

TRANSTHORACIC RESECTION OF THE ESOPHAGUS AND STOMACH FOR CARCINOMA*

ANALYSIS OF THE POSTOPERATIVE COMPLICATIONS, CAUSES OF DEATH,
AND LATE RESULTS OF OPERATION

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THE TECHNICAL ADVANTAGES of the transthoracic approach are now well established in the surgical management of certain cases of carcinoma of the esophagus and of the cardia and fundus of the stomach. Starting with the cases of carcinoma involving the cardia and fundus of the stomach or the esophagus close to the cardia, the application of this procedure has been extended during the past three years to include many cases requiring a total gastrectomy and more recently, by effecting certain modifications of the technic of operation, resections with anastomosis have been performed high in the chest for the removal of midesophagus lesions.

In general, from the standpoint of the operative technic to be used, the cases can be arranged in three groups according to the location of the growth: (1) *Lesions in the middle half of the thoracic portion of the esophagus.* These require an esophagectomy with a high intrathoracic esophagogastric anastomosis, either just above or just below the aortic arch (Fig. 1). (2) *Lesions arising in the lower esophagus or fundus of the stomach.* In this group the resection includes a portion of the esophagus and a relatively large segment of the upper half of the stomach. An esophagogastric anastomosis low in the chest is carried out (Fig. 2). (3) *Lesions which involve the major portion of the stomach but which invade the cardia and often the lower esophagus.* These require a total gastrectomy followed by an esophagojejunostomy low in the chest (Fig. 3).

The cases in Group 1 present a rather special problem which is dealt with in greater detail in another place.¹ Those in Groups 2 and 3 belong together under the heading of transthoracic gastric surgery. With occasional modifications of minor importance the technics described in two former communications were used in these cases.^{2, 3} Descriptions of the technics of these several procedures will, therefore, be omitted here.

From 1939, when the first transthoracic gastric resection was performed at the Massachusetts General Hospital, until the present (November 1, 1944), 127 patients with carcinoma of the stomach or esophagus have been operated upon by the transthoracic approach. Chart 1 illustrates the grouping of these cases as to location and type of operation performed.

There were 85 cases of carcinoma of the stomach or lower esophagus invading the cardia. In 24 of these the disease was inoperable and no

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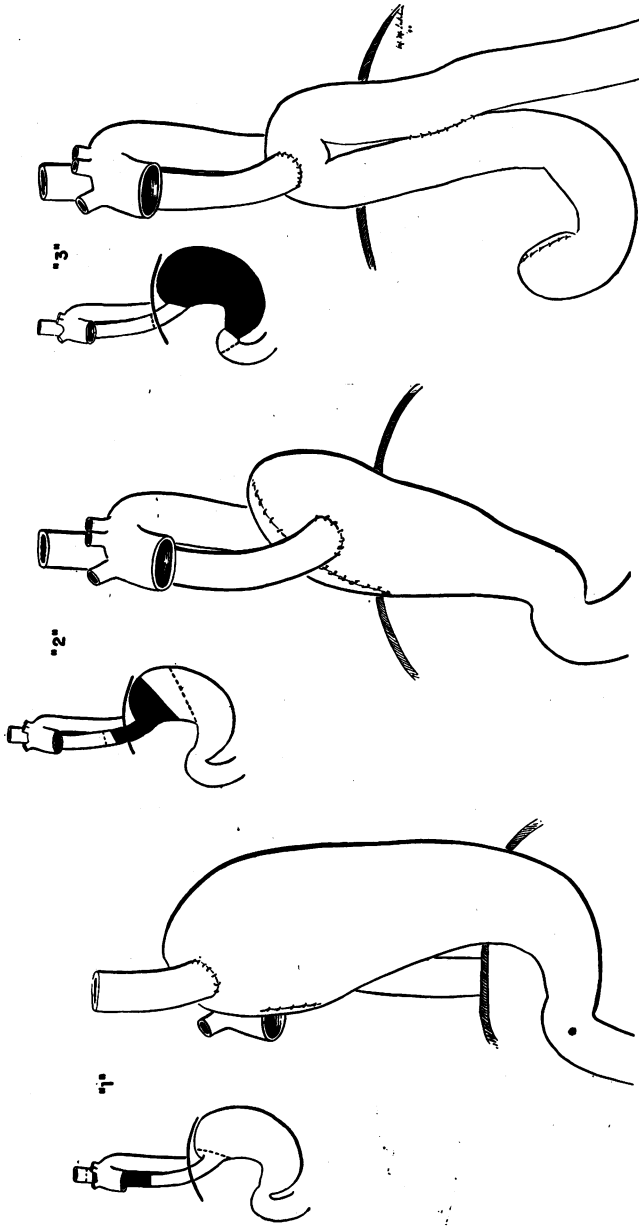


