The Concept of Sphincter Substitution by an Interposed Jejunal Segment for Anatomic and Physiologic Abnormalities at the Esophagogastric Junction *

With Special Reference to Reflux Esophagitis, Cardiospasm and Esophageal Varices

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Previous reports from this laboratory have indicated the manner in which our attention has been drawn to the potential merits of the interposed jejunal segment operation. Recently it has been shown that when the cardiac sphincter was excised and a jejunal segment was interposed between the esophagus and the stomach, accompanied by various percentile resections of the upper stomach and combined with vagotomy and pyloromyotomy, esophagitis was completely prevented.[13] This was true in spite of chronic histamine stimulation. The interposed jejunal segment, in its new position, exhibited greater resistance to acid-peptic trauma than either the stomach or duodenum. This finding was in striking contrast to the spontaneous appearance of esophageal ulcers when continuity of the enteral tract was re-established by means of direct esophagogastrostomy, combined with identical percentile resections of the proximal stomach and vagotomy in the presence of an intact pyloric sphincter.[7]

Theoretical objections to this procedure are based on the erroneous concept that the jejunum is unusually susceptible to acid-peptic digestion and, therefore, cannot be safely anastomosed to the stomach. However, recent evidence[8-10] has indicated that there exists no important increased inherent sensitivity of the small bowel as one progresses distally from the pylorus, at least as far as the mid-jejunum. Additional unpublished evidence supports this thesis.[4] The tendency for stomal ulcer to develop following gastroenteric anastomoses to lower intestine is not related to any inherent sensitivity of that particular intestinal segment but due rather to the fact that the buffering capacity of the intestinal contents has been so altered in transit that at lower levels of the intestine it is quantitatively inadequate to neutralize acid delivered at the stoma. The buffering capacity of the upper small intestine decreases most rapidly in the first 20 to 30 cm.[3, 8] It is for this reason that a short afferent loop is important following a subtotal gastrectomy of the Billroth II plan.

The following experimental work was designed to establish whether it is necessary to resect any stomach in order to prevent esophagitis and, of equal importance, jejunitis when utilizing the interposed jejunal segment and, at the same time, to evaluate the necessity for an adjunct drainage procedure and to compare a pyloromyotomy and Finney pyloroplasty.

Table I.*

Operative Procedure	Dog Number	Prior to Histamine	During Histamine	Total Survival	Length of jejunal segment at autopsy in cm.	Distance from pylorus to jejunojejunostomy in cm.	Origin of distal end of jejunal segment. Distance from pylorus in cm.	Esophagus	Jejunal Segment	Stomach	Duodenum	Comments
Group I												
Standard operation. Intact pylorus.	Y-70	43	6	49	18	64	82	0	1	0	(3)‡	Perforated duodenal ulcer.
	Y-73	40	45	85	13	35	48	0	0	0	0	Sacrificed.
	Y-82	30	21	51	8	55	63	0	3	0	2	Sacrificed because of regurgitation.
	Y-147	30	6	36	17	65	82	0	0	2	(3)	Perforated duodenal ulcer.
	Y-148	30	6	36	17	64	81	0	0	1	(3)	Perforated duodenal ulcer.
	Y-150	30	5	35	25	70	95	0	(3)	2	3	Perforated jejunal ulcer.
	Y-155	30	5	35	19	56	75	0	0	1	(3)	Perforated duodenal ulcer.
	Y-158	30	5	35	18	76	94	0	(3)	1	(3)	Perforated jejunal and duodenal ulcers.
	Y-159	30	44	74	14	72	86	0	0	0	0	Sacrificed.
	Y-160	30	45	75	18	97	115	0	0	1	3	Sacrificed.
Group II												
Standard operation plus Rammstedt pyloromyotomy.	Y-74	30	8	38	12	45	57	0	0	0	(3)	Perforated duodenal ulcer.
	Y-75	30	5	35	4.5	48	52.5	1	2	0	(3)	Perforated duodenal ulcer.
	Y-90	30	39	69	19	72	91	0	(3)	2	3	Perforated jejunal ulcer.
	Y-99	30	45	75	10	39	49	0	0	0	0	Sacrificed.
	Y-100	30	2	32	15	Not Recorded	84	0	1	(3)	2	Perforated gastric ulcers.
	Y-104	30	44	74	9	75	84	0	2	0	2	Sacrificed.
	Y-107	30	47	77	12	57	69	0	0	0	2	Sacrificed.
	Y-111	31	5	36	16	76	92	0	0	2	3	Perforated gastric ulcers.
	Y-121	30	3	33	14	71	85	0	3	(3)	3	Sacrificed.
	Y-122	30	2	32	12.5	50	62.5	0	0	0	(3)	Perforated duodenal ulcer.
Group III												
Standard operation plus Finney pyloroplasty.	Y-92	30	44	74	22.5	79	101.5	0	0	0	0	Sacrificed.
	Y-123	30	45	75	16	106	122	0	0	0	0	Sacrificed.
	Y-125	30	45	75	14	70	84	0	0	2	0	Sacrificed.
	Y-127	31	45	76	17	81	98	0	0	0	0	Sacrificed.
	Y-128	30	44	74	15	51	66	0	0	0	0	Sacrificed.
	Y-136	30	4	34	14.5	83	97.5	0	0	(3)	1	Perforated gastric ulcer.
	Y-138	30	8	38	16.5	60	76.5	0	0	0	(3)	Perforated duodenal ulcer.
	Y-143	30	9	39	11.5	89	100.5	0	0	(3)	2	Perforated gastric ulcer.
	Y-144	30	2	32	14	82	96	0	0	2	0	Death due to severe diarrhea.
	Y-157	31	6	37	20	69	89	0	3	1	(3)	Perforated duodenal ulcer.

Postoperative Survival Days (columns: Prior to Histamine, During Histamine, Total Survival)

Gross and microscopic pathology Graded 1–3 according to severity.† (columns: Esophagus, Jejunal Segment, Stomach, Duodenum)

*The first three animals in each series have been reported previously in a preliminary report.(5)
†The severity of the pathology has been graded numerically, both grossly and microscopically, according to the following scheme:
Grade 1—Inflammation only without erosion or ulceration.
Grade 2—Erosion not greater than 1 cm. in diameter and not extending into the muscularis.
Grade 3—Erosions greater than 1 cm. in diameter or ulcers extending into the muscularis.
‡Parentheses indicate perforation.

OPERATIVE PROCEDURE

BASIC PREPARATION

1. Excision of esophagogastric junction
2. Closure of cardia
3. Interposition of an isoperistaltic segment of jejunum between the esophagus and intact stomach
4. Bilateral vagotomy

ADJUNCT DRAINAGE PROCEDURES

Group I   Intact pyloric sphincter

Group II   Rammstedt pyloromyotomy
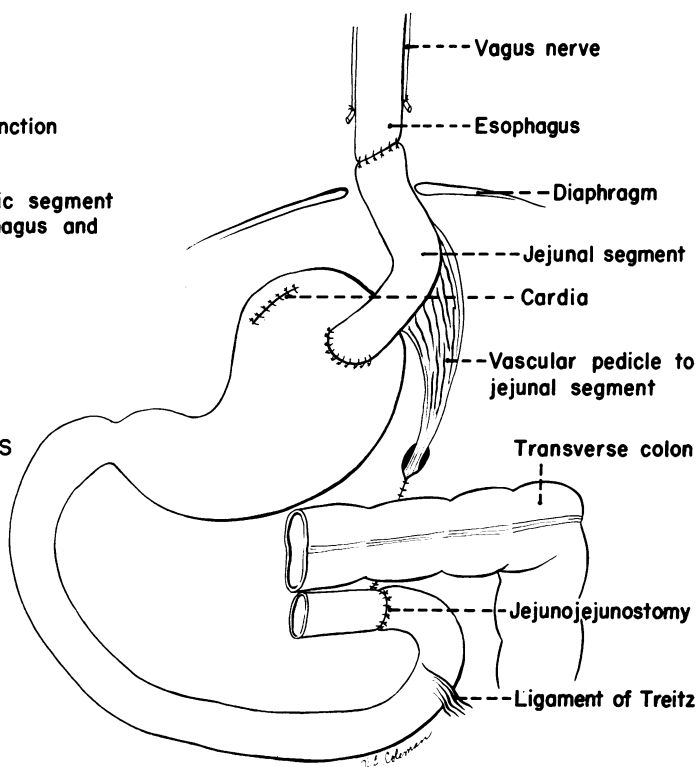
Group III   Finney pyloroplasty

Vagus nerve

Esophagus

Diaphragm

Jejunal segment

Cardia

Vascular pedicle to jejunal segment

Transverse colon

Jejunojejunostomy

Ligament of Treitz

FIG. 1.

METHOD OF STUDY

Thirty adult mongrel dogs, averaging 12.6 Kg., were used in this study. Anesthesia consisted of intravenous Nembutal supplemented with intermittent endotracheal ether and oxygen administered by means of a Palmer respirator. Either an abdominal (27 cases) or a left thoracoabdominal (three cases) incision was used. Excision of the esophagogastric junction, including at least 1 cm. of esophagus, closure of the cardiac end of the stomach, bilateral supra-diaphragmatic vagotomy, and retrocolic interposition of an isoperistaltic segment of jejunum between the esophagus, and a neo-stoma on the anterior surface of the fundus of the stomach were performed on each animal. Three series were developed: Group I (ten animals) had only the standard operative procedure with an intact pyloric sphincter;

Group II (ten animals) had, in addition to the standard operation, a long Rammstedt pyloromyotomy; and, Group III (ten animals) had a Finney pyloroplasty (Fig. 1).

Postoperatively each animal received 300,-000 units of penicillin, I.M. q.d., for three days. Clyses were given for three to six days, depending upon the general condition of the animal. Fluids by mouth were allowed by the fourth or fifth day. A special diet of osterized milk and Friskies dog food was introduced and gradually increased as tolerated over the subsequent week.

