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SUBTOTAL GASTRECTOMY FOR GASTRIC ULCER: A STUDY OF END RESULTS*

HENRY K. RANSOM, M.D.

ANN ARBOR, MICH.

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF MICHIGAN MEDICAL SCHOOL,
ANN ARBOR, MICHIGAN

GASTRIC ULCER differs in a number of respects from duodenal ulcer, a lesion with which it is often discussed and even confused under the common term peptic ulcer. Gastric ulcer is characterized by certain features which are lacking in duodenal ulcer and which exert an important influence upon the management of the disease. These several peculiarities may be summarized briefly as follows: (1) the existence of ulcer, its exact location, size and other characteristics can be demonstrated by roentgenologic examinations and/or gastroscopy in a high percentage of cases; (2) the response to treatment may be very accurately followed and recorded by these same methods; (3) it is often closely mimicked by primary ulcerating carcinoma; (4) carcinomatous degeneration may occur as a late complication of an originally benign chronic gastric ulcer; (5) surgical intervention is required in a larger percentage of cases than in the case of duodenal ulcer; (6) practically all surgical procedures, including the simpler ones, will substantially reduce the gastric acidity; (7) the clinical results of operative treatment are better than in duodenal ulcer and (8) anastomotic ulcer is a rare complication following gastroenteric anastomoses for gastric ulcer.

While during recent years the mortality of all gastric operations and particularly that of resection has steadily declined until it has reached a reasonably satisfactory level, the differentiation of benign ulcers, malignant ulcers and ulcerating carcinomas, remains a vexing clinical problem and one which is far from a satisfactory solution at the present^{1, 2} time. These difficulties in accurate differential diagnosis have prompted certain authors, notably Allen and Lahey³ to take the position that gastric ulcer, unlike duodenal ulcer, is primarily a surgical problem and that, except in certain unusual circumstances, surgical treatment should be advised once the diagnosis is made. They believe that by such a plan fewer lives will be lost from operative deaths than will be the case when gastric cancers are treated medically under a mistaken diagnosis. Other writers, outstanding among whom is Heuer^{4, 5} question the propriety of

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such a radical attitude and especially with regard to gastric resection. The objections usually raised are: (1) an operative mortality that is still appreciable; (2) the unsatisfactory clinical results with or without recurrent ulceration which are seen in the occasional patient, and (3) the late nutritional disturbances which are observed in some cases after subtotal gastrectomy.

In order to formulate a working policy in regard to this matter for our own use in the future, we have endeavored to answer some of these questions on the basis of our own past experience. The present studies, therefore, represent an attempt to: (1) ascertain the risk involved in operation and to some degree the incidence of malignant growth; (2) make a critical analysis of clinical end results as far as the ulcer problem is concerned, and (3) discover the incidence and severity of certain side-effects of the operation, such as post-resection symptoms, nutritional disturbances, blood disorders, etc.

CLINICAL MATERIAL

During the 20 years that have passed since the University Hospital received its first patient in late 1925, 1356 patients with gastric ulcer have been observed and treated on the medical and surgical services. Of this number, 246 patients or 18.9 per cent required surgical intervention. The incidence of surgical treatment during the last 3 years of this study (1943, 1944 and 1945) was just over 30 per cent. Twenty of these 246 patients exhibited acute perforations of a gastric ulcer and required emergency surgical therapy. Since, in such cases, the problem is unique and about it there is no difference of opinion, these 20 cases will not be considered further. Elective surgical procedures were performed in 226 cases. The yearly incidence of all gastric ulcers, as well as of those treated surgically by year, is outlined in Figure 1. This graph also illustrates an experience which has been common in all surgical clinics, *i.e.*, the decline in popularity of the more conservative operations such as gastroenterostomy and knife or cautery excision of the ulcer either singly or in combination, in favor of the more radical procedure of gastric resection. The latter procedure has, here as elsewhere, become the operation of choice in the treatment of gastric ulcer during these past 20 years when 188 partial, subtotal or total gastrectomies have been performed. Whether this procedure, while admittedly giving satisfactory results as far as cure of the ulcer is concerned, will remain the best one for the lesion under discussion, may be questioned by some in view of the dramatic results now being reported from vagal interruption for both gastric and duodenal ulceration. Certainly it is true that additional experience with this newer procedure will be required and a longer time interval for further observations will be necessary before a final evaluation can be made. In view of the ever-present danger of potential or existent carcinoma in ulcers proximal to the pyloric valve, it seems likely that subtotal gastrectomy will continue to hold an important position in the surgical field for the treatment of lesions in this location. In the meantime, it is well from time to time to assess the value of and consider the true worth of this operation in view of the evidence which has now accumulated. For that reason an intensive follow-up

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survey of cases treated by gastrectomy during the past 20 years has been undertaken in order to consider the late end results. Some patients have been followed for as long as 20 years and a considerable number have been followed from the time of operation to their death from whatever cause many years later. Thus an overall survey is possible and certain more or less final conclusions can be drawn.

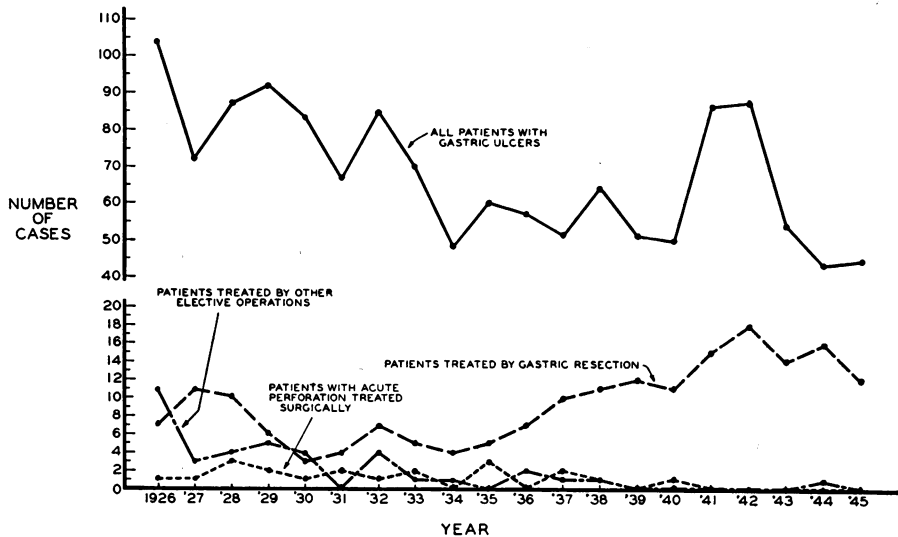


FIG. 1.—Graph showing yearly incidence of all gastric ulcers and those treated surgically. Surgical treatment was carried out in 18.9 per cent of the entire group (including acute perforations) and in 30.5 per cent (all elective operations) during the last three years.

