Percutaneous drainage for hinchey Ib and II acute diverticulitis with abscess improves outcomes

David R. Rosen[1,2], Emily G. Pott[1], Kyle G. Cologne[2], Sang W. Lee[2], Glenn T. Ault[2], Daniel J. Grabo[1], Damon H. Clark[1], Aaron M. Strumwasser[1]

[1]Division of Trauma and Acute Care Surgery, USC Department of Surgery, Los Angeles County University of Southern California Medical Center, Los Angeles, CA, USA

[2]Division of Colon and Rectal Surgery, USC Department of Surgery, Los Angeles County University of Southern California Medical Center, Los Angeles, CA, USA

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ABSTRACT

Background/Aims: *The role of percutaneous drainage in Hinchey Ib and II diverticulitis is controversial. The aim of the present study was to clarify the indications for percutaneous drainage in such circumstances.*

Materials and Methods: *This was a single-center retrospective review at an academic tertiary care hospital. All Hinchey Ib and II diverticulitis cases admitted from 2012 to 2014 were considered.*

Results: *Overall, 104 (78%) patients underwent successful conservative treatment, whereas 30 (22%) patients underwent surgery during admission. During the index admission, abscess drainage was performed in 21 patients, of which 19 patients were successfully managed without surgery on the index admission and two patients ultimately required surgery. Elective versus same-admission surgery resulted in an increase use of laparoscopy (p=0.01), higher rate of restoration of gastrointestinal continuity with the index operation (p=0.04), and lower rate of diverting stoma formation (p<0.01).*

Conclusion: *Percutaneous drainage may diminish the need for emergent surgery for Hinchey Ib and II diverticulitis. Elective surgery following conservative management increases the use of laparoscopy and decreases the rates of stoma formation.*

Keywords: *Diverticulitis, laparoscopy, abscess, surgery*

INTRODUCTION

Diverticular disease continues to be a significant healthcare burden in the emergent setting (312,000 admissions, 1.5 million days of inpatient care, and $USD2.6 billion annually) (1). The increasing incidence of diverticulitis (1,2) has resulted in wide variation in management strategies. It is generally accepted that uncomplicated diverticulitis can be successfully treated with non-operative management, and that emergent surgical intervention is required for patients with peritonitis (1). However, patients with complicated diverticulitis whose disease severity lies somewhere within the clinical spectrum present a clinical dilemma for surgeons. There has been a paradigm shift toward non-operative management with improved antibiotics and the emergence of interventional treatments for diverticulitis (3-5). In addition, the role of elective colectomy following non-operative management is unclear as practice parameters recommend that the decision for surgical intervention be individualized (6). Moreover, recent literature shows a high failure rate of non-operative management in patients with abscesses, suggesting that perhaps the pendulum of delaying an operation has swung too far (7,8). Some data suggest that patient satisfaction may be increased following surgical intervention (9).

Data regarding the role of percutaneous drainage in complicated diverticular disease are mixed. Studies have aimed to show a clear benefit of percutaneous drainage compared with antibiotics alone in Hinchey II diverticulitis with confounding results (10,11). Some data suggest that the use of percutaneous drainage catheters may help avoid emergent surgery, with larger abscesses being more amenable to percutaneous drainage (12). A clinically relevant cutoff in the literature is 3-4 cm (13-17).

Given the evolving treatment patterns in the treatment of complicated diverticulitis with abscess, the aim of the present study was to determine whether early percutaneous drainage reduced the need for emergent surgery and improved outcomes for patients with Hinchey Ib and II diverticulitis.

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Corresponding Author: ***David R. Rosen; david.r.rosen@gmail.com***
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MATERIALS AND METHODS

The study was approved by the Institutional Review Board (IRB#HS-16-00436). Informed consent was not required for the present study by the Institutional Review Board.

A retrospective review of all patients presenting to our tertiary medical center with Hinchey Ib and II diverticulitis between 2012 and 2014 was conducted. Pediatric and pregnant patients were excluded from the study. Patients were selected from a prospectively managed database of all patients presenting with diverticulitis. All patients were followed up for 1 year after index admission to monitor for recurrences or progression to surgery. Radiology reports were reviewed to identify Hinchey classification, and this was corroborated with intraoperative findings of those who ultimately progressed to surgical intervention. Failure of conservative management for persistent or recurrent diverticulitis was defined by the need to progress to surgery. Demographic information, radiographic characteristics of diverticular abscesses on computed tomography (CT) (including size (cm) and anatomic location), interventional radiology (IR) consultation notes and procedure records, and surgeon detailed operative reports were identified. IR consultations were obtained on all patients except those patients taken directly to surgery and those whose initial CT scan report stated that

