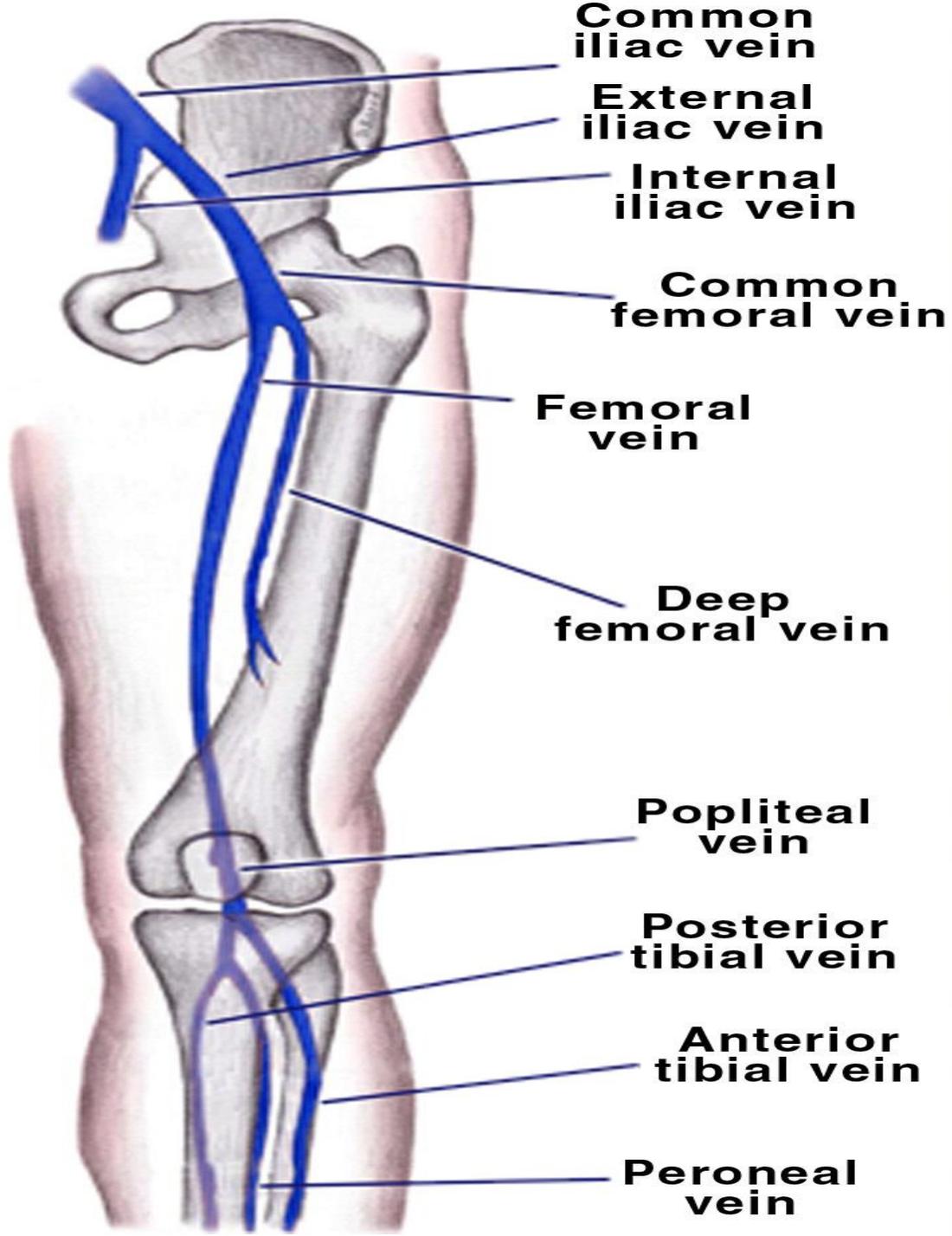
- Internal Iliac Vein
 - Drains the pelvis
 - Also called the “hypogastric vein”

Common Iliac

- Formed by the External Iliac and Internal Iliac Veins
- Left Common Iliac Vein courses behind the Right Iliac Artery
- Pressure on the Left CIV may account for a higher incidence of Deep Vein Thrombosis (DVT) and swelling of the leg
 - May-Thurner Syndrome*

Inferior Vena Cava

- Formed by the:
 - Right Common Iliac
 - Left Common Iliac
 - Commonly at the level of L5
- Carries blood to the right atrium of the heart



