

# Free Perforation of the Small Intestine

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Surgeons operating on patients with an obscure peritonitis should be aware of the diverse etiologies of small intestinal perforation and the general principles of management of each. A series of 16 adult patients with free perforation of the small intestine and spreading peritonitis in the absence of bowel obstruction, incarcerated hernia, or trauma is reviewed. Etiologies were as follows: Crohn's disease, four patients; foreign body ingestion, two patients; jejunal diverticulosis, one patient; lymphoma, two patients; cancer chemotherapy, one patient, amyloidosis, one patient; idiopathic, five patients. Although all patients presented with diffuse peritonitis, the findings of fever and leukocytosis were inconstant. Free air was demonstrated on radiographs in only eight of 16 patients, and the correct preoperative diagnosis was not made except in the four patients with Crohn's disease. Resection and primary anastomosis were utilized successfully in ten patients, the remainder of the patients undergoing oversewing the the perforation. Four patients (25%) died.

IN THE UNITED STATES, adults with perforation of the small intestine generally have small bowel obstruction and gangrene, strangulating groin hernias, or trauma as the underlying cause. In neonates, necrotizing enterocolitis remains the most common cause. Perforation of the intestine leading to generalized peritonitis in the absence of these predisposing conditions is distinctly rare, however, and because of this and also the nonspecific clinical picture manifested by these patients, preoperative diagnosis is usually not possible. Therefore, the general surgeon performing exploratory celiotomy on a patient with peritonitis must be aware of the diverse etiologies of spontaneous perforation, the unique characteristics of each, and their management. This review was stimulated by the recent exposure to three such patients, and an attempt was made to review the combined experience in four university-associated private and public institutions, recognizing that because of the rarity of this condition, surgeons at any one hospital were unlikely to have seen sufficient numbers of patients to make such a review worthwhile.

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## Methods

The charts of all patients undergoing celiotomy for perforated small intestine associated with spreading peritonitis were reviewed for a ten-year period, 1971-1981. The four hospitals (one university, one Veterans Administration, and two community hospitals) comprising the Loyola University surgery training program were utilized; approximately 45,000 major operations were performed at these four institutions during the ten-year period. All adult patients who harbored an incarcerated hernia, a small bowel obstruction, or who presented with abdominal trauma were excluded, as were all children. Additionally, those patients who had a perforated small intestine and localized abscess formation were omitted from review.

## Results

Sixteen patients, six male and ten female, were identified. Their ages ranged from 25 to 83 years. The etiologies of the perforations are listed in Table 1. Four patients had Crohn's disease and in all, the perforation originated in an area of active ileal inflammation. All four patients were taking 20 to 30 mg per day of prednisone, and one had undergone appendectomy three years previously. The duration of Crohn's disease in these four patients ranged from two to eight years. Despite steroid administration, all patients were seriously ill with obvious spreading peritonitis, and the correct preoperative diagnosis was made in each instance. The terminal ileum was the site of the perforation in each, and resection of the distal ileum and right colon was carried out with primary anastomosis in three patients and formation of an ileostomy and colonic mucous fistula in one patient. This last patient successfully underwent reanastomosis four months later. There was no morbidity in this group of patients. The two patients with foreign body perforations gave no history of ingesting the offending objects, a toothpick in one and a

TABLE 1. *Clinical Data on 16 Patients with Small Bowel Perforation*

Patient #	Etiology	Sex/age	Temp.	WBC	Radiography findings	Preop DX.	Operation	Morbidity & Mortality
1	Crohn's	F-64	37.6	5,300	Ileus	Perf. Crohn's	Resection & Ileocolostomy	—
2	Crohn's	M-34	37.8	11,400	Free Air	Perf. Crohn's	Resection & Ileostomy	—
3	Crohn's	F-25	37.1	33,400	Ileus	Perf. Crohn's	Resection & Ileocolostomy	—
4	Crohn's	M-34	37.4	13,600	Ileus	Perf. Crohn's	Resection & Ileocolostomy	—
5	Foreign Body	M-52	38.2	15,500	Bowel Obst.	Bowel Obst.	Resection & Anastomosis	—
6	Foreign Body	F-47	38.5	11,200	Ileus	"Peritonitis"	Resection & Anastomosis	—
7	Diverticulum	F-83	39.0	2,700	Free Air	Perf. Viscus	Oversew	Death
8	Lymphoma	F-43	39.0	10,000	Free Air	Perf. Viscus	Resection & Anastomosis	—
9	Lymphoma	M-62	36.6	2,300	Free Air	Perf. D.U.	Oversew	Death
10	CA Ovary	F-66	38.4	2,000	Free Air	Perf. Viscus	Oversew	Death
11	Amyloid	F-54	38.2	1,000	Free Air	Perf. D.U.	Resection & Anastomosis	Death
12	Idiopathic	F-36	38.0	3,900	Ileus	Bowel Obst.	Resection & Anastomosis	—
13	Idiopathic	M-65	36.4	8,000	Free Air	Perf. Diverticulitis	Oversew	Dehiscence
14	Idiopathic	F-57	37.6	11,200	Ileus	Bowel Obst.	Oversew	—
15	Idiopathic	M-32	38.2	13,000	Free Air	Perf. D.U.	Resection & Ileocolostomy	—
16	Idiopathic	F-55	36.7	6,100	Ileus	LGI Bleeding	Resection & Anastomosis	—

fruit pit in the other. Both foreign bodies lodged in and perforated the terminal ileum. Neither patient was edentulous nor had a psychiatric history. Ileal resection and anastomosis was successfully carried out in both.

