# Chapter 27
# The Role of Laparoscopic Peritoneal Lavage in the Operative Management of Hinchey III Diverticulitis

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## Introduction

The 2014 American Society of Colon and Rectal Surgeons practice parameters for the treatment of sigmoid diverticulitis recommend urgent sigmoid colectomy for patients presenting with diffuse peritonitis or for those in whose initial nonoperative management fails [1]. While open Hartmann's procedure has been long considered the 'gold standard' in these situations, primary anastomosis with proximal diversion is increasingly supported in recent literature [2, 3]. Laparoscopic sigmoidectomy in the emergency setting is safe, with decreased morbidity compared to open sigmoidectomy [4].

In the only recent randomized clinical trial (RCT)comparing primary anastomosis with diversion to Hartmann's procedure in the emergency setting, Oberkofler [3] reported similar outcomes with the initial colectomy, but superior overall results in the primary anastomosis group owing to the higher rate of stoma closure and relative safety/efficiency of ileostomy closure as opposed to Hartmann takedown. The trial has been criticized for the influence of surgeon discretion on the choice of technique, as well as calculation of the sample size [5, 6]. A similar RCT [7] was prematurely terminated due to slow accrual.

Stoma avoidance altogether in the emergency setting is also described in limited and somewhat dated series; intraoperative colonic lavage is often employed in these studies to prepare the colon for primary anastomosis, with acceptable morbidity and anastomotic leak rates [8, 9]. Two recent retrospective analysis also concluded that primary anastomosis without diversion is an appropriate option in the urgent setting,

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including patients with Hinchey III (purulent) and Hinchey IV (feculent) peritonitis; careful patient selection is advised [10, 11].

The broad body of literature does not stratify outcomes based on intraoperative Hinchey classification, though authors recognize that patients with Hinchey IV disease are likely to have increased perioperative morbidity and mortality as compared to those with Hinchey III disease. Pending further meta-analysis or randomized trials, choice of operation in the emergency setting is still predicated on surgeon experience and preference.

Attempts at nonoperative management in patients presenting with complicated diverticulitis including extra-digestive air and free fluid is supported by single-institution series. In one series including 136 patients, ~88 % of patients with extra-digestive air >2 cm, non-loculated fluid, or abscess >4 cm were able to be successfully treated without surgery [12]. Another study reported similar results, with an 86 % success rate in 132 patients with nonoperative management in the absence of diffuse peritonitis or free pelvic fluid [13]. One study including 39 patients, ¾ of whom presented with signs of peritonitis, described a 92 % success rate with nonoperative management [14].

Elective sigmoidectomy after episodes of acute uncomplicated diverticulitis is an individualized, case by case decision based on patient specific factors. In contrast, patients with *complicated* diverticulitis who are successfully managed nonoperatively are still generally offered elective resection owing to high recurrence rates [1].

The technique of laparoscopic peritoneal lavage, first described and largely popularized in European centers [15], challenges both the notion that sigmoidectomy is necessary in patients requiring emergency operative intervention, and that elective resection is really required in patients that do successfully navigate an initial nonresectional approach. This chapter aims to examine the evidence for or against laparoscopic peritoneal lavage.

## Search Strategy

Using the PICO format, laparoscopic peritoneal lavage (hereafter also referred to as simply 'lavage') was compared to any technique of sigmoidectomy—laparoscopic or open Hartmann's procedure or primary anastomosis with or without diversion—in patients presenting with Hinchey III diverticulitis requiring operative intervention due to generalized peritonitis or failure of medical management (Table 27.1). The outcomes evaluated were morbidity and mortality, non-resolution requiring reintervention and sigmoidectomy, rate of disease recurrence requiring sigmoidectomy,

**Table 27.1** PICO table

| P (patients) | I (intervention) | C (comparator) | O (outcomes) |
|---|---|---|---|
| Hinchey III diverticulitis | Sigmoidectomy (Hartmann's or primary resection and anastomosis with or without diversion) | Laparoscopic peritoneal lavage (washout) | Resolution recurrence |

and the number of patients who are symptom free with no episodes of recurrence (definitive lavage), or those who were successfully able to undergo elective sigmoidectomy prior to a recurrent episode (lavage as a bridge to elective resection).

