

Experience with a New Technic of Intestinal Bypass in the Treatment of Morbid Obesity

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FOUR years ago we began a study of the clinical and metabolic responses of patients with morbid obesity who were unequivocal dietary failures and who were submitted to the intestinal bypass described by Payne and DeWind.² In that procedure the proximal jejunum is divided 14 inches from the ligament of Treitz and anastomosed to the side of the terminal ileum 4 inches from the ileocecal valve. The aim of the extensive intestinal bypass is to reduce absorptive capacity and thus induce weight loss despite anticipated persistence of gluttonous dietary intake combined with minimal physical exercise.

Metabolic and body compositional studies during follow-up periods of 1 to 4 years in 11 patients so treated have shown that weight loss resulted chiefly from malabsorption of fat and carbohydrate; body fat appears to be the principal component of weight loss.^{3, 4} Although six of 11 patients treated by the Payne procedure have had satisfactory weight reduction and good physical rehabilitation, five patients so treated have had unsatisfactory courses with persistent diarrhea and failure to lose adequate amounts of weight. Radiologic study of possible causes of these five failures has shown hypertrophy, dilatation and elonga-

tion of the proximal jejunum and elongation of the terminal ileum. In addition, orally ingested barium refluxes into the bypassed ileum for distances of 3 to 5 feet. These changes appear to have thwarted the aim of the Payne procedure.

In the hope of obviating some of these defects and eliminating the uncontrollable reflux of nutrients into the bypassed ileum, a new technic of intestinal bypass has been devised which may give more accurate control of the surgically reduced intestinal absorptive capability while maintaining the integrity of the ileocecal valve in alimentary continuity. The principle involved in the new procedure is to divide jejunum a few inches distal to Treitz ligament and to divide ileum a few inches proximal to the ileocecal valve; proximal jejunum is then anastomosed end-to-end to the distal ileum. The end of distal jejunum is closed and drainage of bypassed small intestine accomplished by anastomosis of proximal ileum to transverse colon or to sigmoid.

During the last 15 months, 12 massively obese patients have been submitted to the new procedure. A clinical and metabolic appraisal of these patients has prompted this report.

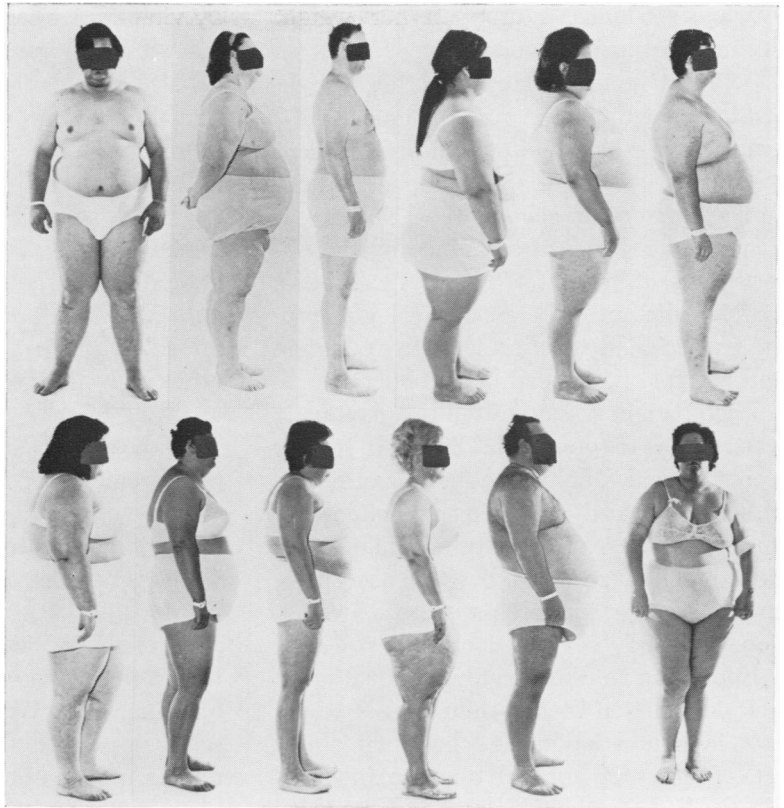
Clinical Study

Criteria for selection of patients with massive obesity as candidates for extensive jejunoileal bypass have continued to be

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FIG. 1. Composite photograph of 12 patients with morbid obesity prior to operation.



essentially the same as those used by Payne and DeWind.² These are as follows:

1. Obesity of massive degree (weights two or three times ideal levels) of at least 5 years' duration.

2. Evidence from attending physician indicating failure of dietary efforts to correct obesity over a period of years.

3. Evidence from patients' history and evaluation indicating patients' apparent incapability to adhere to prescribed dietary regimens and/or exercise programs.

4. Absence of any correctible endocrinopathy (such as hypothyroidism or Cushing's syndrome) which might be the cause of obesity.

5. Absence of any other unrelated significant disease which might increase operative risk.

6. Presence of certain complications such as Pickwickian syndrome, hyperlipidemia, adult onset of diabetes, and hypertension,

which might be alleviated by significant weight reduction with intestinal bypass.

