External Fistulas Arising from the Gastro-intestinal Tract *

L. Henry Edmunds, Jr., M.D.,** G. M. Williams, M.D.,**
Claude E. Welch, M.D.***

*From the Massachusetts General Hospital and the Harvard Medical School,
Boston, Massachusetts*

Fistulas arising from the stomach, intestine or colon have furnished challenging problems to surgeons for many decades. They represent an important subgroup of abdominal fistulas, many of which by definition (such as biliary, pancreatic, and urinary fistulas) are excluded from consideration in this paper. In addition, in this review, internal fistulas, in which the fistula connects one segment of the bowel to another, or. to other intra-abdominal organs, also will not be discussed.

Consequently, only external fistulas that represent abnormal communications from some part of the gastro-intestinal tract to the skin will be considered. It also should be noted that fistulas must be defined temporally, since a fistula is not synonymous with a perforation of a viscus. A bowel perforation may develop into a local abscess, a generalized peritonitis, or a fistula; one or more of these complications may occur simultaneously. For purposes of this study and survey of the literature, we have stated arbitrarily that external drainage of gastric or enteric contents for 48 hours or more is necessary for inclusion. This definition, therefore, will exclude patients with perforation who succumb rapidly to shock and

peritonitis, before an external fistula has formed.

Fistulas that were established by surgeons purposely as part of planned operations, such as catheter duodenostomy or catheter gastrostomy for decompression, enterostomy for feeding, cecostomy, and colostomy have not been included except where fistulous drainage persisted for over four weeks after withdrawal of tubes. Also, fistulas involving the esophagus after total gastrectomy in which the esophagus is anastomosed to duodenum or jejunum have not been considered in this paper.

Since the introduction and widespread use of antibiotics, no large series of these fistulas has been studied. Bartlett and Lowell,[1] in 1937, collected all of the cases of duodenal fistulas from the world literature and Brown [3] added 24 cases in 1950. Fecal fistulas have been considered in several papers, of which the last, by Marshall and Gerber,[13] considered cases treated before 1945. The etiology of fecal fistulas and the important available reports are summarized in Table 1.

No recent comprehensive reports of these fistulas have been made. The improvements now available in therapeutics and the changing significance of various abdominal diseases in recent years, have suggested a thorough review of the problem.

From 1946 to 1959, 157 patients with external gastric, intestinal, or colic fistulas have been treated at the Massachusetts General Hospital. Of this number, 113 patients developed their fistulas in this hos-

TABLE 1. *Etiology of Fecal Fistula. A Summary of Important Published Papers*

Number of Cases	Rankin & Gorder[18] 1932 264* %	Lewis & Penick[10] 1933 109 %	Ransom & Coller[19] 1935 94 %	Mayo & Schlicke[15] 1941 155 %	Lichtman & McDonald[11] 1944 408 %	Dixon & Benson[7] 1946 65 %	Marshall & Gerber[13] 1950 71 %	Mass. Gen. Hospital 1960 102 %
Surgical complication	8	19	51	—	10	—	21	57
Inflammation	77	58	47	80	75	65	69	21
Appendicitis	37	45	32	32	24	—	23	9
Diverticulitis	8	2	—	6	7	18	10	3
Tuberculosis	13	4	14	15	8	3	4	2
Obstruction	—	—	—	4	1	—	6	5
Cancer	5	2	—	10	9	11	4	6
Trauma	3	5	2	3	2	—	—	7
Other	7	16	—	13	3	24	0	4

* 18% are internal fistulas or combinations of internal and external fistulas.

pital, while the rest were referred for treatment of an existing fistula. This group of patients was treated by both private and resident surgeons, and various methods of treatment were evaluated.

These patients may be divided into three clinical groups, depending upon the anatomic location of the gastric, enteric, or colic opening, and the maximum amount of drainage from the fistula. The first group of 55 patients includes all intra-abdominal fistulas arising from the stomach or duodenum proximal to the ligament of Treitz. The second group of 46 patients identifies all with jejunal or ileac fistulas, which drained over 100 cc. of intestinal contents daily; most of these fistulas drained large amounts which frequently exceeded 1,000 cc. daily. All large bowel fistulas and those small bowel fistulas which drained less than 100 cc. daily make up the third group. No jejunal fistulas drained less than 100 cc. daily. However, some ileac fistulas did

TABLE 2. *Anatomic Location of Gastric and Duodenal Fistulas*

Duodenal stump	25
Antral stump	3
Lateral duodenal	9
Gastrojejunal	13
Gastric	4
Combination gastrojejunal and duodenal stump	1
Total	55

drain less than 100 cc. daily, and since these scantily draining ileac fistulas clinically resemble the large bowel fistulas, they are included under the heading "Lower Bowel Fistulas."

It is important to determine the presence of a fistula, the location of the gastro-intestinal opening, and the approximate amount of discharge as promptly as possible. The most satisfactory method for determining the anatomic location of the fistula has been injection of lipiodol or hypaque into the tract. Such studies may permit other information concerning location of abscesses or distal partial obstruction. Barium given orally or rectally may be helpful also, but must be used with extreme caution in the acute case. Carmine red orally may prove the existence of an external fistula, but negative results do not rule out a duodenal stump or lower bowel fistula.
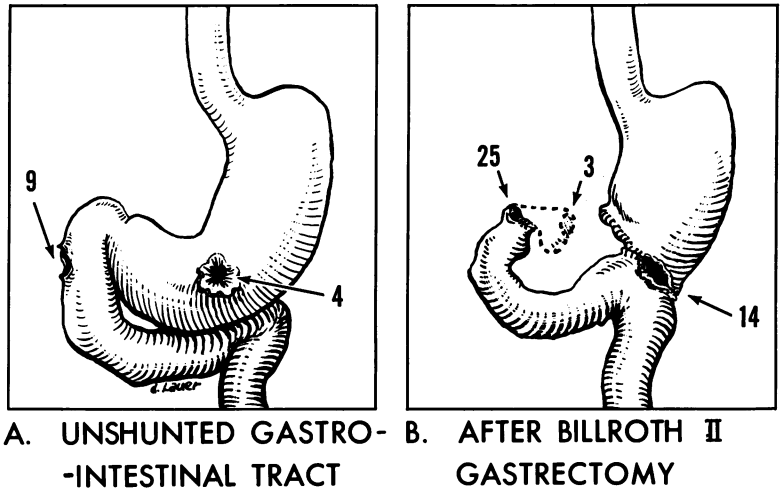
Gastric and Duodenal Fistulas

This category includes all gastric, duodenal and gastrojejunal fistulas. The stomach and duodenum produce up to two liters of secretion daily and receive an additional 1 to 2 liters of enzymes, electrolytes and water from the pancreatic and bile ducts. Saliva and oral intake double the volume of fluid that must traverse this section. Therefor, it is not surprising that a fistula here may discharge up to 4,000 cc. daily, even

FIG. 1. Location of gastric and duodenal fistulas.

A. UNSHUNTED GASTRO- -INTESTINAL TRACT

B. AFTER BILLROTH II GASTRECTOMY

though no fluids are allowed by mouth. Furthermore, the duodenum is deeply situated and tethered by its tributary ducts and short vascular pedicle, so that operative closure is difficult. Thus, the most important denominators of fistulas in this group are the limited mobility of the gut above the ligament of Treitz, and the intestinal torrent produced and received by this section.

Since 1946, 2,648 subtotal gastrectomies have been performed at the Massachusetts General Hospital; thirty-seven of these patients developed a gastrojejunal or duodenal

stump fistula following their surgery. Thus, the incidence of fistula of all types following gastrectomy in this hospital is 1.4 per cent. Five similar fistulas occurred in patients who came initially to this hospital after the fistula was established. The remaining fistulas were gastric or lateral duodenal in type (Table 2). Figure 1 shows the anatomic subdivision of this group of fistulas. The average age of the patients was 60 years.

