

AN OPERATION ON DOGS FOR OBTAINING PURE
PANCREATIC JUICE IN LONG EXPERIMENTS

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Various operations have been used to obtain pure pancreatic juice from dogs [1-4, 6, 7, and others]. The choice is determined by the purpose of the experiment, taking into account the advantages and disadvantages of each method.

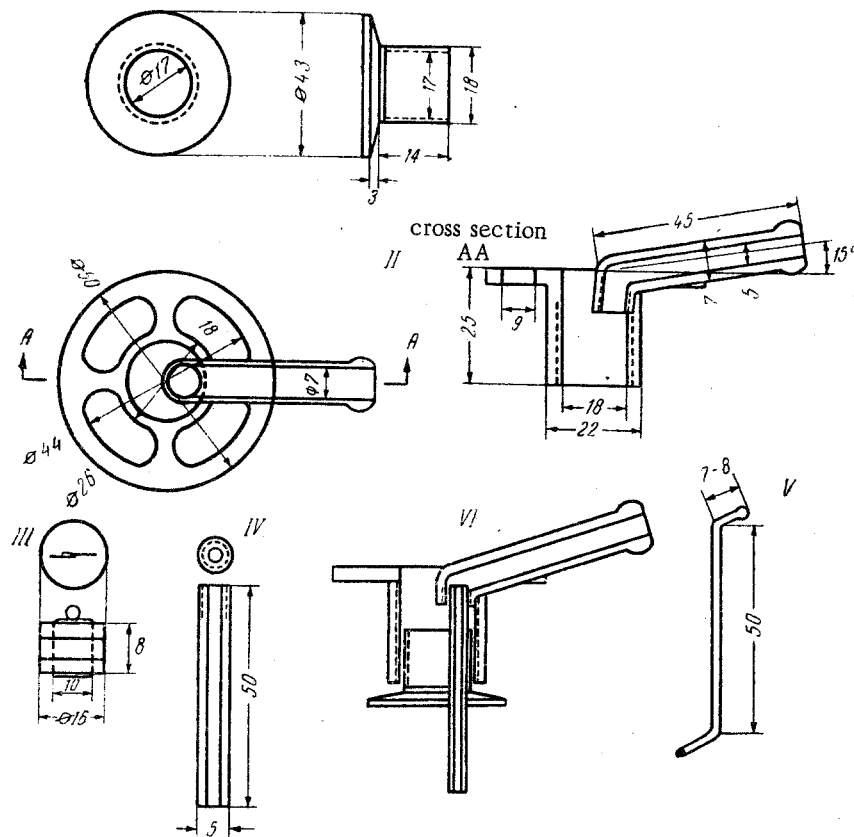
When studying the power of adaptation of the enzyme-secreting function of the pancreas, it is essential that the dogs be kept for a long time in a physiologically sound condition, and that the juice obtained from the animals be free from contamination.

Our earlier modification [5] of Thomas's operation satisfies most of these requirements, but it leads to considerable anatomical changes in the intestine, which may affect the pancreatic function. We have developed a new operation minimizing injury to and anatomical changes in the intestine. The dogs lose neither juice nor chyme, and pancreatic juice can easily be obtained in a pure form during application of various (including food) stimuli.

The fistula used in the operation (see figure) consists of an inner part (I) made of organic glass, and an outer part (II) made of stainless steel mark 1X18H9T. The stopper (III) of the fistula has two outer layers (of organic glass) and one inner layer (of rubber). The parts of the apparatus made of organic glass are sterilized by the method recommended by the Institute of Traumatology of the USSR Academy of Medical Sciences. The fistula is placed for 6 h or longer in a solution containing (in 1 liter) 3 g carbolic acid, 15 g sodium carbonate, and 20 g formalin. The metal part of the fistula is sterilized by boiling.

For 30 h before the operation the dog receives half its usual ration of food. Water is withheld for 2-3h before the operation. Before anesthesia (by the usual method, with morphine and ether), an intramuscular injection of 2 ml of 20% camphor oil should be given. The operation begins in the same way as for the formation of a pancreatic fistula by Pavlov's method. The abdomen is opened in the midline. A flap is cut from the duodenum, about 20 mm in diameter, with the ampulla of the greater pancreatic duct at its center. The excised area of duodenum is taken on four ligatures. The duct and its accompanying vessels is mobilized for a distance of 8-10 mm, taking care not to injure the pancreatic tissue. The defect in the wall of the duodenum is closed by a double layer of sutures. The excised duodenal flap is fixed by the ligatures to the connecting piece of the fistula, with the mucous membrane inside the fistula tube. The ampulla of the pancreatic duct must lie in the center of the lumen of the fistula (so that it is accessible for subsequent work). When fixing this flap, moderate (but not great) tension of the tissue must be used. The side piece of the fistula is introduced through a special incision into the duodenum 25-30 mm below the site of excision of the duodenal flap, and fixed by two purse-string sutures. The fistula and side tube are carefully covered with omentum. Two silk sutures are passed through the serous and muscular coats of the duodenum above and below the site of excision of the flap (for supporting sutures).