7. Assurance of patients' cooperation in conduct of pre- and postoperative metabolic and body compositional studies and prolonged follow-up evaluation.

Twelve patients who have met these criteria have thus far been admitted to the present study. These are eight women and four men whose ages range from 16 to 43 years. After preliminary appraisal, each of these has been accepted for study and submitted to operation. Figure 1 shows the habitus of each patient immediately prior to operation. There was a long history (10 years or more) of massive obesity in each instance. In six patients, maximal weights were in the 300 pound range, whereas in the other six, maximal weights ranged from 330 to 464 pounds. One woman had been submitted to the Payne procedure of end-to-side jejunoileal anastomosis 3½ years

previously and had dropped her weight during the first postoperative year from 330 to 260 pounds. However, her weight stabilized at this level over the ensuing 2½ years. She was admitted to the present study for revision of the jejunoileal shunt. In her case and in each of the 11 other patients, there was firm assurance by the observations of the referring physicians that various dietary and pharmacologic programs designed to effect weight reduction and control obesity had been ineffective.

Each patient was admitted to a metabolic ward prior to operation. Baseline studies were carried out with special attention directed toward detecting possible endocrine causes of obesity, evaluation of cardiopulmonary status, baseline absorptive and metabolic studies, psychiatric evaluation, and body composition studies.

Endocrine studies included evaluation of thyroid function by determination of serum protein bound iodine and basal metabolic rate. Studies of adrenal function included plasma F determinations and 24-hour urine collections for measurement of 17-hydroxycorticosteroids and 17-ketosteroids. Films of the skull were taken in each instance. Pulmonary studies included measurement of arterial PO_2 , PCO_2 , and pH in addition to spirometry for determination of respiratory rate, tidal volume, inspiratory capacity, inspiratory reserve volume, forced vital capacity, and other aspects of pulmonary function. Cardiovascular appraisal included roentgenograms of the chest, electrocardiograms and Master's test, and determination of serum lipids including cholesterol, triglycerides, phospholipids, and lipoprotein electrophoretic pattern.

In addition to an extensive dietary history, gastroenterologic studies included x-ray examinations of the stomach, small bowel, and colon with measurement of small intestinal transit time. Twelve-hour nocturnal collection of gastric juice with measurement of gastric acid secretion were made. Intestinal absorption was evaluated

by vitamin A tolerance tests, d-xylose tolerance tests, glucose tolerance tests, and the cobalt 60 vitamin B_{12} absorption test (Schilling test). Preoperative measurements of serum calcium, potassium, magnesium, and other electrolytes as well as vitamins A, B_{12} , C, E, and folic acid were carried out. Dietary intakes were calculated and recorded and serial 3-day collections of stool with daily collections of urine were obtained. These were analyzed for electrolytes and nitrogen, and stools were also analyzed for fat.

Studies of body composition included measurements of total body potassium by 40 K whole body counting; total body and extracellular water, red cell and plasma volumes were measured by isotope dilution methods.

Psychologic evaluation of each patient involved the use of standard psychologic tests including Weschsler adult intelligence scale, Bender-Gestalt, Rorschach, and Thematic Apperception tests as well as interviews with a staff psychiatrist.

Operative Procedure

Preoperative preparation included a 3- to 5-day bowel cleansing regimen involving liquid diet, castor oil, cleansing enemas, and oral Kanamycin. Anesthesia in each patient consisted of endotracheal halothane with bag assistance and succinylcholine intravenously as a muscle relaxant. For the larger patients, the standard operating table was inadequate in width and a delivery table was substituted. A 15- to 20-minute scrub of the large redundant expanse of skin of the abdomen, chest, perineum, and upper thighs was carried out in each instance with an iodine-containing soap solution. A long transverse elliptical incision was used with excision of the redundant fatty apron and umbilicus in the larger patients. In the smaller patients who had no redundant fatty apron, a simple supra-umbilical transverse incision was used. Both rectus muscles were divided transversely

