



Gastric Operations and Vagotomy: *

Study of Results

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THE RECENT renewed interest in operations other than conventional gastric resection for peptic ulcer, many of which include vagotomy, has prompted study of the results of surgical treatment of those patients at the Lahey Clinic who have had vagotomy, either alone or combined with other procedures, in the surgical management of this disease. It must be emphasized that criteria for success or failure of surgical treatment of peptic ulcer are based not alone upon the development of recurrent ulcer but upon many factors brought out in this study and enumerated in this paper.

Material and Methods

Dragstedt and Owens,³ in 1943, revived interest in bilateral vagotomy and emphasized in continued reported observations the effect and value of this procedure as an adjunct in surgical treatment of peptic ulcer. Since the initial interest in this method, various gastric drainage procedures combined with vagotomy have been suggested and reported by many with reports, pro and con, of the value of vagotomy. More recently most reports have centered upon the efficacy of vagotomy plus removal of the antrum or hemiresection.

Inasmuch as surgeons at Lahey Clinic have, to a large measure, relied upon con-

ventional gastric resection for peptic ulcer, because of our excellent results with this type of operation, and have performed only relatively few vagotomies, we thought that a careful, accurate, follow up report of the actual results of our experience with vagotomy might serve a useful purpose.

The series to be reviewed includes all those patients who underwent bilateral vagotomy over a period of 14 years, from 1945 through 1958. During this same period an average of 140 patients each year had conventional partial resection for duodenal or jejunal ulcer without concomitant vagotomy. A total of 207 patients constitutes the material used in this study, 184 men and 23 women. The average age of all patients was 50 years, the men averaging 55 years, the women 45. One hundred and twenty-five were operated on over five years ago (five to 14 years); in 82 the postoperative period was five years or less.

Only those patients who had vagotomy for benign peptic ulcer of the duodenum or jejunum have been included in this series. All patients who underwent vagotomy in association with resection of the esophagus or stomach for carcinoma, or resection of the esophagus for the complications of esophagitis, have been excluded from analysis.

All data have been collected through review of patients' clinical records, careful interviews and examinations, and recently by means of a detailed follow up questionnaire sent to all patients.

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Results

Of the total of 207 patients with vagotomy, a group of 187 patients contributed data to this study; four patients died postoperatively and accurate data are not obtainable in 16. Thus, we have been able to study fairly accurately the postoperative results in 90 per cent of our patients. Eighty-seven patients had previously had operations for ulcer (Table 1), and 120 had no surgical treatment before vagotomy. Of this group of 87 patients, 13 had been operated on at the Lahey Clinic, 69 had been operated on elsewhere and five had had more than one operation either at the clinic or in some other hospital.

Symptoms before vagotomy are recorded in Table 2. Pain alone occurred in the majority of the patients, while pain and bleeding were second in frequency, followed by pain and obstruction.

The preoperative weight of the patients has been noted when this information was available. Based on weight tables of the Metropolitan Life Insurance Company, 114 were within normal limits, 45 were under-

weight, 22 overweight and in 26 patients the preoperative weight was not recorded.

The results of gastric analyses before operation are listed in Table 3. Only one patient had a Hollander insulin test before operation and the results were positive.

The types of operation performed on these patients at the clinic are recorded in Table 4. Transthoracic vagotomy was performed in ten cases, while 197 patients had the infradiaphragmatic operation. Gastric analyses after vagotomy are recorded in Table 5.

Hollander insulin tests were performed when possible during follow-up visits after

TABLE 2. *Symptoms before Vagotomy (207 Patients)*

Symptoms	No. Patients
Pain	71
Bleeding	26
Pain and bleeding	53
Obstruction	2
Pain and obstruction	36
Pain, bleeding and obstruction	13
Other	6

TABLE 1. *Previous Ulcer Operation before Vagotomy at Lahey Clinic*

Operation	No. Patients
Closure of perforated ulcer	19
Gastroenterostomy	16*
Gastric resection	35
Closure of perforation and gastroenterostomy	4**
Gastric resection and vagotomy	1
Gastric resection and suture of bleeding vessel	1
Other (excluding pyloroplasty, resection of antrum, hemigastrectomy, wedge and sleeve resection, vagotomy)	11
Total	87

* Twelve had later gastric resection at Lahey Clinic.