FIG. 1

FIG. 2

FIG. 3

Fig. 1.—Diagram illustrating arrangement of viscera after completion of operation for resection of carcinoma of the midthoracic portion of the esophagus. Stomach drawn high in the chest; esophagus divided above the aortic arch; and anastomosis placed in front of arch. Insert shows the region in the esophagus where the tumor lies in these cases.

Fig. 2.—Diagram illustrating arrangement of viscera after resection of lower esophagus, cardia, and fundus of stomach. Distal segment of stomach drawn into chest for a low intrathoracic esophago-gastric anastomosis. Insert shows the region involved in this type of case.

Fig. 3.—Diagram illustrating arrangement of viscera after total gastrectomy, with intrathoracic esophagojejunostomy. Insert shows region involved in such cases (entire stomach).

resection was carried out. A resection and anastomosis was carried out in 61 cases. This makes a resectability in the gastric and lower esophagus cases of 71.7 per cent (of cases operated upon). Of the 61 cases of resection, ten lesions were low in the esophagus and 33 were in the fundus or cardia of the stomach, making 43 cases of partial resection of the stomach and esophagus followed by an esophagogastric anastomosis low in the chest. In the remaining 18 cases so much of the stomach was involved that a total gastrectomy was required. In these an esophagojejunal anastomosis was performed.

The middle esophageal carcinoma group included 42 cases. Of these, 17 were found to be inoperable. In 25 cases a resection was carried out, but in only 11 of these was a high intrathoracic esophagogastric anastomosis performed. This operation has been in use in this clinic only during the past year (1944). Previous to that the Torek operation was used. The latter was performed in 14 cases. These will not be discussed in this paper, in which it is intended to deal only with the cases in which an anastomosis was performed. The resectability for the entire group of 42 midesophageal cases was 59.5 per cent.

Age of Patients Operated Upon.—Before discussing the complications and causes of death following resection, it is important to realize that a relatively large proportion of the patients subjected to operation were of advanced age. Table I gives the number of patients in each decade.

IMMEDIATE RESULTS OF OPERATION

(A) *Inoperable Cases Explored.*—Exploration by the transthoracic route is a relatively benign procedure if one takes into account the nature of the disease and the almost universally poor condition and advanced age of the patients operated upon.

Cases were considered to be inoperable when metastases were found in the lung, the liver, or in the peritoneum, or when the primary tumor was too adherent or was invading adjacent tissues or organs excepting the spleen or tail of the pancreas which could be removed. Regional lymph nodes containing metastases were removed in resectable cases along with the growth. In several cases a resection was performed even when involved nodes which were inaccessible had been found. The removal of an obstructing growth in such circumstances was considered to be justifiable because of the palliative relief which was brought about by the operation. In general, a radical approach to the problem was adopted and any growth which could be resected was removed, always hoping to effect a cure but actually expecting in the majority of cases a reasonable degree of palliation.