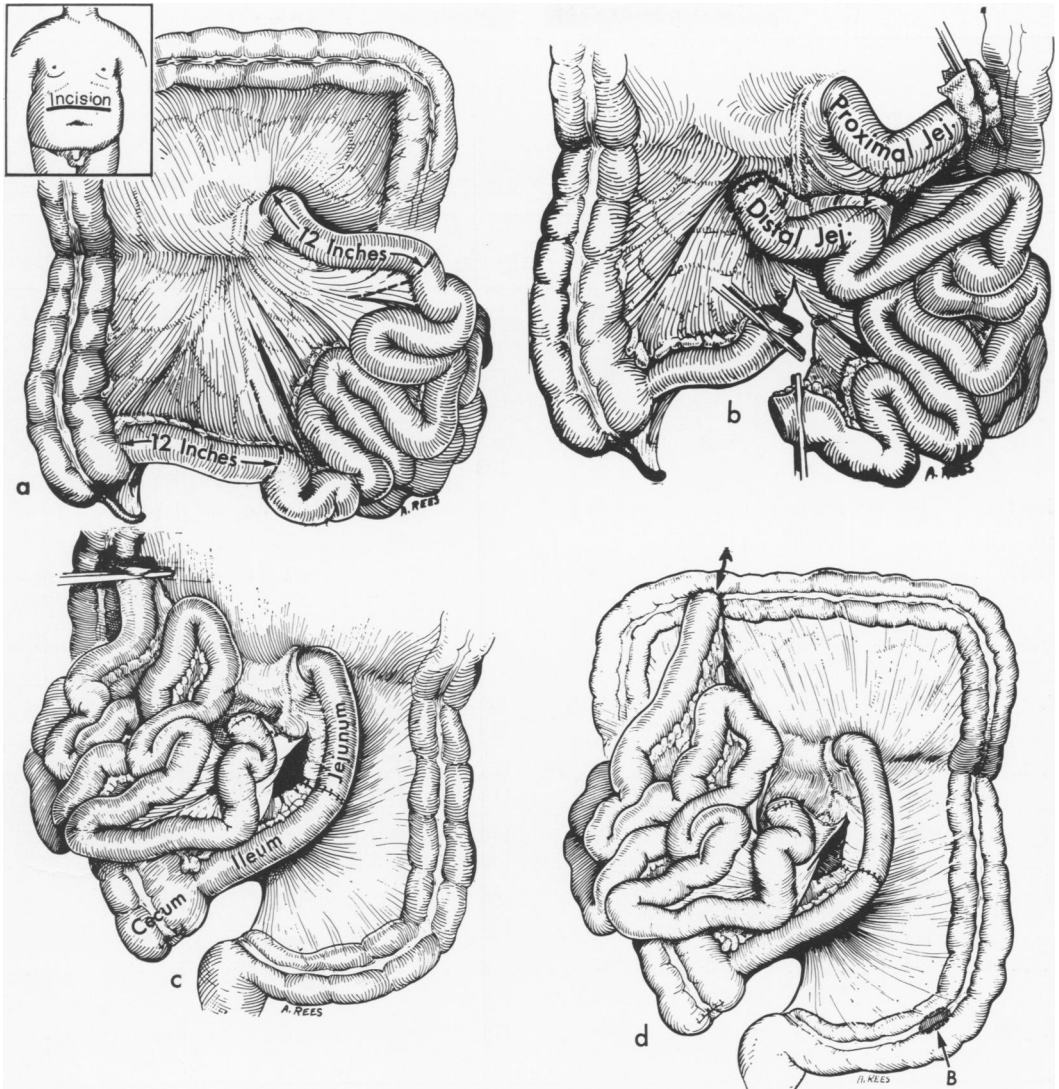


FIG. 2. Steps in a new technic of intestinal bypass for morbid obesity. Proximal end of jejunum is anastomosed to distal end of ileum. Distal jejunum is closed, sutured to mesentery. Bypassed jejunioileum is drained by anastomosis of proximal ileum to (A) transverse colon or (B) sigmoid.

and after entering the peritoneum a plastic wound protector was inserted. With the use of large retractors coupled with liberal administration of muscle relaxants, the celomic cavity was explored. A liver biopsy was done as a routine. The proximal jejunum was identified, placed on the stretch, and carefully measured along its mesenteric border to a point 12 inches from the ligament of Treitz. At this point the jejunum was transected. The distal end was closed

in two layers with non-absorbable sutures and anchored to the root of the transverse mesocolon to prevent postoperative intussusception. The terminal ileum was then identified, placed on the stretch, measured along its mesenteric border, and transected at a point 12 inches proximal to the ileocecal valve. The proximal jejunum was then anastomosed to the end of the terminal ileum. In ten patients, the anastomosis between proximal jejunum and terminal ileum

TABLE 1. *Pre- and Postoperative Values*

Age & Sex		Fecal Fat (Gm./ day)	Serum Carotene (mcg./ 100 ml.)	Serum Cho- lesterol (mg./ 100 ml.)	D-xylose toler- ance (Gm./ 5 hr. urine)	Fecal Nitrogen (Gm./ day)	Serum A/G (Gm./ 100 ml.)	Serum Uric Acid (mg./ 100 ml.)	
									Normal
1. I. K.	43M	Preop.	—	230	233	—	—	4.8/2.7	6.2
		Postop.	39.4	20	118	—	4.3	3.7/2.5	6.6
2. J. H.	24F	Preop.	2.5	106	156	5.4	0.98	3.5/3.8	7.3
		Postop.	—	23	164	—	—	3.0/3.6	8.7
3. W. J.	39F	Preop.	12.8	46.7	182	5.6	2.1	4.2/3.1	5.9
		Postop.	121	—	108	3.0	3.25	3.5/3.1	4.5
4. L. C.	16F	Preop.	—	72	182	4.4	0.6-1.4	4.3/3.7	8.2
		Postop.	—	—	100	—	—	3.9/3.2	7.4
5. M. T.	25F	Preop.	0.9-1.7	61	146	7.2	0.21-3.2	4.3/3.7	6.3
		Postop.	5.18	—	115	2.3	1.4	3.9/2.9	8.4
6. C. T.	28F	Preop.	3.7	78	182	7.6	—	4.0/3.8	6.8
		Postop.	41.7	33	130	3.9	2.4	4.1/4.4	9.5
7. D. B.	20M	Preop.	13	32.7	206	—	2.8-3.8	4.3/3.2	10.5
		Postop.	106	—	119	—	—	3.2/2.9	—
8. L. G.	23F	Preop.	7.8	91	178	6.7	—	4.6/2.8	4.6
		Postop.	58.7	10	116	3.0	4.31	3.6/3.9	4.7
9. R. A.	18M	Preop.	17.6	80	140	8.0	2.5-2.6	4.8/2.6	6.8
		Postop.	57.2	17.5	100	2.4	3.81	4.0/3.9	8.5
10. J. G.	35F	Preop.	27	54	156	6.5	2.9	3.6/3.3	6.4
		Postop.	—	—	102	—	—	—	—
11. E. W.	41F	Preop.	5.5	137.7	218	8.6	1.8-2.6	3.9/3.0	4.6
		Postop.	—	42	120	—	—	2.6/2.8	5.8
12. J. P.	39M	Preop.	6.05	109	214	—	1.72	4.0/3.4	5.
		Postop.	22.4	79	151	0.79	2.02	3/3.5	6.2

