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Surgery for Diverticulitis: A Re-Evaluation of the Changing Trends

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The surgical management of diverticulitis continues to evolve but recent literature has not qualified just how different current practice is compared with the previous era. This study aims to update the seminal paper by Rodkey and Welch regarding indications and operation types performed for diverticulitis by comparing their findings with present practice at a community based institution. The charts of 407 patients admitted with "diverticular disease" between 2005 and 2010 were identified. For each admission, patients' demographics, presentations and management were recorded. Direct comparisons were made with results from the study by Rodkey and Welch. Of the 407 admissions studied, the distribution was 335 emergency and 72 elective. Medical management alone treated 90% of emergency admissions, while 4% required additional radiologic intervention. Emergency surgery was necessary in only 6% of cases with Hartmann's procedure being the most common procedure. Recurrent diverticulitis was a prime indication for elective surgery with 96% of cases undergoing a 1-staged procedure. Compared with the previous era, the nonoperative approach to managing acute diverticulitis is now applied for the vast majority of admissions. Improved success in medically temporizing patients in the present era has allowed for a higher percentage of successful single-staged elective surgeries.

Key words: Diverticulitis – Surgery

The management of diverticular disease is well established, with extensive literature describing numerous approaches for its treatment. The pioneering work of Rodkey and Welch in 1984,[1] however, studying the differences in surgical management for diverticular disease over the previous 4 decades highlighted important trends during that era that contributed to modern surgical practices known today. For example, this seminal paper provided early evidence in support of the funda-

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mental change from the traditional 3-stage resection for diverticulitis, i.e., proximal colostomy, segment resection then delayed closure, to resection of the bowel perforated segment at the first operation.[1] Since that time, the surgical management of acute diverticulitis has continued to evolve with more conservative approaches emerging in contemporary literature.[2] Indeed, in uncomplicated diverticulitis, nonoperative alternatives have extended to utilizing home treatment alone, avoiding hospital admission altogether,[3] In select cases, nonoperative management has become an established option to treating some of the complications of diverticulitis,[4] while minimally invasive approaches that include laparoscopic peritoneal lavage have been used more recently with some success.[5,6]

Despite extensive literature describing the numerous changes in practice over the years, there have been no recent studies that have compared surgical practice over two time periods as was done by Rodkey *et al*, particularly regarding the indications and types of procedures being performed.

The aim of the study was therefore: (1) to review the management of acute diverticulitis at our institution particularly focusing on the indications and types of surgeries being performed presently and (2) to compare our findings with those of the previous era as described by Rodkey and Welch[1] in an effort to identify just how much surgical practice for diverticulitis has changed over that time.

Materials and Methods

This study was conducted as an institutional review board-approved retrospective review of a prospectively maintained database of patients admitted to Providence Hospital. A search for all patients admitted between 2005 and 2010 with a clinical code of "diverticular disease" was conducted via our hospital coding department. Of the 725 admissions identified, 407 were located for a retrospective chart review. The remaining admissions on the list were excluded as they were either unobtainable from medical records or, upon further chart review, it was discovered that the final diagnosis following inpatient management was not diverticular disease. Patients treated on an outpatient, ambulatory basis, were also not considered.

For each admission, demographic data, clinical presentation and in-hospital management were recorded, paying particular attention to the surgical procedures performed and their indications. Emergency diverticulitis and elective surgical patients were studied separately. Definitions for "complicated diverticulitis" and "immunocompromised" were adapted from the studied paper.[1] Complicated diverticulitis was defined as episodes associated with diagnosed abscess, fistula, and bowel perforation causing purulent or feculent peritonitis, obstruction, and massive hemorrhage. Immunocompromised was defined as those patients with an underlying history of diabetes, steroid use, splenectomy, organ transplants, cancer chemotherapy, and alcoholism.

Direct comparisons were made with the results of Rodkey and Welch's study[1] in order to obtain objective measures of changes in clinical practice. Differences in the percentages of patients with complicated diverticulitis under differing clinical circumstances within our study were calculated by means of the Chi-squared test using SPSS (SPSS Inc., Chicago, Illinois, USA).