Etiology: Table 3 lists the disease preceding the operation subsequently complicated by fistula. Duodenal ulcer preceded

TABLE 3. *Gastric and Duodenal Fistulas. Disease Preceding Operation that was Followed by Fistula*

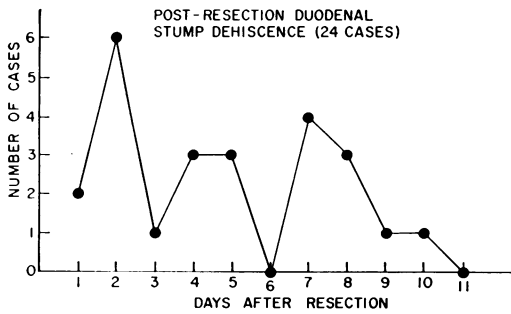| Disease	Stump	Lateral duodenal	Gastro-jejunal	Gastric	Combination
Duodenal Ulcer	24	3	5	2	1
Bleeding	16		3		1
Obstruction	4				
Perforation	4	2		2	
Intractability		1	2		
Cancer	2		4	2	
Gastric ulcer	2				
Gastritis (bleeding)			1		
Stomal ulcer			2		
Afferent loop obstruction			1		
Pancreatitis		3			
Cholelithiasis		2			
Injury		1			
Totals	28	9	13	4	1

FIG. 2. Date of dehiscence of duodenal stump after gastrectomy.

nearly 70 per cent of gastric and duodenal fistulas. Of the 42 gastrectomies complicated by fistulas, nearly half followed emergency operations to stop hemorrhage. Actually, however, the etiology of the fistula depends not only on the underlying disease, but, in the great majority of cases, the fistula arose from a specific surgical error. In this way Table 4 is constructed. Thus, suture line failures accounted for 82 per cent of the fistulas. The suture line leak became apparent 0 to 34 days following surgery. However, if the records are analyzed carefully in retrospect for the first recorded clinical sign suggesting a leak, the maximum interval is 11 days, (Fig. 2). Twenty-five of these 45 suture-line fistulas were drained within one day of the first suggestive clinical sign.

Duodenal or antral stump fistulas account for almost half of the 55 fistulas in this group. In 22 of these 26 fistulas, the surgeon classified the stump turn-in as difficult.

Local edema and inflammation, adhesion to the pancreas, proximity of the turn-in to the ulcer, pancreas or bile ducts were the most frequent causes of difficulty. The three antral stump fistulas occurred after the Bancroft procedure of stripping out the antral mucosa prior to turning in the stump. In 11 patients a drain had been placed near the stump at gastrectomy. Four patients had associated efferent loop stomal obstruction. The incidence of afferent loop obstruction probably was high, but impossible to determine in retrospect.

The causes of fistulas arising from *gastrojejunostomies* have received little attention in the literature. In eight of these 13 cases an important contributory cause could be found. In three instances the patient had had a palliative gastrectomy for malignant tumor, and the suture line was found to contain cancer. In two cases splenectomy was done simultaneously with high subtotal gastrectomy together with ligature of the left gastric artery at its origin, so that ischemia probably was a major contributing factor. Wound dehiscence, stomal obstruction, pancreatitis, tension on the suture line, and gross trauma to stomach or jejunum were obvious causes in other instances.

A lateral duodenal fistula occurs in the unshunted gastro-intestinal tract. This type may complicate perforated peptic ulcer, necrotizing pancreatitis, or surgery of the duodenum, biliary or pancreatic ducts,

TABLE 4. *Etiology of Gastric and Duodenal Fistulas*

	Stump	Lateral Duodenal	Gastro-jejunal	Gastric	Combination
Suture line failure	28	4	12	1	1
Injury		1	1		
Inflamation					
Perforated ulcer		1		2	
Pancreatitis		2			
Erosion by gallstone		1			
Perforated cancer				1	

TABLE 5. *Complications of Gastric and Duodenal Fistulas*

Cases	Stump 28	Lateral 9	Gastro-jejunal 13	Gastric 4	Combination 1
Electrolyte deviation	6	4	6		1
Moderate malnutrition*	4	3			1
Severe malnutrition**	8	2	8	3	
Infection					
Peritonitis, general	8	3	10	1	1
Abscess	6	5	6		1
Wound	2	2	8	1	
Pancreatitis	5	3	1		
Postoperative stomal malfunction	4				
Jaundice over 2.0 mg. %	9	3	4		
Bled from fistula	1				
Skin digestion	10	3	10	2	1
Pneumonia	5	5	8		
Pulmonary embolus	2	2	4		

* Moderate malnutrition defined as serum protein below 5.6 Gm. %, and/or weight loss of 15 pounds.
** Severe malnutrition defined as serum protein below 4.8 Gm. %, and/or weight loss of over 25 pounds.

right kidney or right colon. Blunt or penetrating trauma is a rare cause of these fistulas. Three of our nine cases followed duodenotomy for pancreatic sphincterectomy. Two others represent failure to close a perforated peptic ulcer successfully. Distal obstruction contributed to the formation of three of these lateral fistulas.

Persistent *gastro-cutaneous fistulas* are relatively rare. These fistulas are seldom serious and sometimes are created for feeding purposes. However, occasional gastro-cutaneous fistulas arising from the antrum or associated with distal obstruction may discharge considerable fluid and should be considered true fistulas. The four gastric fistulas in this series each discharged over 800 cc. daily; two were due to gastric cancer obstructing the pylorus, and two to obstructing prepyloric ulcers.

Complications: The major complications of this group of fistulas are listed in Table 5. Nearly one-third of these patients developed severe *fluid and electrolyte deviations* which were abnormal for over 48 hours. Only one of these patients had kidney disease. Thirteen of the 17 patients with such deviations died. Fifty-three per cent of the patients suffered significant *malnutrition,* and of this depleted group, nearly 60 per cent died. Those who were significantly malnourished and survived, usually did not have any associated infection.

Sepsis was a third major complication of these fistulas. In all there were 54 separate infections, excluding pancreatitis, in this group of 55 patients. Nearly one-half of the 55 patients developed generalized peritonitis. Of the 23 patients with general peritonitis, only three survived. When the enteric opening occurs, the abdomen frequently is soiled massively before egress through the wound is found. Thus, the need for prompt drainage of a suture line leak is obvious.

Abscess and wound infections must be defined further in order to get a clear impression of their significance. An abscess which was drained and then was followed by the discharge of intestinal contents was not considered a complication of the fistula.

TABLE 6. *Relation of Important Complications to Mortality*

| | Type of Fistula | | | | | | | | |
| | Gastric or Duodenal | | | Jeujnal or Ileac | | | Lower Bowel | | |
	No. Pts.	Died	% Mortality	No. Pts.	Died	% Mortality	No. Pts.	Died	% Mortality
Electrolyte imbalance	17	12	71	6	6	100	0	0	0
Malnutrition (moderate or severe)	29	18	62	34	20	59	11	7	64
General peritonitis	23	20	87	14	10	71	14	4	29

The 18 intraperitoneal abscesses in this series, therefore, represent abscesses which occurred or were discovered after the fistula was established. Since all of the wounds were contaminated, the category "wound infection" included only cases with wound dehiscence and intramural or satellite abscesses. There were six wound dehiscences.

Nearly half of the patients had skin irritation and digestion significant enough to be referred to in three or more separate progress notes. One patient actually exsanguinated from the fistulous tract after leaving the hospital. Usually, however, skin irritation was not life-endangering, but it frequently caused the most subjective discomfort.

Jaundice and/or pancreatitis not infrequently was associated with these right quadrant fistulas. Nine patients had unequivocal pancreatitis (defined in Russell units as 75 or over; the top normal is 20 units.) All these patients had duodenal fistulas. Slight to moderate jaundice was found in 16 patients. Sepsis in the upper abdomen led to definite pneumonia in 18 patients; aspiration was probably an important factor.

The relation of these important complications to mortality is shown in Table 6.

Therapy: Supportive management of gastric and duodenal fistulas is of great importance since frequently these fistulas are not eligible for operative cure. In those fistulas which are treated by surgery, proper supportive management is essential to prevent deterioration of the patient and potentially lethal complications.

Sump suction is the cornerstone of conservative therapy. By this means the skin is protected and the fistulous discharge is collected for accurate measurement and replacement.

Quantitative control of fluid and electrolyte balance is essential. If the fistulous drainage is large, analysis of electrolytes in the drainage, and daily serum electrolyte determinations, aid replacement therapy. Huge amounts of intravenous electrolytes in addition to plasma, albumin, and occasional transfusions may be necessary. Intravenous fat feedings in addition to intravenous hypertonic glucose and protein hydrolysate solutions help to maintain nutritional balance and prevent weight loss.

Restriction of oral intake may decrease the fistulous discharge of gastric, gastrojejunal, and lateral duodenal fistulas. Occasionally a nasal tube may be manipulated past the enteric exit these fistulas and tube feedings instituted. However, a distal feeding jejunostomy is more reliable and comfortable. Protective powders and pastes, frequent dressing changes and a prone position are useful adjuncts to sump suction in the control of skin irritation. Contrary to published reports, neutralizing compounds and devices to block the fistulous discharge, have proved uniformly unsuccessful in our hands.

