

STRUCTURE AND VASCULARIZATION OF THE PERICARDIUM AND EPICARDIUM IN MAN

M. Madzharova

In modern surgery opening of the fibroserous sac of the heart, or utilizing one of its components — the pericardium — as an additional supply source of the heart muscle, is ever more frequently resorted to. This, in turn, compels the surgeon to be thoroughly aware of the histological structure and vascularization of the pericardium and epicardium. In all instances, the literature reports on the issue outlined deal either with the pericardium, or with the epicardium alone.

Although it is a long time since the presence of proper vessels in the pericardium has been demonstrated, it should be pointed out that it is a matter mainly of superficial researches. Rather more systematic data about the structure and vascularization of the pericardium were furnished by Yarovich (1961), Kupryanov (1964), Serebrova (1964), Tentimishev (1966) and Kudrova (1969). Regarding vascularization of the epicardium the opinions are divergent. Some of the authors (Alexandrovich — 1948, Ognev et al. — 1954, Eliskova and Eliska — 1964, 1966, Mishkina — 1965, Farrer Brown — 1968) make reference only to vessels situated in the subserous layer or in the deeper layers of the epicardium. Others, based on studies of the heart vessels, describe also the presence of a voluminous vascular network within the epicardium (Trifonov — 1959, Gavasheli — 1963, Dzhavahashvili and Komahidze — 1967 and Makoeva — 1967, 1969.)

Our data make possible the comparative study of pericardium and epicardium which are considered as two components of the serous sac of the heart, united by their common function, but related in different patterns to the tissues they are in contact with. No similar comparisons were found in the literature owing to the fact that none of the authors has undertaken parallel researches into the structure and vascularization of the two objects.

Material and methods

The data in the present work are based on postmortem studies carried out on 48 cadavers belonging to individuals aged 0—50 years. The intraorganic vascular bed of the peri- and epicardium was demonstrated by means of total Indian ink-gelatin injection according to Vankov (1968). From the places of complete capillary network demonstration both cleared preparation were worked out (total and sectional), as well as histological specimens, stained with hematoxylin-eosin and orceine. To determine the vascular networks density, all vessels in the cleared preparations, intersected by a one millimeter long straight line, were counted with the ocular micrometer of a stereomicroscope MBS-2. In the histological preparations interpretations were made of

the structural peculiarities of pericardium and epicardium, as well as of the distance between vessels and mesothelium upon reading their total thickness.

Results and discussion

Pericardium and epicardium possess a common structural and vascularization layout. In each of them four tissue layers and two vascular formation

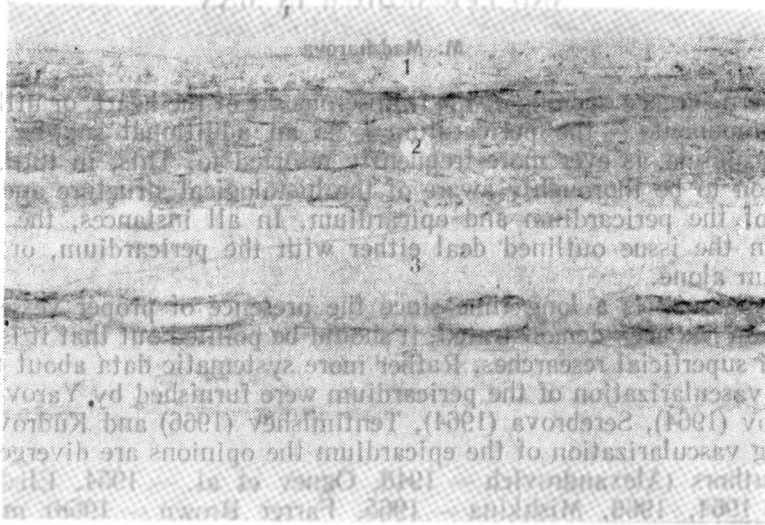


Fig. 1. Histological structure of the pericardium (36 years). Histological preparation — cross section. Stained with orceine. Microphotograph: oc. 10, ob. 20.