** Two had later gastric resection at Lahey Clinic.

TABLE 3. *Preoperative Gastric Analysis (207 Patients)*

Free Acid Levels (Normal 10-35 Units)		Total Acid Levels (Normal 20-50 Units)	
High	73	High	78
Normal	65	Normal	56
Low	11	Low	15
No test	58	No test	58

TABLE 4. *Operation Performed with Vagotomy (207 Patients)*

Operation	No. Patients
Gastroenterostomy	65
Gastric resection	111
Resection of antrum	5
Vagotomy only	19
Hemigastrectomy	1
Other	6

TABLE 5. *Gastric Analysis after Vagotomy*
(203 Patients*)

Free Acid Levels (Normal 10-35 Units)		Total Acid Levels (Normal 20-50 Units)	
High	10	High	16
Normal	56	Normal	44
Low	28	Low	36
Not recorded	109	Not recorded	107

* Four postoperative deaths in 207 cases.

operation. The results are noted in Table 6. Following operation, work activity and maintenance of normal weight are important criteria in evaluating the results of operation. Most of the patients have returned to their original work, 128 (68% of 187 who had follow up studies) continuing in their preoperative occupations. Of the remainder of this series of 207 patients, 11 are engaged in lighter work, one described his employment as heavier, ten (5.3%) are unable to return to their usual occupation, 43 have retired due to causes unrelated to operation, four died and in ten patients the type of employment is not known.

Of the 187 patients who had accurate follow up studies, 112 (60%) have regained and maintained normal weight, 23 (12%) are overweight, 38 (20%) are underweight and in 14 the postoperative weight is not known. Thus, 72 per cent of the 187 patients have maintained normal weight or increased their weight after operation.

In the group of 203 patients who survived operation, persistence of an ulcer type of pain was noted before meals by two patients, after meals by three patients, both before and after meals by six patients, and in nine cases no data were recorded; 183 patients (94 % of the 194 patients who recorded pain, or 90% of the 203 patients who survived operation) have no pain. Other forms of abdominal distress were noted constantly by two patients, fre-

quently by 19, occasionally by 17, never by 155 (76%) and distress was not recorded in ten cases.

One hundred and fourteen patients enjoy a better appetite than before operation, in 64 the situation is unchanged, three patients record worsening of appetite and in 22 patients such information is not recorded. Sixty-three patients follow a diet regularly, 108 do not, seven follow a diet occasionally, and in 25 the routine diet is unknown.

Medication of some type for continued digestive distress is taken regularly by 25 patients, occasionally by 11 and none is required by 145 patients; in 22 cases no information is available.

Ninety patients continue to smoke, while 82 do not; alcoholic beverages are consumed in variable amounts by 116 patients, and 49 patients abstain from its use. Frequent or occasional episodes of abnormal fullness after meals were reported by 90 of 178 patients who replied to this question. Frequent stools and diarrhea have not been troublesome features in this series; only 18 of 169 patients who replied to this question have three or more bowel movements a day.

One hundred and forty-eight (79%) of 187 patients stated that they felt entirely well, while 39 did not. One hundred and seventy-three (92.5%) were satisfied with the results and 14 were not. Only ten patients have required further operation for ulcer.

TABLE 6. *Results of Hollander Insulin*
Test after Vagotomy
(203 Patients)

Results	No. Patients
Positive	20
Negative	42
No test	137
Negative, later positive	3
Positive, later negative	1

Four patients died after operation, an operative mortality of 1.93 per cent (of a total of 207 patients). A total of 35 patients have died since operation. In only five (2.41%) can death be attributed to causes related to operation. One patient died of pneumonitis, evisceration, bowel obstruction and thrombophlebitis after the fourth operation for ulcer. Another death was caused by fulminating pancreatitis after gastric resection and vagotomy. One patient died of uremia, empyema of the left side of the chest, bronchopneumonia and hemorrhagic tracheobronchitis after gastroenterostomy and vagotomy for duodenal ulcer. This patient had a history of bleeding. A fourth patient with chronic pyelonephritis and Laennec's cirrhosis died as a result of hypotensive shock and central nervous system damage after gastric resection and vagotomy for bleeding. The fifth death occurred four years after vagotomy and gastroenterostomy for bleeding duodenal ulcer; the cause of death was bleeding gastric ulcer.