All of the patients with gastric and duo-

denal fistulas in this series were treated by sump suction and were given intravenous electrolytes and glucose. Other specialized solutions, including intravenous fat, were used in specific cases. All patients received antibiotics in large doses. Penicillin and streptomycin were used most frequently, except when sensitivity tests indicated other antibiotics were more valuable. Nasal tubes seldom decreased the fistulous discharge but proved useful in controlling ileus in some patients.

Operations for these fistulas logically may be divided into two categories—those to remedy the complications and those to remove the fistula. The first group of non-definitive operations includes all feeding and draining enterostomies and operations to drain pus or intestinal content. Twenty-one of these 55 patients had enterostomies, but since nine of these 21 jejunal catheters were put in at the time of original surgery, only 12 were inserted after the fistula was established.

Definitive operations for fistulas arising from stomach or duodenum were carried out in nine cases.

Results: Table 7 shows the over all results of treatment of this group of 55 gastric and duodenal fistulas. Nondefinitive surgical therapy carried a mortality of 65 per cent, compared to a 44 per cent mortality with definitive therapy. It should be emphasized that this represents the therapy of established fistulas. All of the 17 fistulas which closed spontaneously did so in two months or less.

Only nine of these 55 patients had any definitive surgery. Two gastric fistulas treated by gastric resection were cured. One lateral duodenal fistula was cured by gastric resection. One chronic stump fistula was cured by exploration and removal of a retained silk suture. One patient had closure of a perforation at a gastrojejunal anastomosis about a catheter with recovery. Four other patients died after unsuccessful direct attacks on the fistula.

Discussion: Three considerations deserve further emphasis in this review: (1) comments on the pertinent literature; (2) prevention of fistula; and (3) treatment of established fistula.

Previous Reports: Bartlett and Lowell collected 128 cases of duodenal fistulas including 12 of their own, that had appeared in the literature between 1865 and 1937. Since that time we have found 29 reports in the English literature that list an additional 118 cases (Table 8). To this number we have added 35, so that a total of 281 cases of duodenal fistulas are available for study. No significant data can be acquired from the literature about gastric or gastrojejunal fistulas.

Figure 3 shows the relative incidence and mortality of stump and lateral duodenal fistulas in these series. It is obvious that there has been a greatly increased incidence of stump fistulas in recent years. The increasing indications for gastric resection and the increasing number of surgeons to perform them have spawned a host of stump and gastrojejunal fistulas.

A comparison of the over all mortality figures actually indicates that the mortality of both end and lateral fistulas now is higher in our institution than that reported

TABLE 7. *Mortality of Gastric and Duodenal Fistulas—M.G.H. Series*

Type of Operation	Stump			Lateral Duodenal			Gastro-jejunal			Gastric			Combined			Total		
	No. Pts.	Died	%	No. Pts.	Died	%	No. Pts.	Died	%	No. Pts.	Died	%	No. Pts.	Died	%	No. Pts.	Died	%
Nondefinitive	27	14*	52	6	4	67	10	9	90	2	2*	100	1	1	100	46	30	65
Definitive	1	0	0	3	2	67	3	2	67	2	0	0	0	0	0	9	4	44
Totals	28	14	50	9	6	67	13	11	85	4	2	50	1	1	100	55	34	62

* Two patients died of cancer in each group; other 30 deaths due to fistula.

TABLE 8. *Review of Lateral Duodenal and Stump Fistulas Published Since 1937*

(Note that reports of perforated duodenal stumps not associated with fistulas have been excluded in this table.)

Year	Author	Total Cases	Lateral	Nondefinitive Operation	Definitive Operation	Definitive Operative Mortality	Lateral Fistulas Total Mortality	Stump	Nondefinitive Operation	Definitive Operation	Definitive Operative Mortality	Stump Fistulas Total Mortality	Duodenal Fistulas Overall Mortality	Remarks
1937	Vehrs, G. R.[50]	2						2	0	1	0	0	0	1 pt. had 2 attempts to suture fistula
1937	Hall, A. J. et al.[43]	1	1	1	0		0						0	Jejunostomy
1939	Thompson, L. R.[57]	1	1	0	0		0						0	
1942	Donald, C. J., Jr.[40]	1						1	0	0		0	0	
1943	Lemmon, W. T. et al.[47]	1	1	0	1	0	0						0	Fistula resected
1943	Taylor, C. B. & Taylor, J. M.[56]	1	1	0	0		0						0	
1944	Consales, P. A. & O'Connell, W. T.[37]	1	1	0	0		0						0	
1944	Schneider, D. H.[52]	4	4	0	1	1	3						3	One suture closure
1944	Thorstad, M. J.[58]	1	1	1	0		0						0	Jejunostomy
1945	Selous, C. F. & Perryman, P. W.[53]	2	1	1	0		0	1	0	0		0	0	Draining gastrostomy & Jejunostomy
1945	Snyder, W. H., Jr. et al.[55]	1	1	0	0		0						0	Pyloric exclusion
1947	Bell, L. G. et al.[34]	1	1	0	0		0						0	
1948	Large, A. & Walker, G. L.[45]	1	1	0	1	0	0						0	Attempted suture closure
1948	Rékai, J.[50]	1						1	0	0		1	1	
1949	Denton, D. A.[39]	1						1	0	1	1	1	1	One resection; one suture closure
1950	Albright, H. L. & Leonard, F. C.[32]	5	4	1	1	0	1	1	0	0		0	1	Suture closure 5 mo. after onset
1950	Brown, R. B. et al.[3]	6	3	0	0		1	3	0	1	1	1	2	2 suture closures
1950	Robinson, J. R.[51]	6						6	2	2	0	0	0	
1951	Gardner, A. M. N.[42]	2	2	0	2	0	1						1	2 pts. had suture closures
1951	Henley, R. B. & Bell, H. T.[44]	11						11	5	2	2	9	9	No operations except drainage
1951	Larsen, B. B. & Foreman, R. C.[46]	11						11	4	0	0	7	7	Jejunostomy
1952	Caffery, E. L. & Musselman, M. M.[35]	1	1	1	0		0						0	One patient had unsuccessful suture closure
1952	Eiseman, B. & Stephenson, H.[41]	3	3	0	0		0						0	
1953	O'Neill, T.[49]	7	3	0	2	0	0	4	1	0	0	0	0	2 lat. fist. closed with sutures
1954	Avola, F. A. & Ellis, D. S.[33]	8						8	4	1	0	5	5	1 suture closure; 4 laparotomies
1954	Craighead, C. C. & St. Raymond, A.[38]	22	10	—	—	—	4	12	—	—	—	8	12	No data regarding surgical therapy
1954	McKirdie, M.[48]	7	7	—	—	—	0						0	No data regarding surgical therapy
1956	Smith, D. W. & Lee, R. M.[54]	4	1	0	0		0	3	1	0		0	0	Laparotomy & drainage
1958	Chamber, K.[36]	5						5	1	0		0	0	One jejunostomy
	Totals	118	48	5	8	1	10	70	18	8	4	32	42	

BARTLETT & LOWELL 1865–1937 128 CASES	LITERATURE REPORTS 1937 — 1959 118 CASES	MGH SERIES * 1948 – 1959 35 CASES
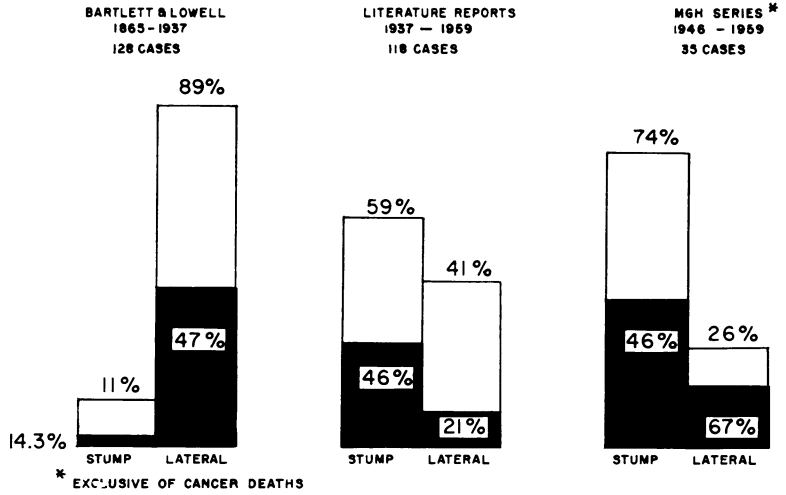
FIG. 3. Incidence and mortality of duodenal fistulas. Black areas represent mortality.

