Surgical Treatment of Obesity

Intestinal bypass in the form of jejunocolic shunt as a technic to induce weight reduction in man has been reported by several authors [1-5]. The course of weight loss in these patients was complicated by intractable diarrhea, abdominal discomfort, electrolyte depletion, and liver failure. In accord with the plan adopted before our first study was undertaken in 1956, intestinal continuity was re-established when the desired weight was reached or when electrolyte disturbance required it. Weight gain to preshunt levels occurred promptly in all subjects whose intestinal continuity was restored to normal. For these reasons, this approach, jejunocolic shunt, was abandoned.

Our interest in inducing weight loss by an intestinal shunt technic continued because of the well recognized hazards of severe obesity and the ineffectiveness of all current weight reduction programs to maintain a near normal body weight after initial weight loss. We and others have tried to develop a technic which could be applied with safety and would avoid the necessity of a second operation to restore intestinal continuity with consequent serious weight gain [6,7]. Several levels for the intestinal shunt were tried with limited success. We are gratified with the present combination, which is 14 inches of jejunum and 4 inches of ileum.

Material and Methods

This paper describes our experiences with

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eighty patients with a planned intestinal shunt. There were nineteen male and sixty-one female patients. The oldest was fifty-six, the youngest twenty-one, and the average age was 34.6 years. The total weight of the eighty patients was 24,941 pounds, with an average weight of 310.7 pounds. A total of 10,373 pounds have been lost by the patients. Patients selected had uncontrollable obesity, in most instances more than 100 pounds over the norm for their height and age as determined by standard tables. Many presented with one or more of the complications often found with obesity, namely, hypertension, cardiovascular disease, cardiopulmonary disease (Pickwickian syndrome), diabetes, gout, arthritis, liver disease, peripheral edema, stasis dermatitis, menstrual disturbances, and infertility. All patients had a complete survey to detect the presence of complicating disease and to form a baseline for postoperative comparison. This preoperative survey included history and physical examination, urinalysis, complete blood count, blood sedimentation rate, electrocardiogram, chest roentgenogram, serum cholesterol, serum carotene, serum electrolytes (potassium, calcium, and phosphate), alkaline phosphatase, protein bound iodine, serum iron, blood urea nitrogen, total protein and albumin, glucose tolerance test, urinary excretion of 17-ketosteroids and 17-ketogenic steroids, and blood lipids. More recent patients had additional tests performed as part of an automated biochemical panel (total bilirubin, uric acid, lactic dehydrogenase, alkaline phosphatase, and serum glutamic oxalacetic transaminase). An attempt was made to evaluate the emotional state of the patients, especially in relation to predicting the acceptance of some inevitable postoperative discomfort and the loss of the obese state. In a few instances, a formal psychiatric examination was available. An effort was made to evaluate the motivation of each subject in submitting to this major operative procedure. We especially sought to screen out the hostile person and the one who showed extreme passive dependent tendencies. We considered a reasonably successful education, employment, and marital history as favorable factors.

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TABLE I	Surgical	Treatment	of	Obesity*
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Procedure	No. of Cases
Jejunocolic shunt	10
Jejunoileal shunt:	
20 inches of jejunum, 10 inches of ileum	1
15 inches of jejunum, 20 inches of ileum	1
15 inches of jejunum, 10 inches of ileum	1
15 inches of jejunum, 5 inches of ileum	9
14 inches of jejunum, 4 inches of ileum	58

* Payne and DeWind (1956-1968).