After a 30 day recovery period, all animals were begun on daily injections of 30 mg. histamine base in oil and beeswax. Histamine phosphate was employed in this preparation. Each new mixture was tested for potency on Heidenhain pouch dogs and, also, concurrently was given to a control
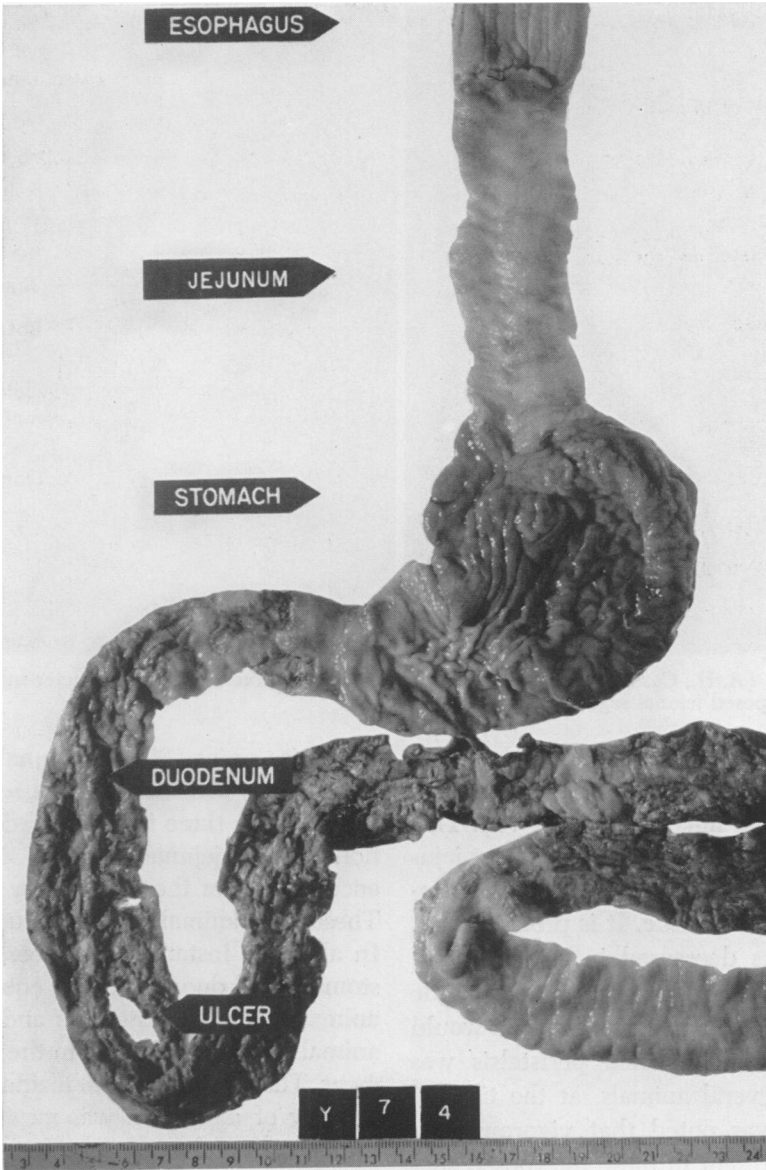
FIG. 2. Dog No. Y-74 (Group II). Photograph showing severe duodenitis with ulceration and perforation after eight days of histamine administration. There is no jejunal segment pathology. The esophagus is clean.

series. Each preparation was found to be ulcerogenic. After a course of 45 days on histamine, all survivors were sacrificed. Gross abnormalities were noted and representative photographs taken.

Histological sections were taken on all animals as follows: (1) through the esophagus, 5 cm. proximal to the esophago-jejunal anastomosis; (2) through the esophago-jejunal anastomosis; (3) from the center section of the jejunal segment; (4) across the jejuno-gastric anastomosis; and (5) other sections as indicated.

RESULTS

The severity of pathologic conditions encountered is tabulated and explained in Table I.
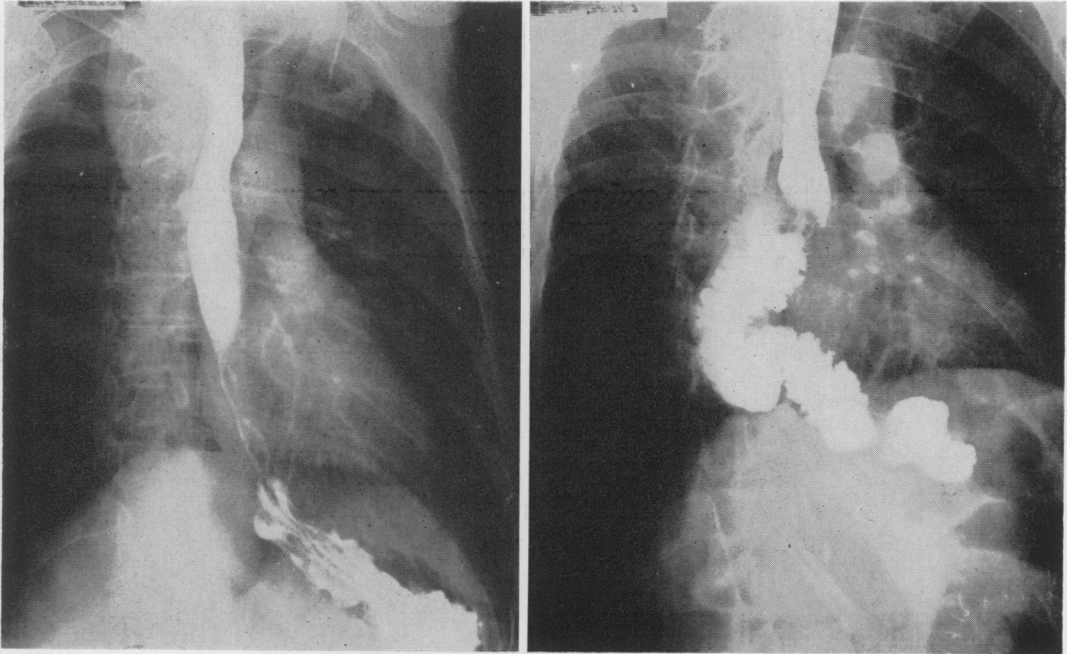
Fig. 3. (A. H., Case 1.) Roentgenologic studies taken before and after sphincter substitution by an interposed jejunal segment.

There were no ulcers of the esophagus in any of the animals. There was only one case of even minimal inflammation (Y-75). This occurred in an animal with the shortest jejunal segment (4.5 cm.) which was immobilized by scar tissue. It is probable that peristalsis was decreased in this segment; consequently, regurgitation of acid-peptic juices could occur more readily than would be possible when normal peristalsis was present. In several animals, at the time of sacrifice, it was noted that vigorous peristalsis was present in these interposed segments. In others this was observed by barium swallow.

Severe gastric and duodenal ulceration was produced in all groups. Eighty per cent of the animals in Group I had ulceration of the stomach and/or duodenum, 90 per cent in Group II, and 60 per cent in Group III. There was some degree of jejunal reaction in 40 per cent of the animals in Group I, 50 per cent in Group II, and only in 10 per cent of the animals in Group III. In six animals of the entire series (30) the jejunal pathologic change was considered to be severe. However, in only three instances did the ulceration in the jejunal segment exceed that encountered in the stomach or duodenum. These three animals were in Groups I and II. In all other instances the ulceration of the stomach and duodenum was equal to (three animals) or more extensive and severe (17 animals) than that found in the jejunal segment. Therefore, both the incidence and the severity of ulceration was much greater in the stomach and duodenum than in the interposed jejunum in all three groups (Fig. 2). However, by comparison, the results were best in Group III.

The average length of the interposed jejunal segment was 16.7 cm. in Group I; 12.4 cm. in Group II; and 16.1 cm. in Group III. Jejunal ulceration, when it did occur, was always in the distal portion of the interposed segment, and was never found more than 14 cm. proximal to the jejunogastric anastomosis, and in most instances, not over 4 to 5 cm.
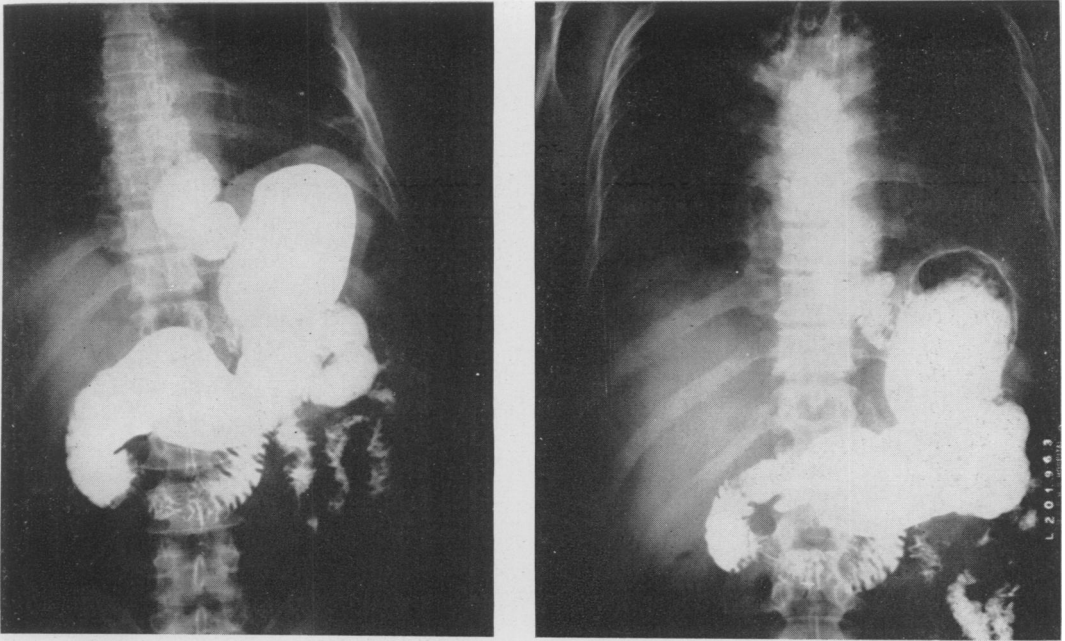
FIG. 4. (M. C., Case 7.) In these postoperative roentgenograms the interposed segment gives a "coiled spring" appearance. The mobility and peristaltic activity of the segment is well demonstrated. Both factors are important in its behavior as a substitute sphincter.

