Surgical Treatment of Acute Diverticulitis by Staged Procedures

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A retrospective 10-year experience with the traditional three-stage plan (diverting colostomy, resection, colostomy closure) for perforated diverticulitis of the colon in four urban hospitals was reviewed to accurately assess the mortality rate. Only patients who were admitted in a non-elective manner with signs of an acute abdomen or who were already hospitalized with another illness and developed an acute abdomen were considered. Fecal or generalized purulent peritonitis, or pelvic peritonitis with abscess were observed at laparotomy in all instances. Two hundred and eight patients representing 211 episodes met the above stated criteria for inclusion in the study. A transverse colostomy was performed in 203 instances associated with 16 deaths, and 8 sigmoid colostomies were associated with two deaths. The overall mortality after the first stage was 8.5%. A loop colostomy was constructed most frequently and a completely divided colostomy performed in only 31 of 211 (15%) instances. Of 147 instances in which the diseased sigmoid colon was resected, 44 (30%) had the colostomy ablated at the same operation, resulting in only one death (0.7% mortality). Colostomy closure as a separate procedure in 103 instances resulted in 4 deaths (3.9% mortality). The highest mortality rate occurred in patients in the eighth decade. Staged procedures for perforated colonic diverticula can be carried out with a mortality rate of 11%.

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the perforated area, followed weeks later by; 2) resection of the perforated segment, and subsequently; 3) colostomy closure. During the past decade there have been advocates for primary resection and anastomosis of the sigmoid colon in such circumstances.[7,9,15,23] Proponents of a single procedure have stated that the traditional three-staged plan results in a 21–45% mortality. The purpose of this study was to accurately assess the mortality from the three-staged plan for perforated sigmoid diverticulitis.

Material and Method

A retrospective 10-year experience with the three-staged plan for perforated sigmoid diverticulitis in four urban hospitals in Baltimore was reviewed. Information was obtained by Record Room survey, Operative Room Log and followup from clinical out-patient notes or physicians' office records in the community hospitals. One of the problems with assessment of various methods of treatment is definition of the disease process, thus only cases which were admitted in a non-elective manner with signs of an acute abdomen or who were already hospitalized with another illness and developed an acute abdomen were considered. Furthermore, the initial operative procedure was not on the "elective" schedule. Fecal or generalized purulent peritonitis or pelvic peri-

P ERFORATED DIVERTICULAR DISEASE of the colon has been a source of considerable morbidity and mortality particularly in our geriatric population. The treatment has been a challenging one for surgeons because of the difficulty in management of peritonitis and sepsis associated with colon perforation. The traditional method of treatment has been a three-staged plan: 1) diversion of the fecal stream (proximal colostomy) and drainage of
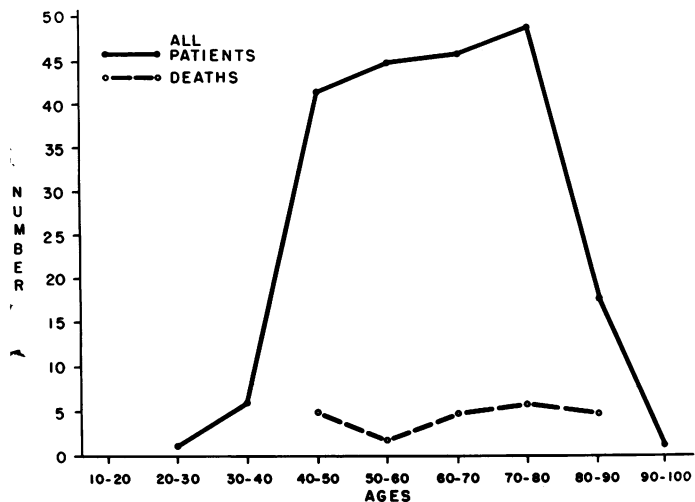
FIG. 1. Distribution of total patients and deaths by age.

TABLE 2. *Mortality After First Stage*

Colostomy	Patients	Deaths	Rate
Transverse	203	16	7.9%
Sigmoid	8	2	25%
Total	211	18	8.5%

tonitis with abscess was observed at laparotomy. All patients reviewed were initially treated by drainage of the perforated area and proximal colostomy (Stage I).

Results

Nine hundred charts were reviewed at the four hospitals to cull 208 patients representing 211 episodes suitable for inclusion by the above stated criteria. Three patients had recurrent episodes of perforation and received the same treatment plan. The age distribution of the patients is shown in Fig. 1. The admitting diagnosis was frequently uncertain and included a spectrum of presumptive causes for an acute abdomen (Table 1). Twenty-one (10%) of all patients had free intraperitoneal air by x-ray. Similarly, 10% of the patients who died had free air preoperatively. Drainage of the perforated area was accomplished by a variety of methods including mushroom catheter into the perforation or penrose drains to the fixed sigmoid colon adjacent to the perforation. A transverse colostomy was performed in 203 instances associated with 16 deaths and 8 sigmoid colostomies were associated with 2 deaths (Table 2). The overall mortality after the first stage was 8.5%. A loop colostomy was constructed most frequently and a completely divided colostomy performed in only 31 of 211 (15%) instances. Four of the 18 deaths (22%) after Stage I occurred in the divided colostomy group.

