

# Laparoscopic lavage/drainage as a bridge treatment for perforated diverticulitis with purulent peritonitis associated with an abdominal aortic aneurysm

## A retrospective case-control study



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Giulio Illuminati, Dimitri Krizzuk, Francesco G. Calio\*, Paolo Urciuoli, Giulia Pizzardi, Rocco Pasqua

Department of Surgical Sciences, The University of Rome "La Sapienza", Rome, Italy

\*Division of General and Vascular Surgery "Sant'Anna" Hospital, Catanzaro, Italy

### Laparoscopic lavage/drainage as a bridge treatment for perforated diverticulitis with purulent peritonitis associated with an abdominal aortic aneurysm. A retrospective case-control study

**AIM:** Laparoscopic lavage /drainage (LALA) or surgical resection are both methods of treatment for perforated diverticulitis with purulent peritonitis (Hinchey Stage III). In case of associated abdominal aortic aneurysm (AAA), laparoscopic lavage/drainage could be an interesting bridge option to treat sepsis before endovascular exclusion of the aneurysm and resection of the sigmoid. We performed LALA as a bridge treatment of peritonitis before elective, staged endovascular exclusion of the aneurysm (EE) and elective resection of the colon.

**MATERIAL AND METHODS:** Seven patients presenting a perforated diverticulitis with purulent peritonitis (Hinchey III), associated with an uncomplicated AAA of a mean diameter of 6 cm, underwent LALA followed by staged EE and resection. They were retrospectively reviewed for a case-control study. The mean length of follow-up after completing all the procedures was 28 months. Primary endpoints were mortality and morbidity of each procedure, complications related to each procedure and to the untreated disease in the interval between each one of them, late outcome and complications related to each treatment method. As secondary endpoints, the mean length of surgery for resection, of stay in the hospital, of the interval between each procedure, and of time required for the treatment of both the diseases were considered.

**RESULTS:** Postoperative mortality was absent. Morbidity consisted of a sigmoido-vescical fistula 18 days after resolution of peritonitis and sepsis, not hindering EE, and a delayed healing of the surgical wound for access to the common femoral artery (28.6%). No complications of untreated disease in the interval between each procedure were observed. No late complications of both diseases occurred. The mean interval between LALA and EE, and between EE and resection was, respectively, 19 days and 18 days. Both the diseases were treated within a mean delay of 37 days after LALA (range, 24-61 days).

**CONCLUSIONS:** LALA, as a bridge treatment, before EE and resection, in patients presenting a perforated diverticulitis with purulent peritonitis, associated with an uncomplicated AAA, may be an effective treatment option.

**KEY WORDS:** Perforated diverticulitis, Purulent peritonitis, Abdominal aortic aneurysm

## Introduction

Bowel diseases associated with an abdominal aortic aneurysm (AAA), both requiring surgical treatment, have an incidence of 9 to 13%<sup>1-11</sup>.

Isolated, perforated diverticulitis has been estimated to have an incidence of 3.5 per 100.000 in the overall population<sup>12,13</sup>.

Although elective treatment of large bowel carcinoma associated with AAA has been extensively studied, the issue of the association of diverticular disease with AAA, both with an indication for surgical treatment, has been studied less extensively<sup>1</sup>.

When dealing with perforated diverticulitis general consensus exists about conservative treatment for Hinchey's

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Correspondence to: Giulio Illuminati MD, Via Vincenzo Bellini, 14 00198 Rome, Italy (e-mail: giulio.illuminati@uniroma1.it)

stages I – II and surgery for stage IV<sup>12,14</sup>. For perforated diverticulitis associated with purulent peritonitis (Hinchey's stage III) available treatments include Hartmann's operation, resection with primary anastomosis, and laparoscopic lavage/drainage (LALA). Different opinions exist on which the optimal treatment could be, in this setting. The results of recent trials, comparing LALA with resection have not been fully conclusive<sup>15-17</sup>, and, as not all the patients are suitable for an isolated LALA, the challenge remains of identifying patients in whom this treatment would fail<sup>12</sup>. LALA has also been proposed as a possible "bridge" treatment for resolving peritonitis before elective resection<sup>18-20</sup>.

The association of perforated diverticulitis with purulent peritonitis (Hinchey III) and an AAA, bearing an indication for elective repair, is very rare but especially challenging. Performing a laparotomy for resection, either according to the Hartmann's technique or with primary anastomosis, can expose to a substantial risk of a subsequent, accelerated risk of rupture of the untreated AAA. However, simultaneous resection and open AAA repair is contraindicated by both the magnitude of the operation itself and the elevated risk of aortic graft infection, in a patient with peritonitis and a septic state. In this special setting, we considered LALA as a "bridge" treatment, for an immediate treatment of peritonitis and septic status, before elective endovascular exclusion (EE) of the AAA and resection. The assumption was that resolution of peritonitis by LALA would allow staged EE and resection within a short delay, for a durable treatment of both diseases, while minimizing the probability of complications of the untreated disease in the interval between the different procedures.

