THE ABSORPTIVE FUNCTION OF THE DIGESTIVE APPARATUS AFTER PARTIAL RESECTION OF THE SMALL INTESTINE

COMMUNICATION 1. ABSORPTION OF WATER AND GLUCOSE AFTER RESECTION OF THE PROXIMAL OR DISTAL HALF OF THE SMALL INTESTINE

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The changes in the absorptive function of the small intestine after exclusion of parts of the gastrointestinal tract have received inadequate experimental study, although their importance to the theory and practice of medicine is considerable. We have previously shown how the absorptive function of the small intestine is affected by subtotal gastrectomy [12]. The aim of the present investigation to study the effect of partial resection of the small intestine on the absorptive function of the remaining part.

The information given in the literature on this problem is controversial. There is doubt about the late results of extensive resection of the small intestine [1, 3, 4, 5, 7, 9, 11, 13, 15], and also about the comparative effects of removal of the jejunum or ileum [2, 14, 16].

EXPERIMENTAL METHOD

Various workers [6, 8, 10] have demonstrated that the absorptive function of the small intestine may be studied in normal and pathological conditions in isolated segments of bowel.

We studied the absorptive power of the small intestine after resection of its proximal or distal half in chronic experiments on 4 dogs. The operation of exteriorization of a loop of bowel and resection of the intestine was performed on the experimental dogs by N. Sh. Amirov. The general care and diet of all the experimental animals was the same. The dogs received balanced and adequate meals at the same time once or twice daily. Systematic observations were made on their weight, appetite, and general condition. The absorption of glucose and water was studied before resection and at various time thereafter. For this purpose, 15 ml of test solution was introduced into an isolated loop of bowel (15-20 cm) for 7 minutes. The temperatures of the test solution and of the water used for flushing the intestine was constant (37°). The glucose concentration in the test solutions was determined by the Hagedorn-Jensen method. The degree of absorption was determined from the volume of test solution absorbed from the isolated loop of bowel in the course of 7 minutes, and expressed as a percentage of the volume of solution introduced. The technique of these experiments is described in detail in our earlier communication [12].

EXPERIMENTAL RESULTS

Despite the extensive resection (about one half of the small intestine was removed), all the experimental animals remained in a satisfactory condition for a long time (from $4\frac{1}{2}$ to 11 months after operation, to the end of the observation period). No gastrointestinal disorders were observed, and their appetite was normal throughout this period. Apart from the dog Ozornitsa, which lost a little weight in spite of its good general condition, the dogs did not lose weight.

We also examined the stools at various intervals after resection of the intestine (on the 14th day, after 2, 3, 6, and 12 months). The results of these investigations (which will be described in detail in the next communication) showed that the degree of digestion of the food (in so far as this is reflected in the state of the stools) varied

between the original limits after resection of 50% of the small intestine. The stools were usually formed and rarely liquid. They contained a few muscle fibers, undigested and digested areolar tissue, a few starch cells and granules in different stages of digestion, and also neutral lipids, fatty acids and soaps.

The dog Zhuchka, in which the proximal division of the small intestine was formed into a loop after resection, remained under observation for more than 10 months. The dog withstood the operation well, and gained in weight despite the extensive resection. Its condition remained good for a long time after the operation; no disturbances of excitation by food or of its digestion were observed.

Normally 41.2, 60 and 70% of introduced sugar was absorbed from the isolated loop of small intestine in the dog Zhuchka, and after resection the figures were 50, 65, and 70%. Resection of the intestine in this dog caused an increase in the absorption of water during the first months up to 50% from an original level of 10-30%. The absorption of water then remained at the level of 30-35% for a considerable time, with isolated falls to 20-25%. At the end of the investigation an increase in the absorption of water to 60% was observed. According to the mean results of the pilot experiments the absorption of glucose in 7 minutes was 46%, and after resection of the intestine the figure was 63%. According to the mean results of the pilot experiments the absorption of water was 14%, and after resection 34%.