An important aspect relative to this procedure is concerned with the relative sensitivity of the gastro-intestinal tract. The question arises whether it is safe to use a jejunal segment taken some distance distal to the ligament of Treitz. To further test this, the distance from the pylorus to the jejuno-jejunal anastomosis was measured. This was the site from which the interposed jejunal segment was taken. Therefore, this distance, plus the length of the interposed jejunal segment, represents the site of origin of the distal end of the interposed segment. This is the mucosa which is exposed most directly to the gastric contents. If the sensitivity of the intestinal mucosa increases progressively in lower segments of the bowel, one would expect some correlation between this distance and the degree of jejunal involvement encountered. Such was not the case (Table I). This fact further supports an earlier contention that no important differential sensitivity of the mucosa of the upper small bowel to acid and pepsin exists.

DISCUSSION

In problems of severe stenosing esophagitis, when excision is contemplated, the vagi often are so tightly incorporated in the fibrotic reaction that the sacrifice of these nerves is frequently unavoidable. Furthermore, instances of peptic esophagitis, associated with ulcerations of the stomach and/or duodenum, are not uncommonly encountered as well. In anticipation of these clinical situations, bilateral vagotomy was incorporated into this experimental preparation. Consequently, this necessitated a consideration of the addition of an ancillary drainage procedure.

In dogs with Heidenhain pouches it has been reported that vagotomy considerably increased pouch secretion, presumably because of stasis stimulation of the hormonal phase of gastric secretion.[14] Furthermore, after vagotomy, a Finney pyloroplasty restored pouch secretions almost to control levels.[11] This observation is supported by contrasting the incidence and severity of
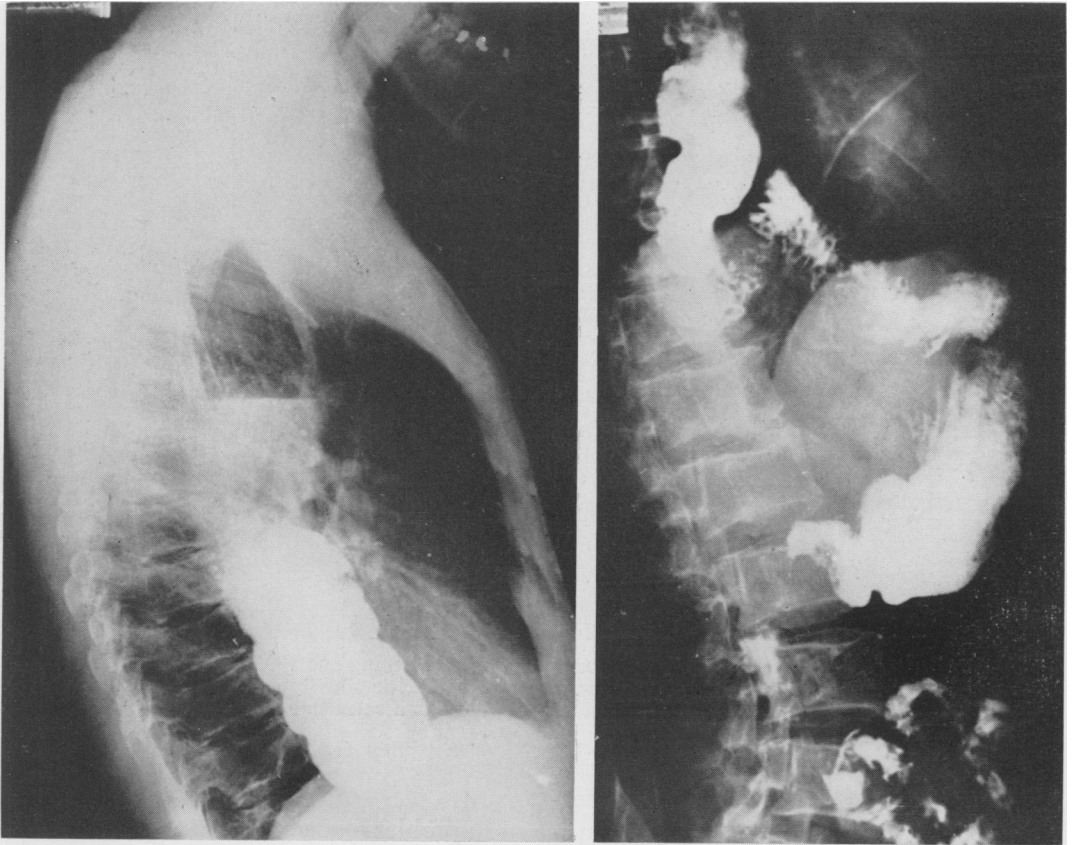
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FIG. 5. (G. H., Case 9.) *Left.* A preoperative side view of this patient with cardiospasm. *Right.* A postoperative roentgenologic study with the patient in approximately the same position following sphincter substitution by an interposed jejunal segment.

acid-peptic disease observed in Group I (intact pylorus) and Group II (pyloromyotomy) versus that observed in Group III (pyloroplasty). Because of the similar results in Groups I and II, one must conclude that the use of a pyloromyotomy is probably an inadequate drainage procedure for the vagotomized stomach. By contrast, those animals in which a Finney pyloroplasty (Group III) was performed exhibited a marked reduction in acid-peptic disease. Therefore, it is apparent that a pyloroplasty is an effective drainage operation in the experimental preparation used.

In the normal course of events, vagotomy would be expected to exert a protective influence with regard to peptic ulcerations; however, these benefits have been negated

in these experiments by the artificial stimulation with histamine which acts directly on the parietal cell. While there is some experimental evidence showing that the effectiveness of histamine stimulation is decreased by vagotomy,[8] the occurrence of severe gastric and duodenal ulceration in these dogs indicated that this factor was probably obscured by severe histamine stimulation. In fact, the per cent of ulceration obtained was essentially the same as that obtained for histamine stimulation in normal unoperated dogs. Consequently, the protective advantage of the vagotomy in these experiments has been bypassed.

In no instance in this series was jejunal pathologic change of even a microscopic nature observed 15 cm. proximal to the
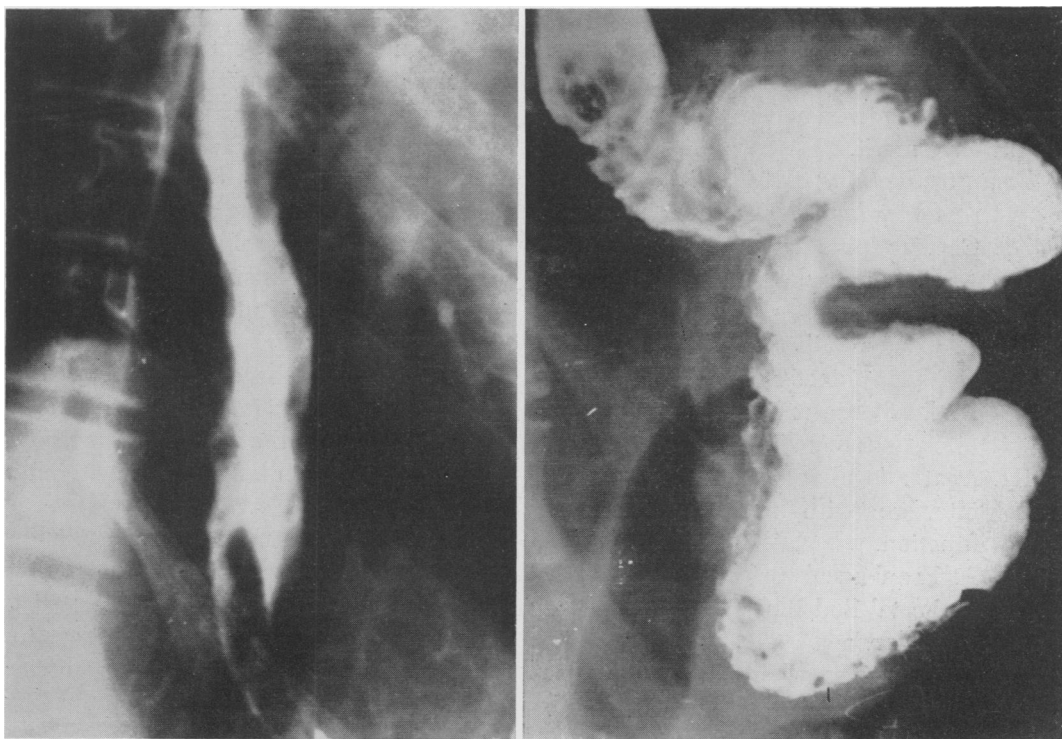
Fig. 6. (G. O., Case 11.) *Left*. Preoperative visualization of large esophageal varices. *Right*. A close-up view of the interposed jejunal segment on the tenth postoperative day.

jejunogastrostomy. Undoubtedly, shorter segments would be effective as well. On the other hand, the shortest segment (4.5 cm.) utilized was associated with mild esophagitis. An additional factor affecting the length of jejunal segment necessary to replace the cardiac sphincter in the dog may be related to the horizontal position of its upper gastro-intestinal tract. Consequently, in the dog, contrasted with the upright human, reflux may occur more readily. The fact that reflux in these dogs did not constitute a problem indicates that the jejunum behaves as a physiological sphincter. This behavior must be related to the retained peristaltic pattern of the jejunum. The law of peristalsis creates unidirectional flow. This pattern undoubtedly limits the extent of reflux from the stomach. In addition, segmental contractions would tend to exert a restricting influence as well. Both types of peristaltic patterns tend to protect not only the jejunum

but also the esophagus. An additional factor undoubtedly helpful in protecting the jejunum is the constant bathing of the mucosa by salivary secretions, plus the fact that it is out of the normal pathway for the egress of gastric contents.