was made beneath the root of the mesentery. In these individuals, the proximal end of the transected ileum was then anastomosed to the side of the transverse colon as a means of draining the bypassed segment of jejunioileum. In two other patients, the anastomosis between proximal jejunum and terminal ileum was made superior to the root of the mesentery and for drainage of bypassed jejunioileum the proximal end of ileum was anastomosed to the side of the sigmoid colon. The mesenteric defects were then carefully closed with interrupted non-absorbable sutures. The appendix was re-

moved routinely. In one patient, in addition tubal ligation was done, and in two others cholecystectomy was carried out.

Prior to closure of the abdominal incision copious peritoneal lavage with saline solution was used. The transverse incisions were closed with interrupted #0 dacron sutures to the peritoneum and posterior sheath and interrupted #0 dacron to the anterior rectus fascia and external oblique aponeurosis. Stay sutures were not used. Catheters were placed beneath the subcutaneous layer and exteriorized through a stab wound for postoperative suction drainage. The thick

in Twelve Patients with Morbid Obesity

Prothrombin Time (%)	Vitamin A (mcg./100 ml.)	Vitamin B ₁₂ (Ng./ml.)	Vitamin C (mg./100 ml.)	Serum Calcium (mg./100 ml.)	Serum Folate (mµg/ml.)	Serum Magnesium (mEq./l.)	Serum Potassium (mEq./l.)	Hematocrit (%)
60-100	26-82	>200	0.5	8.5-11	>4.5	1.4-1.8	3.5-5	♂44-48 ♀37-46
—	30	—	1.6	9.7	—	1.38	3.8	57
—	30	700	0.6	9.5	7.5	—	4.3	42
65	24	—	—	9.9	—	1.6	4.0	45
72	16.4	—	—	9.4	—	—	4.3	40
—	38	350	0.53	9.4	7.3	1.63	4.3	37
—	—	550	0.6	9.5	—	1.66	3.7	37
65	30.6	300	0.51	9.1	7	1.75	3.8	41
—	—	—	—	8.6	—	—	4.6	37
79	26.6	375	—	9.9	8.6	1.7	4.3	43
—	—	850	0.7	9.7	10.8	1.9	4.1	40
72	27	300	0.7	10.	5.3	1.6	3.4	47
60	19.5	725	0.8	10.5	20.0	1.4	4.0	47
86	—	—	—	10.5	—	—	4.5	45
72	32.5	—	—	10.5	—	1.39	4.2	41
79	28.6	—	—	10.5	—	1.45	4.8	42
86	—	900	0.86	10.	12	1.8	4.5	43
—	71	—	0.64	10.2	8.6	2.0	4.6	52
86	35.1	—	—	9.5	—	1.8	4.2	47
100	31	850	1.3	9.4	7.0	1.6	4.1	43
—	—	—	—	9.8	—	—	—	35
—	25	950	1.28	9.5	8.4	2.0	4.5	35
58	39	—	—	8.7	—	—	4.1	30
79	25.6	—	0.6	9.5	18.	1.7	4.3	52
58	30.7	—	0.5	9.0	—	1.9	3.4	45

fatty layer was closed with interrupted #2-0 and 3-0 plain catgut sutures and the skin edges were approximated by vertical mattress sutures of fine dacron. Figure 2 shows the steps in the operative procedure.

Results

At the time of admission to our study 11 patients had weights which ranged from 270 to 442 pounds. One patient (J. G.) who weighed 260 pounds 3½ years after the Payne procedure was admitted to this study for a revision of her jejunoileal shunt. A family history of individual parents,

grandparents or siblings with massive obesity was elicited in six of the 12 patients.

Preoperative clinical evaluation of the 12 patients showed relatively few abnormalities of any significance excepting massive obesity. Two individuals had asymptomatic gallstones and one young woman was found to have fibroadenoma of the breast.

Four patients had glycosuria and diabetic glucose tolerance tests. Endocrine status was otherwise normal in each of the 12 patients prior to operation.

Pickwickian syndrome was present in one patient who also had diabetes and hyper-

tension with severe exertional dyspnea. This man (I. K.) usually slept 12 to 16 hours per day and fell asleep readily in a sitting position. His pulmonary function studies before operation showed total vital capacity 83% of normal and forced vital capacity was 71% of normal. However, blood gas studies in this patient preoperatively showed arterial pH 7.46 with P_{CO_2} 35 mm./Hg and P_{O_2} 80 mm./Hg.

