The Lymphatics of the Greater Omentum
An Experimental Study in the Dog

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Lymphology 1 (1969), 3–7

No detailed description of the lymphatics of the greater omentum has hitherto been presented. In an earlier, preliminary study on dogs *(Intonti, Nylander* and *Tjernberg,* 1964) we found the peripheral parts of the omentum to be relatively richly supplied with lymph vessels of very fine calibre. These marginal lymphatics formed a delicate net-like pattern. Local bulges indicated the presence of valves in the collecting lymph channels which increased surprisingly little in calibre in their course towards the base of the omentum. We suggested that these lymph channels might be responsible for the peritoneal drainage to a considerable extent.

In the present investigation we have further studied the lymphatics of the omentum and their connexions with the lymph vessels of neighbouring organs, especially the stomach and the spleen. The study of these topographical relations was initiated by the well-known fact that the greater omentum is very often the seat of metastases from abdominal and pelvic carcinoma.

Material

Ten full-grown mongrel dogs were used. They were all healthy, with no symptoms of disease in the abdominal organs. The investigations were performed in general anaesthesia (veterinary pentobarbital sodium, endotracheal intubation, and controlled respiration).

Methods

The abdomen was opened by an upper midline incision. The greater omentum was brought out through the incision and spread out on a dissection table, covered with soaked compresses. In this way the respiratory movements of the dog did not disturb the examination. A Zeiss operating microscope, combined with a Leica (Leitz) body, was used. For photography of anatomical details, Kodak Kodachrome II film was employed.

Two different methods were used for visualizing the lymph vessels:

1. An isotonic solution of Patent Blue V stain was injected into the margins of the omentum. After gentle massage of the injected area the circulating lymph was stained blue. In two cases the stain was injected directly into a lymphatic which had been cannulated with a polythene tube (PE 10).

2. Thorotrast was deposited in the tissue of the omentum. A series of roentgen examinations was performed during the first two hours after the injection. They were

repeated 1–14 days later. The dog was then anaesthetized as described above and the omentum arranged in the same way outside the abdominal cavity.

Finally, the omentum was removed and fixed in 10% neutral formaldehyde for at least 2 weeks. Specimens were then taken for histological investigation, both from the trabeculae and from the thin connective-tissue membranes lying between these trabeculae. The material was embedded in paraffin and cut longitudinally into 5 μ sections. The sections were stained with haematoxylin and eosin or haematoxylin and van Gieson's stain.

Results

The greater omentum is developed from the dorsal mesogastrium, i.e. that part of the dorsal mesentery that envelops the spleen and part of the pancreas and is continuous with the serosal coat of the stomach. In connexion with rotations of the stomach around both a longitudinal and a sagittal axis the rapidly growing mesogastrium forms a sac behind and below the stomach, the opening of the sac facing cranially and to the right. In man this sac is generally obliterated but in the dog it remains open, as is demonstrated in Fig. 1. From the embryological development it is clear that the omentum has close connexions with the stomach and the spleen.

As is seen from Fig. 1, the greater omentum is built up of a net-like framework of connective-tissue trabeculae containing varying amounts of adipose tissue. In the meshes between the trabeculae thin connective-tissue membranes are interposed and are often perforated. They contain a great number of richly anastomosing fine blood vessels (Figs. 2 and 3), which are continuous with arteries and veins passing centrally in the trabeculae (Fig. 2).

Fig. 1 The greater omentum stretched outside the abdominal cavity. It has the form of a sac. The general architecture of trabeculae and thin membranes between them is obvious.

Fig. 2 Enlargement of a part of the omentum. The blood vessels in the thin membranes empty themselves into the blood vessels centrally in the trabeculae (×4).

Fig. 3 Detail of Fig. 2, showing the ramifications of the blood vessels in the thin membrane.

Fig. 4 Lymphatic filled with Patent Blue V, running eccentrically in a trabecula. The blood vessels run centrally in the trabecula. The injection of Patent Blue V is seen on the left.

