A MASSIVE RESECTION OF THE SMALL INTESTINE FROM FIFTEEN CENTIMETERS DISTAL TO THE LIGAMENT OF TREITZ TO WITHIN SIX CENTIMETERS OF THE ILEOCECAL VALVE—WITH A FOUR YEAR FOLLOW-UP*

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THE FIRST SUCCESSFUL extensive small intestinal resection was reported by Koeberle in 1881. Since then sporadic cases have been reported,[1-10] in all of which emphasis was placed upon the loss of absorptive power and the resulting nutritional disturbances caused by such extensive resections of the small bowel. In this paper I wish to discuss briefly the alterations in physiology that occurred in the cases which have been reported in the literature, to report a case in which all but 21 cm. of the small intestine was successfully removed, and to give the management of this patient over a period of four years.

Though most of the case reports found in the literature were clinical in nature, several contained investigative studies. E. S. West[10] and Todd, et al.,[9] did repeated nutritional surveys in 1938 and 1940 on a patient with only three feet of remaining small intestine. In 1950 Berman, et al.,[3] reported extensive metabolic studies of an unusual case of survival following resection of all but 18 inches of small intestine. Undoubtedly extensive massive resections are being done frequently enough today to make desirable further investigative studies reporting the physiologic and metabolic changes occurring in these patients.

Absorption of all essential nutrients is practically completed in the small intestine. The problem of absorption is not only related to the surface available for absorption, but also what might be called the time contact relationship between food, mucosa and enzymes. In addition, experimental and clinical studies have demonstrated that the presence of normal gastric and duodenal secretions should assure a normal digestive potential. These two facts are of significance in the management of this group of cases. We cannot make too concrete deductions, however, as each patient has some variations or idiosyncrasies.

Berman and his co-workers showed that removal of the upper half of the small bowel causes no more disturbance than removal of the lower half. Two-thirds may be removed in the human being without risk of life. There is no alteration in the nutritional status when one-third of the small bowel is removed. However, if over 50 per cent is removed, absorptive and nutritional disturbances appear. West and Todd, in nutritional studies in their case, found that carbohydrates were utilized normally, proteins were not completely absorbed, only 70 to 75 per cent being utilized, and fats were absorbed very poorly, 45 per cent being lost. They also noted an excessive loss of calcium when a large amount of fat was included in the diet. In essence, these alterations in the patient's ability to handle the components of his diet have been those most widely accepted. In view of these deficiencies in absorption, Todd, et al., suggest that as fats are poorly tolerated, they should be re-

FIG. 1. Preoperative roentgenogram of the abdomen showing staghorn calculus in the left kidney and small bowel distention in the upper abdomen.

stricted, proteins should be given in an easily absorbable form, and carbohydrates should be given at frequent intervals. The feeding process must be almost continuous throughout the day in order to utilize the absorptive capacity of the remaining bowel. There have been minor differences in the diet employed, but in principle, the diet suggested by Todd and his co-workers has been the one which has usually been followed. Little or no interest has been shown in attempting to slow up the activity of the gastro-intestinal tract and thereby increase the length of time that food is in contact with the mucosa and digestive enzymes.

An analysis of the case reports and investigative studies on this problem indicates that the commonest changes following massive resection of the small intestine are: (1) loss of weight, (2) anemia, (3) intractable diar-

rhea, (4) edema, (5) loss of fat and protein in the stools, (6) lowering of the blood calcium and serum protein and, finally, (7) the remaining bowel may undergo elongation, dilatation and hypertrophy. The intractable diarrhea presents the most distressing problem in these patients. This troublesome complication should receive concentrated attention, because, if the diarrhea is overcome, many of the other changes may be appreciably, if not entirely, corrected.

