Anatomy of the Blood Vessels
• Vascular System
  – Arteries → arterioles
  – Veins → venules
  – Capillaries
MICROSCOPIC ANATOMY OF THE BLOOD VESSEL
Microscopic Anatomy of Blood Vessels

• The walls of the vascular system (except capillaries) have three coats or TUNICS.
  – TUNICA INTIMA. Lines the lumen, interior of the vessel, decreases friction as blood flows through.
  – TUNICA MEDIA. Middle coat, changes the diameter of the vessels.
  – TUNICA EXTERNA. Outermost tunic, support and protect the vessels.
Structure of Blood Vessels (a) Arteries and (b) veins share the same general features, but the walls of arteries are much thicker because of the higher pressure of the blood that flows through them.
Microscopic Anatomy of Blood Vessels

(c) A micrograph shows the relative differences in thickness. LM × 160. (Micrograph provided by the Regents of the University of Michigan Medical School c 2012)
Structural Differences in Arteries, Veins

- Artery walls are thick and strong to withstand pressure fluctuations. They expand and recoil as the heart beats.
- Vein walls are thinner, their lumens are larger, and they are equipped with valves. These modifications reflect the low-pressure nature of veins.
### Comparison of Arteries and Veins

<table>
<thead>
<tr>
<th></th>
<th>Arteries</th>
<th>Veins</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direction of blood flow</strong></td>
<td>Conducts blood away from the heart</td>
<td>Conducts blood toward the heart</td>
</tr>
<tr>
<td><strong>General appearance</strong></td>
<td>Rounded</td>
<td>Irregular, often collapsed</td>
</tr>
<tr>
<td><strong>Pressure</strong></td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Wall thickness</strong></td>
<td>Thick</td>
<td>Thin</td>
</tr>
<tr>
<td><strong>Relative oxygen concentration</strong></td>
<td>Higher in systemic arteries Lower in pulmonary arteries</td>
<td>Lower in systemic veins Higher in pulmonary veins</td>
</tr>
<tr>
<td><strong>Valves</strong></td>
<td>Not present</td>
<td>Present most commonly in limbs and in veins inferior to the heart</td>
</tr>
</tbody>
</table>

Table 20.2
Figure 20.15 Skeletal Muscle Pump The contraction of skeletal muscles surrounding a vein compresses the blood and increases the pressure in that area. This action forces blood closer to the heart where venous pressure is lower. Note the importance of the one-way valves to assure that blood flows only in the proper direction.
Capillaries

• Has transparent walls of one cell layer thick (just the tunica intima) facilitating exchanges.
• They form interweaving networks called capillary beds.
• Type of circulation that passes the capillary:
  – Microcirculation (arteriole - capillary bed-venule)
Capillaries

• Two types of vessels in the capillary bed:
  • A. Vascular Shunt. A vessel that directly connects the arteriole and the venule at the opposite ends of the bed.
  • B. True Capillaries. The actual exchange vessel.
Homeostatic Imbalance

• Varicose Veins.
  – Pooling of the blood in the feet and legs and inefficient venous return resulting from inactivity or pressure on the veins.
  – Thrombophlebitis
  – Pulmonary Embolism
GROSS ANATOMY OF THE BLOOD VESSELS
Major Arteries of the Systemic Circulation

• Aorta (largest artery of the body)
  – Ascending aorta
  – Aortic arch
  – Thoracic Aorta
  – Abdominal Aorta
The aorta has distinct regions, including the ascending aorta, aortic arch, and the descending aorta, which includes the thoracic and abdominal regions.
Spinal cord, cervical vertebrae, fuses with left vertebral to form basilar artery in cranium

Muscles, tissues, skin of neck, thyroid gland, shoulders, upper back

Right thyrocervical trunk

Right subclavian

Brachiocephalic trunk

Left subclavian

Left thyrocervical trunk

Right pectoral and axilla muscles

Right axillary

Skin and muscles of chest and abdomen, mammary gland, pericardium

Right internal thoracic

Right brachial

Right radial

Right ulnar

Ulnar side of forearm

Digital arteries

Left ventricle

Aortic arch

Thoracic aorta

Left radial

Left ulnar

Left brachial

Left digital arteries
Arterial Branches of the Thoracic Aorta

- Intercostal artery
- Bronchial artery
- Esophageal artery
- Phrenic artery.
Arterial Branches of the Abdominal Aorta

