

Overview of Systemic Veins

Systemic veins return blood to the right atrium. Since the blood has already passed through the systemic capillaries, it will be relatively low in oxygen concentration. In many cases, there will be veins draining organs and regions of the body with the same name as the arteries that supplied these regions and the two often parallel one another. This is often described as a “complementary” pattern. However, there is a great deal more variability in the venous circulation than normally occurs in the arteries. For the sake of brevity and clarity, this text will discuss only the most commonly encountered patterns. However, keep this variation in mind when you move from the classroom to clinical practice.

In both the neck and limb regions, there are often both superficial and deeper levels of veins. The deeper veins generally correspond to the complementary arteries. The superficial veins do not normally have direct arterial counterparts, but in addition to returning blood, they also make contributions to the maintenance of body temperature. When the ambient temperature is warm, more blood is diverted to the superficial veins where heat can be more easily dissipated to the environment. In colder weather, there is more constriction of the superficial veins and blood is diverted deeper where the body can retain more of the heat.

The “Voyage of Discovery” analogy and stick drawings mentioned earlier remain valid techniques for the study of systemic veins, but veins present a more difficult challenge because there are numerous anastomoses and multiple branches. It is like following a river with many tributaries and channels, several of which interconnect. Tracing blood flow through arteries follows the current in the direction of blood flow, so that we move from the heart through the large arteries and into the smaller arteries to the capillaries. From the capillaries, we move into the smallest veins and follow the direction of blood flow into larger veins and back to the heart. **Figure 20.35** outlines the path of the major systemic veins.

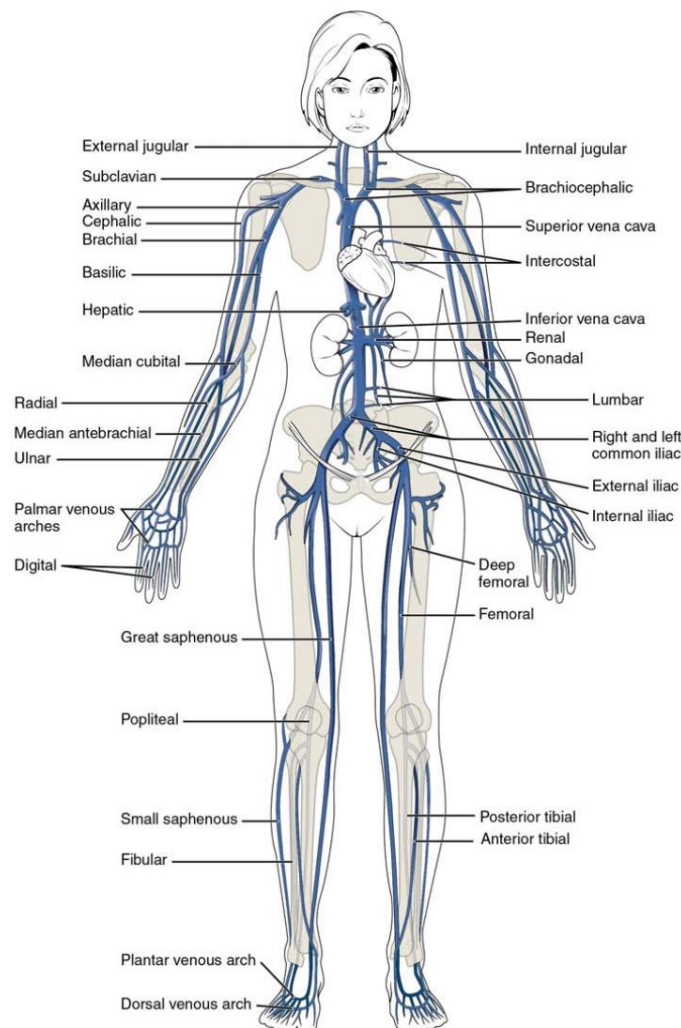


Figure 20.35 Major Systemic Veins of the Body The major systemic veins of the body are shown here in an anterior view.

The right atrium receives all of the systemic venous return. Most of the blood flows into either the superior vena cava or inferior vena cava. If you draw an imaginary line at the level of the diaphragm, systemic venous circulation from above that line will generally flow into the superior vena cava; this includes blood from the head, neck, chest, shoulders, and upper limbs. The exception to this is that most venous blood flow from the coronary veins flows directly into the coronary sinus and from there directly into the right atrium. Beneath the diaphragm, systemic venous flow enters the inferior vena cava, that is, blood from the abdominal and pelvic regions and the lower limbs.

The Superior Vena Cava

The **superior vena cava** drains most of the body superior to the diaphragm (**Figure 20.36**). On both the left and right sides, the **subclavian vein** forms when the axillary vein passes through the body wall from the axillary region. It fuses with the external and internal jugular veins from the head and neck to form the **brachiocephalic vein**. Each **vertebral vein** also flows into the brachiocephalic vein close to this fusion. These veins arise from the base of the brain and the cervical region

of the spinal cord, and flow largely through the intervertebral foramina in the cervical vertebrae. They are the counterparts of the vertebral arteries. Each **internal thoracic vein**, also known as an internal mammary vein, drains the anterior surface of the chest wall and flows into the brachiocephalic vein.

The remainder of the blood supply from the thorax drains into the azygos vein. Each **intercostal vein** drains muscles of the thoracic wall, each **esophageal vein** delivers blood from the inferior portions of the esophagus, each **bronchial vein** drains the systemic circulation from the lungs, and several smaller veins drain the mediastinal region. Bronchial veins carry approximately 13 percent of the blood that flows into the bronchial arteries; the remainder intermingles with the pulmonary circulation and returns to the heart via the pulmonary veins. These veins flow into the **azygos vein**, and with the smaller **hemiazygos vein** (hemi- = “half”) on the left of the vertebral column, drain blood from the thoracic region. The hemiazygos vein does not drain directly into the superior vena cava but enters the brachiocephalic vein via the superior intercostal vein.

The azygos vein passes through the diaphragm from the thoracic cavity on the right side of the vertebral column and begins in the lumbar region of the thoracic cavity. It flows into the superior vena cava at approximately the level of T2, making a significant contribution to the flow of blood. It combines with the two large left and right brachiocephalic veins to form the superior vena cava.

Table 20.11 summarizes the veins of the thoracic region that flow into the superior vena cava.

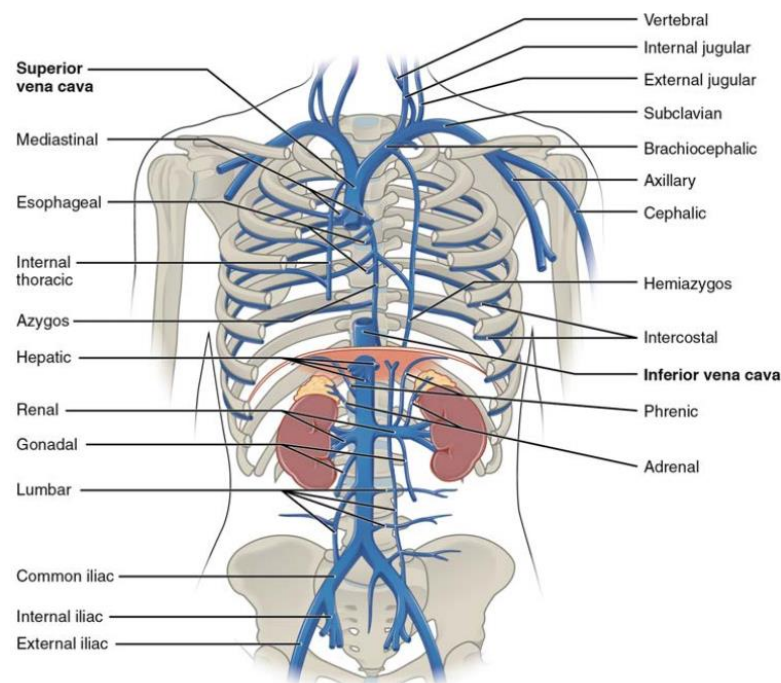


Figure 20.36 Veins of the Thoracic and Abdominal Regions Veins of the thoracic and abdominal regions drain blood from the area above the diaphragm, returning it to the right atrium via the superior vena cava.

Veins of the Thoracic Region

Vessel	Description
Superior vena cava	Large systemic vein; drains blood from most areas superior to the diaphragm; empties into the right atrium
Subclavian vein	Located deep in the thoracic cavity; formed by the axillary vein as it enters the thoracic cavity from the axillary region; drains the axillary and smaller local veins near the scapular region and leads to the brachiocephalic vein

Table 20.11

Veins of the Thoracic Region

Vessel	Description
Brachiocephalic veins	Pair of veins that form from a fusion of the external and internal jugular veins and the subclavian vein; subclavian, external and internal jugulars, vertebral, and internal thoracic veins flow into it; drain the upper thoracic region and lead to the superior vena cava
Vertebral vein	Arises from the base of the brain and the cervical region of the spinal cord; passes through the intervertebral foramina in the cervical vertebrae; drains smaller veins from the cranium, spinal cord, and vertebrae, and leads to the brachiocephalic vein; counterpart of the vertebral artery
Internal thoracic veins	Also called internal mammary veins; drain the anterior surface of the chest wall and lead to the brachiocephalic vein
Intercostal vein	Drains the muscles of the thoracic wall and leads to the azygos vein
Esophageal vein	Drains the inferior portions of the esophagus and leads to the azygos vein
Bronchial vein	Drains the systemic circulation from the lungs and leads to the azygos vein
Azygos vein	Originates in the lumbar region and passes through the diaphragm into the thoracic cavity on the right side of the vertebral column; drains blood from the intercostal veins, esophageal veins, bronchial veins, and other veins draining the mediastinal region, and leads to the superior vena cava
Hemiazygos vein	Smaller vein complementary to the azygos vein; drains the esophageal veins from the esophagus and the left intercostal veins, and leads to the brachiocephalic vein via the superior intercostal vein

Table 20.11

Veins of the Head and Neck

Blood from the brain and the superficial facial vein flow into each **internal jugular vein** (Figure 20.37). Blood from the more superficial portions of the head, scalp, and cranial regions, including the **temporal vein** and **maxillary vein**, flow into each **external jugular vein**. Although the external and internal jugular veins are separate vessels, there are anastomoses between them close to the thoracic region. Blood from the external jugular vein empties into the subclavian vein. **Table 20.12** summarizes the major veins of the head and neck.