Of the 17 patients with inoperable carcinoma of the midthoracic esophagus who were explored through the chest, four died in the hospital. The causes of death were in one case perforation of the aorta by direct extension of the tumor, in two cases mediastinitis from perforation of the growth, and in another case aspiration pneumonia. Of the 24 patients with carcinoma of

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SPECIAL PROCEDURES ADOPTED IN TREATMENT OF 127 PATIENTS WITH CARCINOMA OF THE STOMACH OR ESOPHAGUS

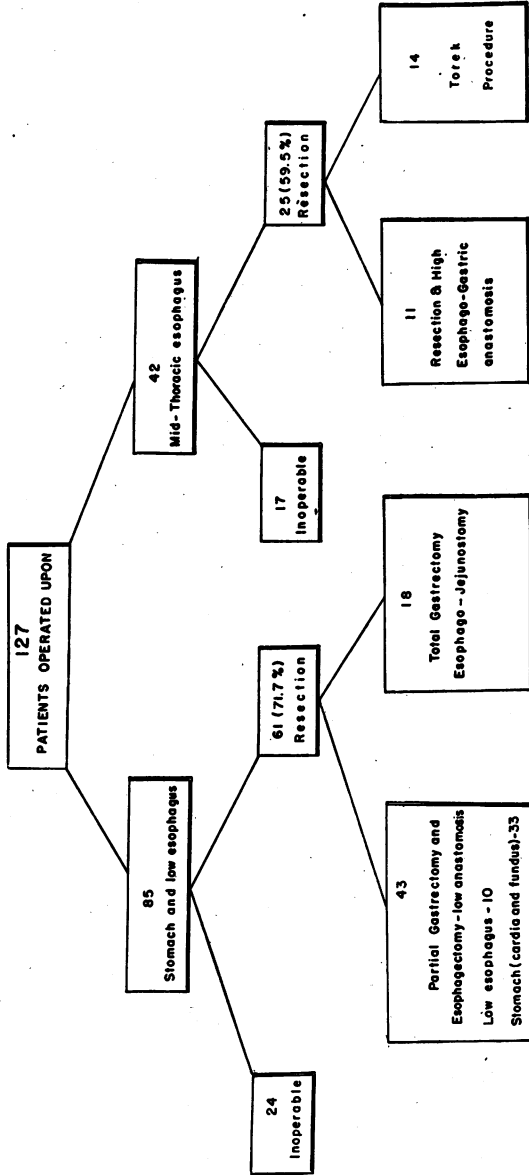


CHART I

the stomach and cardia who were found to have an inoperable tumor, two died of pneumonia and one of an undetermined cause. There were, therefore, in all, seven postoperative deaths in the total group of 41 patients who were explored and found to have inoperable disease. This makes a postoperative mortality rate of 19.5 per cent.

TABLE I

AGE DISTRIBUTION OF PATIENTS WITH CARCINOMA OF THE ESOPHAGUS AND STOMACH WHO WERE OPERATED UPON

Age	Entire Series	Resection Cases Only
30-40.....	5	2
40-50.....	23	17
50-60.....	37	28
60-70.....	35	26
70	13	7
Unknown.....	14	.

(B) *Cases of Resection and Anastomosis.*—Although the total group of radical operations numbers 86 cases, as was pointed out above, the 14 cases of midthoracic esophageal carcinoma in which the Torek operation was used are not included in this communication because of the entirely different technical problem involved and because the Torek procedure has been supplanted in all recent cases by resection and high esophagogastric anastomosis. Confining ourselves, therefore, to the radical resections followed by some form of anastomosis, 72 cases are available for study. Chart 2 summarizes the results of this experience.

There were 43 cases of carcinoma of the lower esophagus or of the fundus of the stomach invading the cardia in which a low esophagogastric anastomosis was performed. Eight of these patients died in the hospital (18.6 per cent). Of the 18 patients upon whom a total gastrectomy was performed, seven died in the hospital (38.8 per cent). In the midesophagus carcinoma group, where an anastomosis was performed, there were three deaths among 11 patients (27.2 per cent). Thus, of the entire group of 72 cases of radical resection followed by anastomosis, 18 patients died postoperatively. The over-all postoperative mortality rate therefore, was 25.0 per cent. Table II, which supplements Chart 2, indicates that of those who recovered following radical resection and anastomosis there were 13 patients whose convalescence was marred by complications of one sort or another. The total number of patients who manifested postoperative complications, obtained by adding together the number of deaths and the number of complicated cases ending in recovery, was 31, or 43 per cent. The total number of recoveries without complications was 41, or 67 per cent.