89%

59%

74%

47%

46%

41%

46%

26%

11%

21%

67%

14.3%

STUMP   LATERAL   STUMP   LATERAL   STUMP   LATERAL

* EXCLUSIVE OF CANCER DEATHS

by Bartlett and Lowell, in 1938. Obviously the samples are not large, but they do include all cases that have been observed in this hospital. Though collected reports in the literature would indicate that the mortality of lateral fistulas is definitely lower than that reported by Barlett and Lowell, additional factors must be considered. There is a natural reticence for surgeons to report unsuccessful cases. Consequently, the less optimistic figures reflecting the entire experience of large institutions with these fistulas rarely appear. A notable exception is that published from the University of California Hospital by Henley and Bell; [44] 12 of their 16 patients died.

Prevention of Fistula Formation: Because of the high mortality attending fistulas in this portion of the gastro-intestinal tract, it is apparent that prevention is much more important than the cure. From the data presented above, several points may be emphasized. Gastric fistulas that arose from the stomach in continuity with an intact intestinal tract in this study were all due to obstruction near the pylorus that had not been relieved by operation. They could have been prevented by primary resection of the obstructing lesion or by a gastrojejunostomy performed above the obstruction.

Fistulas arising from gastrojejunal anastomoses are due to technical defects in the procedure. Devascularization of the gastric stump, tension on the anastomosis, cancer in the anastomotic line, stomal obstruction and wound dehiscence have already been mentioned.

Some lateral duodenal fistulas likewise follow technical errors with insecure closure of an open duodenum. Thus careful suture, without tension or constriction of the duodenum is important.

Numerically, the most important group of fistulas, however, is that which arises from the duodenal or antral stump after gastric resections of the Billroth II type. This fistula, since it is the most common, needs detailed discussion.

It has been recognized for many years that at least half of the deaths following gastrectomy for duodenal ulcer are due to complications arising about the duodenal stump, of which perforation and fistula are the most important. Theoretically there is little difficulty encountered with the duodenum in cases of gastric ulcer and cancer.

The incidence of blown-out duodenal stumps is necessarily higher than that of stump fistulas. Although very small leaks may not be lethal, or in some patients, not even diagnosed, no patient recovers from

a major leak or perforation without the for-
mation of a fistula. In 2,648 gastrectomies
that were performed in the Massachusetts
General Hospital from 1946 to 1959, only
three of the patients who died postopera-
tively, were found at autopsy to have had
a stump perforation which had not drained
externally for at least 48 hours. The inci-
dence of dehiscence of the stump was 1.1
per cent, and the mortality due to this
cause, 0.6 per cent.

Several specific methods of prevention
have been advocated in addition to the
well-established surgical principles. They
will not be repeated here, except to observe
that vagotomy and gastroenterostomy should
be performed in preference to a difficult dis-
section about the duodenum, since the late
results of the latter operation are now not
greatly inferior to those of resection.

Three other specific methods of preven-
tion of duodenal or antral stump perfora-
tion after gastrectomy will be considered.
First, prevention of afferent loop obstruc-
tion by the use of a prosthetic tube placed
in the anastomosis has been advocated by
Alesen [22] who has ascribed his success in
avoiding duodenal fistulas to this maneuver.
In our experience it has been very difficult
to assess the importance of afferent loop
obstruction as a cause of duodenal fistula,
though Robinson [51] proved in many of his
cases that it was a common factor.

Secondly, many surgeons have advised
primary drainage of the right upper quad-
rant, leading a Penrose drain or sump down
near to the duodenal stump in the hope
that if perforation occurs, duodenal con-
tents will discharge along this tract, rather
than produce a general peritonitis. Often,
however, the drain tract has been walled
off from the stump before the perforation
becomes established, so that the peritoneal
cavity may become widely contaminated
before drainage occurs from the wick.

On the other hand, suggestive evidence
that primary drainage of the right upper
quadrant at the time of gastrectomy is

valuable is furnished by the course of 26
patients who established stump fistulas and
in whom the presence or absence of pri-
mary drainage was stated. Of 11 patients
who had such drainage primarily and es-
tablished a fistula, four (36%) died, while
of 15 who did not have previous drainage
and established a fistula, ten (67%) died.
There was nothing to indicate that drain-
age per se increased the number of fistulas.

In the third place, specific operations
may be employed to avoid the hazards of
the difficult duodenal stump. The Bancroft
operation, the McKittrick two-stage resec-
tion, and Waddell's combination of antral
exclusion and vagotomy may be mentioned.
Of these procedures, the Bancroft opera-
tion has, in our institution, carried nearly
a five per cent incidence of perforation, with
such a high mortality from this complication
that unless it is combined with Harvey's [27]
method of catheter decompression, we be-
lieve it should not be used. Dangers of
fistula formation following the McKittrick
and Waddell operations are much less,
though there are other technical objections
to their use, particularly in the presence of
massive hemorrhage.

As a specific method to prevent fistula
formation, we have been interested par-
ticularly in catheter duodenostomy as an
adjunct to gastrectomy. Here a planned
fistula is established but is controlled com-
pletely by the indewlling catheter and re-
placement of the duodenal content through
a jejunostomy tube. This method allows re-
section of the bleeding ulcer.

It is of interest to compare results in pa-
tients who had such a planned duodenos-
tomy with those in this series. In the pa-
tients reported in this paper, of 28 who de-
veloped a duodenal fistula, 24 had difficult
stump turn-ins and ten died. In a series of
51 cases of planned duodenostomy recently
reported by Rodkey and Welch,[31] all of
whom had difficult stumps, one died. Five
had drainage from the fistula that lasted
more than 48 hours after the catheter was

removed; this drainage persisted for over two weeks in only one patient.

Therapy of the Established Fistula: We had expected, as these cases were being investigated during the past decade, that the profuse use of antibiotics, blood, human albumin, and improved replacement of electrolytes would lower the mortality rate of an established fistula. It has been shown, however, that these ancillary measures have not reduced the mortality. Is there anything else that can be offered for the patient with an established fistula?

Surgical measures may be classed as supportive or nondefinitive in which the complications of the fistula are treated, or as definitive, in which the fistula is eliminated by resection or closure. In this section of the gastro-intestinal tract, supportive operations are extremely important. Immediate direct drainage of the perforated stump, drainage of abscesses associated with the fistula and jejunostomies for replacement of aspirated electroyltes, and for feeding are examples of this type of therapy.

Certain definitive surgical measures may be considered for certain fistulas. For *gastric fistulas*, resection of the fistula and the distal obstruction is indicated. For fistulas arising at the *gastrojejunostomy* stoma, a significant contribution has been made recently by Carter and Bruck: [24] their experimental work deserves application in the man. They found that anastomotic fistulas, clinically, were extremely serious. They produced suture-line defects after Billroth I gastrectomies in dogs. Four to eight hours after the leak was produced they carried out various operative procedures. By resecting the anastomosis and then turning in the stomach and duodenum as blind stumps, drained respectively by a gastrostomy and lateral catheter duodenostomy, they were able to achieve 100 per cent survival in eight dogs; they later restored continuity in the gastro-intestinal tract. Alternate methods, including direct suture of the fistula and re-resection, with the formation

of a Billroth II anastomosis were associated with nearly 100 per cent mortality. Whether or not survival would follow if the perforation had occurred over eight hours before the secondary operation is not known. It seems quite improbable that an anastomotic leak could be diagnosed in the human patient in such a brief interval, but the human may be more resistant to infection than the dog.

The lateral duodenal fistula theoretically should, in a number of cases, be amenable to direct closure, or resection and closure. In other instances it may be possible to shunt the oral and gastric contents away from the duodenum and to decompress the duodenum by means of Harvey's modification of the Bancroft resection.

Fistulas from the duodenal stump, in our experience, have not been amenable to direct closure except for an isolated case of late closure of a chronic fistula.

Reports available in the literature indicate that definitive operations rarely have been employed for fistulas in this section of the gastro-intestinal tract, and that the mortality rate is high. Reference to Table 8 will show that definitive operations have been carried out for eight lateral duodenal fistulas and for eight stump fistulas in the reports that have appeared in the literature from 1937 to 1959. Of these, seven in the first group and four in the latter were cured by operation. For the lateral fistulas, closure by suture, resection and pyloric exclusion have been successful procedures. Of the stump fistulas, two were treated in the chronic phase with suture and cure, while in the two that were treated by early suture it is difficult to be sure that much was accomplished by operation other than direct drainage to the site of perforation.

In the present series five patients were cured by definitive attack upon the fistula. Because these cases are so rare, brief abstracts will be included. It is of interest that in four of these cases a definitive surgical attack was carried out at a relatively

early period, and in one the fistula was chronic, with only a small amount of drainage.