Analysis of Results

The most important consideration in this study is the incidence of recurrent ulceration. Recurrence is presumed or proved to have developed in 25 of the 187 patients who had follow up studies, an incidence of 13.4 per cent, while in 162, or 86.6 per cent, no recurrent ulcer has resulted. The diagnosis of recurrence was based on presumptive clinical evidence in 15 of the 25 patients. A radiological diagnosis was made in one patient and in nine patients a recurrent ulcer was demonstrated at subsequent operation. Nineteen of the 25 patients with presumptive or proved recurrent ulceration had hematemesis, melena, or both, as manifestations of recurrence, an incidence of bleeding after vagotomy of 10 per cent (187 patients).

In the gastroenterostomy and vagotomy group of 65 patients, evidence of recur-

rence has developed in 16 or 24.6 per cent. Bleeding occurred in 12 of this group after operation.

In the series of 111 cases of gastric resections with vagotomy, recurrent ulceration has been demonstrated in six, an incidence of 5.4 per cent. All these patients had bleeding as a manifestation of recurrent disease. Of the 19 patients who had vagotomy alone, a recurrent ulcer has developed in three. In one of this group bleeding was evidence of return of the ulcer.

Manifestations of the dumping syndrome were present in seven patients in this series, in three after gastroenterostomy and vagotomy, in two after gastric resection and vagotomy and in two after vagotomy alone. This incidence is decidedly lower than in comparable series recorded in the literature.

Stringent criteria were used in evaluating the results of the operative procedures in 203 cases. Sixty-four patients (31.5%) have obtained an excellent result. These patients had no symptoms, were of optimal weight and were pursuing their usual occupations. A result classified as good occurred in 64 patients as well (31.5%). These patients occasionally had slight disturbances in motility, indicated by vomiting, diarrhea or fullness, but had no symptoms suggestive of recurrent ulcer. Fifty-three patients had an unsatisfactory result; four of this group died soon after operation. The remainder complained of frequent episodes of vomiting and fullness, recurrent pain or bleeding, diarrhea, symptoms or signs of the dumping syndrome, recurrent ulcer, inability to work, or failure to maintain an optimal weight with a weight loss over ten pounds. The result was classified as undecided in 26 patients; one of these patients died before an adequate evaluation could be made, and the remainder were lost to follow up.

Although the figures based on an estimate of result leave much to be desired,

TABLE 7. *Correlation of Insulin Test after Operation with Estimated Result (203 Patients)*

Insulin Test		Estimate of Result			
		Excellent	Good	Unsatisfactory	Undecided
Positive	20	9	3	7	1
Negative	42	7	21	11	3
No test	137	47	38	30	22
Negative, later positive	3	1	1	1	0
Positive, later negative	1	0	1	0	0

perhaps more significant figures are those obtained from answers to the questions, "Do you feel entirely well?" and "Are you satisfied with your operation?" To the former question, 145 of 187 patients (77.5%) replied in the affirmative, while 39 patients (21%) stated that they did not feel entirely well. Many of these appended to the questionnaire the fact that diseases unrelated to the original ulcer were present. A total of 173 of the 187 patients (92.5%) were satisfied with the results of operation. Only eight patients (4.3%) considered the results of operation unsatisfactory. The remaining patients in both groups unaccounted for include those lost to follow up and a few who did not commit themselves as to their state of health and their satisfaction with the operation.

An attempt has been made to correlate the estimate of result obtained with insulin test data after vagotomy (Table 7). The individual test groups are too small to be statistically valid, but the absolute figures reveal that 12 of 20, (60%) with a positive Hollander test had an excellent or good result from operation, while in seven (35%) the result was unsatisfactory; 28 of 42 patients (67%) with a negative test were considered to have a favorable result, while 11 (26%) did not. Where no test was performed, 62 per cent, or 85 cases, were classified in the excellent or good group, while in 30 patients, (22%) the results of operation were clinically unsatisfactory.

