

Why do I perform laparoscopic Peritoneal Lavage in Purulent Peritonitis of Diverticular Origin?

Ricardo Esteban Mentz, Juan Pablo Campana, Esteban Agustín González Salazar,
Carlos Alberto Vaccaro, Gustavo Leandro Rossi

Colorectal Section, General Surgery Unit,
Hospital Italiano, Buenos Aires, Argentina

Acute diverticulitis is a public health problem of great importance due to its frequency, treatment costs, and controversy about different aspects of its treatment. In 2009, it was estimated to be the third most frequent diagnosis of gastrointestinal pathology in the emergency rooms of the United States of North America, with almost 220,000 patients per year, of whom 6% underwent surgery with 0.4% mortality.¹ More importantly, recent reports show a generally stable prevalence of diverticular disease with an increased incidence of complicated acute diverticulitis.²

Surgical resection was the most frequent therapeutic resource for complicated diverticulitis, usually through a Hartmann's procedure. The advent of percutaneous drainage in the 1980s, laparoscopic surgery in the 1990s, the evolution of critical care, the greater availability and efficacy of antibiotics, the better understanding of the pathophysiology of inflammation, and the quality of computed tomography imaging have allowed us to improve diagnostic precision and adapt therapy to each individual patient, with a clear tendency towards minimally invasive treatments.³ This less aggressive approach can help us overcome the acute inflammatory state to transform it into an elective decision-making scenario. In this way, it has been seen how the proportion of patients treated with resective surgery for diverticular perforation has decreased, while other therapeutic modalities such as percutaneous drainage, laparoscopic peritoneal lavage (LPL), and non-surgical treatment have increased for this group in particular. Therefore, the treatment chosen for acute diverticulitis largely depends on the form of presentation that corresponds to the Hinchey classification.⁵ There is little controversy that Hinchey I or II diverticulitis is in general medically managed and percutaneous drainage may be necessary in a larger abscess. Likewise, fecal peritonitis or Hinchey IV requires resection of the affected colonic segment, while the treatment of purulent peritonitis (Hinchey III) has been a matter of debate for more than 20 years.

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Ricardo Esteban Mentz

ricardo.mentz@hospitalitaliano.org.ar

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At the Italian Hospital in Buenos Aires we perform LPL in diverticular peritonitis (Hinchey III) based on four main considerations:

1. The pathophysiological concept
2. The LPL is effective and less invasive to control the septic focus
3. Elective resection after complicated diverticulitis is not categorical
4. The support of our own experience

Pathophysiological basis

In 1996 O'Sullivan, et al⁶ published the first series of laparoscopic peritoneal lavage for purulent peritonitis of diverticular origin without associated mortality and resolution of sepsis, in the eight patients who made up the cohort. Their work was based on the observation made by Krukowski in 1988, which saw that the majority of patients with diverticular purulent peritonitis (DPP) had no evidence of faecal contamination and the perforation could not be evidenced during surgery. Therefore, they were the first to propose that if there is no obvious perforation at the time of the emergency surgery, there would be no need to remove the intestinal segment that gave rise to the initial peritoneal contamination, unnecessarily prolonging the procedure and increasing surgical stress. They also clearly expose the therapeutic implication of differentiating purulent peritonitis (Hinchey III) from faecal peritonitis (Hinchey IV), since the latter requires immediate colonic resection.

In 2013 O'Leary et al,⁷ published a series of 53 patients who underwent surgery for complicated diverticulitis, in which they analyzed the surgical pieces searching for a patent diverticular perforation. They found that 100% of patients with fecal peritonitis had a patent macroscopic perforation, while only 37% of those with Hinchey III had a hole, in some cases so small that only could be seen in a histological preparation. Furthermore, they found that patients who still had an open perforation had higher mortality, morbidity, and hospital stay than those in whom it was sealed, even after receiving the same treatment.

We believe that accurate identification of patients with

open diverticular perforation is essential, to allow determining who should be resected, since in them the peritoneal lavage will not be sufficient treatment.

