

A Comparative Evaluation of Changes in Weight After Partial Gastrectomy and After Vagotomy with Gastro-enterostomy *

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NUMEROUS REPORTS indicate that loss of weight occurs in an appreciable number of patients after gastric operations. For example, Ivy, Grossman, and Bachrach¹ collected 864 cases from the literature in which weights before and after subtotal gastrectomy for peptic ulcer were compared. In 42 per cent of these patients the postoperative weight at the time of follow up was less than the normal preoperative weight.

To obtain additional information concerning the incidence and severity of loss of weight after gastric operations, a comparative follow up study has been made of 318 patients subjected to partial gastrectomy (Billroth II type) and 118 patients subjected to vagotomy with gastroenterostomy for peptic ulcer at the Hines Veterans Administration Hospital and the University of Illinois Research and Educational Hospital during the period 1946-1954.

COMPARATIVE CHANGES IN WEIGHT AFTER PARTIAL GASTRECTOMY AND VAGOTOMY WITH GASTRO-ENTEROSTOMY

In a patient with peptic ulcer it would not seem proper to consider weight at the time of operation as the patient's usual or standard weight to which the preoperative weight may frequently bear little or no relation. For example, the preoperative weight is likely to be abnormally low in a patient with pyloric obstruction and ab-

normally high in a patient on a rigid dietary regimen of milk and cream, etc. A more rational value for purposes of post-operative comparison would appear to us to be the patient's average weight in health as known by the patient himself.

In this study, weights at the time of follow up (one to eight years after operation) were compared with average healthy weights before operation (Table 1). 71.2

TABLE 1. *Changes in Weight After Gastric Operations (Comparison with Average Healthy Weight)*

	Vagotomy with Gastro- enterostomy (No. of Patients)	Partial Gastrectomy (No. of Patients)
Total No. of Patients	118	318
Gain in Weight	18 (15.3%)	38 (12.0%)
No Change in Weight	16 (13.6%)	19 (6.0%)
Loss of Weight	84 (71.2%)	261 (82.1%)
10 Lbs. or More Loss	55 (46.6%)	167 (52.5%)
20 Lbs. or More Loss	23 (19.5%)	92 (28.9%)
30 Lbs. or More Loss	12 (10.2%)	42 (13.2%)

per cent of 118 patients subjected to vagotomy with gastro-enterostomy were found to be below their preoperative average healthy weight at the time of follow up with an average loss of 16 pounds as compared to 82.1 per cent of 318 patients subjected to partial gastrectomy with an average loss of 18 pounds. 15.3 per cent of the patients with vagotomy and gastro-enterostomy and 12.0 per cent of those with partial gastrectomy were above their preoperative average healthy weight at the time

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TABLE 2. *Correlation of Estimated Extent of Gastric Resection with Postoperative Weight (Comparison with Average Healthy Weight)*

Estimated Extent of Gastric Resection	Total No. of Patients	Postop. Loss of Weight (No. of Patients)	10 Lbs. or More Loss of Weight (No. of Patients)	20 Lbs. or More Loss of Weight (No. of Patients)	30 Lbs. or More Loss of Weight (No. of Patients)
$\frac{1}{2}$ - $\frac{3}{8}$	55	40 (72.2%)	27 (49.1%)	9 (16.4%)	6 (10.9%)
$\frac{3}{8}$ - $\frac{3}{4}$	88	70 (79.5%)	40 (45.5%)	23 (26.1%)	11 (12.5%)
$\frac{3}{4}$ or more	69	62 (89.9%)	51 (73.9%)	27 (39.1%)	13 (18.8%)
?	106	89 (84.0%)	59 (55.7%)	33 (31.1%)	12 (11.3%)

of follow up with an average gain of 14 pounds and 12 pounds respectively. 13.6 per cent of patients with vagotomy and gastro-enterostomy and 6.0 per cent with partial gastrectomy showed no weight change.