ANALYSIS OF THE COMPLICATIONS OCCURRING AFTER RESECTION

Table III gives a list of the principal complications which were recognized clinically or at autopsy. It must be remembered that in many cases several different complications occurred in the same patient so that the sum of the complications is greater than the total number of complicated cases.

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RESULTS OF RESECTION AND ANASTOMOSIS IN 72 CASES OF CARCINOMA OF THE STOMACH AND ESOPHAGUS

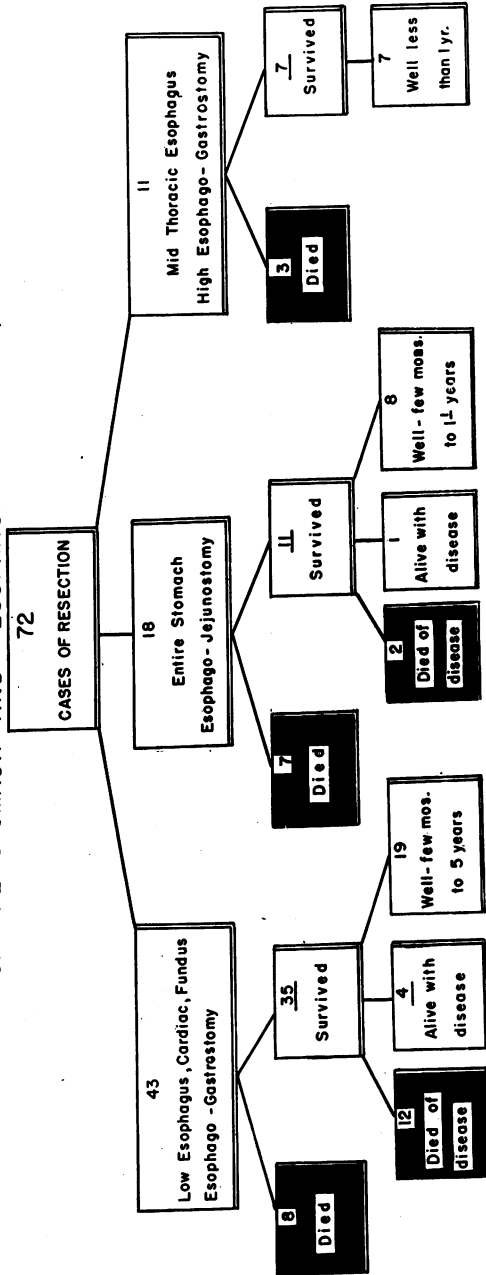


CHART 2

MANIFESTATIONS OF INFECTION.—*Empyema* was observed in eight cases. It was a contributing cause of death in five of the patients who had a total gastrectomy. In all of these there was widespread sepsis with peritonitis, mediastinitis, or septic embolism, and the empyema was merely one aspect

TABLE II
IMMEDIATE RESULTS OF OPERATION

	No. of Cases	Deaths	Recovery with Complications	Recovery without Complications
Low esophagogastric anastomosis.....	43	8	10	25
Total gastrectomy.....	18	7	2	9
High esophagogastric anastomosis.....	11	3	1	7
Entire group.....	72	18	13	41

of the generalized infection. It occurred in three cases of resection of the cardia and fundus followed by a low thoracic esophagogastric anastomosis. All were operated upon before the year 1942, at a time when sulfanilamide was being used locally in the chest and before catheter drainage of the left pleural cavity was used routinely in all cases. Since then there have been no cases of empyema except in the total gastrectomy group. All three of these patients recovered after suitable drainage of the empyema was effected by rib resection.

Mediastinitis was recognized in four patients, as proven by autopsy examination. It may have occurred in others who recovered or upon whom no autopsy was performed. It was usually accompanied by other evidences of infection.

Peritonitis, as mentioned above, was found at autopsy in five patients who died of overwhelming sepsis after total gastrectomy.

Major wound sepsis occurred in two cases. In one of these there is little doubt that the patient's life was saved by the use of penicillin. The organism in this case was staphylococcus aureus.

Acute parotitis occurred in three cases, but in all of these the patient survived. In none was the patient extremely ill. All were bilateral.