A systematic literature search was performed of MEDLINE and PubMed to identify English language publications related to utilization of laparoscopic peritoneal lavage in perforated diverticulitis, published from January 1990 through December 2015. Combinations of key words were constructed and applied to these databases. The search strategy used in MEDLINE included both MeSH subject headings when possible and/or keyword mapping alias operator commands for the terms 'diverticulitis' or 'diverticulum', AND 'laparoscopy' or 'laparoscopic', AND 'peritoneal lavage', 'lavage', or 'therapeutic irrigation'. Similar combinations were then applied to PubMed. The biographies of all the original articles were then explored for any additional germane publications. Studies that did not include more than one laparoscopic peritoneal lavage or therapeutic irrigation patient were excluded. Case reports, letters, systematic reviews, and duplicate articles were also excluded.

## Results

Twenty-two English language studies were identified. Several studies represented extended series including previously reported patients [15–22]. One database analysis out of Ireland [23] may include the patients reported by Myers et al. [24].

### *Results of Low and Very-Low Quality Studies*

Using the GRADE system approach to developing practice guidelines, 19 of 22 studies were rated either low or very low quality; reasons for this included small sample size, lack of institutional comparator, allocation concealment, surgeon bias, failure to adhere to the intention-to-treat principle, and lack of reporting on salient outcome metrics such as non-resolution or recurrence requiring resection. Most of the excluded studies had more than one of these limitations. These studies are summarized in Table 27.2.

There are a total of 946 patients represented by low or very low quality studies undergoing laparoscopic peritoneal lavage and at least 758 are presumed unique patients across a 22-year period (1991–2013). Of studies clearly reporting intraoperative Hinchey classification, 76 % of patients (311 of 416) had Hinchey III diverticulitis, defined as free purulent contamination of the peritoneal cavity. Some studies allowed patients who had failed an initial trial of medical management with or without percutaneous drainage of accessible abscess cavities; others only included patients determined to be urgent surgical candidates on presentation. Four studies included an intraoperative decision point to proceed with lavage, recognizing the inherent surgeon bias in this approach.