Superficial Veins

- Small Saphenous Vein

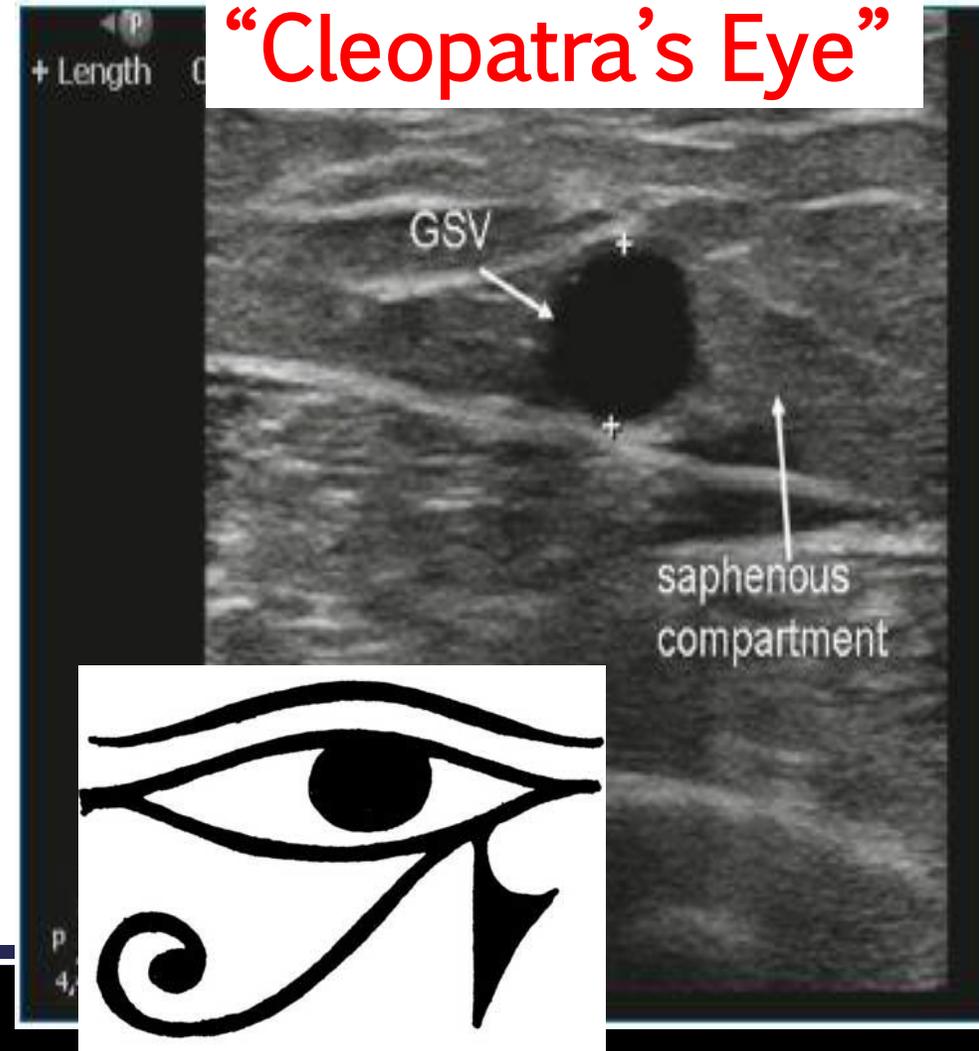
- Formerly called the Lesser or the Short Saphenous Vein
- Begins posterior to the lateral malleolus
- Courses midline along the back of the calf
- Normally joins the Popliteal vein
 - May continue up the posterior aspect of the thigh and unite with the Great Saphenous