CARDIAC DISORDERS.—Table III enumerates the kinds of cardiac disorders encountered. Disturbances of rhythm without other cardiac signs were relatively infrequent, four cases in all. In three of these auricular fibrillation occurred and digitalization was of benefit. Auricular flutter occurred in one case and was of alarming seriousness. It was finally controlled by the administration of quinidine. Congestive failure of the heart was the principal or at least a major contributing cause of death in six patients. The majority of these had other complications as well, mostly sepsis. A diagnosis of myocardial infarction was made in three cases.

PULMONARY EMBOLISM.—Massive pulmonary embolism occurred in four cases, representing an incidence of 5.5 per cent. In two of these sudden death resulted. In neither case was there any evidence of venous thrombosis in the

legs. One patient died while on her way to the front door of the hospital on the day she was to be discharged. The other died sitting in a chair the day before it had been planned to send her home. In the two other cases massive pulmonary emboli were found along with other complications when

TABLE III

ANALYSIS OF COMPLICATIONS WHICH DEVELOPED IN 72 PATIENTS IN WHOM A RESECTION WAS PERFORMED

	Low Anastomosis	High Anastomosis	Total Gastrectomy	Summary	Per Cent
Empyema	3 (no deaths) (2 operated upon)	0	5 (all died)	8	11.1
Mediastinitis.....	2	1	1	4	5.5
Peritonitis..... (usually with empyema, often with mediastinitis)	0	0	5	5	6.9
Major wound sepsis.....	1	1	0	2	2.8
Acute parotitis.....	2	0	1	3	4.2
Cardiac disorders:					
Auricular fibrillation.....	2	1	0	3	4.2
Auricular flutter.....	1	0	0	1	1.4
Congestive failure.....	3	2	1	6	8.3
Myocardial infarction.....	1	2	0	3	4.2
Pulmonary embolism.....	1	0	3	4	5.5
Thrombophlebitis of femoral vein (requiring ligation).....	0	0	2	2	2.8

an autopsy was performed. In one of these the patient was so ill because of sepsis, including empyema and peritonitis, that he would have died even if he had not suffered the embolism. Although pulmonary embolism was probably the immediate cause of death, this case was included in the group of deaths from sepsis. In none of these cases of pulmonary embolism was there warning beforehand or time enough after the embolism occurred to tie the femoral veins.

THROMBOPHLEBITIS OF THE FEMORAL VEIN requiring bilateral superficial femoral vein ligation occurred in two cases.

CAUSES OF DEATH AFTER OPERATION

In the entire series of 72 radical resections followed by some form of anastomosis (thus excluding the Torek operations) 18 postoperative fatalities occurred. The distribution of these fatalities according to the type of operation performed is shown in Table IV.

In the 18 fatalities an exact anatomic diagnosis of the cause of death was obtained by postmortem examination in 11 cases. In most of these there were several complicating factors, but in each it was possible to determine the principal cause. In the remaining seven cases the clinical diagnosis unconfirmed by autopsy is given.

Table V illustrates the principal causes of death arranged according to the type of operation performed. For the sake of brevity, in all those cases where the chief cause of death was infection of some type, the cause of death is ascribed to sepsis. In the majority of these there was widespread

overwhelming infection including often in the same case empyema (frequently bilateral), mediastinitis, peritonitis, pericarditis, septic infarcts of the liver, pancreatitis, and other foci. As was mentioned above, although massive pulmonary embolism occurred in four cases, it was thought to be the principal cause of death in only three. In the fourth case the embolism was probably the terminal event in a patient who was almost certain to die

TABLE IV
POSTOPERATIVE MORTALITY OF THREE TYPES OF OPERATION IN 72 CASES OF CARCINOMA OF THE ESOPHAGUS,
CARDIA, OR STOMACH

	No. of Cases	No. of Deaths	Per Cent
Resection, with low esophagogastrostomy.....	43	8	18.6
Resection, with high esophagogastrostomy.....	11	3	27.3
Total gastrectomy, with esophagojejunostomy.....	18	7	38.9
Entire series.....	72	18	25.0

of sepsis. In the remaining cases the chief cause of death could almost certainly be ascribed to congestive cardiac failure (three cases) or to myocardial infarction (two cases).