Surgical Procedure

Prior to surgery an intravenous cutdown was established for fluid and electrolyte administration. By this means, blood samples could be obtained and central venous pressure measured. General anesthesia was employed with an endotracheal airway using mechanical assistance. The larger patients were operated on in their beds. The patients were placed in a moderate reverse Trendelenburg position to relieve pressure on the diaphragm. A transverse incision above the umbilicus was used. At first a panniculectomy was performed; recently, however, this had been abandoned. After dividing both rectus muscles transversely, the celomic cavity was entered and explored. If accessible, a biopsy specimen was taken of the liver. Although various lengths of bowel were tried at first, in fifty-eight of our patients the jejunum was divided 14 inches from the ligament of Treitz. (Table I.) The proximal end of the bypassed jejunum was closed in two layers and fixed to the mesentery in an effort to prevent intussusception. The end of the proximal jejunum was anastomosed to the side of the ileum 4 inches from the ileocecal valve. (Fig. 1.) All measurements were made on the mesenteric border. After the intestinal bypass was accomplished, any diseased organs, such as the gallbladder, appendix, or uterus, are excised. Umbilical hernioplasty was performed when indicated. The wound was closed with continuous No. 1-0 chromic catgut in the peritoneum; the fascia was approximated with No. 1-0 Polydek[®], and the subcutaneous tissue with No. 26 wire. The wounds were irrigated with a solution containing one million units of penicillin, 1 gm. of Kantrex®, and 1 gm. of tetracycline. The wounds were drained by suction.

Patients were kept in the recovery room for a few hours and then transferred to the in-



Fig. 1. Surgical procedure.

tensive care unit, where they remained for an average of forty-eight hours. Hourly vital signs were recorded. Nasogastric suction was not used, but nothing was permitted by mouth. Nasal oxygen as well as intermittent positive pressure breathing was used when indicated. One of the largest patients had an elective tracheostomy before he left the operating room.

Results

Weight Loss. Weight loss occurred in all subjects and continued at a decreasing rate throughout the period of study. Average weight loss was 10.9 pounds per month during the first six months, 6 pounds per month during the second six months, 8.1 pounds for the first year, 4.6 pounds per month the second year, and 2.2 pounds per month the third year. After the third year the weights plateau, but loss continues if dietary intake is restricted. To the present date, no patient with 14 inches of jejunum and 4 inches of ileum has reached a weight that could be considered lower than his ideal weight. One patient (W.H.), shown in Figure 2 at the time of surgery in June 1966, weighed 538 pounds. Figure 3 shows the same patient at 190 pounds, twenty-six months later. He has maintained his weight between 185 and 190 pounds for seven months. Another patient (M.M.) with an initial weight of 592 pounds reached 206 pounds in thirty months and has maintained the weight for an additional thirty-six months. Studies on three pa-



Fig. 2. Patient (W.H.) weighing 535 pounds preoperatively.

Fig. 3. Patient (W.H.) twenty-six months postoperatively weighing 190 pounds.

tients who had stopped losing weight at the expected rate revealed reflux of intestinal content into the bypassed bowel segment. In one of these patients (E.C.) the distal end of the bypassed segment was anastomosed to the transverse colon to prevent reflux into the bypassed segment. Weight loss again resumed in a satisfactory fashion.

Laboratory Tests. Mean values and standard deviations for a number of blood indices before and after intestinal shunt surgery are presented in Table II. Significant anemia was encountered in two patients. Low serum carotene levels were uniformly seen and reflect decreased absorption of fat. Serum cholesterol levels dropped an average of 25 per cent, less of a decrease than that reported by Buchwald and Varco [8], who constructed a partial bypass in their subjects. Serious depression in serum potassium levels is accompanied by weakness and muscle cramping. Most patients are given potassium supplements and are advised to eat foods high in potassium content. We have observed no significant lowering in serum calcium.

Absorption of protein is probably adequate as reflected by normal values for serum proteins and lack of edema.

In most instances we measure serum levels of sodium, carbon dioxide, chlorides, and occasionally magnesium, but find them unchanged.

Alterations in glucose tolerance curves dur-

TABLE II Pre- and Postoperative Laboratory Studies in the Surgical Treatment of Obesitv*

	Preshunt Values		Postshunt Values	
Study	Mean	S.D.	Mean	\$.D.
Hemoglobin				
(mg. per cent) Hematocrit	14.2	1.9	13.5	0.9
(per cent)	43.5	1.5	40.4	1.4
Serum iron				
(µg./100 ml.)	77.8	35.6	75.5	36.5
Serum carotene				
(µg. per cent)	85.4	36.0	30.2	23.0
Serum cholesterol				
(mg. per cent)	227.0	32.6	169.0	40.1
Serum potassium				
(mEq./L.)	4.3	0.58	4.3	0.44
Serum calcium				
(mEq./L.)	4.9	0.35	4.7	0.41
Serum albumin				
(gm. per cent)	3.9	0.57	4.0	0.36

* Payne and DeWind (1956-1968).

ing the postoperative period may be related to decreased glucose absorption. (Fig. 4.) In no instance did we document a state of hypoglycemia. Many random blood glucose determinations were made and all were in the normal range.