Case Reports

Case No. 831951: This 78-year-old white man developed a gastrocutaneous fistula with profuse drainage after closure of a perforated pyloric ulcer. Three weeks after the onset of the fistula a gastroenterostomy and double catheter jejunostomies were performed. The discharge from the fistula continued to be profuse and the patient developed a staphylococcal pneumonia. Three weeks after the gastroenterostomy the stomach was transected and the antrum turned in without a drain. Fistulous discharge decreased, but did not stop. He developed severe diarrhea which complicated fluid and electrolyte management. One month later, and 80 days after the onset of the fistula, the antrum and fistula were excised and the duodenum turned in. The right upper quadrant was drained but there was no significant discharge. The patient was discharged 16 days after his fourth operation. This case demonstrates the superiority of resection over bypass operations which fail to defunction the fistula completely.

Case No. 7622261: This 51-year-old white man entered an outside hospital with a perforated pyloric ulcer which was sutured two weeks before entry. He reperforated a week before entry and the ulcer was closed the second time. Six days thereafter the wound began to drain profusely and he was referred to the Massachusetts General Hospital. At that time he was draining several hundred cc. of clear fluid daily from his abdominal incision. No bile was present in the drainage. Barium studies indicated that he had a fistula from the pyloric end of the stomach. At operation a subtotal gastrectomy was carried out. The fistula was found to arise from the suture of his perforation at the pyloric end of the stomach. The pylorus had been completely occluded by scar tissue. Dissection was carried well beyond the pylorus, and a typical Billroth II gastrectomy carried out. Postoperatively there was a moderate amount of drainage from the right upper quadrant where drains had been inserted. However, at no time did a fistula develop postoperatively and the patient recovered uneventfully in three weeks. He has been well since that time.

Case No. 732971: This 66-year-old white man had a subtotal gastrectomy with antecolic gastrojejunostomy performed 7 years previously for duodenal ulcer. This had been followed by several bouts of abdominal distention. On admission at this time the afferent loop was found to be greatly distended. At operation the gastrojejunostomy was resected, the jejunum was united by an end-to-end anastomosis and a new gastroenterostomy was made just distal to it. Postoperatively he developed peritonitis and was therefore re-explored on the third day. A perforation of the afferent loop very close to the gastrojejunostomy was found. This was at a spot where the jejunum had been injured at the time of the previous laparotomy. The opening was small and through it a No. 24 Foley catheter with a 5 cc. bag was inserted. The perforation was closed snugly about this catheter. Postoperatively he drained a large amount through the catheter but recovered from the peritonitis. The catheter was removed 9 days later, and a sump drain was inserted. This drained for 50 days and was then removed. The patient then made an uneventful recovery.

Case No. 630861: This 59-year-old white man entered the hospital with severe right upper quadrant abdominal pain. Two years before he had an episode of upper gastro-intestinal bleeding and, by x-ray, was shown to have chronic hypertrophic gastritis. At the present time the gastro-intestinal series showed deformity of the duodenum, and a positive Graham test. At operation soon afterward an acutely inflamed gallbladder was removed with great difficulty due to adherence to the duodenum. The duodenum was opened and then closed carefully in two layers. However, on the first postoperative day he began to drain copious amounts of duodenal contents from his stab wound drain. A Sump suction tube was inserted and collected up to 2,500 cc. a day. This gradually rose to 3,500 cc. on the tenth postoperative day. On the eleventh postoperative day, through a left paramedian incision, a free peritoneal cavity was entered. A subtotal gastrectomy was carried out with a Billroth II anastomosis. The antral mucosa was stripped out according to Bancroft's method and the serosa was turned in. A retrograde jejunostomy tube was placed back into the stomach for drainage, and a distal jejunostomy tube placed for feeding. Following the operation copious discharge continued from the right upper quadrant fistula, but all the duodenal contents that were aspirated were re-fed through the feeding jejunostomy tube. Drainage persisted for approximately 10 days when it essentially stopped. The fistula closed shortly thereafter and the patient was discharged. At no time did he develop electrolyte imbalance, malnutrition or general peritonitis.

Case No. 341910: This 47-year-old man entered the Massachusetts General Hospital complaining of intermittent, irritating abdominal drain-

FIG. 4. Anatomic location of enteric and colonic fistulas.
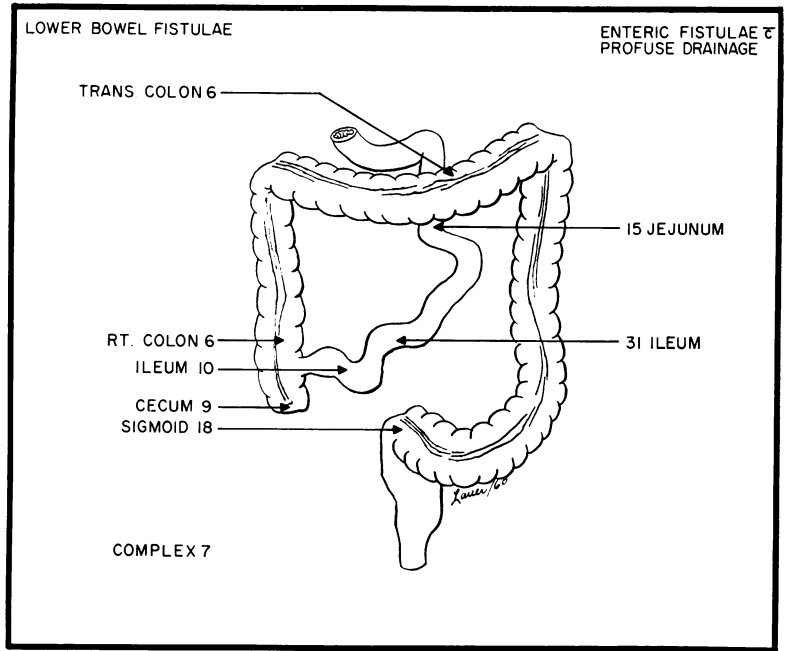
age eight months following a subtotal gastrectomy at an outside hospital. This patient developed a massive fistula following gastrectomy which was treated with sump suction with spontaneous closure in three weeks. However, the drainage recurred intermittently and the patient became disabled by the irritating discharge and associated tenderness.

Physical examination revealed a well-nourished man with an abdominal wall sinus in the gastrectomy incision. The sinus was injected with hypaque and a communication with the duodenum visualized.

This chronic fistula was initially treated expectantly by excising the sinus margins to allow full drainage. As the fistula continued to drain for 3 months it was elected to excise the fistula with a small margin of duodenum. This procedure was carried out and a large silk suture was found at the origin of the fistula. The patient made an uneventful recovery.

This case illustrates the role of foreign bodies in sustaining gastro-intestinal fistulas.

Small Bowel Fistulas with Profuse Drainage

This group includes all fistulas of the small bowel which drained at least 100 cc. daily at some time in their course. Gastrojejunal fistulas were described in the previous category, and those ileac fistulas which never drained over 100 cc. in 24 hours are included with large bowel fistulas.

There are several important anatomic and physiologic features of fistulas of the jejunum and ileum. The relatively great mobility and length of the small bowel allow an easier and more effective surgical attack on these fistulas than can be secured with fistulas arising from stomach or duodenum. The large fluid volume of the enteric stream, particularly in the proximal jejunum, accentuates the serious nature of such fistulas. Since the small bowel is able to absorb more water and electrolytes as the cecum is approached, in general, the lower the fistula the less malign its significance.

Forty-six of the 157 patients in this study had fistulas of the small bowel which drained profusely. Fifteen of them arose from the jejunum and the remainder from the ileum (Fig. 4). The average age of these patients was 55 years. Twenty were men. One-third of these patients were referred to this hospital after the fistula was established.

Etiology: The principal etiologic factor causing these small bowel fistulas is listed

in Table 9. Frequently there were several such factors in an individual case, but always one disease, event, or complication could be considered more directly responsible for the fistula than the others. For example, if cancer was found at the site of an anastomosis that had dehisced to form a fistula, the anastomotic failure would be listed as the principal cause of the fistula and the cancer would be considered a contributory factor. This method of classification emphasizes the importance of surgical errors in the production of fistulas.

Judged in this fashion, surgical complications were directly responsible for 72 per cent of these 46 small bowel fistulas. Imperfect anastomoses leading to dehiscence and inadvertent injury to the bowel were important factors. Unusual gross technical errors included a retained intra-abdominal sponge, laceration of the bowel by tension wires used to close an abdominal incision and mistaken identification and exterioriza-

tion of the ileum while attempting a colostomy. It was of interest that in this group there was a significant contributory cause for formation of the fistula in 15 patients (cancer—4, obstruction—4, and inflammation—7).