Major Veins of the Head and Neck

Vessel	Description
Internal jugular vein	Parallel to the common carotid artery, which is more or less its counterpart, and passes through the jugular foramen and canal; primarily drains blood from the brain, receives the superficial facial vein, and empties into the subclavian vein
Temporal vein	Drains blood from the temporal region and flows into the external jugular vein
Maxillary vein	Drains blood from the maxillary region and flows into the external jugular vein
External jugular vein	Drains blood from the more superficial portions of the head, scalp, and cranial regions, and leads to the subclavian vein

Table 20.12

Venous Drainage of the Brain

Circulation to the brain is both critical and complex (see **Figure 20.37**). Many smaller veins of the brain stem and the superficial veins of the cerebrum lead to larger vessels referred to as intracranial sinuses. These include the superior and inferior sagittal sinuses, straight sinus, cavernous sinuses, left and right sinuses, the petrosal sinuses, and the occipital sinuses. Ultimately, sinuses will lead back to either the inferior jugular vein or vertebral vein.

Most of the veins on the superior surface of the cerebrum flow into the largest of the sinuses, the **superior sagittal sinus**. It is located midsagittally between the meningeal and periosteal layers of the dura mater within the falx cerebri and, at first glance in images or models, can be mistaken for the subarachnoid space. Most reabsorption of cerebrospinal fluid

occurs via the chorionic villi (arachnoid granulations) into the superior sagittal sinus. Blood from most of the smaller vessels originating from the inferior cerebral veins flows into the **great cerebral vein** and into the **straight sinus**. Other cerebral veins and those from the eye socket flow into the **cavernous sinus**, which flows into the **petrosal sinus** and then into the internal jugular vein. The **occipital sinus**, sagittal sinus, and straight sinuses all flow into the left and right transverse sinuses near the lambdoid suture. The **transverse sinuses** in turn flow into the **sigmoid sinuses** that pass through the jugular foramen and into the internal jugular vein. The internal jugular vein flows parallel to the common carotid artery and is more or less its counterpart. It empties into the brachiocephalic vein. The veins draining the cervical vertebrae and the posterior surface of the skull, including some blood from the occipital sinus, flow into the vertebral veins. These parallel the vertebral arteries and travel through the transverse foramina of the cervical vertebrae. The vertebral veins also flow into the brachiocephalic veins. **Table 20.13** summarizes the major veins of the brain.

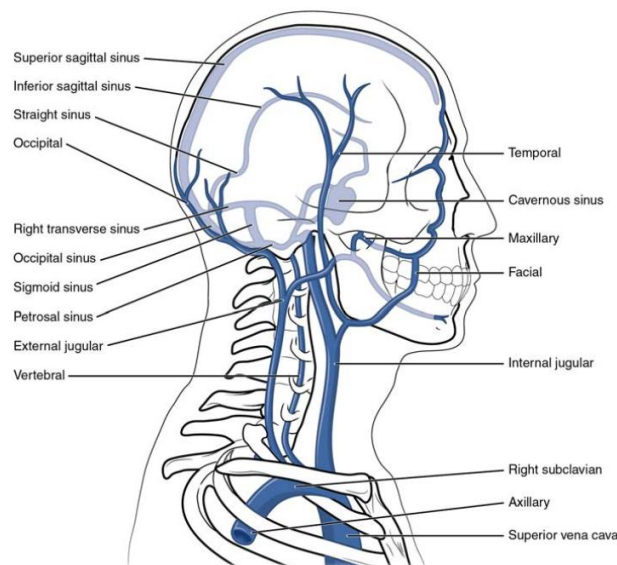


Figure 20.37 Veins of the Head and Neck This left lateral view shows the veins of the head and neck, including the intercranial sinuses.

Major Veins of the Brain

Vessel	Description
Superior sagittal sinus	Enlarged vein located midsagittally between the meningeal and periosteal layers of the dura mater within the falx cerebri; receives most of the blood drained from the superior surface of the cerebrum and leads to the inferior jugular vein and the vertebral vein
Great cerebral vein	Receives most of the smaller vessels from the inferior cerebral veins and leads to the straight sinus
Straight sinus	Enlarged vein that drains blood from the brain; receives most of the blood from the great cerebral vein and leads to the left or right transverse sinus
Cavernous sinus	Enlarged vein that receives blood from most of the other cerebral veins and the eye socket, and leads to the petrosal sinus

Table 20.13

Major Veins of the Brain

Vessel	Description
Petrosal sinus	Enlarged vein that receives blood from the cavernous sinus and leads into the internal jugular veins
Occipital sinus	Enlarged vein that drains the occipital region near the falx cerebelli and leads to the left and right transverse sinuses, and also the vertebral veins
Transverse sinuses	Pair of enlarged veins near the lambdoid suture that drains the occipital, sagittal, and straight sinuses, and leads to the sigmoid sinuses
Sigmoid sinuses	Enlarged vein that receives blood from the transverse sinuses and leads through the jugular foramen to the internal jugular vein

Veins Draining the Upper Limbs

The **digital veins** in the fingers come together in the hand to form the **palmar venous arches** (Figure 20.38). From here, the veins come together to form the radial vein, the ulnar vein, and the median antebrachial vein. The **radial vein** and the **ulnar vein** parallel the bones of the forearm and join together at the antebrachium to form the **brachial vein**, a deep vein that flows into the axillary vein in the brachium.

The **median antebrachial vein** parallels the ulnar vein, is more medial in location, and joins the **basilic vein** in the forearm. As the basilic vein reaches the antecubital region, it gives off a branch called the **median cubital vein** that crosses at an angle to join the cephalic vein. The median cubital vein is the most common site for drawing venous blood in humans. The basilic vein continues through the arm medially and superficially to the axillary vein.

The **cephalic vein** begins in the antebrachium and drains blood from the superficial surface of the arm into the axillary vein. It is extremely superficial and easily seen along the surface of the biceps brachii muscle in individuals with good muscle tone and in those without excessive subcutaneous adipose tissue in the arms.

The **subscapular vein** drains blood from the subscapular region and joins the cephalic vein to form the **axillary vein**. As it passes through the body wall and enters the thorax, the axillary vein becomes the subclavian vein.

Many of the larger veins of the thoracic and abdominal region and upper limb are further represented in the flow chart in Figure 20.39. Table 20.14 summarizes the veins of the upper limbs.

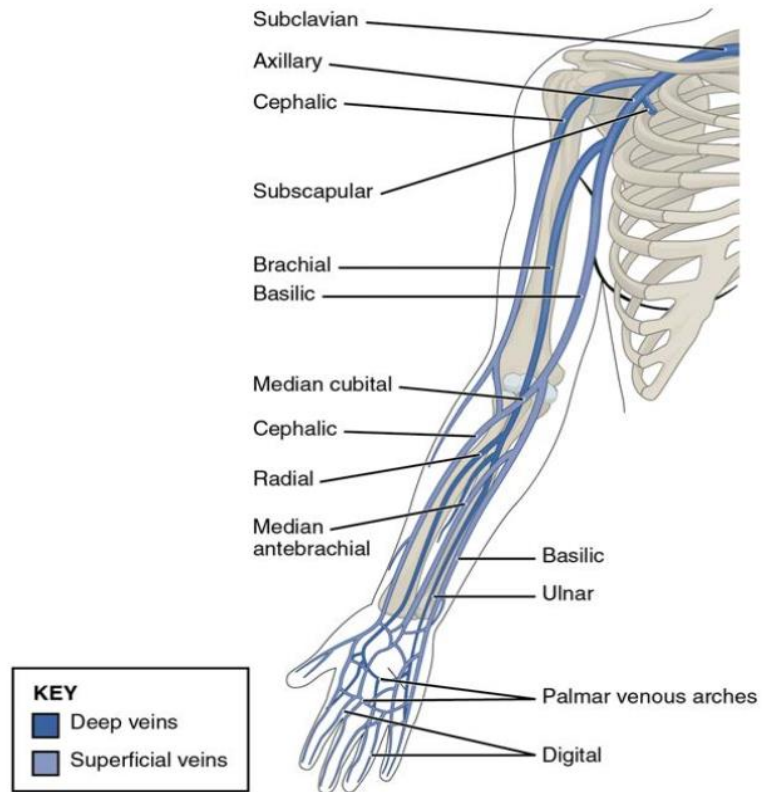


Figure 20.38 Veins of the Upper Limb This anterior view shows the veins that drain the upper limb.