## Material and Methods

From January 2011 to September 2016, 7 consecutive patients, 6 males of a mean age of 78 years (range: 67 – 86 years), admitted for a Hinchey III diverticular peritonitis, associated with a non-complicated abdominal aortic aneurysm (AAA), were treated with laparoscopic lavage/drainage (LALA), followed by EE and finally resection at a tertiary care, academic hospital and one affiliated surgical center. The procedures were performed by the senior authors (GI, FGC, PU). The study, as retrospective case control, did not require institutional ethics committee approval and informed consent for each treatment method was obtained from all the patients. This case series represents 29% of 24 patients with Hinchey II – IV complicated diverticular disease and 37% of 19 patients with Hinchey III peritonitis, treated at the same centers at the same time interval. The diagnosis of Hinchey III peritonitis was made at CT scan and confirmed at diagnostic laparoscopy in all the patients. Purulent peritonitis was the index complication of diverticular disease in 3 patients (43%), whereas it

followed a previous episode of diverticulitis, regressive with appropriate medical treatment, in 4 (57%) of them. In 2 patients (28%) the presence of the AAA was known from previous diagnostic workup. The general functional status was ASA II (n = 4) and ASA III (n = 3). LALA of the 4 quadrants was performed with irrigation of warm saline solution until clear fluid was obtained. Pneumoperitoneum was obtained with a 12-mm periumbelical trocar, whereas two 5-mm trocars for additional, right and left port sites, were used. Adhesions to the sigmoid were not dissected and two Douglas non-suction drains were placed on each side of the pelvis. As peritonitis regressed, a marked leukocyte scintigram was obtained, to exclude the possible septic etiology of AAA in all the patients. The mean interval between LALA and EE was 18.6 days (range: 11-30 days). According to our established protocol of preoperative cardiac workup for peripheral vascular diseases<sup>21,22</sup>, all the patients underwent a coronary angiography, eventually followed by percutaneous angioplasty and stenting (PCI) of significant coronary arteries' stenoses [n = 2 (29%)], before undergoing EE. In these 2 patients, EE was performed respectively 1 and 4 days after PCI, under dual antiplatelet treatment (Aspirin 100 mg + Clopidogrel 75 mg / day, orally). Subsequently, resection was performed under dual antiplatelet treatment as well. EE was performed via trans-femoral aorto-biiliac with suprarenal fixation in 5 patients with an infrarenal AAA (Bolton Treo, Bolton Medical, Sunrise, FL, USA) and a chimney technique with the adjunct of a suprarenal cuff + snorkel stents in the renal arteries in 2 patients (BeGraft, Bentley Innomed GmbH, Hechingen, Germany) in the two patients with a pararenal AAA, interrenal in one patient and juxtarenal in the other one. Endovascular grafts were inserted through a common femoral artery surgical cut-down in 3 patients and a percutaneous puncture, closed with a Proglide device (Abbott Vascular, Santa Clara, CA, USA) in 4 of them. In the two patients undergoing suprarenal covering with snorkel stenting, an additional, percutaneous brachial arterial access was required for renal stents' insertion.

Resection was performed with open technique in 4 patients and by laparoscopy in 2. Conversion to open resection was required in one patient, after a failing attempt of laparoscopic resection. The surgical technique was standard, both by open surgery or laparoscopy. A light ureteral stent was inserted before resection by laparoscopy and retired at the end of the intervention. Two trans-elevator or one lateral port, 28 mm, perianastomotic silicone drains, respectively after laparotomy or laparoscopy completed the procedure. Protective ileostomy was not performed.

All the patients underwent a CT-scan of the thoraco-abdominal aorta at one month after EE, in order to assess the correct exclusion of the AAA and absence of endo-leaks, irrespective to whether diverticular disease had been treated in the meanwhile or not. One month

after completion of treatment of both diseases, all the patients were clinically controlled on an outpatient basis. Thereafter, they underwent a standard protocol of scheduled controls of the excluded AAA, consisting of a thoraco-abdominal CT-scan at 6 months then every 2 years and a Duplex ultrasound of the abdominal aorta every 6 months. The mean length of follow-up was 28 months (range, 11-41 months).

The primary endpoints of the study were mortality and morbidity after each procedure, complications related to the untreated AAA in the interval between LALA and EE, septic complications of aortic graft induced by diverticular disease, recurrence of complications related to diverticular disease in the interval between LALA and resection, late outcome and complications related to each treatment method. As secondary endpoints, the mean operative duration of resection, the mean length of the interval between each procedure, and the mean, overall, length of time required for the treatment of both the diseases were considered.

