

THE STATE OF THE LYMPHATICS DURING DISTURBANCE OF THE VENOUS RETURN FROM THE LIMBS IN DOGS

A. G. Fedorova

Department of Normal Anatomy (Head — Corresponding Member AMN SSSR
Prof. B. A. Dolgo-Saburov) of the S. M. Kirov Order of Lenin Military
Medical Academy, Leningrad

(Presented by AMN SSSR V. N. Chernigovskii)

Translated from *Byulleten' eksperimental'noi biologii i meditsiny*
Vol. 49, No. 1, pp. 118, January, 1960

Original article submitted February 28, 1959

The anatomy of the parietal and visceral lymphatic vessels has now been studied in some detail in respect to all the organs and tissues of man and certain animals [2, 3, 6, 8, 11, 12, 15, and many others]. The role of the lymphatic system in metabolism and hemopoiesis and its participation in pathological processes have also been demonstrated.

Many authors have investigated the collateral circulation of lymph [1, 4, 5, 6, 7, 9, 10, 13, 14, and many others].

Considerable attention has been devoted to lymphatic-venous anastomoses. The majority of workers categorically deny the existence of such structures. Nevertheless, V. Kh. Frauchi [19] demonstrated the existence of a direct connection between the thoracic duct and the veins of the inferior vena cava system in the region of the lower thoracic and the lumbar vertebrae. The presence of a close connection between the lymphatic and blood systems has been known since the end of the last century. I. A. Notkin [13], for instance, in experiments in which he ligated the portal vein in dogs, found dilatation of the mesenteric lymphatic vessels, and V. N. Popov [16] drew attention to the fact that ligation of veins results in an increase in the volume of lymph. After ligation of arteries, bleeding, and stimulation of the vagus nerve, V. N. Popov observed the converse effect.

V. V. Stavskaya [14] ligated various main venous trunks (femoral, external iliac, subclavian, and inferior vena cava) in acute experiments on dogs, and investigated the parietal lymphatic vessels. She found an abnormally large number of lymphatic vessels, starting 5-10 minutes after ligation of the veins. M. S. Yaroshetskaya [21] observed a similar picture in chronic experiments in which the external iliac vein was ligated in dogs. M. V. Shevelev [20] ligated the portal vein in cats and observed enlargement of the mesenteric lymph glands and dilatation of the lymphatic vessels in the mesentery of the large and small intestines.

Recently, V. Petrovskii and his co-workers [15] have shown by means of physiological methods of investi-

gation that "the tone of the lymphatic vessels is determined by the activity of their center, which is a part of the vasomotor center. A change in the tone of the lymphatic vessels occurs simultaneously with a change in the tone of the blood vessels". Similar phenomena were observed after the stimulation of zones known to be reflexogenic for blood vessels (regions of the aorta, the pulmonary vessels, the carotid sinuses, the inferior vena cava and the portal, mesenteric, splenic, and renal veins). Besides reflexes from the blood vessels to the lymphatics these authors also established reflexes in the opposite direction. An increase of pressure in the receptaculum chyli and the thoracic duct, for instance, produced a reflex lowering of the arterial pressure.

Our attention was drawn to the lymphatic system after we had found that when the venous return was disturbed in chronic experiments, dilatation and partial varicosity of not only the veins but also the visceral arteries of medium and small caliber ensued.

This fact led us to make a special investigation of the reaction of the lymphatic vessels under these circumstances, in order to obtain a complete picture of the state of the vascular system as a whole after excision of the main veins of the limbs. The results obtained (because of the small number of animals investigated) cannot, of course, claim to provide an exhaustive answer to the problem. They are merely the beginning of the study of this important problem.

METHOD

Investigations were made of the lymphatic vessels of the fore and hind limbs of 6 dogs at various times after operation — two were studied 14 days after excision of the main veins of the limbs, two 45 days after and two 90 days after operation. Injection of the parietal lymphatic vessels of the experimental and control animals gave no particular difficulty. Injection of the visceral lymphatics was a different matter. In this case satisfactory injection could only be achieved in the network

of lymphatic vessels of the fascia and tendons of certain muscles (the triceps brachii and the triceps surae).

RESULTS

The preparations obtained showed that excision of the main veins leads to disturbance of the lymphatics as well as of the blood vessels.

In the animals two weeks after operation, an increase was observed in the number and caliber of the

parietal lymphatic vessels (Fig. 1). The visceral lymphatic vessels of the muscle fascia and tendons were also sharply dilated (Fig. 2). In the preparations obtained from animals which survived 1½ months after excision of the main veins, the caliber of the parietal lymphatic vessels remained enlarged as before, but their number had decreased approximately to that seen in the control limbs. The visceral lymphatic vessels were appreciably dilated, but this dilatation was less pronounced than in the animal 2 weeks after operation.