The initial colostomy was accepted as a permanent diversion in 34 patients (16%) either by physician decision based on concurrent medical illness or by patient request. The various reasons are tabulated in Table 3.

Surprisingly, there were 12 patients (6%) who had colostomy closure without resection of the sigmoid colon. Nine had generalized peritonitis and three had pelvic abscess. From operative descriptions, none had an inflammatory segment of colon. All had relatively normal barium enemas in followup without evidence of stricture or mucosal lesion. Followup in this group, 7 of whom were less than 60 years old, has shown that they have had minimal symptoms and no further complications of diverticular disease.

Of 147 instances in which the diseased sigmoid colon was resected (Stage II), 44 (30%) had the colostomy ablated at the same operation. There was only one death for a 0.7% mortality. Less than 30 weeks transpired between Stages I and II in 80% of instances and less than 20 weeks in 50%.

Colostomy closure (Stage III) was carried out as a separate procedure in 103 instances (49%). There were four deaths (3.9% mortality) resulting from colostomy closure, alone.

The causes of death are shown in Table 4. All of the myocardial deaths occurred in the fifth and sixth decades of life and the highest overall mortality rate occurred in the eighth decade. Figure 1 shows the number of deaths by decades in comparison with the overall age distribution of patients.

The various complications are shown in Table 5. Of the cardiovascular complications, the four myocardial infarctions are well documented and there were individual instances of cerebral vascular accident and femoral artery embolus. However, the occurrence of thrombophlebitis and pulmonary embolism appears unrealistically low to

TABLE 1. *Preoperative Diagnosis*

1. Acute appendicitis
2. Perforated peptic ulcer
3. Small bowel obstruction
4. Mesenteric thrombosis
5. Acute abdomen
6. Perforated diverticulitis
7. Twisted ovarian cyst

TABLE 3. *Reasons for Definitive Colostomy*

Age	11
Patient decision	6
Incidental cancer	5
Cardiac	4
Abortive resection	3
Chronic renal failure	3
Awaiting improvement	1
Cerebrovascular	1
	34

TABLE 4. *Causes of Death*

Deaths	
8	Sepsis
6	Myocardial infarction
4	Pulmonary embolus (2 septic)
1	G.I. Hemorrhage due to stress ulcer
1	Chronic lung disease
2	Renal failure*
1	Aspiration pneumonia*

* Associated with sepsis.

TABLE 5. *Complications*

Cardiovascular
Myocardial infarction
C.V.A.
Thrombophlebitis
Pulmonary embolus
Embolus to femoral artery
Wound
Herniae
Fistulae
Evisceration
Prolapse of colostomy
Other
Renal failure
Pulmonary insufficiency
Infection
Aspiration pneumonia

ascribe an incidence rate. Herniae occurred with high frequency, 13% of patients, in colostomy closure wounds, abdominal incisions, and wound drainage sites.

Fistulae occurred in 11% of patients. It occurred from colostomy closure site only when the colostomy had been completely divided initially or when the colostomy stoma was resected necessitating a formal anastomosis. Colocutaneous fistulas occurred also from the drainage site and from anastomotic sites. Evisceration occurred only in one instance. Prolapse of colostomy was a common observation. Documented wound infection rate was 15% of all procedures. The days of hospitalization for Stage I and total days for Stage I, II and III combined as shown in Fig. 2.

Discussion

The reports of primary resection and anastomosis of the colon in the presence of free perforation or abscess formation[7,9,15,23,26,27] are based on personal experience by skilled surgeons with between 10 and 25 patients in the references cited, with a mortality rate between nil and 20%. A comparison has been drawn in each report to higher mortality rates with the traditional three-staged procedures. There appear to be certain ideal circumstances, e.g., early diagnosis and treatment, ab-