**Table 27.2** Low and very low quality evidence on laparoscopic peritoneal lavage

| Study | Study period | Unique lavage patients | H3 | Lavage population | Morbidity (%) | Death (%) | Non-resolution requiring resection (%) | Recurrence requiring resection (%) | Elective resection without recurrence (%) | Symptom free, no resection (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| O'Sullivan et al. [16] | '91–'94 | 8 | 8 | CD and GP intra-op; (H3 only) | 2 (25) | 0 | 0 | 0 | 0 | 6 (75) |
| Faranda et al. [24] | '94-'98 | 18 | 16 | CD and GP on presentation | 3 (17) | 0 | 0 | NR | 15 (83)<br>~4 m | NR |
| Mutter et al. [29] | '96–'03 | 10 | 10 | CD, (−) PCD, intra-op with (−) GP, (−) visible perforation, (−) H4 | 0 | 0 | 1 (10) | 0 | 6 (60)<br>~2–3 m | NR |
| Taylor et al. [20] | '02–'05 | 14 | 10 | CD with perforation | 0 (major) | 0 | 3 (21) | 0<br>2–15 m | 8 (57)<br>~6w later | 2 (14)<br>2–15 m |
| Bretagnol et al. [18] | '00–'04 | 24 | 18 | CD and GP or FoMM or septic shock | 2 (8) | 0 | 0 | 0<br>~4 m; 2–6 m | 24 (100%)<br>~4 m;<br>2–6 m | 0 |
| Franklin et al. [22] | '91–'06 | 40 | 32 | CD and GP | 8 (20) | 0 | 0 | 0<br>96 m;<br>1–168 m | 24[a] (60) | 16 (40)<br>96 m;<br>1–168 m |
| Myers et al. [26] | '00–'07 | 92 | 67 | CD and GP; (+) free air, (−) H4 | (4) | 3 (3.2) | 1 (2) | 0<br>36 m;<br>12–84 m | 0<br>36 m;<br>12–84 m | 88 (96)<br>36 m;<br>12–84 m |
| Favuzza et al. [30] | NR | 7 | NR | CD and peritonitis; Imaging (+) fluid (−) discrete abscess | NR | 0 | 1 (14) | 1 (14)<br>3 m | 5 (71) | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Karoui et al. [23] | ’94–‘06 | 35 | 35 | CD and GP on presentation (H3 only) | 9 (26) | 0 | 1 (3) | 0 | 25 (71)<br>4 m; 2–7 | 8 (23)<br>21 m; 7–48 m |
| White et al. [19] | ’99–‘08 | 35 | 11 | CD and GP, or (+) free air or 2QP (+) >3 cm collection with FoMM | 19 (54) | 0 | 8 (23) | 8 (23)<br>6 m; 2–12 m | 8 (23)<br>2–3 m later | 11 (31)<br>20 m; 6–60 m |
| Liang et al. [21] | ’91–‘10 | 47 | 36 | CD and GP with (+) free air and (+) contrast extravasation | 2 (4) | 0 | 3 (6.4) | 0 | 18[a] (38) | 26 (55) |
| Rogers et al. [25] | ’95–‘08 | 427 | NR | NR | 60 (14) | 17 (4) | NR | NR | NR | NR |
| Edieken et al. [31] | ’09–‘12 | 10 | 8 | CD with FoMM or (+) free air; (+) HDS | NR | 0 | 3 (30) | 3 (30) | 0 | NR |
| Swank et al. [32] | ’08–‘10 | 38 | 33 | CD with perforation; (+) free air or H3 | 17 (45) | 4 (11) | 5 (13) | 3 (8)<br>6–12 m | 0 | 30 (79)<br>3 m |
| Gentile et al. [33] | ’09–‘12 | 14 | 3 | CD with perforation (H2-3 only) | 3 (21) | 1 (7) | NR | NR | NR | NR |
| Rade et al. [17] | ’00–‘13 | 71 | 47 | CD with GP; (−) shock (−) distention (−) previous surg (−) H4 | 20 (28) | 4 (6) | 11 (15) | NR | 55 (77)<br>3 m; 1–9 m | NR |

(continued)

**Table 27.2** (continued)

| Study | Study period | Unique lavage patients | H3 | Lavage population | Morbidity (%) | Death (%) | Non-resolution requiring resection (%) | Recurrence requiring resection (%) | Elective resection without recurrence (%) | Symptom free, no resection (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Rossi et al. [34] | '06–'13 | 46 | 46 | CD with GP; intra-op H3 only, (+) HDS | 11 (24) | 0 | 5 (11) | NR | NR | NR |
| Horesh et al. [35] | '07–'12 | 10 | 7 | CD and peritonitis with (+) free air, or FoMM | 3 (30%) | 0 | 1 (10%) | 2 (20%) ~9 m | NR | 6 (60%) |
| Sorrentino et al. [36] | '01–'13 | 63 | 54 | CD and intra-op; (−) fecal peritonitis >1 quadrant | 9 (14) | 1 (2) | 6 (10) | 4 (7) ~5y | 0 | 53 (84) ~5y |

Shaded studies are those whose patients are represented within more current studies in the table

*CD* complicated diverticulitis, *FoMM* failure of medical management, *GP* generalized or 4-quadrant peritonitis, *H* Hinchey, *HDS* Hemodynamic stability, *NR* Not recorded, *PCD* percutaneous drainage, *2QP* 2-quadrant peritonitis

[a]Value inferred from text

Lavage technique varied, including decision to disrupt inflammatory adhesions, use of pelvic drains, decision to patch, suture, or apply fibrin glue to visible perforations, volume of warm saline used, addition of agents to the irrigant (betadine or heparin) and duration of postoperative antibiotics. It is not known whether any one lavage technique positively or negatively influenced outcome.