The dog Ozornitsa, which also had an isolated loop of the proximal portion of the intestine, was kept under observation for 6 months after resection of the proximal division of the small intestine. The dog withstood the operation well. For a long time after the operation Ozornitsa had a good appetite, with no disturbances of excitation by food or of its digestion. This dog lost about 1.5 kg in weight.

Before resection of the intestine from 50 to 78% of introduced glucose was absorbed in the dog Ozornitsa. One month 5 days after the resection the absorption was 52.5%. Before resection of the intestine, from 33 to 62% of water was absorbed by this dog. After resection the absorption of water by this dog was 60% during the first months, and then 50-40%, after which it rose to 70-80%. According to the mean results of the pilot experiments, the absorption of glucose during 7 minutes was 65.3%, and after resection 50%. The corresponding figures for the absorption of water were 53 and 64%.

The dog Pestrushka, in which an isolated loop was made from the distal part of the intestine, remained under observation for $4\frac{1}{2}$ months after resection of the distal segment of the intestine. Normally the absorption of water by Pestrushka during 7 minutes varied from 7 to 20%. On the 12th day after resection its value was 13% and on the 15th day—20%. The next two experiments showed a fall to 12-10% and one month later an increase in the absorption to 30% was observed. Subsequently it reached 45-50%. The normal glucose absorption of the dog Pestrushka was 52.5-56.5%. After resection the rate of absorption was 53-56%, falling later to 40%. According to the mean results of the pilot experiments the water absorption in this dog was 11.8%, and after resection—26.6%. The corresponding figures for glucose absorption were 54.5 and 49.6%.

The dog Tuzik, which also had an isolated loop of the distal segment of the intestine, remained under observation 11 months after resection of the proximal division of the small intestine. The normal water absorption of this dog varied between 40 and 60%. On the 13th day after operation the absorption fell to 25%, but on the 24th day it had risen to 60%, at which level it remained. The mean experimental results showed that before resection the absorption of water by the dog Tuzik was 59.5%, and resection—61%. The glucose absorption, according to the mean results of the pilot experiments, was 55% and after resection—60%.

It will be seen from the results cited that the changes in the absorption of glucose and water in the small intestine of the experimental animals were different in character after the removal of the various parts of the intestine, as follows: the absorption of water was increased, while the absorption of glucose underwent a slight change in the direction of either an increase or a decrease. The results of the experiments verified the conclusions reached from experiments on dogs by several researchers [3, 9, 15, 16], that resection of half the small intestine may be fully compensated. All our experimental animals remained for a long time in a satisfactory condition after resection of the proximal or distal half of the small intestine, as shown by their weight, appetite, and composition of the stools.

As we pointed out above, it is impossible to decide on the basis of the information in the literature which segment of the small intestine (the jejunum or the ileum) is more important for ensuring the restoration of the function of the bowel after resection [15]. During our study of the absorption of glucose and water in the various segments of the small intestine, we also found no special difference in the rate of absorption after resection of the different parts.

The results of our investigation thus showed that after extensive resection of both the proximal and distal halves of the small intestine, the absorption of water and glucose from the isolated bowel in dogs is not markedly disturbed.

SUMMARY

Experiments were conducted on 4 dogs with isolated portions of the superior or inferior portion of the small intestine according to Thiery. A study was made of the absorption of 1 percent glucose solution and water (observations – 4½ to 11 months) at various periods following resection of the superior or inferior half of the small intestine. All the experimental animals, irrespective of resected superior or inferior portion of the small intestine, were in a satisfactory condition for a long period after the operation this being confirmed by the indices weight and appetite as well as by data of coprologic examination. Studies of glucose and water absorption in various portions of the small intestine, revealed no essential difference in the rate of absorption in the intestine in resection of its various. Experimental results show that water absorption increased after the resection both of the superior and inferior portions of the small intestine, whereas glucose absorption changed but insignificantly.

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