CLINICAL ASPECTS

Clinical evidence indicates that when the cardiac sphincter is destroyed by incision, esophagitis frequently occurs.[2] In addition, when excision of the cardiac sphincter is carried out, with restoration of the gastro-intestinal tract by esophagogastrostomy, the subsequent development of esophagitis is not an infrequent complication.[12] Therefore, it would appear logical to consider the use of a sphincter substitution procedure in conditions where cardiac sphincter dysfunction, on an anatomic or physiologic basis, is manifest, or where, by the nature of the pathologic changes present, the car-

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diac sphincter must be sacrificed by the operative procedure, or is unavailable for use. As a consequence, a tentative working classification has evolved where this procedure might have merit.

Tentative working classification:
Physiological Disorders

I. Cardiac sphincter relaxation.
  A. Reflux esophagitis with complications.
  B. Congenitally short esophagus.

II. Cardiac sphincter spasm.
  A. Cardiospasm or achalasia.

Anatomic Disorders

III. Anatomic abnormalities which may interfere with normal sphincteric function.
  A. Esophageal varices (Extrahepatic Portal Bed Block).

IV. Miscellaneous.
  A. Situations wherein the sphincter is unavailable or must be sacrificed.
    1. Circumferential heterotopic gastric mucosa.
    2. High lying gastric ulcer.
    3. Benign tumor.
    4. Lye strictures.
    5. Distal esophageal atresia, with or without tracheo-esophageal fistula.

The primary patho-physiology in reflux esophagitis is an incompetent cardiac sphincter. Because of sphincter relaxation the regurgitation of gastric chyme occurs. The development of esophagitis and its complications is a secondary phenomenon; consequently, the primary need is for a replacement of the sphincter itself. It appears superfluous to mention that the reflux of gastric chyme occurs with and without esophageal hiatus hernia, and with or without serious esophagitis. In order to avoid misunderstanding, a sphincter substitution procedure would not be considered in the asymptomatic patient or patients with reflux esophagitis associated with hiatus hernia which is readily curable by hiatal repair. To date, an interposed jejunal segment has been considered only in the patient with serious complications of esophagitis, *viz.*, stricture and/or ulceration, hemorrhage, and perforation, which may not be satisfactorily managed by ordinary surgical procedures. Esophagitis likewise frequently occurs in the patient with congenitally short esophagus. While the jejunal segment may be used as an esophageal substitute in the deliverance of the stomach below the diaphragm, the primary value of the operation is that of sphincteric substitution. This would appear to be true whether the stomach is deposited into the abdomen, or left partially within the chest.

The exact counterpart of cardiac sphincter relaxation is cardiospasm, or achalasia. In our experience, those patients subjected to either the Gröndahl or Heller operations too frequently have traded their primary disease of cardiospasm for that of reflux esophagitis. It would appear that the primary need in the patient with cardiospasm is a new sphincteric mechanism.

Esophageal varices have been cited as an example of an anatomic abnormality which may interfere with normal sphincteric function. The rationale for the utilization of a substitute sphincteric mechanism in this situation centers about several considerations. We are in agreement with those who believe that massive hemorrhage from esophageal varices is, in the main, secondary to acid-peptic esophagitis.[1, 15] In patients with bleeding esophageal varices uncontrolled by medical management, on surgical exploration the bleeding site has been so low in the esophagus that it is difficult at times for the operator to be sure whether the bleeding site is from the lower esophagus or the upper stomach. While exceptions to this undoubtedly can be related, they remain exceptions to the rule. In attempting to explain the propensity of esophageal varices to bleed, in contrast to the rectal hemorrhoid in the same patient, it should be pointed out that both are subjected to the trauma of semi-coarse

Peradium

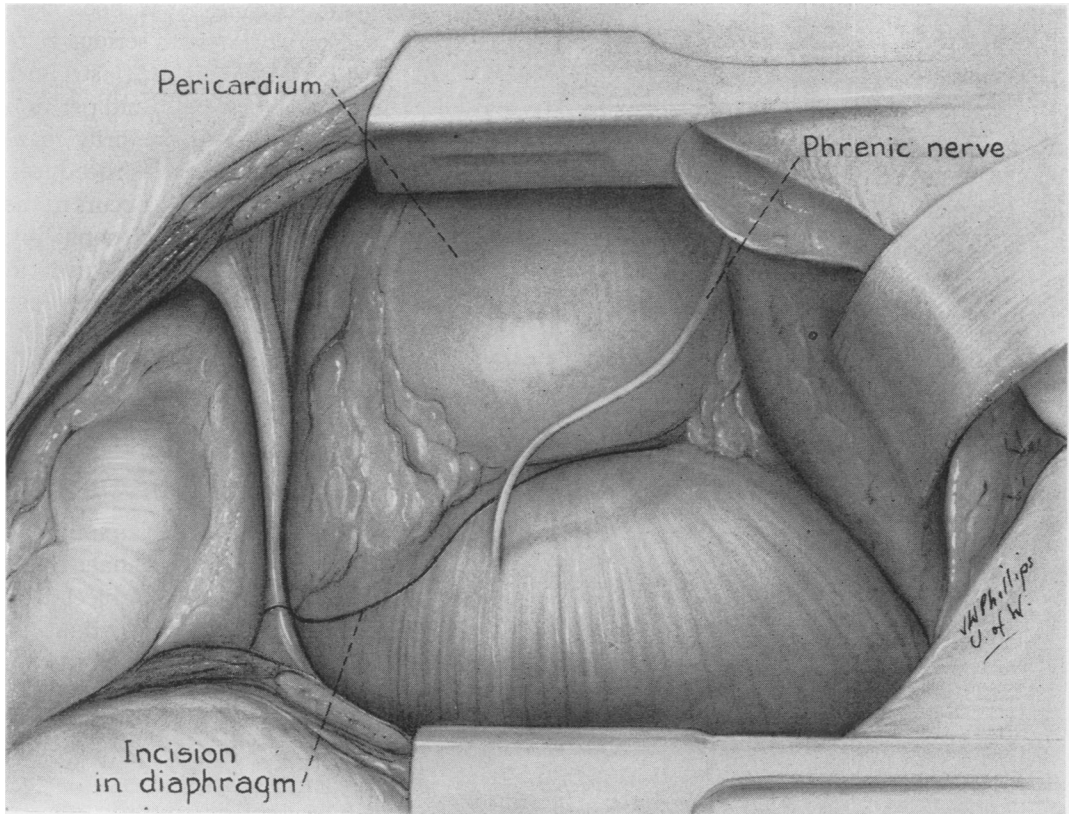Phrenic nerve

Incision
in diaphragm

FIG. 7. Exposure indicating level of diaphragmatic incision between the phrenic nerve and the pericardial attachment to the diaphragm.

material passing over them. One might anticipate that rectal hemorrhoids, in this situation, might bleed more readily than esophageal varices, for the actual pressure in the rectal hemorrhoid is greater than that in the esophageal varix. In our experience, rectal hemorrhage has never been observed in patients with portal bed block. Actually, the major difference between the esophageal varix and the rectal hemorrhoid in bleeding potential is the juxtaposition of gastric chyme to the esophageal varix. In attempting to explain the occurrence of esophagitis in the patient with the esophageal varix, one can only speculate. It is our feeling that the mere mass and weight of the varix when the patienet is upright may allow it to prolapse into the stomach much as a rectal hemorrhoid prolapses to the outside. When this occurs, the extremely sensitive esopha-

geal mucosa is exposed to acid-peptic juice. The esophagus exhibits a relatively minor submucosal layer, which in the stomach, by comparison, is thick and gives added protection to upper gastric varices. Therefore, when the esophageal mucosa becomes eroded, the varix wall itself is immediately beneath. Furthermore, it is conceivable that the contour of the varices does not allow the complete protection of the esophagus at all times from the reflux of gastric chyme into the esophagus. With little imagination, one may envision incomplete closure of the esophagogastric junction with the seepage of gastric chyme between the longitudinal varices themselves.