The patient with a perforated jejunal diverticulum was 83, had no previous abdominal symptoms referable to the diverticulosis, and entered the hospital with evidence of peritonitis and sepsis. Despite prompt operation, she died within one day with septic shock.

The two patients with non-Hodgkins lymphoma presented with free perforation of the intestine as the first evidence of their disease. Both presented with pain of one day's duration and had free air on abdominal radiographs. In both, a perforated viscus, believed to be a duodenal ulcer, was suspected. One patient had eight separate perforations scattered throughout the entire length of the small bowel and because of this, each was oversewn rather than resected. Histologic examination of the margins of the perforations disclosed lymphoma in each instance. This patient succumbed with renal failure and stress upper G.I. hemorrhage, and it was presumed that the peritoneal infection was ongoing and uncontrollable. The other patient had a jejunal perforation through an area of lymphoma and survived resection and anastomosis without complications. The third patient with a malignancy had ovarian carcinoma and was receiving cyclophosphamide and chlorambucil. She entered the hospital with diffuse peritonitis and a white blood cell count of 2,000 cells/cumm. Although carcinoma was present throughout the peritoneal cavity, the small bowel perforation involved normal intestine, both grossly and histologically. It was oversewn, but the patient succumbed with multiple organ system failure.

Five patients had a perforated small intestine with no evidence of local or systemic disease. All were promptly operated upon with resection and anastomosis in three and oversewing of the perforation in two. No patient had evidence of reperforation after operation, and all have remained well for periods ranging from three to five years. Histologic evaluation of the edges of the perforation in all five patients showed only nonspecific enteritis. Three patients underwent analysis for stool pathogens plus ova and parasites; none were found.

The single patient with amyloidosis had massive thickening of the small intestinal wall as a result of amyloid infiltration with a perforation, peritonitis, and resultant ischemia of approximately one half of the intestine. Death occurred 47 days after operation, and autopsy disclosed only resolving peritonitis but an intact G.I. tract.

## Discussion

The wide diversity of etiologies of spontaneous small intestinal perforation and the rarity of this condition in the United States make it unlikely for any one surgeon or institution to amass an extensive experience in managing these patients. Indeed, there is no such series of patients originating from this country, although many series, predominantly including patients with typhoid fever and tuberculosis, have been published from underdeveloped countries. The paper by Huttunen is the only one comparable with the present study, and many similarities are noted (Table 2).<sup>1</sup> In both series, patients with perforated diverticula, foreign bodies, Crohn's disease, and malignancies form the largest group of pa-

TABLE 2. Etiology of Small Bowel Perforation in Present Study and that of Huttunen et al.<sup>1</sup>

	Present Study		Huttunen et al.	
	No.	(No. deaths)	No.	(No. deaths)
Crohn's disease	4	(0)	2	(2)
Foreign body	2	(0)	4	(1)
Diverticulum	1	(1)	4	(0)
Malignancy	3	(2)	1	(0)
Idiopathic	5	(0)	3	(0)
Other	1	(1)	3	(2)
	16	(4) 25%	17	(5) 29%

tients. Additionally, however, both series noted a significant number of patients presenting with small intestinal perforation and no underlying disease. The authors overall mortality rate of 25% is comparable with the 29% described by Huttunen.

World-wide, typhoid fever undoubtedly represents the most common cause of small intestinal perforation.<sup>2-5</sup> In two large series of patients with typhoid fever, perforation occurred in 78 of 1470 patients (5.3%), and 141 of 789 patients (17.9%).<sup>2,5</sup> Males account for over two thirds of cases of typhoid perforation and in endemic areas, the diagnosis is readily made; in one series reported from India, an accurate preoperative diagnosis was made 81% of the time.<sup>5</sup> Swelling and ulceration of Peyer's patches with subsequent necrosis and perforation occurs and the classical presentation is that of an acute peritonitis, usually developing during the second or third week of the illness. Perforations are predominantly in the terminal ileum, over 80% being within 60 cm of the ileocecal valve. Eighty-five per cent of typhoid perforations are solitary.<sup>3</sup> Cultures of peritoneal fluid are rarely positive for *Salmonella typhi* and disclose only the usual intestinal flora.<sup>5</sup> Treatment consists of vigorous peritoneal cleansing and systemic antibiotics. Simple plication of the perforation is suitable in the majority of cases.<sup>2,5,6</sup> However, if multiple perforations occur in one segment, resection and anastomosis should be carried out. Repair and exteriorization has been advocated for patients with more extensive peritonitis, but clear documentation of the superiority of this treatment is lacking.<sup>7</sup> Postoperative mortality rates ranging from 10% to 35% are usually reported.