Intestinal obstruction was the principal cause of the fistula in five cases. Two of these patients had exteriorization of "obstructed bowel" and two others had incision and drainage of abdominal wall infections secondary to incarcerated hernias. The fifth patient developed a skin ulcer which finally eroded into an irreducible ventral hernia. Although intestinal obstruction was the direct cause of only five (11%) of these fistulas, it occurred sometime during hospitalization in 57 per cent of these 46 patients. In 12 patients intestinal obstruction precipitated an emergency laparotomy which later became complicated by a fistula. In nine patients intestinal obstruction or prolonged ileus occurred distal to an anas-

TABLE 9. *Chief Etiologic Factor of Fistulas Arising from Small Intestine or Colon*

Factor	Small Bowel			Lower Bowel		
	No. Pts.		%	No. Pts.		%
Surgical complications	33		72	25		45
Anastomotic failure		19			20	
Surgical injury		11			5	
Gross surgical error		3				
Obstruction	5		11	0		
Inflammation	2		4	19		34
Appendicitis					9	
Diverticulitis					3	
Regional enteritis		2				
Ulcerative colitis					1	
Chronic abscess					4	
Tuberculosis					2	
Cancer	3		6.5	3		5
Trauma	3		6.5	4		7
Catheter		1			2	
Blunt		1			1	
Penetrating		1			1	
Persistent cecostomy				4		7
Undetermined				1		2
Totals	46			56		

tomosis, area of trauma, or necrotic cancer, and led to fistula formation at this weakened spot in the bowel.

Two patients with regional ileitis and three patients with irradiated adenocarcinoma suffered bowel perforations which developed into small bowel fistulas. One patient perforated the ileum while irrigating her ileostomy. In two other patients trauma was the most important factor.

Cancer was present in 22 (48%) of the patients in this group of small bowel fistulas. In the majority, (15 patients) the cancer was an incidental finding and did not contribute to the formation of the fistula. On the other hand, inflammation was present in less than one-third of these patients.

Complications: (Table 10.) Since there is less discharge from the small bowel fistulas than from duodenal fistulas, significant fluid or electrolyte deviations occurred in only six cases: however, all of these six patients died.

Seventy-four per cent of these patients suffered significant malnutrition as defined previously, and 59 per cent of these malnourished patients died. There was no correlation between the degree of malnutrition and the site of the enteric opening, since a proportionately equal number of these 34 fistulas arose from the jejunum and ileum. Only four of these patients, all with jejunal fistulas, had any tube feedings.

Sepsis is a major complication of these fistulas. There were 55 separate infections in these 46 patients. Fourteen patients developed generalized peritonitis and 10 (72%) died. The large number of intraperitoneal abscesses which occurred, or which first were discovered after the formation of the fistula, emphasizes the need of careful search for this complication in patients with fistulas.

As in the gastric and duodenal group, the incidence of significant skin digestion and irritation was high (43%). Aside from the discomfort, severe skin digestion, with or without concomitant wound infection,

TABLE 10. *Complications of Fistulas Arising from Small Bowel or Colon*

Complications	Small Bowel (46)	Lower Bowel (56)
Fluid and electrolyte imbalance	6	0
Significant malnutrition	34	11
Moderate	18	3
Severe	16	8
Infection	55	55
Septicemia	2	
Generalized peritonitis	14	14
Intraperitoneal abscess	18	23
Wound infection	21	18
Significant skin inflammation	20	1
Moderate	11	1
Severe	9	
Intestinal obstruction	4	4
Hernia*	1	4

* Follow up is not complete.

may delay indicated operative therapy or may dictate a less satisfactory secondary abdominal incision. Furthermore, these surface complications may eventually result in ventral hernias, though absence of late follow up data precludes determination of its incidence in this study.

Conservative Therapy: Although early definitive operation is recommended, severe complications may delay surgery and necessitate supportive management. In many instances in this series a false optimism led to persistence in such a conservative fashion for protracted periods. When used, the conservative management of small bowel fistulas is similar to that of gastric or duodenal fistulas. Only technics peculiar to the treatment of small bowel fistulas will be listed here.

If the fistula arises from the proximal jejunum, restriction of oral intake and a distal feeding jejunostomy will decrease the fistulous discharge and provide for enteric replacement. Oral feeding of low residue nutrients is feasible with ileac fistulas.

Prevention and control of diarrhea is particularly important in all patients with small bowel fistulas. Bacterial infection and hypertonic feeding mixtures may precipitate severe diarrhea. The use of appropriate antibiotics, depending upon stool cultures, opiates and Kaopectate are helpful adjuncts
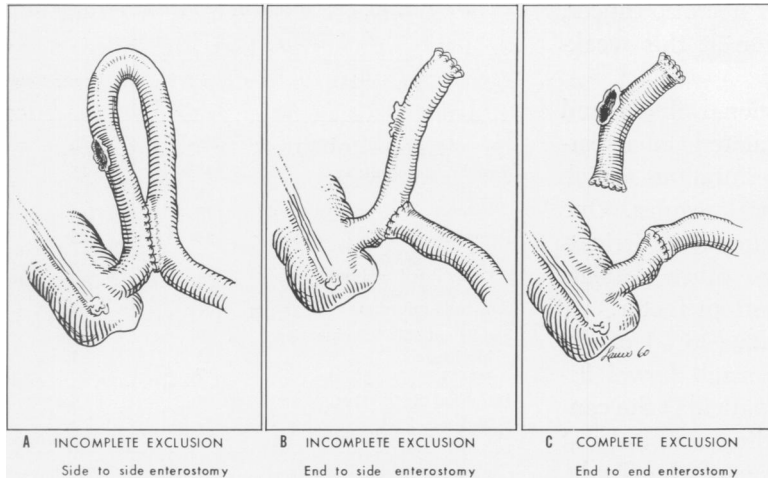
FIG. 5. Types of exclusion operations for small-bowel fistulas.

| A INCOMPLETE EXCLUSION | B INCOMPLETE EXCLUSION | C COMPLETE EXCLUSION |
| Side to side enterostomy | End to side enterostomy | End to end enterostomy |

for control. By these measures only one of the 46 patients developed uncontrolled diarrhea.

As with gastric and duodenal fistulas, sump suction and antibiotics were used in all of the patients. Nasal tubes seldom decreased fistulous discharge, and, in one-third of the patients, were omitted. Packing of the fistula was used unsuccessfully in four cases, and, in one of these, an abscess developed in the abdominal wall adjacent to the pack. While jejunostomies at the onset of the fistula formation theoretically should be of value, actually they were helpful in only three instances.

Operative Therapy: Nondefinitive operations for small bowel fistulas include feeding jejunostomies, drainage of localized pus, and incomplete bypass operations, in which the fistula is not completely excluded from the intestinal tract (Fig. 5A, B). The definitive operations listed in Table 11, include resection of the fistula and segment of intestine from which it arises, bypass with complete exclusion of the fistula (Fig. 5C), and a turn-in of the fistula at the point it arises from the small bowel.

Results: The results of both conservative and surgical treatment are listed in Table 11. The over-all mortality was 54

TABLE 11. *Operative Management and Results of Small Bowel Fistulas*

Type of Operation	No. Pts.	Cure	Recurrence	Dead of Fistula	Dead of Unrelated Disease
None	14	2	0	9	3
Nondefinitive operations					
Feeding enterostomy only	4	0	0	4	0
Incomplete bypass	2	0		1	1
Laparotomy only	3	0		2	1
Definitive operations					
Primary resection	11	10	0	1	0
Resection preceded by:					
Incomplete Bypass	6	6	0	0	0
Complete Bypass	1	1	0	0	0
Turn-In of Fistula	4	1	1	2	0
Turn-In preceded by					
Incomplete Bypass	1	0	0	1	0
Totals	46	20	1	20	5

per cent. Of the 23 patients treated without definitive operation, five died of unrelated causes. As far as could be determined, the complications in the remaining patients treated conservatively were no more severe than those in the group who had resection of the fistula. Thus, the two groups are fairly comparable. The mortality, however, is strikingly different. Eighty per cent of patients treated conservatively died of their fistula, while only one patient (6%) of the 17 treated by resection died.

Primary resection of the fistula and adjoining small bowel used in 11 patients was the most frequent and successful operation. In six cases an end-to-side, and therefore, incomplete bypass preceded the resection. In addition to the low mortality rate of six per cent there were no recurrences of the fistula. The average interval between the onset of the fistula and resection was 40 days.

Turn-in of the fistula, whether or not preceded by a defunctioning bypass operation, was remarkably unsuccessful. Only two of these five patients survived, and one of these survivors suffered a recurrence.