Table 1. Demographics of the study population

	Conservative Treatment (Antibiotics/Antibiotics + IR)		Emergent Surgery		
Total Patients	N=104 patients	Median (N=100)	N=30 patients	Median (N=30)	p
Age	46 (1.3)	49 (36-56)	45 (2.1)	46 (35-54)	0.45
% Male	63%		63%		0.98
% Cardiopulmonary Disease	34%		30%		0.71
% Immunosuppressed	29%		20%		0.34
% Septic	64%		63%		0.99
Temperature (°F)	99 (0.1)	98.8 (98.4-99.8)	99 (0.2)	98.4 (98.1-98.8)	0.07
Heart Rate (beats/min)	98 (1.8)	99 (85-110)	93 (3.1)	93 (80-108)	0.14
Mean Arterial Pressure (mmHg)	95 (1.3)	94 (87-102)	92 (3.1)	93 (83-103)	0.31
Respirations (breaths/min)	18 (0.2)	18 (18-20)	18 (0.4)	18 (18-20)	0.53
WBC (cells/mm^3)	14 (0.5)	13 (10-16)	14 (1.1)	13 (9-19)	0.46
PaO_2/FiO_2 Ratio	578 (15.8)	612 (457-691)	556 (31.0)	611 (457-691)	0.49
Platelet Count (x10^3/microliter)	327 (15.8)	295 (227-393)	317 (22.3)	324 (200-413)	0.77
Bilirubin (mg/dL)	0.6 (0.04)	0.5 (0.4-0.7)	1.1 (0.3)	0.6 (0.3-0.9)	0.14
Serum Creatinine (mg/dL)	0.8 (0.03)	0.73 (0.61-0.89)	0.9 (0.1)	0.7 (0.6-0.9)	0.30
Median GCS Score	15 (IQR 25-75% 15)		15 (IQR 25-75% 15)		1.0
Mean SOFA	0.3 (0.1)	0 (0)	0.8 (0.3)	0 (0-1)	0.11
Location of Diverticulitis					
Ascending Only	0%		0%		1.0
Transverse Only	0%		0%		1.0
Descending	3%		3%		1.0
Sigmoid	88%		77%		0.10
Combined	9%		20%		0.45
Disease Recurrence					
Total (Pre/Post Op) (%)	21%		7%		0.07
Time to Recurrence (days)	76 (11.7)	24 (13-66)	61 (4.5)	61 (52-70)	0.85

Data is represented as mean (standard error of the mean), median (IQR, interquartile range) or percentages, respectively (p value vy unpaired Student's t-test or Chi Square Analysis).
WBC: white blood cell count; PaO_2: arterial pressure of oxygen; FiO_2: fraction of inspired oxygen; GCS: Glasgow coma scale; SOFA: Sequential Organ Failure Assessment Score.