• Celiac trunk
  – L. gastric artery
  – Splenic artery
  – Common hepatic artery
• Superior mesenteric artery
• Renal Artery
• Gonadal artery
• Lumbar artery
• Inferior mesenteric artery

• Common iliac artery
  – Internal iliac artery
  – External iliac artery
    • Femoral artery
    • Deep artery of the thigh
    • Popliteal artery
    • Anterior/posterior tibial artery
    • Dorsalis pedis artery
    • Arcuate artery
Major Veins of the Systemic Circulation

• Superior vena cava
• Inferior vena cava

• Visit this site ([http://openstaxcollege.org/l/veinsum](http://openstaxcollege.org/l/veinsum)) for a brief online summary of the veins.
Veins Draining in the SVC

- Dural Sinuses
  - External Jugular Veins
  - Internal Jugular Veins
  - Vertebral Veins

- Subclavian Veins
- Brachiocephalic Veins
  - Azygos Veins
    - Superior vena cava

- Axillary Veins
- Brachial Veins
- Cephalic Veins
  - Median Cubital Veins
- Basilic Veins
- Radial and Ulnar Veins
SPECIAL CIRCULATIONS
Arterial Supply of the Brain and the Circle of Willis
Fetal Circulation

- Umbilical artery
  - Common Iliac artery
    - Fetal organs
      - Aorta
        - Ductus Arteriosus
          - Pulmonary Trunk
            - Small bld quantity to the lung
        - Tricuspid Valve
          - Right Ventricle
            - Pulmonic Valve
        - Foramen Ovale
          - Left Atrium
            - Mitral Valve
              - Left Ventricle
                - Aortic Valve
  - Umbilical Vein
    - O2, nutrient rich
    - Ductus Venosus
      - Inferior Vena Cava
        - Right Atrium
          - Tricuspid Valve
            - Right Ventricle
              - Aortic Valve
                - Common Iliac artery
                  - Fetal organs
                    - Aorta
                      - Ductus Arteriosus
                        - Pulmonary Trunk
                          - Small bld quantity to the lung

Hepatic Portal Circulation

- Oxygenated blood
- Hepatic artery
- Inferior/Superior mesenteric vein, Splenic vein, L. gastric vein
- Hepatic portal system veins
  - specialised immune cells termed kupffer cells
- Sinusoids
- Hepatic vein
- Inferior Vena Cava
Vital Signs

• T,P,R,BP

• Arterial Pulse
  – The pressure wave created by the alternating expansion and recoil of an artery that occurs with each beat of the left ventricle.

• Blood Pressure
  – The pressure exerted by the blood against the inner walls of the blood vessels and it is the force that keeps blood circulating continuously even between heartbeats.
Measuring Blood Pressure

• Two arterial blood pressure measurements:
  – Systolic Pressure – pressure in the arteries at the peak of ventricular contraction.
  – Diastolic Pressure – pressure when the ventricles are relaxing.

• Unit:
  – Millimeters of mercury (mm Hg)

• Method:
  – Auscultatory method in the brachial artery
Effects of Various factors on Blood Pressure

• BP = CO x PR
• CO – amount of blood pumped out of the left ventricle per minute.
• PR – the amount of friction the blood encounters as it flows through the blood vessels.
  – Neural factors (ANS)
  – Renal factors
  – Temperature
  – Chemicals
  – Diet
Variations in the Blood Pressure

- Hypotension / Hypertension
- Orthostatic Hypotension
- Acute and Chronic Hypotension
Capillary Exchange of Gases and Nutrients

- Substances move to and from blood and tissue cells through capillary walls.
- Some substances are transported in vesicles, but most move by diffusion – directly through the endothelial cells plasma membranes, through intercellular clefts, or through fenestrations.
- Fluid is forced from the bloodstream by blood pressure and drawn back into the blood by osmotic pressure.
Developmental Considerations

• CHD account for half of all infant deaths resulting from congenital problems.

• Arteriosclerosis is an expected consequence of aging. Gradual loss of elasticity in the arteries leads to CAD and stroke. CVD is an important cause of death in individuals over the age of 65.

• Modifications in diet, stopping smoking, and regular aerobic exercise may help to reverse the atherosclerotic process and prolong life.