Table 8 reveals the data obtained when the different types of operation performed were compared with the results after surgical treatment. In the gastroenterostomy and vagotomy group, 58.5 per cent of the 65 patients obtained an excellent or good result, while in 30.8 per cent the results were unsatisfactory. Gastric resection and vagotomy on 111 patients produced 74 excellent or good results (66.6%). In 24 patients (21.6%) the result was unsatisfactory. Resection of the antrum and vagotomy, "other" operations plus vagotomy, and hemigastrectomy and vagotomy groups were too small for evaluation. From vagotomy alone, 52.7 per cent of patients gained a satisfactory result, while in 42.1 per cent the results were unsatisfactory.

Discussion

Until the precise etiologic factors in the genesis of peptic ulcer are established with certainty, the choice of surgical procedure to be performed in the treatment of this disease will remain a matter of the individual surgeon's preference and experience. A careful assessment of the individual case is necessary for it is essential to the patient's well-being that the operation to be performed be suited to the peculiarities of the disease as it occurs in a particular patient. Thus, age, sex, stature, acid levels, general health, location and status of the ulcer, the complications of the disease requiring operation, the find-

ings at operation, and the presence of primary or recurrent ulceration, all must be considered in determining the choice of procedure.

From the physiologic viewpoint, the addition of vagotomy to the surgeon's armamentarium is to be commended. The elimination of the cephalic phase of gastric secretion achieved by complete vagal denervation of the stomach should add greatly to the possibility of cure of the disease. When vagotomy is combined with conventional subtotal gastric resection, which removes the hormonal phase of secretion provided by the antrum, as well as much of the acid and pepsin-producing glands, recurrent ulcer theoretically should never occur. Such a result, unfortunately, is not obtained for recurrent disease does develop in some cases after these apparently complete operations.

It is difficult to compare the figures given by many authors since standard criteria and terminology have not been established for the evaluation of the degree of success or failure. Thus, the terms excellent, good, satisfactory, unsatisfactory, fair, poor, dubious, failure and recurrence all appear in analyses of the results obtained with vagotomy alone or combined with other gastric procedures. Even the criteria adopted to indicate recurrence of the ulcer differ, for not all surgeons con-

sider hemorrhage as an indication of recurrent disease. In this series, however, recurrent bleeding has been incontrovertible evidence of the presence of a recurrent ulcer. Moreover, the small number of some series reported in the surgical literature limits the validity of the percentage listed by the authors as indicating the incidence of good or poor results.

It is of value to review some of the results of vagotomy reported in the literature, starting with the employment of vagotomy alone and the gradual adoption of gastroenterostomy. Then, when reports of surgical failure appeared, other gastric drainage procedures were utilized until, finally, hemiresection or antral resection with vagotomy came into more general use, with increasing numbers of good surgical results reported. None of these procedures have completely controlled all cases of complicated ulcer, however, and the operative mortality of most procedures is similar, as is the occurrence of an appreciable number of recurrent ulcers. Problems of dumping, postprandial discomfort, failure to regain and maintain weight, and occasional hemorrhages continue to plague the surgeon. It may be possible and perhaps is highly probable that, with the elapse of time following these operations, surgical failures will continue to be encountered and with increasing numbers of

TABLE 8. *Surgical Procedure with Vagotomy and Results (207 Patients)*

Procedure, Totals	Estimate of Result								
	Excellent		Good		Unsatisfactory*		Undecided		
	No.	%	No.	%	No.	%	No.	%	
Gastroenterostomy	65	27	41.5	11	16.9	20	30.8	7	10.8
Gastric resection	111	31	27.9	43	38.7	24	21.6	13	11.6
Resection of antrum	5	0	0	1	20.0	1	20.0	3	60.0
Other	6	1	16.7	3	50.0	0	0	2	33.3
None	19	4	21.0	6	31.6	8	42.1	1	5.3
Hemigastrectomy	1	1	100.0	0	0	0	0	0	0

* Four operative deaths.

years, a higher percentage of recurrent ulcers will be reported. Certainly, definite progress has been made in the surgical treatment of the complicated peptic ulcer.