Results

From the 407 admissions studied, 335 (82%) of them were emergency admissions while 72 (18%) were elective admissions.

Emergency admissions

The charts of 335 emergency admissions with acute diverticulitis were studied. The gender distribution of admitted patients was 70% (n = 233) female and 30% (n = 102) male (Fig. 1). The median age at presentation for females was 67 (range, 28–99) years; for males it was 58 (range, 25–99) years. The median length of stay was 4 days.

The predominant presenting symptom at admission was localized abdominal pain (80%; 269/335) (Fig. 2). The median duration of symptoms at presentation was 3 days (range, 0.5–365). The focus of diverticulitis episodes was the sigmoid colon alone in 76% (256/335) of cases.

From the 335 emergency admissions studied, 286 patients had clear documentation of the number of diverticulitis episodes prior to admission. Sixty-six percent (188/286) of admitted patients were "first-episode" presenters while 34% (98/286) had recurrent disease (Fig. 3). Of the "first-time" presenters, 5% (9/188) required surgery during that admission. Upon admission, 23% (78/335) of patients had complicated diverticulitis while 77% (257/335) had uncomplicated disease (Fig, 4). Of the patients with diverticulitis younger than 40 years, a higher proportion (46%; 11/24) had complicated diverticulitis versus patients older than 40 years (22%; 68/

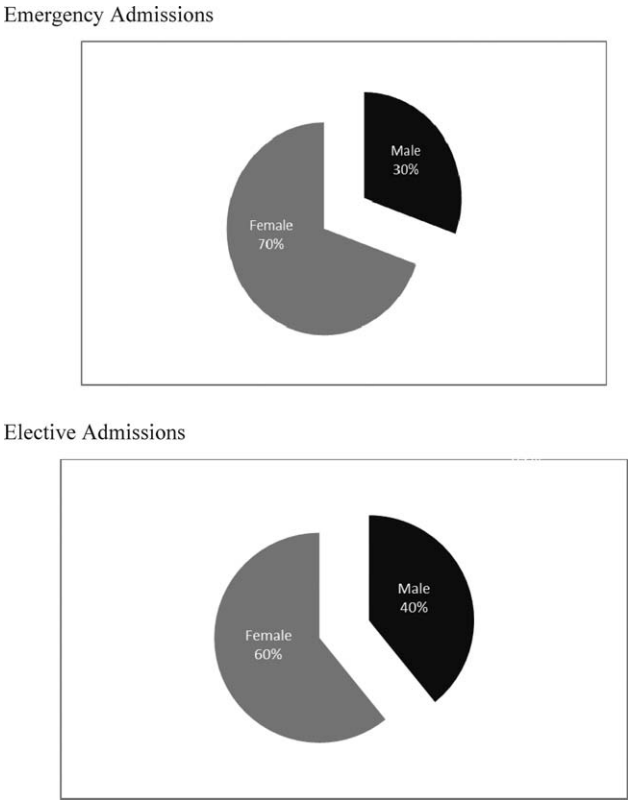

Fig. 1 Patient distribution by gender.

311; $P = 0.008$). The proportion of patients with complicated diverticulitis was higher in those patients with recurrent disease (30%; 30/98) than those first-time presenters (18%; 34/188), ($P = 0.015$). There was no statistically significant difference in the rate of complicated diverticulitis between "immunocompetent" and "immunocompromised" patients ($P = 0.81$).

Medical management alone using aggressive antibiotic treatment, analgesia, and fluid resuscitation was the mainstay of treatment in 90% (300/335) of acute diverticulitis admissions (Fig, 5). In 4% (14/335) of cases, radiologic intervention was necessary in addition to medical treatment in the form of computed tomography (CT)-guided drainage of abscesses. The majority (71%; 10/14) were pericolonic abscesses while 29% (4/14) were pelvic abscesses that were successfully managed to complete resolution in this way. In the remaining 6% (21/335) of cases, surgery was the definitive treatment offered to the patient during the admission.