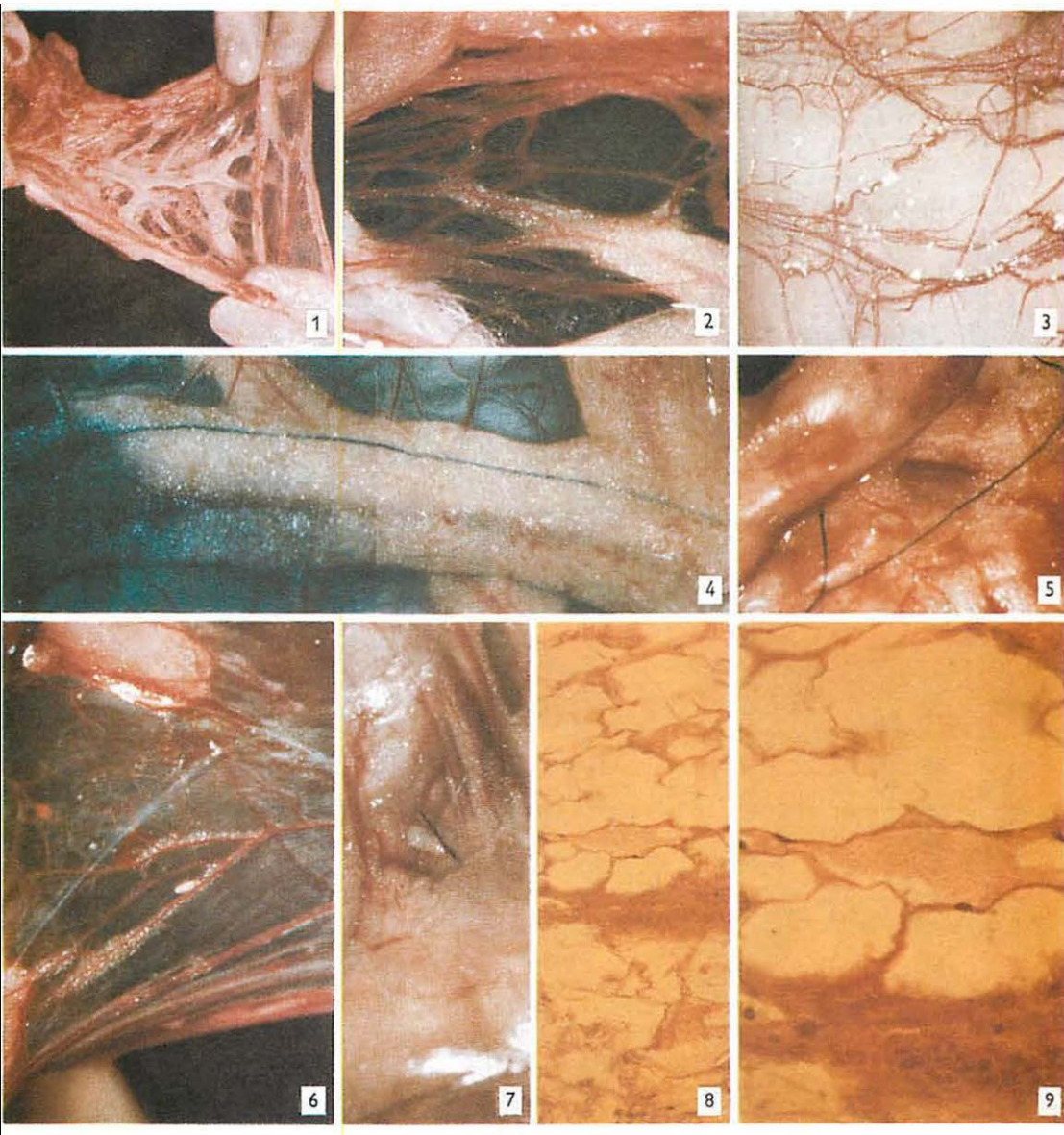
Fig. 5 The lymphatic dividing dichotomically in its progress in a proximal direction.

Fig. 6 Thin membrane between the omentum (at the bottom on the left) and the spleen (at the top on the right). Fine-calibre, blue-stained lymphatics pass between the omentum and the serosal coat of the spleen.

