ANATOMY OF THE CIRCULATORY SYSTEM
Divisions of the Circulatory System

- Human circulation can be divided as
  - Pulmonary circulation
  - Systemic circulation
- Both are closed circuits
- The two circuits are arranged in series
- The output of one becomes the input of the other
Diagram of blood flow

1. Right atrium (deoxygenated blood)
   - Tricuspid valve

2. Right ventricle
   - Pulmonary trunk and pulmonary arteries
     - Pulmonary valve

3. Pulmonary trunk and pulmonary arteries
   - Pulmonary veins (oxygenated blood)
     - Bicuspid valve

4. In pulmonary capillaries, blood loses CO₂ and gains O₂

5. Pulmonary veins (oxygenated blood)
   - Left atrium

6. Left atrium
   - Left ventricle
     - Aortic valve

7. Left ventricle
   - Aorta and systemic arteries

8. Aorta and systemic arteries
   - Superior vena cava
     - Inferior vena cava
     - Coronary sinus

9. In systemic capillaries, blood loses O₂ and gains CO₂

10. Superior vena cava
    - Inferior vena cava
    - Coronary sinus

Figure 20.07 Tortora - PAP 12/e
Copyright © John Wiley and Sons, Inc. All rights reserved.
Pulmonary Circulation

• Is the movement of blood from the heart to the lungs, and back to the heart again
• This type of circulation adds oxygen and removes carbon dioxide from the blood
Systemic Circulation

• Is the circulation of blood between the heart and the body
• Brings blood to and from the cells
• Can be subdivided into
  – **Coronary circulation**: supplies blood directly to the heart muscle
  – **Hepatic-portal circulation**
  – **Cerebral circulation**
Arteries of the upper limb

- Subclavian
- Axillary
- Brachial
- Radial
- Ulnar

Arteries of the head and trunk

- Internal carotid
- External carotid
- Left common carotid
- Brachiocephalic
- Aortic arch
- Pulmonary trunk
- Splenic
- Thoracic aorta
- Renal (kidney not shown)
- Celiac trunk
- Superior mesenteric
- Inferior mesenteric
- Abdominal aorta
- Common iliac
- Internal iliac

Arteries of the lower limb

- External iliac
- Deep femoral
- Femoral
- Popliteal
- Anterior tibial
- Posterior tibial
- Fibular
- Dorsalis pedis
Hepatic-Portal Circulation

- Carries nutrients from the gastrointestinal tract to maintain glucose level in the body
(b) Scheme of principal blood vessels of hepatic portal circulation and arterial supply and venous drainage of liver
Cerebral Circulation

Movement of blood through the network of blood vessels supplying the brain

Major arteries serving the brain
(inferior view, right side of cerebellum and part of right temporal lobe removed)

Anterior

Frontal lobe
Optic chiasma

Cerebral arterial circle (Circle of Willis)

Internal carotid artery
Mammillary body

Posterior

Temporal lobe
Pons
Occipital lobe

Basilar artery
Vertebral artery
Cerebellum
Cerebral Circulation

- The brain accounts for about 2% of the body weight
- Receives 17% of the cardiac output
- Consumes about 20% of the entire oxygen used by the body
- 10 seconds of interruption in blood flow leads to unconsciousness
Arterial supply of the head and neck

• The internal carotid artery supplies the brain
• The external carotid artery supplies the other parts of the head such as the face, scalp, skull and meninges.
Arterial supply of the upper extremity
Venous drainage of the upper extremity

- Path of venous blood flow from the upper limb to the right atrium
The Aorta and its branches

The Aorta is usually divided into 4 sections:

- Ascending Aorta (between the heart and the aortic arch)
- Aortic Arch
- Descending Aorta: this is divided into
  - Thoracic Aorta (above the diaphragm)
  - Abdominal Aorta (extends from below the diaphragm to the common iliac arteries)
Arterial supply of the lower extremity

• The major artery supplying the lower limb is the **femoral artery**

**Femoral artery**
• Continuation of the external iliac artery beyond the inguinal ligament
• Branches supply most of the thigh, all of the leg and foot
• Other arteries supplying parts of the lower limb are:
  - Superior gluteal
  - Inferior gluteal
  - Obturator
Arterial supply of the lower extremity

- Inferior vena cava
- Abdominal aorta
- Median sacral artery
- Internal iliac artery
- Lateral sacral artery
- Internal pudendal artery
- Obturator artery
- Femoral artery
- Deep femoral artery
- Popliteal artery
- Genicular arteries
- Anterior tibial artery
- Posterior tibial artery
- Dorsalis pedis artery
- Medial plantar artery
- Digital arteries
- Superior gluteal artery
- Common iliac artery
- External iliac artery
- Lateral circumflex artery
- Descending branch of lateral circumflex artery
- Fibular artery
- Lateral plantar artery
Major venous drainage of the lower extremity

Divided into two groups

• **Superficial:** originate from the dorsal venous arch in the foot
  - Great saphenous vein
  - Small saphenous vein

• **Deep:** generally follow the arteries
  - The major deep vein draining the lower limb is the **femoral vein**
  - Becomes the external iliac vein when it passes underneath the inguinal ligament to enter the abdomen
Venous drainage of the major systemic veins

The major systemic veins are:

**Superior vena cava**
- carries de-oxygenated blood from the upper half of the body to the right atrium
- Formed by the right and left brachiocephalic veins
- The azygos vein joins it just before it enters the right atrium

**Inferior vena cava**
- Carries de-oxygenated blood from the lower half of the body into the right atrium
- Formed by the union of the left and right common iliac veins
- Anastomoses with the azygos vein system (which runs on the right side of the vertebral column) and venous plexuses next to the spinal cord
Azygos system of veins

Major veins in the system are:

- The azygos vein on the right
- The hemiazygos vein and the accessory hemiazygos vein, on the left
- Serves as an important anastomotic pathway capable of returning venous blood from the lower part of the body to the heart if the inferior vena cava is blocked
• Pulmonary system is inactive in the fetus
• Oxygenated blood is shunted from the pulmonary to systemic circulation by two ways
  – foramen ovale (fossa ovalis in adults)
  – ductus arteriosus (ligamentum arteriosum in adults)
• Shunting allows for bypassing the pulmonary circulation
• The ductus venosus (ligamentum venosum in adults) shunts less than a third of the blood flow of the umbilical vein directly to the inferior vena cava
  – Allows oxygenated blood from the placenta to bypass the liver
• Closure of the ductus arteriosus and foramen ovale completes the transition of fetal circulation to newborn circulation