The number of cases manifesting complications is too small to make any significant correlation between the type of operation or the location of the tumor and the nature of the complications which might occur. In the cases of carcinoma of the stomach requiring total gastrectomy, however, there was a much higher incidence of severe sepsis than in the other cases. This may have been the result of technical faults, but it would seem more likely that it was due to the fact that these patients were in a more depleted nutritional state than those who had less involvement of the stomach. During the past two years greater emphasis has been put upon the details of preoperative preparation of the patient and, possibly as a result of this, less trouble has been encountered.

COMMENTS REGARDING IMPROVEMENTS IN THE IMMEDIATE RESULTS OF OPERATION

Chart 3 serves to illustrate the fact that as a result of accumulated experience and the establishment of a now fairly standardized routine of preoperative preparation, operative technic, and postoperative care, the relative frequency of complications after operation and the percentage of postoperative deaths have fallen, especially during the years 1943 and 1944. Starting in 1939 with one operation, the number of radical resections has increased rapidly each year so that thus far in ten months of 1944 there have been 34 cases. At first, the number of cases attended by complications or resulting in death was roughly parallel with the total number of cases (Chart 3). But during 1943 and 1944 there has occurred a progressive decrease in the complicated or fatal cases and a relative increase in the survivors with or without complications. This reduction in the rate of occurrence of postoperative complications, whether fatal or not, cannot be ascribed to the operation of any one factor in the management of these

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cases. It is more certainly the result of the benefits resulting from the accumulation of experience with the difficult problems which are presented. In the early cases the preoperative preparation was not so intensive or so prolonged, and did not include the intravenous use of amino-acid preparations

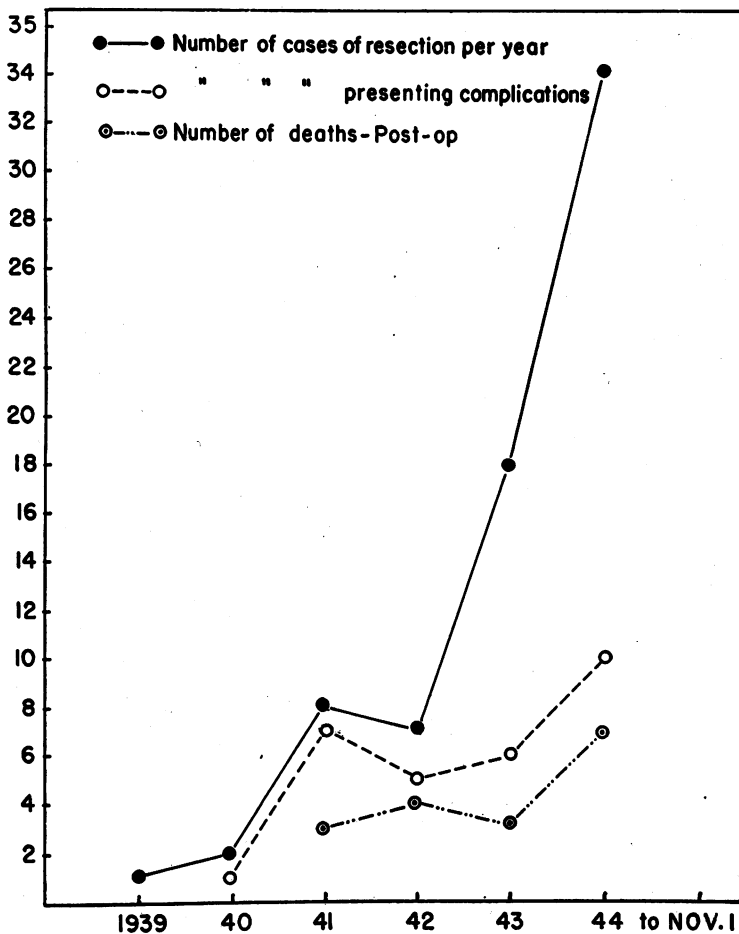


CHART 3.—Number of cases of resection and anastomosis per year, starting in 1939 and including the first 10 months of 1944; number of complications and number of deaths each year.