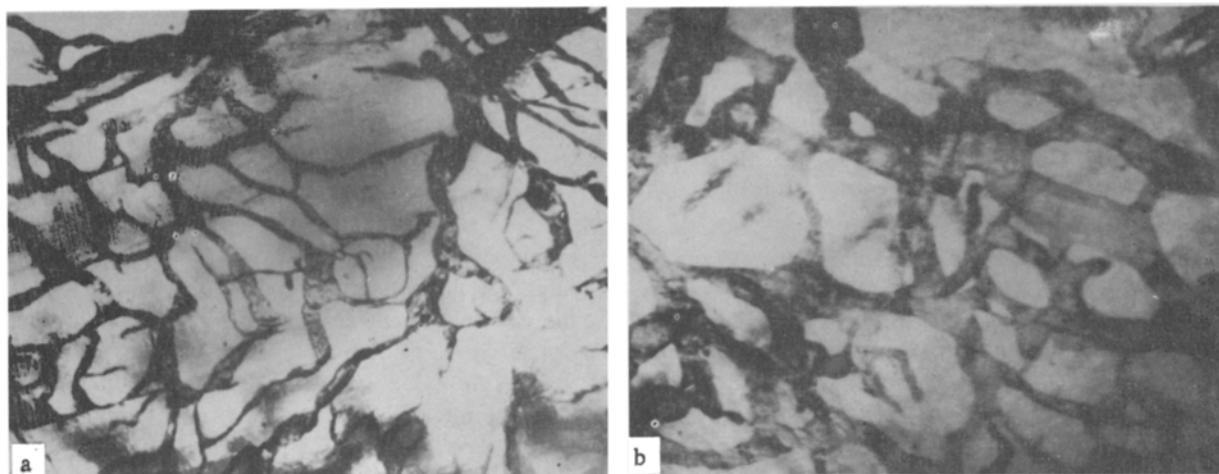


Fig. 1. Superficial parietal lymphatic vessels of the fore limbs of dogs on the 14th day after excision of the main veins. a) Control; b) experiment.

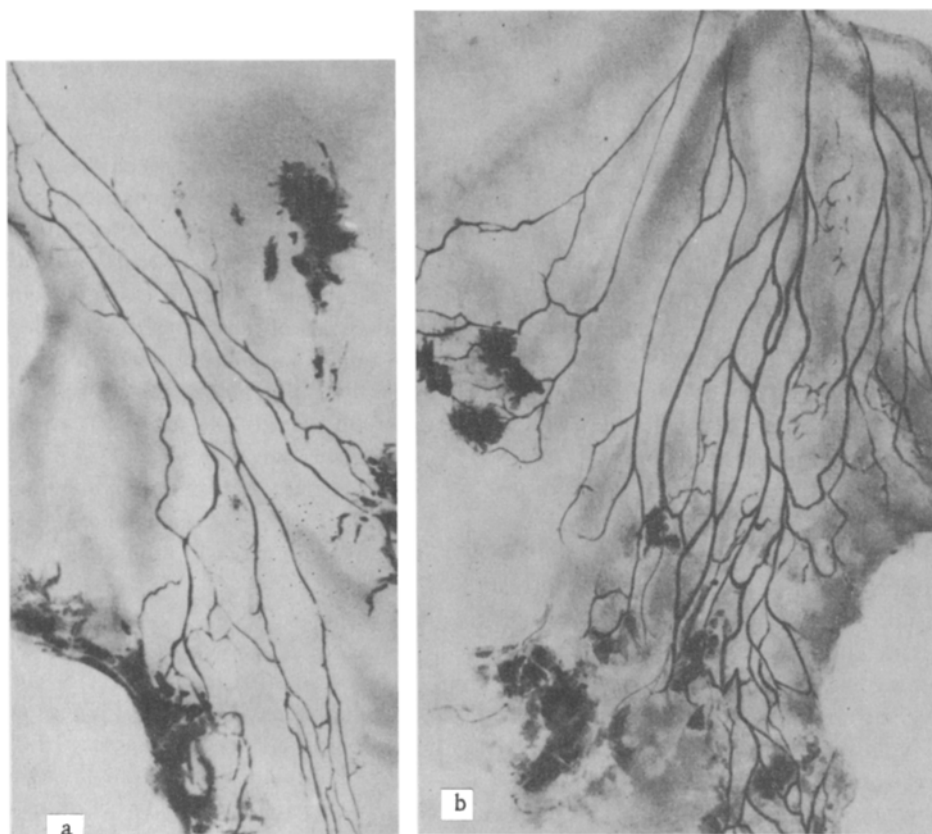


Fig. 2. Visceral network of lymphatic vessels of the tendo Achillis. a) Experiment; b) control.