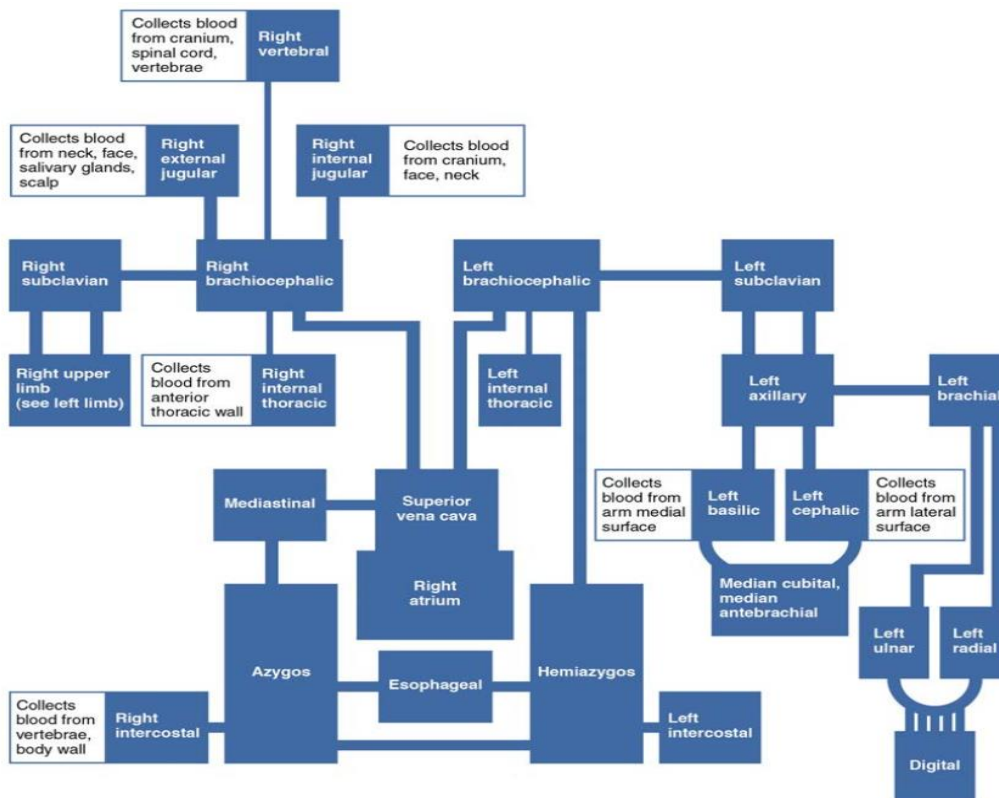


Figure 20.39 Veins Flowing into the Superior Vena Cava The flow chart summarizes the distribution of the veins flowing into the superior vena cava.

Veins of the Upper Limbs

Vessel	Description
Digital veins	Drain the digits and lead to the palmar arches of the hand and dorsal venous arch of the foot
Palmar venous arches	Drain the hand and digits, and lead to the radial vein, ulnar veins, and the median antebrachial vein
Radial vein	Vein that parallels the radius and radial artery; arises from the palmar venous arches and leads to the brachial vein
Ulnar vein	Vein that parallels the ulna and ulnar artery; arises from the palmar venous arches and leads to the brachial vein
Brachial vein	Deeper vein of the arm that forms from the radial and ulnar veins in the lower arm; leads to the axillary vein
Median antebrachial vein	Vein that parallels the ulnar vein but is more medial in location; intertwines with the palmar venous arches; leads to the basilic vein

Table 20.14

Veins of the Upper Limbs

Vessel	Description
Basilic vein	Superficial vein of the arm that arises from the median antebrachial vein, intersects with the median cubital vein, parallels the ulnar vein, and continues into the upper arm; along with the brachial vein, it leads to the axillary vein
Median cubital vein	Superficial vessel located in the antecubital region that links the cephalic vein to the basilic vein in the form of a v; a frequent site from which to draw blood
Cephalic vein	Superficial vessel in the upper arm; leads to the axillary vein
Subscapular vein	Drains blood from the subscapular region and leads to the axillary vein
Axillary vein	The major vein in the axillary region; drains the upper limb and becomes the subclavian vein

The Inferior Vena Cava

Other than the small amount of blood drained by the azygos and hemiazygos veins, most of the blood inferior to the diaphragm drains into the inferior vena cava before it is returned to the heart (see **Figure 20.36**). Lying just beneath the parietal peritoneum in the abdominal cavity, the **inferior vena cava** parallels the abdominal aorta, where it can receive blood from abdominal veins. The lumbar portions of the abdominal wall and spinal cord are drained by a series of **lumbar veins**, usually four on each side. The ascending lumbar veins drain into either the azygos vein on the right or the hemiazygos vein on the left, and return to the superior vena cava. The remaining lumbar veins drain directly into the inferior vena cava.

Blood supply from the kidneys flows into each **renal vein**, normally the largest veins entering the inferior vena cava. A number of other, smaller veins empty into the left renal vein. Each **adrenal vein** drains the adrenal or suprarenal glands located immediately superior to the kidneys. The right adrenal vein enters the inferior vena cava directly, whereas the left adrenal vein enters the left renal vein.

From the male reproductive organs, each **testicular vein** flows from the scrotum, forming a portion of the spermatic cord. Each **ovarian vein** drains an ovary in females. Each of these veins is generically called a **gonadal vein**. The right gonadal vein empties directly into the inferior vena cava, and the left gonadal vein empties into the left renal vein.

Each side of the diaphragm drains into a **phrenic vein**; the right phrenic vein empties directly into the inferior vena cava, whereas the left phrenic vein empties into the left renal vein. Blood supply from the liver drains into each **hepatic vein** and directly into the inferior vena cava. Since the inferior vena cava lies primarily to the right of the vertebral column and aorta, the left renal vein is longer, as are the left phrenic, adrenal, and gonadal veins. The longer length of the left renal vein makes the left kidney the primary target of surgeons removing this organ for donation. **Figure 20.40** provides a flow chart of the veins flowing into the inferior vena cava. **Table 20.15** summarizes the major veins of the abdominal region.

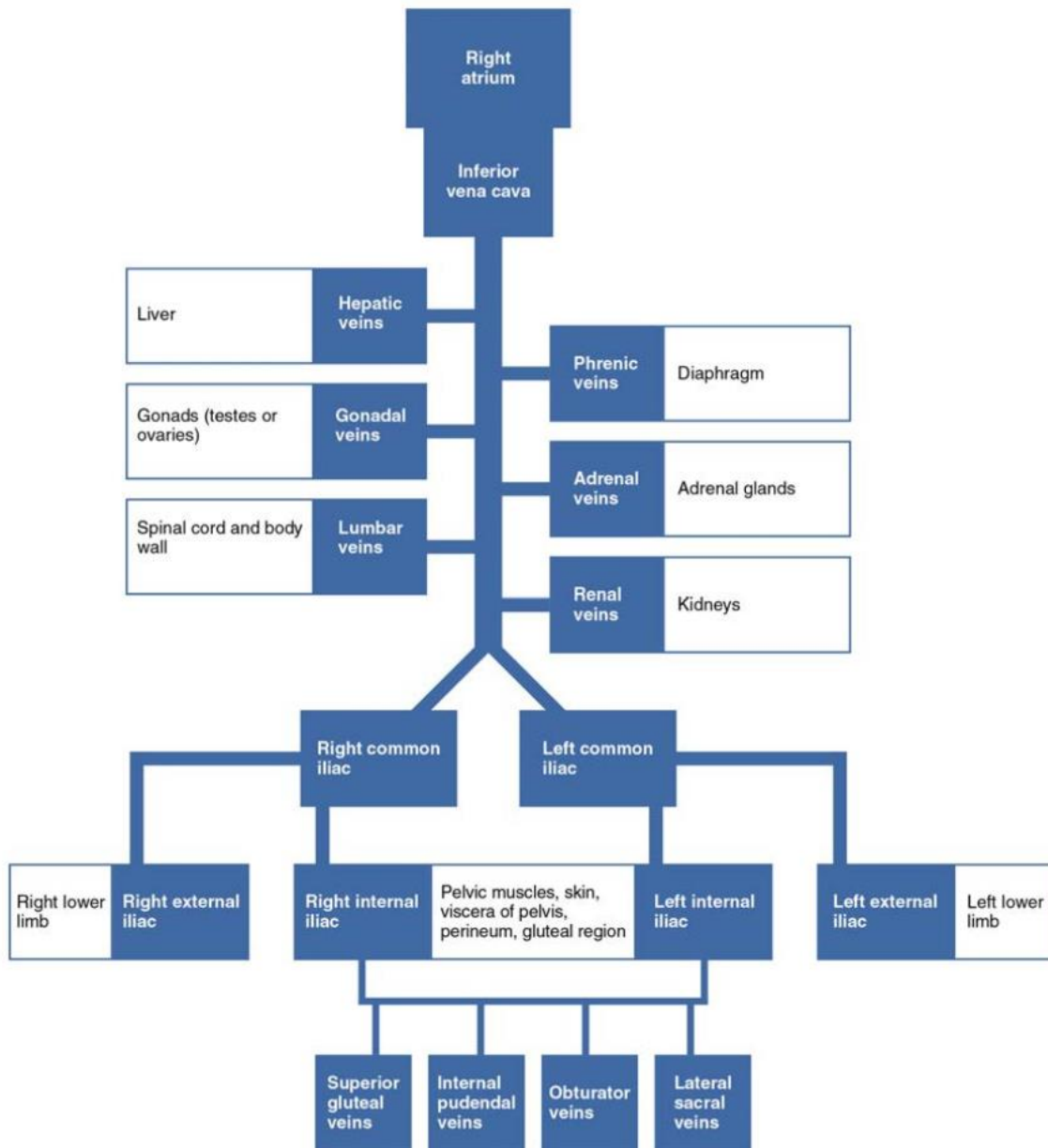


Figure 20.40 Venous Flow into Inferior Vena Cava The flow chart summarizes veins that deliver blood to the inferior vena cava.