The utilization of the interposed jejunal segment here is based not upon the principle of esophageal resection and substitution but on the basis of the spatial separation of
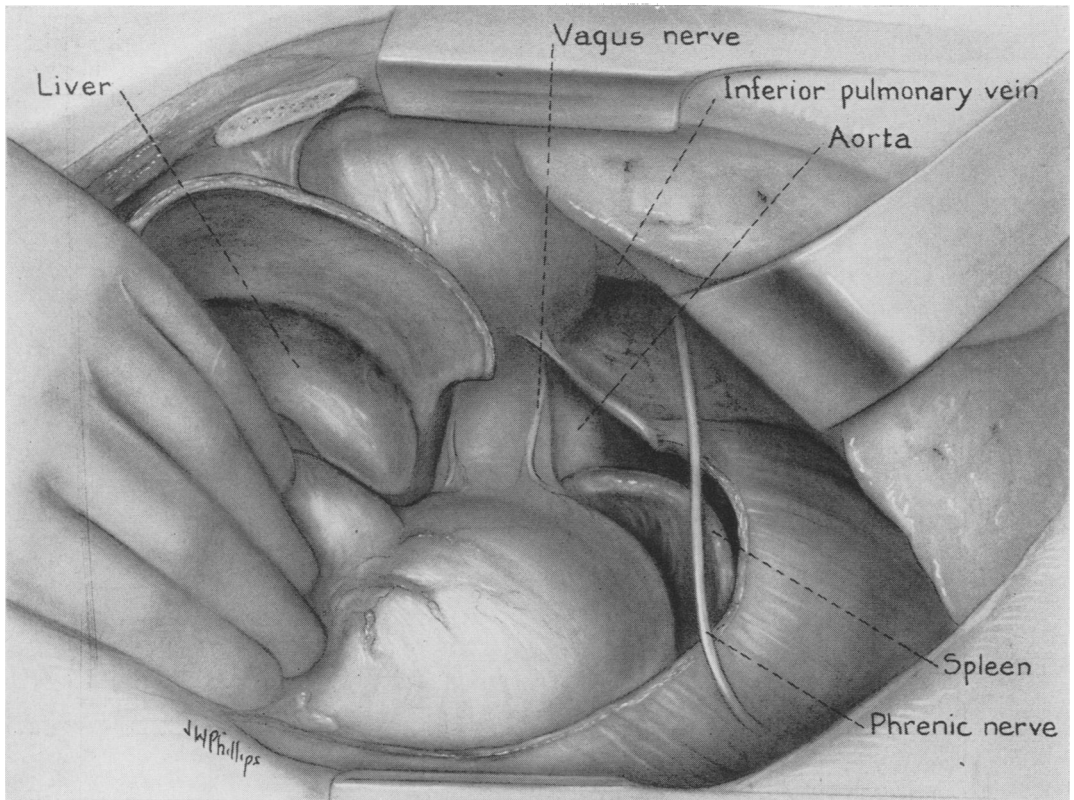
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FIG. 8. Completed diaphragmatic incision except for the unimportant anterior branch, the phrenic nerve is preserved. In order to avoid tension on the nerve it must be separated with the pericardiacophrenic vessels from the pericardium. The coronary ligament of the left hepatic lobe has been cut and the left lobe of the liver retracted. The inferior pulmonary ligament has been severed.

the esophageal mucosa with its varices from contact with gastric juice. By the utilization of the interposed segment, one is exposing the jejunal mucosa, which is more resistant to acid-peptic digestion than is the esophageal mucosa. In addition, this segment presumably will not develop varices itself. Whether these theoretical considerations are valid, time alone will tell.

The lesions listed in the miscellaneous category are only examples. This list is not meant to be all inclusive; however, these examples do have one common denominator. Essentially, they represent situations in which the cardiac sphincter must be excised incidental to the removal of localized pathologic conditions or where the lower esophagus and sphincter are not available for re-

constructive surgery. It is apparent that the presence of free acid would be an important factor in the decision to employ the interposed jejunal segment. If achlorhydria were present there would be little merit in considering the interposition operation, for its utilization is based on the protecton of the esophagus against acid-peptic digestion.

Encouraged by consistent experimental findings, combined with a dissatisfaction of the clinical results when certain other operations have been utilized for some of the above conditions listed, this operation has been performed on 12 patients: In eight patients for reflux esophagitis with esophageal ulcer and/or stricture, one with cardiospasm, two with extrahepatic portal bed block with esophageal varices, and one in

the miscellaneous category. The following is a brief case report on each patient.

CASE REPORTS

I. Cardiac Sphincter Relaxation.
A. Reflux Esophagitis with Complications.

Case 1. A. H., KCH #238757, a 42-year-old white male, a chronic alcoholic, first noted dysphagia, hematemesis and melena in 1950. Roentgenologic studies on April 28, 1951, revealed lower esophageal stricture with hiatus hernia. These were confirmed by esophagoscopy on August 10, 1951. By April 22, 1952, the lower one-third of the esophagus was stenotic, with a diameter of less than 0.5 cm. Esophageal dilatations were carried out without benefit. On June 3, 1952, the first stage of a planned 2-stage operation was carried out. This consisted of excision of the lesion with a Roux-en-Y esophagojejunostomy, bilateral vagotomy, and pyloromyotomy. The stomach was bypassed and out of circuit.

On October 22, 1952, the isolation of the jejunal segment was completed, and the distal end anastomosed to the anterior stomach wall. Between stages the patient was losing weight despite the intake of a carefully calculated 2500 calorie diet. Following the second operation the patient exhibited marked subjective and objective improvement, with progressive weight gain, and has been completely free of any complaints (Fig. 3).

Comment. This patient has remained a chronic alcoholic and has been on alcoholic sprees, including coma, on several occasions. Consequently, the operative procedure has been given the acid test, both literally and figuratively, for alcohol is a severe stimulator of gastric juice, and presumably acts directly on the parietal cell. The patient, in this sense, is by-passing the protective influence of vagotomy and is reduplicating the animal experiments in which histamine experimentally has been used to accomplish the same thing. It would appear that A. H., in a 2½ year follow-up, has exposed his jejunal segment to more trauma than a more conservative patient might conceivably do in a lifetime!

Case 2. L. M., VAH #7382, a 46-year-old white male fisherman and miner, a chronic alcoholic, was first admitted on August 6, 1952, with symptoms of reflux esophagitis and hiatus hernia. This was confirmed by esophagoscopy and roentgenogram. At operation on August 14, 1952, a sliding esophageal hernia was found, and a penetrating ulcer of the herniated portion of the fundus was entered into. Although some shortening of the esophagus was present, the esophagogastric junction was deposited below the reconstructed diaphragm. Some tension was present. During this admission previous neurological findings became more manifest. The patient developed marked extremity weakness and incoordination. This was diagnosed as pellagra secondary to alcoholism, with prolonged inadequate nutrition.

He was readmitted on May 6, 1953, to the hospital for further study of his peripheral neuritis; however, the patient had suffered a 40 pound weight loss, and demonstrated almost complete esophageal obstruction. Roentgenograms and esophagoscopy confirmed the diagnosis of lower esophageal stricture. On May 25, 1953, the stricture was excised and the first stage of a planned, two-stage procedure was carried out. This consisted of an esophagojejunostomy en-Roux-Y, bilateral vagotomy, and a pyloromyotomy with the stomach out of circuit.

Upon discharge he returned to Alaska to work, and did not return for the second stage of the procedure. He gained 26 pounds. He returned eventually with the complaint that large meals were poorly tolerated. At this time, on January 3, 1955, the second stage was completed, with isolation of the jejunal segment and anastomosing the distal portion into the anterior wall of the stomach. Because the pyloric sphincter at the site of pyloromyotomy appeared to be reformed, a Finney pyloroplasty was done. At the time of discharge he was eating well, without postprandial distress and had no complaints referable to his intestinal tract.

Case 3. A. M., KCH #142407, a 65-year-old white male blacksmith, a chronic alcoholic, with symptoms of esophageal stricture and hematemesis since January, 1953. Medical treatment was attempted on several occasions, without success. Roentgenograms on November 5, 1953, revealed lower esophageal stricture with small hernia. On November 11, 1953, an interposed jejunal segment operation was carried out, with bilateral vagotomy and longitudinal incision of the pyloric sphincter with transverse closure. His convalescence was uneventful. Subsequent roentgenograms revealed some delayed emptying of the stomach which eventually improved. His only complaint has been palpitation and sweating after some meals but without diarrhea.
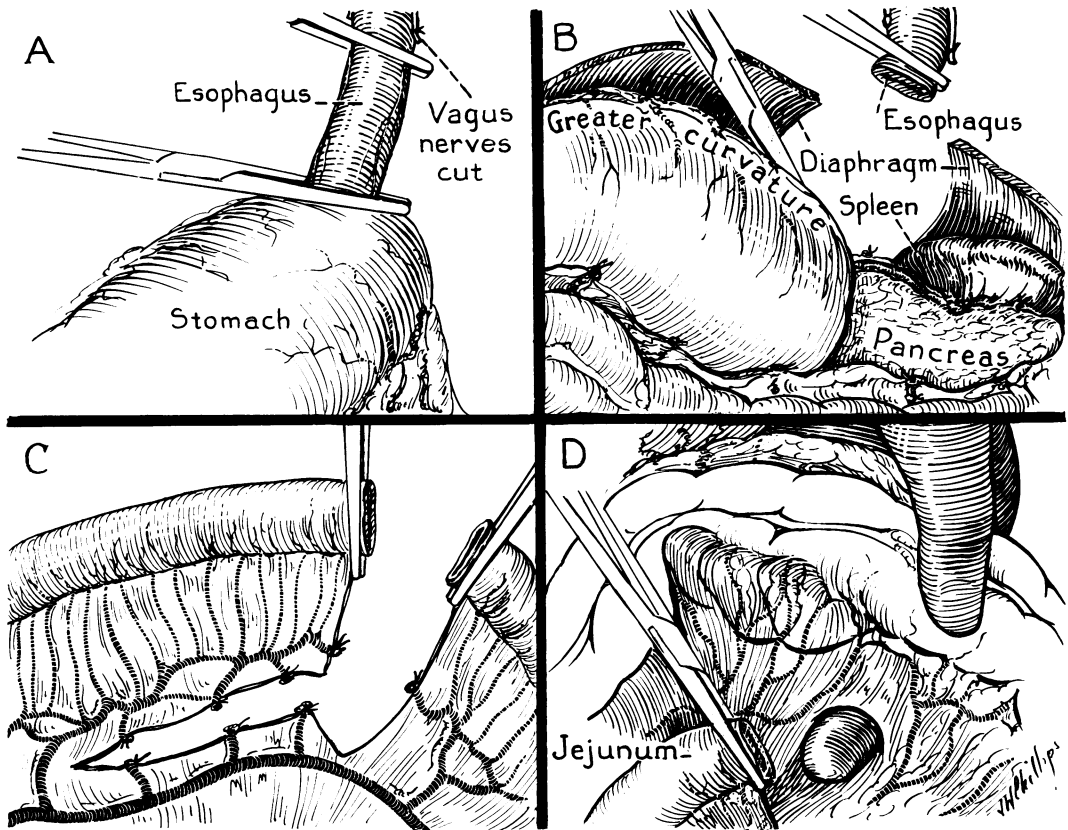
FIG. 9. (A) A bilateral vagotomy has been performed. The lesion is excised, making sure that all of the squamous epithelium of the esophagus has been removed with the cardia. (B) The gastro-splenic ligament is divided, as well as the attachments between the dorsal wall of the somach and posterior peritoneum and pancreas. This maneuver makes the lesser omental sac and posterior mediastinum contiguous. (C) Development of the jejunal segment. (D) An opening is made in an avascular area of the transverse mesocolon and the jejunal segment, with blood supply intact, is delivered in retrocolic fashion into the lesser omental sac.