Certain data may be reviewed from the work of others. Brooks and Moore,¹ in 1953, surveying the results after ten years, considered 67 per cent of their 82 patients with duodenal ulcers cured by trans-thoracic vagotomy alone; the incidence of recurrent ulcer in their cases was 13 per cent. Of a total of 36 patients treated by vagotomy and posterior gastroenterostomy, 75 per cent were cured; recurrent ulceration developed in 14 per cent. They also include a small series of 14 patients who had vagotomy later for marginal ulcer after subtotal gastrectomy; of these, another recurrence developed in one (7%). The authors noted, furthermore, that after five years acid levels were higher, more of their patients had positive insulin tests and gastric motility returned, while uropepsin levels remained low, indicating perhaps a greater effect of vagotomy on pepsin secretion. They concluded that vagotomy alone has no place in the treatment of uncomplicated intractable duodenal ulcer.

Better results after vagotomy were reported by Crile² in 1952. Of 140 patients whose course was followed two to five years, 90 per cent were free of symptoms; evidence of recurrent ulceration developed in only 5 per cent.

Hoerr,⁴ in 1955, reviewed 145 patients who had follow up studies for five years after subdiaphragmatic vagotomy and posterior gastroenterostomy for chronic duodenal ulcer. An excellent or good result was obtained in 81.4 per cent, while recurrent ulcer developed in 8 per cent and postoperative hemorrhage in 4 per cent. Using the criterion of hemorrhage as indication of recurrence, we would consider that this complication developed in 12 per cent. Hoerr has stated that his total failure rate of 15 per cent relegates the operation

to a lesser position in the treatment of duodenal ulcer, but that the procedure is indicated in the debilitated elderly patient or in technically difficult cases. Lower mortality and lesser incidence of annoying side effects make it worthy of further use.

Oberhelman and Dragstedt,⁵ in 1955, reported a 12-per cent incidence of recurrent ulcer after vagotomy for duodenal ulcer; the total incidence of poor results was 31 per cent. Marginal ulceration developed after vagotomy and gastroenterostomy in only 5.8 per cent of these cases, while 90 per cent enjoyed a good or fair result. They stressed the importance of placing the gastroenterostomy stoma in the antrum to prevent gastric stasis with increased humoral secretion.

Similar figures were reported by Pollard⁶ and his colleagues in 1952. Vagotomy alone resulted in an incidence of recurrent ulceration of 18.2 per cent, while ulceration again developed in 47 per cent of patients who had had vagotomy and gastroenterostomy. An analysis of 53 cases of subtotal gastric resection alone revealed a 9.4-per cent incidence of marginal ulceration.

Pollock,⁷ in 1952, reviewed 1,524 patients with peptic ulceration treated with vagotomy. Vagotomy alone was performed in 736 cases, with unsatisfactory results in 44 per cent. In 73 patients with gastric ulcer, recurrence was noted in 18 per cent. Of 74 patients with jejunal ulcer treated by vagotomy alone recurrence was noted in 16 per cent, while in 589 patients with duodenal ulcer, recurrent ulceration developed in 6.0 per cent. In 788 patients vagotomy was combined with a drainage operation. Of this group, a proved recurrence developed in 1.0 per cent; 7.0 per cent had symptoms suggesting recurrence; and results were unsatisfactory in 12 per cent. Of the total number who had a combined procedure, 507 patients had vagotomy with gastrojejunostomy; an ulcer type of pain persisted in 8.0 per cent, proved recurrent ulceration occurred in

1.0 per cent, and 12 per cent of this group were classed as having unsatisfactory results. Vagotomy with pyloroplasty or pylorotomy was performed in 266 cases, with an ulcer type of pain postoperatively in 6.0 per cent, proved recurrence in 2.0 per cent and unsatisfactory results in 13 per cent. Only 37 patients had vagotomy with limited partial gastrectomy, but in this group there were no instances of recurrent ulceration, and the results were considered unsatisfactory in 14 per cent.

The place of vagotomy in the treatment of gastrojejunal ulceration was considered by Walters *et al.*,¹¹ in 1955, in a follow up study of 301 cases. Of this group, 115 cases of recurrent ulcer had occurred after gastric resection, and 186 cases after gastroenterostomy. The authors concluded that vagotomy is the treatment of choice after gastric resection, with 70 per cent of patients obtaining excellent results; gastric resection is the preferred operative method of management after gastroenterostomy, providing excellent results in 86.5 per cent, while only 77.8 per cent derived this benefit from vagotomy alone. Furthermore, they found a greater incidence of achlorhydria after resection than after vagotomy.