LPL is effective and less invasive to control septic focus

Laparoscopic surgery for acute diverticulitis, compared to the conventional approach, has been associated with less morbidity, less blood loss and shorter hospitalization time.⁸ The common practice of these procedures teach us that there is less parietal aggression (for not performing a laparotomy) and shorter surgical time, since after washing the abdominal cavity (as would be done in resection surgery), dissection, resection and even intestinal anastomosis are not performed.

Also mortality was found to be less for LPL⁹. Constantinides et al.,¹⁰ in a systematic review of studies comparing Hartmann's operation versus resection with primary anastomosis, observed a mortality of 15.1% and 4.9%, respectively. In 2012 the first clinical trial comparing Hartmann's procedure with sigmoid resection with primary anastomosis plus ileostomy for diverticular perforation was published.¹¹ It presents an overall morbidity greater than 65% with a mortality of 13% and 9%, respectively. In this study, as in most publications, patients are not discriminated according to whether they have purulent or fecal peritonitis, a fact that as we have seen is pathophysiologically of great importance.

The first systematic review on LPL, which includes 13 studies, mainly case-series, with 231 patients, shows frankly better results with this procedure than with resection surgeries. LPL showed mortality of 1.7%, morbidity of 10.4% and failure rate of 4.3%.¹² Subsequently, other series reported similar results with a high rate of sepsis resolution without requiring additional procedures, and lower morbidity and mortality than those of resection surgery.^{9,13,14} However, all of these published series are retrospective, with selection biases that make it difficult to draw fully valid conclusions. Even with this evidence of questionable quality available, some local guidelines proposed to include LPL within the algorithm for treating complicated diverticular disease.^{15,16}

Then, three clinical trials are published that provide more information and no less controversy.

The LADIES trial,¹⁷ is a superiority, randomized clinical trial that proposed as hypothesis that LPL vs. sigmoidectomy (SIG) would reduce major complications and mortality in patients with purulent peritonitis of diverticular origin. Only DPP patients without evidence of patient perforation on laparoscopy were included in intraoperative randomization. Forty-six patients went to LPL while 40 patients went to SIG (20 Hartmann's proce-

dures and 22 sigmoidectomies with primary anastomosis, with or without a protective ileostomy). Only 7 (17%) SIG were performed by laparoscopy. The LPL was done with saline, releasing loose adhesions to look for the perforation and to completely wash the cavity, but leaving the firm adhesions in place. Only a drain in the bottom of the pouch of Douglas was placed. This study was terminated early because the LPL group had a high rate of adverse events requiring reoperation or percutaneous abscess drainage (40% vs. 5% $p = 0.011$).

The combined morbidity and mortality index at 30 days showed a clear inferiority of the LPL compared to the SIG (39% vs. 19%, OR 2.74, 95% CI 1.03 - 7.27, $p = 0.04$). When the composite primary objective for which the trial was designed (morbidity and mortality at 12 months) was analyzed, no differences were found between both groups (30 LPL vs. 25 SIG patients, OR 1.28, 95% CI 0.54 - 3.03, $p = 0.58$). The 12-month mortality was 9% for LPL and 14% for SIG (OR 0.53, 95% CI 0.13 - 2.15 $p = 0.37$). In the SIG group, the Hartmann's reconstruction or the closure of a protective ostomy (the second surgery necessary to restore the anatomical continuity of the intestine), was considered part of the sigmoidectomy strategy and logically not accounted for as a complication, despite being a procedure with significant morbidity and mortality.¹⁸

Sepsis was controlled with the first intervention in 76% of patients by LPL and in 90% of patients by SIG. Despite a higher number of unscheduled reoperations in LPL, there was no increase in mortality, suggesting that if LPL fails, salvage resection surgery with similar overall mortality is still possible. Importantly, 30-day mortality from SIG was 2%, much lower than in the previously cited series, although fecal peritonitis is usually included in these series.

In this study, the 90 patients were selected in 30 participating hospitals over almost two and a half years at a rate of 1.2 patients / hospital / year, showing a low overall incidence of the pathology and the procedure.