Comment. This mild dumping syndrome is not disturbing to the patient. His complete freedom from the previous symptoms of esophagitis, in his opinion, more than compensate him for his mild difficulties at present.

Case 4. H. C., KCH #300018, a 75-year-old white female, a moderately severe arthritic, with a past history of cholecystectomy on March 11, 1953. On April 30, 1953, a hiatus hernia was demonstrated. The patient at this time had mild symptoms of esophagitis. On August 13, 1953, roentgenologic examination revealed a narrowed esophagus, beginning just distal to the aortic arch. By November 17, 1953, the entire lower half of the esophagus was narrowed. Upon dilatation a #24 French bougie could be passed with difficulty. Symptoms

persisted and the patient was dissatisfied with repeated dilatations.

Consequently, the lesion was excised on October 6, 1954, and an interposed jejunal segment procedure was performed, together with a bilateral vagotomy and Finney pyloroplasty. The esophagojejunal anastomosis was just beyond the aortic arch. The patient's course was complicated by continued nasal suction, which resulted in a severe fluid balance problem; this was recognized late. After careful, slow adjustment of fluids and electrolytes, the patient developed atelectasis, and expired on the thirteenth postoperative day.

Comment. Autopsy examination revealed an intra-abdominal abscess adjacent to the Finney pyloroplasty, with perforation of the stomach wall immediately adjacent to the

anastomotic line. The patient had had an indwelling nasal gastric tube of a rather hard plastic material. It was felt that this tube had eroded through the gastric wall, as no defect in the anastomotic line could be seen at autopsy.

This patient represents the only death in this series. It should be recorded as a preventable fatality.

Case 5. B. J., KCH #203060, a 71-year-old white male dishwasher, had symptoms of dysphagia in early 1953. In July, 1953, a hiatus herniaplasty was performed. Complete relief of symptoms was obtained until November, 1953, when dysphagia returned. In September, 1954, roentgenologic studies revealed lower esophageal stricture with free reflux. Esophagoscopy revealed chronic ulcerative esophagitis. This was confirmed microscopically. On November 22, 1954, the lesion was excised and a jejunal segment, 20 cm. long, was interposed between the esophagus and cardia, accompanied by a bilateral vagotomy and Finney pyloroplasty. The esophago-jejunal anastomosis was made in an area which was grossly reddened. While the squamous epithelium was identified posteriorly, it was not identifiable anteriorly too well. The esophagus was not sectioned more proximally, as it was felt that similar pathology extended up much higher. While the lumen was not full sized, it was thought to be adequate.

The patient's postoperative course was uneventful. Soft diet was taken by the fifth postoperative day. Following discharge he ignored requests to return for follow-up, but in March 1955 he returned voluntarily with dysphagia, regurgitation, and some weight loss. Roentgenologic examination revealed esophageal stenosis immediately proximal to the esophago-jejunal anastomosis. This stricture was approximately ¾ in. in length. Beyond this area there was no obstruction, and the stomach emptied normally. This stricture was dilated to a #45 French, and the patient was discharged to be followed as an out patient. He was taking a regular diet without difficulty, and was gaining weight rapidly.

Comment. In our opinion, this result does not represent a failure of the procedure. Actually, the esophagus proximal to his present stricture appears normal by esophagoscopy. In essence, his stenosis resulted from the continued healing of his esophagitis present at the time of operation. This result represents an error in judgment. On previous occasions the esophago-jejunal anastomosis had been made in areas of abnormal esophagus and the results had been excellent. In retrospect, the beefy esophagitis present here was the most severe noted to which an anastomosis has been effected. It is apparent that, had the esophageal resection been extended an inch higher, which could easily have been done, this complication would have been avoided. It is hoped that dilatations will be infrequent and possibly discontinued since the patient no longer has reflux of acid-peptic contents into this area.

Case 6. F. C., KCH #130206, a 59-year-old white, male merchant seaman, a chronic alcoholic, with dysphagia with vomiting since 1950, was admitted with active tuberculosis at Firlands Sanatorium. A 2-stage, 7 rib thoracoplasty, left, was performed. During hospitalization a hiatus hernia was diagnosed by roentgenogram. Patient was discharged on January 19, 1951, and was seen at this hospital on November 22, 1954, with severe esophagitis with hematemesis. Roentgenogram revealed a lower esophageal stricture, with hiatus hernia.

On December 31, 1954, an interposition operation was performed with bilateral vagotomy and Finney pyloroplasty. The segment extended between the esophagus and cardia. His postoperative course was uneventful except for a wound infection which healed following excision of a short projecting rib segment. Following discharge there was temporary difficulty with gastric stasis, but this has subsided. At present the patient has no complaints.

Comment. This patient's vital capacity was 1000 cc. Maximum breathing capacity, 30 per cent of normal. Differential bronchospirometry indicated that 90 per cent of his pulmonary function was on the right side. Consequently, it was felt that a left thoracotomy would not disturb the patient greatly. His postoperative course was exceptionally smooth. Because of the left thoracoplasty an intercostal incision was impossible. Therefore, it was necessary to sever several ribs in order to gain adequate exposure under the thoracoplasty.

Case 7. M. C., PHH #201963, a 45-year-old white male, a marine foreman who was a chronic alcoholic. On admission, August 18, 1954, the
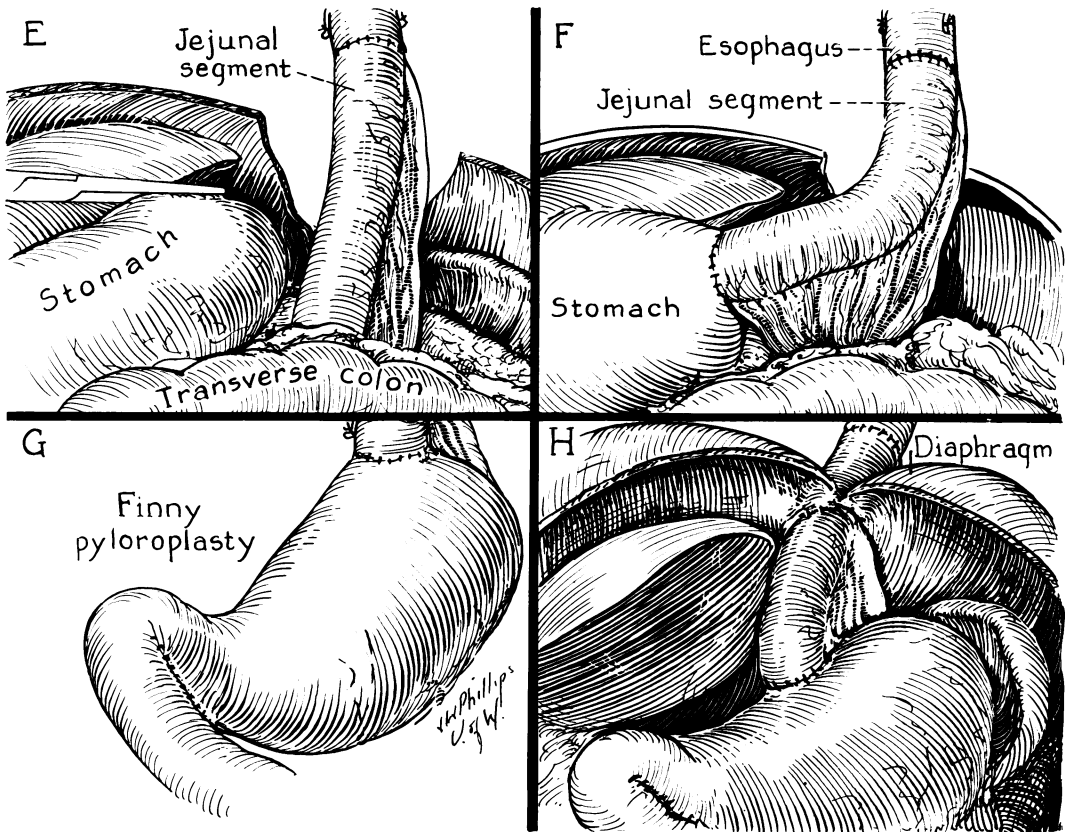
FIG. 10. (E) End-to-end esophagojejunostomy. (F) The jejunum has been divided, isolating a 15 to 20 cm. segment. The lower end has been anastomosed, end to end, to the cardia. (G) Finney pyloroplasty. (H) The diaphragm has been approximated by two sutures ventral to the original apex of the crura. By means of a slight downward pull, the interposed segment is straightened in the posterior mediastinum. Sutures are taken between the edges of the diaphragm and the segment, in order to hold it in this position.

patient gave a history of a constant, severe, high epigastric pain, unrelieved by food or medication. A more severe pain was precipitated by eating solid food. This was associated with substernal burning and dysphagia. There was some penetration of this pain to the lower dorsal area. There was occasional hematemesis and melena, with loose watery stools. Esophagoscopy revealed an esophageal ulcer 2 to 3 cm. above the cardia. Medical therapy was attempted, without success. Roentgenograms on August 25, 1954, revealed constant constriction of the esophagus two inches above the cardia, and lumen 0.5 cm. in diameter.

On November 29, 1954, the lesion was excised and a segment of jejunum (20 cm. long) was interposed between the proximal esophagus and cardia, accompanied by a bilateral vagotomy and a longitudinal incision of the pylorus with transverse closure. His postoperative course was uncompli-

cated. Only complaints at present are related to the chest incision (Fig. 4).