DISTRIBUTION OF MALIGNANT GASTRIC ULCERS (19 CASES)

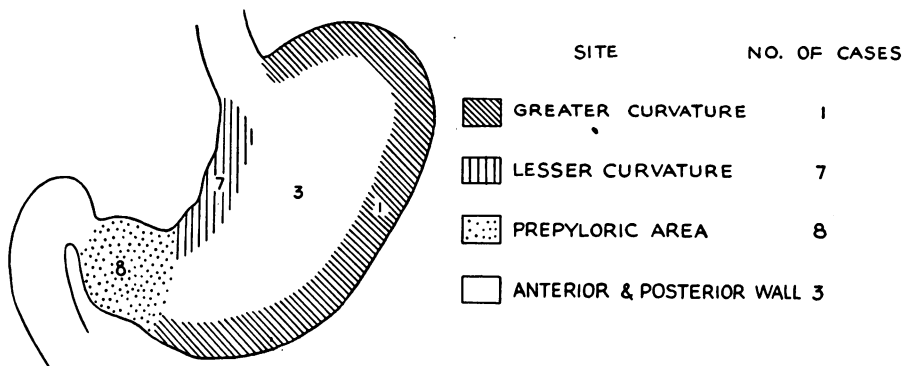


FIG. 2.—Diagram showing location of 19 "malignant ulcers."

The group of 188 patients under consideration consisted of 154 men and 34 women whose ages range from 29 to 74 years, the average age being 52.3 years. In all cases, with the exception of one, in which a palliative gastrectomy^{6, 7} was performed, the ulcer was removed at operation and subsequently

investigated by histologic study. While in many cases the preoperative diagnosis was that of possible malignancy, in all cases at operation it was the opinion of the operator that he was dealing with a benign lesion, as no unusual features which led him to suspect malignancy were noted in either the lesion itself or the regional lymph nodes. Accordingly the usual type of ulcer resection was carried out without resorting to wide removal of omenta or lymph node bearing areas. Moreover gross examination of the surgical specimen in no case revealed conclusive evidence of malignancy. In the last analysis, however, as the result of microscopical studies, 19 patients or 10.1 per cent were found to have malignant disease superimposed upon an old chronic ulcer. The

DISTRIBUTION OF BENIGN GASTRIC ULCERS (169 CASES)

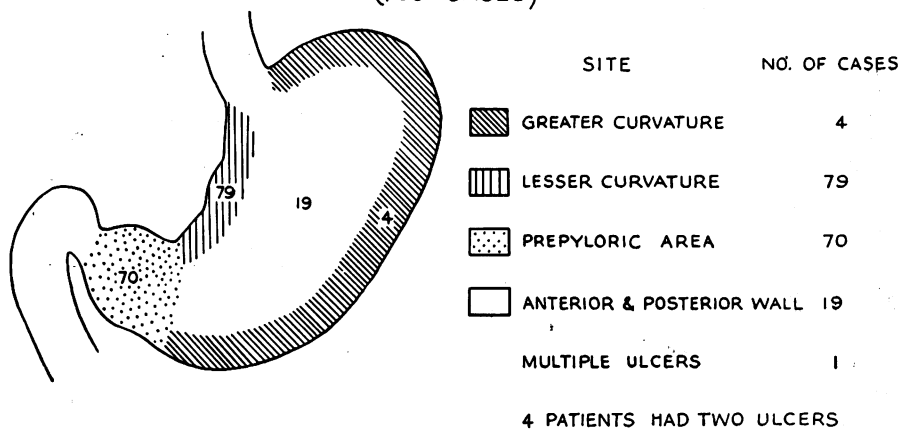


FIG. 3.—Diagram showing location of 169 benign gastric ulcers.

location of these malignant ulcers is shown in Figure 1. In all of the remaining 168 cases, the diagnosis of a benign ulcer was confirmed by the pathologist. The location of the benign ulcers is shown in Figure 2. Four patients had two independent and coexistent gastric ulcers, while in one case there were multiple ulcers of the stomach and duodenum. In 31 of the 188 cases an associated duodenal ulcer, either active or healed, was also present as noted at the time of operation. In every case, however, this lesion was of secondary importance and the behavior of the gastric ulcer governed the treatment of the patient.

INDICATIONS FOR OPERATION

During the 20-year period under discussion a conservative attitude in treatment has been shared by members of both the medical and surgical departments as far as peptic ulcer is concerned and relatively few patients have been advised to have surgical therapy unless there was convincing proof as the result of a fair trial of thorough medical treatment that no other measures would suffice. In Table I the original indications for surgical intervention in these

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TABLE I
GASTRIC RESECTION FOR GASTRIC ULCER
INDICATIONS FOR SURGERY

Chief Indication	No. of Cases	Per Cent
Intractable to Conservative Treatment	69	36.7
Probable Carcinoma.....	56	29.8
Obstruction.....	41	21.8
Penetrating ulcer.....	10	5.3
Hemorrhage.....	9	4.8
? Perforation.....	3	1.6
Total.....	188	100.0