Cardiac evaluation prior to operation showed elevated diastolic pressures in the range of 100 to 120 mm./Hg in four of the 12 patients. Roentgenograms of the chest showed no cardiac enlargement in any patient. Electrocardiograms were within normal limits in 10 subjects and two patients had left axis deviation. Serum cholesterols were in the normal range in each of the twelve obese subjects; however two men (D. B. and I. K.) had consistently elevated serum triglycerides in the range of 400 to 600 mg./100 ml. Lipoprotein electrophoretic patterns in these two men indicated a Fredericksen type 4 in one and type 5 hyperlipoproteinemia in the other.

Preoperative appraisal of intestinal fat, carbohydrate and nitrogen absorption as summarized by data in Table 1 was normal in each patient excepting the woman (J. G.) who had had the previous Payne procedure. Her fecal fat losses were elevated to the average of 27 Gm./day; otherwise her absorptive parameters were in the normal range. Three other patients showed slight increases in fecal fat excretion prior to operation. One of these (D. B.) a massively obese young man, also had a slight increase in serum uric acid, a slight elevation in stool nitrogen as well as stool fat and a reduced level of serum carotene.

Measurements of serum vitamin levels, electrolytes and hematologic function prior to operation in these obese patients showed no significant abnormalities.

Radiologic studies of the gastrointestinal tract before operation showed no abnormalities in 11 patients. Small intestinal

transit times as measured with liquid barium ranged from 1½ to 4 hours. In the patient (J. G.) with the previous Payne procedure radiologic measurements prior to reoperation estimated the length of jejunum proximal to the jejunoileostomy to be about 24 inches and showed reflux of orally ingested barium into the bypassed ileum for approximately 36 inches.

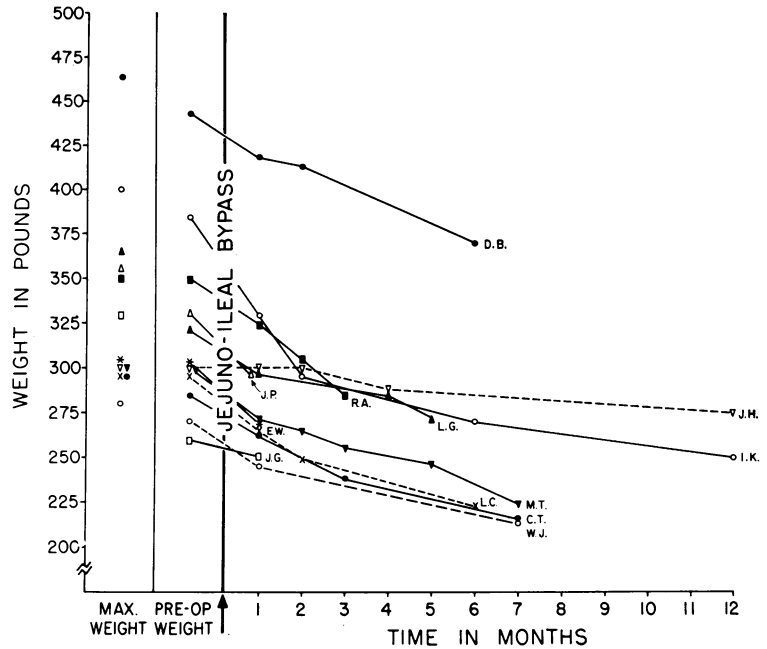
Psychiatric study and evaluation by psychologic testing revealed no single common denominator in the personality structure of this group of 12 obese patients. Seven of the 12 patients demonstrated mild depression, anxiety and passive dependence on psychologic testing. The diagnostic impression in three other patients was "passive aggressive personality." Most patients were thought by the staff who dealt with them to be relatively immature.

Liver biopsies were taken at operation in nine patients and all showed accumulations of fat. In addition, two of the patients had early microscopic evidence of periportal cellular infiltration and lobular fibrosis.

At operation on the patient (J. G.) who had remained obese after the Payne procedure there was hypertrophy of the jejunal wall proximal to the end-to-side anastomosis to ileum with dilation to a diameter of 2½ to 3 inches. The jejunum proximal to the anastomosis to ileum had elongated to 26 inches. The terminal ileum was also dilated to a 2-inch diameter and elongated to 9 inches distal to the anastomosis. The terminal 2-feet of bypassed ileum were also dilated to a 2-inch diameter for a distance of 2 feet with proximal diminution in caliber. The end-to-side anastomosis with 3 inches of distal ileum and 14 inches of proximal jejunum were resected; end-to-end anastomosis of proximal jejunum to distal ileum was done and the bypassed jejunoileum drained by anastomosis to sigmoid.

After operation each patient was maintained in the Surgical Intensive Care Unit

FIG. 3. Chronology of weight loss after jejunio-ileal bypass.



with special attention paid to respiratory support and pulmonary toilet. Ventilatory assistance was not needed. Low grade fever which was possibly pulmonary in origin occurred in most of the patients for the first few days after operation, but no significant incidence of atelectasis or pneumonia was encountered.