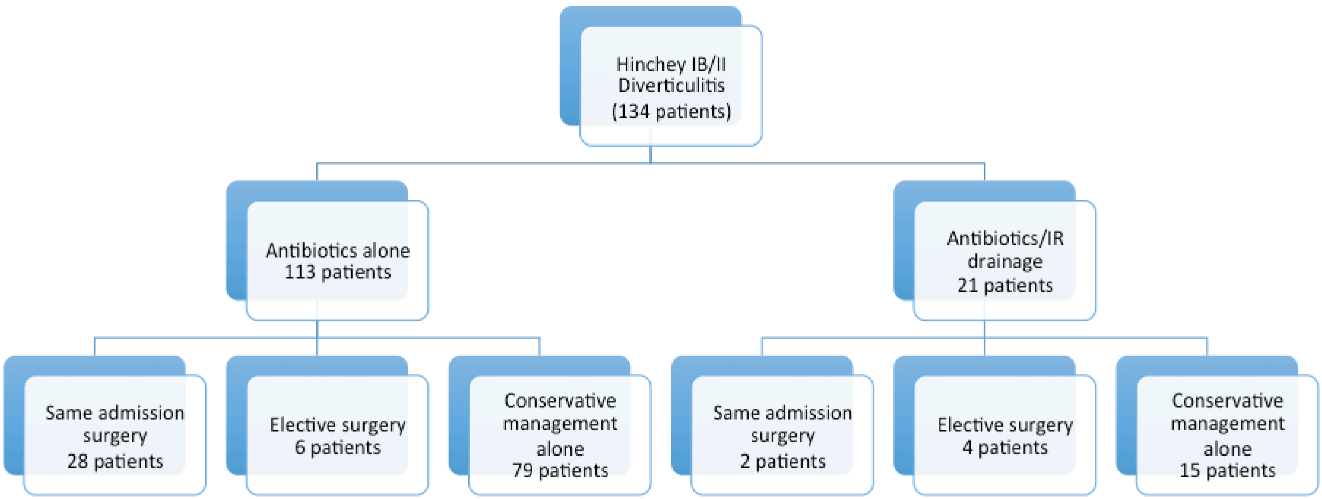

Figure 1. *Patient flowchart.*

the abscess was not amenable to percutaneous drainage. All radiographic reports were reviewed by board-certified radiologists for interpretation. Primary outcomes included hospital length-of-stay (HLOS, days), intensive care unit (ICU) length-of-stay (LOS), morbidity, and in hospital mortality. Specific morbidities included the incidence (%) of infections (superficial and deep incisional site infections, organ space infections, and pneumonia), acute kidney injury (AKI), thromboembolic events, bleeding, intraoperative technical complications (iatrogenic bleeding and/or enterotomy), and the development of prolonged ileus/postoperative bowel obstruction. Among patients who were successfully managed conservatively, the operative outcomes of same-admission surgery versus delayed surgery were obtained. These outcomes included total operative time (min), need for extensive resection (resection of structures in addition to the colon—small bowel, bladder, and uterus), blood loss (mL), crystalloid (mL), transfusion burden (units packed red blood cells), fresh frozen plasma, platelets, and cryoprecipitate). Postoperative outcomes included restoration of gastrointestinal (GI) continuity (%), need for diverting stoma (%), and clinical (seen in reoperative surgery) or radiologic leak rates after GI re-anastomosis (%).

Statistical analysis was performed utilizing Microsoft Excel 5.0 spreadsheet (Microsoft Corporation, Redmond, WA, USA). For continuous variables, an F-test was used to compare the distribution of variance, and an unpaired Student's t-test was used to compare outcomes between the patient groups. Chi-square test, Mann-Whitney U test, or Fisher's exact test was used to compare differences between categorical variables in the patient cohorts, where appropriate. An α value ≤0.05 denoted statistical significance.

RESULTS

Patient demographics

A total of 134 patients were included in the study. Overall, 104 (78%) patients underwent successful conservative treatment with either antibiotics or antibiotics and IR drainage, whereas 30 (22%) patients required surgery during the initial admission. The patients were well-matched based on baseline characteristics and diverticulitis location (Table 1). A patient flowchart illustrating the subjects included in the study is shown in Figure 1. Conservative management with antibiotics alone had a success rate of 75% (85/113), whereas conservative management with antibiotics and percutaneous drain placement had a success rate of 90% (19/21) (p=0.12). During the index admission, abscess drainage was performed in 21 patients, of which 19 patients were successfully managed without surgery on the index admission and two patients ultimately required surgery. Five patients underwent emergent surgery <24 h after assessment due to worsening clinical status despite an attempt of conservative management. This typically consisted of hemodynamic instability and/or worsening physical examination findings. The remaining 25 patients underwent surgery after a period (>24 h) of failed conservative management. The reasons for failure of conservative management included persistent leukocytosis/

Table 2. Abscess characteristics of the study population

Total Patients Abscess Locations on CT (%)	Conservative 104 Patients	Median (25-75%)	Emergent Surgery 30 Patients	Median (25-75%)	p	Mann-Whitney p
Paracolonic	52%		47%		0.61	
Intramural	4%		0%		0.28	
Interloop	2%		3%		0.65	
Antevesicular/Retrouteral	10%		13%		0.55	
Retrovesicular/Anterior to Rectum	6%		10%		0.41	
Paracolic Gutters	7%		3%		0.49	
Extracolonic (Solid Organ/Extracavitary)	1%		0%		0.59	
Multiple Locations/Diffuse Fluid	19%		23%		0.62	
IR Triage at Admission						
Got IR Consult (%)	62%		93%		0.01	
Mean Abscess Size (cm)	4.1 (0.2)	3.9 (2.6-5.0)	4.2 (0.3)	4.3 (2.9-5.0)	0.85	0.70.
Reason Abscess Not Drained						
Too Small	38%		23%		0.15	
No Safe Window	23%		30%		0.44	
Improving Clinically	10%		10%		0.95	
Combination	8%		7%		0.85	

Data is represented as mean (standard error of the mean) or percentages, respectively (p value by Mann-Whitney U-Test or Chi-Square Analysis).

sepsis (64%), unresolving pain (20%), inability to tolerate oral diet (12%), and peritonitis (4%). A trend of increased disease recurrence was present in the conservative treatment group (21%) versus the same-admission surgery group (7%) (p=0.07). There were no differences in time to recurrence (days) between the two groups (78±11.9 days vs. surgery 61±4.5 days, p=0.85).

