Answers

2.7 Blood and Lymph Vascular Systems

273. a + b + c + d + e +

274. a + b + c + d + e +
The roles of the blood are numerous and include the transport of the essential respiratory gas (oxygen) to all the tissue of the body and the transport of carbon dioxide to the lungs. The blood transport nutrients to the tissue and cells and serves an excretory role in the transport of waste metabolites to the excretory organs. The blood transports and distributes hormones and is important in physiological homeostatic process such as maintenance of the acid-base balance and osmotic balance in the tissue of the body. Blood is also important in thermoregulation, in protection of the body tissues from invading micro-organisms and in preserving vascular integrity in the event that blood vessels are damaged.

275. a – b + c – d + e +
Blood smears are usually stained with one of the common Romanovsky-type stains. These contain eosin and also methylene blue, which w hen oxidized results in the formation of azures which stain specific components of many blood cells and enable them to be classified.

276. a – b + c + d + e +
Hemoglobin is a conjugated protein and is a respiratory pigment with a high affinity for oxygen. The heme part of the molecule has iron in its structure. Carbon monoxide combines quite strongly with hemoglobin, forming carboxy-hemoglobin, and in sufficient quantities binds all the hemoglobin and prevents oxygen-binding. Carbon monoxide poisoning causes rapid oxygen depletion of vital body organs and is often fatal. The differences in the physicochemical characteristic between fetal and adult hemoglobin are mainly due to differences in the amino acid composition of the globin part of the molecule. The fetal hemoglobin has isoleucine, which is absent in adult hemoglobin. The oxygen-binding capacity of fetal hemoglobin is much greater and more stable to alkali than the adult hemoglobin.

277. a + b + c + d + e –
During the maturation process and formation of erythrocytes the precursor cells show a reduction in cell volume, nuclear volume, nucleolar size and in the number of polyribosomes. At the same time there is a relative increase in the quantity of hemoglobin thata accumulates in the developing erythrocytes.

278. a – b + c + d + e +

279. a – b + c – d – e –

Erythrocytes at various stages of fetal growth develop in the yolk sac, liver, red bone marrow and spleen. In adults the sole source of erythrocytes is the reticular tissue of red bone marrow.

280. a – b – c – d – e +

281. a + b + c + d + e +

282. a + b – c – d + e –
The life span of erythrocytes in adults in about 120 days. They develop into their final form from reticulocytes, which are basophilic. The mature erythrocytes are eosinophilic and lack nuclei and cytoplasmic organelles. They are biconcave disks in which carbonic anhydrase activity is found. Erythrocytes are flexible and can squeeze through spaces narrower than their diameter. Their main roles is in gaseous exchange and in the transport of digested metabolites to the tissues and the removal of excretory products from the tissues. Myoglobin is a muscle protein and should not be confused with hemoglobin, which is found in erythrocytes.

283. a – b + c – d + e +
Reticulocytes, also called 'polychromatophilic erythrocytes', are formed in the bone marrow, but are also found for a short period in the peripheral blood. These circulating reticulocytes possess cytoplasmic ribosomal RNA, which is stained with cresyl blue. The reticulocytes are the immediate precursors of the erthrocytes are the immediatebprecursos of the erthrocytes. Stainable rRNA in circulating reticulocytes remains for a maximum of about 48 hours.

284. a + b + c + d + e –
Erythrocytes developin red bone marrow, which is also the site of the formation of megakaryocytes from which blood pltelets are formed. Reticular fibers are also found in bone marrow. Yellow bone marrow does not produced erythrocytes or any other type of blood cell, but contains a large number of fat cells, which give it a yellow appearance. There are no lymphatic vessels in bone marrow, which is a myeloid tissue and not a lymphoid tissue.

285. a – b + c + d + e –
Blood plasma proteins include fibrinogen, albumin and prothrombin. Hemoglobin is restricted to the erythrocytes and myoglobin is found exclusively in striated muscle.

