A CHRONIC FISTULA OF THE INTESTINAL LYMPHATIC DUCT OF THE CAT

B. N. Stepanov

From the Department of Normal Anatomy (Head – Prof. K. V. Romodanovskii) of the Novosibirsk Medical Institute (Director – Prof. G. D. Zalesskii)

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The principal investigations of the absorption of foodstuffs into the lymphatic system from the gastrointestinal tract were carried out either by the use of a fistula of the thoracic duct or during acute experiments on anesthetized animals. In spite of the obvious defects of these methods they are still used by experimenters today.

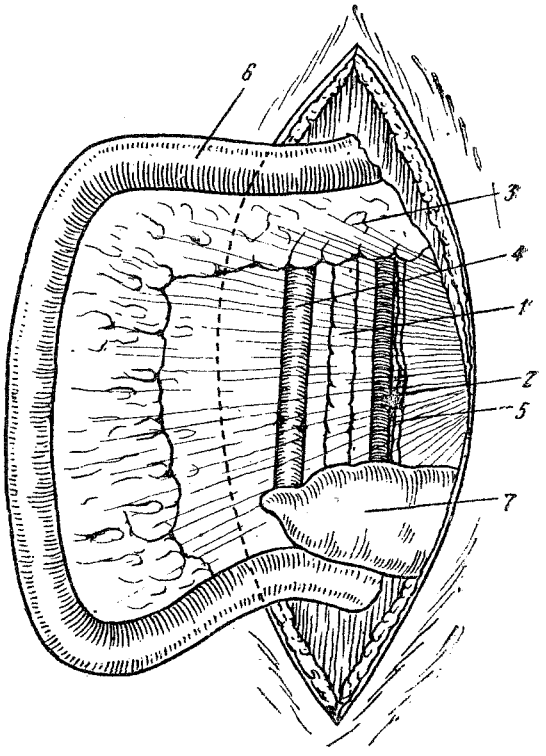

Fig. 1. Topography of the mesenteric lymphatics of the cat. 1) Main lymphatic duct of the small intestine; 2) cranial mesenteric artery; 3) pancreas; 4) cranial mesenteric vein; 5) lymphatic duct of the large intestine; 6) duodenum; 7) cecum.

In order to find out the possibility of developing this present method, a preliminary study was made of the anatomy of the lymphatic vessels of the gastrointestinal tract of various laboratory animals. In dogs, in which digestive processes have been studied in the greatest detail, the distribution of lymphatic vessels in the mesentery is variable and they constantly anastomose with each other by means of slender vessels which cannot be seen without the use of special methods. The most suitable experimental animal for these purposes is the cat.

There are usually three efferent lymphatic vessels from the mesenteric glands in the cat: 1) a vessel from the ganglia receiving lymph from the large intestine which lies to the left of the cranial mesenteric artery; 2) the main intestinal lymphatic duct, which is situated between the cranial mesenteric vein and the cranial mesenteric artery; 3) a third, slender lymphatic vessel from the duodenal gland, to the right of and dorsal to the cranial mesenteric artery (Fig. 1). All these vessels become confluent close to their point of entry into the cisterna chyli.

In the living animal the main intestinal lymphatic duct is easily visible after a milk feed 1-2 hours before the operation.

We used the principle of inserting the lymphatic vessel into a tube to develop a simple method of forming a permanent fistula of the intestinal lymphatic duct. As a fistula tube we used paraffin-coated polyvinyl tubes 3-4 cm in length and with an internal diameter of 1.5-2 mm. At one end of the tube 4 longitudinal

incisions were made, 4 mm in length and equidistant from each other. Immediately after sterilization in paraffin the strips formed as a result of the incisions in the tube are bent at a right angle. As suture material we used thread made from polyamide resin with a cross section of 0.15-0.3 mm.