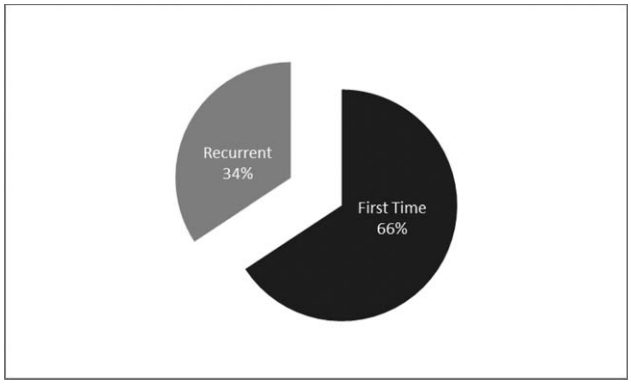

Fig. 3 "First time" versus "Recurrent" presenters.

The indications for emergency surgery were perforation with general peritonitis (10/21; 48%), local perforation (4/21; 19%) not improving with nonoperative treatment, abscess not responding to medical and/or radiologic drainage (2/21; 10%), large bowel obstruction (3/21; 14%), phlegmon (1/21; 5%) and persistent severe pain (1/21; 5%) (Fig. 6). Of the patients that required emergency surgery for abscess, both had pelvic abscesses.

Two-stage procedures were the predominant emergency procedure type with 76% (16/21) of

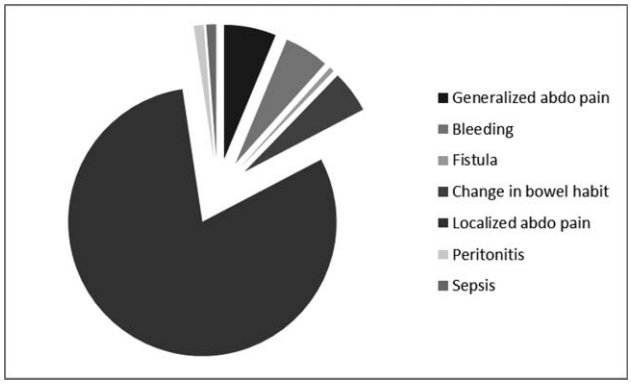

Fig. 2 Symptoms at presentation.

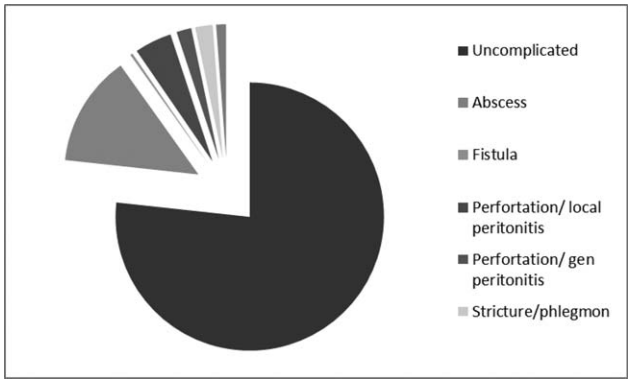

Fig. 4 Distribution of diverticulitis complications.

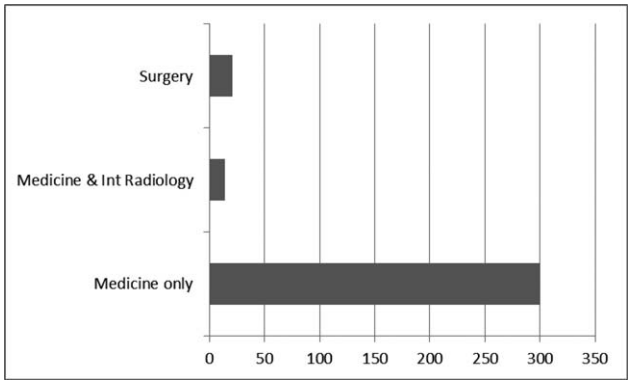

Fig. 5 Management of emergency admissions.