286. a – b – c + d + e –

287. a + b + c + d – e +
Basophils are larger than erythrocytes and have nuclei that typically have irregular twisted S-shaped configurations. Thhe granules of basophils are coarse, irregular, and stain metachromatically. These granules contains heparin and

histamine as in mast cells. Despite having similar granules, basophils are not identical to mast cells. Basophils show a capacity for ameboid movement.

288. a – b + c – d –e +

289. a + b + c + d + e +
Eosinophils have bilobed nuclei and cytoplasm that has coarse specific granules, which contain lysosomal enzymes and which by electron microscopy are seen to contain crystalloids. Eosinophils may be phagocytic. They contain profibrinolysin, whose function is thought to be connected with the maintenance of blood fluidity and keeping the blood in intact vessels from clotting. Treatment with corticosteroid drugs reduces the number of eosinophils in the blood.

290. a – b – c + d – e –

291. a + b – c – d – e +

292. a – b + c – d + e –
Neutrophils have a segment nucleus and small, delicate, cytoplasmic granules that stain purple with Giemmsa's blood stain. The granules are lysosomes. In peripheral blood the 'drumstick' or Barr's body is seen in neutrophils of females, where it represent the site of condensation of an X-chromosome. These drumsticks may be occasionally found in male neutrophils, but in such cases appear in fewer than six out of 500 neutrophils.

293. a + b + c – d + e +

294. a – b – c – d – e +
Phagocytins are antibacterial proteins found in the specific granules of neutrophils. Pus that accumulates in sites of boils and abscesses is composed primarily of masses of dead neutrophils

295. a – b + c + d + e +

296. a – b – c + d + e +
Monocytes develop in the bone marrow and a belong to the mononuclear phagocytic system (MPS). They pass from the blood to the connective tissue, but not vice versa, and can survive in the tissue for several months. Monocytes have horseshoe or kidney-shaped nuclei, with two or three nucleoli and loose, poorly stained chromatin. In blood smears monocytes are sometimes difficult to distinguish from the large lymphocytes. Normally the monocytes are larger (12-15 um) than the large lymphocytes (10-12 um), possess relatively more cytoplasm and have a less densely stained, indented nucleus.

297. a + b – c – d – e +

298. a – b – c – d + e +
Lymphocytes constitutes about 25-30 % of all the leukocytes. They develop from stem cells that originate in the bone marrow. Small lymphocytes can be converted to lymphoblasts after antigenic stimulus

299. a – b + c + d + - e +

300. a – b + c – d + e +
T lymphocytes originate from stem cells of the bone marrow. They reach maturity in the paracortical area of the thymus. They are long-lived cells and play an important role in the cell mediated immune response. The B lymphocytes develop from stem cells in lymphoid structures analogous to the bursa of Fabricius of birds (possibly the Peyer's patches of the ileum). B lymphocytes can be converted to plasma cells under antigenic stimulus and are important in the humoral-mediated immune response. Once it was thought that B lymphocytes could be distinguished from T lymphocytes on their appearance in the scanning electron microscope, but this view is not longer held. B lymphocytes can be distinguished from T lymphocytes because they have surface immunoglobin, which can be demonstrated by immunofluorescence. T lymphocytes can be distinguished as they respond specifically with sheep erythrocytes to form the so-called 'rosettes'.

301. a – b – c + d + e +

302. a + b – c – d + e +
Blood platelets in man do not have nuclei (hence it is a misnomer to refer to them as thrombocytes). They develop in the bone marrow from megakaryocytes. Platelets often possess glycogen deposits and typically have a marginal bundle of microtubules. They have very dense, membrane bound granules containing serotonin (though this is not synthesized by the platelets) and larger, less electron-dense alpha granules. During blood clotting the plateletes aggregate at the site of the vascular damage and change their disk-like shape becoming more irregular. During the clumping of platelets, vasoconstrictors, including serotonin, are released and the marginal bundle of microtubules becomes more central. The alpha granules also become more centralized. In blood smears the area of the granules is called the granulomere, whilst the less densely stained peripheral part of the platelets is called the hyalomere.

