VEIN ANATOMY AND PHYSIOLOGY (FUNCTION)

In order to understand and appreciate the anatomy of the venous system, it is sometimes good to contrast this by gaining insight into the arterial system.

Arteries are thick walled tubular structures that carry blood pumped under high pressure from the heart pump down into our legs, muscles, bones and skin supplying oxygen and nutrients for muscle activity and cellular metabolism. Veins, on the other hand, are thin walled tubes that carry blood back to the lungs and heart from the lower extremities. There is no heart in the lower extremities pumping the blood back up against gravity and to facilitate this flow of blood against gravity, veins have one-way check valves similar to that used in a sump pump or other type of lift pump device. I also equate these one-way check valves to an upside down umbrella, which when the blood is flowing upward toward the heart and lungs out of the legs, the umbrella remains closed allowing blood to flow in the appropriate direction. When one assumes a sitting or upright position and the blood is drawn downward by gravity, these "umbrellas" will open trapping the blood and preventing it from dropping down any further in the venous system within the leg. There are many valves in various veins and when working properly they provide the correct flow of blood up out of the legs and into the lungs and heart so that toxic elements can be removed and the blood replenished.

The venous system is composed of named veins that lie within the deep and superficial areas of our legs. The deep system of veins run deep within the muscles of the legs and the muscles are surrounded by tight white glistening fascia or membrane, making these muscles a true compartment in the legs able to withstand high pressure when the muscles are contracted. Contraction of the muscles in the deep portion of our leg also facilitates in squeezing the deep veins and acting as a pump driving blood up out of the legs into the larger veins of the pelvis, abdominal cavity and eventually into the lungs and heart. Main deep veins that we speak about and that we will address in your review are the *common femoral vein* near the groin, the *femoral vein* in the thigh, the *popliteal vein*, which runs behind the knee and multiple smaller branch veins in the calf of the leg within the gastrocnemius muscle, which provide the muscular contour in the back of one's calf.

The veins in the superficial system of the leg consist of those venous tubes that lie between the muscle compartment and the skin. Important veins for you to learn are the *great saphenous vein*, the *small saphenous vein*, *anterior and posterior accessory branches* as well as other numerous branches that come off of these dominant veins, some of which become quite distended, dilated and tortuous during times of venous insufficiency or backward flow of blood. The *great saphenous vein* is the dominant superficial vein in the thigh and lower leg. This vein connects to the deep system at the *saphenofemoral junction* in the groin skin crease in our upper thigh. This vein joins the *common femoral vein* just like a "T" intersection in a highway. The *small saphenous vein* joins the deep system behind the knee and enters the *popliteal vein* in a good percentage of cases. Occasionally, there is also a *thigh extension branch* that continues up the posterior part of the thigh, in the inside of the thigh (or medially) and joins the *great saphenous vein* in the upper (or proximal) portion of the thigh. This vein is also called the *vein of Giacomini*. Once again, there can be many branches off of the *small saphenous vein* as there are in the *great saphenous vein*, just like branches off of a trunk of a tree.

Additionally, the superficial venous system can join the deep venous system through short branches, which also have one-way check valves. These short veins are called *perforator veins* because they perforate or penetrate through the muscular fascia surrounding the muscles in the thigh and calf area.

Hence, we have a picture similar to a ladder where we have one vertical side of the ladder being the deep system and one vertical side being the superficial system with the rungs of the ladder connecting the two comprising the *perforating veins*.

Remember that all three vein systems, the *great*, *small* and *perforator veins* have these one-way check valves, which must function normally for a healthy venous system in the legs. If these valves fail at any point along the way, reflux or retrograde (backward) flow of blood ensues allowing blood to drop down to the next valve or dilate a vein branch creating distention of the vein and further reflux or incompetency of the one-way check valve below the level of involvement. Over time the pressure builds because of the weight of blood and the backward flow further compromising the system causing vein dilation and further valve failure. This ultimately results in high pressure in the venous system in the lower leg, which in turn leads to loss of fluid from the veins into the surrounding tissues, swelling of the feet, ankles and legs and the ultimate consequences, which are discussed in another section entitled, "S*kin conditions from venous insufficiency."* Thus, the symptoms from venous insufficiency or valvular failure, which consists of leg pain, swelling, achiness, heaviness, restlessness, itching, skin color changes and even open ulcerations are all caused by the high pressure which develops in the venous system and the stagnation of venous blood. Venous blood is blood that has just come out of the cells and muscles of the legs and contains an acid or lower PH as well as toxic elements from cellular metabolism. If this blood pools in the lower legs and in the veins and stagnates, it can cause an irritation in the veins further leading to symptoms of restlessness and pain. Additionally, when blood slows down in its proper flow there is always a chance of clotting and thrombus (blood clots) to form.

The majority of the blood should be flowing back to the heart through the deep veins and only a small portion flowing through the superficial veins. When the valves fail in the superficial system, for example, blood will stagnate and dilate these superficial veins and cause visible problems with the legs. On the other hand, if the valves fail in the perforator veins, then each time the calf muscle compresses veins trying to squeeze blood up out of the deep veins, some of the blood will jettison through these perforator veins and flow into the superficial venous system causing high pressure within the superficial system and results in dilation of the venous system. Kindly see the section on blood clots to learn about the affect that clotting has on these delicate valves and vein walls.