188 cases are summarized. Although frequently there were several factors which combined to indicate surgery, for the sake of simplicity the most important one has been selected for this tabulation. While in practically all cases the possibility of malignancy was present in 56 cases or 29.8 per cent a clinical diagnosis of probable carcinoma was made on the basis of all of the data available. This diagnosis was entertained in view of the age of the patient, the short clinical history, achlorhydria, roentgen studies and gastroscopy, considered either singly or in combination. In five instances large ulcers on the greater curvature of the stomach strongly suggested a malignant lesion and in others the prepyloric location increased the likelihood of malignancy since Holmes and Hampton⁸ have found 65 per cent of prepyloric ulcerating lesions to be malignant. The largest group, *i.e.*, 69 patients or 36.7 per cent, were proven beyond peradventure of a doubt to have lesions quite intractable to conservative measures. These ulcers failed to heal or to remain healed or as not infrequently happened actually increased in size while a strict medical regimen was in progress. They were, therefore, necessarily regarded as malignant ulcerations or calloused benign ulcers which could not be closed by conservative measures and accordingly surgery was in order. Persistent obstruction failing to yield to conservative means was largely responsible for the necessity of surgical intervention in 41 patients or 21.8 per cent of the group. Repeated bouts of alarming hemorrhage required surgical therapy in 9 cases or 4.8 per cent and in a considerable number of other patients bleeding was an important item in the clinical history. There were no instances in this series of emergency surgery for acute massive hemorrhage. In three cases operation was performed during an episode of acute abdominal symptoms which strongly suggested an acute perforation. An incorrect diagnosis was proven at laparotomy, at which time, however, resection was performed. In ten cases the fact that roentgenograms showed evidence of a deeply penetrating ulcer constituted the indication for surgery. In summary, it may be said that in almost every case in which operation was performed malignancy could not be positively excluded and, if for no other reason, the operation was justified on the assumption that that particular lesion was a possible or probable carcinoma.

A summary of the status of the medical program, prior to operation, is given in Table II. It will be observed that exactly one-half of these cases

TABLE II
GASTRIC RESECTION FOR GASTRIC ULCER
STATUS OF MEDICAL TREATMENT

Character of Treatment	No. of Cases	Per Cent
Adequate or intensive. In hospital.....	95	50.5
None.....	53	28.2
Brief.....	29	15.4
None. Much elsewhere.....	11	5.9
Total.....	188	100.0

received an intensive course of medical management in the hospital before being advised to accept surgical treatment. In all of these cases the evidence was convincing that further attempts at conservative therapy would be useless. Eleven patients or 5.9 per cent were referred by their home physicians for surgery. They had all received good medical management by their physicians before coming to the hospital and for them any further attempt at medical treatment was thought superfluous. Because of the strong presumptive evidence of malignant disease, surgical treatment was carried out at once in 53 cases or 28.2 per cent. Twenty-nine patients or 15.4 per cent were given a trial of conservative treatment but when because of persistent obstruction, continued bleeding or constant pain it became apparent such treatment would not succeed, surgery was undertaken at an early date.

TYPE OF OPERATION

In Table III the several types of operation which were performed in the 188 cases are listed. During the past decade our preference has been for the

TABLE III
TYPE OF OPERATION—188 CASES

Operation	No. of Cases
Polya	
Antecolic.....	3
Retrocolic.....	44
Hoffmeister	
Antecolic.....	15
Retrocolic.....	113
Finsterer.....	6
Finsterer (?).....	2
Finsterer-Bancroft.....	1
Palliative gastrectomy.....	1
Total gastrectomy.....	3

Hoffmeister type of reconstruction with a retrocolic anastomosis if and when technically feasible. Partial closure of the cut end of the gastric pouch has seemed to reduce the incidence of malfunctioning stomas during the early post-operative period and to avoid too rapid emptying of the stomach later. The removal of practically all of the lesser curvature, a desideratum in the treatment of peptic ulcer, especially when duodenal ulcer is present, is likewise facilitated. In the first decade from 1926 to 1936 the posterior Polya reconstruction was the procedure most often employed.

Total gastrectomy was performed in three cases in all of which the ulcer was situated high on the lesser curvature or on the posterior wall and had proven quite intractable under most intensive medical treatment. The radical complete gastrectomy was elected at the time of laparotomy in the belief that the lesion must be malignant, whereas subsequent microscopic studies in all three cases revealed it to be benign. With the mortality of total gastrectomy still relatively high and with the higher incidence of post-resection symptoms, it is questionable whether total gastrectomy should often be performed for benign ulcer. In the future, for such lesions, we would suggest excision of the ulcer in order to have tissue for microscopical examination, in combination with vagotomy and with or without a complementary gastric drainage operation. A second alternative is the transthoracic resection of the upper portion of the stomach as suggested by Sweet.⁹

Palliative gastrectomy as recommended by Colp was performed in only one case. This patient had a large gastric ulcer high on the lesser curvature and also an old duodenal ulcer which made the dissection of the upper portion of the duodenum a tedious and time-consuming task. In order to avoid the risk of an exceptionally high sub-total or even total resection, the ulcer containing segment of the duodenum and the lower two-thirds of the stomach were resected leaving the gastric ulcer *in situ*.

Finsterer's¹⁰ resection for exclusion as usually performed for very active duodenal ulcers has been followed by a high incidence of stomal ulcer in the experience of practically all surgeons and has now generally been discarded. Six such Finsterer procedures were noted in this series. All of these operations were performed in the early years when the importance of elimination of all of the antral mucous membrane was not fully appreciated. In all cases the gastric ulcer was removed, but this procedure was elected when inflammation about the pylorus would have made a dissection beyond it dangerous and the closure of the duodenal stump difficult and uncertain. It would seem from a perusal of the operative notes in two additional cases that the lower transection was just proximal to the pylorus and that the operation which was performed was probably a form of the Finsterer exclusion operation. Presumably this prepyloric transection was used in order to expedite the operation in that particular case. In one instance in which the Finsterer type of resection was intentionally performed, the mucosa of the antral segment was carefully dissected out and removed as suggested by Bancroft.¹¹

