THORACIC DUCT LYMPH IN ACUTE PANCREATITIS

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In dogs with acute pancreatitis the rate of flow of the lymph, its viscosity, and its protein content are all increased. Amylase and lipase activity in the lymph are increased to a greater degree than in the blood. External draining of the thoracic duct does not reduce the enzyme concentration in the blood, but it reduces the severity of the lesion in the pancreas.

The presence of pancreatic enzymes in the lymph of the thoracic duct has been described previously [5, 7, 9]. The view is expressed that the thoracic duct plays the role of a safety valve during changes in the pressure inside the ducts in the pancreas [10]. However, the lymph in diseases of the pancreas has received little study. The writers' first investigations in this field showed that in the early stages of acute pancreatitis changes take place in the rate of flow of the lymph and in its enzyme content [3].

The object of this investigation was to study changes in the lymph in the thoracic duct (its rate of flow, viscosity, protein content, enzyme content) in acute pancreatitis.

EXPERIMENTAL METHOD

Experiments were carried out on 24 dogs with acute pancreatitis from the 1st to 6th days of the disease. To produce anesthesia, trimeperidine (0.1 mg/kg) and thiopental-sodium (20 mg/kg) were given. The left thoracic duct was then exposed in the neck and a vinyl chloride catheter introduced. The rate of flow of the lymph, its viscosity [6], its protein content [1], and the content of amylase [4] and lipase [12] in the lymph and blood were determined.

Acute pancreatitis was produced by injecting autogenous bile in a dose of 0.25 ml/kg body weight under pressure into the main pancreatic duct. The diagnosis was confirmed by investigation of the blood for pancreatic enzymes and by histopathological examination of the pancreas [2].

EXPERIMENTAL RESULTS

The rate of flow of lymph from the thoracic duct in the intact animals averaged 0.35 ± 0.06 ml/min (Fig. 1). The rate of flow of lymph increased in the first few hours of acute pancreatitis to 1.04 ± 0.21 ml/min. A decrease in the rate of flow of the lymph was observed 6 h after the beginning of the disease. After 24 h the mean rate of flow was 0.62 ± 0.4 ml/min. On the 2nd day of acute pancreatitis a fresh increase in the lymph flow to 0.95 ± 0.05 ml/min was observed. Starting from the 3rd day of the disease, the rate of flow of the lymph (which at that time was 0.5 ± 0.1 ml/min) began to decrease rapidly, returning to normal on the 6th day (Fig. 1). The lymph became the color of blood 5-6 h after the beginning of acute pancreatitis. Its erythrocyte content rose appreciably when a profuse hemorrhagic effusion occurred into the abdominal cavity. The rate of flow of lymph from the thoracic duct under these circumstances fell appreciably.

The viscosity of the lymph also changed substantially in the course of acute pancreatitis. Its value in intact animals was 1.7 ± 0.09 cP, and 6 h after the beginning of the disease it has risen to 3.1 ± 0.18 cP.

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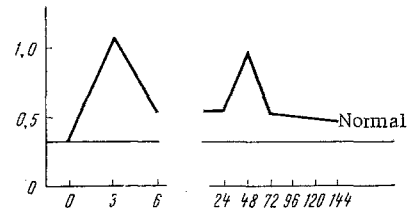

Fig. 1. Rate of flow of lymph from thoracic duct in acute pancreatitis. Abscissa, time (in h); ordinate, rate of flow of lymph (in ml/min).

The viscosity of the lymph remained at this level and after 24 h of acute pancreatitis it was 3.2 ± 0.1 cP. It then gradually fell, particularly on the 3rd day. After the 3rd day the viscosity of the lymph was 2.4 ± 0.1 cP, and by the 5th-6th day of the disease it had fallen to 1.9 ± 0.05 cP.

The protein concentration in the lymph changed in the same direction as the viscosity in acute pancreatitis. In the intact animals the protein concentration in the lymph was 3.6 ± 0.25 g%. Corresponding to the increase in viscosity of the lymph secreted during acute pancreatitis, the protein concentration also increased, reaching 5 ± 0.37 g% after 6 h of the disease. The protein concentration was particularly high in the lymph on the 1st-2nd day of the disease (6.1 g%), when vascular permeability was greatest [2]. It then began to fall gradually, to reach 5.4±0.1 g% on the 3rd day and 4.0 ± 0.1% on the 5th-6th day.