Frequent determinations of blood urea nitrogen levels were made throughout the study period and all were in the normal range. In several patients, protein bound iodine levels were measured at intervals; all were in the normal range. Several patients on thyroid medication before the shunt were continued on it afterward if evidence of hypothyroidism had been established. It does not seem likely that the intestinal shunt has any significant effect on thyroid function or absorption of thyroid medication.

Output of 17-ketosteroids and 17-ketogenic steroids was normal before and after the intestinal shunt. In the absence of suggestive clinical evidence of adrenal insufficiency, these tests were not performed in the majority of subjects.

Liver Function

An attempt to evaluate liver function preoperatively was made by measuring bromsulfalein retention. At surgery, liver biopsy was performed in seventy-three patients. Only three of



Fig. 4. Representative glucose tolerance curves.

Fig. 5. Initial liver biopsy (No. B–2702–66) exhibits marked fatty metamorphosis of the liver. There is no significant fibrosis, necrosis, or hemosiderin deposition. Weight 535 pounds; original magnification \times 125.

Fig. 6. Liver biopsy (No. B–3316–68) in same patient twenty-six months later showing marked change; no demonstrable fatty metamorphosis. Weight 190 pounds; original magnification \times 125.

the grossly obese patients did not have a fatty metamorphosis of the liver to some degree. We have had occasion in four subjects to re-examine the liver at a second surgical procedure. There was increased fatty change in two, one of whom showed early portal cirrhosis. One woman, four years after intestinal bypass, showed a distinct decrease in fatty change. One man (W.H.) with a jejunoileal shunt showed complete reversal of liver disease in twenty-six months. (Fig. 5 and 6.) Those patients who demonstrated an increase in liver disease all had jejunocolic shunts. Indeed, the one patient (M.A.) who died in liver failure had a jejunocolic shunt. There have been isolated instances reported in the literature of hepatic failure and death after intestinal bypass for obesity [9]. All but one of these patients had jejunocolic shunts.

In our opinion a jejunocolic shunt should not be used for control of obesity, confirming our recommendation in 1963 [1].

Complications

Complications of the procedure in the immediate postoperative period were relatively few. A list of complications encountered is presented in Table III. All patients had successful correction except two patients with myocardial infarction, one with hepatic failure, and two with pulmonary embolus. Brief case histories of the five patients who died are presented.

A twenty-three year old girl weighed 400 pounds. Careful laboratory evaluation revealed all studies to be within normal limits except for retention of bromsulfalein dye which was 40 per cent in forty-five minutes. A jejunotransverse colostomy was formed 18 inches from the liga-

Complications	Cases	Deaths
Wound:		
Seroma	2	
Necrosis	2	
Hernia	3	
Infection	1	
Bowel obstruction	1	
Intussusception	2	
Electrolyte imbalance	4	
Mental confusion		
(alcohol and/or narcotic		
intake)	2	
Myocardial infarction	2	2
Pulmonary embolism	2	2
Hepatic failure	1	1
Gastric ulcer-hemorrhage	1	-

TABLE III	Complications after Surgical
	Treatment of Obesity*

* Payne and DeWind (1956-1968).

ment of Treitz. Postoperative course in the hospital was uneventful. She failed to return for observation. It was reported to us by the County Coroner that she had died in hepatic coma.

Our largest patient, a man weighing 635 pounds, was hypertensive and had a life-long history of obesity. The patient died suddenly on the ninth postoperative day. Necropsy revealed severe coronary arteriosclerosis with recent thrombotic occlusion of the anterior descending coronary artery and focal myocardial fibrosis.

