

I. EXPERIMENTAL PROBLEMS

REGULARITIES OF THE VASCULARIZATION OF HUMAN ARTERIAL VESSELS

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The regularities determining the vascularization of the arterial wall are still not enough clarified. The literature data available on this question are based on investigations performed by using imperfect methods on the material of single vessels only (pulmonary trunk, aorta, some muscular arteries). Contemporary investigators such as J. Lang (1962), J. Clarke (1965) doubt the possibility for complete revealing of the capillary network in the walls of blood vessels. A number of studies of the arterial vessels of dog which were performed in the Dept. of Anatomy and Histology (V. Vankov, et al., 1965; V. Vankov et al., 1969) proved convincingly the possibility for complete manifestation of intramural vessels and showed that the vascularization of the arterial wall can be rather different in arteries of various size and structural type.

Material and methods

Our data are based on systemic studies of the vascularization of 23 different arterial vessels — pulmonary trunk, aorta and its branches, arteries of the upper and lower limbs of 14 individuals, aged 3-88 years. The vascularization was investigated by ink-gelatin injection technique (prescription of V. Vankov, 1968). Total cleared preparations and histological sections between 10 and 150 micrometers thick were made of 353 samples with completely revealed intramural vessels.

Results and discussion

We studied the pulmonary trunk, aorta and the branches of the aortic arch as arteries of elastic type. The intramural vessels in the wall of pulmonary trunk enter deeply the media. They have a shrubby type with various structural complexity and terminate in capillary loops forming at single places a capillary net, too. The relative thickness of vascularized part of the proper wall (both media and intima) reaches up to 58 % out of its total thickness. In any investigated individuals the intramural vessels in the media of ascendent aorta and aortic arch have a type of small vascular shrubs terminating either in capillary loops in their periphery, or in single capillary loops only. The vascularized part of the wall reaches up to 43 % out of the total thickness of the proper vessel wall. This shows that the wall of both ascendent aorta and aortic arch is vascularized in a lower degree than that of pulmonary trunk. Along the thoracic and abdominal aorta the intramural vessels formations which enter the media as a rule are represented by single capillary loops (fig. 1). This regularity is displayed also in the wall of branches of abdominal aorta (brachiocephalic trunk, common carotid

and subclavian artery). In them the intramural vessels are presented with a relatively widemeshed vascular plexus in the adventitia, which usually has terminal vessels' formations in the fibroelastic layer (fig. 2). The latter stick to the media and enter its outer quarter at certain places. This enter shows gradual differences between the three vessels corresponding to the thickness of their wall.

Based on the data obtained we can conclude that the appearance of terminal vessel formations of loop-like type with various complexity depending on the depth of penetration is a common feature of arteries of elastic type. With diminishing the thickness of proper wall, respectively of the media and the attached to it intima the depth of penetration of intramural vessels into the walls of arteries of elastic type decreases absolutely and relatively between approximately 50 % in the ascendent aorta till 10 % in the subclavian artery. The pulmonary trunk is an exception to that rule because despite its thinner wall it is vascularized in a higher degree than the ascendent aorta. This can be explained with the lower blood pressure and the weaker intramural compression which gives the possibility for intramural blood circulation in deeper layers of the wall. This conclusion demonstrates that the vascularization of the arterial wall is influenced by physical factors, too. The visceral branches of abdominal aorta and the arteries of the upper and lower limbs were studied as arteries of muscular type.

The walls of these vessels are vascularized by a vascular plexus located in the outer loose part of the adventitia and a terminal vessel network, which is formed by vessels with different size, mainly capillaries. It is thicker and with a space character at some districts and quite thinner and flattened at other ones. It can be located entirely in the connective tissue part of the adventitia (fig. 3) and enter at different depth the fibroelastic layer and even sometimes the most external part of the media (fig. 4). The presence of capillaries in the media of arteries of muscular type is definitely depending on the thickness of the wall and individuals' age. As a rule with advancing age the capillaries enter more profoundly the media which is more expressed at the places of thickened intima. Such enter is extraordinarily rarely observed in the visceral branches of abdominal aorta while it occurs considerably often with the main arteries of the lower extremity. It is due to the significantly greater thickness of the wall of the latter vessels. The vascular lumen also influences the vessel enter the media. We establish that the capillaries enter the media in regions with thickness of the wall between 780 and 1300 micrometers in the femoral and popliteal artery and between 380 and 820 micrometers in the arteries of the crus and foot. Most arteries of the upper limb are vascularized only within the limits of the adventitia and single capillaries only come into contact with the media.