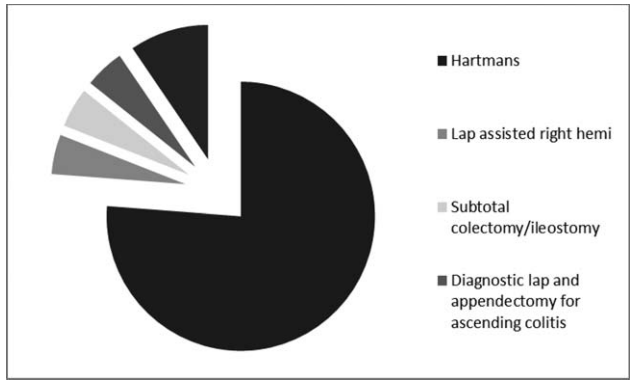

Fig. 7 Surgery procedure types; Emergency.

cases undergoing a Hartmann's procedure while 10% (2/21) underwent colectomy with primary anastomosis with a covering loop ileostomy and a single case (5%; 1/21) underwent a subtotal colectomy and ileostomy (Fig. 7). One-stage procedures were performed in a single case (laparoscopic right hemicolectomy; 8% (1/12). In a single case, ascending diverticulitis was diagnosed laparoscopically while performing surgery for assumed appendicitis. This case of diverticulitis was managed with antibiotics in the postoperative period.

There were no noted morbid or mortality events in the cohort of patients managed medically, while a single patient suffered a stroke following a radiologic drainage procedure. In the operative group, there were 4 reported complications: one reported ureteric injury that was identified and repaired at the index procedure, delayed wound closure that was managed with local wound care in a single case, upper extremity deep vein thrombosis in a single casem and persistent postop sepsis in a single case. There was also a single mortality reported in a patient admitted with general peritonitis who had undergone surgical drainage of a large abscess but succumbed to severe sepsis postoperatively.

Elective admissions

The charts of 72 elective admissions for diverticular disease surgery were studied. The gender distribution of patients was female predominant with 60% (n = 43) and 40% (n = 29) male (Fig. 1). The median age at admission was 61.5 (range, 40–83) years for females and 54 (range, 25–85) years for males. The median length of stay for elective admissions was 6 days (range, 2–24).

The indications for elective surgery were recurrent diverticulitis in 67% (48/72), fistula in 17% (12/72), stricturing phlegmon in 7% (5/72) , previous local perforation in 4% (3/72) , previous abscess in 4% (3/72), and chronic pain in 1% (1/72) of cases (Fig. 8).

One-stage procedures were the predominant procedure type, used in 96% (69/72) of cases. Of these, 50% (36/72) were open colectomies and 46% (33/72) were laparoscopic-assisted colectomies (Fig.

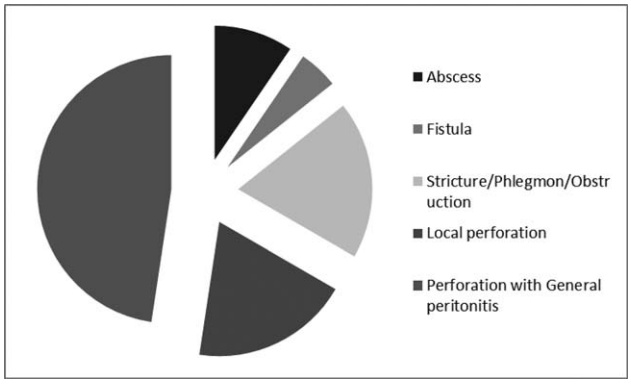

Fig. 6 Surgery indications; Emergency.

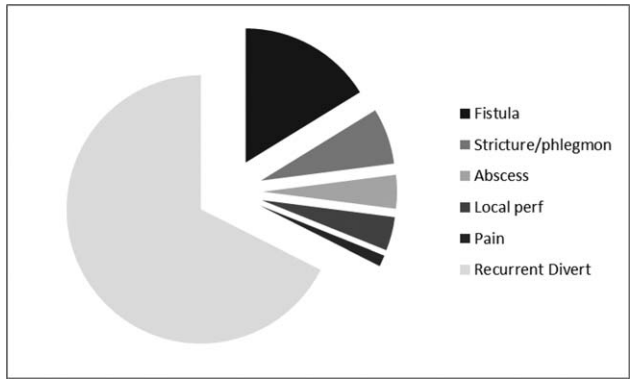

Fig. 8 Surgery indications; Elective.