Half of the LPL group reoperations were due to abscesses, and in this sense it is valid to ask whether generalized peritonitis can be adequately drained with only a drain offered to the Douglas cul-de-sac. One of the authors of this clinical trial shows his personal post-study experience with 7% failure of LPL in Hinchey III.¹⁹ Suggests that perhaps the surgeon's experience in laparoscopic colon surgery and the medical center volume would be of great importance.

Recently, the cost analysis was published, where LPL is less expensive than sigmoidectomy, € - 3,512 (95% CI -16,020 to -8,149). It was observed that unscheduled reoperations in LPL and bowel transit reconstruction in

SIG were the main factors that increased the total costs.²⁰

Subsequently, SCANDIV trial was published,²¹ a superiority clinical trial conducted in 21 hospitals in Sweden and Norway, recruiting patients between 2010 and 2014 (2.3 patients / hospital / year). Its main objective was to evaluate severe postoperative complications (Clavien-Dindo > IIIa),²² within 90 postoperative days, in patients with Hinchey III peritonitis undergoing LPL or SIG. Before surgery 101 patients were randomized to LPL and 96 patients to SIG, based on clinical and tomographic findings. Patients who had faecal peritonitis or evident perforation detected in surgery underwent a conventional Hartmann's procedure, regardless of the group assigned in the preoperative randomization. After performing the LPL, and leaving the sigmoid adhesions intact, two non-suction drains were placed in the pelvis. There were no differences in the results of the main objective between the two groups (30.7% vs. 26%, difference 4.7%, CI95% -7.9 - 17%, $p = 0.53$), nor in mortality at 90 days (13.9% vs. 11.5%, difference 2.4%, CI95% -7.2% - 11.9%, $p = 0.67$). As in the LADIES trial, the rate of unscheduled reoperations was higher in LPL (20.3% vs. 5.7%, $p = 0.01$). Results at one year show the less ostoma permanence the LPL group (14% vs. 42%, $p < 0.001$). In this study, 80% of patients resolved sepsis with LPL and 20% required a reoperation.

DILALA trial is the third published clinical trial, comparing LPL (n: 39) versus conventional open Hartmann's procedure (n: 36), in patients with Hinchey III peritonitis. It was carried out in nine European hospitals for four years (at the rate of 2 patients / hospital / year).

The first publication of this clinical trial refers to the short-term results, where no differences were observed in morbidity at 30 days nor in mortality at 90 days (7.7% vs. 11.4%, $p = 0.583$). The hospital stay was 6 vs. 9 days ($p = 0.05$). The 30-day reoperation rate was 13.2% vs. 17.1% ($p = 0.634$). It should be noted that only one patient in the LPL group underwent reoperation for generalized peritonitis and two for abscesses.²³

The second publication of this study addresses the main objective: to compare the percentage of patients with one or more reoperations within 12 months after the index surgery. In the LPL group 27.5% (n: 12) patients had reoperations, compared to 62.5%²⁵ in the Hartmann's group (RR 0.41, 95% CI 0.23-0.72, $p = 0.004$).

The third publication analyzes the occurrence of additional surgeries two years after index surgery, observing a RR of 0.55 (95% CI 0.36-0.84; $p: 0.012$) in favor of LPL.²⁴ Additionally, it was able to determine a significant reduction in economic costs in favor of LPL, as in LADIES TRIAL, with a difference of €19,794 (95% CI -34,615 - 4,931).²⁵

Subsequently, multiple systematic reviews and meta-analyses based on these three studies were published, generally agreeing that LPL has a higher rate of unscheduled reoperations, fewer remote surgeries, and fewer definitive ostomies.²⁶⁻²⁸

In our group, we considered that an LPL without complications is less aggressive and has a better postoperative quality of life than a Hartmann's procedure without complications.