In 1957, Walters and Mobley¹⁰ reported a five- to ten-year follow up study of 162 patients with duodenal ulcer treated by vagotomy alone or with associated gastric operations. Twenty-eight patients underwent vagotomy alone, with an incidence of recurrence of 25 per cent. Vagotomy and gastroenterostomy were performed in 123 patients with recurrence of ulcer in 13 per cent. Vagotomy and pyloroplasty were performed in seven patients with no recurrences, while four patients had vagotomy and resection without recurrence. It is interesting that in this series 89 per cent of all patients were men; recurrent disease developed in four (22%) of the 18 women and in 19 (13%) of the 144 men.

In 1958, a combination of hemigastrec-

tomy and vagotomy was advocated as the procedure of choice in the management of duodenal ulcer. Smithwick⁹ and others reported a decreased incidence of immediate postoperative complications and fewer undesirable physiologic sequelae after this operation when compared with subtotal gastrectomy. Of significance are the figures for the incidence of weight loss, postoperative pain, dumping symptoms and recurrent ulceration. In all incidences, the results after hemigastrectomy and vagotomy are better than after gastric resection.

In 1960, Scott *et al.*⁸ reported on 765 patients who had undergone vagotomy and antral resection during a 13-year period. The operation consisted of vagotomy accompanied by a 35 to 55 per cent distal gastrectomy. There were 21 hospital deaths, a mortality rate of 2.7 per cent. The follow up in their group varied from less than one year to 13 years. Only 156 patients (20.4%) had follow up studies for six or more years after operation. The follow up period was less than five years in 514 patients (67.2%). They reported an excellent or good result after operation in 90 per cent.

Summary and Conclusions

Vagotomy is a useful adjunct in the surgical management of peptic ulcer, but adequate subtotal gastrectomy with removal of all antral mucosa and most of the acid-producing portion of the stomach should continue to be employed for many patients with duodenal ulcer, in particular those with long-standing, adherent, complicated ulcer. For such problems the patient who has had previous gastric surgery with failure to control the disease (many of whom were included in this series of 207 patients), the addition of vagotomy to adequate gastrectomy may well prove beneficial.

An analysis of results of operation for peptic ulcer requires more accurate definition of terminology and the adoption of

standard nomenclature in order to be more amenable to critical evaluation. It is difficult to draw conclusions regarding any type of operation for duodenal ulcer unless a long period of observation (at least seven years) follows operation.

Our own results with conventional partial resection (70%) for duodenal ulcer have been so uniformly good that we are loath to abandon this operation completely and substitute hemiresection and vagotomy. Has this operation stood the test of time or do we need a longer period to evaluate accurately the postoperative results?

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DISCUSSION

DR. J. WILLIAM HINTON: Dr. Marshall has given me the privilege of reading his paper. After having read it twice, I found something that makes me feel personally very much happier. That is his recurrent rate in gastroenterostomy with vagotomy of 24.5 per cent.

I had the privilege, in 1928, of starting a clinic at Bellevue Hospital to study the indications for operating on patients with ulcers and the end results, with the definite understanding by my chief that it wasn't a corral for operative patients.

We soon found that by following gastroenterostomies for a sufficient time the recurrent rate jumped every year, as Dr. Marshall has stated, and after 4½ years, in some 66 patients, we had a recurrent rate of 16.5 per cent. When we followed those patients for 7.1 years, 106

patients in all, we had a recurrent rate of 24.5 per cent. That is the same length of time that Dr. Marshall has followed his gastroenterostomies with vagotomy, and he has the exact recurrence rate.

To me, I cannot see where the vagotomy has prevented the recurrent rate, and I am sure, as Dr. Marshall has emphasized, if those patients were followed for 15 years, our recurrent rate would be in excess of Dr. Richard Lewishon's report in 1925, of 34 per cent gastrojejunal ulcers after gastroenterostomy. I am not talking against vagotomy, except that my results have not been improved by the procedure.

In 1945 to 1948, I ran a series of 62 subtotal resections without vagotomy and 68 in another series with a complimentary vagotomy. Incidentally, I am referring only to duodenal ulcers. In the first series our dumping syndromes in sub-