9). Two-stage procedures were performed in only 3 cases [Hartmann's 3% (2/72) and diverting ostomy 1% (1/72)].

There were 10 reported postoperative complications. Four patients who had undergone open sigmoidectomy had fascial dehiscence of their wounds requiring closure under general anesthesia. The advanced age of these patients (average age, 80) was considered the primary contributing factor for this complication in this group. Two patients had anastomotic leaks that resulted in anastomosis takedown procedures being performed during the same admission. The remaining complications were minor, including 2 patients with prolonged ileus that eventually resolved, a single patient with urosepsis treated with antibiotics, and a single patient with epidural-related upper extremity paresthesia that resolved on epidural discontinuation. There were no postoperative mortalities in the elective resections. Malignancy was not found in any of the resected specimens on pathologic examination.

Discussion

The surgical management of diverticulitis continues to evolve. The work of Rodkey and Welch in 1984 provided a clear representation of the surgical practice at that time when the idea of resecting the perforated segment at the first operation was just becoming more widely accepted.[1] Incidentally, it was during this same era that the advent and refinement of computed tomography in diagnosing diverticulitis[7] and interventional radiology in draining abscesses[8] became more established. The more recent development of combination antibiotic regimes now commonly applied in diverticulitis including ampicillin-sulbactam and third-generation cephalosporins[9] has added to the options available in effectively treating the microbes that would induce sepsis in complicated diverticulitis. Advances in critical care and total parenteral nutrition have also improved outcomes. Although surgical practice has changed, there is no recent literature defining the differences in practice over the last 30 years, a question that was the motivation behind this study.

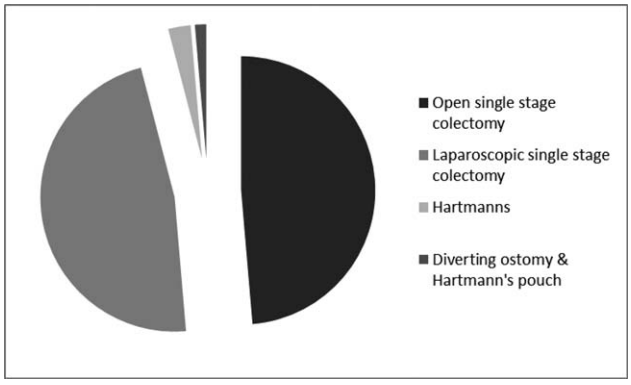

Fig. 9 Surgery procedure types; Elective.

Nonoperative management of our patients was successful in 93% (medical alone, 89%; medical and radiologic intervention, 4%) of emergency admissions, consistent with contemporary data from recent studies.[4,10,11] Interestingly, of the patients with diverticulitis younger than 40 years, 46% (11/24) developed complicated diverticulitis when compared to patients older than 40 years (22%; 68/311) ($P = 0.008$), reinforcing previous suggestions that acute diverticulitis in younger patients follows a more aggressive course.[12,13] A further explanation may be that this population of patients presented to the hospital later in the course of their disease and therefore appear to have more advanced disease at first contact. Contrary to prior literature, immunocompromised[2] was not associated with an increased risk of developing complicated diverticulitis.

During the era of Rodkey and Welch, surgery was deemed necessary at first presentation in 33% of cases within 1 week of symptoms.[1] The evidence from our study suggests that this is now an infrequently applied practice, with only 5% of first-time presenters requiring surgery during their first admission (Table 1). This finding provides a previously undocumented difference in surgical management of diverticulitis between the studies, with the more frequent application of nonoperative approaches used nowadays compared to the previous era. Considering that currently patients who are admitted are likely to have more advanced disease having failed outpatient treatment, you would expect that the proportion of these patients that would require surgery during the same admission would be at least comparable or higher than that found in the previous era. The benefit of postponing surgical intervention in the emergency setting is found in the avoidance of "temporary" ostomy formation[14] and anastomosis formation in mechanically unprepared bowel.