Elective resection after complicated diverticulitis is not categorical

Traditionally, elective sigmoid resection was indicated after an episode of complicated diverticulitis managed with medical and / or percutaneous treatment and was recommended by some clinical guidelines.²⁹

In 2008, Myers et al.,³⁰ published a series of 88 patients successfully treated with LPL, with a mean follow-up of 36 (range 12-84) months. Only two patients had diverticulitis again and required medical treatment. Other retrospective analysis of 81 patients with complicated diverticular disease (CDD) (extraluminal air on CT or abscess), with a mean follow-up of 32 (range 4-63) months treated conservatively (without surgery), shows a recurrence of diverticulitis only in 6 (7.5 %) patients, all treated on an outpatient basis.³¹

You et al.,³² analyze the evolution of 127 similar patients who were managed with medical treatment. The patients were randomized into two groups, one with elective sigmoid resection (n: 26) and the other under observation (n: 81). They observed that patients who had a resection had a lower recurrence of diverticulitis (8% vs. 32%, $p = 0.019$) with an average follow-up of 36 months and none required emergency surgery. Therefore, they conclude that elective surgery would not be necessary after an episode of medically resolved complicated acute diverticulitis. As elective resection is not mandatory after CDD, we can use the LPL to resolve septic focus in the acute situation and enable elective decision-making according to each particular case.

What was our experience?

In general, we perform exploratory laparoscopy in all surgical acute abdomens, unless it has clear contraindications to it, allowing us to make a certain diagnosis. The next step is to determine if the diverticular perforation that led to the peritoneal contamination is evident. We do this by direct inspection or by a hydropneumatic test, blowing air through the rectum while the diverticular inflammatory process is below the fluid level (physiological solution). If such perforation is not evident through bubbling or direct observation, a peritoneal lavage is performed.

med without resection. Other modalities of limited value have been described to demonstrate diverticular perforation, such as rectal instillation of radiological contrast during diagnostic computed tomography or methylene blue during surgery,³³ we have not used any of them. We always consider that the most important and still unresolved aspect of this procedure is the appropriate selection of patients to perform peritoneal lavage; proof of this is the non-negligible failure rate of this strategy. Lavage requires some skill in handling laparoscopic procedures, both to access the entire cavity and wash it properly, and to mobilize loose adhesions to expose liquid collections. Finally, the drains must be placed in the sites and amounts that are necessary to ensure the drainage of residual liquids in the postoperative period.

In 2014, we published our 8-year experience with LPL.³⁴ Of the 75 patients who underwent surgery for complicated acute diverticulitis in the period studied, 46 (61%) presented Hinchey III diverticulitis on laparoscopic examination, with no obvious signs of diverticular perforation, and an LPL was attempted on them. Two patients (4%) had to be converted to conventional surgery due to the impossibility of washing the entire abdominal cavity and had a colonic resection in a conventional way; while the remaining 44 (96%) patients were treated with an LPL. Eighty-five percent of the patients resolved the infectious symptoms without the need for another procedure, while 5 (15%) patients had to be reoperated (2 resections with primary anastomosis by conventional approach, 2 Hartmann's procedures by conventional approach and 1 laparoscopic resection with anastomosis and loop colostomy). All the reoperated patients were reoperated for subsequent bowel transit reconstruction, and

none of them had a stoma at the time of the last follow-up.

Until 2019, the therapeutic success of laparoscopic lavage in our group was 87.2% out of a total of 70 patients, who underwent a LPL, with 9 (12.8%) patients who had to undergo reoperation. At the end of the follow-up there was no mortality related to the disease or surgery and no patient continued to have an ostomy.

Final thoughts

- It is important to improve the way of properly selecting patients, which allows us to accurately discriminate who will evolve with a free perforation and who will not in the following days.
- We must be prepared for a higher rate of "unscheduled" surgeries than the resection surgeries, but with fewer total surgeries and long-term ostomies.
- The development of remote postoperative abscesses should be considered as a poor application of washing and drainage, rather than a failure of the therapeutic strategy.
- LPL may have a place in the CDD therapeutic algorithm that includes medical treatment, perhaps percutaneous drainage or LPL, and if this fails resection surgery.
- LPL is less expensive, does not change mortality, has a lower rate of surgeries after index surgery (although a higher percentage of unscheduled reoperations), and fewer transient and definitive ostomies.
- The existing bibliography is controversial and must be balanced with the experience and resources available in each healthcare center.

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