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Review Article

An Update on the Surgical Management of Complicated Left-Sided Colonic Diverticulitis: Review Article

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Abstract: Acute left-sided colonic diverticulitis can be categorized into complicated and uncomplicated. The surgical treatment for complicated diverticulitis can be divided into the sigmoid resection with stoma formation (Hartmann's procedure) or sigmoid resection with anastomosis, accompanied by a protective ileostomy. In instances where patients with complicated left-sided diverticulitis are hemodynamically unstable, damage control surgery is indicated. Laparoscopic lavage serves as a bridging procedure for complicated diverticulitis with purulent discharge or classified as Hinchy 3, aiming to stabilize the patient for subsequent definitive surgery. This review will examine the surgical treatment of complicated left-sided diverticulitis, focusing on sigmoid resection with stoma (Hartmann's procedure) and colonic resection with anastomosis. Additionally, the role of laparoscopic lavage in the treatment of complicated diverticulitis with purulent discharge will be explored.

Keywords: Colonic Diverticulitis, Hinchey Classification, Laparoscopic Lavage, Hartmann's Procedure, Sigmoid Colectomy, Sigmoid Diverticulitis, and Open Surgery.

INTRODUCTION

Acute diverticulitis is characterized by inflammation of the diverticulum within the colon, with the sigmoid colon being the most frequently affected site, followed by the ascending colon and cecum. It is categorized into uncomplicated diverticulitis, where there is acute inflammation with or without phlegmon formation, and complicated diverticulitis, which involves diverticular inflammation accompanied by complications like abscess and perforation, with or without peritonitis. It is more prevalent in the West, with an incidence rate of 100 to 200 cases per 100,000 individuals. Left-sided colonic diverticulitis predominantly occurs in individuals over the age of 50 and exhibits an equal prevalence among males and females (Ambrosetti & Gervaz, 2016; Bhatia & Mattoo, 2023; Kaise *et al.,* 2020; Peery, 2021). The risk factors for diverticulitis include reduced fiber intake, smoking, the use of medications such as steroids and non-steroidal anti-inflammatory drugs (NSAIDs), and obesity. Clinically, diverticulitis manifests as left-sided lower abdominal pain accompanied by fever, with laboratory investigations typically indicating leukocytosis and elevated C-reactive protein (CRP) levels. Computerized tomography is used primarily to confirm a diagnosis of diverticulitis (Hanna & Kaiser, 2021).

The Hinchey classification has staged acute diverticulitis into stage 1, which involves a localized abscess; stage 2, which involves a pelvic intra-abdominal or retroperitoneal abscess; stage 3, which involves purulent generalized peritonitis; and stage 4, which involves feculent generalized peritonitis. The modified Hinchey classification further subdivides stage 1 into 1a, characterized by confined pericolic inflammation/phlegmon, and 1b, characterized by a confined pericolic abscess within the sigmoid mesocolon. (Hawkins *et al.,* 2020). The treatment of acute, uncomplicated diverticulitis involves a low fiber diet, analgesics, antipyretics, and the selective use of antibiotics.(Horesh *et al*., 2016; Koprowski *et al*., 2022; Lumpkin & Chaumont, 2019; Nally & Kavanagh, 2019; Stocchi, 2010; You *et al*., 2019).

Laparoscopic lavage may serve as a procedure to stabilize them from complicated diverticulitis with purulent discharge and perform a definitive sigmoid resection at a later stage. However, laparoscopic lavage is associated with a high recurrence rate, necessitating

careful patient selection for subsequent elective surgery (Deery & Hodin, 2017). Laparoscopic sigmoid resection for elective complicated sigmoid diverticulitis is feasible, though further studies are required to validate its use in the emergency management of left-sided diverticular disease. Laparoscopic sigmoid resection and Hartmann's procedure are performed in selected patients and at tertiary high-volume centers where the expertise is available. (Collins & Winter, 2014).