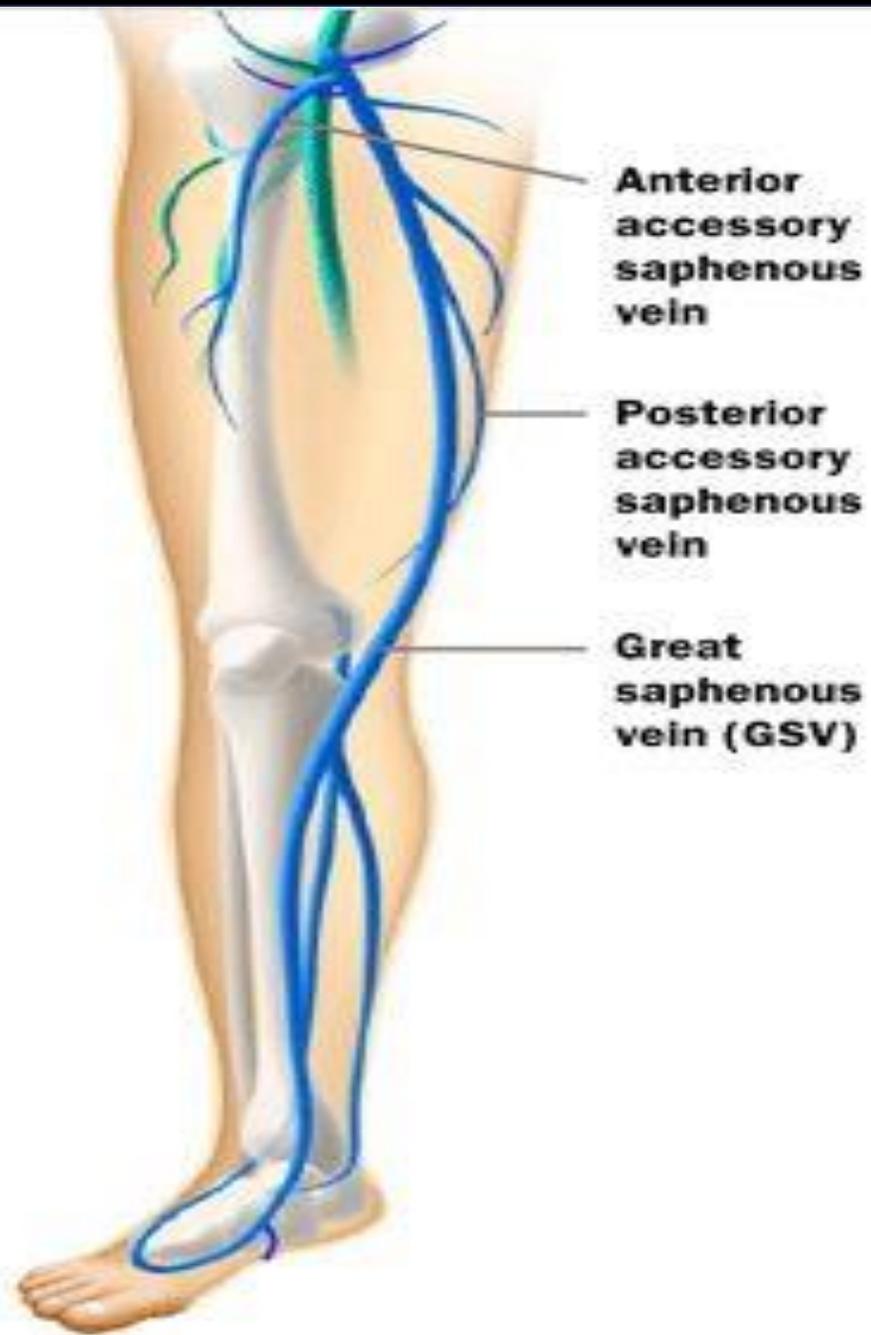
Superficial Veins

▪ Great Saphenous Vein

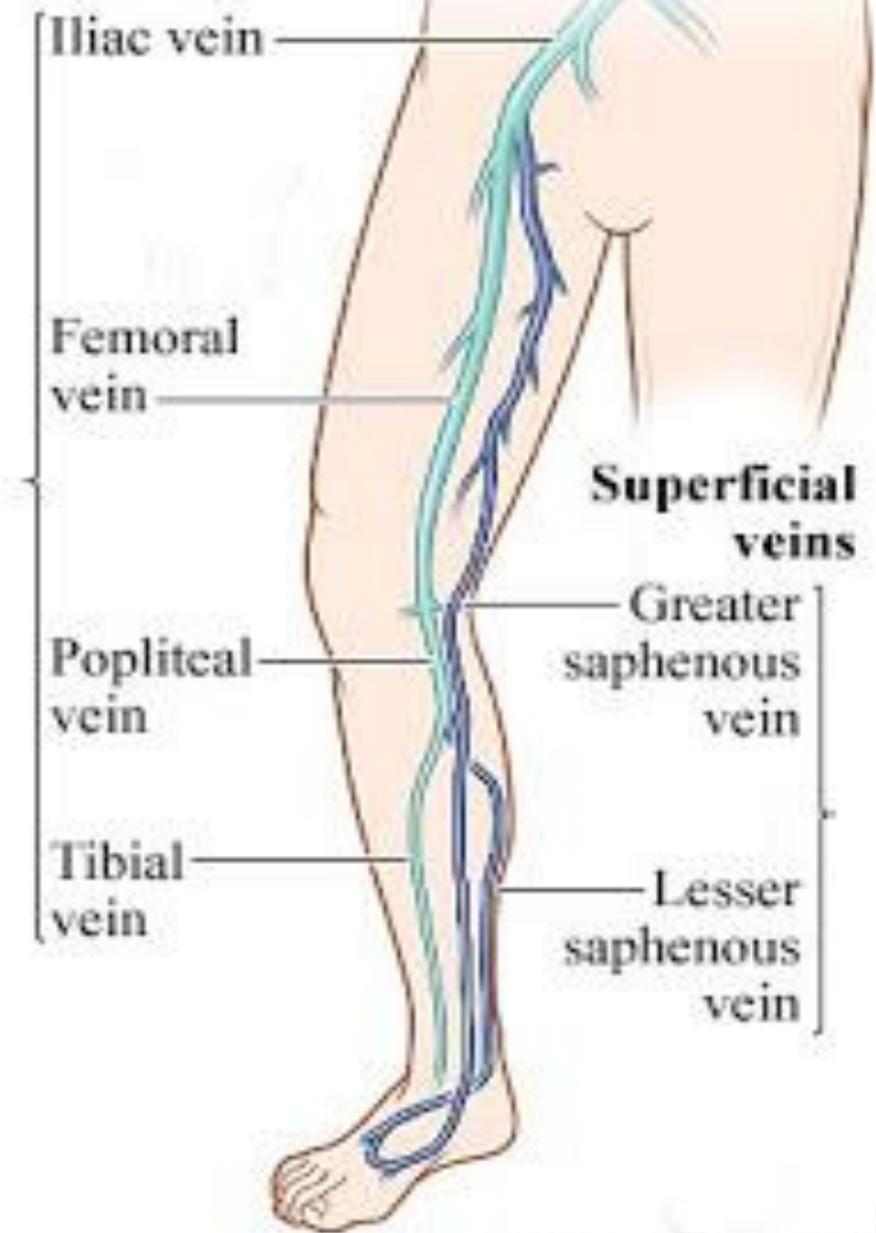
- Formed from digital veins that become larger venous channels of the foot
- Originates on the dorsum of the foot traveling medially to the Saphenofemoral Junction ending in the Common Femoral Vein
- Often duplicated (can have 2 GSV's)