Since many losses in weight were of only a few pounds, the two series were also analyzed with respect to the percentage of patients 10 pounds or more below average preoperative healthy weight at the time of follow up. One hundred sixty-seven of 318 patients after partial gastrectomy (52.5 per cent) and 55 of 118 patients after vagotomy with gastro-enterostomy (46.6 per cent) were 10 pounds or more below average preoperative healthy weight at the time of follow up. Likewise 92 of 318 patients after partial gastrectomy (28.9 per cent) and 23 of 118 patients after vagotomy and gastro-enterostomy (19.5 per cent) were 20 pounds or more below average preoperative healthy weight at the time of follow up. Forty-two of the patients after partial gastrectomy (13.2 per cent) and 12 patients after gastro-enterostomy and vagotomy (10.2 per cent) were 30 pounds or more below preoperative average healthy weight. The maximal losses in weight recorded in patients subjected to partial gastrectomy were 80, 65, 65, 46, and 44 pounds as compared with maximal losses of 84, 50, 48, 46 and 38 pounds in patients subjected to gastro-enterostomy and vagotomy. Thus, although loss of weight tended to be more

frequent and more severe after partial gastrectomy, the difference in the percentage of patients who lost an appreciable amount of weight after partial gastrectomy and after vagotomy with gastro-enterostomy was not great.

CORRELATION OF ESTIMATED EXTENT OF GASTRIC RESECTION WITH POSTOPERATIVE WEIGHT STATUS

In Table 2 the estimated extent of gastric resection (as stated in the surgeon's operative record) is correlated with the status of postoperative weight (comparison with average healthy weight) in the 318 patients subjected to partial gastrectomy. In those instances in which the surgeon did not specifically estimate the magnitude of the resection, no attempt was made by the authors to do so from the surgeon's description of the operative procedure. These data confirm the frequently expressed clinical impression that the incidence and severity of loss of weight increase directly with the extensiveness of the gastric resection. (Since, in the great majority of instances, the surgeon's estimate of the extent of resection was a subjective impression without confirmation by objective measurements, it must be recognized that these figures may include gross errors. The studies of Harkins and Moore^{5,6} have clearly established the value of objective measurements to estimate more accurately the magnitude of gastric resection.)

TABLE 3. *Standard ("Ideal" or "Desirable") Weights for Men Ages 25 Years and More*

Height (inches)	10% Below "Ideal" Weight (lbs.)	"Ideal" Weight (lbs.)	10% Above "Ideal" Weight (lbs.)
62	116	129	142
63	119	132	145
64	122	136	150
65	126	140	154
66	129	143	157
67	133	148	163
68	136	151	166
69	139	155	171
70	144	160	176
71	148	164	180
72	152	169	186
73	157	174	191
74	162	180	198
75	166	185	204

TABLE 4. *Standard ("Ideal" or "Desirable") Weights for Women Ages 25 Years and More*

Height (inches)	10% Below "Ideal" Weight (lbs.)	"Ideal" Weight (lbs.)	10% Above "Ideal" Weight (lbs.)
60	105	117	129
61	107	119	131
62	111	123	134
63	113	126	139
64	116	129	142
65	119	132	145
66	123	137	151
67	126	140	154
68	130	144	158
69	133	148	163
70	136	151	166
71	139	154	169
72	142	158	174

THE CONCEPT OF "IDEAL" OR "DESIRABLE" WEIGHT

Tables of weights compiled by life insurance companies provide information with respect to standard weight for individuals of a given height and sex. Although these values are commonly called "ideal" or "desirable" weights they are in reality only average weights and probably not completely true averages since, as Keys and his associates³ have pointed out in their classical studies of human starvation, there is a large variation about these levels in the general population and the distribution of weights in samples of the American population tend to be skewed toward the higher values; i.e. in the direction of obesity. (For example, in one sample of non-starved individuals cited by Keys et al, 11 per cent of the population sample deviated below the mean value by 15 per cent or more of the standard weight.) Thus, an individual above standard weight for his height and sex is probably overweight, but a similar individual below this standard weight may not necessarily be undernourished. Likewise, as Keys² has succinctly stated in discussing the concept of "ideal"

weight, "it is assumed implicitly that the average connotes the best; this is a nice democratic arrangement but scarcely scientific."