The surgical treatment of left-sided colonic diverticulitis has undergone gradual evolution. Hartmann's procedure continues to be the predominant emergency surgical intervention. However, sigmoid resection and anastomosis with a covering ileostomy is increasingly recognized as a viable option for the emergency treatment of left-sided colonic diverticulitis. This review article explores the surgical management strategies for left-sided colonic diverticulitis. Additionally, the role of laparoscopic lavage in managing left-sided colonic diverticulitis is examined. A comprehensive literature review was conducted using PUBMED, the Cochrane database of clinical reviews, and Google Scholar, focusing on clinical trials, observational and cohort studies, systematic reviews, and meta-analyses from 1980 to 2025. The following keywords were utilized: "Sigmoid diverticulitis," "Hinchey classification," "Colonic diverticulitis," "Hartmann's procedure," "Sigmoid colectomy," "Laparoscopic lavage," and "open surgery." All articles were restricted to the English language. Additional articles were identified through manual cross-referencing of the literature. Case reports, studies with fewer than 10 patients, and editorials were excluded. The study included adult male and female patients. Pediatric patients were not included in this review.

DISCUSSION

The Surgical Management of Acute Complicated Left-Sided Diverticular Disease

The World Society of Emergency Surgeons (WSES) has issued guidelines for the management of acute colonic diverticulitis in emergency settings, recommending Hartmann's procedure for critically ill patients with medical diseases. For stable patients without medical diseases, sigmoid resection with or without anastomosis is advised. Laparoscopic resection is recommended only when the expertise are available (Sartelli *et al*., 2016, 2020).The American Society of Colon and Rectal Surgeons (ASCR) suggests sigmoid resection for the emergency surgical management of acute left-sided colonic diverticulitis, with the decision to perform an anastomosis or stoma contingent upon patient factors, recommendation factors, and the operating surgeon's preference (Hall *et al*., 2020).German clinical guidelines recommend primary resection and anastomosis of the sigmoid colon with an ileostomy for patients presenting with acute stable diverticular disease, while reserving Hartmann's procedure for those who are hemodynamically unstable (Kruis *et al*., 2022). Similarly, the European Association of Emergency Surgeons (EAES) and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) have endorsed these strategies for the surgical management of acute left-sided diverticulitis. (Francis *et al*., 2019).

The surgical treatment of complicated acute left-sided colonic diverticulitis is determined by the patient's clinical condition and if peritonitis is present, with options including Hartmann's procedure or sigmoid resection and anastomosis with a covering ileostomy. Traditionally, Hartmann's procedure has been the preferred emergency operation, while sigmoid resection is reserved for selected patients. The choice of operation is typically made by the surgeon who is treating the patient (Khan & Hawkins, 2021; Meara & Alexander, 2018).A systematic review and meta-analysis by Cirocchi *et al*., included 14 studies with 1,041 patients, showed that patients who underwent sigmoid resection experienced reduced mortality and shorter hospital stays compared to those who underwent Hartmann's procedure (Cirocchi *et al*., 2013).(A similar systematic review and meta-analysis by Halim *et al*., also concluded that primary resection anastomosis was associated with lower mortality (Halim *et al*., 2019).

Ryan *et al*., conducted a systematic review and meta-analysis to evaluate the efficacy of primary sigmoid resection and anastomosis compared to Hartmann's procedure in the treatment of acute diverticulitis with generalized peritonitis. The analysis included twelve studies with a total of 918 patients, of whom 367 were treated with primary resection and anastomosis, while 551 were treated with Hartmann's procedure. The results indicated no significant difference in the 30-day mortality rate between the two groups; however, the sigmoid resection and anastomosis group exhibited reduced morbidity and a lower incidence of permanent stoma formation (Ryan *et al*., 2020). Similarly, Acuna *et al*., conducted a systematic review and meta-analysis on surgical strategies for perforated diverticulitis, encompassing six studies with 626 patients. Their findings revealed comparable mortality rates between Hartmann's procedure and sigmoid resection and anastomosis, yet the sigmoid resection group showed improved morbidity and stoma reversal rates (Acuna *et al*., 2018). In addition, a systematic review and meta-analysis conducted by Gachabayov *et al*., evaluated the outcomes of resection with primary anastomosis compared to sigmoid resection with stoma formation in cases of perforated diverticulitis with peritonitis, concluding that mortality rates were comparable between the two groups. (Gachabayov *et al*., 2018).