Major Veins of the Abdominal Region

Vessel	Description
Inferior vena cava	Large systemic vein that drains blood from areas largely inferior to the diaphragm; empties into the right atrium
Lumbar veins	Series of veins that drain the lumbar portion of the abdominal wall and spinal cord; the ascending lumbar veins drain into the azygos vein on the right or the hemiazygos vein on the left; the remaining lumbar veins drain directly into the inferior vena cava
Renal vein	Largest vein entering the inferior vena cava; drains the kidneys and flows into the inferior vena cava
Adrenal vein	Drains the adrenal or suprarenal; the right adrenal vein enters the inferior vena cava directly and the left adrenal vein enters the left renal vein

Vessel	Description
Testicular vein	Drains the testes and forms part of the spermatic cord; the right testicular vein empties directly into the inferior vena cava and the left testicular vein empties into the left renal vein
Ovarian vein	Drains the ovary; the right ovarian vein empties directly into the inferior vena cava and the left ovarian vein empties into the left renal vein
Gonadal vein	Generic term for a vein draining a reproductive organ; may be either an ovarian vein or a testicular vein, depending on the sex of the individual
Phrenic vein	Drains the diaphragm; the right phrenic vein flows into the inferior vena cava and the left phrenic vein empties into the left renal vein
Hepatic vein	Drains systemic blood from the liver and flows into the inferior vena cava

Table 20.15

Veins Draining the Lower Limbs

The superior surface of the foot drains into the digital veins, and the inferior surface drains into the **plantar veins**, which flow into a complex series of anastomoses in the feet and ankles, including the **dorsal venous arch** and the **plantar venous arch** (Figure 20.41). From the dorsal venous arch, blood supply drains into the anterior and posterior tibial veins. The **anterior tibial vein** drains the area near the tibialis anterior muscle and combines with the posterior tibial vein and the fibular vein to form the popliteal vein. The **posterior tibial vein** drains the posterior surface of the tibia and joins the popliteal vein. The **fibular vein** drains the muscles and integument in proximity to the fibula and also joins the popliteal vein. The **small saphenous vein** located on the lateral surface of the leg drains blood from the superficial regions of the lower leg and foot, and flows into to the **popliteal vein**. As the popliteal vein passes behind the knee in the popliteal region, it becomes the femoral vein. It is palpable in patients without excessive adipose tissue.

Close to the body wall, the great saphenous vein, the deep femoral vein, and the femoral circumflex vein drain into the femoral vein. The **great saphenous vein** is a prominent surface vessel located on the medial surface of the leg and thigh that collects blood from the superficial portions of these areas. The **deep femoral vein**, as the name suggests, drains blood from the deeper portions of the thigh. The **femoral circumflex vein** forms a loop around the femur just inferior to the trochanters and drains blood from the areas in proximity to the head and neck of the femur.

As the **femoral vein** penetrates the body wall from the femoral portion of the upper limb, it becomes the **external iliac vein**, a large vein that drains blood from the leg to the common iliac vein. The pelvic organs and integument drain into the **internal iliac vein**, which forms from several smaller veins in the region, including the umbilical veins that run on either side of the bladder. The external and internal iliac veins combine near the inferior portion of the sacroiliac joint to form the common iliac vein. In addition to blood supply from the external and internal iliac veins, the **middle sacral vein** drains the sacral region into the **common iliac vein**. Similar to the common iliac arteries, the common iliac veins come together at the level of L5 to form the inferior vena cava.

Figure 20.42 is a flow chart of veins flowing into the lower limb. Table 20.16 summarizes the major veins of the lower limbs.

Lecture 14

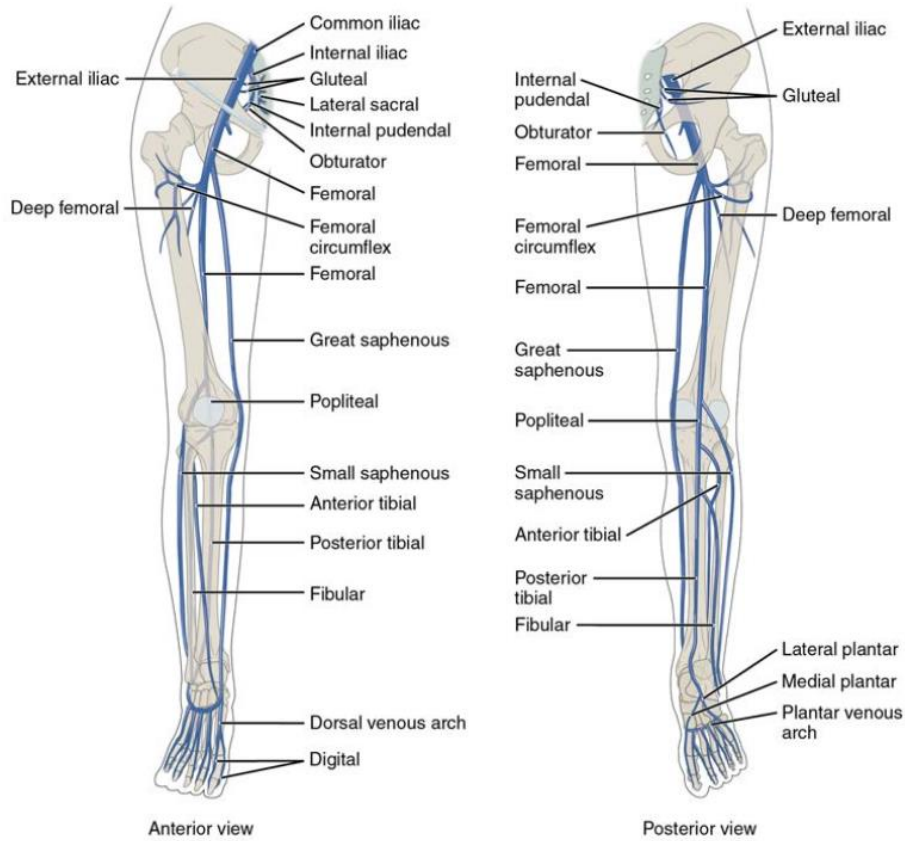


Figure 20.41 Major Veins Serving the Lower Limbs Anterior and posterior views show the major veins that drain the lower limb into the inferior vena cava.

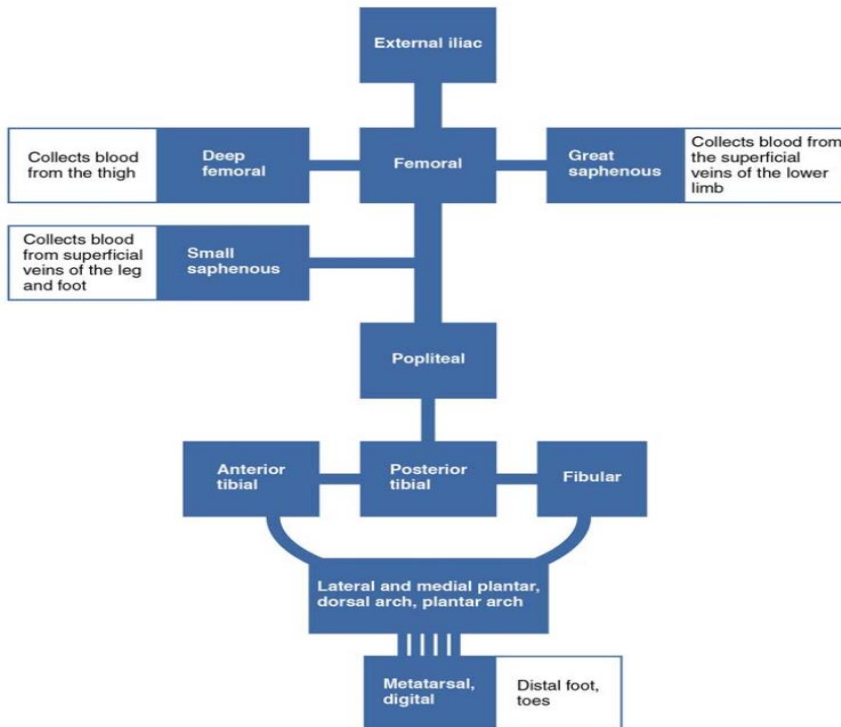


Figure 20.42 Major Veins of the Lower Limb The flow chart summarizes venous flow from the lower limb.

Veins of the Lower Limbs

Vessel	Description
Plantar veins	Drain the foot and flow into the plantar venous arch
Dorsal venous arch	Drains blood from digital veins and vessels on the superior surface of the foot
Plantar venous arch	Formed from the plantar veins; flows into the anterior and posterior tibial veins through anastomoses
Anterior tibial vein	Formed from the dorsal venous arch; drains the area near the tibialis anterior muscle and flows into the popliteal vein
Posterior tibial vein	Formed from the dorsal venous arch; drains the area near the posterior surface of the tibia and flows into the popliteal vein
Fibular vein	Drains the muscles and integument near the fibula and flows into the popliteal vein
Small saphenous vein	Located on the lateral surface of the leg; drains blood from the superficial regions of the lower leg and foot, and flows into the popliteal vein
Popliteal vein	Drains the region behind the knee and forms from the fusion of the fibular, anterior, and posterior tibial veins; flows into the femoral vein

Vessel	Description
Great saphenous vein	Prominent surface vessel located on the medial surface of the leg and thigh; drains the superficial portions of these areas and flows into the femoral vein
Deep femoral vein	Drains blood from the deeper portions of the thigh and flows into the femoral vein
Femoral circumflex vein	Forms a loop around the femur just inferior to the trochanters; drains blood from the areas around the head and neck of the femur; flows into the femoral vein
Femoral vein	Drains the upper leg; receives blood from the great saphenous vein, the deep femoral vein, and the femoral circumflex vein; becomes the external iliac vein when it crosses the body wall
External iliac vein	Formed when the femoral vein passes into the body cavity; drains the legs and flows into the common iliac vein
Internal iliac vein	Drains the pelvic organs and integument; formed from several smaller veins in the region; flows into the common iliac vein
Middle sacral vein	Drains the sacral region and flows into the left common iliac vein
Common iliac vein	Flows into the inferior vena cava at the level of L5; the left common iliac vein drains the sacral region; formed from the union of the external and internal iliac veins near the inferior portion of the sacroiliac joint

Table 20.16

Hepatic Portal System

The liver is a complex biochemical processing plant. It packages nutrients absorbed by the digestive system; produces plasma proteins, clotting factors, and bile; and disposes of worn-out cell components and waste products. Instead of entering the circulation directly, absorbed nutrients and certain wastes (for example, materials produced by the spleen) travel to the liver for processing. They do so via the **hepatic portal system** (Figure 20.43). Portal systems begin and end in capillaries. In this case, the initial capillaries from the stomach, small intestine, large intestine, and spleen lead to the hepatic portal vein and end in specialized capillaries within the liver, the hepatic sinusoids. You saw the only other portal system with the hypothalamic-hypophyseal portal vessel in the endocrine chapter.