LONGEST VEIN IN THE BODY



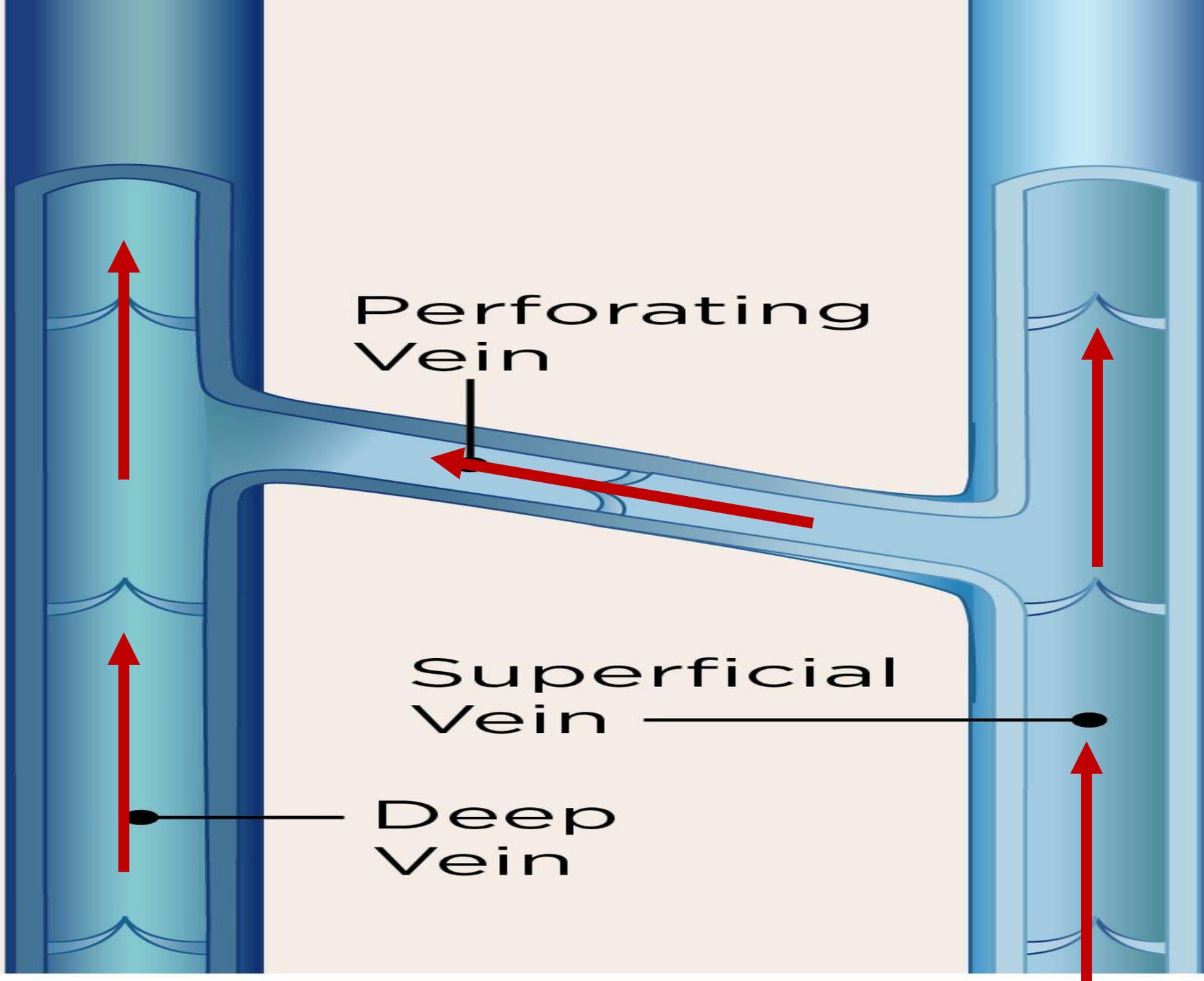


Deep veins



Perforating Veins

- Also known as Perforators
- Forms the communication between the superficial and deep venous systems
- *Carries blood from the superficial veins into the deep system* via the Perforators
- Contains valves that prevent bidirectional flow (as long as they are functioning properly)
 - Typically <2 mm and not easily visible if normal