Fig. 7 The omentum in the lower right-hand part and the stomach in the upper left-hand part. In the centre of the picture is a blue-stained lymphatic passing between the omentum and the serosal coat of the stomach.

Fig. 8 Histogram of the thin membrane between the trabeculae. In the middle of the picture a capillary-like lymphatic can bee seen running parallel to a blood vessel (×90).

Fig. 9 The same lymphatic as in Fig. 8 with greater magnification. The flat nuclei in the endothelial cells stand out clearly (×230).



The injected stain solution revealed lymph channels of obviously very fine and uniform calibre eccentrically in the trabeculae, passing parallel to the blood vessels but at a little distance from them (Fig. 4). On their way, in the proximal direction, they split up dichotomically at intervals (Fig. 5). They are provided with valves, which cause local bulges of the lumen. The collecting vessels in the proximal parts of the omental sac communicate with lymphatics passing along the greater curvature of the stomach. Fine lymphatics pass directly between the omentum, on the one hand, and the serosal coats of the spleen (Fig. 6) and the stomach (Fig. 7), on the other hand.

The histological examination revealed in the connective-tissue membranes between the trabeculae a great number of fine-calibre lymph vessels coated with endothelium-like cells and filled with amorphous, weakly stained material. They run parallel with blood vessels (Figs. 8 and 9).

In *radiograms* of the spread-out omentum the trabeculae appear as a system of multiple communicating arcades (Fig. 10). After interstitial injection of Thorotrast, in most cases only a few fine-bore lymphatics were filled in the immediate vicinity of the injection spot. The filling was best during the first hour after the injection. In radiograms taken 1–14 days after the injection the contrast depots were gradually loosened up, their outlines becoming spiny and unsharp, but no lymphatics were visible. No lymph nodes filled with the contrast medium could be seen.

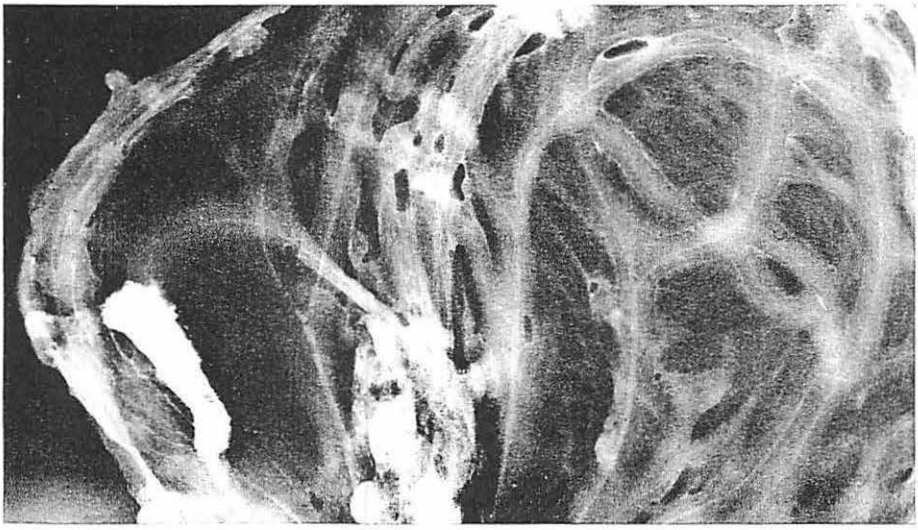


Fig. 10 Radiogram of stretched omentum with depots of Thorotrast in the tissue. A few very fine lymphatics, especially on the left and in the centre of the picture, are filled with contrast medium. Veins can also be seen running centrally in the trabeculae. The arcade-like architecture of the trabeculae and their communicating blood vessels can clearly be seen.

In the radiogram presented in fig. 10, taken a little more than one hour after the injection of Thorotrast, more lymphatics were filled than in the other cases. Most of them are seen centrally and to the left. In this case also the veins are

visible in the middle of each trabecula. The arcade-like arrangement of the vessels is demonstrated.