The hepatic portal system consists of the hepatic portal vein and the veins that drain into it. The hepatic portal vein itself is relatively short, beginning at the level of L2 with the confluence of the superior mesenteric and splenic veins. It also receives branches from the inferior mesenteric vein, plus the splenic veins and all their tributaries. The superior mesenteric vein receives blood from the small intestine, two-thirds of the large intestine, and the stomach. The inferior mesenteric vein drains the distal third of the large intestine, including the descending colon, the sigmoid colon, and the rectum. The splenic vein is formed from branches from the spleen, pancreas, and portions of the stomach, and the inferior mesenteric vein. After its formation, the hepatic portal vein also receives branches from the gastric veins of the stomach and cystic veins from the gall bladder. The hepatic portal vein delivers materials from these digestive and circulatory organs directly to the liver for processing.

Because of the hepatic portal system, the liver receives its blood supply from two different sources: from normal systemic circulation via the hepatic artery and from the hepatic portal vein. The liver processes the blood from the portal system to remove certain wastes and excess nutrients, which are stored for later use. This processed blood, as well as the systemic blood that came from the hepatic artery, exits the liver via the right, left, and middle hepatic veins, and flows into the inferior vena cava. Overall systemic blood composition remains relatively stable, since the liver is able to metabolize the absorbed digestive components.

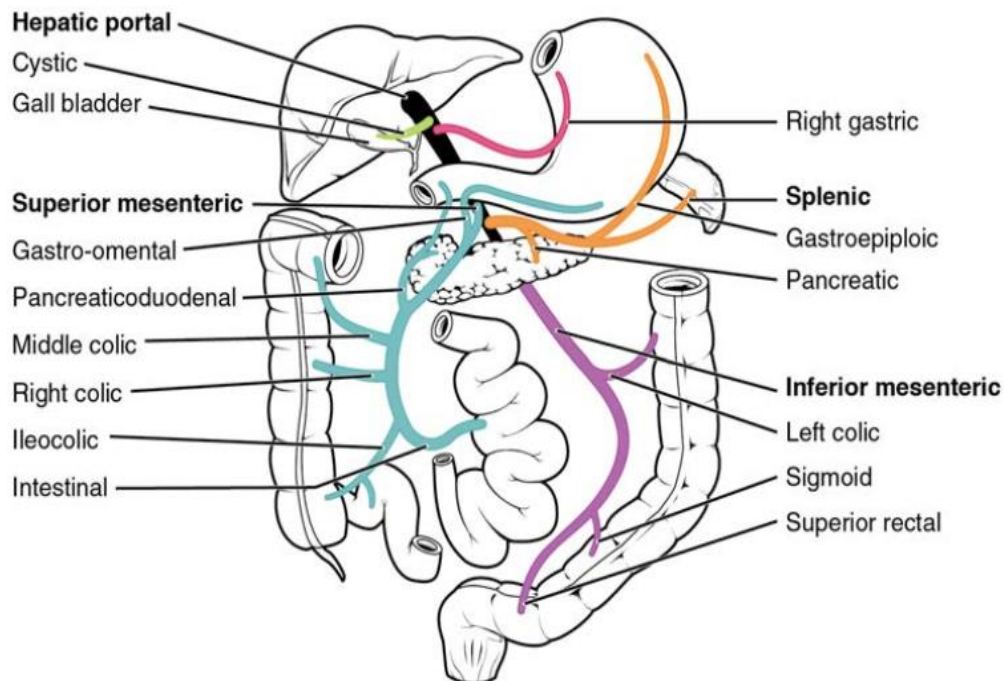


Figure 20.43 Hepatic Portal System The liver receives blood from the normal systemic circulation via the hepatic artery. It also receives and processes blood from other organs, delivered via the veins of the hepatic portal system. All blood exits the liver via the hepatic vein, which delivers the blood to the inferior vena cava. (Different colors are used to help distinguish among the different vessels in the system.)

| Development of Blood Vessels and Fetal Circulation

By the end of this section, you will be able to:

- Describe the development of blood vessels
- Describe the fetal circulation

In a developing embryo, the heart has developed enough by day 21 post-fertilization to begin beating. Circulation patterns are clearly established by the fourth week of embryonic life. It is critical to the survival of the developing human that the circulatory system forms early to supply the growing tissue with nutrients and gases, and to remove waste products. Blood cells and vessel production in structures outside the embryo proper called the yolk sac, chorion, and connecting stalk begin about 15 to 16 days following fertilization. Development of these circulatory elements within the embryo itself begins approximately 2 days later. You will learn more about the formation and function of these early structures when you study the chapter on development. During those first few weeks, blood vessels begin to form from the embryonic mesoderm. The precursor cells are known as **hemangioblasts**. These in turn differentiate into **angioblasts**, which give rise to the blood vessels and pluripotent stem cells, which differentiate into the formed elements of blood. (Seek additional content for more detail on fetal development and circulation.) Together, these cells form masses known as **blood islands** scattered throughout the embryonic disc. Spaces appear on the blood islands that develop into vessel lumens. The endothelial lining of the vessels arise from the angioblasts within these islands. Surrounding mesenchymal cells give rise to the smooth muscle and connective tissue layers of the vessels. While the vessels are developing, the pluripotent stem cells begin to form the blood.

Vascular tubes also develop on the blood islands, and they eventually connect to one another as well as to the developing, tubular heart. Thus, the developmental pattern, rather than beginning from the formation of one central vessel and spreading outward, occurs in many regions simultaneously with vessels later joining together. This **angiogenesis**—the creation of new blood vessels from existing ones—continues as needed throughout life as we grow and develop.

Blood vessel development often follows the same pattern as nerve development and travels to the same target tissues and organs. This occurs because the many factors directing growth of nerves also stimulate blood vessels to follow a similar pattern. Whether a given vessel develops into an artery or a vein is dependent upon local concentrations of signaling proteins.

As the embryo grows within the mother's uterus, its requirements for nutrients and gas exchange also grow. The placenta—a circulatory organ unique to pregnancy—develops jointly from the embryo and uterine wall structures to fill this need. Emerging from the placenta is the **umbilical vein**, which carries oxygen-rich blood from the mother to the fetal inferior vena cava via the ductus venosus to the heart that pumps it into fetal circulation. Two **umbilical arteries** carry oxygen-depleted fetal blood, including wastes and carbon dioxide, to the placenta. Remnants of the umbilical arteries remain in the adult. (Seek additional content for more information on the role of the placenta in fetal circulation.)

There are three major shunts—alternate paths for blood flow—found in the circulatory system of the fetus. Two of these shunts divert blood from the pulmonary to the systemic circuit, whereas the third connects the umbilical vein to the inferior vena cava. The first two shunts are critical during fetal life, when the lungs are compressed, filled with amniotic fluid, and nonfunctional, and gas exchange is provided by the placenta. These shunts close shortly after birth, however, when the newborn begins to breathe. The third shunt persists a bit longer but becomes nonfunctional once the umbilical cord is severed. The three shunts are as follows (**Figure 20.44**):

- The **foramen ovale** is an opening in the interatrial septum that allows blood to flow from the right atrium to the left atrium. A valve associated with this opening prevents backflow of blood during the fetal period. As the newborn begins to breathe and blood pressure in the atria increases, this shunt closes. The fossa ovalis remains in the interatrial septum after birth, marking the location of the former foramen ovale.
- The **ductus arteriosus** is a short, muscular vessel that connects the pulmonary trunk to the aorta. Most of the blood pumped from the right ventricle into the pulmonary trunk is thereby diverted into the aorta. Only enough blood reaches the fetal lungs to maintain the developing lung tissue. When the newborn takes the first breath, pressure within the lungs drops dramatically, and both the lungs and the pulmonary vessels expand. As the amount of oxygen increases, the smooth muscles in the wall of the ductus arteriosus constrict, sealing off the passage. Eventually, the muscular and endothelial components of the ductus arteriosus degenerate, leaving only the connective tissue component of the ligamentum arteriosum.
- The **ductus venosus** is a temporary blood vessel that branches from the umbilical vein, allowing much of the freshly oxygenated blood from the placenta—the organ of gas exchange between the mother and fetus—to bypass the fetal liver and go directly to the fetal heart. The ductus venosus closes slowly during the first weeks of infancy and degenerates to become the ligamentum venosum.