A study of the pancreatic enzymes in the lymph and blood showed that the amylase and lipase content in the thoracic duct lymph was much higher than in the blood (Figs. 2 and 3). Starting from the first few hours of acute pancreatitis, the blood amylase activity rose sharply to 1024 units, and then fell to 512 units. The content of this enzyme in the lymph rose during the same period to a much greater degree. For example, 3 h after the beginning of the disease amylase activity was 4096 units, falling to 2048 units after 6 h. In the early period of acute pancreatitis, the amylase content in the lymph was much higher than in the blood.

The lipase activity in the blood was 75 ± 11.1 i.u., and in the lymph 85.7 ± 10.8 i.u. Its activity 3 h after the beginning of acute pancreatitis in the blood showed an increase of 100%, and after 6 h it was 192 ± 19.1 i.u., or 153% above its initial level. The activity of this enzyme in the lymph rose to a much greater degree. For example, after 3 h the lipase activity reached 2-3.9 ± 37.6 i.u. (136% above its initial level), and it continued to rise to 288 ± 57.9 i.u. (270% of the control). The lymph amylase activity 24 h after the beginning of the disease was 4 time higher than in the blood. This difference remained just as substantial during the first 3 days of the disease. From the 4th to the 6th days, the amylase activity gradually returned to normal both in the blood and in the lymph, although inflammatory changes were still present in the pancreas.

A similar pattern was revealed by studies of the lipase in the blood and lymph. For instance, 24 h after the beginning of the disease, the lipase activity in the blood was raised by 180%, and in the lymph by 240% compared with the control. Lipase activity in the blood was increased by 230% and in the lymph by 317% 48 h after the beginning of the disease.

In 4 dogs, immediately after the onset of acute pancreatitis, from 85 to 100 ml lymph escaped through the thoracic duct during 6 h. The activity of the pancreatic enzymes in the blood was increased to the same extent in the experimental animals as in the controls, but visual observations on the state of the pancreas showed that edema and hemorrhages in the gland developed more slowly and stearin plaques appeared 1.5-2 h later than in the control. As a rule, the peritoneal exudate was small in amount.

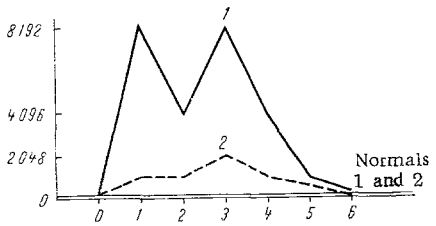

Fig. 2. Amylase content in thoracic duct lymph (1) and blood (2) of dogs with acute pancreatitis. Abscissa, days of investigation; ordinate, amylase content (in units).

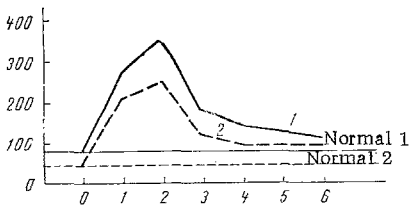

Fig. 3. Lipase content in thoracic duct lymph (1) and blood (2) of dogs with acute pancreatitis. Abscissa, days of investigation; ordinate, lipase content (in i.u.).

These experiments showed that acute pancreatitis leads to an increase in the flow of lymph through the thoracic duct, especially during the first few hours of the disease. The composition of the lymph is also changed quantitatively. It becomes more viscous, and its protein content increases, evidence of increased vascular permeability [5]. The increase in the rate of flow of the lymph is considered to be a result of development of acute portal hypertension, increased vascular permeability, and hyperacetylcholinemia in pancreatitis [2, 8, 11]. Acute pancreatitis has also been shown to lead to a shift of enzymes not only into the blood, but also into the lymph. Amylase and lipase activity in the lymph, under these circumstances, is much higher than their activity in the blood. External lymphatic drainage did not reduce the content of these enzymes in the blood. This does not support the views of those workers [9] who consider that the lymphatic system is the only route for elimination of enzymes under these pathological conditions. Since external lymphatic drainage is accompanied by an improvement in the course of the local pathological process, it is possible that planned exposure and drainage of the thoracic duct may be of great practical value in such cases.

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