GLYCOGEN CONTENT IN LEUKOCYTES FROM PERIPHERAL BLOOD OF PANCREATECTOMIZED DOGS

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UDC 616.37-089.87-07:616.155.3
-008.934.458.3-074

Much remains unknown in the problem of the link between the pancreas and the blood system, and further research in this field is required. There have been many reports [5, 6, 14-16, 20] of sharp changes in the leukocyte count, together with variations in many hematological indices, in the presence of various disturbances of pancreatic activity.

The object of the present investigation was to determine whether partial pancreatectomy with ligation of the pancreatic ducts is accompanied by changes in the glycogen content of the leukocytes as well as by changes in their number. The opinion has been expressed [7, 18, 21, 22] that glycogen is one of the principal sources of energy for maintaining the physiological integrity and activity of the leukocytes.

A further object of the investigation was to examine the relationship between the hypothetical changes in the functional activity of the leukocytes after pancreatectomy and the disturbance of acetylcholine synthesis in the body. This hypothesis was based on several investigations [10-13], showing that partial extirpation of the pancreas and ligation of its ducts are followed, on the 8th-15th day after the operation, by a severe disturbance of the phospholipid metabolism, a decrease in acetylcholine formation, and a corresponding depression of the functional activity of the parasympathetic nervous system. Meanwhile, no disturbances of carbohydrate metabolism are found at these times [8-10].

EXPERIMENTAL METHOD

Experiments were carried out on nine dogs. Blood was taken from the tibial vein at the same time of day. Glycogen was detected by the histochemical reaction for polysaccharides with fuchsin-sulfuric acid by Bauer's method [18]. One hundred neutrophils were counted in a film and the percentage of cells containing glycogen determined. Depending on the intensity of staining and the number of granules, the neutrophils were distributed into groups (with high, average, and low contents of glycogen). To make the method more accurate, each time blood was taken from each animal 3-6 films were made and the mean of 3-6 parallel determinations was obtained.

Before the operation the initial degree of saturation of the cells with glycogen was determined for each dog. The pancreatic ducts of all the experimental animals were then ligated and two-thirds of the pancreas removed. Starting on the 2nd day after the operation, one group of experimental animals (3 dogs) received intravenous injections of 0.5 ml of acetylcholine in a dilution of 1×10^{-4} daily for 2 weeks. The leukocyte count of all the experimental animals was determined and their blood sugar was estimated by the Hagedorn–Jensen method.

EXPERIMENTAL RESULTS

Ligation of the duct and subtotal resection of the pancreas led in all the experimental animals to a sharp and lasting increase in the leukocyte count (8106±107.08 before the operation, 18 470±315 and 15 250±212.3 per mm^3 respectively 2 weeks and 1 month after the operation). The blood sugar rose significantly during the first days after the operation (from 82.6±1.24 to 110.5±7.25 mg%; $P<0.01$), presumably on account of the operative trauma. From the 7th until the 40th day after the operation the blood sugar was unchanged from its initial level.

The results of investigation of the degree of saturation of the polymorphonuclear neutrophils with glycogen are shown in Fig. 1 and 2. As.Fig. 1 shows, in the course of 35 days after pancreatectomy the

Department of Normal Physiology, Altai Medical Institute, Barnaul (Presented by Active Member of the Academy of Medical Sciences of the USSR S. R. Mardashev). Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 63, No. 3, pp. 72-74, March, 1967. Original article submitted June 30, 1965.

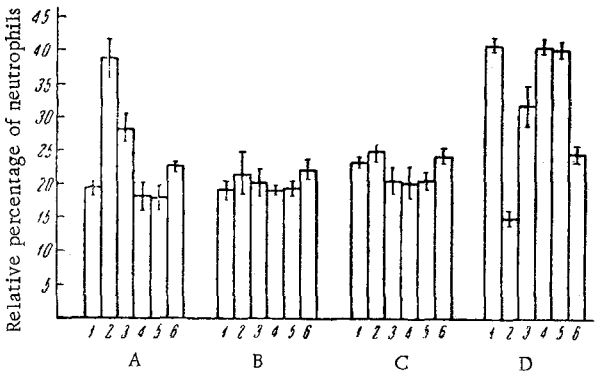

Fig. 1. Percentage of neutrophils with different glycogen contents in the blood of pancreatectomized dogs. A—neutrophils with a high glycogen content at different times after ligation of the duct and partial removal of the pancreas, B—neutrophils with a mean glycogen content, C—neutrophils with a low glycogen content, D—neutrophils not containing glycogen. 1) before operation; 2-6) on the 3rd-5th day, the 8th, 15th, 20th, and 35th days respectively after the operation.

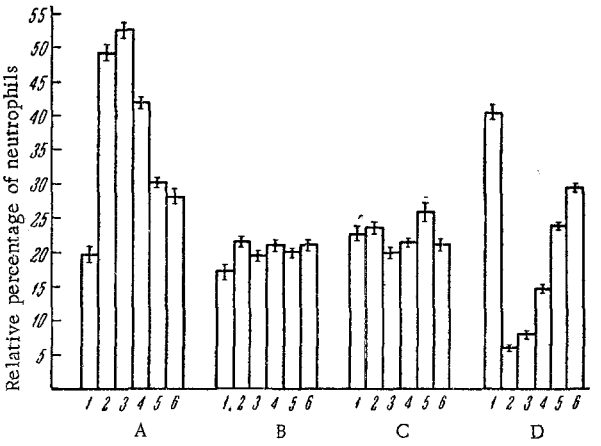

Fig. 2. Percentage of neutrophils with different glycogen content in the blood of pancreatectomized dogs receiving acetylcholine injections for 2 weeks after the operation. Legend as in Fig. 1.

relative percentage of neutrophils containing glycogen was higher than before the operation ($P<0.001$), and the percentage of cells without glycogen correspondingly lower ($P<0.001$). Meanwhile the degree of saturation of the neutrophils with glycogen rose: the relative number of neutrophils with a high glycogen content increased sharply ($P<0.001$).

The dogs receiving acetylcholine after the operation showed changes in the glycogen content only in the first 8 days of the postoperative period (Fig. 2). On the 15th-20th day the glycogen content in the leukocytes was at the preoperative level ($P>0.1$). After the control operation (laparotomy) an increase in the number of leukocytes with a high glycogen content was observed only during the first week after the operation. The increase in the glycogen content in the leukocytes on the first days after the operation can thus be regarded as a result of the operation itself. The increase in the glycogen concentration in the leukocytes from the 8th to the 35th days after the operation, when the blood sugar level was normal, demonstrates that ligation of the ducts and partial pancreatectomy did not result in a disturbance of the insulin-forming function of the pancreas at these times.

It may be assumed that the marked increase in the glycogen content in the leukocytes after pancreatectomy was associated to some extent with a disturbance of acetylcholine synthesis in the body and with weakening of the activity of the parasympathetic division of the nervous system, because adminstration of acetylcholine to the animals after operation restored the glycogen level to normal. The fact that acetylcholine has a depressant action on saturation of the cells with glycogen is in agreement with the concept of the inhibitory effect of the parasympathetic and the stimulant effect of the sympathetic nervous system on the functional state of the leukocytes as manifested by their phagocytic activity [2-4, 7].

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