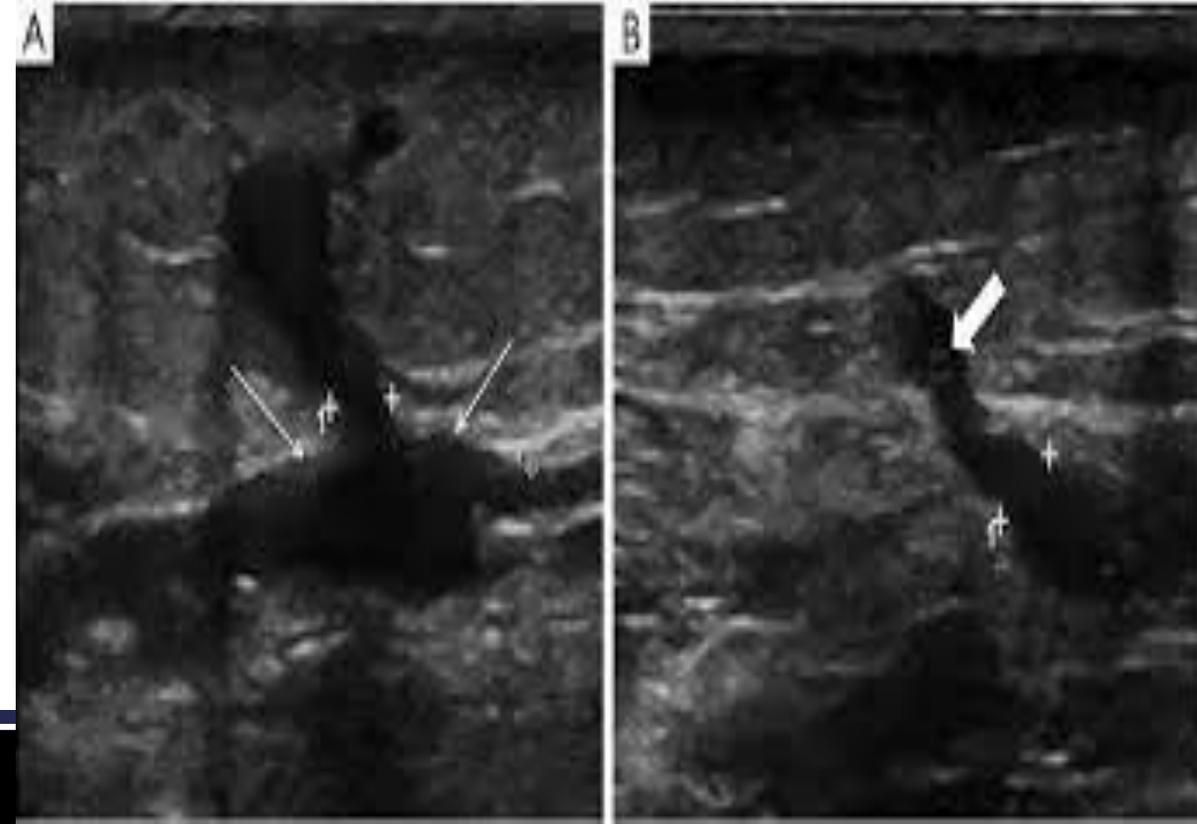
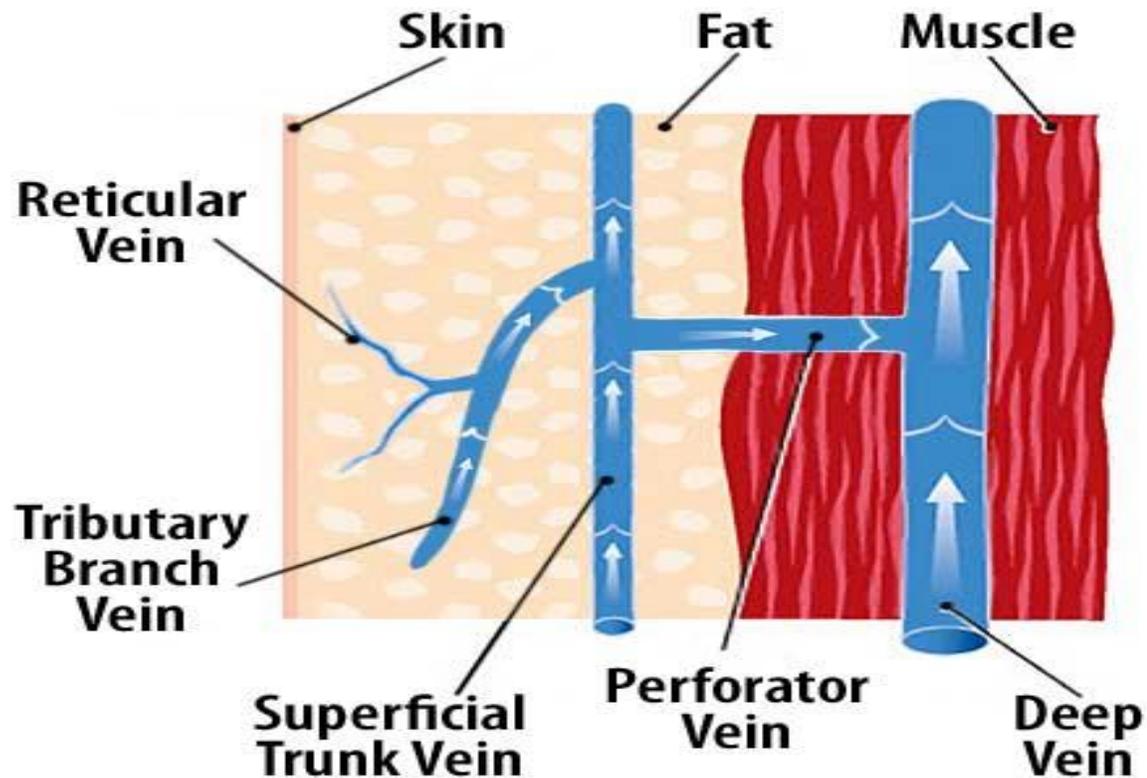
Perforating Vein