1 — superficial collagen-elastic layer; 2 — deep collagen — elastic layer; 3 — subserous layer.

are differentiated. Two collagen-elastic layers are comprised between the mesothelium and subserous layer. Some authors consider them as a single layer, whereas others distinguish separate elastic and collagen layers (Yarovih, 1961 — for the pericardium; Baron, 1936 and Fedyai, 1959 — for the epicardium). Our personal data show that in each collagen-elastic layer the elastic fibers, although exhibiting a variable concentration, are encountered throughout its full thickness and therefore their differentiation as an independent layer is by no means justified. The two collagen-elastic layers are distinguished from each other by the different direction of their fibres — longitudinal (parallel to the long axis of the heart) in the superficial layer, and transverse — in the deep layer (Fig. 1). Corresponding to the two collagen-elastic layers, we established both in the pericardium and in the epicardium two vascular networks — an external one, situated in the deep collagen-elastic layer, and inner (capillary) one, situated in the superficial collagen-elastic layer in the vicinity of the mesothelium (Fig. 2).

According to our data the difference between epicardium and pericardium is quantitative and regional alike. The quantitative differences become appa-

rent by the fact that the overall thickness of the epicardium is smaller than that of the pericardium which is explained by the slower development of the two collagen-elastic layers. Moreover, the epicardium is the thickest in the area of the atria, whilst the pericardium — in the thoracocostal and lateral aspects. Obviously the epicardium is subjected to a greater stress (stretching) in the atrial area where the wall is substantially thinner than in the chambers, whereas the pericardium is subjected to a greater stress (stretching) in its anterior and lateral parts which are more mobile, and to a lesser extent — in the diaphragmal and posterior parts which are rather firmly fixed to the diaphragm and to the organs of the posterior mediastinum. The quantitative differences in the vascularization of the pericardium and epicardium are attributed to the fact that the vascular networks in the epicardium are flatter and rather distant from each other as compared to the pericardium (Fig. 3 a, b). Presumably, the inner submesothelial capillary network plays an important functional role. The pe-

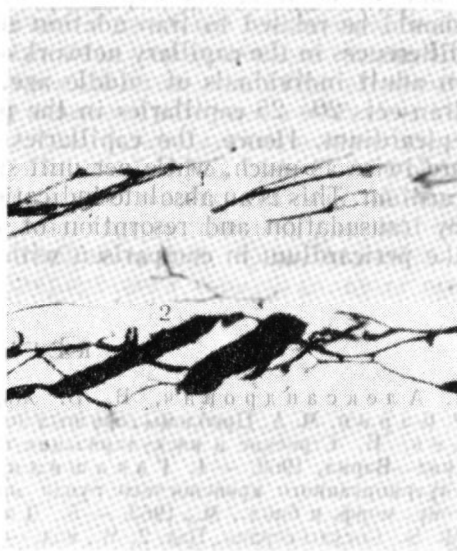


Fig. 2. Proper vessels in the pericardium (55 years). Cleared preparation — cross section. Microphotograph: oc. 8, ob. 7.
1 — vessels of the external network; 2 — vessels of the inner network.

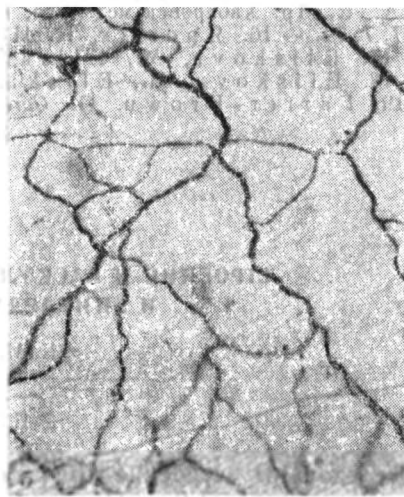
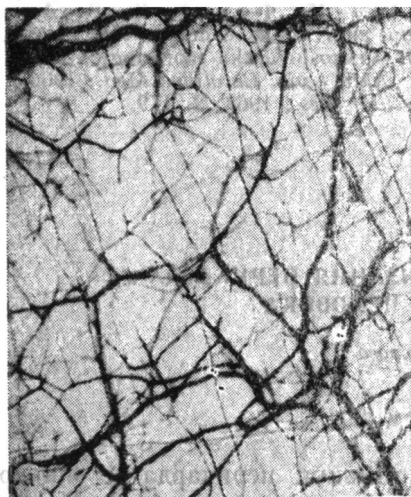


Fig. 3 a. Terminal vascular network of pericardium (34 years). Indian ink gelatin. Total cleared preparation. Microphotograph oc. 8, ob. 7.

