Impact of Primary Resection on the Outcome of Patients With Perforated Diverticulitis

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Background: Primary resection has replaced the conventional drainage procedure in the management of patients with generalized peritonitis complicating diverticular disease of the colon. This study investigates the impact of primary resection on operative mortality, identifies predictors of mortality, and compares the results with those of our earlier experience.

Hypothesis: Primary resection of the perforated diseased segment of the colon is associated with lower mortality rates than the drainage procedure in patients with Hinchey stages 3 and 4 diverticulitis.

Design: Retrospective analysis.

Setting: Tertiary care referral center.

Patients: We included 138 consecutive patients who underwent emergent operation for generalized peritonitis complicating diverticular disease of the colon (Hinchey stages 3 and 4) during a period of 16 years (January 1983 to May 1999).

Main Outcome Measures: The 30-day mortality rate was analyzed and predictors of mortality identified.

Results: Patients were classified as having spreading purulent peritonitis (n=44, 31.9%), diffuse peritonitis (n=64, 46.4%), or fecal peritonitis (n=30, 21.7%). One hundred thirty-one patients (94.9%) underwent primary resection, 6 patients (4.3%) underwent resection and primary anastomosis, and 1 patient required total colectomy and end ileostomy. Thirteen of the 138 patients in the present group died (1983-1998), representing a perioperative mortality rate of 9%. There was no significant difference in mortality when compared with our earlier study (1972-1982), which had a mortality rate of 12%, considering that more than 25% of the patients in that group were managed by colostomy and drainage alone. Factors identified univariately as predictors of mortality were age of more than 70 years (P=.047), 2 or more comorbid conditions (P<.01), obstipation at initial examination (P=.02), use of steroids (P=.01), and perioperative sepsis (P<.001).

Conclusions: Primary resection has become the standard practice for patients with generalized peritonitis complicating diverticulitis. Mortality rates have not significantly declined despite more aggressive surgical management of the septic source. Because advanced age, comorbid conditions, and perioperative sepsis predict mortality, it is suggested that further reduction in mortality will require improvement in medical management of perioperative sepsis and comorbid conditions.

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D I V E R T I C U L O S I S   O F   T H E   C O L O N

Diverticulosis of the colon is very common in the Western population, affecting one third of the population older than 45 years of age and up to two thirds of the population older than 85 years of age.1,2 Fortunately, only 10% to 25% of these individuals develop symptomatic disease.3-10 Although most patients with symptomatic diverticulitis resolve with conservative management, 20% of them develop complications including obstruction, abscesses, fistulas, and perforation, often requiring surgical intervention.11 Free perforation causing generalized peritonitis (Hinchey stages 3 and 412) is the most severe of these complications.13 These patients require emergent operation with mortality rates reported in the literature ranging from 0% to 100%.14,15 The conventional surgical approach in the management of these patients with generalized peritonitis included a 3-stage drainage procedure as advocated by Smithwick3 in 1942. This was associated with an acceptably high morbidity and mortality16,17 attributed to the diseased segment of colon, which was left in situ. In an effort to improve the outcome, a 2-stage approach involving resection of the diseased colon at the initial surgery was recommended,18-20 which has become the current practice at most centers. Our own institution’s experience with the management of this disease, as reported in 1985, also supported and recommended the 2-stage approach.21

Our continued experience prompted us to undertake this retrospective review to study the changing trend in the surgical approach in the management of this disease and determine its impact on patient outcomes.
We collected data on 138 consecutive patients with generalized perforated sigmoid diverticulitis and generalized peritonitis admitted to the Mayo Clinic between January 1983 and May 1999. There were 78 women (56.5%), and the median age was 70 years (range, 30-94 years). The difference in median age of the men (68 years) and women (72 years) was not statistically significant (P = .10).

### CLINICAL PROFILE

Eighty-three percent of the patients had abdominal pain. Other symptoms at the initial examination included fever (oral >100.9°F, 46%), obstipation (31%), vomiting (38%), diarrhea (23%), bleeding per rectum (8%), and hypotension (systolic blood pressure <90 mm Hg, 8%). The median duration from the initial onset of symptoms to referral to the Mayo Clinic for operative intervention was 2 days.

### COMORBIDITIES

Eighty-one percent of the patients had 1 or more of the following comorbid conditions: coronary artery disease/hypertension, respiratory disease (chronic obstructive pulmonary disease, emphysema), diabetes mellitus, visceral malignancy, and immunosuppressive therapy. The median number of comorbid conditions was 1 (range, 0-4).

### LABORATORY FINDINGS

Sixty-seven percent of the patients had preoperative leucocytosis (white blood count >12,000), with a median absolute leucocyte count of 14,400 cells/µL (range, 12,000-34,000). Forty-one percent of the patients were anemic, with a median absolute hemoglobin value of 12 g/dL (range, 7.18-18 g/dL). Free intraperitoneal air was evident in 80 patients (58%), while 114 patients (83%) had evidence of ileus or partial intestinal obstruction.