In nine patients the large abdominal wounds healed per primum without evidence of seroma or infection. However, subcutaneous wound infections developed in three patients which required opening of the wound down to the fascia and delayed convalescence. The only other complication in this series was a mild postoperative urinary tract infection which responded to appropriate antibiotics.

Nasogastric suction was discontinued 3 to 5 days after operation and oral liquids usually restricted to 1,500 cc. daily were started. In the first few days after the institution of oral liquids three to five watery stools per day resulted. Low fat diet, restriction of fluids with meals and diphenoxylate hydrochloride in a dosage of 5 mg. three to four times a day resulted in control

of the diarrhea during the early postoperative period.

After discharge from the hospital each patient was followed on a regular basis in the Surgical Clinic with the plan of periodic readmission to our metabolic ward. Figure 3 documents the chronology of weight loss in pounds during the follow-up period. After the precipitant fall in weight induced in most patients by the operative procedure and the catabolic effects of the immediate postoperative period, a majority of the patients has lost weight on a gradual and steady basis during the period of follow-up. Patients who have been followed from 3 to 6 months have lost from 54 to 75 pounds. The longest follow-up is 13 months and this patient (I. K.) has lost 136 pounds. The next longest follow-up is 12 months and the patient (J. H.) has the disappointing small loss of only 28 pounds during this time. In this woman a longer segment of jejunum (18 inches) had been left in alimentary continuity than in the other patients of this group.

During the brief period of follow-up in this small group of patients the voracious

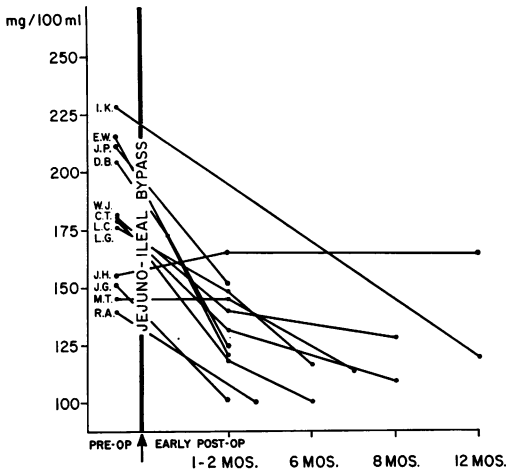


FIG. 4. Serum cholesterol levels before and in months after jejunioileal bypass.

appetites and the large caloric intake which they had before operation have continued unchanged since the operative procedure. With a single exception (J. H.) the patients followed for 3 to 12 months have been pleased with their weight loss and degree of clinical improvement. Symptoms of Pickwickian syndrome have disappeared since operation in the patient (I. K.) who had it previously with relief of exertional dyspnea and hypertension.

The diarrhea of the first few weeks after operation with the requirement of diphenoxylate hydrochloride for its control has gradually ceased to be a problem in the period of postoperative follow-up. No patient in the group has required regular medication for control of diarrhea after the first 1 to 3 months following operation. The nine patients who have been followed from 3 to 13 months have one to four formed to semi-formed stools per day unless they indulge in excessive liquid or fat intake. Their experience has taught them that excessive liquid intake and fat intake will induce diarrhea.

Excepting the three patients who were operated on most recently, all patients have returned to the occupations of the preoperative period and unrestricted activity.

Seven of the group have returned to full time work; one 16-year-old girl has returned to her high school studies and a 20-year old man is seeking employment with the help of Vocational Rehabilitation.

Table 1 documents the changes in metabolic parameters which have resulted from jejunioileal bypass in the obese individuals of this study. In the table postoperative data represent observations at 3 to 13 months following operation except in the case of the last three patients (J. G., E. W., and J. P.) whose postoperative data were collected in the first month after operation. A great increase has occurred in fecal fat in each instance in which it has been possible to measure this in the period since operation. The steatorrhea which has resulted from the operation has also been accompanied by a drop in serum carotene and serum cholesterol levels. In Figure 4 and Figure 5 serum cholesterol and triglyceride levels are plotted in graphic form in the preoperative and postoperative periods. As seen in Figure 4 there has been an impressive drop in serum cholesterol in

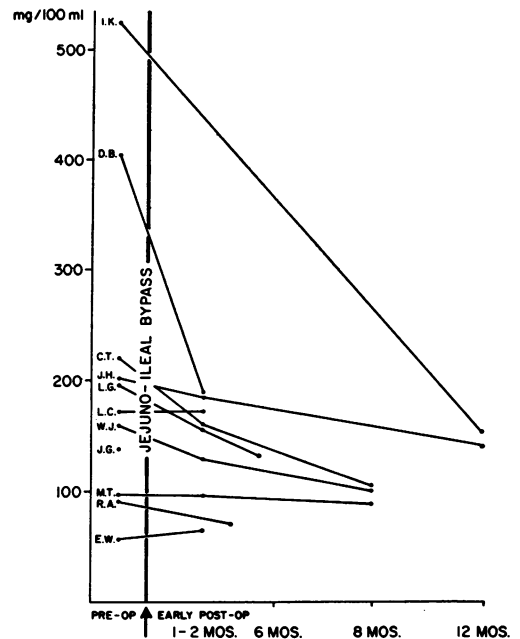


FIG. 5. Serum triglyceride levels before and in months after jejunioileal bypass.

the postoperative period in all but one patient in the group. This patient (J. H.) is the individual who had a longer segment of jejunum (18 inches) left in alimentary continuity and who has failed to lose a significant amount of weight in the 12-month period since operation. As seen in Figure 5 two patients had hypertriglyceridemia before operation and have dropped the serum triglyceride level into the normal range in the postoperative period. One of these men (I. K.) has changed his lipoprotein electrophoretic pattern from a Fredericksen type 5 to normal (Fig. 6).