Fig. 3 b. Terminal vascular network of epicardium (39 years). Indian ink gelatin. Total cleared preparation. Microphotograph: oc. 8, ob. 7.

ricardium and epicardium are made entirely of bradytrophic tissues and consequently, the presence of a duely formed capillary network within them could by no means be explained by nutritive demands alone. Obviously, it should be related to transudation and resorption of serous fluids. The outlined differences in the capillary network of the pericardium are quite considerable — in adult individuals of middle age, over a segment long 1 mm, a single line transects 20—25 capillaries in the pericardium, and 10—12 capillaries in the epicardium. Hence, the capillaries in the pericardium per unit linear extent are twice as much, while per unit surface — four times as much as in the epicardium. This is an absolute indication that the functional activity, manifested by transudation and resorption of serous fluids, is much more pronounced in the pericardium in comparison with the epicardium.

REFERENCES

1. Александрович, В. В. *Журн. здравоохран. Казахстана*, 1948, 7, 21. —
2. Барон, М. А. Проблемы серозных покровов. Сб. тр., I, ММИ, 7, М., 1936. —
3. Ванков, В. Строение и васкуляризация стенки вен и их клапанов. Дисс. докт. Ленинград—Варна, 1968. —
4. Гавашели, О. А. О некоторых возрастных особенностях внутриорганичного кровеносного русла эпикарда человека. Матер. IV науч. конф. по вопросу морф. и биох., М., 1963. —
5. Джавахишвили, Н. А., Комахидзе, М. Э. Сосуды сердца. Изд. 2, М., изд. — Наука, 1967. —
6. Кудрова, В. А. *Вопр. морф. кровеносной и нервной систем*. Куйбышев, 1969, II, 217. —
7. Куприянов, В. В. *Тр. Тадж. мед. и-та*, 1964, 68, 58. —
8. Макоева, З. Х. *Арх. АГЭ*, 1967, I, 36. —
9. Макоева, З. Х. Сб. морф. особ. серд. сосуд. и нервн. системы в норме и патологии. Ростов на Дону, 1969, 95. —
10. Мышкин, Н. В. *Тр. Куйбышевского мед. и-та*. Куйбышев, 1965, 35. —
11. Огнев, Б. В., Савин, В. Н., Савельева, Л. А. Кровеносные сосуды сердца в норме и патологии. М. 1954. —
12. Семенов, Ю. Сб. матер. теор. и клин. мед. Томск, 1964, 3, 97. —
13. Тентимишев, Е. С. *Вопр. хирургии и снежных областей*, 1966, 262. —
14. Трифонов, А. Е. *Тр. Хабаровск мед. и-та*, 1959, 18. —
15. Федяй, В. В. *Арх. АГЭ*, 1959, 37, 74. —
16. Яровых, И. И. *Вопр. анат. лимф. системы*, Ленинград, 1961, 133. —
17. Eliskova, M., Eliska, O. *Ceskoslovenska morfologie*, 1964, 12, 3 327. —
18. Eliskova, M., Eliska, O. *Akta Univ. Carolinae Med.*, 1966, 112, 1 21. —
19. Fagget-Brown, G. *Cardiovascular Res.*, 1968, 2, 179.

СТРОЕНИЕ И ВАСКУЛЯРИЗАЦИЯ ПЕРИКАРДА И ЭПИКАРДА У ЧЕЛОВЕКА

М. Маджарова

РЕЗЮМЕ

Исследованы строение и васкуляризация перикарда и эпикарда у 48 лиц, в возрасте от 0 до 50 лет. Устанавливается, что перикард и эпикард имеют общий план строения и васкуляризации. В них дифференцируются 4 тканевых слоя и 2 сосудистых формирования. Между мезотелием и субсерозным слоем включаются два коллагенно-эластических слоя, которые дифференцированы друг от друга различным направлением своих волокон —

продольным (параллельным продольной оси сердца) в поверхностном слое и поперечным — в глубоком слое. В соответствии с двумя коллагенно-эластическими слоями, как в перикарде, так и в эпикарде обнаружены две сосудистые сети — наружная, расположенная в глубоком коллагенно-эластическом слое и внутренняя, расположенная в поверхностном коллагенно-эластическом слое. Особое функциональное значение придается внутренней субмезотелиальной капиллярной сети. Указанные различия в этой сети в перикарде и эпикарде весьма значительны. Она более плоская и более рыхлая в эпикарде, в сравнении с таковой в перикарде. Так как присутствие оформленной капиллярной сети в брадитрофических тканях, какими являются перикард и эпикард, объясняется не только их нутритивными требованиями, но и трансудацией и резорбцией серозной жидкости, предполагается, что эта функциональная активность капиллярной сети гораздо сильнее выражена в перикарде, чем в эпикарде.