ON THE VASCULARIZATION OF THE WALL OF THE FEMORAL VEIN IN MAN

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The vessels of the vascular wall (vasa vasorum) constitute a significant objective for morphological investigation. Being intra-organic vessels, they essentially add to the characteristic morphological features of the vascular wall. Furthermore, one could judge for its nourishment peculiarities by the distribution of the same vessels. This is owing to the fact that nourishment is secured not merely by intramural vessels, but by means of the blood flow through the lumen of the main vessel as well. Thus, the degree of penetration of intramural vessels into the wall is indicative for their participation in the nourishment of the wall, determining also to a considerable extent the role played in this process by the blood flow through the lumen.

The literature data on the vein wall vascularization refer to sources of blood supply, degree of vascularization, angio-architectonics of the wall etc. These data however, are controversial in a number of points. According to some of the authors, only the tunica adventitia is vascularized, the rest of the layers remaining avascular (Komahidze — 1955). According to other authors, the layers supplied with intramural vessels are the adventitia and the media, respectively the muscular coat (Plotnikov — 1884, Epstein —1887, Short — 1940, Nylander — 1960, Lang — 1961). Some authors report evidence for the presence of avascular regions in the vein wall (Short — 1940, Komahidze — 1955, Lang — 1961).

The data on vascularization of the wall of the femoral vein refer to various aspects of the problem. It is established that all deep main veins are supplied with blood by sources common for them and the accompanying arteries and nerves, and the nutrient arteries are given off from the respective artery-satellite, or from its branches (Ostrogorski — 1929, Margorin — 1938, Short — 1940, Gusev — 1949).

The literature data on the degree of vascularization and angio-architectonics of the femoral vein wall are rather contradictory. According to Short, in the latter there are two plexuses: 1. adventitial one with longitudinal orientation and 2. muscular one with transverse orientation. The intima is vascularized only in the instances of sclerotic processes. Belianski reports that in the deep limb veins, being with simple wall structure, the adventitia is the only vascularized coat. Komahidze studied the vascularization of the wall of main veins in a number of

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laboratory animals and newborns, among which that of the femoral vein as well; in the latter, as well as in the remainder, three plexuses were found — perimuscular, adventitial and perivascular, which means that the media and intima are not vascularized.

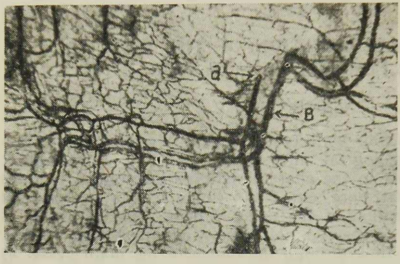

Fig. 1. Cleared total preparation of the vein wall. The blood vessels are filled up with contrast substance. The arterial vessels are outlines more sharply, whereas the venous — more weakly. Micröphoto: 8×4

The literature survey shows that the question of vascularization of the vein wall in general, and femoral vein wall in particular can not be considered satisfactorily elucidated.

Our studies are carried out on cadavers of individuals of all age groups — from birth to advanced senility. Vasa vasorum were revealed by indian ink-gelatine injection technique with preparation of cleared total speciments and histological sections.

The findings we came across refer to various aspects of vascularization of the femoral vein wall, namely blood supply sources, degree of vascularization of the wall, angio-architectonics of the same etc.

Responsible for the blood supply of the femoral vein are the arterial vessels, given off most frequently from the branches of the femoral artery, and more seldom — directly from the artery. After their arising, the arterial branches proceed into the connective tissue sheath of the neuro-vascular bundle, completely directing themselves, or emanating branches to the grooves formed by the arterial adherence to the vein, or to the nerve trunks accompanying them. Besides the femoral vein, they supply with blood the wall of the femoral artery and the branches of the femoral nerve, constituting part of the bundle. In certain cases the nutrient arteries supply only the vein wall. They arise from the branches of the femoral artery, pass across the posterior or anterior sur-

Fig. 2. Transverse section of the vein wall. The blood vessels are filled up with contrast substance. Staining with orcein. Microphoto 10×10

face of the vein, and are situated in the connective tissue sheath of the neuro-vascular bundle. The arteries supplying the femoral vein wall, reach to the latter through the junction with the femoral artery or through the adhering nerve trunks, and much more seldom — through other areas on its surface.

The blood from the vein wall is discharged through the venous vessels, which follow the course of the arteries. They leave the vein wall, more precisely its adventitia, mainly in the region of the intervascular grooves, where they join the veins coming from the arterial wall. Simultanecusly, they open into the veins of the nerve trunks. Subsequently, the blood enters the veins which empty into the affluents of the femoral vein, in to the veins, accompanying the femoral artery or directly into the femoral vein.

Fig. 3. Cleared total preparation of the vein wall. The blood vessels are filled up with contrast substance. Microphoto: 10×10

The arterial plexus in the femoral vein adventitia is characterized with marked variability in the different regions of the vein wall. The two inter-vascular grooves alongside the entire length of the vein are situated paralelly along the periphery of its contact surface, i. e. the surface facing the artery. This fact accounts for the great constancy of the nature of adventitial arterial branches in the region of its contact surface. Alongside the edges of this surface chains are situated of longitudinal arteries, anastomosing between them, and from which approximately transverse branches are separated to the internal regions of the surface; some of them anastomoze with those coming from the other margin of the contact surface. Relatively large calibre anostomoses are observed, as well as single unions of secondary branches.