IR consultations and outcomes

IR consultations were obtained in 62% of the conservative treatment group and 93% of the same-admission surgery group (p=0.01). Consultation was not requested if the patient was taken directly to surgery or if the CT radiology read stated that the abscess was not amenable to drainage. The anatomic distribution of abscesses seen on CT (paracolonic, intramural, interloop, antevesicular/retrouteral, retrovesicular/anterior to rectum, paracolic gutters, extracolonic, and/or multiple locations and/or diffuse fluid) is delineated in Table 2. No significant difference in the distribution of abscesses was noted (p>0.1 for each location), and mean abscess size was similar between the conservative and same-admission surgery groups (4.1±0.2 vs. 4.2±0.3 cm, p=0.85). The specific reasons IR physicians were cited for not draining abscesses (conservative group vs. same-admission surgery group) included inadequate size (38% vs. 23%), unsafe window to drain (23% vs. 30%), clinical improvement of the patient not necessitating drainage (10% vs. 10%), or some combination of these factors (8% vs. 7%). These reasons for not draining were equally distributed between the conservative treatment and same-admission surgery groups (p>0.1 for each). All abscesses >5 cm ultimately required either surgery or percutaneous drain placement. All IR drainage procedures were done under CT guidance. There were no complications from IR drainage procedures.

Conservative management with elective resection versus same-admission surgery

Of the patients successfully treated with conservative management, 10 underwent elective resection on subsequent admission. These 10 patients (n=10) were compared with the 30 patients who underwent same-admission surgery with respect to outcomes. Findings are shown in Table 3. Time without oral diet (3 vs. 9 days, p<0.01) was significantly greater in the emergent surgery group. There was a statistically non-significant trend toward decreased HLOS (of all admissions combined including admission for elective surgery or readmissions) in the elective surgery group (7 vs. 11 days, p=0.07). There was no difference between ICU LOS and time requiring mechanical ventilation (p=0.28 for both). Morbidity was similar between the two groups (p>0.05 for each, Table

Table 3. Outcomes of patients who underwent elective resection following conservative treatment and patients who underwent emergent (same-admission) surgery

Total Patients	Conservative Followed by Elective Resection (*) 10 patients	Median (25-75%)	Emergent Surgery 30 patients	Median (IQR 25-75%)	p	Mann-Whitney p
Underwent IR Drainage Up Front	40%		7%		0.01	
Hospitalization Outcomes						
HLOS (Total Inpatient/Outpatient)	7 (0.5)	7 (6-8)	11 (0.9)	11 (7-14)	0.23	0.07
ICU LOS (Total Inpatient/Outpatient)	0 (0.0)	0 (0)	1.3 (0.6)	0 (0)	0.04	0.28
Ventilator Days						
(Total Inpatient/Outpatient)	0 (0.0)	0 (0)	0.4 (0.4)	0 (0)	0.05	0.28
Total Days NPO						
(Total Inpatient/Outpatient)	3 (0.5)	3 (2-4)	9 (0.6)	9 (7-11)	<0.01	<0.000001
Surgical Morbidity						
Infectious (%)	0%		0%		1.0	
AKI (%)	10%		0%		0.08	
VTE (%)	0%		3%		0.56	
Bleeding (%)	0%		0%		1.0	
Postop Obstruction (%)	0%		7%		0.40	
Technical Complication (%)	0%		3%		0.56	
Operative Outcomes						
Intraoperative Time (min)	195 (4.4)	204 (183-230)	185 (12.8)	173 (126-219)	0.72	0.23
% Done Laparoscopically	30%		3%		0.01	
Extensive Resection (%)	50%		30%		0.25	
Restroed GI Continuity (%)	80%		67%		0.04	
Needed Diverting Stoma (%)	0%		50%		<0.01	
Blood Loss (mL)	194 (9.6)	200 (163-300)	234 (45.9)	200 (100-288)	0.31	0.58
Crystalloid (mL)	2900 (118.5)	3200 (2175-3330)	2428 (186.1)	2150 (1525-2975)	0.44	0.05
Required Transfusion (%)	0		10%		0.29	

HLOS: hospital length of stay; ICU: intensive care unit; NPO: nil per os; AKI: acute kidney injury; VTE: venous thromboembolism.