Ileal perforation secondary to tuberculosis is extremely rare in the Western hemisphere. Of patients with tuberculosis, less than 1% will have G.I. involvement, and of these perhaps 10% will perforate leading to peritonitis.<sup>8</sup> The clinical picture will be that of a diffuse peritonitis with free air often absent radiologically.<sup>9</sup> A chest radiograph will often manifest changes of tuberculosis, and this can be a clue to the etiology of the acute

abdominal process. The most common site of G.I. involvement is the ileum, and operative differentiation from Crohn's disease may be difficult. Although bypass of the affected segment has been recommended, the results are so poor that resection should be considered as the preferred treatment.<sup>9</sup> The decision whether to exteriorize or anastomose will depend upon the degree of peritonitis and other individual circumstances. Antituberculous chemotherapy is mandatory after operation.<sup>10</sup>

Free perforation of the intestine is rare in Crohn's disease, because of the chronic nature of the condition and the tendency to form abscesses and fistulae if full thickness penetration of the bowel occurs. The reported incidence of this complication is 1% to 2% of all cases of Crohn's disease.<sup>11</sup> Perforation may occur in an area of active inflammation or through normal bowel proximal to an obstructing lesion. Although many patients with Crohn's disease are receiving corticosteroids, reviews of this subject have found it difficult to implicate steroid administration as part of the pathophysiology in bowel perforation.<sup>11,12</sup> Resection of the involved segment is the cornerstone of management. Attempts at bypass or oversewing of the perforation are likely to be unsuccessful.<sup>11,13</sup> Although it has been stated that all cases should be treated by resection and exteriorization utilizing a double-barreled ileocolostomy,<sup>13</sup> there are undoubtedly cases that will lend themselves to primary anastomosis.

Ingestion of foreign bodies presents a fairly common clinical problem. Of those that reach the stomach, over 90% will pass per rectum without incident.<sup>14</sup> Small bowel perforation, usually in the ileum, will occur in less than 1% of these cases.<sup>14,15</sup> Many authors have stressed the role of dentures leading to inadequate mastication of food, and it is likely that the lack of normal palatal and gingival sensation in the edentulous patient predisposes towards inadvertent foreign body ingestion.<sup>16,17</sup> In this country, mentally retarded or psychotic individuals make up a large group of these patients, but accidental ingestion of the tabs from canned beverages by those that drop the tab into the can after removal is also reported.

Jejunioleal diverticulosis occurs in from 0.25 to 1% of the population.<sup>18</sup> Symptoms, such as abdominal pain or G.I. hemorrhage, occur in less than 10% of those affected, and perforations occur mainly in the elderly. The great majority of these patients harbor multiple diverticula, usually in the jejunum. Etiology is probably on a hypermotility basis with symptomatic patients showing active but uncoordinated peristalsis.<sup>19</sup> Importantly, these diverticula are associated along the mesenteric border of the intestine at the points of perforation of the wall by blood vessels. Because of their mesenteric

location, they may be hard to identify at celiotomy. Oversewing is unsatisfactory because of this location, and treatment consists of resection.

Perforation of the intestine secondary to malignant disease is becoming more frequent as the numbers of patients undergoing successful initial treatment increase. Perforation may occur in an area of cancerous involvement, often secondary to a partial or complete distal obstruction. Additionally, patients with infiltrating malignancies of the bowel such as lymphoma may perforate during chemotherapy due to rapid lysis of the tumor.<sup>20</sup>

Regardless of the etiology of small bowel perforation, the clinical syndrome mimics that of many other acute abdominal conditions, making preoperative diagnosis unlikely. Fever, leukocytosis, and hyperamylasemia are inconstant and nonspecific, and free air is often not demonstrated radiologically, as noted in eight of these 16 cases. If, at the time of celiotomy in a patient with peritonitis, the cause of the peritonitis is not readily apparent, the small intestine should be thoroughly examined. If a perforation is noted, resection will be indicated in most instances. This will not only remove the area of disease but will allow sufficient material to be examined pathologically, unlike the situation that occurs when an area is merely oversewn following a limited excision of an edge for biopsy. Whether or not exteriorization or primary anastomosis is preferable cannot be answered definitively from this study. In this series, ten patients underwent resection and primary anastomosis, and in all normal anastomotic healing occurred. The one patient in this group who succumbed had advanced amyloid infiltration into all organs and died of pulmonary failure. Surely situations in which peritonitis is minimal will lend themselves to anastomosis, whereas in patients with extensive peritoneal soilage, consideration must be given to exteriorization with subsequent reanastomosis. Closure of the abdomen should be with strong nonabsorbable monofilament suture, the authors' preference being monofilament wire. Delayed wound closure is important in preventing wound complications, and antibiotics effective against both gram negative aerobes and

anerobes should be begun before operation. With a knowledge of the common causes of small bowel perforation and adherence to these principles, the current excessive mortality rates noted in this condition should be reduced in the future.

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