In the dogs which survived 3 months after operation, we were unable to find any appreciable morphological changes whatsoever in the lymphatic system of the limbs.

The reorganization of the lymphatic system which we observed in the first 1½-2 months after excision of the main veins must be regarded as a regular phenomenon. At this period, as we know, stimuli are constantly in action. Foremost among these is the raised blood pressure in the distal divisions of the limb. This factor, as shown by V. Petrovskii and his co-workers, causes reflex dilatation of the lymphatic capillaries. With the cessation of the action of these stimuli, the caliber of the lymphatic vessels gradually returns to normal, as we found in our own experiments.

In the presence of disturbance of the venous return, it is absolutely inadequate to investigate the venous system alone. In order to evaluate accurately the conditions under which the tissues function, it is of the utmost importance to direct attention to the arterial and lymphatic vessels also, for the vascular system functions as a single entity, not only when the normal conditions of existence of the animal apply, but also when the blood flow is disturbed.

SUMMARY

After excision of the great of extremities in dogs, there is observed not only the development of parietal collateral venous paths and dilatation of the visceral blood vessel network (arteries and veins), but also considerable changes in the lymphatic vessels. The latter were considerably dilated during the first 14-45 days after the experimental surgical intervention. Both parietal and visceral lymphatic vessels are subject to dilatation. At the end of the third month of the post-operative period the changes observed earlier begin to gradually disappear and the lymph vessels of the limb under experiment show no morphological differences from the control limb.

LITERATURE CITED

[1] R. A. Bardina, Anatomy of the Visceral Vessels [in Russian] (Leningrad, 1948) p. 262.

[2] V. V. Ginzburg, Paths of the Outflow of Lymph from the Muscles of the Lower Limb [in Russian] Doctorate dissertation (Samarkand, 1944).

[3] V. P. Golev, Transactions of the Fifth All-Union Congress of Anatomists, Histologists, and Embryologists [in Russian] (Leningrad, 1951) p. 144.

[4] D. E. Gol'dshtein, Trudy Kazansk. nauch.-issled. inst. ortopedii i vosstano-vitel'noi khirurgii 3, 297 (1949).

[5] D. A. Zhdanov, General Anatomy and Physiology of the Lymphatic System [in Russian] (Leningrad, 1952).

[6] N. I. Zotova, Anatomy of the Visceral Vessels [in Russian] (Leningrad, 1948) p. 271.

[7] A. I. Ivanova, Anatomy of the Visceral Vessels (Leningrad, 1948) p. 267.

[8] G. M. Iosifov, The Lymphatic System in Man [in Russian] (Tornsk, 1914).

[9] K. S. Malinovskii, The Lymphatic System of the Lower Limb [in Russian] Dissertation (Vitebsk, 1906).

[10] N. N. Mirolyubov, Anatomy of the Visceral Vessels [in Russian] (Leningrad, 1948) p. 264.

[11] N. N. Mirolyubov, Collected Transactions of the Irkutsk Medical Institute [in Russian] (1951) p. 78.

[12] V. N. Nadezhdin, Investigation of the Anatomy of the Lymphatic System of the Lower Limb in Man [in Russian] Author's abstract of dissertation (Leningrad, 1957).

[13] L. A. Notkin, On the Origin of Ascites [in Russian] (Kiev, 1890).

[14] V. V. Stavskaya, Anatomy of the Visceral Vessels [in Russian] (Leningrad, 1948) p. 270.

[15] V. Petrovskii, Med. Rabotnik (July 20, 1956), p. 3.

[16] V. N. Popov, The Drainage of Lymph [in Russian] (Moscow, 1893).

[17] M. G. Prives, Collected Papers on Field and General Surgery [in Russian] (Leningrad, 1944) p. 103.

[18] V. V. Fedyai, Anatomy of the Lymphatic Vessels and Glands [in Russian] (Gor'kii, 1942) p. 197.

[19] V. Kh. Frauchi, Khirurgiya 11, 12 (1948).

[20] M. V. Shevelev, Collection of Abstracts of Scientific Papers of the Military Medical Academy for the Period 1953-1955 [in Russian] (Leningrad, 1957) p. 32.

[21] M. S. Yaroshetskaya, Anatomy of the Visceral Vessels [in Russian] (Leningrad, 1948) p. 268.