Superficial Vein

Deep Vein

Perforators

- Must cross the fascial plane (muscle covering) to connect the superficial and deep systems
- Assisted by the muscle pump mechanism



Perforators

- Most prominent in the calf
- There are a number of major perforators in the Great Saphenous, often seen with duplex imaging
- **Hunterian Perforator** – Great Saphenous and Superficial Femoral at the level of the adductor canal
- The Small Saphenous has several perforators

Perforators

- Greater Saphenous
 - Connecting to Posterior Tibial Veins
 - Multiple perforators in the calf
- Lesser Saphenous
 - Also connect to the deep system in the calf



Venous Sinuses

- Large sac-like veins that accumulate blood and then drain into the Posterior Tibial and Peroneal Veins
- Calf muscles – Soleal and Gastrocnemius
 - Squeeze the veins and allow the blood to move into the deep system, hence the “Calf Muscle Pump”

Valve Location & Number

No Valves	1 Valve	3-6 Valves	6-20 Valves
IVC SVC	Jugular	Femoral	Great Saphenous
Common Iliac Internal Iliac	**Perforators	SFV	Small Saphenous
*External Iliac	***CFV	Popliteal	Calf veins
Soleal Sinuses	Profunda Femoris		

*Usually valve-less; may have one valve in 25% of patients

**May have one or more

***Contain one valve 75% of the time, may be valve-less

Valves

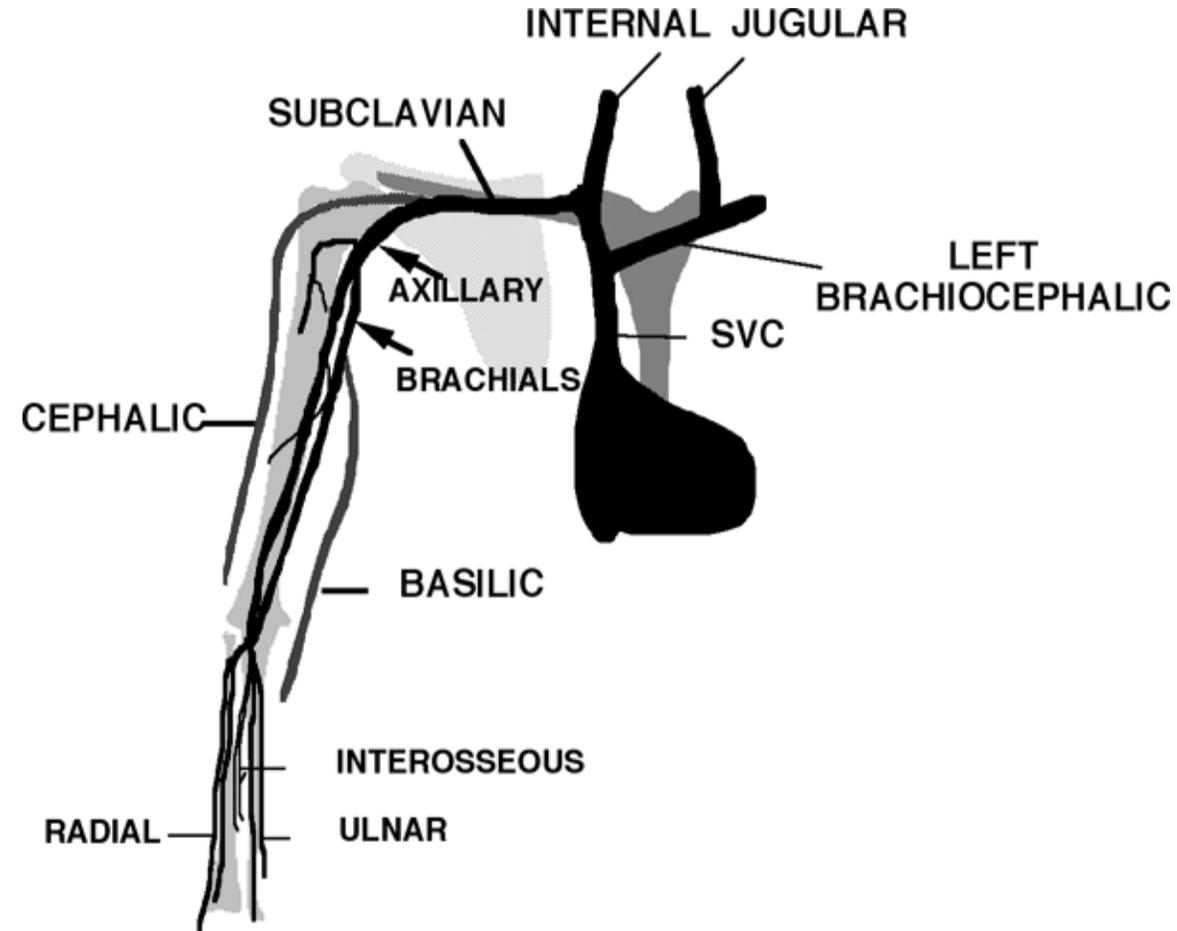
- The number of valves increases towards the foot
- Valves of the lower extremities are more susceptible to disease
- Valves are present in the deep system of the upper extremity but venous disease is uncommon compared to lower extremity