303. a + b + c +d + e –

304. a + b – c + d + e +
Red bone marrow in adults has a very limited distribution. It is present in the sternum, bodies of the vertebrae, ribs, diploe of bones of the vault of the skull, in spongy bone of some short bones and the ends of some long bones. A good biopsy or smear of red bone marrow can be taken from the sternum or the iliac crest. The main function of red bone marrow (myeloid tissue) is the production of blood cells, including erythrocytes and leukocytes. The stem cells from which T

lymphocytes and B lymphocytes will eventually develop are also found in the red marrow, as are the megakaryocytes from which the blood platelets are formed.

305. a – b + c + d + e –
Iron is stored in the form of ferritin or hemosiderin (the breakdown pigment of hemoglobin) in the cytoplasm of macrophagic cells of the bone marrow. It is also stored in large amounts in hepatocytes, skeletal muscle fibers and in macrophages of the spleen.

306. a – b + c – d + e –

307. a + b + c + d + e +
Typical musclar aarteries have concentric smooth muscle fibers in their middle tunic (tunica media). In addition they possess an inner, elastic limiting membrane, which in fixed tissue has an undulating appearance owing to the contraction of the elastin during the fixation process. The smooth muscle of arterial walls serves functions including helping maintain the diameter of the vessel (tonus), propelling the blood forward and maintaining blood pressure. The smooth muscle of the arterial wall is innervated by the sympathetic nervous system. Vasodilators and vasoconstrictors respectively cause the relaxation and contraction of the smooth muscle fibers in the wall of blood vessels.

308. a – b – c + d + e +
Anatomical end arteries, as opposed to functional end arteries, are unable to form anastomoses with adjacent vessels in the event of their being obstructed or ligatured. As a result the tissue they supply becomes ischemic and undergoes necrosis or infarct. Coronary arteries of the heart belong to the category of anatomical end arteries, and in the event of blockage lead to an infarct of the cardiac muscle they supply.

309. a + b + c + d + e –
Vasa vasorum are profusely branched, small blood vessels supplying nutrients to arteries and veins. They can be considered as the blood vessels of the blood vessels. In arteries they only reach the adventitial layer, but in veins, which have a poorer supply of oxygen, they are more numerous and may be also extend into the middle tunic (tunica media). Vasa vasorum are never found in the tunica intima.

310. a + b – c + d + e –

311. a + b + c – d + e +
Elastic arteries are found mainly near the heart. They have a structure that helps absorb some of the high pressure induced by the contractions of the cardiac muscle (especially the ventricular contraction). Elastic arteries contract during diastole and this helps propel the blood forward more evenly. When examined histologically, elastic arteries are seen to possess a relatively thick middle tunic (tunica media) packed with many concentric fenestrated elastic laminae as well as

smooth muscle fibers. The internal elastic limiting membrane is not readily distinguished from the many other elastic laminae. After staining with orcein the elastic laminae are well demonstrated.

312. a + b – c + d + e –
Arteioles typically have diameters smaller than 0.5mm. they have a very thin, internal, elastic limiting membrane and only about 4 or 5 layers of smooth muscle in their walls. No subendothelial layer is present.

313. a + b – c + d + e –
Arteriovenous anastomoses function when the metabolic needs of a particular tissue or organ are reduced and they provide a mechanism to reduce blood flew through the capillary bed of the tissue by making use of a bypass system. In these cases blood flows directly from arterioles to venules. Arteriovenous anastomoses are very common in the dermis of the skin, where they play an important role in thermoregulation. When the oxygen needs of the tissue or organ are increased, the direct arteriovenous connection is broken and blood passes again through the capillary bed.

314. a + b + c + d – e +
Blood sinusoids are a form of blood capillary. They are irregular in diameter and shape and are lined with fenestrated endothelial cells. Sinusoids are found in many endocrine glands and in the lobules of the liver.

315. a + b – c + d – e +
Blood capillaries are lined with a single layer of endothelial cells. They have no smooth muscle in their walls. The endothelial cells have a basal lamina similar in appearance to that of epithelial cells. Capillaries can very their diameter. Pericytes (perivascular cells) may be found associated with capillaries.