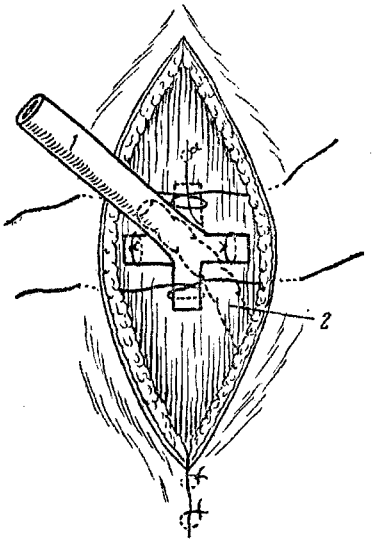

Fig. 2. Fixation of the fistula tube. 1) Fistula tube; 2) lymphatic duct.

The operations were carried out under intratracheal ether anesthesia. A longitudinal skin incision, about 5 cm long, was made from above downward , starting at the level of a line joining the subcostal arches and situated 3 cm from the midline on the right. A longitudinal incision was made in the linea alba of the abdomen, about 4 cm long, at the same level.

The proximal section of the large intestine and the duodenum with their mesenteries were brought out of the operation wound. The main lymphatic duct was identified in the mesentery between the cranial mesenteric vein and the cranial mesenteric artery and ligated 1.5-2 cm distal to the lymphatic gland. The portion of the lymphatic vessel situated between the ligature and the gland was swollen from the lymph entering it while the remaining portion of the vessel was collapsed. The collapsed portion of the vessel was completely divided between ligatures. The distended end of the lymphatic vessel was mobilized by blunt dissection for a distance of 1 cm. In doing this we strove to spare the blood vessels supplying the wall of the lymphatic vessel. Next the lymphatic vessel was incised for $\frac{2}{3}$ of its diameter near the ligature and by the aid of this ligature the vessel was drawn into the tube – the tube as it were was clothed over the lymphatic vessel.

Two of the strips of tube ("paws"), bent at a right angle, were fixed with sutures to the peritoneum of the mesentery. If there were a space between the base of the tube and the peritoneum a purse-string suture was inserted. The ligatures, together with the partly divided vessel were withdrawn by careful traction. As a result of this the lymphatic vessel within the tube remained free. The base of the tube, together with the mesentery were fixed by means of the other two "paws" to the abdominal wall when this was sutured (Fig. 2) and the free end of the tube exteriorized through a stab incision made in the skin in the midline.

After the operation the cats were kept at liberty in a warm and commodious room in which the experiments were conducted. The cats were familiarized with convenient soft bedding on which they lay throughout the experiment. The lymph was collected in a vessel fixed under the animal.

Excretion of lymph through the fistula continued for 6-7 days. The cessation of excretion is explained by the development of a connective tissue scar at the base of the tube, and drainage of lymph from the intestine takes place subsequently along developing collaterals.

We are in agreement with the view of Freeman [6] and D. A. Zhdanov [1] that all the lymph flowing from the organ cannot be judged from the amount which flows along this particular vessel on account of the presence of numerous anastomoses. These anastomoses, like a proportion of the efferent lymphatics, cannot be demonstrated in the living animal [2]. Hence we consider that when investigating the intestinal lymph special attention must be paid to its qualitative indices.

The volume and composition of the lymph excreted through the fistula was dependent on the diet. The refractometric index varied from 1.3360 after intake of water to 1.3565 in cats fed on milk. The volume of intestinal lymph excreted during half an hour in starving cats was about 0.1 ml and after a milk feed it reached 20-24 ml.

An experimental study was made of the refractometric index after water intake.

The experiments were carried out 2-3 days after operation, on animals deprived of food or water for 18-24 hours before the experiment. For the duration of one hour the refractometric index and the volume of lymph excreted were determined. Next, 100 ml of water at room temperature was injected into the stomach through a tube.

The refractometric index of the intestinal lymph after an intake of water constantly showed an extremely sharp change, falling from 1.3450-1.3440 to 1.3360 (Fig. 3).