OPERATIVE MORTALITY AND POSTOPERATIVE COMPLICATIONS

There were 15 operative deaths in the aforementioned 188 resections—a mortality of 7.9 per cent. The causes of death are listed in Table IV. In gastrectomy as in all other operations of similar magnitude, the mortality has decreased steadily during recent years. Better preoperative and postoperative care as well as the better methods of anesthesia now available, have been responsible for increased experience with the operation and standardization of the technic. It will be noted that pneumonia was the largest single contributor

TABLE IV

GASTRIC RESECTION FOR GASTRIC ULCER—188 CASES
Operative Deaths—15 Mortality—7.9 Per Cent

Cause of Death	Cases With	
	Autopsy—8	Cases Without Autopsy—7
Pneumonia.....	3	1
General peritonitis—leak at gastro-enteric anastomosis.....	3	
Pancreatic fat necrosis.....	1	
Volvulus of afferent limb of jejunum. Peritonitis.....	1	
Wound disruption.....		1
Uremia.....		2
Shock.....		2
Acute vascular accident (pulmonary embolism or coronary thrombosis).....		1

to the operative mortality, as four patients or over one-quarter of the group died from that complication. With the advent of chemotherapy and the antibiotic agents, this menace to success has been substantially reduced. The three deaths due to general peritonitis, all of which were the result of a leaking suture line, of course represent surgical errors, whereas the case of pancreatic fat necrosis and the one of volvulus of the jejunum are examples of surgical accidents possibly unavoidable but nevertheless regrettable. The volvulus of the jejunum occurred in a total gastrectomy in the proximal limb used for the anastomosis in a reconstruction after the method of Roscoe Graham.¹² Two cases are listed as dying of uremia. Since autopsies were not performed it is possible that peritonitis was primary with secondary renal suppression. In one of these cases a nephrectomy had been performed previously and here renal insufficiency is more probable. Likewise, in the two patients recorded as dying of surgical shock, autopsies were not permitted. Both patients died a few hours after return from the operating room and, since there was nothing unusual about their particular lesions and no complications had arisen during the operative procedure, they perhaps may be best classified as anesthetic deaths.

In making a final appraisal of the end results of gastric resection in the treatment of ulcer, not only must the clinical results over a number of years be considered but also the primary operative mortality. Our overall mortality rate of 7.9 per cent seems high at the present time and as such would serve as an indictment against the procedure. However, it must be borne in mind that most of these deaths occurred prior to 1936 and that the mortality has been greatly reduced in recent years. Many personal series composed of private patients would show a considerably lower death rate.

Table V gives the non-fatal postoperative complications, 64 such complications having been observed among 53 patients. It will be noted that major or minor wound sepsis constituted the largest group. These wound infections ranged from stitch abscesses to three cases of disruption in which a secondary operation for closure was required. It will be noted by referring to Table IV that in one case wound disruption was responsible for a fatal outcome, thus forcibly emphasizing the fact that disruption remains a serious complication

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and carries a high death rate. Pulmonary complications occurred with disturbing frequency as there were 13 cases of bronchopneumonia, 8 of atelectasis and 1 of lung abscess. The latter lesion was post-pneumonic in origin. In recent years pulmonary complications have been reduced in frequency and severity by virtue of chemotherapy, early ambulation, better management of abdominal distention, improved anesthesia, tracheo-bronchial suction and aspiration bronchoscopy. In the two cases of postoperative intestinal fistula, fortunately, both closed spontaneously. They indicated either leakage at the anastomosis or more probably a small blow-out of the duodenal stump. The single example of a subdiaphragmatic abscess probably occurred by the same mechanism. The case of sulfonamide hepatitis occurred at a time when large quantities of sulfanilamide powder or crystals were introduced into the peritoneal cavity at the time of laparotomy as a prophylactic measure. In this case

TABLE V
GASTRIC RESECTION FOR GASTRIC ULCER
NON-FATAL POST OPERATIVE COMPLICATIONS
(64 complications among 53 patients)

Complication	No. of Cases
Wound sepsis	17
Broncho-pneumonia	13
Urinary tract infection	10
Pulmonary atelectasis	8
Wound dehiscence	3
Ileus	3
Intestinal fistula	2
Auricular fibrillation	2
Subphrenic abscess	1
Lung abscess	1
Cerebral hemorrhage	1
Thrombophlebitis	1
Abortion	1
Sulfonamide hepatitis	1

there was intense jaundice but spontaneous recovery took place without sequelae. The other complications for the most part occurred singly and were not serious. Urinary tract infections were fairly frequent but fortunately all terminated promptly under appropriate therapy.

MALIGNANT ULCERS

In 19 cases or 10.1 per cent the microscopical examination of the operative specimen disclosed unmistakable evidence of malignant disease. In none of these cases was suspicion sufficiently aroused at the time of operation to alter the course of the operative procedure and the usual ulcer resection was performed. The operative notes in these cases indicate findings identical with those of the lesions microscopically benign, and in none of these cases were the regional lymphnodes found noteworthy and accordingly extensive resection of lymphnode-bearing areas or omentumectomy were not performed. In 17 of the 19 cases microscopical study revealed an early or even advanced carcinoma developing on the basis of an old chronic peptic ulcer. In all of these cases the original lesion was definitely an ulcer with the carcinoma

superimposed and none were primary ulcerating carcinomas. Two cases showed at the edge of a chronic ulcer an area of lymphosarcoma. In this group of 19 patients with associated malignant disease, there were 15 men and 4 women. The two lymphosarcoma cases occurred in male patients. The age range for this group was 30 to 67 years, with an average of 56 years. This average age is slightly higher than that for the entire group which was 52.3 years or for the group of 169 benign lesions where it was 52.2 years. In 12 of the ulcer-cancer cases special studies of the regional lymphnodes attached to the operative specimen were made. In four there was involvement by metastatic carcinoma while in eight the nodes were negative. The regional lymphnodes in one of the lymphosarcoma cases revealed evidence of neoplasm. In view of the ultimate diagnosis of malignancy in this group, it is interesting to reconsider the status of the preliminary medical program. Three patients had had prolonged and intensive medical treatment elsewhere before entering the hospital and surgery was advised at once. In 9 cases there was no delay and for one reason or another prompt surgical intervention was recommended, whereas in 7 cases considerable valuable time was spent in unsuccessful medical treatment by us, and surgery was performed only when check-up roentgenograms showed failure of the ulcer to improve. There was one operative death in this group which has already been referred to as an anesthetic death.

