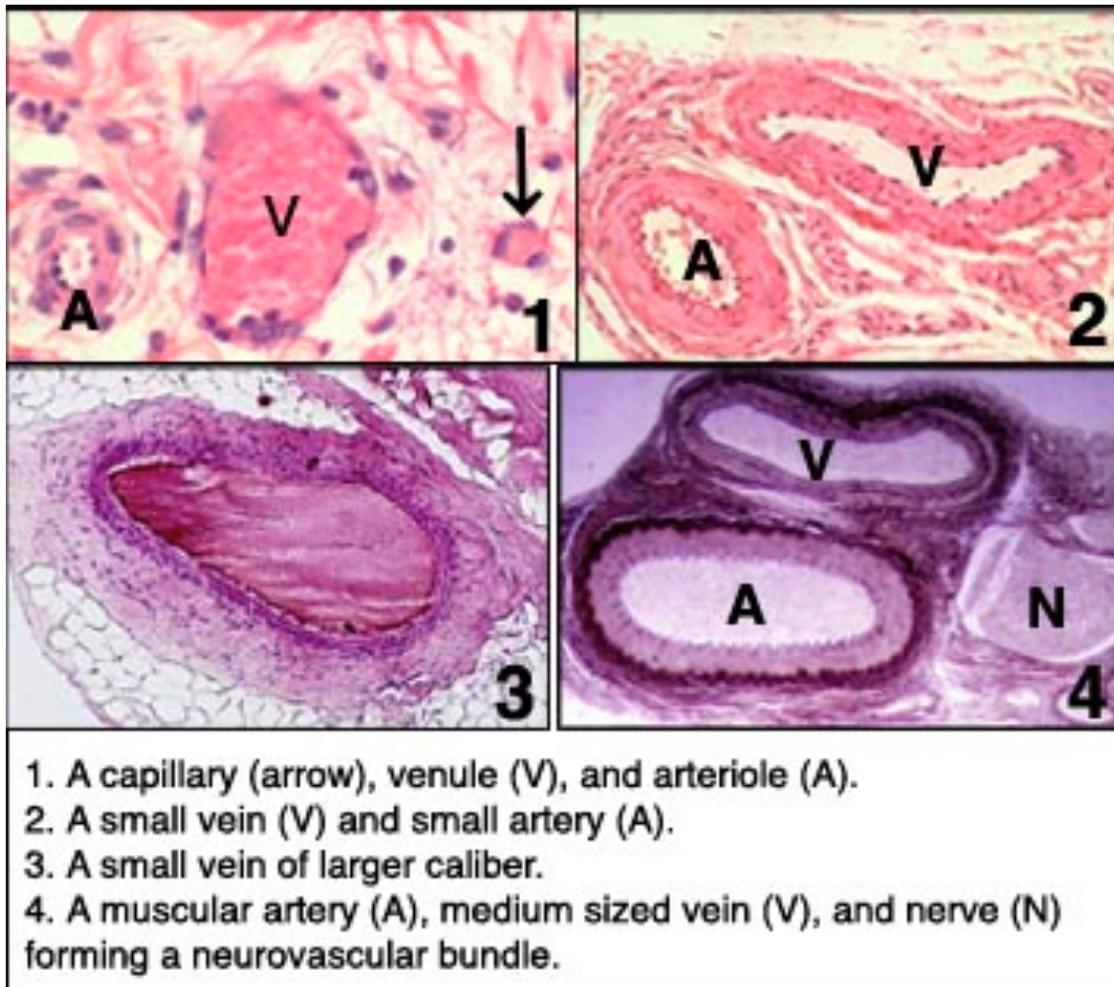


## Veins



The venous side of the circulatory system carries blood from the capillary beds to the heart, and in their progression, the veins gradually increase in size and their walls thicken. Their structure basically is the same as that of arteries, and the three coats - tunica intima, media, and adventitia--can be distinguished but are not as clearly defined. In general, veins are more numerous and larger than the arteries they accompany, but their walls are thinner because of a reduction of muscular and elastic elements. Since their walls are less sturdy, veins tend to collapse when empty and in sections may appear flattened, with irregular, slitlike lumina. Structurally, veins vary much more than arteries. The thickness of the wall does not always relate to the size of the vein, and the same vein may differ structurally in different areas. Histologic classification of veins is less satisfactory than for arteries, but several subdivisions usually are made - namely, venules and small, medium, and large veins.