Reduction in carbohydrate absorption is indicated by impairment in d-xylose tolerance in the patients in whom this has been measured before and after operation and by the flattening of oral glucose tolerance curves in the postoperative period. In four patients with diabetic glucose tolerance curves prior to operation the curves have flattened into the normal range during the follow-up period.

In four patients postoperative fecal nitrogen excretion has exceeded normal ranges; however, total serum proteins have been maintained in most patients in the preoperative range but there was hypoalbuminemia in four individuals.

The absorption of vitamins A and K as reflected by serum levels of vitamin A and prothrombin times has shown a trend towards reduction of vitamin A serum levels and slight prolongation of prothrombin time in the follow-up period. However, follow-up data are as yet inadequate. Despite the steatorrhea induced by the operation serum calcium, magnesium and potassium levels have remained in the normal range. Hematocrits have been maintained in the normal range except for a reduction in the early postoperative period in two patients. Data on serum vitamin B₁₂ and serum folate concentrations remain inadequate for conclusion but in the four patients who have had postoperative mea-

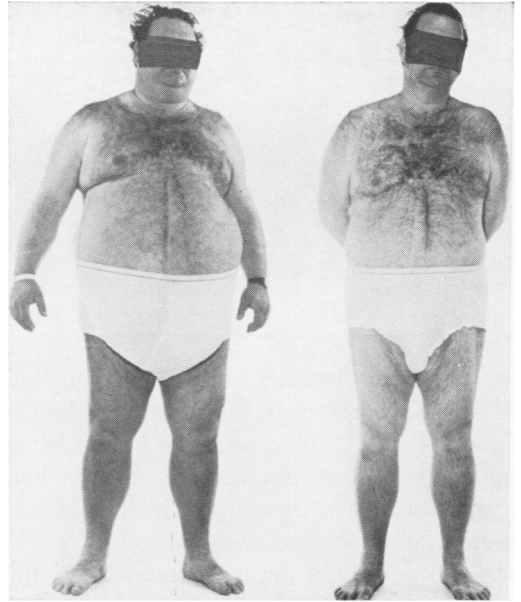


FIG. 6. Patient I. K.: before (386 lb.) and 13 months after jejunioileal bypass (250 lb.).

surements serum concentrations of these substances are normal.

Table 2 summarizes the percentage changes in body weight, lean body mass and potassium per kilogram of body weight as determined by ⁴⁰K whole body counting in 6 patients 3 to 13 months after the intestinal bypass procedure. These data suggest that the patients lose more fat than lean tissue, particularly after 6 months when they recover as far as potassium homeostasis is concerned. The number of patients is as yet too small to permit firm conclusions but similar observations in obese patients who lost weight after the Payne procedure support this interpretation.³

Upper gastrointestinal radiologic studies have been made in eight patients at intervals of 2 to 12 months after operation. Orally ingested liquid barium passed from stomach to cecum within 5 minutes in two patients, 10 minutes in two others, 15 minutes in two patients and 30 minutes in two patients. Four of the eight patients showed hypertrophic changes in the jejunum and ileum with dilatation of the

TABLE 2. *Per Cent Change in Weight, Lean Body Mass and Potassium Per Kilogram, as Determined by ^{40}K Whole Body Counting*

Patient	Time (Months)	Initial Weight (Kg.)	% Change in Wt.	Initial Lean Body Mass (Kg.)	% Change in LBM	Initial K/Kg. (mEq.)	% Change K/Kg.
R. A.	3	157.1	-18.0	93.2	-21.4	40.4	-4.0
D. B.	3	206.7	-9.3	74.5	-23.5	24.5	-15.5
L. G.	5.5	145.6	-15	68.9	-22.6	32.2	-10.9
C. T.	7	128.4	-21.9	45.7	-9.6	24.2	+16.1
M. T.	7	135.1	-23.6	54.3	-20.6	27.4	+3.6
I. K.	13	184.2	-36.1	100.8	-27.4	37.3	+13.7

lumen to a diameter of 2 to 2½ inches (Fig. 7). There was no apparent elongation of bowel in five patients, but in three individuals elongation of 1, 4 and 6 inches, respectively, was measured. In five patients there was no detectable evidence of reflux of the orally ingested barium from the colon into the bypassed ileum during observation periods of one to 2½ hours; in two others reflux of barium from colon into the bypassed ileum occurred after 30 to 40 minutes. In the single patient studied in this manner whose bypassed bowel had been drained into the sigmoid, there was very minimal reflux from the filled colon at one hour.