The follow-up studies in this group are of special interest (Table VI). In addition to the patient who died in the hospital, another patient, a woman, returned as an emergency exactly one month after her discharge and required a tracheotomy for upper respiratory tract obstruction due to necrosis of the cricoid cartilage. This lesion was undoubtedly due to the prolonged use of a Levine tube for Wangenstein suction during the postoperative period. She died shortly after her return from the operating room. In addition to these two cases, six other patients have since died. All six with one exception have died of recurrent carcinoma. This latter patient survived for seven years and eight months free from recurrence and in good health and died of a cerebral hemorrhage. The survival period of the patients who died of malignant disease (excluding the one operative and the one early postoperative death) ranged from seven months to three years and seven months, the average being 24.6 months. Eleven patients of this malignant group are still living, their survival periods ranging from one year to seven years and ten months. All of them are in good health at the time of this report with one exception. This patient reports that his health is poor but in view of the fact that he has survived for six years and six months recurrence seems improbable. The two lymphosarcoma patients are both living and in good health at the present time.

In summarizing this group of 19 patients with microscopically verified malignancy associated with a chronic gastric ulcer, 7 or 36.9 per cent have now survived for more than five years; but if the two postoperative deaths are excluded, the five-year survival rate becomes 41.2 per cent. This is similar to the findings of Allen, who reported a 40 per cent five-year survival rate

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TABLE VI
GASTRIC RESECTION FOR GASTRIC ULCER
GASTRIC ULCERS—MALIGNANT
END RESULTS IN 18 PATIENTS WHO SURVIVED OPERATION

Survival Period	Living	Dead
Less than 1 year		2
Over 1 year	1	2
Over 2 years	1	1
Over 3 years		1
Over 4 years	3	
Over 5 years	2	
Over 6 years	1	
Over 7 years	3	1
7 Five year survivals =		
36.8 per cent including operative deaths		
41.2 per cent excluding operative deaths		

TABLE VII
GASTRIC RESECTION FOR GASTRIC ULCER—1926-1945 INCLUSIVE

1. Cases included in present study of end results	138
2. Cases which have been followed for less than two years	17
3. Cases of gastric ulcer with superimposed malignancy—microscopical evidence	19 (10.1%)
4. Operative deaths	15 (7.9%)
5. Total number of resections performed	188
(One case is included in both groups 3 and 4)	

including operative deaths in a similar group of malignant lesions. When it is remembered that the number of five-year survivals in the average reports of cancer of the stomach is in the neighborhood of 20 per cent of the cases resected, it becomes apparent that an aggressive attitude toward gastric ulcer should assist in improving the present poor results in the treatment of gastric carcinoma.

METHOD OF EVALUATION OF END RESULTS

It is a well-known fact that a final judgment of the results of treatment is possible only after many years when one is studying a lesion such as gastric or duodenal ulcer. For that reason we have arbitrarily excluded from final consideration all patients who have not been observed for at least two years postoperatively. This automatically eliminates 12 patients who were operated upon during 1945 as well as five others operated upon earlier but who died of intercurrent disease in less than two years. There have been no unsatisfactory results in these groups.

There remain 138 cases (Table VII) suitable for evaluation of end results and these have been followed for periods ranging from two to 20 years. Data are available on all of these patients. The information has been obtained principally through return visits for check-up examinations, but also by letters, questionnaires and telephone conversations with both patients and their physicians and finally, in case of death, from the Michigan State Department of Health. The follow-up study has been a continuous one, having been inaugurated many years ago. For the present purpose, the various reports for each patient have been assembled and a rating given based upon the combined

evidence. Emphasis has been placed upon the most recent reports inasmuch as occasionally a shift in position up or down the scale becomes necessary, even after a number of years. As a rule changes have been for the better,

TABLE VIII
DURATION OF FOLLOW-UP STUDY—155 CASES

Number of Years After Operation	Living	Dead
Less than 2 years.....	12	5
2-5.....	43	14
5-10.....	34	10
10-15.....	10	10
15-20.....	9	7
Over 20.....	..	1
Total.....	108	47

TABLE IX
GASTRIC RESECTION FOR GASTRIC ULCER
CAUSE OF DEATH IN 47 PATIENTS WHO HAVE DIED SINCE DISCHARGE

Cause of Death	No. of Cases
1. Cardio vascular disease.....	18
Cerebral hemorrhage.....	7
Cardiac disorders (including coronary thrombosis).....	9
Rupture aneurysm aorta.....	1
General arteriosclerosis.....	1
2. Pulmonary disease.....	9
Pneumonia.....	5
Pulmonary tuberculosis.....	3
Lung abscess.....	1
3. Trauma.....	8
4. Jejunal ulcer.....	3
5. Renal disease.....	2
Pyelonephritis.....	1
Chronic nephritis.....	1
6. Miscellaneous.....	7
Carcinoma of remaining gastric pouch.....	2
Carcinoma of colon.....	1
Meningitis.....	1
Alcoholism.....	1
Suicide.....	1
Unknown.....	1

TABLE X
SUMMARY OF END RESULTS OF GASTRIC RESECTION FOR BENIGN GASTRIC ULCER

Type of Result	No. of Cases	Per Cent
1. Excellent.....	86	62
(a) Completely symptom free.....	65	
(b) Very slight symptoms.....	21	
2. Good.....	41	30
3. Poor.....	7	5
4. Jejunal ulcer (verified).....	4	3
Total.....	138	100

Satisfactory results in 127 cases = 92 per cent

although occasionally the reverse is true. For example, some patients who for a time were classified as only improved, because of their inability to regain strength or maintain proper weight have finally overcome this trouble and have been shifted to the excellent group. Again certain other patients whose

residual symptoms were principally related to the small size of the remaining stomach have in time compensated for this difficulty and now remain among the excellent result cases. Patients who have developed jejunal ulcers and most of those who have obtained poor results have had a poor record from the beginning. For convenience a classification consisting of four categories has been employed. These are: (1) Excellent; (2) Good; (3) Poor; and (4) Jejunal ulcer (verified).