From 70-75% of the circulating blood is contained in the veins, and much of it can be made available to organs as needed. Blood is moved along the veins by the massaging action of muscles and fascial tissues and by the special arrangements of vessels in the soles of the feet that act as pumps when pressure is exerted on them. Blood flows away from the area of compression but is prevented from flowing backward by the valves. Negative intrathoracic pressure created during inspiration also contributes in moving venous blood in the direction of the heart.

## **Venules**

Venules arise from the union of several capillaries to form vessels 10 to 50  $\mu\text{m}$  in diameter. The junctions between venules and capillaries are important sites of fluid exchange between tissues and blood. The tunica intima consists of a thin, continuous endothelium, the cells of which are loosely joined by poorly developed intercellular junctions. The thin basal lamina is pierced by pericytes that appear to make contact with the endothelial cells. The tunica media is missing in the smallest venules, and the relatively thin adventitia contains a few collagen fibers, scattered fibroblasts, mast cells, macrophages, and plasma cells. As the vessels increase in size to reach diameters of 50  $\mu\text{m}$ , circularly oriented, scattered smooth muscle cells begin to appear and form a somewhat discontinuous and incomplete tunica media. The adventitia increases in thickness and consists of longitudinally arranged collagen fibers that form an open spiral around the vessel. Fibroblasts often are irregular in shape and bear thin processes.

## **Small Veins**

Small veins vary from about 0.2 to 1.0 mm in diameter. The tunica intima consists only of a continuous endothelium that rests on a thin basal lamina. Smooth muscle cells make up a tunica media, which contains one to four layers of cells. Between the smooth muscle cells is a thin network of elastic and collagen fibers. The tunica adventitia forms a relatively thick coat and contains longitudinally oriented collagen fibers and some thin elastic fibers.

## **Medium Veins**

The medium class of veins includes most of the named veins of gross anatomy except for major trunks. They vary in size from 1 to 10 mm in diameter. The thin tunica intima consists of endothelial cells resting on a basal lamina, but a narrow subendothelial layer may be present and contains fine collagen fibers and scattered thin elastic fibers. The elastic fibers may form a network at the junction of tunica intima and media, but a poorly defined internal elastic lamina is formed only in the larger vessels. In most medium veins, the tunica media, though well developed, is thinner than in corresponding arteries. The thick tunica adventitia forms the bulk of the wall and is larger than the tunica media. It consists of collagen and elastic fibers and frequently contains longitudinally oriented smooth muscle cells. Vasa vasorum are present in the larger vessels of this class. Most medium veins are equipped with valves, two pocket-like flaps of tunica intima that project into the lumen, their free edges oriented in the direction of flow. They consist of a core of connective tissue covered on both sides by endothelium. A rich network of elastic fibers is present in the connective tissue beneath the endothelium on the down-stream side of the valves. As blood flows toward the heart, the valves are forced against the vessel wall, but with back-flow, the valves are forced outward against each other to occlude the vessel and prevent reversal of blood flow.

## **Large Veins**

In large venous trunks (venae cavae; renal, external iliac, splenic, portal, and mesenteric veins), the thick tunica adventitia forms the greater part of the wall. It consists of a loosely knit connective tissue with thick, longitudinal bundles of collagen and elastic fibers. Smooth muscle

bundles, also longitudinal in orientation, are present and are especially well developed in the inferior vena cava. Vasa vasorum are present and may extend into the media. A thin tunica media is poorly developed and may even be absent; otherwise it has the same organization as that in medium veins. The tunica intima is supported by a subendothelial layer that may become prominent in larger trunks.

### **Veins with Special Features**

Some veins lack a tunica media, such as the trabecular veins of the spleen; veins of the retina, bone, and maternal placenta: most meningeal and cerebral veins; and those of the nail bed. Veins in the pregnant uterus contain smooth muscle in all three coats; in the intima the fibers run longitudinally rather than circularly, as they do also in the tunica intima of the saphenous, popliteal, femoral, umbilical, and internal jugular veins. At their junctions with the heart, the adventitia of the pulmonary veins and venae cavae are provided with a coat of cardiac muscle; the fibers run longitudinally and circularly about the vessels for a short distance.

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