Case 8. C. Y., PHH #216266, a 56-year-old white male Indian, a chronic alcoholic, with dysphagia, which was noted 4 to 5 years prior to admission. Periodic dilatations had been carried out during this period. At the time of hospitalization here, the patient was unable to swallow solid foods. Esophagoscopy and dilatation were carried out on February 1, 1955. Esophageal ulcerations with a tight stricture at 35 cm. from the incisor teeth was noted. The esophagoscope could not be passed beyond this point. With the greatest difficulty this area was dilated to a #18 French. Repeated subsequent attempts to dilate the stricture met with failure. Roentgenologic studies revealed a dilated proximal esophagus with two pulsion diverticuli. One was 3 cm. in diameter at the level of T_3; a smaller one was just proximal to the stricture.
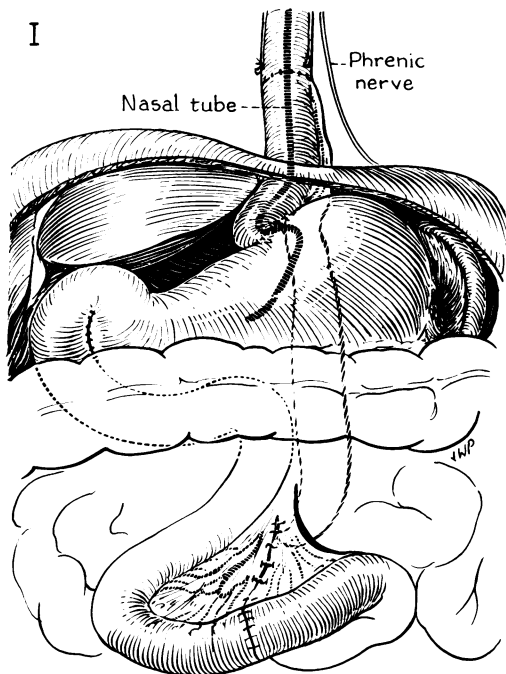
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FIG. 11. Any excess jejunum is delivered below the transverse mesocolon and a jejunojejunostomy is performed. The opening in the mesocolon is closed loosely, taking care not to impinge on the pedicle to the interposed segment. Ordinarily, these steps are taken prior to the Finney pyloroplasty (Fig. 10G) and partial closure of the diaphragm (Fig. 10H).

On February 14, 1955, the lesion was excised and sphincter substitution by an interposed jejunal segment 20 cm. long was carried out. The segment extended between the proximal esophagus and cardia. In addition, a bilateral vagotomy and Finney pyloroplasty were performed. The excised specimen revealed subacute esophagitis with stricture. On the second postoperative day the patient pulled out his nasal tube. By the fourth postoperative day he was eating a soft diet. Roentgenograms on the eighth postoperative day exhibited a normal functioning segment. At present the patient is asymptomatic.

II. Cardiac Sphincter Spasm.
A. Cardiospasm.

Case 9. G. H., KCH #319503, a 47-year-old white male laborer, who in January, 1953, had a Heineke-Mikulicz type of cardioplasty for "achalasia." There was apparent temporary relief from vomiting and dysphagia but symptoms of esophagitis became prominent. In June, 1954, the patient was re-explored for hiatus hernia but none was

found. The hiatus was "tightened." The patient was first seen in this hospital in July, 1954, for severe symptoms of esophagitis. Roentgenologic studies revealed a mega-esophagus with lower esophageal stricture.

On July 19, 1954, the lesion was excised and a jejunal segment 20 cm. long was interposed between the esophagus and the anterior wall of the stomach. In addition, a bilateral vagotomy and Finney pyloroplasty were carried out. Postoperative course was uneventful except for some hematemesis. Patient was eating soft foods well by the eighth postoperative day, and since operation, has been able to eat a normal diet. Patient has complained of some diarrhea, but none has been observed here on two admissions for its investigation. He has remained asymptomatic. Roentgenologic studies reveal the segment functioning well (Fig. 5).

Comment. This patient represents a not uncommon experience in patients with cardiospasm treated surgically. The patient trades cardiospasm for a more serious and debilitating disease, viz., esophagitis.

III. Anatomic Abnormalities Which May Interfere with Normal Sphincteric Function.
A. Esophageal Varices (Extrahepatic Portal Bed Block).

Case 10. R. R., VMH #A-54-2720, a 46-year-old white male with extrahepatic portal bed block with esophageal varices. There was a history of splenectomy in 1930, for Banti's syndrome. In 1943, during an acute bleeding episode, a gastric resection (Billroth II) was performed for presumed bleeding duodenal ulcer. At this time esophageal varices were diagnosed. On October 27, 1952, following a severe bout of hematemesis, the superior mesenteric vein was anastomosed to the inferior vena cava. The portal pressure dropped from 40 to 24 cm. H_2O. However, the operation was difficult, and in order to accomplish the anastomosis, a window was manufactured through a thin portion of the pancreas. The wall of the superior mesenteric vein contained calcium. On April 1, 1954, a severe hematemesis occurred again. On April 22, 1954, sphincter substitution was carried out by means of a 25 cm. interposed jejunal segment, with bilateral vagotomy. The jejunal segment was interposed between the esophagus and anterior wall of the residual gastric pouch. The pathologic report, in addition to varices, noted chronic esophagitis with scarring.

His course was complicated. On May 8, 1954, exploration was carried out for subphrenic abscess:

none was found. In the supra-diaphragmatic area, however, the anterior mesenteric border of the jejunal segment was noted to be necrotic and was broken into. The supra-phrenic area was drained by a large tube above the diaphragm in a closed system. On May 11, 1954, a feeding jejunostomy was made into the interposed jejunal segment, close to the stomach. This was the only bowel identifiable due to a granular reaction of the tissues in the area. The chest drainage was converted to an open type. On June 1, 1954, a feeding jejunostomy below the transverse mesocolon was done. Shortly afterwards he was discharged on jejunostomy feedings and nothing by mouth, and the fistula gradually closed. By November the chest tube had been removed, all incisions were healed, and the patient was eating entirely by mouth. Roentgenologic studies reveal some narrowing at the site of the former fistula, but the patient is doing well at the present time. During this hospitalization, and subsequently, the patient was proved to be a mild diabetic, controlled by diet. There has been no further bleeding to date.

Comment. This unfortunate complication resulted from a technical error. Because of the previous subtotal gastrectomy, the residual gastric pouch was fixed high against the diaphgram. There was some hesitancy in attempting mobilization, as the operator was unsure as to the source of blood supply to the residual stomach. When the first two diaphragmatic sutures dorsally were taken, it became apparent that the interposed jejunal segment was being compressed downward somewhat on the anti-mesenteric border between the gastric pouch and the underside of the edge of the diaphragm. At this point, the operator recognized that the first two sutures of the diaphragmatic closure needed to be removed; however, his attention was diverted and the patient closed. Upon the return of the patient to his room, the operator then recalled his failure to remove these sutures. It was hoped that this moderate compression would not cause difficulty, but after the first temperature spike the pathologic condition was suspected. When open chest drainage was instituted, the fistula was directly visualized, it was noted to extend proximally from the diaphragmatic edge.

Case 11. G. O., VMH #A-54-7533, a 17-year-old white male with extrahepatic portal bed block with esophageal varices. Previous operations: Splenectomy, 1949; in 1952, exploration for possible portacaval anastomosis. This was impossible and the ligation of esophageal varices of the lower one-third of the esophagus was carried out. This patient had, in all, massive hematemesis on 7 occasions before and after each of the previous operative procedures. Melena in the absence of hematemesis occurred on numerous occasions.

On October 27, 1954, an interposed jejunal segment operation was done with bilateral vagotomy and Finney pyloroplasty. The segment length was 17 cm. The site of the jejunogastrostomy was 44 cm. from the ligament of Treitz. The segment extended from the proximal esophagus to the cardia. The pathologic report noted chronic esophagitis with healed foci of esophageal erosion. Convalescence was uneventful. At home, some diarrhea was present which was not troublesome. The diarrhea has abated and patient is well. To date, there has been no episode of hematemesis or melena (Fig. 6).

IV. Miscellaneous

Case 12. N. H., USMH #200482, a 64-year-old white, male merchant seaman. He had a previous history of symptomatic sliding esophageal hiatus hernia, repaired transabdominally on January 22, 1954. Because of recurrence of hernia and symptoms, this was reoperated upon transthoracically on two subsequent occasions, on March 8, 1954, and October 4, 1954. Three months prior to this admission the patient was unable to eat solids or thick fluids. Roentgenologic studies on January 17, 1955, revealed a narrowed distal esophagus (with a maximum diameter of ¾ cm.) and a dilated proximal esophagus with a 3 x 4 cm. recurrent hiatus hernia. Although dilatations were successfully carried out to a #36 French, the patient continued to vomit all foods.

At operation on March 28, 1955, a marked cicatrix at the new hiatus and involving the diaphragm and esophageal wall was noted. It was impossible to determine if the hernia had recurred. The lower esophagus and cardia were removed, and an interposed jejunal segment 20 cm. long was inserted between the proximal esophagus and cardia, accompanied by a bilateral vagotomy and Finney pyloroplasty. On microscopic examination there was focal edema of the *lamina propria,* with disruption of the muscularis by deposition of dense fibrous tissue; also, marked fibrosis of the *tunica adventitia* in these areas. The patient's course was uneventful, and he was discharged on a regular diet without complaints.

OPERATIVE PROCEDURE

The patient is placed supine upon the operating table, with the left side elevated approximately 30°. A midline supraumbilical incision is extended out into the sixth or seventh intercostal space to the anterior or mid-axillary line. The diaphragm is incised anteriorly and medially in order to avoid the left phrenic nerve, and dorsally to the apex of the crura. This diaphragmatic incision is slightly to the left of the pericardial attachment to the diaphragm (Figs. 7 to 11).