In Table VIII the duration of the follow-up study is analyzed and here it will be seen that 108 patients are still living and 47 are dead. These figures include for completeness the 17 cases under two years which are not included in the final calculations. Table IX gives the causes of death in the 47 patients who have died. It will be observed that death in three cases was due to jejunal ulcer and, in fact, it occurred following secondary or tertiary operations for this condition.

REMOTE RESULTS

In general the end results have been extremely satisfactory and in only 11 cases or 8 per cent have definitely unsatisfactory results occurred (Table X). One hundred twenty-seven patients or 92 per cent have entirely satisfactory results, whereas 86 of these can be classified as excellent.

1. *Excellent results.* This is by far the largest group and is composed of 86 patients or 62 per cent. Sixty-five patients or 75 per cent of this group and 47 per cent of the entire series are completely symptom free and restored to a state of normal health. They eat normally without restrictions, are entirely rehabilitated as far as their economic or social status is concerned and suffer

TABLE XI
GASTRIC RESECTION FOR GASTRIC ULCER
SUMMARY OF CASES WITH EXCELLENT RESULTS—86

Completely symptom free.....	65
Minimal symptoms.....	21
Slight weakness.....	6
Slight intolerance to certain foods.....	19
Fats.....	9
Condiments, etc.....	6
Coarse foods.....	5
Acid foods.....	3
Sweets.....	2
Coffee.....	1
Ice cream.....	1
Milk.....	1
Soft drinks.....	1
Alcoholic liquors.....	1
Nuts.....	1

no postresection symptoms. Even on careful questioning no complaints can be elicited. The remaining 21 patients in this group of 86 are also considered as having excellent results. They are well, free from their ulcer symptoms, but on careful questioning report trivial, insignificant or inconsequential symptoms. The latter are not disturbing and consist either of slight weakness or slight intolerance to certain foods (Table XI). A group of normal individuals

would probably show a similar incidence of such symptoms. Fatty foods, for example, pork, fried foods, gravies and rich pastries are troublesome for the largest number of patients. Second in importance are the highly seasoned foods, *e.g.*, pickles, condiments, spices, etc., and third, coarse foods with considerable residue, such as radishes, cucumbers, celery, cabbage, etc. None of these patients requires a special diet and all can remain symptom free by merely avoiding the objectionable items. As far as these 86 patients are concerned the results may be cited as among the best seen following any type of surgical operation of similar magnitude.

TABLE XII

GASTRIC RESECTION FOR GASTRIC ULCER
Analysis of Good Results 41 Patients

Symptoms	No. of Cases
Weakness	11
Symptom free, but adhere to diet.....	3
Referable to small size of stomach.....	11
Referable to hypoglycemic or "dumping" syndrome.....	9
Specific food intolerance.....	18
Fats..... 13	Sweets..... 4
Coarse foods..... 6	Milk..... 3
Condiments, etc..... 6	Acid foods..... 1
* * * *	
Symptoms partially or wholly due to associated disease—20 patients	
Arthritis..... 4	Hemochromatosis..... 1
Cholelithiasis..... 3	Macrocytic anemia..... 1
Heart disease..... 3	C.N.S. lues..... 1
Carcinoma of gastric pouch.... 2	Ch. nephritis..... 1
Carcinoma of colon..... 1	Pul. tuberculosis..... 1
Diabetes..... 1	Hypertension..... 1

2. *Good results.* Forty-one patients or 30 per cent of the group have been placed in this category. These patients are much improved since operation and have remained so. They cannot be said to be completely symptom free, but their symptoms are quite easily kept under control. For the most part the residual symptoms are related to the reduced capacity of the stomach and the altered mechanics of gastric emptying rather than simulating the original symptoms. In Table XII an attempt has been made to analyze and classify these residual symptoms. This group of patients is the one most difficult accurately to appraise. The cases seem to fall conveniently into the following groups although some overlapping necessarily occurs: (a) patients who are not as strong as formerly. Inability to regain former strength is not infrequent and often is associated with failure to regain or maintain weight. These persons require more sleep along with regular hours of work and their physical endurance is somewhat below par. They often are more susceptible to upper respiratory tract infections; (b) patients who are entirely symptom free, but, because in the past they have become so accustomed to following a rigid ulcer diet, they now refuse to discontinue it for fear of further trouble. Some of these patients probably belong in the excellent group; (c) those whose

symptoms are due to the small capacity of the remaining stomach. These individuals are apt to experience discomfort after a heavy meal, from overeating or from eating too rapidly. Many of these symptoms improve gradually as the gastric pouch dilates; some patients never overcome them; (d) those who have symptoms of sweating, a sensation of warmth, cardiac palpitation and faintness and weakness after meals. These have been ascribed by Custer, Butt and Waugh¹³ and others to the dumping syndrome and explained by the rapid entrance of food into the jejunum. It is common experience among roentgenologists to observe rapid emptying of the gastric remnant after subtotal resection whereas only a few patients experience this train of symptoms. Many patients with such symptoms in our experience exhibit definite evidence of spontaneous hyperinsulinism and are relieved by the use of a high protein, low carbohydrate diet; (e) patients who have specific food intolerances similar to those mentioned above but more severe and often necessitating a modified diet for control.

It is important to note that one-half of the patients in this group with residual symptoms have co-existing diseases quite capable of accounting for all or many of their complaints. Thus, three of the living patients have definite roentgen evidence of cholelithiasis and one whose complaint is severe weakness has recently been shown to have developed macrocytic anemia. One patient has bronzed diabetes. Two patients have died of carcinoma developing in the gastric remnant. Presumably their gastric symptoms which returned after several years of complete freedom were due to the new disease, as the microscopic examination of the original ulcers showed them to be benign. Another patient subsequently developed carcinoma of the colon from which he died and which probably explained his symptoms. Other lesions more difficult of evaluation and for the most part occurring singly are listed in Table XII. It is not surprising to find such associated disorders frequently in a group of patients such as these who are at or beyond middle age.