A thirty-nine year old man had been overweight since the age of nine. Examination prior to surgery revealed a blood pressure of 160/130 mm. Hg, diabetic glucose tolerance curve and an electrocardiogram indicating first degree atrioventricular block, anterolateral ischemia, and old posterior infarction. A jejunoileal shunt was performed without complication. Seven days postoperatively, he died suddenly. Necropsy revealed marked atherosclerosis of the aorta and coronary arteries. Myocardial alteration of the interventricular septum, compatible with early myocardial infarct, was found. Focal fibrosis of the lateral wall of the left ventricle was consistent with old myocardial injury.

A forty-seven year old woman weighed 393 pounds. Preoperative examination was remarkable only for the presence of a large abdominal pannus and brawny edema of the lower extremities. The surgical procedure was standard and postoperative recovery was uneventful. She died suddenly four days after hospital discharge (fifteen days postoperatively), with sudden epigastric pain. No postmortem examination was performed. Death presumably was due to either pulmonary embolism or myocardial infarction.

A twenty year old woman who weighed 323 pounds underwent a jejunocolic shunt on June 25, 1957. Postoperative course was uneventful until December 23, 1957, when she suddenly died. Necropsy report revealed pulmonary embolism. The origin of the emboli was pelvic phlebothrombosis.

Comments

A major benefit expected from the surgical approach to obesity that we have presented (jejunoileal shunt) is permanent reduction in body weight. It has not been necessary to restore intestinal continuity for the purpose of preventing intractable weight loss. Control of diabetes from obesity, relief of hypertension, dyspnea, and edema have accompanied the weight loss. Correction of menstrual abnormalities and resumption of fertility in women have been noted. Persons who have been incapacitated from carrying on a gainful occupation have been able to resume work. Reduction of serum cholesterol and serum carotene levels must be considered beneficial in the light of current knowledge. Alteration in glucose tolerance curves probably indicates decreased glucose absorption. (Fig. 4) Not enough insulindependent diabetic patients have been studied to determine whether the severe form of diabetes is ameliorated. We have recorded that elevated blood glucose levels are reduced to normal by the jejunoileal shunt. The relationship of hyperglycemia to atherosclerosis and other degenerative disorders is arousing increasing clinical and research interest.

The majority of our patients are happy with the results. Fortunately we have been able to maintain contact with all but a very few. Obviously the very obese person undergoing a surgical procedure is exposed to increased operative risk. The deaths in our series have been related to acute episodes such as coronary occlusion, pulmonary embolism, and liver failure. Problems with the gastrointestinal tract were for the most part annoyances, and the patients have learned to live with them. Bloat, flatulence, and diarrhea can be controlled with adjustment of dietary intake and medication. Problems arising in the bypassed segment of intestine have been limited to two instances of intussusception. Reflux of intestinal contents into the ileum from the distal

anastomotic site is a possible cause for failure to achieve the desired weight loss in a few patients. It appears evident that very little small bowel is necessary for adequate absorption of essential nutrients and fluid. It has been our observation that ingestion of narcotics and alcohol is not well tolerated by these patients and may be accompanied by psychotic behavior. Effects on the liver are difficult to evaluate. In the obese person there appears to be some impairment of liver function as measured by standard tests. The presence of fat in the liver is probably not deleterious. The possible development of Laennec's cirrhosis must be considered, and for this reason, patients with a shunt must be instructed to eat regularly and to avoid alcohol intake. It is our opinion that liver damage is more likely to increase with a jejunocolic shunt than with a jejunoileal shunt.

Significant anemia has been encountered in only two patients. Depletion of iron stores and stores of vitamin B_{12} may be encountered, however, with time. Certainly one may expect suboptimal absorption of iron, folic acid, and vitamin B_{12} . These deficiencies may be compensated for if they are anticipated.

We have four patients with ureteral calculi. The relationship to the intestinal bypass is uncertain in view of a prior history of renal calculi in one patient. The twenty-four hour excretion of calcium was low in several patients. Gout may accompany hyperuricemia which is occasionally encountered postoperatively.

A number of unsolved problems remain in relation to the long-range effects of this procedure. In addition to effects on the liver, it is conceivable that long-range diminished calcium absorption may result in osteomalacia. Depletion of body stores of magnesium and potassium may have long-range effects on the kidney. To date, the status of the mucous membrane and other structures in the wall of the bypassed segment of jejunum after a long period of observation remains unchanged. Longrange effects on the personality of patients with a shunt is being assessed. It is doubtful, however, that they will represent as much a hazard to the patient as will the continued state of obesity.