### PERITONITIS

Ruptured pericolonic abscess with spreading purulent peritonitis was found in 44 patients (32%), diffuse purulent peritonitis involving the entire peritoneal cavity was found in 64 patients (46%), and diffuse fecal peritonitis (gross feces throughout the peritoneal cavity) was present in 30 patients (22%). Among clinical and laboratory findings, bleeding per rectum was the only item that resulted in a statistically significant difference (P = .04) between patients with spreading purulent peritonitis (15.9%) and those with diffuse or fecal peritonitis (4.3%).

One hundred thirty-one patients (94.9%) underwent primary resection, 6 patients (4.3%) underwent resection and primary anastomosis, and 1 patient required total colectomy and end ileostomy. All patients received broad-spectrum intravenous antibiotics for the duration of their perioperative mortality.
hospital stay. The clinical profile of patients in this study (Group A) was similar to our earlier review of 121 similar patients (Group B) at our institution published in 1985 by Nagorney et al.21 (Table 1). However, none of the patients in the present study underwent a drainage procedure, as compared with 26% of the patients in the earlier group. The overall mortality, however, was not markedly different between the 2 studies.

### MORTALITY

There were 13 perioperative deaths (mortality rate, 9.4%). Perioperative mortality was defined as death in hospital or postdischarge and within 30 days of surgery. There were 5 men and 8 women, with a median age of 75 years. All patients who died had significant comorbid conditions (at least 1 condition) (Table 2). Eight (61.5%) of the 13 patients had diffuse peritonitis, 4 patients (30.8%) had fecal peritonitis, and 1 patient (7.7%) had spreading purulent peritonitis. Withdrawal of life-supportive measures was the immediate cause of death in 12 patients (92.3%). Underlying pathologic features contributing to mortality were septicemia and its associated complications in 10 patients (77%), perioperative myocardial infarction/cardiac failure in 2 patients (15%), and cerebrovascular accident in 1 patient (8%).

On univariate analysis, the 5 factors predictive of perioperative mortality were age older than 70 years, 2 or more comorbid conditions, obstipation at initial examination, use of steroid, and postoperative sepsis (Table 3).

Table 2. Perioperative Deaths*

<table>
<thead>
<tr>
<th>Age, y/Sex</th>
<th>Comorbid Conditions</th>
<th>Steroid</th>
<th>Peritonitis</th>
<th>Complications</th>
<th>Cause of Death</th>
<th>Perioperative Day of Death</th>
<th>DNI/DNR</th>
<th>Withdrawal of Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>86/M</td>
<td>CAD, leukemia</td>
<td>No</td>
<td>Diffuse</td>
<td>Hypotension, reexploration bleding, failed exubtation</td>
<td>Septicemia</td>
<td>18</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>74/M</td>
<td>COPD, CAD</td>
<td>Yes</td>
<td>Fecal</td>
<td>MI, failed exubtation</td>
<td>Myocardial failure</td>
<td>9</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>54/M</td>
<td>CHF, CRI, CMOP, COPD</td>
<td>No</td>
<td>Fecal</td>
<td>ARDS, wound infection, fecal fistula, reoperation</td>
<td>Septicemia</td>
<td>30</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>93/M</td>
<td>CAD, PVD, CRI</td>
<td>No</td>
<td>Diffuse</td>
<td>Hypotension, respiratory failure, lung collapse</td>
<td>Septicemia</td>
<td>13</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>74/F</td>
<td>ITP, COPD, CAD, DM, CRI</td>
<td>Yes</td>
<td>Diffuse</td>
<td>ARDS, CH, pneumonia</td>
<td>Septicemia</td>
<td>10</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>77/F</td>
<td>Temporal arteritis, COPD, CRI, DM, larynx and renal carcinoma</td>
<td>Yes</td>
<td>Fecal</td>
<td>Intracranial bleed, coagulopathy due to CRI</td>
<td>Septicemia</td>
<td>8</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>79/F</td>
<td>CAD, COPD, CRI, DM, vasculitis</td>
<td>Yes</td>
<td>Diffuse</td>
<td>Atrial fibrillation, gram-negative septicemia</td>
<td>Septicemia</td>
<td>3</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>72/F</td>
<td>Polyarteritis nodosa, CAD, COPD, CRI</td>
<td>Yes</td>
<td>Diffuse</td>
<td>Hypotension, shock, respiratory failure</td>
<td>Septicemia</td>
<td>20</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>59/F</td>
<td>Lymphoma, SCC tongue, DM, liver failure</td>
<td>Yes</td>
<td>Fecal</td>
<td>Hypotension, DIC, ARDS</td>
<td>Septicemia</td>
<td>14</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>75/F</td>
<td>Vasculitis, CAD, DM, restrictive lung disease</td>
<td>Yes</td>
<td>Diffuse</td>
<td>ARDS, wound dehiscence, CHF, PE, necrotizing fasciitis</td>
<td>Septicemia</td>
<td>21</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>70/M</td>
<td>Prostate carcinoma, brain METS</td>
<td>Yes</td>
<td>Fecal</td>
<td>Neutropenia, respiratory failure, PE, lower gastrointestinal bleed</td>
<td>Septicemia</td>
<td>13</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>64/F</td>
<td>Leiomyosarcoma, COPD, CAD, brain METS</td>
<td>Yes</td>
<td>Spreading</td>
<td>Wound infection, abdominal abscess, fecal fistula computed axial tomography–guided drain</td>
<td>Septicemia</td>
<td>28</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>83/M</td>
<td>COPD, stroke</td>
<td>Yes</td>
<td>Fecal</td>
<td>VT, stroke</td>
<td>Myocardial failure</td>
<td>20</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Abbreviations: ARDS, acute respiratory distress syndrome; CAD, coronary artery disease; CHF, congestive heart failure; CMOP, cardiomyopathy; COPD, chronic obstructive pulmonary disease; CRI, chronic renal insufficiency; CVA, cerebrovascular accident; DIC, diffuse intravascular coagulopathy; DM, diabetes mellitus; DNI, do not intubate; DNR, do not resuscitate; ITP, idiopathic thrombocytopenic purpura; METS, metastasis; MI, myocardial infarction; PE, pulmonary embolism; PVD, peripheral vascular disease; SCC, squamous cell carcinoma; TIA, transient ischemic attack; VT, ventricular tachycardia.