Beyer-Berjot *et al.,* conducted a systematic review on emergency surgical treatment of acute diverticulitis. This review encompassed seventy-one studies and revealed that patients undergoing the

Hartmann's procedure experienced inferior long-term outcomes and a higher incidence of non-reversal of their stoma (Beyer-Berjot *et al*., 2020). In a prospective randomized multicenter trial (DIVERTI) conducted by Bridoux et al., the Hartmann's procedure was compared with sigmoid resection with an ileostomy for generalized peritonitis resulting from perforated diverticulitis. This study involved 102 patients and the morbidity and mortality rates were comparable between the two groups; however, the reversal of stoma rate was 96% in the primary resection group, in contrast to 65% in the Hartmann's group (Bridoux *et al*., 2017).The long-term outcomes from the prospective multicenter randomized trial (DIVERTI), conducted by Loire *et al*., where seventy-eight of the 102 patients were followed up for nine years. The overall survival rate was 76%, with an incisional hernia rate of 52% in the Hartmann's group and 29% in the primary resection group. This study concluded that sigmoid resection did not affect the long-term survival rate (Loire *et al*., 2021). A multivariate logistic regression analysis of the extended effects of primary anastomosis versus Hartmann's procedure for Hinchey 3 and 4, conducted by Facille *et al*., also reported similar conclusions (Facile *et al.,* 2015).

A systematic review and meta-analysis by Shaban *et al*., examined perforated diverticulitis with or without anastomosis. This study included a total of 765 patients, with 482 had undergone the Hartmann's procedure and 283 who had undergone sigmoid resection with anastomoses. The mortality rate was 10.6% for the sigmoid resection group and 20.7% for the Hartmann's procedure, while the morbidity rate was 41.8% for the sigmoid resection and 51.2% for the Hartmann's procedure. This study concluded that sigmoid resection with anastomosis was feasible and safe for the management of perforated diverticulitis (Shaban *et al*., 2018).

Laparoscopic Surgical Management of Complicated Left-Sided Diverticulitis

The minimally invasive surgical management of complicated diverticulitis can be categorized into laparoscopic primary resection, anastomosis, and Hartmann's procedure. However, their application in cases of complicated diverticulitis is advised only when the requisite expertise is available. Laparoscopic lavage represents another laparoscopic surgical technique, typically employed in patients with Hinchey grade 3 diverticulitis. It acts as a procedure to stabilize them, allowing for an elective procedure once their condition improves (McDermott *et al*., 2014). The laparoscopic approach to complicated diverticulitis has been associated with reduced morbidity and mortality compared to the open procedure. Additionally, patients who underwent the laparoscopic approach experienced improved analgesia and earlier ambulation. (Desai *et al*., 2018; Mbadiwe *et al*., 2013).

Laparoscopic lavage drainage is a laparoscopic procedure employed for patients with Hinchey grade 3 diverticulitis. This procedure entails the drainage of purulent material from the left paracolic gutter, performing an abdominal washout, and placing a drain in the abdomen to facilitate the subsequent removal of all purulent material. (Biffl *et al*., 2017; Daher *et al*., 2016; Papagrigoriadis & Charalampopoulos, 2025).(Laparoscopic lavage is associated with reduced morbidity and mortality; however, it carries the risk of missing a perforation that has closed, feculent peritonitis, and underlying sigmoid cancer(Kiely *et al*., 2021).The Diverticulitis-laparoscopic lavage versus resection (Hartmann's procedure) or DILALA randomized clinical trial, conducted by Kohl *et al*., compared laparoscopic lavage with sigmoid resection for the treatment of perforated diverticulitis. In this trial, eighty-three patients were randomized, with forty-three undergoing laparoscopic lavage and forty undergoing the Hartmann's procedure. The lavage group exhibited a 45% reduced risk of reoperation compared to the Hartmann's procedure group, with no difference in mortality between the groups Kohl *et al*., 2018).

The Scandinavian Diverticulitis trial (SCANDIV) was a multicenter randomized controlled trial conducted across several hospitals in Norway and Sweden. A total of 199 patients were randomized, with 101 undergoing laparoscopic lavage and 98 undergoing sigmoid resection. The one-year results indicated no significant difference in mortality between the groups; however, laparoscopic lavage was associated with higher rates of deep wound infections and reintervention compared to the surgical resection group (Schultz *et al*., 2017). The three-year follow-up of these patients indicated minimal differences in the rates of major complications; however, the recurrence rate was 21% in the lavage group compared to 4% in the resection group. This trial demonstrated that laparoscopic lavage was associated with a higher recurrence rate (Azhar *et al*., 2021).

