Key Concepts:

- Describe the histological similarities and differences of the blood vessels
- Explain the pattern and names of the major arteries and veins of the pulmonary & systemic circulations
- Describe the circulatory changes that occur at birth.
**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)
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
Arteries – ALWAYS carry blood away from heart

Veins – ALWAYS return blood to heart, contain about 2/3 body's blood at any given time
Largest, conducting arteries – lead directly from heart, subject to high pressures

Superior & inferior vena cava and their tributaries

Pulmonary trunk & aorta and their major branches
External and internal jugular, brachial & femoral veins

External and internal carotids, brachial & femoral arteries

Ø 2 - 9 mm

Ø ~ 4 mm
Remember: RBC ~ 7 µm
Capillaries

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

Most body regions

Only endothelium

Variably permeable

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

Somewhat permeable

Intestinal mucosa, choroid plexus, endocrine glands, kidneys

\( \varnothing \sim 8 \, \mu\text{m} \)
Sinusoids (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
Why are valves found in veins but not in arteries?
Gross Anatomy of Circulatory System

Pulmonary & Systemic Circulations
Right ventricle into pulmonary trunk to pulmonary arteries to lungs

Return by way of 4 pulmonary veins to left atrium
Systemic Circulation

Brachiocephalic trunk

1. Right common carotid artery
2. Thyrocervical trunk
3. Right subclavian artery

Left common carotid

Left subclavian artery

Aortic arch

Descending aorta

Ascending aorta
Arteries to the Head

- Common carotid (2)
- Vertebral Artery (2)
  - Through the transverse foramina
- Basilar Artery (1)
  - Through foramen magnum
- Circle of Willis
Circle of Willis = Cerebral Arterial Circle

- Ring of vessels surrounding pituitary gland - supplies cerebrum and cerebellum
- Brain can receive blood from carotid or vertebral or basilar aa.
  - Collateral circulation
    - (significance?)
Arteriovenous malformations (AVM) are masses of abnormal blood vessels which grow in the brain.
Dynamic angio
Arteries of the Arm

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

Body Worlds

Ulnar Artery

Radial Artery

Superficial Palmar Arch
Descending aorta

Thoracic aorta
Abdominal aorta

Abdominal aorta
Common iliac
External iliac
Femoral
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
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
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
- 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

Basilic v.

Median cubital v.

Cephalic v.

See Fig. 20.18
Portal Systems

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

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
Varicose Veins

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- ↑ 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 20.24
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

AO (Aorta), PA (Pulmonary Artery), LA (Left Atrium), LV (Left Ventricle), RA (Right Atrium), RV (Right Ventricle)