# What is the current role of laparoscopic lavage in perforated diverticulitis?

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Ernest E. Moore: grants and shared U.S. patents, Haemonetics; grants, TEM Systems, Inc. The remaining authors have nothing to disclose.

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Submitted: November 14, 2016, Revised: December 23, 2016, Accepted: January 9, 2017, Published online: January 17, 2017.
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DOI: 10.1097/TA.0000000000001390

Diverticulosis is a very common condition, affecting 30% to 50% of adults over the age of 50 and over 65% of those over the age of 80. About one quarter of patients with diverticulosis will at some point suffer diverticultis, of whom one quarter will have "complicated diverticular disease," defined as diverticulitis associated with phlegmon, abscess, fistula, stricture presenting with obstruction, or perforation with peritonitis.[1] In 2012, the current authors collaborated on a Western Trauma Association (WTA) "Critical Decisions" algorithm entitled, "Management of complicated diverticulitis."[1] In the WTA algorithm, we recommended laparoscopic lavage and drainage (LLD) for the management of purulent peritonitis for those patients not presenting in septic shock. This recommendation was based on favorable outcomes reported in several case series.[2,3] Since the publication of the 2012 WTA guideline,[1] the results from at least three prospective randomized clinical trials (PRCTs) have been published, which call into question the utility of the LLD procedure.[4–6] The results of these studies warrant reevaluation of the role of LLD in the management of perforated diverticulitis with purulent peritonitis.

## HISTORICAL PERSPECTIVE

The surgical management of diverticulitis has evolved over the past century. Lockhart-Mummery[7] first described peritoneal lavage, drainage, and closure of the colonic perforation in 1910. Although the first resection for perforated diverticulitis was reported by Mayo and colleagues in 1907,[8] nonresectional approaches continued to be recommended based on poor outcomes.[9,10] Until the 1980s, it was felt that the safest approach was a three-stage procedure: an initial diverting colostomy, followed by resection of the diseased segment, and ultimately colostomy closure. As the benefits of primary resection became recognized, the Hartmann's procedure (HP) became the recommended approach.[11] Over the past 20 years, there have been many articles supporting primary resection and anastomosis, with or without a proximal "protective" diversion. In addition, there have been several case series reporting low morbidity associated with LLD for the management of purulent peritonitis.[2,3] Recognition that many perforations can seal led to the adoption of a minimally invasive strategy for patients with Hinchey III diverticulitis. Naturally, the next step was to critically evaluate this approach in PRCTs.

## PRCTs OF LLD VERSUS SIGMOIDECTOMY—AT FIRST GLANCE

Between September 2015 and January 2016, the results of three PRCTs exploring the outcomes related to LLD versus HP were published.

### The LOLA Group of the Ladies Trial

The first PRCT published was from the LOLA (laparoscopic lavage vs. sigmoidectomy) group of the Ladies trial.[4] The Ladies trial is a multicenter, parallel-group, randomized, open-label superiority trial performed in 34 teaching hospitals and eight academic hospitals in Belgium, Italy, and the Netherlands. The trial has a second arm, the DIVA group (HP vs. sigmoidectomy plus primary anastomosis [SPR]). In this trial, 90 patients were assigned in a 2:1:1 fashion: 47 had LLD, 21 HP, and 22 SPR. A total of 85 underwent assigned treatment, and 87 were included in intention-to-treat analysis. The primary endpoint was major morbidity and mortality within 12 months, with "major morbidity" defined as surgical reintervention, abdominal wall dehiscence, abscess needing percutaneous drainage, urosepsis, myocardial infarction, renal failure, or respiratory insufficiency. On the basis of a significantly higher rate of in-hospital major morbidity or mortality in the LLD group (35% vs. 18%), an independent data safety and monitoring board recommended termination of the study after the third planned interim analysis. The conclusion in the abstract of the article read, "laparoscopic lavage is not superior to sigmoidectomy for the treatment of purulent perforated diverticulitis."

### The SCANDIV Trial

The SCANDIV (scandinavian diverticulitis) trial was a multicenter, two-group, open-label, pragmatic superiority trial performed at 21 surgical units in Norway and Sweden.[5] Patients were enrolled if they had the suspicion of perforated diverticulitis—that is, a CT showing free air and findings compatible with perforated diverticulitis and clinical peritonitis. Adhesions to the sigmoid were not dissected. Of 199 randomized patients, 132 had Hinchey III diverticulitis. These 132 were analyzed along with 12 others who had Hinchey I or II disease. There was no difference in the rate of death or severe complications between the groups. The secondary endpoints did differ, however: reoperation rate (20% vs. 6%) and the number of missed carcinomas (4 vs. 0) were higher in the LLD group. The abstract concluded, "These findings do not support laparoscopic lavage for treatment of perforated diverticulitis."