The Laparoscopic peritoneal lavage or sigmoidectomy for perforated diverticulitis with purulent peritonitis (LOLA) multicenter randomized trial was conducted across forty-two hospitals in Europe. A total of 90 patients were randomized to have either laparoscopic lavage or sigmoid resection performed on them. However, due to elevated mortality rates in both lavage groups, the trial was terminated (Vennix *et al*., 2015).77 patients from the original randomized cohort were followed up for a period of three years and they revealed that the cumulative morbidity and mortality rates between the two groups were comparable, while the reoperation rate was lower in the laparoscopic lavage group. The study concluded that laparoscopic lavage was associated with a reduced reoperation rate and stoma formation (Hoek *et al.,* 2022).

Shaikh *et al*., conducted a systematic review and meta-analysis to compare laparoscopic peritoneal lavage with sigmoid resection for the treatment of perforated sigmoid diverticulitis. This study incorporated three studies involving a total of 372 patients. The findings indicated that laparoscopic lavage was associated with a higher rate of postoperative abscess formation, although the mortality rate was comparable between the two groups (Shaikh *et al*., 2017). Similarly, Cirocchi *et al*., performed a systematic review and meta-analysis on the same comparison, including three studies with 540 patients. Their results also demonstrated a higher postoperative abscess rate in the laparoscopic lavage group, with the same mortality rates between the lavage and surgical resection groups (Cirocchi *et al*., 2017). Furthermore, a systematic review examining the use of laparoscopic lavage in the management of Hinchey grade 3 diverticulitis determined that the recurrence rate was higher in the laparoscopic lavage cohort. (Marshall *et al*., 2017).

Study	Study type	Year	N=numbers	Mortality Rate (%)	Complication Rate (%)	Recurrence Rate (%)
Diverticulitis-laparoscopic lavage versus resection (Hartmann's procedure)-DILALA trial-Schultz *et al*.,	Randomized controlled trial	2018	83-total Patients. 43-laparoscopic peritoneal lavage (LPL) 40-Hartmann's procedure (HP)	LPL-12% HP-11%	LPL-27% HP-20%	LPL-28% HP-29%
Scandinavian diverticulitis trial (SCANDIV)-Azhar *et al*.,	Randomized controlled trial	2020	199 total patients. 101-laparoscopic peritoneal lavage (LPL) 98-Colon Resection (CR)	LPL-32% CR-25%	LPL-29% CR-25%	LPL-21% CR-4%

The table shows the complication rates between laparoscopic peritoneal lavage (LPL) and surgical resection for the SCANDIV and DILALA trials**.**

Damage Control Surgery for Complicated Left-Sided Diverticulitis

Damage control surgery is a multi-step procedure employed for patients with complex left-sided diverticular disease who are hemodynamically unstable. This surgical approach involves the resection of the perforated sigmoid colon, the creation of stapled-off stumps, and peritoneal lavage. The abdomen is temporarily closed, and the patient undergoes sepsis management and fluid resuscitation in the critical care unit for up to 48 hours. Subsequently, the patient is returned to the operating theatre for either anastomosis or stoma formation (Cirocchi *et al*., 2014, 2022). Sohn *et al*., analyzed damage control surgery for the treatment of perforated sigmoid diverticulitis with generalized peritonitis, concluding that the procedure is safe and associated with a reduced morbidity rate (Sohn *et al*., 2016).

A systematic review and meta-analysis conducted by Cirocchi *et al*., examined the role of damage control surgery in the treatment of perforated sigmoid diverticulitis. This study incorporated nine studies encompassing a total of 318 patients. The most prevalent category was Hinchey 3, accounting for 68.3% of cases, while Hinchey 4 comprised 28.9%. Resection with primary anastomosis was successfully executed in 62.1% cases, with an anastomotic leak rate of 4.7% and a mortality rate of 9.2%. The findings indicated that damage control surgery is a feasible option for managing complicated diverticular disease in hemodynamically unstable patients; however, further research is necessary to assess its efficacy comprehensively (Cirocchi *et al*., 2021).

CONCLUSION

Complicated left-sided diverticular disease poses a substantial clinical challenge, particularly in cases involving perforation. Hartmann's procedure is the most performed surgical intervention due to its relative simplicity for the surgeon. However, the high incidence of stoma non-reversibility associated with this procedure has led to an increasing preference for sigmoid colectomy and anastomosis with a protective ileostomy. Laparoscopic lavage serves as a critical interim procedure, facilitating patient stabilization and enabling subsequent resection and anastomosis once stabilization is achieved. Damage control surgery is a viable option only in facilities equipped with robust intensive care unit support to manage these patients effectively.

Conflict of Interest: There is no conflict of interest.

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