or the administration of sulfadiazene. The technic of operation has been modified very little, but now includes such things as the omission of the use of clamps on the esophagus, the utilization of routine drainage of the chest, and the avoidance, if possible, of splenectomy. In the postoperative care a much more thoroughly standardized procedure is followed. A summary of the factors which are considered of primary importance in the management of these cases follows:

(A) PRELIMINARY PREPARATION OF THE PATIENT.—(1) Prolonged preoperative hospitalization of the patient (one to three weeks) to provide for

physical rest and thorough clinical and laboratory study to evaluate the patient's condition.

TABLE V
CAUSES OF DEATH FOLLOWING RESECTION AND ANASTOMOSIS
ARRANGED ACCORDING TO TYPE OF OPERATION

	Sepsis	Congestive Failure	Pulmonary Embolus	Myocardial Infarction	Summary
Resection, with low esophagogastric anastomosis.....	4	3	1	0	8
Resection, with high esophagogastric anastomosis.....	1	0	0	2	3
Total gastrectomy, with esophagojejunostomy.....	5	0	2	0	7
Entire series.....	10	3	3	2	18

(2) Transfusion of whole blood sufficient to restore the results of photo-hemoglobin determination to a normal level.

(3) Administration of a high protein, high carbohydrate diet. This in the obstructed cases must often be almost entirely liquid; for those who can take solid food a well-balanced diet is prescribed.

(4) Exhibition of large doses of ascorbic acid (100 to 1000 mg.) per day.

(5) Exhibition of vitamin B-complex, usually in liquid form.

(6) Digitalization in those with auricular fibrillation and in certain very elderly patients.

(7) Routine administration of sulfadiazene, one gram every four hours for 48 hours preceding the day of operation.

(8) Preliminary jejunostomy for feeding in a few patients who cannot swallow an adequate liquid or semisolid diet.

(B) CONDUCT OF THE OPERATION.—(1) The use of intratracheal positive pressure inhalation anesthesia (ether and oxygen).

(2) Routine complete expansion of the lung by the anesthetist every 20 to 30 minutes during the progress of the operation.

(3) Transfusion of blood during the operation. This is started as soon as the skin incision is made and two or three pints of blood are administered during the course of the procedure.

(4) Use of silk technic throughout, including the anastomosis.

(5) Avoidance of tying large masses of tissue.

(6) Scrupulous hemostasis and particular care to avoid the development of hematomata in the mesentery or walls of viscera.

(7) Avoidance of trauma to tissues; no clamps on the esophagus; no clamps for the anastomosis; no utilization of the cautery.

(8) Avoidance of splenectomy when possible, (to prevent the development of splenic vein thrombosis and subsequent hepatic emboli). The spleen must be removed (a) if torn, (b) if adherent to the growth or if the growth invades the tissues around the splenic vessels; and (c) if it will lie in the way of the anastomosis (especially in those cases in which an esophagojejunostomy is performed).

(9) Avoidance of the local utilization of sulfonamides, which would predispose to the development of empyema.

(10) Routine insertion of catheter for closed system drainage of the chest.

(11) Levin tube left with tip just above but not through the anastomosis.

(C) POSTOPERATIVE CARE.—(1) Routine use of oxygen tent for 24 hours, or sometimes longer.

(2) Removal of Levin tube on the day after operation.

(3) Removal of chest drainage tube 48 to 72 hours after operation, depending upon the amount of drainage.

(4) Careful clinical observation twice each day to detect particularly:

(a) Tension pneumothorax.

(b) Fluid in the chest.

(c) Evidence of intrapulmonic disease (collapse or pneumonia).

(d) Cardiac arrhythmias.

(5) Aspiration of the chest if fluid is suspected.

(6) Routine portable chest roentgenogram on the 5th day, or at any other time if indicated.

(7) Daily administration of intravenous alimentation and medication of water with glucose or salt as indicated; aminogen if protein is low; vitamins (ascorbic acid, riboflavin, thiamine, and nicotinamide).