3) with the exception of a trend of increased incidence of AKI in patients who underwent conservative treatment, followed by elective resection (10% vs. 0%, p=0.08). When operative outcomes were evaluated, there was no significant difference in operative time, the need for extensive resection, blood loss, and transfusion requirement between the two groups (p>0.1 for each). However, there was a significant increase in the amount of crystalloid given for the elective procedures (3200 vs. 2150 cc, p=0.05). All elective cases received an oral bowel preparation with oral and intravenous antibiotics, whereas the same-admission cases only received preoperative intravenous antibiotics. Surgery was performed laparoscopically in 30% of the patients who underwent elective surgery and 3% of the patients who underwent same-admission surgery (p=0.01). GI continuity (defined as primary anastomosis of the colon with or without a diverting ileostomy) was restored more often in patients who underwent elective surgery compared with same-admission surgery (80% vs. 67%, p=0.04), and of the patients who underwent same-admission surgery, a greater proportion of patients needed a diverting stoma (0% vs. 50%, p<0.01). Subgroup analysis of those with small abscesses (<3 cm) found that conservative management with antibiotics and drain placement resulted in fewer days without oral diet than those who received antibiotics alone (3 vs. 8 days, p=0.01). There were no other statistically significant differences between these groups.

DISCUSSION

We hypothesized that the use of percutaneous drainage catheters for Hinchey Ib and II diverticulitis would optimize outcomes. What we found, controlling for patient baseline characteristics, abscess size, location, and IR consultation patterns, regarding drainage amenability was that percutaneous drainage assisted in bridging patients to elective surgery where there was an increased use of laparoscopy, decreased complications, less stoma use, and fewer days without oral diet. Our data suggest that percutaneous drainage may be an underutilized strategy in managing Hinchey Ib and II diverticulitis.

The majority of data on complicated diverticulitis cite abscess size on CT as the key decision factor on whether to perform percutaneous drainage. One study analyzed 511 patients admitted for acute diverticulitis among which 93% of the cases underwent successful percutaneous drainage. In this study, the authors concluded that an attempt for percutaneous drainage should be made for abscesses ≥5 cm in size (16). Another series from Beth Israel Deaconess Medical Center suggests that abscesses <3 cm may be treated successfully with antibiotics alone with regard to a lower limit of drainage (14). More recently, a series published from the United Kingdom developed a CT grading system for acute complicated diverticulitis incorporating disease severity with abscess size (<4 cm vs. >4 cm) which may help guide the clinician with respect to treatment modalities (15). Additional features may include the presence of a safe therapeutic window and clinical response to antibiotics, obtained from our data, incorporated into objective radiologic scoring tools in the future. In our study, abscess size alone was not found to be the determining factor whether or not an abscess was drained. In fact, 38% of the abscesses drained in our study were smaller than the suggested 4 cm cutoff. In addition, there was no difference in average size of abscesses that received drains and those that did not. Intuitively, larger abscesses would be more likely to have a safe window amenable to percutaneous drainage and thus have a higher percentage of successful drainage, but this was not elucidated in our study. Furthermore, we found that small abscesses (<3 cm) that were drained had the benefit of fewer days without oral diet than those treated with antibiotics alone. This may lend credence to draining all accessible diverticular abscesses, regardless of size. Admittedly, our overall IR drainage rate was low (21/134 patients). Although drainage of all abscesses regardless of size was associated with decreased incidence of same-admission surgery and fewer days without oral diet, that is not to say that abscess size does not matter in our population. All abscesses >5 cm ultimately required drainage or surgical intervention. An option that was not explored for patients who did not have IR accessible abscesses is laparoscopic drainage of abscesses as a temporizing measure. This would need to be studied in future studies.

We found that significantly more patients were treated with IR drainage in the group having undergone conservative management, followed by elective surgery, than the group having undergone same-admission surgery. The idea that percutaneous drainage could help patients avoid emergent surgery thereby favoring elective surgery is supported by the literature. Work published from the University of Louisville discusses the use of percutaneous drainage as a method of "cooling off" a patient with stage I or II diverticulitis and suggests that percutaneous drainage as a method of temporizing a patient is 65%-70% effective (13). Another group found in their series of patients with Hinchey II that surgery was successfully delayed or avoided in 67% if percutaneous drainage was performed first (11). We found a significantly greater proportion (40% vs. 7%) of patients who underwent drainage who were able to be successfully bridged to outpatient elective resection, furthering the notion that percutaneous drainage has an important impact on the index hospital admission for complicated diverticulitis.