The primary indication for emergency surgery in both studies was for sepsis related complications (abscess, fistula, local perforation, and general perforation) with 57.8% of cases in the previous study[1] and 81% in the present study (Table 1). It is

Table 1 Summary of the differences in surgical management on emergency admission between the previous study (Rodkey et al) and the present study

	Rodkey and Welch (1974–1983)	Current study (2005–2010) emergency surgery	
Category	%	%	N
Surgery at first presentation	33	5	9/188
Indications for surgery			
Sepsis			
Abscess	10.9	9.5	2/21
Fistula	9.7	4.8	1/21
Local perforation	32.3	19	4/21
General perforation	14.6	47.6	10/21
Obstruction			
Acute obstruction	10.9	14.3	3/21
Phlegmon/stricture	-	4.8	1/21
Bleeding	8.2	-	-
Pain	13.4	-	-
Recurrent diverticulitis	-	–	-
Operations performed			
1-stage procedures	55.7	10	2/21
2-staged procedures	21	90	19/21
3-staged procedures	16.9	-	-

logical that with sepsis being the leading cause of mortality in diverticulitis patients, this complication is the most commonly treated surgically than any other. Unlike in the previous study,[1] emergency surgery for pain, bleeding, and fistula were not necessary in any of our patients, with surgery for these complications being performed in the elective setting.

Recurrent diverticulitis, which was also a former indication for emergent surgery, was the most common indication for elective surgery in our cohort of patients. The described practice of offering surgery to recurrent presenters is justified by our finding of increased risk of developing complicated diverticulitis in these patients (31%; 30/98) when compared to first-time presenters (18%; 34/188) ($P = 0.015$). Unfortunately, we were unable to accurately ascertain the number of episodes prior to presentation to surgery in this cohort of patients, but we can assume that in keeping with current guidelines, the decision to operate was made on a case-by-case basis.[2]

The present study also demonstrated the current thinking that surgery in the emergency setting should be assigned to mainly 2-staged procedures (91% of all emergency surgeries performed), reducing the potential morbidity and mortality associated with attempted anastomosis in the presence of complicated diverticulitis.[2] In the former study[1] 1-stage procedures were attempted more frequently in the emergency setting (55.7%), a practice which today would remain unchallenged in diverticulitis complicated by obstruction or bleeding but not in the presence of sepsis. One-staged procedures were the preferred procedure type in the elective setting in our study, with laparoscopic approaches being performed in almost equal proportions to open approaches, a reflection of the increasing popularity of these techniques in modern surgical practice. Similarly, the performance of 3-staged procedures as was the practice in the former study (16.2% of emergency surgeries) was not deemed necessary in any of the cases managed in the present study.

More frequent and early radiologic diagnosis of diverticulitis, more aggressive inpatient antibiotic treatment and the advent of interventional radiology to treat diverticular abscesses in recent years have down-staged potentially complicated disease processes and aided the success of this conservative approach and avoidance of potentially morbid multiple-staged procedures. It follows that emergency surgery is performed almost invariably for general peritonitis and persistent sepsis from local perforation or abscess after failed conservative treatment.

Although we were unable to study the complete cohort of patients admitted with diverticular disease to our institution, we feel that the sample size was large enough and representative of the overall population to establish the current trend in clinical practice. We believe that by acknowledging the antecedents and preceding events in surgery, the

insight provided by this study may serve as a guide to future management strategies, an important principle in the development of surgical practice.

Conclusion

Compared to the previous era, the nonoperative approach to managing acute diverticulitis is now applied for the vast majority of admissions. Emergency surgery, if necessary, continues to be predominantly for the sepsis-related complications with the most common procedure in this setting now being the 2-staged procedure. Improved success in medically temporizing patients in the present era has allowed for reduced emergent surgeries with potential morbidity or mortality and contributed to the higher percentage of successful single-staged procedures now performed in the elective setting.

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