(8) Oral feeding, begun on the 5th day, of water (one ounce) every hour, with a gradual increase in the amount and kinds of nutritious fluids and later soft solids, depending upon the toleration of the patient.

(9) Patient allowed out of bed on the 4th to 7th day.

(10) Sulfadiazene, five grams daily, continued for five days, or longer if necessary; to be omitted if signs of toxicity occur.

(11) Bilateral superficial femoral vein ligation and division if signs of deep phlebitis develop or after sublethal pulmonary embolism is detected.

END-RESULTS AFTER RADICAL RESECTION FOLLOWED BY ANASTOMOSIS

Reference to Chart 2 demonstrates that of those who survived the operation some are already dead because of metastases or recurrence of the disease; a few are alive with recurrent disease; and some are apparently well. The seven survivors following resection of carcinoma of the midthoracic esophagus followed by a high esophagogastric anastomosis are all apparently well, but all were operated upon less than one year ago, so that one cannot attach much significance to their apparent good results. More of the total gastrectomy cases occurred long enough ago to give some impression of the end-result. But the largest and longest surviving group is composed of those who had resections of the cardia with a low thoracic esophagogastric anastomosis. Table VI gives the results to date in the 35 survivors after resection of the cardia with low esophagogastric anastomosis and the 11 patients who survived after total gastrectomy.

In the former group, 13 patients have been operated upon less than one year. Of these, three already show evidence of recurrent or metastatic

disease. Seven of the 35 patients died less than one year after operation. Fifteen patients survived one year, or longer. But of these, one is alive, with recurrence, and four died from one year to 18 months after operation. Eight

TABLE VI

Time Elapsed after Operation	35 CASES OF RESECTION OF CARCINOMA OF CARDIA			11 CASES OF TOTAL GASTRECTOMY		
	Alive and Well	Alive, with Disease	Died of Recur- rence	Alive and Well	Alive, with Disease	Died of Recur- rence
Less than 6 months.....	5	0	3	5	0	0
Six months to 1 year.....	5	3	4	1	1	2
1 year to 18 months.....	2	1	4	2	..	..
18 months to 2 years.....	2	0	1	..	..	..
2 to 3 years.....	2	..	..	..	..	..
3 to 4 years.....	2	..	..	..	..	..
4 to 5 years.....	..	..	..	..	..	..
Over 5 years.....	1	..	..	..	..	..
Total.....	19	4	12	8	1	2

patients survived more than 18 months. One died before the expiration of two years, and two are alive and well a comparable length of time. Two patients are well between two and three years postoperative. Only three are alive and apparently well three or more years after operation. One of these, the first case of the entire series, is well after five years.

Obviously, too little time has elapsed since the operation in the majority of cases to get any accurate impression of what the end-results from the standpoint of survival are to be. They will no doubt be disappointing if one expects to cure these patients. But the importance of the operation as a method of palliation cannot be stressed too much. A large percentage of these patients before operation cannot swallow enough food to keep from starving. The happiness which results from being able to eat again is truly pathetic in many instances. Furthermore, one should remember that not long ago the great majority of patients with carcinoma in the esophagus or cardiac end of the stomach would have been refused the benefit of surgery because lesions in these locations were considered by the majority of surgeons to be inoperable. As a result of these factors I have adopted the policy of resecting every growth that can be removed even if the operation must be exceedingly radical, such as when it is necessary to remove a portion of the diaphragm, the spleen, the tail of the pancreas, or even portions of the left lobe of the liver. If after such radical surgery the patient is relieved of his obstruction and can swallow satisfactorily again, if only for six months to one year, the operation should be considered worth while.

REFERENCES

- 1 Sweet, R. H.: Recent Advances in the Surgical Management of Cases of Carcinoma of the Midthoracic Esophagus. *New England Jour. of Med.* (to be published).
- 2 Churchill, E. D., and Sweet, R. H.: Transthoracic Resection of Tumors of the Stomach and Esophagus. *ANNALS OF SURGERY*, 115, 897-917 and 116, 566-573, 1942.
- 3 Sweet, R. H.: Total Gastrectomy by the Transthoracic Approach. *ANNALS OF SURGERY*, 118, 816-837, 1943.