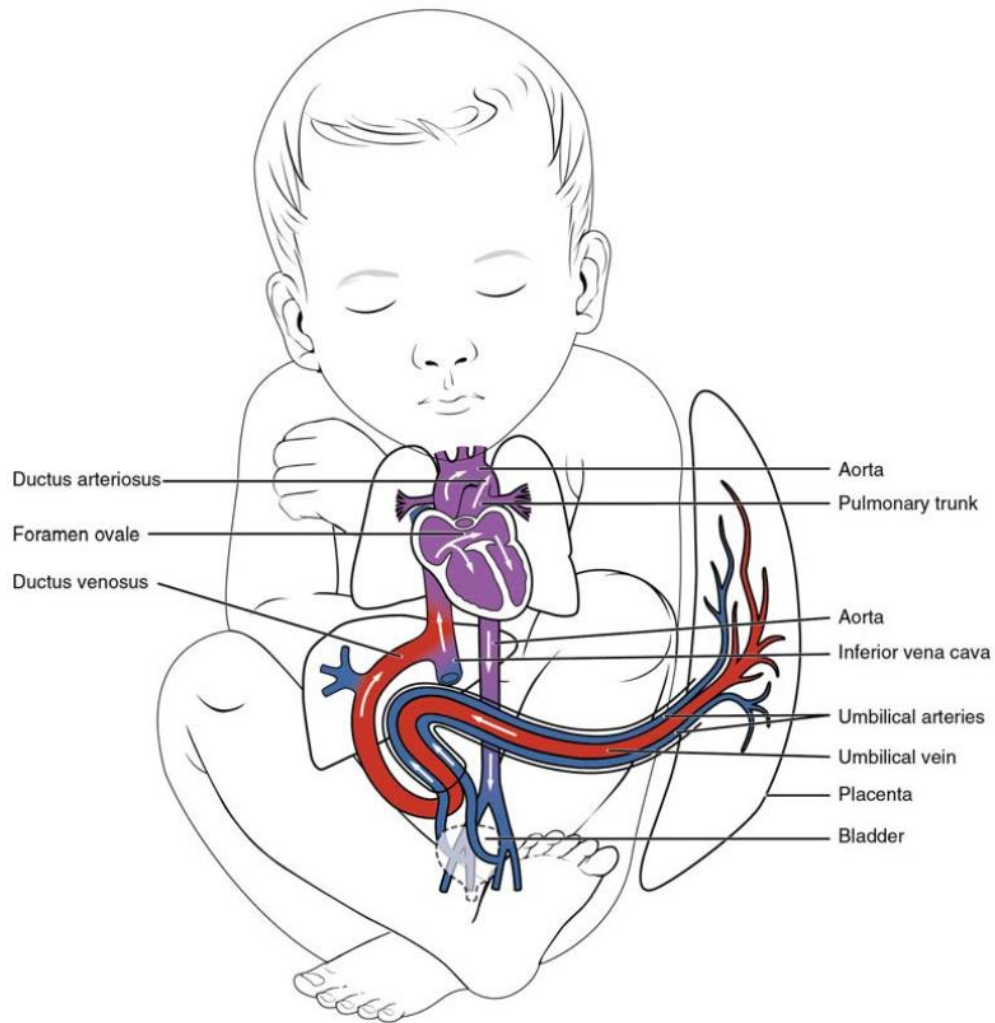


Figure 20.44 Fetal Shunts The foramen ovale in the interatrial septum allows blood to flow from the right atrium to the left atrium. The ductus arteriosus is a temporary vessel, connecting the aorta to the pulmonary trunk. The ductus venosus links the umbilical vein to the inferior vena cava largely through the liver.

KEY TERMS

- abdominal aorta** portion of the aorta inferior to the aortic hiatus and superior to the common iliac arteries
- adrenal artery** branch of the abdominal aorta; supplies blood to the adrenal (suprarenal) glands
- adrenal vein** drains the adrenal or suprarenal glands that are immediately superior to the kidneys; the right adrenal vein enters the inferior vena cava directly and the left adrenal vein enters the left renal vein
- anaphylactic shock** type of shock that follows a severe allergic reaction and results from massive vasodilation
- angioblasts** stem cells that give rise to blood vessels
- angiogenesis** development of new blood vessels from existing vessels
- anterior cerebral artery** arises from the internal carotid artery; supplies the frontal lobe of the cerebrum
- anterior communicating artery** anastomosis of the right and left internal carotid arteries; supplies blood to the brain
- anterior tibial artery** branches from the popliteal artery; supplies blood to the anterior tibial region; becomes the dorsalis pedis artery
- anterior tibial vein** forms from the dorsal venous arch; drains the area near the tibialis anterior muscle and leads to the popliteal vein
- aorta** largest artery in the body, originating from the left ventricle and descending to the abdominal region where it bifurcates into the common iliac arteries at the level of the fourth lumbar vertebra; arteries originating from the aorta distribute blood to virtually all tissues of the body
- aortic arch** arc that connects the ascending aorta to the descending aorta; ends at the intervertebral disk between the fourth and fifth thoracic vertebrae
- aortic hiatus** opening in the diaphragm that allows passage of the thoracic aorta into the abdominal region where it becomes the abdominal aorta
- aortic sinuses** small pockets in the ascending aorta near the aortic valve that are the locations of the baroreceptors (stretch receptors) and chemoreceptors that trigger a reflex that aids in the regulation of vascular homeostasis
- arterial circle** (also, circle of Willis) anastomosis located at the base of the brain that ensures continual blood supply; formed from branches of the internal carotid and vertebral arteries; supplies blood to the brain
- arteriole** (also, resistance vessel) very small artery that leads to a capillary
- arteriovenous anastomosis** short vessel connecting an arteriole directly to a venule and bypassing the capillary beds
- artery** blood vessel that conducts blood away from the heart; may be a conducting or distributing vessel
- ascending aorta** initial portion of the aorta, rising from the left ventricle for a distance of approximately 5 cm
- atrial reflex** mechanism for maintaining vascular homeostasis involving atrial baroreceptors: if blood is returning to the right atrium more rapidly than it is being ejected from the left ventricle, the atrial receptors will stimulate the cardiovascular centers to increase sympathetic firing and increase cardiac output until the situation is reversed; the opposite is also true
- axillary artery** continuation of the subclavian artery as it penetrates the body wall and enters the axillary region; supplies blood to the region near the head of the humerus (humeral circumflex arteries); the majority of the vessel continues into the brachium and becomes the brachial artery
- axillary vein** major vein in the axillary region; drains the upper limb and becomes the subclavian vein
- azygos vein** originates in the lumbar region and passes through the diaphragm into the thoracic cavity on the right side of the vertebral column; drains blood from the intercostal veins, esophageal veins, bronchial veins, and other veins draining the mediastinal region; leads to the superior vena cava

Lecture 14

basilar artery formed from the fusion of the two vertebral arteries; sends branches to the cerebellum, brain stem, and the posterior cerebral arteries; the main blood supply to the brain stem

basilic vein superficial vein of the arm that arises from the palmar venous arches, intersects with the median cubital vein, parallels the ulnar vein, and continues into the upper arm; along with the brachial vein, it leads to the axillary vein

blood colloidal osmotic pressure (BCOP) pressure exerted by colloids suspended in blood within a vessel; a primary determinant is the presence of plasma proteins

blood flow movement of blood through a vessel, tissue, or organ that is usually expressed in terms of volume per unit of time

blood hydrostatic pressure force blood exerts against the walls of a blood vessel or heart chamber

blood islands masses of developing blood vessels and formed elements from mesodermal cells scattered throughout the embryonic disc

blood pressure force exerted by the blood against the wall of a vessel or heart chamber; can be described with the more generic term hydrostatic pressure

brachial artery continuation of the axillary artery in the brachium; supplies blood to much of the brachial region; gives off several smaller branches that provide blood to the posterior surface of the arm in the region of the elbow; bifurcates into the radial and ulnar arteries at the coronoid fossa

brachial vein deeper vein of the arm that forms from the radial and ulnar veins in the lower arm; leads to the axillary vein

brachiocephalic artery single vessel located on the right side of the body; the first vessel branching from the aortic arch; gives rise to the right subclavian artery and the right common carotid artery; supplies blood to the head, neck, upper limb, and wall of the thoracic region

brachiocephalic vein one of a pair of veins that form from a fusion of the external and internal jugular veins and the subclavian vein; subclavian, external and internal jugulars, vertebral, and internal thoracic veins lead to it; drains the upper thoracic region and flows into the superior vena cava

bronchial artery systemic branch from the aorta that provides oxygenated blood to the lungs in addition to the pulmonary circuit

bronchial vein drains the systemic circulation from the lungs and leads to the azygos vein

capacitance vessels veins

capacitance ability of a vein to distend and store blood

capillary bed network of 10–100 capillaries connecting arterioles to venules

capillary hydrostatic pressure (CHP) force blood exerts against a capillary

capillary smallest of blood vessels where physical exchange occurs between the blood and tissue cells surrounded by interstitial fluid

cardiogenic shock type of shock that results from the inability of the heart to maintain cardiac output

carotid sinuses small pockets near the base of the internal carotid arteries that are the locations of the baroreceptors and chemoreceptors that trigger a reflex that aids in the regulation of vascular homeostasis

cavernous sinus enlarged vein that receives blood from most of the other cerebral veins and the eye socket, and leads to the petrosal sinus

celiac trunk (also, celiac artery) major branch of the abdominal aorta; gives rise to the left gastric artery, the splenic artery, and the common hepatic artery that forms the hepatic artery to the liver, the right gastric artery to the stomach, and the cystic artery to the gall bladder