Alongside the free surface of the vein, the nutrient arteries may originate in various sites and proceed in various directions. The big adventitial arteries may be longitudinally, obliquely or transversely orientated, and through their main branches or through their direct extensions could unite, forming arterial loops. The number and characteristic features of these loops are highly variable. In certain areas they have mainly longitudinal orientation. In other regions loops are observed without definite orientation. A very common finding is a region with poorly anastomosing arteries. From the arteries situated in the superficial layers of the adventitia, arise branches, directed to the deeper structures, ramifying in bush-like pattern, the end branches of which penetrate into the muscular coat of the vein wall. Usually, in the area of the affluent orifices, the arterial vessels coming from two or three different directions, get split and anastomose with their branches, forming an arterial ring around the entire circumference of the mouth. From the latter arterial vessels emerge for the deeper layers of the vein wall. Usually arterial vessels pass from the femoral vein to its affluents.

Fig. 4. Transverse section of the vein wall in the region of a valve. The blood vessels are filled up with contrast substance. Microphoto: 10×10

The vein vessels in the adventitia of the femoral vein generally follow the course of the arterial vessels (Fig. 1). The latter are accompanied by one or two veins. They anastomose at the sites of anastomosis of the corresponding arteries. In addition, the venous vessels are more richly ramified than the arterial ones, forming a venous network composed of comparatively small, second-rate loops. At this level the majority of vein vessels are unaccompanied by arteries.

The muscular coat of the femoral vein is pierced by a capillary network (Fig. 2). The latter is supplied by the adventitial vessels. The arterial vessels penetrating from the adventitia in depth and the minute venous vessels carying blood from the muscular coat to the adventitia run as a rule, an independent course. The capillary network has loops with chiefly transverse orientation (Fig. 3). Just around the orifice of the affluents, the capillary loops are orientated with their longsize parallel to the circumference of the mouth. In the area of the valve sinuses the capillary network exhibits an altered structure to a certain extent. Usually its loops lose their transverse orientation. In this particular area, in adults and especially in individuals of advanced age, capillaries are detected in the most inwardly situated coats of the intima, immediately beneath the endothelium (Fig. 4). These capillaries have the form of loops (Fig. 5). In the agger, to which the valve cusp is attached with advancing of age, the capillary network becomes more complex, and finally a dense capillary network is observed with loops orientated mainly paralelly to the agger course. The most superficially situated loops however, lose their orientation. Among the latter loop-like capillaries are also observed, reaching to the immediate vicinity of the endothelium, similar to those described for the valvular sinuses area. Normally the valve cusps lack blood vessels. Our results demonstrate that the adventitia contains vascular plexus, whereas the musculature is pierced by capillary network. In this respect our findings are in accordance with those reported by Short. Against the background of the data adduced on the vascularization of the vein wall, it could be assumed that it receives nutrients and oxygen mainly from the blood circulating through its intramural vessels. The endothelium and the subendothelial layer therein attached are supplied by the blood flow through the venous lumen. This is also confirmed by the fact that the valve cusps which represent reduplications of the endothelium and subendothelial layer, are normally devoid of proper blood vessels.

In compliance with the results of our investigation, the vascularization pattern of the vein wall displays definitely proved differences with respect to the functional conditions in which a particular segment is found. The presence of various functional conditions is owed to the presence of valves. The vein wall in the region of a valve participates in encompassing the valve pouch. The differences here established refer mainly to the vascularization of the subendothelial layers of the wall in the valve areas, whereas in the regions outside the valves such a vascularization is not observed. Excluding the already pointed out erroneous statements concerning the absence of vessels in the valve areas of the wall, other evidence for differences in the vascularization of the valve and contiguous area were not found in the literature.

Fig. 5. Cleared total specimen of the vein wall in the region of a valve. The blood vessels are filled up with contrast substance. Microphoto: 10×10

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О СНАБЖЕНИИ СОСУДАМИ СТЕНКИ БЕДРЕННОЙ ВЕНЫ ЧЕЛОВЕКА

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РЕЗЮМЕ

Путем вливания туш-желатина и последующего приготовления тотально просветленных препаратов и гистологических срезов, была исследована васкуляризация стенки бедренной вены. Полученные данные показывают, что адвентиция содержит сосудистое сплетение, а мускулатура — капиллярную сеть. Капиллярная сеть имеет петли, которые ориентированы преимущественно поперечно. В области клапанных синусов, эти петли обычно теряют свою поперечную ориентацию. В этой области у взрослых индивидуумов и в особенности в старческом возрасте, устанавливается наличие капилляров непосредственно под эндотелием. Они обычно петлевидные. В валике, к которому прикрепляется створка клапана, с прогрессированием возраста капиллярная сеть осложняется, причем в старческом возрасте она густая, и ее петли ориентированы параллельно ходу валика. Нормально, клапанные створки лишены кровеносных сосудов. Данные васкуляризации венозной стенки показывают, что она получает питательные вещества и кислород главным образом из крови, которая циркулирует во внутристеночных сосудах. Только эндотелий и прилегающий к нему субэндотелиальный слой их получают из крови, текущей в просвете самой вены