Summary

Our opinion of the present state of jejunoileal shunt in the treatment of obesity may be summarized as follows: (1) A jejunoileal shunt

is of distinct benefit in selected patients for whom the obese state has become a hazard to health. (2) It is not the procedure one does because an obese patient is 25 to 50 pounds overweight. (3) Inasmuch as a high degree of cooperation is essential, a relationship of mutual respect, trust, and responsibility must be present between the physician and patient. A hostile attitude on the part of the patient cannot be tolerated. (4) Although long-range benefits from the control of factors leading to aggravation of cardiovascular disorders may be expected, it may be dangerous to subject patients with well established cardiovascular disease to this procedure. (5) A jejunocolic shunt should not be used for control of obesity. (6) A jejunoileal shunt should definitely be considered as an investigative procedure, for the present, and should not be undertaken unless facilities are available to handle complications and to conduct significant research into the mechanism of obesity and its attendant complications over a long period of time.

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Discussion

JACK M. FARRIS (Los Angeles, Calif.): Five years ago, when this same subject was being discussed, I suggested that perhaps the same goal could be achieved by simply wiring people's teeth together, as if they had a fractured jaw. I must retract this approach, however, because I have now discovered that to eliminate 100 pounds of excess fat, the energy content of which is about 400,000 calories, would take from six months to one year with complete fasting. Consequently, the man Dr. Payne discussed, who lost 380 pounds, would have to have had his teeth wired together for approximately four years to achieve the same result.

It is amazing to me that although the jejunocolic fistula really has no place in the treatment of obcsity as far as most people are concerned, since it is incompatible with health and vigor, it is still being used in a great number of centers. It is obvious that the dissemination of medical information is slow since many are still performing an operation which has been obsolete on the West Coast for several years.

This surgical treatment of obesity has achieved a respectable place in the armamentarium of a responsible and thoughtful surgeon such as Dr. Payne. Obesity clinics offering near ideal medical, psychiatric, dietetic, and social support achieve results that are no more than fair. Relapse is the rule, and there is a wide gap between effort expended and results achieved.

I would like to discuss one patient operated on at The Good Samaritan Hospital in September 1968. This unmarried woman weighed 310 pounds. A shunt of 14 inches of jejunum and 4 inches of ileum was performed, employing Dr. Payne's precepts. At operation the uterus was found to be enlarged, the exact nature of which was not clear. Despite this, the shunt was carried out. About two weeks ago, she came into my office with her new baby boy. She had lost 67 pounds and had gone through labor uneventfully in the presence of the jejunoileal shunt.

J. ENGELBERT DUNPHY (San Francisco, Calif.): I have been very skeptical of this operation, and certainly I think the old ileocolic shunt did create very serious problems. I was prejudiced from what Dr. Turnbull had told me about them.

Dr. Goldman has performed this operation two or three times and Dr. Tom Hunt in our Department is now running a small series with this 14and-4 operation. I am very impressed that this is an important and sound contribution to the care of these patients provided the criteria emphasized by Dr. Payne are observed. It is another contribution from the West Coast that will gradually drift eastward, like vagotomy and pyloroplasty for bleeding ulcer.

PRESIDENT BREWER (Los Angeles, Calif.): In closing Dr. Payne, would you tell us how long you keep the shunt, when you take it down, if ever, and what happens to these patients after the shunt has been changed.

J. HOWARD PAYNE (closing): In answer to Dr. Brewer's question, we do not plan to take the shunt down; we hope it will be a permanent arrangement. In one patient normal intestinal continuity was returned because of degenerating liver function. To date, reconstitution has not been carried out because of excessive weight loss.

In closing, 1 should like to emphasize the following points. We definitely do not recommend a jejunocolic shunt but do recommend the jejunoileal shunt. The operation must be reserved for the hyperobese patient. Also, it should only be performed in an institution where there are facilities for long range follow-up study.

After twelve years of study, we are pleased with the procedure as described. However, we will continue to study and refine this approach to this method of treating obesity.