cephalic vein superficial vessel in the upper arm; leads to the axillary vein

Lecture 14

- cerebrovascular accident (CVA)** blockage of blood flow to the brain; also called a stroke
- circle of Willis** (also, arterial circle) anastomosis located at the base of the brain that ensures continual blood supply; formed from branches of the internal carotid and vertebral arteries; supplies blood to the brain
- circulatory shock** also simply called shock; a life-threatening medical condition in which the circulatory system is unable to supply enough blood flow to provide adequate oxygen and other nutrients to the tissues to maintain cellular metabolism
- common carotid artery** right common carotid artery arises from the brachiocephalic artery, and the left common carotid arises from the aortic arch; gives rise to the external and internal carotid arteries; supplies the respective sides of the head and neck
- common hepatic artery** branch of the celiac trunk that forms the hepatic artery, the right gastric artery, and the cystic artery
- common iliac artery** branch of the aorta that leads to the internal and external iliac arteries
- common iliac vein** one of a pair of veins that flows into the inferior vena cava at the level of L5; the left common iliac vein drains the sacral region; divides into external and internal iliac veins near the inferior portion of the sacroiliac joint
- compliance** degree to which a blood vessel can stretch as opposed to being rigid
- continuous capillary** most common type of capillary, found in virtually all tissues except epithelia and cartilage; contains very small gaps in the endothelial lining that permit exchange
- cystic artery** branch of the common hepatic artery; supplies blood to the gall bladder
- deep femoral artery** branch of the femoral artery; gives rise to the lateral circumflex arteries
- deep femoral vein** drains blood from the deeper portions of the thigh and leads to the femoral vein
- descending aorta** portion of the aorta that continues downward past the end of the aortic arch; subdivided into the thoracic aorta and the abdominal aorta
- diastolic pressure** lower number recorded when measuring arterial blood pressure; represents the minimal value corresponding to the pressure that remains during ventricular relaxation
- digital arteries** formed from the superficial and deep palmar arches; supply blood to the digits
- digital veins** drain the digits and feed into the palmar arches of the hand and dorsal venous arch of the foot
- dorsal arch** (also, arcuate arch) formed from the anastomosis of the dorsalis pedis artery and medial and plantar arteries; branches supply the distal portions of the foot and digits
- dorsal venous arch** drains blood from digital veins and vessels on the superior surface of the foot
- dorsalis pedis artery** forms from the anterior tibial artery; branches repeatedly to supply blood to the tarsal and dorsal regions of the foot
- ductus arteriosus** shunt in the fetal pulmonary trunk that diverts oxygenated blood back to the aorta
- ductus venosus** shunt that causes oxygenated blood to bypass the fetal liver on its way to the inferior vena cava
- elastic artery** (also, conducting artery) artery with abundant elastic fibers located closer to the heart, which maintains the pressure gradient and conducts blood to smaller branches
- esophageal artery** branch of the thoracic aorta; supplies blood to the esophagus
- esophageal vein** drains the inferior portions of the esophagus and leads to the azygos vein
- external carotid artery** arises from the common carotid artery; supplies blood to numerous structures within the face, lower jaw, neck, esophagus, and larynx
- external elastic membrane** membrane composed of elastic fibers that separates the tunica media from the tunica externa; seen in larger arteries

Lecture 14

external iliac artery branch of the common iliac artery that leaves the body cavity and becomes a femoral artery; supplies blood to the lower limbs

external iliac vein formed when the femoral vein passes into the body cavity; drains the legs and leads to the common iliac vein

external jugular vein one of a pair of major veins located in the superficial neck region that drains blood from the more superficial portions of the head, scalp, and cranial regions, and leads to the subclavian vein

femoral artery continuation of the external iliac artery after it passes through the body cavity; divides into several smaller branches, the lateral deep femoral artery, and the genicular artery; becomes the popliteal artery as it passes posterior to the knee

femoral circumflex vein forms a loop around the femur just inferior to the trochanters; drains blood from the areas around the head and neck of the femur; leads to the femoral vein

femoral vein drains the upper leg; receives blood from the great saphenous vein, the deep femoral vein, and the femoral circumflex vein; becomes the external iliac vein when it crosses the body wall

fenestrated capillary type of capillary with pores or fenestrations in the endothelium that allow for rapid passage of certain small materials

fibular vein drains the muscles and integument near the fibula and leads to the popliteal vein

filtration in the cardiovascular system, the movement of material from a capillary into the interstitial fluid, moving from an area of higher pressure to lower pressure

foramen ovale shunt that directly connects the right and left atria and helps to divert oxygenated blood from the fetal pulmonary circuit

genicular artery branch of the femoral artery; supplies blood to the region of the knee

gonadal artery branch of the abdominal aorta; supplies blood to the gonads or reproductive organs; also described as ovarian arteries or testicular arteries, depending upon the sex of the individual

gonadal vein generic term for a vein draining a reproductive organ; may be either an ovarian vein or a testicular vein, depending on the sex of the individual

great cerebral vein receives most of the smaller vessels from the inferior cerebral veins and leads to the straight sinus

great saphenous vein prominent surface vessel located on the medial surface of the leg and thigh; drains the superficial portions of these areas and leads to the femoral vein

hemangioblasts embryonic stem cells that appear in the mesoderm and give rise to both angioblasts and pluripotent stem cells

hemiazygos vein smaller vein complementary to the azygos vein; drains the esophageal veins from the esophagus and the left intercostal veins, and leads to the brachiocephalic vein via the superior intercostal vein

hepatic artery proper branch of the common hepatic artery; supplies systemic blood to the liver

hepatic portal system specialized circulatory pathway that carries blood from digestive organs to the liver for processing before being sent to the systemic circulation

hepatic vein drains systemic blood from the liver and flows into the inferior vena cava

hypertension chronic and persistent blood pressure measurements of 140/90 mm Hg or above

hypervolemia abnormally high levels of fluid and blood within the body

hypovolemia abnormally low levels of fluid and blood within the body

hypovolemic shock type of circulatory shock caused by excessive loss of blood volume due to hemorrhage or possibly dehydration

hypoxia lack of oxygen supply to the tissues

Lecture 14

inferior mesenteric artery branch of the abdominal aorta; supplies blood to the distal segment of the large intestine and rectum

inferior phrenic artery branch of the abdominal aorta; supplies blood to the inferior surface of the diaphragm

inferior vena cava large systemic vein that drains blood from areas largely inferior to the diaphragm; empties into the right atrium

intercostal artery branch of the thoracic aorta; supplies blood to the muscles of the thoracic cavity and vertebral column

intercostal vein drains the muscles of the thoracic wall and leads to the azygos vein

internal carotid artery arises from the common carotid artery and begins with the carotid sinus; goes through the carotid canal of the temporal bone to the base of the brain; combines with branches of the vertebral artery forming the arterial circle; supplies blood to the brain

internal elastic membrane membrane composed of elastic fibers that separates the tunica intima from the tunica media; seen in larger arteries

internal iliac artery branch from the common iliac arteries; supplies blood to the urinary bladder, walls of the pelvis, external genitalia, and the medial portion of the femoral region; in females, also provide blood to the uterus and vagina

internal iliac vein drains the pelvic organs and integument; formed from several smaller veins in the region; leads to the common iliac vein

internal jugular vein one of a pair of major veins located in the neck region that passes through the jugular foramen and canal, flows parallel to the common carotid artery that is more or less its counterpart; primarily drains blood from the brain, receives the superficial facial vein, and empties into the subclavian vein

internal thoracic artery (also, mammary artery) arises from the subclavian artery; supplies blood to the thymus, pericardium of the heart, and the anterior chest wall

internal thoracic vein (also, internal mammary vein) drains the anterior surface of the chest wall and leads to the brachiocephalic vein

interstitial fluid colloidal osmotic pressure (IFCOP) pressure exerted by the colloids within the interstitial fluid

interstitial fluid hydrostatic pressure (IFHP) force exerted by the fluid in the tissue spaces

ischemia insufficient blood flow to the tissues

Korotkoff sounds noises created by turbulent blood flow through the vessels

lateral circumflex artery branch of the deep femoral artery; supplies blood to the deep muscles of the thigh and the ventral and lateral regions of the integument

lateral plantar artery arises from the bifurcation of the posterior tibial arteries; supplies blood to the lateral plantar surfaces of the foot

left gastric artery branch of the celiac trunk; supplies blood to the stomach

lumbar arteries branches of the abdominal aorta; supply blood to the lumbar region, the abdominal wall, and spinal cord

lumbar veins drain the lumbar portion of the abdominal wall and spinal cord; the superior lumbar veins drain into the azygos vein on the right or the hemiazygos vein on the left; blood from these vessels is returned to the superior vena cava rather than the inferior vena cava

lumen interior of a tubular structure such as a blood vessel or a portion of the alimentary canal through which blood, chyme, or other substances travel

maxillary vein drains blood from the maxillary region and leads to the external jugular vein

Lecture 14

- mean arterial pressure (MAP)** average driving force of blood to the tissues; approximated by taking diastolic pressure and adding 1/3 of pulse pressure
- medial plantar artery** arises from the bifurcation of the posterior tibial arteries; supplies blood to the medial plantar surfaces of the foot
- median antebrachial vein** vein that parallels the ulnar vein but is more medial in location; intertwines with the palmar venous arches
- median cubital vein** superficial vessel located in the antecubital region that links the cephalic vein to the basilic vein in the form of a v; a frequent site for a blood draw
- median sacral artery** continuation of the aorta into the sacrum
- mediastinal artery** branch of the thoracic aorta; supplies blood to the mediastinum
- metarteriole** short vessel arising from a terminal arteriole that branches to supply a capillary bed
- microcirculation** blood flow through the capillaries
- middle cerebral artery** another branch of the internal carotid artery; supplies blood to the temporal and parietal lobes of the cerebrum
- middle sacral vein** drains the sacral region and leads to the left common iliac vein
- muscular artery** (also, distributing artery) artery with abundant smooth muscle in the tunica media that branches to distribute blood to the arteriole network
- myogenic response** constriction or dilation in the walls of arterioles in response to pressures related to blood flow; reduces high blood flow or increases low blood flow to help maintain consistent flow to the capillary network
- nervi vasorum** small nerve fibers found in arteries and veins that trigger contraction of the smooth muscle in their walls
- net filtration pressure (NFP)** force driving fluid out of the capillary and into the tissue spaces; equal to the difference of the capillary hydrostatic pressure and the blood colloidal osmotic pressure
- neurogenic shock** type of shock that occurs with cranial or high spinal injuries that damage the cardiovascular centers in the medulla oblongata or the nervous fibers originating from this region
- obstructive shock** type of shock that occurs when a significant portion of the vascular system is blocked
- occipital sinus** enlarged vein that drains the occipital region near the falx cerebelli and flows into the left and right transverse sinuses, and also into the vertebral veins
- ophthalmic artery** branch of the internal carotid artery; supplies blood to the eyes
- ovarian artery** branch of the abdominal aorta; supplies blood to the ovary, uterine (Fallopian) tube, and uterus
- ovarian vein** drains the ovary; the right ovarian vein leads to the inferior vena cava and the left ovarian vein leads to the left renal vein
- palmar arches** superficial and deep arches formed from anastomoses of the radial and ulnar arteries; supply blood to the hand and digital arteries
- palmar venous arches** drain the hand and digits, and feed into the radial and ulnar veins
- parietal branches** (also, somatic branches) group of arterial branches of the thoracic aorta; includes those that supply blood to the thoracic cavity, vertebral column, and the superior surface of the diaphragm
- perfusion** distribution of blood into the capillaries so the tissues can be supplied
- pericardial artery** branch of the thoracic aorta; supplies blood to the pericardium
- petrosal sinus** enlarged vein that receives blood from the cavernous sinus and flows into the internal jugular vein