These results compare favorably with those of St. John Harvey Guis and Goodman¹⁴ who reported 90 per cent of the survivors of operation as having satisfactory results when grouped according to cases and 92 per cent satisfactory years according to their methods of tabulation. Walters and Clagett¹⁵ state that the results of the surgical treatment of chronic gastric ulcer are among the best in the field of surgery.

3. *Poor results.* Seven patients or 5 per cent of the group have unsatisfactory or poor results not due to stomal ulcer. These are summarized in Table XIII. Four patients are living and three have died at 7 years 9 months, 11 years and 2 months and 18 years and 2 months respectively. Three women who had a conventional type of resection have continued to have the same symptoms following operation. Repeated attempts by various methods of examination have failed to reveal an anastomotic ulcer and the long time which has passed with no essential change in the clinical picture militates against this diagnosis. One of these patients was re-explored 12 years after the original operation for a suspected marginal ulcer, but only a small gastric polyp was

found and removed. Her symptoms remained unchanged. An adequate explanation of the poor results so similar in these three cases is difficult or impossible and perhaps relates to some underlying functional disorder in addition to the organic disease. One man who had a Finsterer type of resection remained in poor health until the time of his death by suicide seven years and nine months later. He was a frequent visitor at the hospital on the Neurology

TABLE XIII
GASTRIC RESECTION FOR GASTRIC ULCER
Analysis of Poor Results—7 Cases

No. of Cases	Comment	
3 Classical operation	Persistence of original symptoms	1 died 18 yrs. 2 mos. 1 living 5 yrs. 8 mos. 1 living 3 yrs. 10 mos.
1 Finsterer operation	Organic brain disease—alcoholism	Died (suicide) 7 yrs. 9 mos.
1 Palliative gastrectomy	Reactivation of ulcer (hemorrhage)	Living 12 yrs. 8 mos.
1 Total gastrectomy	Severe post-resection symptoms macrocytic anemia	Living 5 yrs. 4 mos.
1 Classical operation	Incisional hernia (intermittent obstruction)	Died 11 yrs. 2 mos.

service. An anastomotic ulcer was never demonstrated and due to his demented state, institutional care was required. The one patient upon whom a palliative gastrectomy was performed in our opinion has not had a satisfactory result.

He developed symptoms of reactivation of his unremoved ulcer two years postoperatively. Strict dietary and medical management have sufficed to hold the disease in check. Stomal ulcer in this case has been excluded to the best of our knowledge. One of the three patients who underwent total gastrectomy has a poor result in the form of severe post resection symptoms. He is a severe psychoneurotic, has pronounced hyperinsulinism and has recently developed macrocytic anemia. The final case in this group is listed here in spite of an apparent cure of his ulcer due to the fact that a large incisional hernia developed after operation. Until the time of his death 11 years and two months later, he had symptoms of intermittent intestinal obstruction. He repeatedly refused to have the hernia repaired and while the clinical results in this case must necessarily be recorded as poor, it should not stand as an indictment against the operation as far as the ulcer results are concerned.

4. *Jejunal ulcer.* Jejunal ulcer, while of rare occurrence, following gastrointestinal anastomoses for gastric ulcer is a most serious and distressing complication when it occurs. Church and Hinton^{16, 17} reported three marginal ulcers in nine cases of gastric ulcer treated by gastroenterostomy and a questionable recurrent ulcer in one case treated by resection. Heuer reported three cases in which a stomal ulcer following resection was suspected but not proven. There were four verified jejunal ulcers in the present series. The pertinent clinical data of these cases are epitomized in Table XIV.

The first case is an example of a patient who required multiple operations for repeatedly recurring marginal or jejunal ulcers. This man was operated upon three times for recurrences. The original lesion was a high lesser curvature ulcer and a fairly radical Polya resection was performed. The

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antrum, however, was not removed. Apparently it was left for the sake of simplifying the operative procedure. Accordingly this patient should be regarded as one who did not have an adequate primary resection. Unfortunately at the subsequent operations the antrum and pylorus were not excised. The second case is very similar and in view of the evidence now available, it is quite certain that the Finsterer procedure should never be used when dealing with gastric ulcer. In addition to the fact that one-half of the end results of this operation were unsatisfactory it is noteworthy that none of the remaining cases were in the excellent group. The third case is one in which a type of Finsterer operation was probably performed although not intentionally. The

TABLE XIV
JEJUNAL ULCER—4 CASES

Case	Recurrence	Subsequent Course
1. M 52—Posterior polya (Finsterer) 8-3-27	8 mos.	(1) Reresection 9-26-28 (2) Closure of acute perforation (elsewhere) Dec. 1937 (3) Exclusion of jejunal ulcer 8-12-38 (4) Died (cerebral hemorrhage) 1-5-39
2. M 55—Posterior Hoffmeister (Finsterer) 7-18-28	18 mos.	(1) Exploratory and jejunostomy 11-6-30 (4) Died 11-28-30. No autopsy
3. M 61—Posterior Hoffmeister (Finsterer) 4-1-43	Immediately Gastrojejuno- colic fistula	(1) Resection duodenal stump 5-19-44 (2) Colostomy and jejunostomy 4-25-45 (3) Died 6-23-45. Autopsy—perforation-peritonitis
4. F 69—Posterior Hoffmeister 1-27-44	9 mos.	(1) Reresection 5-17-46 (2) Died 5-18-46. Hemorrhage. No autopsy

lesion was on the lesser curvature and associated with a good deal of inflammatory reaction. The lower transection is stated to have been "close to" the pylorus. Symptoms of a marginal ulcer occurred promptly and one year later it was thought advisable to resect the upper portion of the duodenal stump. McKittrick¹⁸ and Marshall¹⁹ have reported nine cases in which jejunal ulcers have healed following such an indirect attack. Interestingly enough histologic examination of this specimen revealed the presence of gastric mucosa, but unfortunately the ulcer was uninfluenced by the procedure and progressed to the stage of a gastrojejunocolic fistula. Later, perforation occurred with a resultant general peritonitis in spite of the fact that the fistula had been excluded by a proximal colostomy and a catheter jejunostomy for feeding purposes. The remaining case in this group is that of a woman of 69 who had a prepyloric ulcer. A conventional resection which was adequate according to all of the usual criteria was performed. One year later a jejunal ulcer was easily demonstrated roentgenographically. At this examination it was estimated that two-thirds of the stomach had been removed. Gastric acidity remained at about normal levels prior to reresection. It is conceivable in this case that antral tissue was left behind in the upper segment by removal of too little of the lesser curvature, and that a higher resection might have given a better result.