Recent literature suggests that there has been an emerging trend toward decreased operative intervention for complicated diverticulitis. One group out of Canada (utilizing the Canadian National Ambulatory Care Reporting System Registry) found that even though diverticulitis admissions increased over time, patients were less likely to undergo emergent operative intervention (18). In that study, the factors associated with emergent surgery were found to include older age, increased comorbidities, and complicated disease. However, our data did not find any risk factors to be associated with emergent surgery. Furthermore, the literature is unclear whether colon resection is even needed after conservative management with percutaneous drainage, as some studies suggest that source control alone may be a definitive strategy (19,20). This notion was supported by our clinical data in this series, as only 4 out of 19 patients who successfully underwent conservative management with antibiotics and drain placement ultimately went on to have elective resection. Original research into diverticulitis showed it was safe to manage multiple attacks of diverticulitis conservatively (21). However, recently published data show a high failure rate of non-operative management of complicated diverticulitis with abscess (7,8). This is to be contrasted with literature that supports conservative management of complicated diverticulitis with successful outcomes, even in the face of recurrent disease (22). There is additional literature about the role of laparoscopic washout in the management of diverticulitis, though that is generally utilized in patients with Hinchey III diverticulitis and does not apply to our patient population (23).

We found operative outcomes to be significantly different between the two groups as well. Elective procedures had a significantly greater utilization of laparoscopy and restored GI continuity than same-admission procedures, whereas significantly more same-admission procedures needed a diverting stoma. This provides further support of a conservative management strategy utilizing percutaneous drainage, as laparoscopy has many known benefits, such as it decreases pain, shortens interval to oral intake, and shortens HLOS (24-27). The role of laparoscopic lavage in complicated diverticulitis is controversial and remains an active area of research (23,28,29). Our results also showed a greater use of crystalloid in the elective cases. This may be related to the slightly longer operative times seen in the laparoscopic cases in the present study, and the effect of this finding is unclear. The median ages of the two groups in the present study were 46 and 49 years (p=0.45), respectively, which is much lower than that seen in the literature. It is unclear why this is the case, but we have seen a high prevalence of this disease, as well as an earlier onset at our tertiary care medical center that is a safety net hospital to an underserved population.

Our study has limitations. The retrospective nature of the design with inherent selection bias is a limitation. Differences between antibiotics alone versus antibiotics and percutaneous drainage could not be discerned, although the difference in success rate (75% vs. 90%, p=0.12) showed a trend favoring antibiotics with percutaneous drainage. The interpretation of CT findings varied from one radiologist to the next, and the determination of clinical improvement or amenability of drainage may have included a subjective component based on IR practitioner skill level, cumulative experience, and comfort. The degree of laparoscopic experience among surgeons was variable, and protocols (e.g., when to feed and pain control measures) were not standardized postoperatively. Finally, our single-institution data may represent a unique patient population with limited applicability to other centers.

The optimal treatment of Hinchey Ib and II diverticulitis remains unclear. Our study suggests that patient outcomes may be optimized by the early use of IR-guided percutaneous drainage. Elective cases result in decreased morbidity, greater use of laparoscopy, increased restoration of GI continuity, and lower use of a diverting stoma. We found no anatomic reason correlating to amenability of abscess drainage. More aggressive utilization of percutaneous drainage may reduce the need for same-admission surgery, resulting in more favorable outcomes. Prospective studies are needed to validate our findings.

Ethics Committee Approval: Ethics committee approval was received for this study from the Institutional Review Board of the Los Angeles County University of Southern California Medical Center (IRB#HS-16-00436).

Informed Consent: N/A.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - D.R., A.S.; Design - D.R., A.S.; Supervision - D.R., A.S.; Data Collection and/or Processing - D.R., E.G.P., K.G.C., S.W.L., G.T.A., D.J.G., D.H.C., A.M.S.; Analysis and/or Interpretation - D.R., E.G.P., K.G.C., S.W.L., G.T.A., D.J.G., D.H.C., A.M.S.; Writing Manuscript - D.R., E.G.P., K.G.C., S.W.L., G.T.A., D.J.G., D.H.C., A.M.S.; Critical Review - D.R., E.G.P., K.G.C., S.W.L., G.T.A., D.J.G., D.H.C., A.M.S.

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