Upper Extremity

- Venous system divided into 2 systems:
 - Deep System
 - Superficial System
- Since blood travels cephalad, we will start at the hand and work up the arm

Brachial

- Formed by:
 - Radial Vein
 - Ulnar Vein
- Paired veins that usually begin near the antecubital fossa
- Have numerous anastomoses between the deep and superficial veins



Axillary

- Formed by:
 - Brachial Veins
 - Basilic Vein (Medial vein in the superficial system)
- Formed near the armpit

Subclavian

- Formed by:
 - Axillary Vein
 - Cephalic Vein (Lateral vein in the superficial system)
- Begins at the lateral border of the 1st rib and extends medially
- Runs below the clavicle level

Innominate

- Also known as Brachiocephalic Vein
- Formed by:
 - Subclavian Vein
 - Internal Jugular
 - Descends the neck anterior and lateral to the Carotid Artery
- Begins usually at the level of the clavicle

Superior Vena Cava

- Returns blood to the heart from the superior portion of the body
 - Formed by the junction of the innominate veins (both right and left innominate)
 - Begins near the sternum and ends in the superior portion of the right atrium

Superficial Veins

- Dorsal Digital Veins
 - Drain blood from the fingers
 - Pass along the sides of the finger
 - Unite into 3 Dorsal Metacarpal Veins
 - Metacarpal veins form the dorsal venous network

Basilic

- Formed by:
 - Digital veins on the medial aspect of the forearm
- Courses *medially* up the arm and joins the Brachial Veins to become the Axillary Vein

Cephalic

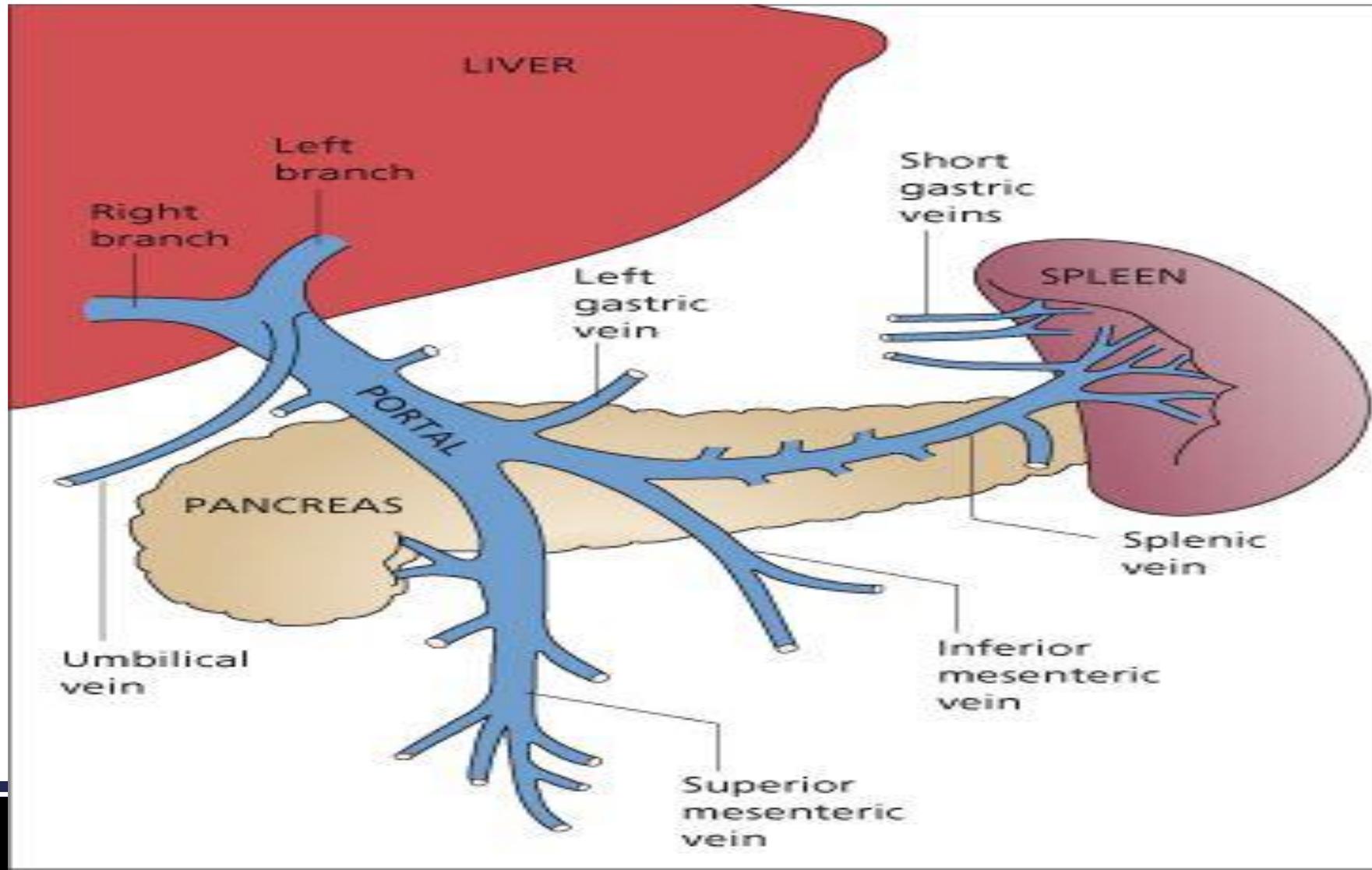
- Formed by:
 - Digital veins on the lateral aspect of the forearm
- Courses *laterally* up the arm and joins the Axillary Vein to form the Subclavian Vein
- Medial Cubital Vein – connects the Basilic and Cephalic Veins at the antecubital fossa