WEIGHT CHANGES

The post resection changes in weight are given in Table XV. An attempt was made to compare the stabilized postoperative weights as attained several years after operation with those of the patients before the procedure. The preoperative weight selected was the average or possibly the best past weight. The weight immediately before operation is a poor criterion as most of these patients had lost from 15 to 25 pounds during the several months prior to surgery and a comparison with this weight would show either little or no change or more probably a gain. It will be noted that after resection the average patient is nearly 12 pounds below his former weight. Rarely is the loss excessive or sufficient to cause concern. It may, however, be associated with loss of strength and in some cases this may become a difficult problem. An

TABLE XV
POST RESECTION CHANGES IN WEIGHT—112 CASES

Change	No. of Cases	Range (Pounds)	Average (Pounds)
Loss.....	84(75%)	5-45	17
Gain.....	15(13%)	3-25	10
No change.....	13(12%)

Overall average, 11.7 pounds loss

interesting study of this matter has been made by Wollager, Comfort, Weir and Osterberg²⁰ who found that following the Polya type of resection nearly all persons lost more fat in the stool when taking a high fat diet than did those who had not had a gastric resection. This was also true in some patients who were on a diet of ordinary fat content. Moreover some patients after the Polya operation lost more nitrogen and total solids in the stool than did normal individuals. The authors conclude that the amounts of fat and nitrogen lost in the feces were not large, but unless a diet of sufficient caloric content to compensate for this loss is taken a decrease in body weight might be expected.

SUMMARY

The end results of gastric resection for gastric ulcer as viewed over a 20-year period support the earlier impression that this is the best means now at our disposal for the treatment of those ulcer cases which require surgery. The operation has limitations and for patients who are exceedingly obese are poor risks or who have high or inaccessible lesions, a less ideal but safer procedure should be selected. With the advent of vagal interruption a new and potent method is available for this group of cases. It is also conceivable that, as suggested by Lahey,²¹ subdiaphragmatic vagotomy may be worth while at the time of subtotal gastrectomy in an attempt to prevent jejunal ulcer in that small group of patients who may be expected to develop this complication even after an adequate resection. The conventional subtotal resection whereby a large portion of the lesser curvature as well as the antrum and pylorus were removed, has given the best results in this series. Little difference has been noted in the late results between those cases in which a Polya or a Hoffmeister

reconstruction was performed, and likewise the clinical results of cases of antecolic and retrocolic anastomoses were essentially the same.

The Finsterer exclusion operation would seem to have no place in the treatment of gastric ulcer and in view of a better understanding of gastric physiology it should be abandoned. Palliative gastrectomy, as observed in one case, did not yield a satisfactory result and it would seem that today there are other and better methods of dealing with high gastric ulcers. The record of the three total gastrectomies is not good. Although there was one excellent result, there was one operative death and one poor result. The procedure seems much too radical for the treatment of a benign ulcer but for the type of case in which it was here employed any substitute operation must be one which includes removal of the ulcer. In general an operation with 92 per cent of satisfactory end results compares favorably with the results of almost any major surgical operation today. The operative mortality herein reported can most certainly be reduced in the future and by heeding some of the lessons learned from this study it is hoped that the unsatisfactory clinical results can be further reduced in number.

The fact that microscopical study revealed malignancy in 10 per cent of the lesions which was not recognized as such at the time of laparotomy would indicate that any indirect operation for gastric ulcer should be accepted with caution. We believe that there is a definite place for medical treatment in the management of certain gastric ulcers but that its dangers and limitations should be realized by internists as well as surgeons. The side-effects resulting from large gastric resections which occasionally occur in the form of post resection symptoms and nutritional disturbances are perhaps the most objectionable feature of the operation. Fortunately most patients experience but little inconvenience on this score, but as newer and better methods of treatment become available, it is to be hoped that all postoperative residual symptoms can be eliminated.

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DISCUSSION.—DR. ROSCOE R. GRAHAM, Toronto: Dr. Ransom was good enough to make available the material in his paper prior to his address. He has rightly stressed that the proper therapy in gastric ulcer is still predicated on our ability or lack of ability to differentiate a benign from a malignant ulcer. It is noteworthy that in his series there was a 10 per cent error in considering as benign an ulcer which histologically was proven to be malignant. In a series of our own cases the error was as high as 17 per cent. Some years ago Dr. Harold Wookey re-examined specimens in our museum which had been labelled as benign gastric ulcer. More detailed histologic study showed that 18 per cent were malignant.

Singleton and Summers reported on 309 patients suffering from pre-pyloric lesions; 189 were carcinoma and 120 were benign lesions. It was interesting, however, that in 24 of the malignant cases the crater was the only index of abnormality and in 17, or 85 per cent of these the crater was less than 2.5 centimeters in diameter.

In a follow-up series of gastric carcinoma, there were a few cases in which it was felt that the carcinoma had been grafted upon a previous chronic ulcer. While these could have been controlled by earlier surgical excision of the ulcer, it was heartening to find that the prognosis in such a gastric carcinoma was better than in one which started primarily as a carcinoma.

Previously we have withheld operation on patients suffering from gastric ulcer until our hand was forced. In most instances we had not advised operation until there was involvement of contiguous structures in practically all cases. This gave a definite mortality and a difficult technical problem. With the data which Dr. Ransom has presented, it becomes obvious that one should entertain very seriously the policy of advising early radical operative procedures for a patient with a gastric ulcer. The present regimen of preoperative care for gastric patients enables a radical gastrectomy to be carried out