Lecture 14

phrenic vein drains the diaphragm; the right phrenic vein flows into the inferior vena cava and the left phrenic vein leads to the left renal vein

plantar arch formed from the anastomosis of the dorsalis pedis artery and medial and plantar arteries; branches supply the distal portions of the foot and digits

plantar veins drain the foot and lead to the plantar venous arch

plantar venous arch formed from the plantar veins; leads to the anterior and posterior tibial veins through anastomoses

popliteal artery continuation of the femoral artery posterior to the knee; branches into the anterior and posterior tibial arteries

popliteal vein continuation of the femoral vein behind the knee; drains the region behind the knee and forms from the fusion of the fibular and anterior and posterior tibial veins

posterior cerebral artery branch of the basilar artery that forms a portion of the posterior segment of the arterial circle; supplies blood to the posterior portion of the cerebrum and brain stem

posterior communicating artery branch of the posterior cerebral artery that forms part of the posterior portion of the arterial circle; supplies blood to the brain

posterior tibial artery branch from the popliteal artery that gives rise to the fibular or peroneal artery; supplies blood to the posterior tibial region

posterior tibial vein forms from the dorsal venous arch; drains the area near the posterior surface of the tibia and leads to the popliteal vein

precapillary sphincters circular rings of smooth muscle that surround the entrance to a capillary and regulate blood flow into that capillary

pulmonary artery one of two branches, left and right, that divides off from the pulmonary trunk and leads to smaller arterioles and eventually to the pulmonary capillaries

pulmonary circuit system of blood vessels that provide gas exchange via a network of arteries, veins, and capillaries that run from the heart, through the body, and back to the lungs

pulmonary trunk single large vessel exiting the right ventricle that divides to form the right and left pulmonary arteries

pulmonary veins two sets of paired vessels, one pair on each side, that are formed from the small venules leading away from the pulmonary capillaries that flow into the left atrium

pulse pressure difference between the systolic and diastolic pressures

pulse alternating expansion and recoil of an artery as blood moves through the vessel; an indicator of heart rate

radial artery formed at the bifurcation of the brachial artery; parallels the radius; gives off smaller branches until it reaches the carpal region where it fuses with the ulnar artery to form the superficial and deep palmar arches; supplies blood to the lower arm and carpal region

radial vein parallels the radius and radial artery; arises from the palmar venous arches and leads to the brachial vein

reabsorption in the cardiovascular system, the movement of material from the interstitial fluid into the capillaries

renal artery branch of the abdominal aorta; supplies each kidney

renal vein largest vein entering the inferior vena cava; drains the kidneys and leads to the inferior vena cava

resistance any condition or parameter that slows or counteracts the flow of blood

respiratory pump increase in the volume of the thorax during inhalation that decreases air pressure, enabling venous blood to flow into the thoracic region, then exhalation increases pressure, moving blood into the atria

right gastric artery branch of the common hepatic artery; supplies blood to the stomach

sepsis (also, septicemia) organismal-level inflammatory response to a massive infection

Lecture 14

septic shock (also, blood poisoning) type of shock that follows a massive infection resulting in organism-wide inflammation

sigmoid sinuses enlarged veins that receive blood from the transverse sinuses; flow through the jugular foramen and into the internal jugular vein

sinusoid capillary rarest type of capillary, which has extremely large intercellular gaps in the basement membrane in addition to clefts and fenestrations; found in areas such as the bone marrow and liver where passage of large molecules occurs

skeletal muscle pump effect on increasing blood pressure within veins by compression of the vessel caused by the contraction of nearby skeletal muscle

small saphenous vein located on the lateral surface of the leg; drains blood from the superficial regions of the lower leg and foot, and leads to the popliteal vein

sphygmomanometer blood pressure cuff attached to a device that measures blood pressure

splenic artery branch of the celiac trunk; supplies blood to the spleen

straight sinus enlarged vein that drains blood from the brain; receives most of the blood from the great cerebral vein and flows into the left or right transverse sinus

subclavian artery right subclavian arises from the brachiocephalic artery, whereas the left subclavian artery arises from the aortic arch; gives rise to the internal thoracic, vertebral, and thyrocervical arteries; supplies blood to the arms, chest, shoulders, back, and central nervous system

subclavian vein located deep in the thoracic cavity; becomes the axillary vein as it enters the axillary region; drains the axillary and smaller local veins near the scapular region; leads to the brachiocephalic vein

subscapular vein drains blood from the subscapular region and leads to the axillary vein

superior mesenteric artery branch of the abdominal aorta; supplies blood to the small intestine (duodenum, jejunum, and ileum), the pancreas, and a majority of the large intestine

superior phrenic artery branch of the thoracic aorta; supplies blood to the superior surface of the diaphragm

superior sagittal sinus enlarged vein located midsagittally between the meningeal and periosteal layers of the dura mater within the falx cerebri; receives most of the blood drained from the superior surface of the cerebrum and leads to the inferior jugular vein and the vertebral vein

superior vena cava large systemic vein; drains blood from most areas superior to the diaphragm; empties into the right atrium

systolic pressure larger number recorded when measuring arterial blood pressure; represents the maximum value following ventricular contraction

temporal vein drains blood from the temporal region and leads to the external jugular vein

testicular artery branch of the abdominal aorta; will ultimately travel outside the body cavity to the testes and form one component of the spermatic cord

testicular vein drains the testes and forms part of the spermatic cord; the right testicular vein empties directly into the inferior vena cava and the left testicular vein empties into the left renal vein

thoracic aorta portion of the descending aorta superior to the aortic hiatus

thoroughfare channel continuation of the metarteriole that enables blood to bypass a capillary bed and flow directly into a venule, creating a vascular shunt

thyrocervical artery arises from the subclavian artery; supplies blood to the thyroid, the cervical region, the upper back, and shoulder

transient ischemic attack (TIA) temporary loss of neurological function caused by a brief interruption in blood flow; also known as a mini-stroke

Lecture 14

transverse sinuses pair of enlarged veins near the lambdoid suture that drain the occipital, sagittal, and straight sinuses, and leads to the sigmoid sinuses

trunk large vessel that gives rise to smaller vessels

tunica externa (also, tunica adventitia) outermost layer or tunic of a vessel (except capillaries)

tunica intima (also, tunica interna) innermost lining or tunic of a vessel

tunica media middle layer or tunic of a vessel (except capillaries)

ulnar artery formed at the bifurcation of the brachial artery; parallels the ulna; gives off smaller branches until it reaches the carpal region where it fuses with the radial artery to form the superficial and deep palmar arches; supplies blood to the lower arm and carpal region

ulnar vein parallels the ulna and ulnar artery; arises from the palmar venous arches and leads to the brachial vein

umbilical arteries pair of vessels that runs within the umbilical cord and carries fetal blood low in oxygen and high in waste to the placenta for exchange with maternal blood

umbilical vein single vessel that originates in the placenta and runs within the umbilical cord, carrying oxygen- and nutrient-rich blood to the fetal heart

vasa vasorum small blood vessels located within the walls or tunics of larger vessels that supply nourishment to and remove wastes from the cells of the vessels

vascular shock type of shock that occurs when arterioles lose their normal muscular tone and dilate dramatically

vascular shunt continuation of the metarteriole and thoroughfare channel that allows blood to bypass the capillary beds to flow directly from the arterial to the venous circulation

vascular tone contractile state of smooth muscle in a blood vessel

vascular tubes rudimentary blood vessels in a developing fetus

vasoconstriction constriction of the smooth muscle of a blood vessel, resulting in a decreased vascular diameter

vasodilation relaxation of the smooth muscle in the wall of a blood vessel, resulting in an increased vascular diameter

vasomotion irregular, pulsating flow of blood through capillaries and related structures

vein blood vessel that conducts blood toward the heart

venous reserve volume of blood contained within systemic veins in the integument, bone marrow, and liver that can be returned to the heart for circulation, if needed

venule small vessel leading from the capillaries to veins

vertebral artery arises from the subclavian artery and passes through the vertebral foramen through the foramen magnum to the brain; joins with the internal carotid artery to form the arterial circle; supplies blood to the brain and spinal cord

vertebral vein arises from the base of the brain and the cervical region of the spinal cord; passes through the intervertebral foramina in the cervical vertebrae; drains smaller veins from the cranium, spinal cord, and vertebrae, and leads to the brachiocephalic vein; counterpart of the vertebral artery

visceral branches branches of the descending aorta that supply blood to the viscera