*Mortality rates are presented as percentages.

A multivariable model was used to simultaneously evaluate the 5 univariately significant risk factors. Two statistically significant covariates were identified: the existence of 2 or more comorbidities (odds ratio, 8.3; 95% confidence interval, 1.6-44.7; P=.01) and the presence of postoperative septicemia (odds ratio, 18.9; 95% confidence interval, 4.7-76.3; P<.001). After accounting for these 2 factors, none of the other candidate variables contributed significantly to the model.

### COMMENT

This study confirms that primary resection has replaced the conventional 3-stage drainage procedure in the manage-
ment of patients with generalized peritonitis complicating diverticular disease of the colon (Hinchey stages 3 and 4). Perioperative sepsis is the major cause of death, and the mortality associated with this condition continues to be high.

In the past, critically ill patients with significant comorbid conditions were considered to be at high surgical risk for colonic resection and were managed by drainage alone. The results of our study, however, prove that primary resection is as safe and can be performed in sick patients without added mortality. Primary resection is more appealing than drainage; it not only eradicates the source of infection but also provides histological confirmation of diagnosis and involves 1 less operation compared with the conventional 3-stage procedure. In our own earlier study, we had observed a significant difference (P<.05) in mortality in patients managed by colostomy and drainage (mortality rate, 26%) compared with primary resection (mortality rate, 7%). More than one fourth of the patients in that study had undergone the drainage procedure. Based on the results of several similar studies, it was assumed that the drainage procedure was the underlying problem, which contributed to postoperative sepsis and death. The drainage procedure gradually lost ground, and primary resection became the preferred approach in managing these patients.

With the adoption of primary resection as the standard of care, it was anticipated that results would improve. Unfortunately, our present study fails to show a significant difference in mortality rates despite totally abandoning the drainage procedure. Perhaps patients in the past were managed by drainage alone only because they were considered to be at high surgical risk. When this subset of patients is managed by primary resection, as is the current surgical practice, the outcome remains the same. Thus, it is probable that the medical conditions of the patients, rather than the choice of the surgical procedure, predispose them to the high death rate. The findings of our study support this belief. In our study, the 5 factors of age older than 70 years, 2 or more comorbid conditions, obstipation at initial examination, use of steroids, and perioperative sepsis on univariate analysis identify a patient group as being at high risk for perioperative mortality. All these factors reflect the medical condition of the patient at initial examination prior to surgical intervention. The presence of perioperative sepsis and 2 or more comorbid conditions were also significant on multivariable analysis. Other studies in the recent literature also have failed to demonstrate a survival benefit following the Hartmann procedure.

Overwhelming sepsis was the cause of death in the majority (78%) of the patients who died. Thus, despite optimal local control of the septic focus, patients succumb to the systemic effects of the initial infective process. Sepsis is poorly tolerated in the elderly, especially if they are immunosuppressed. Ten (77%) of the 13 were immunocompromised by virtue of taking steroids for various medical conditions. Although the precise mechanism of the deleterious effects of steroids is unclear, the association between steroid use and mortality is well established. Interestingly, withdrawal of life support per the family’s request was the immediate cause of death in 12 of the 13 patients who died.

It seems that there exists a significant challenge to mortality associated with this group of patients, which has not improved despite adoption of primary resection. In fact, the medical condition of the patients may be more critical than the precise surgical procedure in determining the overall outcome. Until further randomized prospective data are available, primary resection, which so far provides the best control of the disease process, will remain the standard of care for this highly challenging group of patients.

This study confirms that patients with Hinchey stages 3 and 4 disease still have a high rate of perioperative mortality. The change in the surgical approach from the conventional 3-stage diversion with drainage to a 2-stage procedure of resection and drainage is a safe practice and has not resulted in an increase in mortality. Future efforts to reduce perioperative mortality need to be focused on the management of comorbid conditions and the systemic manifestations of sepsis.

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REFERENCES