VASCULATURE

Large blood vessels and those of the microvasculature branch frequently and undergo gradual transitions into structures with different histologic features and functions.

Elastic Arteries

Elastic arteries are the aorta, the pulmonary artery, and their largest branches; these large vessels are also called conducting arteries because their major role is to carry blood to smaller arteries. The most prominent feature of elastic arteries is the thick media in which elastic lamellae, each about 10 μm thick, alternate with layers of smooth muscle fibers. The adult aorta has about 50 elastic lamellae (more if the individual is hypertensive).

The intima: is well developed, with many smooth muscle cells in the subendothelial connective tissue, and often shows folds in cross section as a result of the loss of blood pressure and contraction of the vessel at death . The internal elastic lamina is not easily discerned because it is similar to the elastic laminae of the next layer . The adventitia is much thinner than the media. The numerous **elastic laminae** of these arteries contribute to their important function of making blood flow more uniform. During ventricular contraction (systole), blood is moved through the

arteries forcefully and the elastin is stretched, distending the wall within the limit set by the wall´s collagen. When the ventricles relax (diastole), ventricular pressure drops to a low level, but the elastin rebounds passively, helping to maintain arterial pressure. The aortic and pulmonary valves prevent backflow of blood into the heart, so the rebound continues the blood flow away from the heart. Arterial blood pressure and blood velocity decrease and become less variable as the distance from the heart increases.

Arterial Sensory Structures:

Carotid sinuses are slight dilations of the bilateral internal carotid arteries where they branch from the (elastic) common carotid arteries; they act as important baroreceptors monitoring arterial blood pressure. At these sinuses the media is thinner, allowing greater distension when blood pressure rises, and the adventitia contains many sensory nerve endings from cranial nerve IX, the glossopharyngeal nerve. The brain's vasomotor centers process these afferent impulses and adjust vasoconstriction, maintaining normal blood pressure. Functionally

similar baroreceptors are also present in the aortic arch.

Histologically more complex chemoreceptors that monitor blood levels of CO_2 and O_2, as well as its hydrogen ion concentration (pH), are found in

the carotid bodies and aortic bodies, located in the walls of the carotid sinuses and aortic arch, respectively. These structures are parts of the autonomic nervous system called paraganglia with rich capillary networks. The capillaries are closely surrounded by numerous, large, neural crest–derived glomus (type I) cells filled with dense-core vesicles containing dopamine, acetylcholine, and other neurotransmitters, which are supported by smaller satellite (type II) cells. Appropriate ion channels in the glomus cell membranes respond to stimuli in the arterial blood, primarily hypoxia (low O_2), hypercapnia (excess CO_2), or acidosis, by activating release of neurotransmitters. Sensory fibers branching from the glossopharyngeal nerve form synapses with the glomus cells and signal brain centers to initiate cardiovascular and respiratory adjustments that correct the condition.

Muscular Arteries

The muscular arteries distribute blood to the organs and help regulate blood pressure by contracting or relaxing the smooth muscle in the media. The intima has a very thin subendothelial layer and a prominent internal elastic lamina. The media may contain up to 40 layers of large smooth muscle cells interspersed with a variable number of elastic lamellae (depending on the size of the vessel). An external elastic lamina, the last

component of the media, is present only in the larger muscular arteries. The adventitia consists of connective tissue. Lymphatic capillaries, vasa vasorum, and nerves are also found in the adventitia, and these structures may penetrate to the outer part of the media.

Arterioles

Muscular arteries branch repeatedly into smaller and smaller arteries, until reaching a size with three or four medial layers of smooth muscle. The smallest arteries branch as arterioles, which have only one or two smooth muscle layers; these indicate the beginning of an organ´s microvasculature where exchanges between blood and tissue fluid occur. Arterioles are generally less than 0.1 mm in diameter, with lumens approximately as wide as the wall is thick. The subendothelial layer is very thin, elastic laminae are absent, and the media consists of the circularly arranged smooth muscle cells. In both small arteries and arterioles, the adventitia is very thin and unobtrusive.

Arterioles almost always branch to form anastomosing networks or beds of capillaries that surround the parenchymal cells of the organ. Smooth muscle fibers act as sphincters closing arterioles and producing periodic blood flow into capillaries . Acting as “resistance vessels,” muscle tone

usually keeps arterioles partially closed and makes these vessels the major determinants of systemic blood pressure.