CASE REPORT

W. C., white male, 56 years of age, was admitted to the Presbyterian Hospital September 15, 1949. He gave a history of severe abdominal pain in the right lumbar region which had started 48 hours before admission, and had moved down to the right mid-abdomen. There was definite muscle guarding over the lower right quadrant of the abdomen. No peristalsis could be heard. The pulse varied between 130 and 140 at the wrist, and 190 to 200 at the apex of the heart; thus a pulse deficit of 60 existed. The temperature was 95.3° F. The BUN was 29 and the CO_2 was 47 volumes per cent. A roentgenogram of the abdomen was taken and it showed a staghorn calculus in the left kidney, almost completely filling the collecting system (Fig. 1). The small bowel showed distention mostly in the upper abdomen. The blood pressure was 146/105, electrocardiogram showed a left heart strain with auricular fibrillation. Obviously, the patient was suffering from an acute abdominal condition that required surgical intervention. The preoperative diagnosis was acute appendicitis, based on the tenderness and muscular rigidity found in the right lower quadrant.

The abdomen was entered through a lower right rectus incision. About 1000 cc. of dark, bloody fluid was aspirated. Loops of gangrenous small bowel were noted and delivered from the abdomen. About 6 cm. of the terminal ileum appeared normal. The duodenum and about 15 cm. of small bowel distal to the ligament of Treitz were found to be viable. The small intestine between these two points with its mesentery was entirely gangrenous. The portal vein was palpated and found to be not involved in the process. The gangrenous bowel with its mesentery was resected. The caecum was mobilized to enable the two ends of viable small bowel to be approximated, and an end-to-end anastomosis was performed. The wound was closed with two cigarette drains, one in the right gutter and the other at the base of the appendix. The heart was fibrillating throughout the procedure, and the patient left

Fig. 2. Shows roentgenologic studies four years postoperatively. This demonstrates the barium is distributed throughout the small bowel which appears to be about a meter in length. The proximal portion of the large bowel fills and it appears to be smaller in lumen than normally. The mucosal pattern of the small bowel is normal and there is no appreciable dilatation. (1) is the site of the anastomosis and (2) shows the small lumen of the proximal portion of the large bowel.

the operating room in only fair condition. The pathological report was mesenteric thrombosis with gangrene of the small intestine.

Immediately following the operation the patient's general condition was poor, particularly from the cardiac standpoint. Digitoxin, O_2, and other supportive measures were given. About ten hours postoperatively he began to show some improvement. The pulse deficit diminished; the apical pulse was 112 and the radial pulse was 88. The pulse deficit had disappeared on the fifth postoperative day. On the seventh postoperative day, fecal drainage was noted, evidently from a leak in the anastomosis. Various measures, including a Sump pump, were tried and the fistula finally closed on the twenty-eighth day after the operation. Early in his postoperative course the BUN was 26 to 29, the chlorides were maintained at a normal level, and the serum proteins ranged between 7.3 and 7.7 Gm. per cent. On the twelfth postoperative day the BUN fell to 19, the plasma chlorides were 580, and the serum proteins were 7.3. Throughout the remainder of his stay in the hospital a satisfactory electrolyte balance was maintained and the serum proteins remained at a normal level.

In this patient we were confronted with a lack of absorptive power with resulting nutritional disturbances, and in addition, a fecal fistula. Until the fistula healed he lost weight very rapidly. After the fistula healed he began to regain weight, and one month after operation he weighed 142 pounds; his preoperative weight had been 180 pounds. To combat the metabolic disturbances we tried many dietary combinations and medications but we were not able to control the diarrhea. At first he had 10 to 12 or more stools a day. He was then put on a high protein diet with Caesac and 2 quarts of milk to supplement it. Later we added Zymacaps, a vitamin preparation which was also supposed to increase the calcium intake. He ate cheese and butter in large amounts. This diet, rich in fats, was contrary to the diet usually prescribed for these patients. After 3 months of this regimen he regained 15 pounds in weight, had 5 to 6 stools a day, and on a good day this number was reduced to 3 or 4. He continued to gain weight slowly, but he still was uneasy about the uncertainty as to when he would have to defecate. Because of this uneasiness, 6 months postoperatively the regimen was changed to the one he is still using.