sence of fecal contamination, unobstructed colon, absence of inflammatory mass, absence of generalized sepsis, and stable clinical condition of the patient, when a single procedure can be accomplished with safety. The theoretical advantages are obvious: avoidance of further operations and a greatly shortened time of morbidity and return to normal activity. The major criticism of the three-staged plan is the continued presence of the perforated colon as a septic focus as well as the column of feces remaining in the colon distal to the colostomy as a potential further source of contamination. In addition, multiple operations may increase morbidity and mortality, and there is no doubt that there is appreciable hospitalization time and loss of activity. The added mortality from the third stage alone (3.9%) as shown by our figures, underlines the criticism of a staged plan and continued use of staged procedures is only justified if the overall mortality is similar or better than primary resection. Also with primary resection, there is an inherent risk of having a perforated carcinoma instead of a diverticulum, or an unsuspected carcinoma associated with a perforated diverticulum.[1,11]
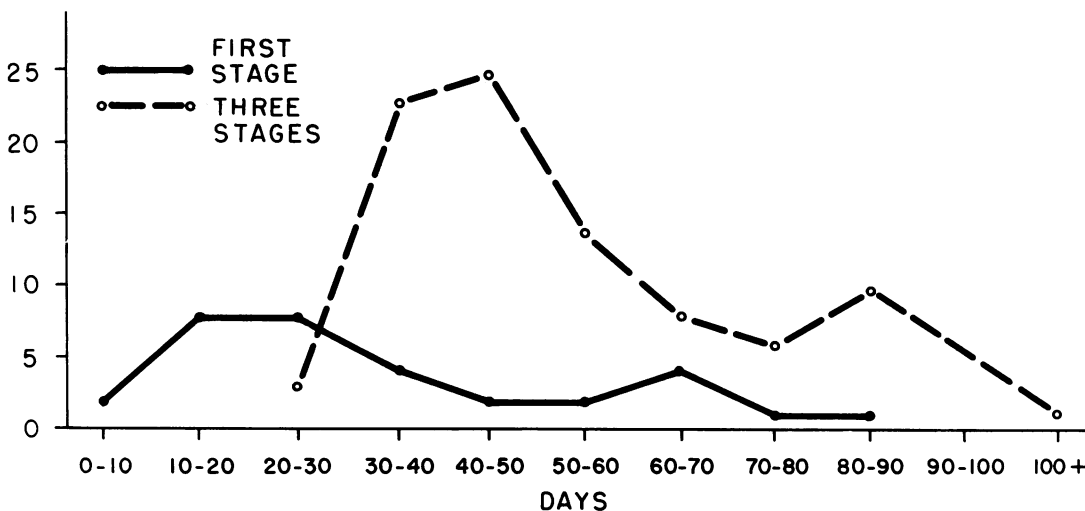

FIG. 2. Days of hospitalization during stage I and total days of hospitalization for all stages.

Other authors have attempted to answer these objections by advocating resection of the perforated segment followed by end colostomy and mucous fistula, or end colostomy and Hartmann's pouch,[5,6,12,13,17,21,22,24,25] thus removing the potential source of continued peritoneal soilage. A second procedure to establish bowel continuity then completes the treatment plan. This approach, when technically feasible, appears to have great merit.

The difficulty of theoretical treatment plans or of assessing the comparative results of various procedures is that the pathological and clinical conditions are varied. These variables include: distention of the colon; induration of the mesocolon; the extent and nature of the peritoneal contamination from a recent or neglected perforation; or an indurated chronically inflamed pelvis with dense adherence of adjacent small intestine, bladder and ureter.

Many experienced surgeons have been unwilling to accept primary resection and anastomosis citing fewer complications, particularly fistulae, and less mortality with a staged-treatment plan.[2,8,10,16,19,20] We agree with the consensus opinion that resection or exteriorization of the perforated segment is desirable when technically feasible as the initial procedure. In answer to criticism of the remaining transverse and left colon proximal to the perforation, peritonitis is accompanied by ileus, hence there is less likelihood of movement of the fecal column. Also, decompression colostomy reduces antegrade peristaltic stimulation, and it is likely that the perforation seals before peristalsis resumes. If the perforation site is large, a mushroom catheter can be inserted to establish a drainage tract and also for irrigation with antibiotic solutions.

That 16% of patients had a colostomy as a definitive procedure imposed by their general medical condition, or willingness to accept only that treatment, indicates the advanced age and severity of associated disease. Proximal colostomy has been found ineffective in the long-term treatment of diverticular disease in 50% of patients reviewed by Bolt and Hughes,[4] unless followed by resection.

The surprising observation of 12 patients subsequently having colostomy closure without further difficulty raises questions regarding possible misdiagnosis (namely, foreign body perforation) or more likely, that a single diverticulum, rather than an inflamed or indurated segment of colon may be the underlying pathology. Berman[3] has suggested that the concept of inflammatory changes in multiple diverticulae or of a diffuse cellulitis of the colon should be abandoned. It is certainly conceivable that a single perforated diverticulum can seal permanently and have minimal or no significant effect on structure or function of the remaining colon.