Moreover, although an effort has been made in some statistical tables of insurance companies to consider body frame (small, medium, large) in determining standard weights, there are actually no quantitative criteria for classifying body frames.^{2, 3, 4} Thus, such classification of body frames would appear to be dependent upon the subjective impression of the examiner and hence susceptible to a high degree of error. In order to remove this subjective factor and thus obviate a probable source of appreciable error in this study, we have modified a current table of weights of an insurance company^{9, 10} by averaging for each height the minimum "desirable" weight of an individual of so-called small frame and the maximum "desirable" weight of an individual of so-called large frame to obtain a standard ("ideal," "desirable") value for each height. In obtaining these values we are aware of the statistical pitfalls of averaging mean values but suggest that the errors of such a pro-

cedure (particularly in large population samples) would be considerably less than those inherent in classification into groups with poorly defined boundaries. The standard (so-called "ideal" or "desirable") weights thus obtained for men or women at age 25 or more are tabulated in Tables 3 and 4. (According to publications by insurance companies progressive increases of weight with age (above age 25) are undesirable for health and longevity.^{9, 10} Thus standard weights are currently expressed at only one age level.)

COMPARATIVE WEIGHT STATUS AFTER PARTIAL
GASTRECTOMY AND VAGOTOMY WITH
GASTRO-ENTEROSTOMY WITH REF-
ERENCE TO "IDEAL" WEIGHT

One hundred eighty-six of 318 patients (58.5 per cent) subjected to partial gastrectomy were below "ideal" weight (as previously defined) at the time of follow up as compared with 67 of 118 patients (56.6 per cent) subjected to vagotomy with gastro-enterostomy. Thus, there was no significant difference in the percentage of patients below "ideal" weight after partial gastrectomy and after vagotomy with gastro-enterostomy.

Because many patients were below "ideal" weight by only a few pounds, the two series were also analyzed with respect to the number of patients 10 per cent or more below "ideal" weight at the time of follow up. (Keys and his associates have stated that most individuals can tolerate 5 to 10 per cent losses of weight with relatively little functional disorganization.) One hundred five of 318 patients (33.0 per cent) subjected to partial gastrectomy and 32 of 118 patients (27.1 per cent) subjected to vagotomy with gastro-enterostomy were 10 per cent or more below "ideal" weight at the time of postoperative study. Again, only a small difference was noted between the two series.

CORRELATION OF PREOPERATIVE WEIGHT
STATUS AND POSTOPERATIVE WEIGHT
STATUS WITH REFERENCE TO
"IDEAL" WEIGHT

In Table 5 preoperative weight status and postoperative weight status after vagotomy with gastro-enterostomy and after partial gastrectomy are correlated with reference to "ideal" weight. Preoperatively the patients have been separated according to the classification suggested by Zollinger and associates;^{7, 8} i.e. Group 1 patients were at "ideal" weight or above at the time of operation, Group 2 patients had attained "ideal" weight in the past but were below "ideal" weight preoperatively, and Group 3 patients had never attained "ideal" weight in adult life.

26.2 per cent (11 of 31) of the patients who were at or above "ideal" weight at the time of operation (Group 1) and subjected to vagotomy with gastro-enterostomy were below "ideal" weight at the time of follow up. Of the Group 1 patients subjected to partial gastrectomy 8.1 per cent (2 of 24) were below "ideal" weight after one-half to two-thirds resection, 15.8 per cent (6 of 38) were below "ideal" weight after two-thirds to three-fourths resection, 50 per cent (10 of 20) were below "ideal" weight after three-fourths or more resection and 26.3 per cent (10 of 38) were below "ideal" weight after resection of unestimated extent.

Superficial inspection of this data might suggest, that there is an appreciable difference in the incidence of Group 1 patients who attain "ideal" weight after vagotomy with gastro-enterostomy and after extensive, three-fourths or more, partial gastrectomy. However, it must be noted that a relatively small number of cases is involved and that subjective measurement of the extent of gastric resection may be susceptible to gross error. Thus, if the two-thirds to three-fourths resection cases and three-fourths or more resection cases are considered as one group, 27.6 per cent (16

TABLE 5. Correlation of Preoperative Weight Status and Postoperative Weight Status (Comparison with "Ideal" Weight)