Discussion

The investigation confirmed our earlier observations that the greater omentum has a rich supply of lymph vessels. Their peripheral components are capillary-like lymph channels in the thin connective-tissue membranes between the trabeculae. They drain into collecting lymphatics in the trabeculae. The most striking feature is, however, that the calibre of the collecting vessels is very fine. Furthermore the circulation in this system of lymphatics seems to be very slow. This held good both of the passage of Patent Blue V from the injection spot and of the transport of Thorotrast from the contrast-medium depots. There is therefore reason to suppose that the resorption activity from the peritoneal cavity to the abdominal lymphatic system is less in the omentum than in other parts of the peritoneum, for instance, the abdominal surface of the diaphragm. If conditions are analogous in man, the theoretical background for the transposition of the greater omentum in cases of lymphoedema may be called into question.

The investigation furthermore showed the intimate connections between the lymphatic system of the omentum and that of the stomach and spleen. This could be expected from the embryological development of the greater omentum from the dorsal mesogastrium and certainly explains the ready spreading of carcinoma of the stomach to the omentum.

The main drainage channels leading the lymph away from the omentum are still incompletely known. It is also not quite clear whether the anterior and posterior sheets of the omental sac have their own vascular supply and therefore a watershed exists somewhere in the organ or whether the circulation takes place exclusively or predominantly in one direction. In our experiments we made most of the injections of the blue dye or Thorotrast at the lateral or inferior border of the omentum, i. e. the side walls and bottom of the omental sac, and in all cases especially the lymphatics in the anterior sheet were filled. For a detailed knowledge of the drainage channels of the posterior sheet and the communications between the lymphatic system of the omentum and the large praevertebral lymph trunks, further investigations are necessary. There is no doubt that a mapping of these lymphatic connexions would be a valuable contribution to our knowledge of the ways in which abdominal and pelvic carcinoma, including carcinoma of the ovary, spread to the greater omentum.

Summary

The lymphatic system of the greater omentum was investigated in 10 dogs. The lymphatics were visualized by the deposition of a vital stain (Patent Blue V) and a radio-opaque substance (Thorotrast) in the margins of the omentum. In addition, histological examinations were performed. The investigations revealed the presence of a network of very-fine-calibre lymphatics parallel to the blood vessels in the thin connective-tissue membranes that constitute a great part of the organ. The collecting lymph vessels, lying in the connective-tissue framework of the omentum, were likewise of very fine calibre. They had connections with the lymphatic system of the stomach and the spleen. The flow of the dye and of Thorotrast through the omental lymphatics seemed to be very slow. It was suggested that the absorptive capacity of the omentum

by way of the lymphatics was rather small. The theoretical background for transposition of the greater omentum in cases of lymphoedema was questioned. The course and ramifications of the drainage channels from the omentum to the large praevertebral lymph trunks are not yet completely known.

Reference

Intonti, F., G. Nylander, B. Tjernberg: Lymph Vessels of the Greater Omentum. A Preliminary Investigation. Vascular Diseases 1 (1964), 203

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Primary Plasmacytoma of Lymph Nodes

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Lymphology 1 (1969) 7–15

Solitary plasmacytomas may occur in a variety of organs and tissues, including the conjunctivae, paranasal sinuses and upper respiratory tract, tonsils, stomach, small bowel, kidney, ovaries, lung, and elsewhere. More commonly, however, solitary plasmacytomas have been described as originating in bone, although multiple myeloma subsequently appears in most of these patients. Four cases of plasmacytoma arising in lymph nodes have been reported (1–4), in which there was no abnormality of the bone marrow or of the serum proteins, or other evidence of systemic dissemination. Especially interesting is the relationship of so-called „solitary" plasmacytomas to multiple myeloma, since some solitary plasmacytomas progress, after months or years, to a clinical picture indistinguishable from multiple myeloma (5).

We report two patients who presented with solitary plasmacytomas arising in cervical lymph nodes. After no other foci of disease could be found, the local lesion was widely resected. Results of treatment of solitary plasmacytomas of lymph nodes and the relationship of this lesion to multiple myeloma are discussed.

Case reports

Case 1: (G. V., M. H. # 141949): A seventy-two year old white male was first seen at Memorial Hospital in April 1954, with a seven-month history of a painless mass in the upper left side of his neck. There were no local or systemic symptoms. Physical

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