It is of interest to consider the results of the various bypass procedures illustrated in Figure 5. Two patients had side-to-side anastomoses and died. Seven patients had the small bowel divided proximal to the fistula, and then an end-to-side anastomosis made below. The fistula did not close in any of these patients. Six were later cured by resection, while the seventh subsequently died after turn-in of the persisting fistula. The single patient with complete exclusion and end-to-end anastomosis was cured.

Discussion: The classification of fistulas used in this study is original and therefore no large previous series that has been published can be compared accurately. Most of the previously published reports concern fecal fistulas and are weighted preponderately with scantily draining chronic lower small bowel and large bowel fistulas. Only a few small series and case reports have been published concerning small bowel fistulas with profuse drainage. Even in the decade of 1920 to 1930, when enterostomy attained great favor as a specific operation for intestinal obstruction, little information of a quantitative nature is available from which the prognosis of such fistulas, evaluated in consecutive series, can be studied. Of the published series the most extensive were made by Ransom and Coller,[19] and by Keyes.[64-66]

It is apparent from the high mortality of these fistulas, such as is shown in the present series, that the surgeon, by careful technic, should make every attempt to avoid damage to the intestine and to take the utmost care with every anastomosis so that fistulas may be avoided. It is certain that many patients treated in the past by exteriorization of gangrenous loops of small intestine are handled much better by primary resection and anastomosis. In the rare instance when the surgeon still believes he must intentionally produce a fistula, (as, for example, in some cases with advanced intussusception or meconium ileus), he should attempt to close it as soon as possible.

Some 30 years ago Witzel enterostomies were made frequently for intestinal obstruction. Probably because many of these patients did well, the tendency has persisted to regard fistulas originating from the small intestine as essentially harmless, and that they eventually will close spontaneously. It is apparent, on the other hand, from a study of our cases, that this optimistic point of view has been carried too far, and that patients have deteriorated while spontaneous closure of a fistula is awaited.

It is probable that most of these fistulas could be attacked safely one to three weeks after onset rather than after the much longer period that was used in these patients. Pleas for earlier operative attack have also been made by Keyes.[65]

When the type of operative procedure

is considered, there are only two that have been proved to be of any value. Direct attack upon the fistula with resection of the fistula and of the segment of the intestine from which it arises, has many advantages. It is possible to identify the loops of intestine accurately and the intestine can be mobilized from the ligament of Treitz to the ileocecal valve so that wrong loops will not be chosen for anastomosis or distal obstructing bands left that will prevent function of the anastomosis. Furthermore, accurate identification of the fistula often makes it possible to save a good deal of intestine that might be short-circuited if a bypass operation were attempted. It has also been a pleasant surprise to see how well patients tolerate laparotomy through the old incision, even though it is the site of a draining fistula.

On the other hand, an indirect attack through a clean abdominal incision also has certain advantages. If it is to be used, great care must be taken to identify the proper loops, and to eliminate any possible site of distal obstruction. Catheters should be placed in the afferent and efferent loops leading into the fistula, and a long intestinal tube passed beyond the ligament of Treitz to aid in identification of the proximal jejunum. Furthermore, if a bypass operation is to be used, the only one that actually can be recommended is complete exclusion of the fistula with end-to-end anastomosis of the proximal and distal intestine. The excluded loop must be decompressed completely either through a large fistula, or by exteriorizing the ends of the intestine to prevent later blow-outs.

Keyes has reported very satisfactory results with bypass procedures. For example, he estimated at one time that 30 cases had been treated successfully by the method in the St. Louis area in a ten-year period; five of his eight personal cases recovered. Harbison has recommended complete exclusion for fistulas and has reported several patients cured by them.[63] Our data would

indicate that no type of bypass other than complete exclusion will be effective.

Because peritonitis is such a frequent complication of this type of fistula special consideration must be given to the choice of operation when it is present. If absent, bypass operations can be done easily in a clean field. However, in many instances an extensive peritonitis is present and cannot be controlled until the fistula, which is the focus, has been removed. If the patient survives the early toxic phase of a general peritonitis, operation may be necessary in the presence of an extensive peritonitis that is plastic or even purulent; here a direct attack on the fistula appears wiser.

In general terms, we believe strongly than an early direct attack upon the fistula is safer and more satisfactory, and that complete exclusions of the fistula are required only in most unusual circumstances, as, for example, in the presence of a badly damaged abdominal wall.

Lower Bowel Fistulas

This category includes all of the fistulas of the large bowel regardless of the amount of drainage, and only those ileac fistulas which never drained over 100 cc. daily.

The function of the large bowel is twofold. The terminal ileum, cecum, and the right colon absorb most of the water and some electrolytes. The remaining colon dries the residue further but serves chiefly as a reservoir for feces. Thus, the relatively small fluid volume of the fecal stream, and the minimal nutritional absorptive ability of the lower bowel are unique features which render fistulas in this section of bowel much less ominous than those discussed in preceding categories.

Forty-six of the 56 patients in this group had fistulas originating from the colon. Ten had ileac fistulas which drained minimum amounts. Figure 4 shows the anatomic location of these fistulas. The average age of these patients was 53. Twenty-six were men. In this period, fecal fistulas occurred

as a complication in slightly over one per cent of all patients with large bowel surgery in this hospital.

Etiology: Table 9 lists the principal etiologic factor of each of these lower bowel fistulas. As in the previous two groups, surgical complications, particularly anastomotic leaks, were the most frequent cause; however, inflammation or cancer at the anastomosis or distal obstruction contributed to the formation of some fistulas.

Inflammatory disease is a more significant cause of lower bowel fistula than in the previous groups, since it was found in 33 per cent of the cases. Nine patients developed a fistula after drainage of a perforated appendix. Three patients developed fistulas after perforation of sigmoid diverticula. Five others who failed to heal a colonic anastomosis because of diverticulitis at the suture line, developed fistulas. The frequent association of appendicitis or diverticulitis with these lower bowel fistulas explains the relatively high incidence of cecal and sigmoid involvement. Four fistulas followed chronic abscesses; two of these abscesses had been quiescent several years before developing into fistulas.

Other causes of the fistulas included cancer and trauma. Two patients developed fistulas after perforating the bowel with irrigating colostomy catheters. Four patients had cecostomies which drained for over four weeks after removal of the catheter.

Inflammation, obstruction and cancer were the most significant contributory causes of these lower bowel fistulas. In addition to the 34 per cent of fistulas directly caused by inflammation, an additional 20 per cent had significant contributory inflammatory disease. Distal partial obstruction contributed to nine (16%) of the fistulas. In three of four patients with persistent cecostomies, and two of five patients with perforated cancer, distal obstruction was present. A total of 20 (36%) of the 56 patients had cancer, but in the majority (15), the cancer was an incidental finding only.

Complications: The important complications of this group of fistulas are listed in Table 10. There were no patients who developed significant electrolyte disturbances. All except two of the 11 patients who had significant malnutrition had cancer.

Sepsis is the most significant complication of this group of fistulas. Fourteen, or one-fourth of these patients had generalized peritonitis, including one case of tuberculous peritonitis. In contrast to the more proximal fistulas, 71 per cent of these patients survived. The high incidence of wound infections, as previously defined, and intraperitoneal abscesses, is not entirely unexpected since inflammatory disease not uncommonly precedes lower bowel fistulas. Significant skin digestion and irritation were virtually unknown in this group of lower bowel fistulas. Partial obstruction occurred in four cases after the fistula was formed. At least four patients later developed ventral hernias.

Conservative Therapy: Since fluid, electrolyte, nutritional and skin complications of these bowel fistulas are rare, the main objective of conservative therapy is the prevention and control of infection. The high incidence of associated inflammatory disease with the lower bowel fistulas emphasizes this need. Frequent cultures, parenteral and enteric antibiotics, and prompt drainage of localized sepsis are the principal methods of controlling sepsis. Chronic infections, such as tuberculosis and actinomycosis require special care.

In these 56 patients sump suction was used in less than 20 per cent since the relatively small amount of semi-solid material was easily handled by dressings. Except in patients with active peritonitis or paralytic ileus, oral low residue diets were well tolerated. Although vigorous parenteral replacement was never necessary, some patients received blood, plasma or albumin to correct anemia or hypoprotemia. Over 85 per cent of these 56 patients received antibiotics. The only exception were those pa-

TABLE 12. *Treatment* and Results of Lower Bowel Fistulas*

Type of Operation	No. Pts.	Cure	Recurrence	Dead of Fistula	Dead of Unrelated Disease
No operation	20	15	2**	1	2
Colostomy or Bypass	8	5		1	2
Primary resection	10	10			
Colostomy followed by resection	8	7		1	
Turn-in	6	5	1***		
Revision colostomy	2	1			1
Exteriorization of fistula	1			1	
Totals	55	43 (79%)	3 (5%)	4 (7%)	5 (9%)

* 1 patient refused treatment.
** 1 patient cured by later resection.
*** Cured by later resection.

tients with scanty drainage from chronic fistulas.