An exception to this rule is the distal third of both radial and ulnary arteries where the capillary net work covers the whole vessel lumen (fig. 4 and 5). The thickness of the vascularized zone of the ulnary arterial wall reaches up to 20 per cent of its total one. This can be due to its larger thickness.

Based on these data it can be concluded that the vascularization within the limits of the adventitia is a common feature of arteries of muscular type. The degree of reaching the media depends on the thickness of both intima and media. Partial enter of the intramural vessels is established with a thicker proper arterial wall.

The studied regularities of the vascularization of human arterial wall enlarge considerably and systematize the old concepts of this problem (see H. F. Robertson, 1929; Ch. A. Woerner, 1959 and J. A. Clarke, 1965 — concerning

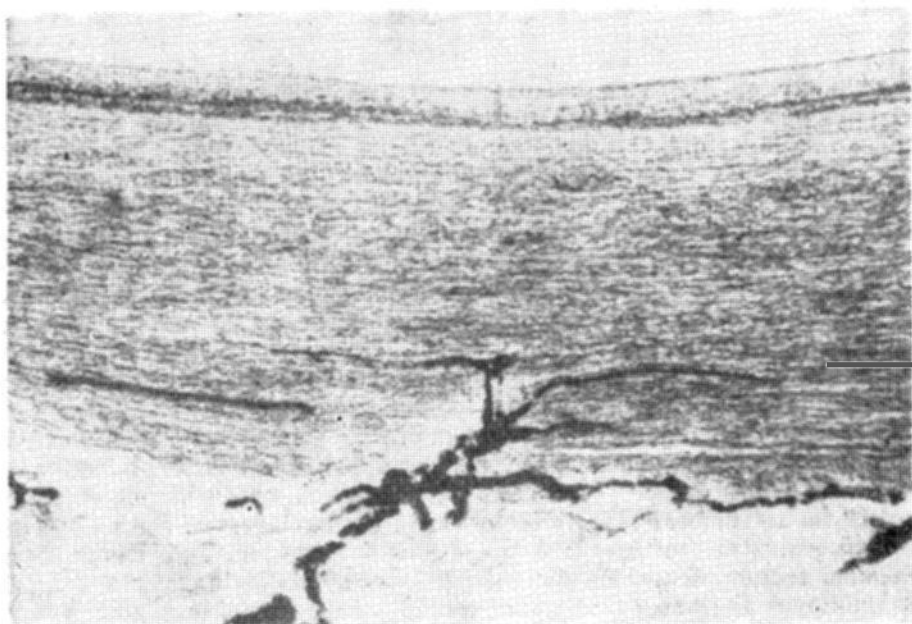


Fig. 1

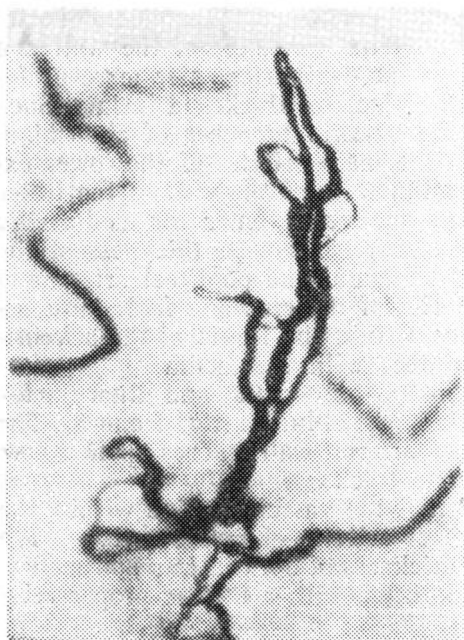


Fig. 2

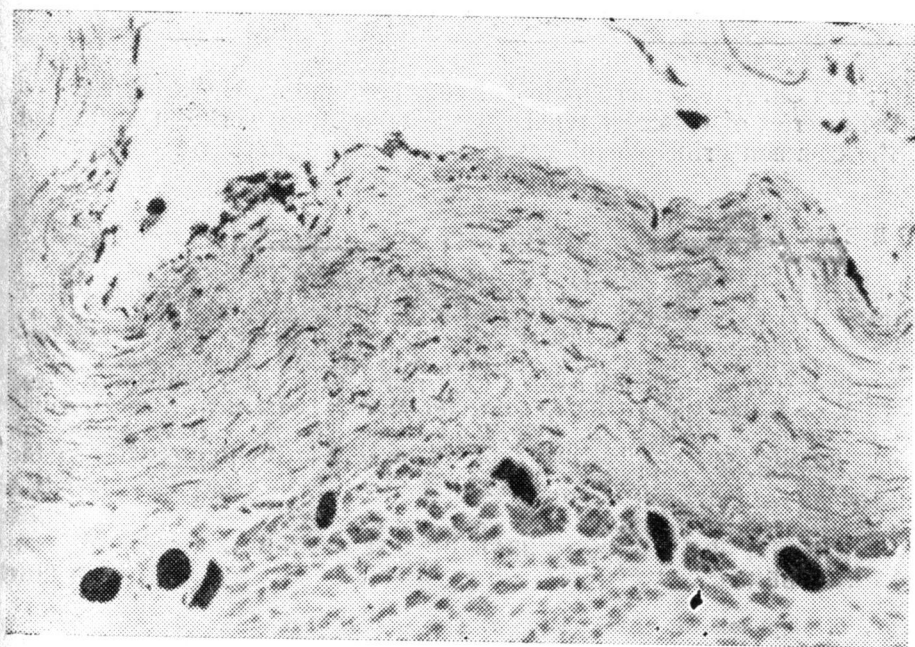


Fig. 3

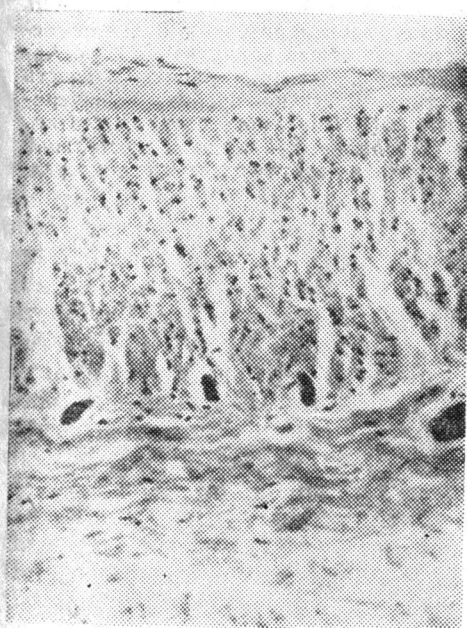
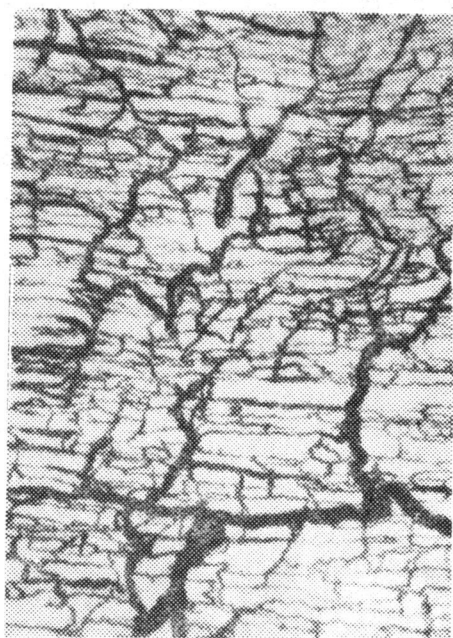


Fig. 4



ig. 5

the A and PT; and Ch. A. Woerner, 1959; J. Lang, 1962 and J. A. Clarke, 1965 — concerning the arteries of muscular type). At the same, they work out an united idea about the common principles of vascularization of the arterial wall.

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ЗАКОНОМЕРНОСТИ ПРИ ВАСКУЛЯРИЗАЦИИ АРТЕРИАЛЬНЫХ СОСУДОВ ЧЕЛОВЕКА

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РЕЗЮМЕ

Изучена васкуляризация стенок магистральных артерий человека. При артериях эластического типа капилляры, проникающие наиболее глубоко, достигают различной глубины в толще меди, причем глубина их проникания зависит от толщины стенки, соответственно меди, с прилегающей к ней интимой.

Концевые сосудистые формации меди имеют форму петли различной сложности строения в зависимости от глубины их проникания. Исключение от этого правила является лишь легочный ствол, который, несмотря на свою тонкую стенку, васкуляризован в большей степени, чем восходящая аорта, и в его стенке формируется настоящая капиллярная сеть. Артерии мышечного типа по правилу васкуляризованы в пределах адвентиции, причем близость к меди зависит от толщины как самой меди, так и интимы. Частичное проникание внутристеночных сосудов наблюдается при большей толщине собственно артериальной стенки. Регулярная васкуляризация наружных слоев меди устанавливается лишь в дистальной трети протяжения локтевой артерии. В этом случае концевая сосудистая сеть меди представляет собой густую капиллярную сеть.