Of unique studies reporting appropriate outcomes, the morbidity of lavage was ~19 %, with ~3 % mortality. Approximately 10 % of patients experienced non-resolution after lavage requiring return to the operating room and sigmoidectomy (~2/3 of studies reporting on this outcome); ~ 6 % of patients experienced a recurrence requiring sigmoid resection over a time frame ranging from 2 months to 14 years, ~28 % of patients underwent elective resection within 2–9 months after peritoneal lavage, and ~68 % of patients are symptom-free without any further intervention over an unknown time interval (~1/2 of studies reporting on the aforementioned three outcomes). The decision to proceed with elective resection was an institutional tenet defining lavage as a strategy to bridge patients through an emergency presentation so that they could undergo surgery in the elective setting. Other studies highlighted lavage as a potentially definitive procedure.

If we are to define success of peritoneal lavage as those patients who are either symptom-free with no recurrences or further intervention, or were able to undergo elective resection prior to any recurrent episode, then lavage was known to be successful in ~46 % of the total unique patient population represented by these studies, with approximately half of studies not reporting on these outcomes.

Several authors suggested criteria to identify those who are likely to fail lavage, including patients with elevated American Society of Anesthesia (ASA) classification, immune suppression, or advanced age [17], those with Hinchey IV diverticulitis (most series) or a visible perforation, and those with distention or obstruction limiting technical feasibility of lavage.

## *Results of Randomized-Controlled Trials*

Of the 22 studies identified, 3 are recent randomized controlled multicenter trials, all rated high quality based on the GRADE system [37, 38, 39]. The results of these studies are summarized in Table 27.3. To allow for better comparison between trials, the author of this chapter utilized supplementary data from these trials to report on similar outcomes; that is 30–90 day morbidity beyond IIIb, and mortality, excluding Hinchey IV patients.

The DILALA Trial [37] included patients at 9 Swedish and Danish institutions from February 2010 to February 2014. All patients had extra-digestive fluid or gas on radiologic evaluation, were intraoperatively determined to have Hinchey III generalized purulent peritonitis, and were randomized to either lavage or open Hartmann's procedure. The primary end-point of the published study was short-term morbidity and mortality [37]; the primary endpoint of the trial will be the number of re-operations at 12-month follow-up with additional secondary endpoints [25].

**Table 27.3** Randomized controlled trials on laparoscopic peritoneal lavage

| Study | N | H3 | Patients excluded after randomization | Morbidity (%) | Death (%) | Non-resolution requiring resection (%) | Recurrence requiring resection (%) | Elective resection w/o recurrence / Stoma reversal | Symptom free, no resection (%) | Conclusion |
|---|---|---|---|---|---|---|---|---|---|---|
| **DILALA** Angente et al. [37] | 83 | CD and (+) free fluid/air and intra-op H3 | | | | | | | | Lavage is feasible and safe in short-term analysis of patients. Long-term outcomes awaiting publication |
| Laparoscopic lavage | 43 | 43 | 4<br>2 neoplasm<br>2 other | 8 (21)<br>≥IIIb; 30d | 3 (8)<br>90d | NR | 0<br>3 m | 0<br>3 m | NR | |
| Open Hartmann's | 40 | 40 | 4<br>1 neoplasm<br>3 other | 6 (17)<br>≥IIIb; 30d | 4 (11)<br>90d | | | NR | | |
| **LOLA/LADIES** Vennix et al. [38] | 90 | CD and GP with (+) free fluid/air and intra-op H3; (−) HDS, (−) high dose steroids | | | | | | | | DSMB terminated LOLA arm early due to high short-term morbidity in the lavage group |
| Laparoscopic Lavage | 47 | 47 | 1 protocol violation | 20 (44)<br>≥IIIb; 90d | 2 (4)<br>30d | 9 (20) | 6 (13)<br>~12 m | 1[b] (2)<br>~12 m | 24 (52)<br>~12 m | |
| Sigmoidectomy[a] | 43 | 43 | 1 intra-op neoplasm | 12 (29)<br>≥IIIb; 90d | 1 (2)<br>30d | | | 24/35 (71)<br><12 m | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **SCANDIV**<br>Schultz et al. [39] | 199 | CD and GP; (−) obstruction, (−) pregnancy; intra-op (−) H4[c], (−) wrong diagnosis | | | | | | | Lavage led to worse outcomes; Findings do not support lavage in the treatment of diverticulitis |
| Lavage | 101 | 69 | 27[c]<br>12 with no CD<br>15 with H4 | 19 (26)<br>≥IIIb[c]; 90d | 6 (8)<br>90d[c] | NR | NR | NR | NR |
| Sigmoidectomy[a] | 98 | 61 | 28[c]<br>13 with no CD<br>13 with H4<br>2 other | 10 (14)<br>≥IIIb[c]; 90d | 5 (7)<br>90d[c] | | | NR | |