On his present routine, he arises at 5:30 in the morning; at that time peristalsis is very active and he usually has two stools which are well-formed. Following that, he takes 10 drams of a mixture containing 5 ounces of Kaomagma and one ounce of paregoric. He then eats a good breakfast which consists of cereal, eggs, toast and coffee. He carries on his work as a traveling salesman, with no further stools during the day. He usually eats a light lunch consisting of a sandwich and a glass of milk. At night he eats a regular dinner of plain food. He does not restrict his diet very much but omits seafoods which he was never able to eat. He avoids stewed fruits and other foods which cause diarrhea. He has no desire for food late at night but takes two drams of Metamucil and a full glass of milk before retiring. In the course of a day he consumes over 2 quarts of milk, eats at least a quarter pound of cheese, and large quantities of butter; thus he has a high fat and adequate calcium intake.

If he takes only the Metamucil and leaves out the mixture of Kaomagma and paregoric, he has 3 or 4 stools during the day, but does not know when they will occur, and has no control over them. If he takes the Kaomagma and paregoric before he has a stool in the morning, he will not have any stool until about noon. He has frequency of urination which necessitates his getting up during the night. If he has a cold which prevents him from being on this regimen, or if he is indiscreet in his diet, he develops diarrhea and may have 15 or 16 stools a day. It is a matter of days before he can

get his regimen well re-established after these experiences. He has mild hypertension and has noted that any sudden change in position will make him dizzy; aside from that he has no symptoms of any significance. On his present regimen he has remained very well with the one exception of a severe nosebleed in May, 1952, which required hospitalization for its control. This was thought to be caused by his moderate hypertension.

On January 14, 1954, many laboratory studies were made on this patient with the purpose of evaluating his absorptive and nutritional status. Urinalysis showed albumin plus 3, 20 to 30 WBC, and 7 to 8 RBC per high power field, and dark and light granular casts. These findings were attributed to the staghorn calculus in the left kidney and the resulting renal damage. The blood count was: Hemoglobin, 12. 5 Gm. or 82 per cent; RBC, 4,800,-000; WBC, 7,500; polymorphonuclears, 65; eosinophils, 2; lymphocytes, 19; monocytes, 15.

Serum proteins, on two determinations, were 6.4 and 6.7 Gm. per cent. Albumin was 3.3, globulin, 3.1. Blood calcium was 10.4; phosphorus, 3.7, and potassium, 5.3. Lipase was 3.2, which is rather high; the blood sugar was 80; the BUN was 23 and the amylase was 120.

Microscopic examination of the stool revealed nothing significant; however, chemical analysis showed loss of 15.3 Gm. of fat per day in the stool, whereas the normal is 2 to 6 Gm. a day. Thus the patient was unable to handle fats satisfactorily.

A roentgenogram was taken of the gastrointestinal tract (Fig. 2). It was reported as follows: "There was no retention in the stomach, all of the barium having entered the small bowel in 90 minutes. At this time the barium is distributed throughout the small bowel which appears to be about a meter in length. The proximal portion of the large bowel fills, and it appears to be smaller in lumen than normally. The mucosal pattern of the small bowel is normal and there is no appreciable dilatation. There is a large calculus almost completely filling the pelvis, infundibula and calyces of the left kidney. There is a moderate osteoporosis of all the bones."

This patient has not developed anemia or hypocalcemia. It was felt that these two deficiencies have not occurred because the patient has had such a well-balanced diet including so much milk, cheese and butter, all high in calcium content. The total proteins are a little below normal, which coincides with the findings in previously reported cases. The patient has gained weight over the past few years, so that he now weighs 170 pounds, which is only ten pounds below his normal weight before operation. The laboratory studies noted above and the general nutrition of this patient are such that we believe the regimen of keeping him constipated and increasing the time that ingested foods have contact with the intestinal tract and enzymes, has been an exceedingly important factor in his relatively good condition. We think that the high intake of dairy products has contributed to his well being even though this is contrary to previous reports. The patient has noted that he loses weight rapidly and has many stools whenever he has an infection or any other condition which takes him off his daily routine. Thus there is a delicate balance between control of his stools and intractable diarrhea.

The purpose of reporting this case is not the surgical result, as today there are many reported and unreported cases of massive resection who have survived. We primarily wanted to report in detail the routine followed by the patient for over four years, which has enabled him to maintain good nutritional status, control his stools very satisfactorily, and carry on his daily work as a traveling salesman.

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