Abdominal Veins

- Portal System

- Drains blood from the digestive tract (pancreas, spleen, gallbladder, and mesentery) and carries it to the portal vein
- Portal vein is formed by the union of the Superior Mesenteric Vein and the Splenic Vein
- Hepatopetal* flow
- Main source of blood flow (~80%) into liver

Portal Venous System



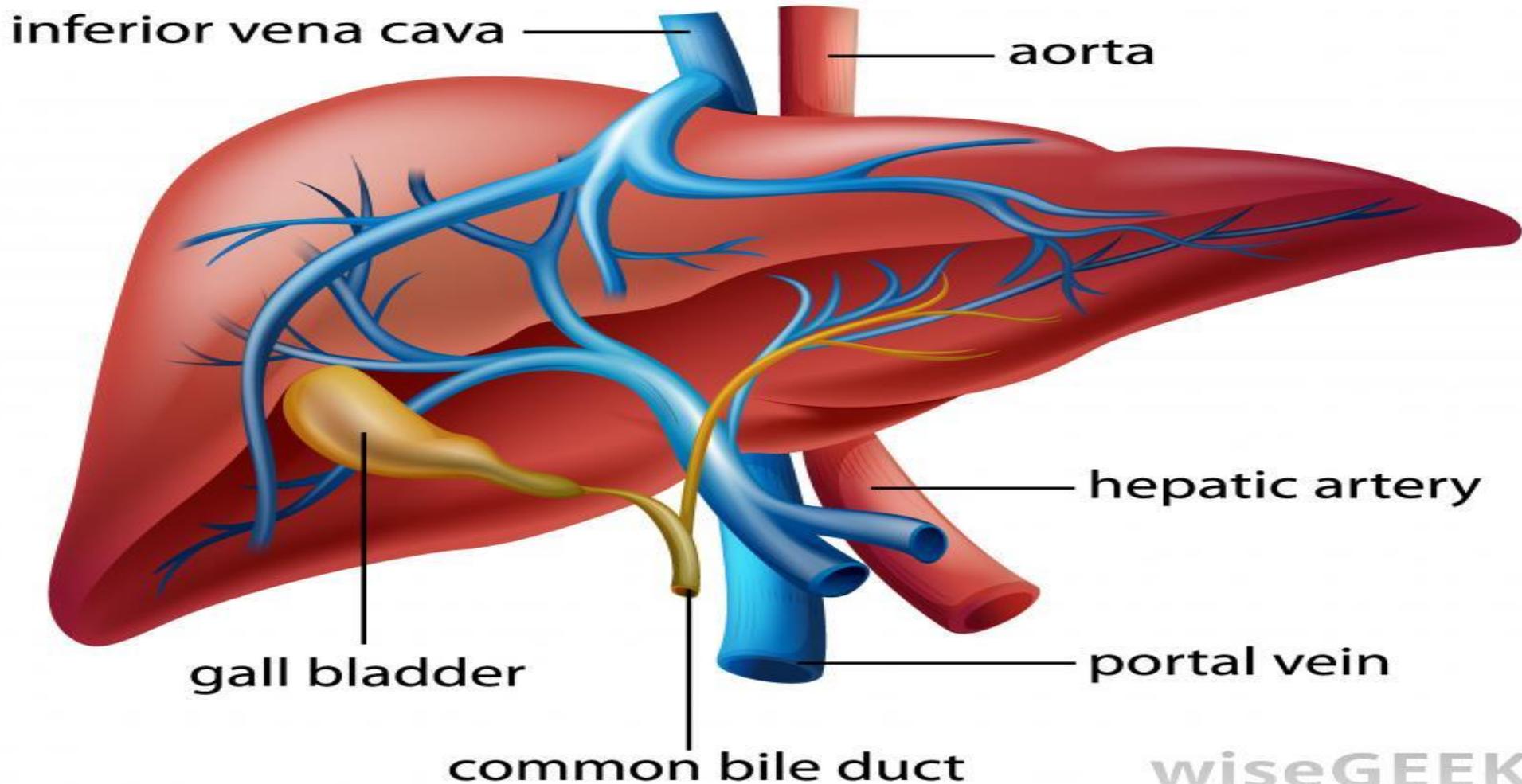
Abdominal Veins

- Hepatic Veins

- Carry blood from the liver into the inferior vena cava
- *Hepatofugal* flow
- Blood passes through two sets of veins before traveling back to the heart

Hepatic Veins

Human Liver Anatomy



Abdominal Veins

- Renal Veins

- Right and left renal veins drain blood from their respective kidney and carry it directly into the inferior vena cava
- Left renal vein crosses anterior to the aorta and is usually longer than the right renal vein
- Both renal veins are positioned anterior to their corresponding renal arteries
 - Remember V-A-U!

Renal Veins