Operative Treatment: Defunctioning operations include colostomy and various bypass procedures. Colostomy is the method of choice to defunction fistulas distal to the transverse colon. Ileac fistulas and fistulas arising from the right colon require ileo-transverse colostomy for adequate defunction. Complete division of the ileum is desirable to defunction the fistula, though, for complete exclusion, the bowel must be divided distal to the fistula as well.

Other definitive operations include resection, turn-in of the fistula, and colostomy or ileostomy revision. A resection or turn-in may be protected by a previous defunctioning colostomy or bypass.

Results: The results of treatment are listed in Table 12. Of the 28 patients who did not have definitive surgery, 22 closed their fistulas spontaneously. Spontaneous closure occurred within five days to one year, with the mean of four weeks. One spontaneous closure reopened after three months, and another after 42 years. Two patients who were treated conservatively died of peritonitis complicating the fistula. One of these two patients had a proximal defunctioning colostomy and the other had no operation.

Definitive surgery resulted in cure in 88 per cent of the cases. Either resection or turn-in was successful, and there was only one recurrence. Definitive surgery was done from one day to 49 years after the formation of the fistula, though the mean was between two and three months. One patient died of peritonitis complicating a complex fistula with four internal openings after an attempt was made to resect it. Of the three recurrences in the entire group, two were later cured by resection.

Discussion: Surgical complications and inflammation account for the overwhelming majority of lower bowel fistulas. Compared to the two previous groups, the incidence of fistulas caused by surgical complications is low, and that due to inflammation is considerably greater.

Appendicitis and diverticulitis were the most common infections which led to lower bowel fistulas. Appendiceal fistulas are relatively benign since of nine cases, four closed spontanueously, four were closed by surgery, while one was not treated at the patient's request. Fistulas arising from diverticulitis usually require resection of the involved colon, although spontaneous closure has been observed. Chronic abscesses were the third major type of inflammation that caused these lower bowel fistulas.

Chronic inflammation, such as actinomycosis and tuberculosis occurs relatively rarely.

In 1928, Ochsner [16] wrote that "spontaneous healing of intestinal fistulae involving the large bowel or the terminal ileum is the rule and not the exception." In 1944, Lichtman and McDonald [11] thoroughly studied the pathology of 50 chronic "fecal" fistulas of the ileum and colon. Fifty-four per cent of these fistulas had an appreciable number of foreign body cells. Small bits of cotton, talc or petrolatum droplets were the most frequently found foreign material. They concluded that active disease at the internal fistulous opening, foreign bodies, fistulas of large diameter, (1 cm. or more), and distal intestinal obstruction were the major causes preventing spontaneous closure. To these causes of persistent fistulas should be added eversion of mucous membrane, and epithelialization of the fistulous tract.

Lichtman and McDonald [11] found that 73.5 per cent of 200 fecal fistulas treated by turn-in, or resection, with or without a proximal enterostomy or colostomy, were cured. The recurrence rate was 17.5 per cent and the hospital mortality nine per cent, when late deaths were excluded. Their series is eligible for comparison to our lower bowel fistula group since they excluded proximal jejunal fistulas, and since 83 per cent of the fistulas in their series had drained more than six months. Thus, although they did not record the amount of fistulous discharge, it is safe to assume that these fistulas were chiefly ileac or colonic fistulas, with scanty drainage. The cure rate in our series treated by resection or turn-in was 92 per cent. One fistula recurred and one patient died. Thus, in the years between these reports, the cure rate apparently has increased, the recurrence rate has diminishd, and the hospital mortality has not changed significantly.

The high rate of cure and low hospital mortality from definitive surgery for these lower bowel fistulas now offer an attractive alternative to prolonged medical management. On the basis of Lichtman and McDonald's pathologic study, and the data presented here, the indications for definitive surgery or conservative management can be established.

Since lower bowel fistulas usually are not rapidly debilitating, conservative management for several months or longer is feasible. Generalized peritonitis or distal obstruction are important exceptions to this statement. In the absence of these complications, medical management for six weeks is indicated to allow active inflammation to subside and to evaluate progress toward spontaneous closure. If, after 6 weeks, inflammation is still active, defunctioning procedures are indicated. When the inflammation subsides definitive surgery or conservative management can be carried out. Care must be taken to exclude other causes of persistent fistulas. If distal partial obstruction is present, it should be relieved with or without concomitant definitive surgery.

Definitive surgery is indicated in fistulas which fail to progress satisfactorily after six weeks and in those fistulas which, as described above, are likely to be persistent. The actual operation, either resection or turn-in, must be determined by the local factors and the surgeon's preference. We prefer resection whenever possible to turn-in procedures.

In patients who have a fistula and generalized peritonitis, early emergency resection, or occasionally exteriorization of the fistula, is indicated. Proximal defunctioning operations are inadequate since they do not stop the source of the contamination immediately. Generalized peritonitis is the most frequent lethal complication of these fistulas and requires early aggressive treatment. It is of interest that all four patients who succumbed because of their lower bowel fistulas died of peritonitis.

Summary and Conclusions

1. One hundred and fifty-seven patients with external fistulas arising from stomach, intestine, or colon were observed in the Massachusetts General Hospital, from 1946 to 1959.

2. They have been divided into three groups: (1) fifty-five originating from stomach, duodenum, or gastrojejunal anastomosis; (2) forty-six arising from jejunum or ileum, with drainage of over 100 cc. of intestinal content daily; and (3) fifty-six arising from lower ileum, with drainage of less than 100 cc. daily, and the colon. It is suggested that this classification has prognostic and therapeutic significance.

3. Surgical complications were the direct cause of 67 per cent of these 157 fistulas.

4. The most significant complications of these fistulas are fluid and electrolyte imbalance, malnutrition, and generalized peritonitis. The over all death rate of these complications was 78 per cent, 61 per cent and 67 per cent respectively.

5. The over all mortality of the three groups of external fistulas was as follows: Gastric or duodenal—62 per cent; small bowel with profuse drainage—54 per cent; and lower bowel—16 per cent.

6. Despite antibiotics, and modern methods of replacement therapy, there is no evidence that the mortality of external fistulas of the gastro-intestinal tract has decreased significantly in the past 20 years. Since surgical complications are now the most frequent cause of external fistulas, prevention is essential. In addition to well-established surgical principles, a wider use of catheter duodenostomy after gastric resection is suggested.

7. Five cures of gastric or duodenal fistulas following definitive surgery are reported.

8. An established small-bowel fistula is treated most satisfactorily by early resection of the fistula and the segment of intestine from which it arises.

9. Fistulas of the lower bowel have a high incidence of spontaneous closure; expectant treatment is satisfactory in many instances. The characteristics of fistulas which require operation have been presented. Definitive surgery led to cure in 88 per cent of the cases in which it was attempted, when the fistula arose from the lower ileum or colon.

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DISCUSSION

DR. SAMUEL P. HARBISON: I have been very impressed in reading the manuscript of this paper because it is quite all-inclusive. I am a little surprised, as was Dr. Sweet, about the large number of fistulas, but we have not counted them at home and perhaps we are the same.

In any event, this is a very comprehensive paper of Dr. Edmunds, Dr. Williams and Dr. Welch, and it's an excellent summary of the general experience, I am sure, over the country, and emphasizes important considerations in the prevention of these gastro-intestinal fistulas.

In a group of fistulas following gastrectomy one half, as I read the manuscript, were related to emergency operations for bleeding, indicating probable compromises of surgical principles due to the seriousness of the immediate situation. Blowouts of duodenal stumps have been related directly to inadequate closures consequent upon ulcer-scarred or friable tissues or hurry in bleeding cases.

The preventive measures are clearly evident: An alternate procedure to eliminate a necessarily hazardous technic, a vagus resection and gastroenterostomy or catheter drainage, where there may be doubt about duodenal stump closure. The principle may also be used in the severely bleeding patient, and I was very impressed with the paper tonight of Dr. Smith and Dr. Farris with regard to this procedure. I have not had personal experience with it, but I am very sure that I am going to use it next time, because of the avoidance of a major resection.

In reference to Dr. Scott's remarks tonight, I believe a hemigastrectomy and restitution of continuity by a Billroth I is an entirely different technical procedure from simply opening the duodenum and stomach and sewing it up transversly as in the classical pyloroplasty.

We agree entirely with the conclusions of Drs. Edmunds, Williams and Welch that in dealing with fistulas of the jejunum and upper ileum, partial exclusion by bypass technics is to be con-