### The DILALA Trial

The DILALA ("diverticulitis-laparoscopic lavage vs. resection [Hartmann's procedure] for acute diverticulitis with peritonitis") trial was performed in nine surgical departments in Sweden and Denmark, in which LLD was compared with HP.[6] Randomization of 83 patients occurred intraoperatively, after confirmation of Hinchey III diverticulitis. The initial publication of the DILALA trial[6] offered only short-term outcomes. There were no statistical differences between the groups, although the LLD group had shorter hospital length of stay by 3 days and lower reoperation (13% vs. 17%), mortality (8% vs. 11%), and readmission (0% vs. 6%) rates. The abstract concluded, "Laparoscopic lavage as treatment for patients with perforated diverticulitis was feasible and safe in the short term."

A recent publication reported longer-term follow-up of this study.[12] The primary outcome was the percentage of patients having one or more reoperations within 12 months. Key secondary outcomes were number of reoperations, hospital readmissions, total length of hospital stay during 12 months, and adverse events. Significantly fewer patients in the LLD group had reoperations in 12 months (28% vs. 63%), and total length of hospital stay was 35% shorter. Fewer LLD patients had a stoma at 12 months (7% vs. 28%). The abstract concluded, "Laparoscopic lavage reduced the need for reoperations, had a

similar safety profile to the Hartmann's procedure, and may be an appropriate treatment of choice for acute perforated diverticulitis with purulent peritonitis."

## PRCTs OF LLD VERSUS SIGMOIDECTOMY—A DEEPER DIVE

On first glance (or after reading only the abstracts), one might have taken away the message that LLD should be discarded as an option in the management of patients with Hinchey III diverticultis. However, the articles warrant a closer look.

Regarding the Ladies/LOLA group trial,[4] early termination of a study is generally considered a death knell. However, the long-term serious adverse events (Table 1) were not different between the two groups, and 76% of patients had sepsis definitively controlled by LLD; that is, they left the hospital without sigmoidectomy. The major difference in short-term outcomes—the reason for study termination—was the higher rate of in-hospital reinterventions in the LLD group (18 vs. 2). This should not have been unexpected. This study and the other two trials[4–6] were designed to compare the outcomes of two procedures with different goals. Sigmoidectomy is a definitive procedure, meant to control sepsis and eliminate its source. Although not 100% "curative"—the rate of recurrent diverticulitis after colectomy is 6% to 9%[13]—resection has long been acknowledged as superior to nonresectional therapy for controlling sepsis associated with perforated diverticultis. On the other hand, outcomes following emergency versus elective colectomy are worse[12]—hence, the desire to control sepsis and defer colectomy until an elective setting. Moreover, despite the notion that the colostomy in HP is temporary, 35% to 45% of colostomies after HP are never reversed.[13] Among patients undergoing elective colostomy reversal, there is significant attendant morbidity. For these reasons, the concept of LLD is sound. The fact that LLD is successful in controlling sepsis in 70% to 80% of patients certainly warrants discussion during the informed consent process. It would be inappropriate to exclude LLD from the discussion based on "inferior" short-term outcomes.

**TABLE 1.** Serious Adverse Events From the LOLA Group of the Ladies Trial[4]

| | LLD (n = 46) | Sigmoidectomy (n = 42) | *p* Value |
|---|---|---|---|
| Short-term serious adverse events | 18 (39%) | 8 (19%) | 0.043 |
| Death | 2 (4%) | 1 (2%) | 0.624 |
| Surgical reintervention | 9 (20%) | 3 (7%) | 0.123 |
| Abscess with drainage | 9 (20%) | 0 | 0.003 |
| Fascial dehiscence | 0 | 3 (7%) | 0.105 |
| Myocardial infarction | 0 | 1 (2%) | 0.477 |
| Respiratory failure | 6 (13%) | 2 (5%) | 0.196 |
| Renal failure | 2 (4%) | 2 (5%) | 0.921 |
| Long-term serious adverse events | 17 (37%) | 17 (40%) | 0.116 |
| Death | 2 (4%) | 5 (12%) | 0.188 |
| Surgical reintervention | 13 (28%) | 5 (12%) | 0.116 |
| Abscess with drainage | 2 (4%) | 2 (5%) | 0.921 |
| Fascial dehiscence | 5 (11%) | 5 (12%) | 0.436 |
| Sigmoid carcinoma | 5 (11%) | 2 (5%) | 0.305 |
| Recurent diverticultis | 9 (20%) | 1 (2%) | 0.032 |
| Composite primary outcome 12 months | 30 (67%) | 25 (60%) | 0.580 |