After dissection of the esophagus, at which time the extent of the disease is determined by palpation and the tip of the nasal tube in the esophagus, the esophagus is transected proximally. A bilateral vagotomy is performed at this stage. The point of distal transection is immediately below the transition of the squamous epithelium of the esophagus and glandular epithelium of the stomach. The specimen is immediately opened in order to be certain that the distal line of transection is beyond all squamous epithelium and through glandular epithelium in its entirety. Following distal transection, the fundus and corpus of the stomach can be delivered into the wound. The gastrosplenic ligament is divided between clamps, allowing easy access to the attachments of the dorsal wall of the stomach to the posterior peritoneum and pancreas. These attachments are severed. The lesser omental space is now widely open at its apex with the posterior mediastinum.

Consideration now is given to the development of the jejunal segment. No attempt is made to utilize the jejunum immediately distal to the ligament of Treitz. The jejunum is transected at a point which appears to be the most favorable in terms of adequate vascular arcades, and the easy mobilization of the segment into the posterior mediastinum. Seldom is it necessary to sacrifice more than one or two vascular pedicles. Care is taken to sever the vascular pedicle immediately proximal to its division into arcades,

taking care to avoid blind vessel ends, longer than needed, into which arterial pulsations may be dissipated. At the same time, sufficiently proximal so as not to interfere with the circulation of blood through the most proximal arcade. Equal attention must be paid to both arterial and venous arcades, for venous congestion must be avoided, as well as arterial ischemia. In general, however, the venous vascular pattern follows closely that of the arterial arcades.

After transection of the jejunum, an opening is made into the avascular area of the transverse mesocolon. The jejunum distal to the transection then is passed through this opening into the lesser omental space behind the stomach into the posterior mediastinum. This esophago-jejunal end-to-end anastomosis is performed in the usual fashion, utilizing a posterior row for the fixation of the jejunum to the esophagus, and in inner row posteriorly of through-and-through interrupted sutures, including not only mucosa but the muscular coat of the esophagus with the seromuscular coat and mucosa of the jejunum. Anteriorly, a single row of interrupted sutures is utilized to invaginate and appose the mucosal layer. After completion of the esophagojejunostomy, the nasal tube is passed through this anastomosis into the interposed jejunal segment. The site of transection of the distal jejunum is made in that portion of the segment which fits comfortably to the cardia from which the esophagogastric sphincter has been excised. It is our present feeling that 15 to 20 cm. is an adequate length, if there is no need for a greater length. As with the proximal jejunal transection, the jejunum here is sectioned in an oblique fashion, as for any intestinal anastomosis, and an open anastomosis is effected, end-to-end, with the stomach utilizing an inner row of running catgut and an outer row of interrupted 0000 silk sutures. If excessive jejunum remains in the lesser omental space and cannot be delivered comfortably below the transverse mesocolon, this is removed by careful dissection, with divi-

sion and ligation of the vascular supply close to the bowel wall. The excess jejunum then is delivered below the transverse mesocolon and amputated so that a jejunojejunostomy can be effected in the usual fashion. The defect in the transverse mesocolon then is loosely closed about the vascular pedicle.

Because a bilateral vagotomy is performed, an ancillary drainage procedure is an important part of the operation. Although a Rammstedt pyloromyotomy or a Heineke-Mikulicz type of longitudinal incision of the pyloric area with transverse closure have been utilized on one or two occasions, in most cases this has been a Finney pyloroplasty, and must be considered the procedure of choice.

Closure of the diaphragm is begun dorsally anterior to the original esophageal hiatus. Two or three sutures are first placed in such a fashion to avoid any pressure upon the interposed jejunal segment. No attempt is made to close the hiatus posteriorly. At this juncture it is important to exert slight tension on the interposed segment so that it resides in a relatively straight position in the posterior mediastinum and without tension. Any redundancy of the segment should reside below the diaphragm. In this position, interrupted 0000 silk sutures are taken between the edge of the diaphragm and the interposed segment in order to maintain a straight position of the jejunum in the thorax. Ordinarily, only four or five sutures are needed. If this precaution is not taken, the interposed segment tends to migrate into the chest, and its alignment may be disadvantageous. Closure of the diaphragm is then completed anteriorly by means of 00 and 000 interrupted silk. A stab wound is made in the left posterior chest for thoracotomy tube drainage. The chest is closed by means of interrupted pericostal sutures of 00 chromic doubled and running single strand of the same material in the muscular layer. The abdominal component of the incision is closed by interrupted stainless steel wire No. 28 and No. 30.

POSTOPERATIVE CARE

Postoperative care is similar in all respects to any vagotomized patient. The patient is allowed clear liquids when he has awakened fully from the operation. Nasal suction is continued usually for three to five days, and a progressive gastric diet begun. Bowel tones return surprisingly quick postoperatively. Thoracotomy drainage is maintained by means of a Stedman pump with a breakover mercury manometer at 15 cm. of negative water pressure. This is removed when no further drainage occurs, ordinarily by the morning of the second or third postoperative day. At this time, progressive ambulation is begun.

DISCUSSION

Twelve patients have been subjected to cardiac sphincter substitution by means of an interposed jejunal segment. This operation was used as a planned, two-stage operation on the first two patients in this series. All subsequent cases have been done as a one-stage procedure. In earlier cases, the cardia at the site of the excision of the esophagogastric junction was closed by suture and the jejuno-gastrostomy was effected to the anterior stomach wall in a new area. Now, routinely, the jejuno-gastrostomy is made with the cardia at the site of excision of the cardiac sphincter. This maneuver saves time and re-establishes continuity in the normal manner.

Originally there was some hesitancy in isolating the jejunal segment completely in one stage from the continuity of the intestine below. This fear was engendered by the possible significance of the blood supply to the most proximal segment which might be passing upward within the bowel wall itself. However, experimentally this was routinely carried out without difficulty, and was incorporated into the clinical procedure. In this series of patients there has not been a single instance of an anastomotic leak. This fact

gives assurance that the blood supply to the interposed segment, through its mesentery is adequate for anastomotic purposes.

It is apparent that a new procedure in the hands of any surgeon does not readily lend itself to immediate standardization. The technical features of the operation have been modified from case to case as experience has been gained. The complications encountered to date have resulted from surgical errors of technic or judgment, which seem to accompany the learning process. Standardization of technic, however, has resulted, and the operation as it is presently performed has been described. The important gross items of the operation consist of excision of the lesion and the interposition of a jejunal segment between the esophagus and the cardia of the stomach accompanied by vagotomy and a Finney type pyloroplasty in one stage.

To date, in those patients with reflux esophagitis, there is no instance of failure of the operation in any patient. All have been followed periodically by roentgenologic examination, without any evidence of pathologic change in the esophagus or in the segment itself. Upon swallowing, the barium mixture is picked up by the jejunum without delay, and deposited into the stomach. The complaints from some patients have been similar to those which one might expect in any series of patients in whom a bilateral vagotomy and an ancillary drainage procedure has been done. It is difficult, if not impossible, to ascribe any symptomatology referable to the jejunal segment.

In the patient with cardiospasm there has been no real decrease in the size of the esophagus thus far, nor was it anticipated. Although the operation was utilized in this case as a secondary procedure, after destruction of the sphincter had resulted in esophagitis, it is our belief that sphincter substitution as the primary operation in cardiospasm should prove of value. This procedure for esophageal varices has been restricted to patients with extrahepatic portal bed block

for obvious reasons, and to date only in those patients where all other conventional methods of surgical therapy have been tried without lasting success. Neither patient with extrahepatic portal bed block has had evidence of esophagitis or subsequent bleeding. It is apparent that a longer follow-up with a larger series is needed for this observation to be meaningful.

There can be little question of the effectiveness of the interposed jejunal segment's role as a substitute sphincteric mechanism. Therefore, the concept of cardiac sphincter substitution appears valid. It is fortunate that the interposed segment can behave not only as a physiological sphincter but as an esophageal substitute, when necessary. Contrary to popular belief, there exists no important increased inherent sensitivity of the small intestine to acid-peptic digestion. Consequently, there need be no real concern in anastomosing the jejunum to the stomach. Experimentally, all aspects of the procedure are on exceptionally firm grounds.

From the surgeon's viewpoint, this procedure appears to fulfill the criteria for a satisfactory operation in that: (1) It represents a direct approach to the primary surgical need, viz., a new sphincteric mechanism. (2) Only diseased tissue is removed. (3) Gastro-intestinal continuity is restored in normal sequence. In addition, the operation is relatively atraumatic. It is accompanied by a minor blood loss, and is well tolerated, even by the aged.

The clinical results to date have, in a sense, confirmed the experimental data. It is anticipated that this procedure will find its proper place in the surgical armamentarium for the treatment of certain conditions, which in the past have been most difficult problems to handle by surgical means.

CONCLUSIONS

Experimental.

1. An interposed jejunal segment accompanied by a bilateral vagotomy, with or

without an intact pyloric sphincter, protects the esophagus against acid-peptic esophagitis in spite of chronic histamine stimulation.

(a) A 15 cm. segment is of adequate length.
(b) The interposed segment behaves like a physiological sphincter.

2. Because of vagotomy, an ancillary drainage procedure is of great importance in protecting the jejunal segment from acid-peptic damage. The Finney pyloroplasty is superior to a pyloromyotomy in this regard.

3. When an adequate drainage procedure is utilized, the interposed jejunal segment exhibits greater resistance to acid-peptic damage than either the stomach or duodenum.

4. The anatomic site of origin of the jejunal segment appears to be unimportant. Its origin can be dictated on the basis of technical ease.

Clinical.

5. The concept of cardiac sphincter substitution for certain clinical conditions has been developed.

6. Sphincter substitution by an interposed jejunal segment with bilateral vagotomy and an ancillary drainage procedure has been performed on 12 patients, with one death. The first patient in this series has been followed two and one-half years.

7. The clinical results to date have been so encouraging that this operation has become standard procedure for some diseases unsatisfactorily treated in the past, and the indications for its use are being extended.

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