A hole, as small as possible (about 25 mm in diameter), is made in the right upper quadrant of the abdominal wall, through all its layers, in which to fix the fistula tube. The tube of the inner part of the fistula, into which the outer part is screwed, is passed through this hole. The orifice of the fistula is closed with the stopper. The threads of the sutures supporting the duodenum are passed through all the layers of the abdominal wall and tied over a gauze wick. When the position of the fistula on the abdominal wall and of the supporting sutures is chosen, the object must be to ensure minimal disturbance of the anatomical relations of the duodenum, of its excised portion fixed to the fistula tube, and of the pancreas.



Details of the fistula. I) outer part of the fistula, made of steel mark 1X18H9T (external thread); II) inner part of the fistula, made of organic glass (internal thread); III) stopper for the fistula (2 layers of organic glass separated by a layer of rubber, fixed by stainless steel wire); IV) organic glass tube for washing out the side tube of the fistula (at one end it has an external thread for screwing into the side tube of the fistula); V) glass drain for insertion into the greater pancreatic duct; VI) section through the assembled fistula. The dimensions of the fistula are shown approximately. They may be modified to suit the wishes of the experimenter and the size of the dog.

Before the abdominal cavity is sutured it must be irrigated with penicillin solution (200,000-300,000 units) and the same dose of penicillin should be injected intramuscularly. A thick layer of gauze is inserted beneath the outer disk of the fistula. While the dog is still anesthetized, from 400 to 800 ml of physiological saline, warmed to 38-40°, is injected subcutaneously into the dorsal surface of the trunk. After 24-36 h the supporting sutures are removed and the thick gauze beneath the disk of the fistula is replaced by thin. The dog is given small amounts of water (30-50 ml) to drink every 20-30 min until its thirst is completely relieved. Subsequently, water is given ad lib. Feeding begins 48 h after operation: at first broth is given, followed next day by biscuit, and later by stewed meat, gruel, and vegetables. The food should be well minced and given for a few days in small helpings 4 or 5 times a day. At the end of the first week the sutures are removed, and the animal is put on a normal diet and returned to the kennels. For a few days after the operation the skin around the operation wound is painted with weak potassium permanganate solution, or with a strong solution (4-5%) if irritation appears.

In some cases the dog may lick the irritated skin around the fistula and unscrew the outer part of the apparatus. To prevent this, 2 or 3 turns of very fine silk thread are wound around the grooves of the thread on the fistula tube near the outer disk; if the fistula is turned, the silk thread bites on the groove and makes it difficult for the outer part to become unscrewed.

Care must be taken to ensure that the side piece of the fistula, through which pancreatic juice is returned to the duodenum, does not become obstructed. The side tube is washed with warm water, using a special tube (IV in the figure) for this purpose, which may be screwed into the fistula end of the side tube. The same tube may also be used for introducing substances into the intestine and for obtaining chyme. By closing this tube, the escape of chyme during the experiment is prevented.

As a rule experiments on the dogs may commence 20-25 days after operation. The secretion is collected by a special glass drain (V), inserted into the duct to a depth of 10-15 mm. The size of the glass part is chosen individually for each dog; the external diameter of the part introduced into the duct usually varies from 1 to 2 mm. The drain is fixed by a thread to the outer disk of the fistula, and the direction of the drainage tube must correspond to that of the duct. Incorrect fixation of the drainage tube leads to injury to the duct and interferes with the free flow of pancreatic juice.

Long experiments may be performed on dogs undergoing this operation. If juice is collected regularly 3 times a week for 4-5 h continuously, no appreciable disturbances of secretion are observed. In our series of experiments continuous investigations were carried out for 6 months. Observations have now been kept on the animals for 10-11 months after operation. The dogs maintained a constant weight, a normal appetite, and normal mobility, and their skin and hair remained in good condition. The pancreas functioned normally.

For example, experiments on these dogs demonstrated that the pancreas was capable of secreting in response to food stimuli juice of different enzymic composition. Juice obtained after giving 200 g of raw meat contained 2500 units of trypsin, 4600 units of amylase, and 830 units of lipase, while juice obtained after 60 g of butter contained 2200, 12,200 and 2820 units respectively. Compared with the meat, administration of fat increased the concentration of lipase in the juice by 3.4 times, and of amylase by 2.6 times; the concentration of trypsin remained practically unchanged. A specific increase in the lipase production took place to correspond to the nature of the stimulus applied.

The suggested operation thus makes it possible to study the fine physiological changes in the enzyme-secreting function of the pancreas. It is particularly suitable for carrying out prolonged experiments requiring biochemical investigation of the enzymic composition of the pancreatic juice, for example, for studying the effect of different diets.

SUMMARY

A method of operating on dogs has been developed in which the intestine is injured, but insignificantly, and the pancreatic and chyme secretion is not impaired. Pure pancreatic juice may be obtained with the use of different stimuli, including food. A scheme of a special fistula is given.

Dogs operated on by the method described are in a good state and may be used in chronic experiments.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