The authors of the Ladies/LOLA trial suggest that the high rate of early reinterventions may have been related to misdiagnosis of free perforations—potentially due to the study protocol that called for removing adherent tissues unless they were "firmly adherent." The authors speculate that a contrast enema might aid in patient selection by excluding Hinchey IV disease. Clearly, patients with feculent peritonitis are not candidates for LLD, as the continued spillage of stool is unaffected. Whether contrast enema becomes a useful tool remains to be seen. The surgeon should make an attempt to confirm that there is no active spillage. Of note, the SCANDIV investigators[5] reported that 50% of the sigmoidectomy specimens contained a perforation. This is not surprising, as the dissection for resection would require taking down all adhesions to the colon and thereby uncover the perforation. It is particularly noteworthy that, even after dissection, 50% did *not* have a perforation, attesting to the fact that perforations can and do seal.

Another issue raised in the studies is the incidence of "missed" sigmoid carcinoma in the LLD groups.[13] This has always been a consideration in the management of diverticulitis and should by no means be a major determinant of the decision for primary resection. Patients with uncomplicated diverticulitis have a very low incidence of colon cancer, so follow-up colonoscopy should be based on their age and baseline risk rather than the inflammatory episode.[14,15] On the other hand, patients diagnosed with complicated diverticulitis have an 11% risk of having cancer mimicking the disease. For this reason, colonoscopy is recommended in all such cases.[14,15] But just like the patient who has a localized abscess managed by percutaneous drainage, the patient with Hinchey III disease can undergo LLD and then later have colonoscopy to rule out cancer. Current literature supports individualizing the decision for elective colectomy, and patients should be informed that, after a perforation, the risk of another such episode is not increased; in fact, the appearance of scars makes it less likely that they will develop another perforation at the same location.[3,13]

The SCANDIV trial was the largest and may be the most influential—and its methodological shortcomings should not be overlooked. It should be noted that, in the LLD group, the most experienced surgeon on the operating team was a registrar in 32% of cases and colorectal surgeon in 46% of cases; in the sigmoidectomy group, a colorectal surgeon performed the operation in 77% of cases. This may have had a bearing on the outcomes.

The DILALA trial is most supportive of the LLD strategy as a means of controlling sepsis while averting colostomy. It has focused the outcome discussion on the early goals of care. In fact, a recent health economic analysis based on the results of this trial demonstrates significant cost reduction associated with the strategy of LLD compared with HP for Hinchey III diverticulitis.[16]

## CONCLUSIONS

The recent PRCTs have raised appropriate cautions against considering LLD as the definitive procedure for Hinchey III diverticulitis. On the other hand, we feel that it is a perfectly appropriate procedure in carefully selected patients, primarily as a bridge to elective colectomy. Patient selection factors include the following:

- The patient must be able to tolerate recurrent infection, as one quarter of patients will not have sepsis control with LLD alone. Thus, the frail, septic elderly patient or a patient with major comorbid medical problems is not a good candidate.
- Acute presentation. If a patient fails initial nonoperative management with phlegmon or abscess on computed tomography, a resection is probably best. The source control likely requires resection of the inflamed bowel and phlegmonous material, and there may be mesenteric or interloop abscess that would not be treated with LLD.
- Purulent peritonitis without evidence of free perforation. This may not be apparent until the time of laparoscopy.
- Sepsis is attributable to the purulent peritonitis. This requires surgical judgment.

The LLD procedure sits squarely in the wheelhouse of the acute care surgeon. Acute care surgeons manage patients with surgical sepsis on a daily basis and make determinations regarding the necessity and urgency of surgery. Technically, the LLD procedure is straightforward and does not require advanced laparoscopic skills. Generally, there is no closure of colonic perforation—if that is seen, resection is advisable.

### AUTHORSHIP

All authors contributed to manuscript concept, literature review, manuscript preparation and critical review. All authors approved the final manuscript.

### DISCLOSURE

The authors declare no conflicts of interest.

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