*CD* complicated diverticulitis, *NR* Not recorded, *H* Hinchey, *HDS* Hemodynamic stability, *GP* generalized peritonitis, *DSMB* Data & safety monitoring board

[a]Laparoscopic or open Hartmann's procedure, or primary resection and anastomosis +/− diversion at surgeon's discretion

[b]Four additional resections for cancer

[c]H4 included in primary outcome analysis in SCANDIV; shown are only H1-3 values to allow for better comparison between RCTs

The LOLA group of the LADIES trial [38] involved 42 hospitals in Belgium, Italy, and the Netherlands from July 2010 to February 2013. The LOLA group was designed to compare lavage to sigmoidectomy—Hartmann's or primary anastomosis with or without diversion—in Hinchey III diverticulitis. A separate subgroup analysis compared Hartmann's procedure vs. resection and primary anastomosis in both Hinchey III and IV diverticulitis and is not relevant to the aim of this chapter. Patients with generalized peritonitis and radiologic evidence of diffuse extradigestive fluid or gas were randomized during diagnostic laparoscopy; those with Hinchey III purulent peritonitis were then eligible for the LOLA group. Patients on high-dose steroids, dementia, advanced age, or hemodynamic instability were excluded. The primary end-point of the LOLA group was a composite including major morbidity and mortality within 12 months.

The SCANDIV Trial [39] included patients at 21 participating centers in Sweden and Norway from February 2010 to June 2014. Patients with diverticulitis and peritonitis were randomized to receive lavage or sigmoidectomy— Hartmann's or primary anastomosis with or without diversion— and then underwent diagnostic laparoscopy. Those with a non-diverticular pathology identified intraoperatively were then excluded from all but the primary analysis. Those with Hinchey IV feculent peritonitis were randomized but were included only in a modified intention-to-treat analysis, as they all underwent sigmoidectomy. Those with Hinchey I-III disease, and those with Hinchey IV disease, were analyzed separately in regard to secondary outcome measures. The primary outcome was severe postoperative complications within 90 days.

The short-term analysis of the DILALA trial concluded that lavage for Hinchey III diverticulitis, as compared to open Hartmann's procedure, is feasible and safe in the short term with no difference in30-day ≥ IIIb morbidity (21 % vs. 17 %, respectively) or 90-day mortality (7.7 % vs. 11.4 %, respectively), and resulted in shorter operating time and length of stay. This trial is awaiting final review and publication of its 12-month outcomes.

The other trials, LOLA/LADIES and SCANDIV, did not support use of lavage. The LOLA group of the LADIES trial was terminated early by the Data Safety & Monitoring Board (DSMB) due to increased event rate defined as in-hospital major morbidity or mortality in the laparoscopic lavage group, with 37 events in the lavage group and 10 events in the sigmoidectomy group ($p = 0.0005$), owing mainly to an increased rate of surgical re-intervention. The study was not sufficiently powered to make a statement on inferiority of lavage, but suggested that it is not superior. Twenty percentage of lavage patients required sigmoidectomy due to non-resolution of their inflammatory process. 52 % of lavage patients were symptom free with no recurrence at 12-month follow up. Four cancers were missed in the lavage group and later required resection.