Preoperative Weight Classification	Total No. of Patients	"Ideal" Weight or Above (No. of Patients)	Below "Ideal" Weight (No. of Patients)	10% or More Below "Ideal" Weight (No. of Patients)
Vagotomy with Gastroenterostomy				
Group I	42	31 (73.8%)	11 (26.2%)	3 (7.1%)
Group II	36	16 (44.4%)	20 (55.6%)	5 (13.9%)
Group III	40	1 (2.5%)	39 (97.5%)	24 (60.0%)
$\frac{1}{2}$ to $\frac{2}{3}$ Estimated Gastric Resection				
Group I	24	22 (91.9%)	2 (8.1%)	0
Group II	18	11 (61.1%)	7 (38.9%)	4 (22.2%)
Group III	13	1 (7.7%)	12 (92.3%)	7 (53.9%)
$\frac{2}{3}$ to $\frac{3}{4}$ Estimated Gastric Resection				
Group I	38	32 (84.2%)	6 (15.8%)	0
Group II	23	6 (26.1%)	17 (73.9%)	9 (39.1%)
Group III	27	1 (3.7%)	26 (96.3%)	21 (77.7%)
$\frac{3}{4}$ or More Estimated Gastric Resection				
Group I	20	10 (50.0%)	10 (50.0%)	1 (5.0%)
Group II	27	8 (29.6%)	19 (70.4%)	8 (29.6%)
Group III	22	0	22 (100.0%)	15 (68.2%)
? Estimated Gastric Resection				
Group I	38	28 (73.7%)	10 (26.3%)	3 (7.9%)
Group II	31	12 (38.7%)	19 (61.3%)	7 (22.6%)
Group III	37	1 (2.7%)	36 (97.3%)	30 (81.1%)

of 58) were below "ideal" weight at the time of follow up as compared with 26.2 per cent (11 of 42) after vagotomy with gastro-enterostomy.

7.1 per cent (3 of 42) of Group 1 patients subjected to vagotomy with gastro-enterostomy were 10 per cent or more below "ideal" weight at the time of study. None of the Group 1 patients in this study were 10 per cent or more below "ideal" weight after one-half to two-thirds resection or two-thirds to three-fourths resection. 5.0 per cent (1 of 20) of Group 1 patients were 10 per cent or more below "ideal" weight after estimated three-fourths or more resection while 7.9 per cent (3 of 38) were 10 per cent or more below "ideal" weight after resection of unestimated extent.

From the above data we are unable to conclude that in patients preoperatively

classified as Group 1 (at or above "ideal" weight) there is any significant difference in the percentage of patients below "ideal" weight after vagotomy with gastro-enterostomy or after extensive partial gastrectomy at the time of follow up.

55.6 per cent (20 of 36) of the patients who had attained "ideal" weight in the past, but were less than "ideal" weight preoperatively (Group 2) and subjected to vagotomy with gastro-enterostomy, were below "ideal" weight at the time of follow up. Of the Group 2 patients subjected to partial gastrectomy 38.9 per cent (7 of 18) were below "ideal" weight after one-half to two-thirds resection, 73.9 per cent (17 of 23) were below "ideal" weight after two-thirds to three-fourths resection. 70.4 per cent (19 of 27) were below "ideal" weight after three-fourths or more resection, and

61.3 per cent (19 of 31) were below "ideal" weight after resection of unestimated extent.

13.9 per cent (5 of 36) of Group 2 patients subjected to vagotomy with gastro-enterostomy were 10 per cent or more below "ideal" weight at the time of study. 22.2 per cent (4 of 18) of Group 2 patients were 10 per cent or more below "ideal" weight after one-half to two-thirds resection as compared with 39.1 per cent (9 of 23) after two-thirds to three-fourths resection, 29.6 per cent (8 of 27) after three-fourths or more resection and 22.6 per cent (7 of 31) after resection of unestimated extent.

Although the number of cases in some categories was small, there appeared to be a somewhat greater tendency for patients who preoperatively were below "ideal" weight although at "ideal" weight sometime during their lives to remain below "ideal" weight after partial gastrectomy than after vagotomy with gastro-enterostomy. Likewise, the percentage of patients in this group who were 10 per cent or more below "ideal" weight at the time of follow up was approximately one and a half to three times greater after extensive partial gastrectomy than after vagotomy with gastro-enterostomy. Thus, the conclusion of Zollinger and associates that the percentage of Group 2 patients who attained "ideal" weight postoperatively was greater after vagotomy with gastro-enterostomy than after extensive partial gastrectomy was confirmed in this study.