Comment and Summary

Our previous experience⁴ with the end-to-side jejunoileal shunt described by Payne and DeWind² in surgical treatment of morbidly obese subjects has prompted the development of the technic of intestinal bypass described in this report.

The aim of the operation is to reduce small intestinal absorptive capability and thus induce loss of excess body fat in carefully selected massively obese patients who are incapable of following dietary advice. The principle involved is to unite a very short segment of proximal jejunum to a very short segment of terminal ileum with the important "braking" effect of the ileocecal valve maintained in alimentary continuity; reflux of highly nutritional chyme into the bypassed jejunoileum is reduced by draining the latter into transverse colon or sigmoid.

Although the dimensions involved in a surgical reduction of intestinal absorptive function are uncertain, empiric experience has shown that extremely large amounts of jejunal and ileal mucosal surface areas must be taken out of contact with the huge amount of food ingested by morbidly obese patients if excess body fat is to be effectively reduced. Ingelfinger's¹ excellent review of what is known concerning regional absorption has influenced us to maintain short segments of both jejunal mucosa, ileal mucosa and the ileocecal



FIG. 7. Patient M. T.: upper gastrointestinal series 6 months after jejunoileal bypass; transit time is 30 minutes; jejunum shows hypertrophic changes.

valve mechanism in alimentary continuity in devising this operation.

Early experience with the 12 obese patients treated in this series by the procedure described indicates a satisfactory rate of weight loss in all but one individual with an associated reduction in serum lipids and a minimal problem with diarrhea. Further study of these patients over a longer period of time is obviously needed before this procedure can be recommended for wide clinical use.

DISCUSSION

DR. RICHARD L. VARCO (Minneapolis):

Dr. Scott has invited our response to this presentation, and I accept that privilege, particularly on behalf of my associate, Dr. Buchwald, who has done the vast majority of the work during the several years that we have been interested in dealing surgically with certain aspects of the problems of individuals with hyperlipidemia.

I would like to indicate that we believe the principal points in the presentation which you have just heard, relate to the erratic results achieved when the conventional jejunio-ileal "bypass" is carried out. For the unpredictability of this procedure, of course, is related to the fact that "bypass" is not taking place to the degree anticipated by the operating surgeon, due to proximal ileal loop reflux after end-to-side jejunio-ileostomy. To correct that inadequacy, an end-to-end anastomosis of the proximal bowel with the distal small bowel is essential. Indeed, we have to come to precisely these conclusions, although our research interests have followed a somewhat dissimilar path; our results have been reported at the recent meeting of the Society of University Surgeons in New Haven. Upon that occasion we referred to the fact that Dr. Scott and his associates have been doing a similar but not identical operation. Thus, we are in complete agreement with the importance of the principles they propose.

Briefly, I will trace the path that our group has taken in arriving at similar conclusions. Within the total population of the hyperlipidemics exist a number of subsets. Yet, before speaking of anyone in particular, I shall comment on the ubiquitous and grossly misleading use of so-called "normal" cholesterol values. By employing the word "normal" for these individuals who are demonstrably at very high risk, we lull many unwary minds into a totally false sense of security. Tens of thousands die annually of atherosclerosis with "normal" blood lipid values. In fact, it could be said to be "normal" to die from atherosclerosis.

There are individuals among the total group of hyperlipidemias, with elevations of their blood

References

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cholesterol values—well into the 300 mg. 100 ml. range. This subset, however, is *not* generally characterized by a tendency toward obesity. Rather more often they are the lean, dynamic type who may even have a problem in weight maintenance. For these individuals we have employed a different procedure: The distal 200 cm. or $\frac{1}{3}$ of the ileum is bypassed. Subsequently, there is no weight loss associated with this operation; these people maintain their weight very handily year after year. Associated with this procedure is, on the average, a 40% reduction in the circulating cholesterol concentration as calculated after the lower cholesterol values achieved by a carefully designed dietary management program. This cholesterol reduction is maintained year after year along with the failure to absorb an average 60% of the exogenous and endogenous cholesterol. This shortened piece of bowel also dumps unabsorbed bile salts into the colon where they are degraded to a non-absorbable form. As a result of that breakdown in the normal enterohepatic bile salt recirculation, an excess daily loss of bile salts occurs. Since bile salts can only be synthesized from cholesterol, a second and indirect drain on the body cholesterol is created.

There is another set of individuals—and this is how we have been led to the obesity group—who are both catastrophically corpulent and whose jeopardy is further enhanced by hyperlipidemia to tragically high levels. As an important aside, it is relevant to state that any change in cholesterol values is not associated with a simple arithmetic progression in the risk rate. Any increase or decrease in the cholesterol concentration is associated with an exponential alteration in the risk rate; the calculated exponent is three or more. The geometric analysis of this, I'm sure, becomes immediately apparent in terms of the awesome risk for those individuals with cholesterol values in the 300–400 mg. 100 ml. range.

For individuals grossly overweight and also hyperlipidemic we have carried out an operation which markedly reduces caloric uptake from the bowel. The proximal 40 cm. of jejunum are anastomosed to the distal 3–4 cm. of ileum. Thereafter, the percentage fat and general caloric absorption from the extremely shortened bowel is very low.