The SCANDIV trial was carried to completion. While 90-day ≥ IIIb morbidity and mortality was no different, patients undergoing lavage had a significantly higher reoperation rate within 90 days (20.3 % vs. 5.7 % in the sigmoidectomy group, p 0.01) in patients with Hinchey I-III diverticulitis. Hospital stay was not significantly different. As with LOLA/LADIES, four cancers were missed in the lavage group and later required resection.

## Recommendations Based on the Data

There are some outcome measures for which lavage is clearly superior. The significantly shorter operating time offered by lavage is widely supported by both low- and high quality literature. While this makes lavage a tempting strategy for the surgeon to deploy in the emergency setting, the clinical benefit of a 1-h lavage vs. a 2- or 3- h sigmoidectomy is questionable. Length of stay in the lavage group was not significantly different in the SCANDIV or LOLA/LADIES Trials; it was significantly shorter in the DILALA Trial (6 vs. 9 days; p 0.037) [37, 38, 39].

In order to make a recommendation on the role of laparoscopic peritoneal lavage in the management of Hinchey III diverticulitis, one must define what is an acceptable and unacceptable outcome. For whom is this intervention applicable, how should it be applied, and what are the outcomes of alternative techniques? Is laparoscopic peritoneal lavage a rescue procedure meant to bridge a patient to elective resection with the goal of stoma avoidance, or is lavage better defined as a definitive intervention?

The author defined unacceptable outcomes in utilization of the lavage technique as significantly increased morbidity and mortality, non-resolution requiring resection, and missed neoplasm.

*In patients presenting with Hinchey III diverticulitis and peritonitis, there is no subset for which laparoscopic peritoneal lavage is clearly the preferred method, as compared to sigmoidectomy.* **(Recommendation:** Conditional; **Quality of Evidence:** High)

In patients presenting with Hinchey III diverticulitis and generalized peritonitis or who are failing nonoperative management, there is no subset of patients for which laparoscopic peritoneal lavage is clearly the preferred method compared to sigmoidectomy. This is a conditional recommendation based on high quality evidence with limited long-term data and lack of reporting on some of the outcomes of interest. Two randomized trials demonstrated a significant rate of surgical reintervention in the lavage group, many of which were take-backs for sigmoidectomy. Thirty to ninety day major (≥IIIb) morbidity in the three RCTs ranged from 21–44 % in the lavage group and 17–29 % in the sigmoidectomy group. Thirty to ninety day mortality ranged from 4–8 % in the lavage group and 2–11 % in the sigmoidectomy group. The overall reported major morbidity and mortality in the sigmoidectomy group in these three RCTs is lower than historically reported for the emergency setting, which may not be entirely explained by increased use of laparoscopic resection or improved perioperative care. The rate of recurrent diverticulitis after laparoscopic peritoneal lavage, when reported, is markedly lower than is expected after an episode of complicated diverticulitis and suggests further research is needed.

*Patients with high ASA class, advanced age, immune suppression, distention or obstruction, or feculent peritonitis (Hinchey IV) should not be offered laparoscopic peritoneal lavage. An intraoperative assessment prior to any decision to proceed with lavage is reasonable.* **(Recommendation:** Conditional; **Quality of Evidence:** Low)

There is no defined group for which laparoscopic peritoneal lavage is clearly favored, but there are several patient subsets in whom lavage should not be considered. The majority of low and very-low quality studies do not recommend this approach in Hinchey IV feculent peritonitis [16–20, 23, 26, 31, 33, 35–37]. Obstruction and bowel distention, as with any laparoscopic technique, limits visibility and precludes lavage [19, 31]. Rade et al. were the only authors to analyze factors predicting failure of the approach; patients with ASA class >2, advanced age >80 years, and immunocompromised patients were significantly more likely to require re-intervention due to failure of lavage [17]. The recommendation to exclude patients with Hinchey IV peritonitis, obstruction, advanced age, immune suppression, and high ASA class is conditional based on low quality evidence. Recognizing that not all patients with Hinchey III purulent peritonitis are alike, fully embracing surgeon discretion with diagnostic laparoscopy and intraoperative assessment prior to the decision to proceed with lavage is reasonable if use of the technique is desired, pending further data which may better guide patient selection and risk stratification.