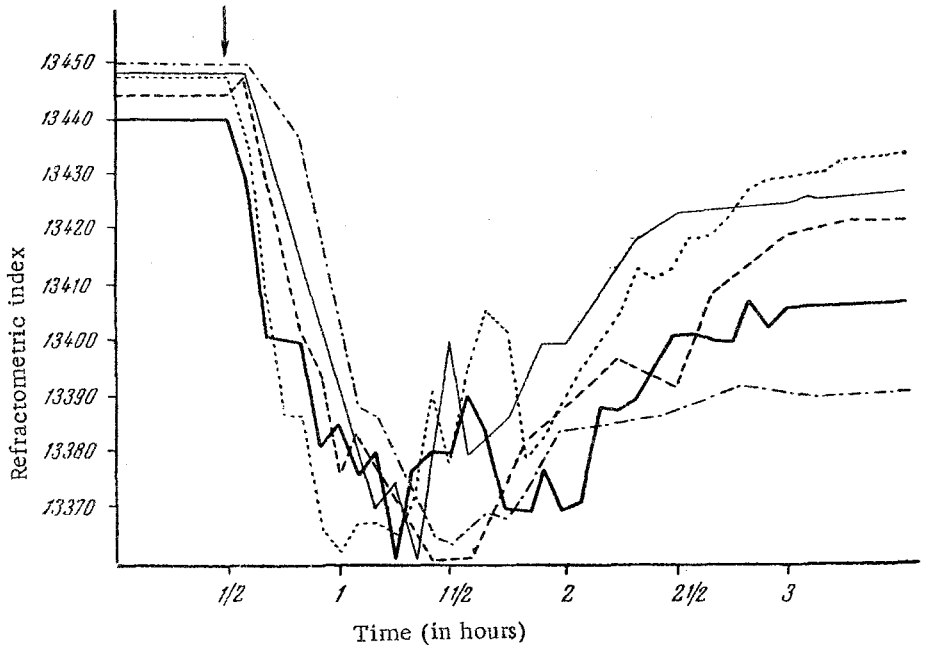

Fig. 3. Changes in the refractometric index of the intestinal lymph after injection of 100 ml of water through a gastric tube. Results of 5 experiments. The arrow indicates the moment of injection of the water.

We did not consider it possible to translate the refractometric index into protein values since this index is determined not only by refraction of protein but acts at the same time as an index of the total dry residue of the lymph.

The volume of lymph was increased after intake of water from 0.1 ml per ½ hour during the control period to 2.4-3 ml in 5 minutes, half an hour after giving the water, and it returned to its initial level after 2 hours.

Denial of the importance of the lymphatic system in the absorption of water from the gastrointestinal tract evidently needs re-examination, and the result obtained by Bollman and his co-workers [3, 4, 5, 7] must be given an alternative interpretation.

In confirmatory experiments on anesthetized animals, like other workers we were unable to observe any essential changes in the refractometric index and the volume of lymph. The same results were obtained in experiments on cats with a fistula, but placed in a special cage for fixation.

Anesthesia and fixation of the animal evokes significant functional changes which do not allow study of the normal physiological features of absorption of food products into the lymphatic system.

The method described, as our results show, can be used for the study of absorption of all the food products into the lymphatic system from the gastrointestinal tract.

SUMMARY

A new method of obtaining a chronic fistula of intestinal lymphatic duct in cats, functioning for 6-7 days is described. The lymph from the fistula was examined in conditions of a chronic experiment. It was revealed that the refractometric index after forcing fluid is decreased from 1.3450 – 1.3440 to 1.3360, while the quantity of the lymph is increased from 0.1 for half an hour to 3 ml within 5 minutes. The same experiments were carried out on anesthetized cats – no significant changes of refractometric index or of the quantity of the lymph from the fistula could be noted after forcing fluids.

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