97.5 per cent of patients who had never attained "ideal" weight in adult life (Group 3) and were subjected to vagotomy with gastro-enterostomy were below "ideal" weight at the time of follow up. Of the Group 3 patients subjected to partial gastrectomy 92.3 per cent (12 of 13) were below "ideal" weight after one-half to two-thirds resection, 96.3 per cent (26 of 27) were below "ideal" weight after two-thirds to three-fourths resection, 100 per cent (22

of 22) were below "ideal" weight after three-fourths or more resection and 97.3 per cent (36 of 37) were below "ideal" weight after resection of unestimated extent.

60 per cent (24 of 40) of Group 3 patients subjected to vagotomy with gastro-enterostomy were 10 per cent or more below "ideal" weight at the time of study. 53.9 per cent (7 of 13) of Group 3 patients were 10 per cent or more below "ideal" weight after one-half to two-thirds resection as compared with 77.7 per cent (21 of 27) after two-thirds to three-fourths resection, 68.2 per cent (15 of 22) after three-fourths or more resection and 81.1 per cent (30 of 37) after resection of unestimated extent.

TABLE 6. *Postoperative Change in Weight from Usual Healthy Weight (Group 3 Patients)*

	Vagotomy with Gastro- enterostomy (No. of Patients)	Partial Gastrectomy (No. of Patients)
	39	96
Gain in Weight (pounds)		
1-5	4 (10.3%)	6 (6.2%)
6-10	0	3 (3.1%)
11-20	2 (5.1%)	0
No Weight Change	6 (15.4%)	9 (9.4%)
Loss of Weight (pounds)		
1-5	10 (25.6%)	7 (7.3%)
6-10	6 (15.4%)	16 (16.7%)
11-20	9 (23.1%)	35 (36.5%)
21-30	2 (5.1%)	9 (9.4%)
31+	0	11 (11.5%)

The date of this study accordingly confirms the observation of Zollinger and associates that few Group 3 patients attain "ideal" weight after either partial gastrectomy or vagotomy with gastro-enterostomy. However, since it might seem unreasonable to expect weight status to be better after a gastric operation than during previous healthy life, the Group 3 patients were also analyzed with respect to postoperative variation in weight from usual healthy weight. These data are summarized in Table 6. 30.8 per cent of these patients after

vagotomy with gastro-enterostomy and 18.7 per cent after partial gastrectomy had gained weight or had no change from usual healthy weight at the time of follow up. Decrease from usual healthy weight occurred in 69.2 per cent after vagotomy with gastro-enterostomy and in 81.4 per cent after partial gastrectomy. In 5.1 per cent of Group 3 patients after vagotomy with gastro-enterostomy and 20.9 per cent after partial gastrectomy losses of 21 pounds or more from usual healthy weight had occurred at the time of follow up. Thus, loss of weight (from the usual healthy weight) tended to occur with greater frequency and severity in Group 3 patients after partial gastrectomy than after vagotomy with gastro-enterostomy.

Although there was an overall tendency for less weight to be lost in patients of groups 2 and 3 after vagotomy with gastro-enterostomy than after partial gastrectomy, the percentage differences in our series (which sometimes were based on small numbers of patients) do not appear to be sufficiently great to give preference to the utilization of vagotomy and gastro-enterostomy over adequate partial gastrectomy on the basis of better nutritional status.

SUMMARY

1. A comparative nutritional follow up study has been made of 318 patients subjected to partial gastrectomy (Billroth II type) and 118 patients subjected to vagotomy with gastro-enterostomy at the Hines Veterans Administration Hospital and the University of Illinois Research and Educational Hospital during the period 1946-1954.

2. Although loss of weight (comparison with average healthy weight) tended to occur more frequently and more severely after partial gastrectomy, the differences in the percentage of patients who lost an appreciable amount of weight after partial gastrectomy and after vagotomy with gastro-enterostomy were not great.

3. The data confirm the frequently expressed clinical impression that the incidence and severity of loss of weight increase directly with the extensiveness of the gastric resection.

4. No significant difference was noted in the percentage of patients below "ideal" weight after partial gastrectomy and after vagotomy with gastro-enterostomy.

5. Patients who preoperatively were below "ideal" weight tended to have less deficit in weight after vagotomy with gastro-enterostomy than after partial gastrectomy. In our opinion, the percentage differences noted in our series are insufficient to advocate the use of vagotomy and gastro-enterostomy in preference to adequate partial gastrectomy on the basis of better nutritional status.

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