*If laparoscopic peritoneal lavage is to be used as a definitive or bridging strategy, recent complete colonoscopy should be documented in order to avoid missed neoplasm.* (**Recommendation:** Strong; **Quality of Evidence:** Low)

While most studies excluded patients in whom cancer was apparent during initial operation, this cannot always be known intraoperatively. In the case of neoplasm masquerading as perforated diverticulitis, the strategy of sigmoidectomy clearly results in a more immediate diagnosis and therapy. Resection according to oncologic principles should be considered if recent colonoscopy is not documented. Three observational studies [19, 26, 33] and two randomized controlled trials [38, 39] reported on a total of 12 cancers that were not noted during laparoscopic peritoneal lavage. How many patients need to benefit from successful lavage for a missed neoplasm to be acceptable? It is unclear whether the delay in diagnosis caused by utilization of lavage influenced recurrence or survival these patients. If laparoscopic peritoneal lavage is to be used as a definitive strategy or as a bridge to elective resection, complete colonoscopy should be performed in order to avoid missed neoplasm. This is a strong recommendation based on low quality evidence, with risk of harm clearly outweighing reported benefit.

## Personal View of the Data

In the author's opinion, the current evidence forecasts a future of low applicability of the technique of laparoscopic peritoneal lavage. There is no clear patient population standing to benefit, and this approach is not used in practice at our institution.

Stoma formation is an undesirable consequence of emergency surgery for diverticulitis. Though the morbidity is lower than end colostomy takedown, diverting loop ileostomy reversal does carry risk [3]. The technique of primary anastomosis without diversion for diverticulitis in the emergency setting is described but limited to observational series [9–12]. Stoma avoidance was not factored in to the proposed

recommendations. This is because the small number of patients present in the lavage literature who underwent sigmoidectomy *without* stoma formation limits this author's ability to make an evidence-based recommendation. That said, the LOLA/LADIES Trial [38] and the SCANDIV Trial [39] both reported on quality of life in patients up to 6 months postoperatively, with no significant differences in the lavage and sigmoidectomy groups; 16–24 % vs. 69–83 % had a stoma, respectively. This suggests patients are capable of adapting reasonably well to temporary stoma formation in the setting of emergent surgery for diverticulitis.

Future randomized controlled trials as well as longer follow up of the current laparoscopic peritoneal lavage cohort are likely to influence the author's conclusion. After successful nonoperative management of acute complicated diverticulitis, recurrence rates range from 28 to >40 %, and elective resection is recommended [1, 26, 27]. Particularly for surgeons' whose attitude is in support of restorative resection and primary anastomosis *without* stoma formation—including in the setting of Hinchey III diverticulitis— laparoscopic lavage does not avoid a secondary major surgical intervention and attendant morbidity, making it an unappealing option. If the validity of laparoscopic primary resection and anastomosis as one-stage management of Hinchey III diverticulitis is demonstrated in larger prospective studies, this is likely to further weaken the case for lavage. We would no longer need to factor in the known morbidity of a temporary stoma and takedown in those undergoing emergent resection.

The high recurrence rates reported after nonoperative management has also led to reasonable speculation that in these instances of short-term "recurrence", the original episode has actually not resolved— so-called 'smoldering' diverticulitis. In contrast, after appropriate resection with colorectal anastomosis, recurrence is <3 % [28]. Follow up of the current lavage cohort indicates astonishingly lower recurrence rates then are historically expected for complicated diverticulitis; does this suggest that lavage may alter the natural history of Hinchey III diverticulitis in a way not previously described? If this is substantiated, the increased rate of intervention with lavage due to non-resolution may be acceptable if it means the greater cohort is able to avoid emergent stoma formation, need for elective resection, and future recurrence. One can easily envision a shift toward the strategy of laparoscopic peritoneal lavage in lower acuity patients, with greater applicability to Hinchey II patients, if long-term symptom-free resolution and these compellingly low recurrence rates are observed in prospective studies. As mentioned earlier, any nonresectional management approach should be limited to patients with recent complete colonoscopy, in order to avoid missed neoplasm.

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