The explanation for the low overall mortality, 11%, is the remarkably low mortality rate (0.7%) of the interval colectomy series. The high percentage of sepsis-related deaths after the first stage underlines the severity of the initial insult as well as the possible continued source of sepsis. Eighteen of the total of 23 deaths (78%) occurred after Stage I, 13 of which (57%) were associated with sepsis. The four deaths at the time of colostomy closure, a procedure generally considered of low risk, is disturbing. All were of cardiac etiology—myocardial infarction or arrhythmias.

Mitty et al.[18] reported a significantly higher mortality rate in surgical treatment of patients over 70 years old with complications of diverticulitis. Our results confirm the observation, however, in their hands the three-staged procedure resulted in no deaths, compared with an 11% mortality rate with primary resection. As previously stated, we did observe a higher mortality rate in the 8th decade, despite the staged plan.

The duration of hospital stay (Fig. 2) is considerable, however, considering the advanced age and presence of peritonitis, it is certainly understandable that a prolonged convalescence would be predictable. Levy, Pitts and Lench[14] found that the three-stage procedure had ten-times as long a recuperation period and two-and-one-half times more complications than single staged procedures in their overall experience with various complications of diverticular disease.

When our 10-year survey was split into two 5-year periods, 40% of cases included were treated before 1970 and 60% were treated after 1970. Fifteen of 23 deaths (65%) occurred before 1970, whereas 35% (8 of 23) occurred after 1970. Four of the 8 deaths after 1970 were cardiovascular, unrelated to sepsis, perhaps reflecting the addition of more effective antibiotics to treat gram-negative and anaerobic bacteria. Hopefully, the additional aid of postoperative low-dose heparin therapy may further decrease the incidence of cardiovascular complications.

Conclusion

Staged procedures for perforated colonic diverticula can be carried out with a mortality rate of 11%, compared to mortality rates of 21–45% reported in the surgical literature in the past decade.

Acknowledgments

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DISCUSSION

DR. CHARLES K. MCSHERRY (New York, New York):In the early nineteen hundreds, Dr. Cheever, from Boston, felt compelled to write in the *Annals of Surgery*, (94:705, 1931) criticizing his colleagues about their impatience to do primary resection for perforated and obstructed cancer of the distal large bowel. The problem was relatively quiescent until about 1951, when Gregg (Surgery 37:754, 1951) initiated the current enthusiasm for primary resection for acute disease of the distal colon.

Since 1955, a number of surgeons have felt compelled to prove that they too could do primary resections without significant mortality. The only problem with that philosophical approach was the fact that it was not the surgeons, but the patients, who were at risk.

In any event, we, too, became distressed at the spate of reports advocating primary resection, and looked up our experience at the New York Hospital in 1969 (Arch. Surg. 98:749, 1969). We reviewed 150 patients with acute disease of the distal bowel, treated by staged resection and compared them with 50 patients treated by primary resection.

In essence, the operative mortality for the patients subjected to staged procedures was 6%, there was only one death in this group from generalized peritonitis. We did not feel that the argument that primary resection was necessary to prevent death from continuing peritonitis was valid. With respect to the patients who had primary resection, that group of patients had an operative mortality of 18%, and there was one death from peritonitis. Patients with left colon lesions treated by primary resection, the operative mortality was 27%.

Looking at the complications, there were 24 wound infections in 150 patients. The over-all morbidity rate for staged resections was 31%. In contrast, the morbidity for patients treated by primary resection was as high as 46%; and, proportionately, the number of infections was just as bad in the group treated by primary resection. In recent years, the problem has resolved such that there is really no good answer to the management of patients with acute disease of the large bowel. Certainly, the overwhelming experience suggests that most of these patients should be treated by staged procedures. But we recognize that there are certain patients who do, indeed, require primary resection.

In recent years, the problem has resolved such that there is really no good answer to the management of patients with acute disease of the large bowel. Certainly, the overwhelming experience suggests that most of these patients should be treated by staged procedures. But we recognized that there are certain patients who do, indeed, require primary resection.

One example was a patient who died following surgery by staged resection, the hole in her bowel being kept open by a chicken bone. The problem of persistent drainage, devascularization, a hole in the colon big enough to admit a mushroom catheter indicated that these patients should be treated by primary resection. However, my argument is not with the surgeon who wants to do primary resection; my argument is with the surgeon who wants to do primary resection and an immediate anastomosis. I think those patients are much better handled by the Hartmann procedure.

I would like to ask Dr. Classen if he thinks there is any place for the use of the Hartmann procedure in certain patients with emergent disease of the distal bowel.

DR. SYLVESTER STERIOFF (Closing discussion): With regard to Dr. McSherry's question, whether we indeed feel that a resection and Hartmann's procedure has merit, the answer is: yes, we do. In fact, I think this might be the ideal procedure in many instances. The other possibility is a resection with colostomy and mucous fistula, when it can technically be done with safety.

We do not advocate that drainage and proximal colostomy be done in every instance, but it should be part of the treatment plan, which can be implemented as necessary.