316. a – b – c + d + e +
Pericytes (also called perivascular or adventitial cells) are closely associated with many capillaries, though not all. They are considered to be undifferentiated, mesenchyme-like cells that persist in adults and which have the potential to develop into connective tissue cells or smooth muscle cells.

317. a – b – c + d + e +
Portal systems are formed when a blood vessel, usually a vein, terminates at both ends in a capillary bed. In other words a blood vessel breaks up into a capillary bed and then reforms a blood vessel containing the same sort of blood (usually venous). Typical venous portal systems are found in the liver and in the area of the hypothalamus-hypophysis. An example of an arterial portal system is seen in the cortex of the kidney, where afferent arterioles form a capillary bed in the glomeruli of the renal corpuscles and then reform as efferent arterioles.

318. a + b + c – d + e –

319. a + b + c + d + e +
The walls of veins are thinner than those of equivalent-sized arteries, though in these veins the adventitial have layer is better developed. Smooth muscle is present in the middle tunic (tunica media) of larger veins, but this is not as well-developed as in similar-sized arteries. Many veins have valves, especially where the blood flow is against the force of gravity. The valves, which are not muscular, help prevent the backflow of blood. Valves usually occur in pairs and are formed from folds of the tunica intima. They are lined with endothelial cells.

320. a – b – c + d + e +
The vein of the umbilical cord is atypical. It transports oxygen-rich blood and has a thick muscular wall composed of both longitudinal and circular layers of smooth muscle. Like all blood vessels its lumen is lined with endothelial cells.

321. a + b + c + d + e +
Umbilical arteries have an atypical arterial structure. Their tunica intima consists only of endothelium and no internal elastic membrane is found. The tunica media is both longitudinal and circular layers of smooth muscle. In the extra-abdo-minal portion, the walls of these arteries in some places may be very thin, composed almost exclusively of circularly-arranged muscles, which results in the formation of oval swelling or varicosities at these sites. The umbilical arteries carry mainly deoxygenated blood from the fetus to the placenta.

322. a + b – c + d + e +
Lymph is a fluid originating from the excess tissue fluids of the intercellular spaces of loose connective tissue. This excess fluid is taken up by blind-ending lymphatic capillaries, passes through the lymphatic vessels and lymph nodes, before reaching the larger lumphatic vessels and eventually being returned to the blood. Lymph is usually fairly transparent, though after a meal rich in fats it may become fairly white or milk-like as digested emulsified fats are absorbed into he lymphatic vessels or ‘lacteals’ of the villi of the small intestine. Lymph is not actively secreted by glands. The main source of lymph proteins is the liver. Lymph transport, which is passive, provides a mechanism for the return to the blood of a number of substances that have collected in the tissue spaces, including water and minerals.

323. a + b – c + d + e –

324. a + b – c + d – e +
Lymph is transported passively in lymphatic vessels. Transport is facilitated by the movements of adjacent structures. In light microscope preparations the

lymphatic vessels are seen to have very thin walls consisting almost entirely of a single layer of endothelial cells. The walls lack smooth muscles. The lumina of lymphatic vessels appear empty and lack any sign of erythrocytes, such as are seen in sections of typical veins. Transport in lymphatic vessels is unidirectional and backflow is prevented by a system of valves.

325. a + b + c + d – e +

Lymphatic capillaries are blind-ending tubes lined with endothelial cells and supported on a discontinuous basal lamina. They are able to collect water, solutes and macromolecules from the tissue spaces. Lymphatic vessels, including lymph capillaries, are absent from the central nervous system and bone marrow. Bone marrow, though a source of lymphocytes, is not a lymphatic structure in the accepted sense of the term, but is myeloid.

326. a + b + c + d + e +

The large lymphatic ducts are the sole route for the return of lymph to the blood vascular system. The thoracic duct drains into the venous system at the junction of the left jugular and subclavin veins at the base of the neck. The right lymphatic duct draining lymph from the right upper portion of the body opens into the right brachiocephalic vein at the junction of the internal jugular and subclavian veins. The large lymphatic ducts have walls that are much more muscular than those of typical large veins. Their tunica intima is lined with endothelial cells and thin layers of collagenous and elastic fibers are found in the tunic.