## Results

### PRIMARY ENDPOINTS

No patient died after each procedure or during hospitalization for the workup or treatment of each condition, which results in the overall absence of postoperative mortality. One patient (14%) developed a sigmoido-vescical fistula 18 days after an uneventful LALA, followed by complete regression of peritonitis and septic status, while at home and waiting for EE. The fistula formation did not cause a septic status and did not delay EE which was successfully performed, as scheduled, 30 days after LALA (Fig. 1). In this same patient, resection

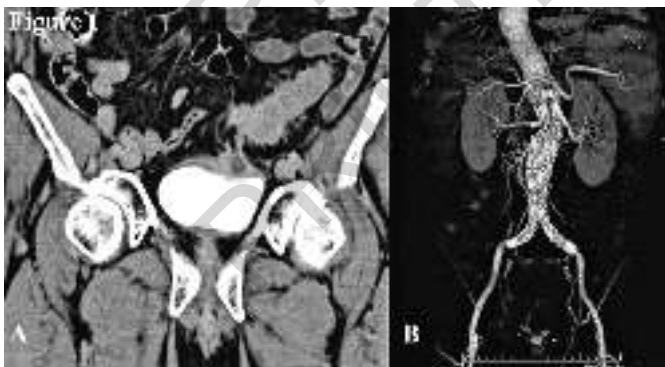


Fig. 1: CT-scan of the abdomen showing a sigmoido-vescical fistula 18 days after laparoscopic lavage/drainage (LALA) of Hinchey III perforated diverticulitis (A). Ct-scan control of endovascular exclusion + renal chimney grafts for an interrenal aortic aneurysm performed 30 days after the endovascular procedure in the same patient, showing the correct morphology of the grafts and absence of endoleak (B).

and lateral suture of the bladder were successfully performed 6 days after EE. Concerning EE, one patient presented a delayed healing of the wound at Scarpa's triangle, after surgical exposure of the femoral artery for EE (14%), which could be managed conservatively. No postoperative complication was observed after resection, either performed by open surgery or laparoscopy.

The overall, cumulative complication rate of all the performed procedures was 28.6%. No complication related to the AAA in the interval between LALA and EE was observed, nor was any septic complication of the aortic graft observed in the interval between EE and resection or after this latter. Beside the one sigmoido-vescical fistula formation, electively treated after EE as scheduled, no other complication of diverticular disease or recurrence of diverticulitis was observed both in the interval between LALA/EE and between EE /resection.

At a mean follow-up of 28 months no patients' death was observed. One patient died of unrelated cause 38 months after resection.

No late recurrence of diverticulitis, anastomotic stenosis or other resection-related complications were observed during follow-up. As well, no late, aortic graft-related complications, including sepsis, stenosis or renal function impairment were registered.

### SECONDARY ENDPOINTS

The mean operative time for laparoscopic resection was 240 minutes (range, 220 and 260 minutes), whereas it was 137 minutes for open resection (range, 115-150 minutes).

The mean operative time for LALA was 66 minutes (range, 55 – 75 minutes). The mean length of the interval between LALA and EE was 19 days (range, 11-30 days). The mean length of the interval between EE and resection was 18 days (range, 6-38 days). Both the diseases were treated within a mean delay of 37 days after LALA (range, 24-61 days) (Table I).

Essential clinical data and overall outcome of the patients are resumed in Table II.

Table I - Length of interval between the treatment procedures.

Patient#	LALA/EE (Days)	EE/Resection (Days)	Completion of all Procedures (Days)
1	12	12	24
2	30	6	36
3	22	11	33
4	23	38	61
5	17	13	30
6	19	11	30
7	11	37	48

EE, Endovascular exclusion of the aneurysm; LALA, Laparoscopic lavage/drainage

Table II - Essential clinical data of the patients' series.

Patient#, Sex	Age (Years)	AAA Classification (Diameter)	Procedures (Days treatment from initial)	Follow-Up (Months)	Final Outcome
1, M	73	Infrarenal(6 cm)	LALA, EE (12 Days), Sigmoidectomy (24 Days)	25	Favorable
2, M	77	Interrenal(5.5 cm)	LALA, Sigmoido – Vescical Fistula (18 Days), EE + Chimney Grafts (30 Days) Sigmoidectomy+ Bladder Suture (6 Days)	20	Favorable
3, F	82	Infrarenal(5 cm)	LALA, EE (22 Days), Sigmoidectomy (33 Days)	38	+ Exitus
4, M	79	Infrarenal(7 cm)	LALA, PCI (13 Days), EE (23 Days), Sigmoidectomy (61 Days)	37	Favorable
5, M	84	Juxtarenal(6 cm)	LALA, PCI (13 Days), EE (17 Days), Sigmoidectomy (30 Days)	41	Favorable
6, M	67	Infrarenal(5 cm)	LALA, EE (19 Days), Sigmoidectomy (11Days)	27	Favorable
7, M	86	Infrarenal(7.5 cm)	LALA, EE (11 Days), Sigmoidectomy (48 Days)	11	Favorable

AAA, Abdominal aortic aneurysm; EE, Endovascular exclusion of the aneurysm; LALA, Laparoscopic lavage/drainage; PCI, Percutaneous intervention on the coronary arteries.

## Discussion

The results of this study show that LALA, as a “bridge” operation, may be a safe and effective method of treatment for perforated diverticulitis with purulent peritonitis (Hinchey III), in patients with an associated AAA. Limited to such a special setting of patients, this method seems to yield a rapid resolution of peritonitis and sepsis, further allowing elective EE of the aneurysm, finally followed by definitive treatment of diverticular disease by resection. The complete treatment of both diseases can be performed within a short delay from the onset of perforation. A previous report showed the interest of endovascular surgery in shortening the interval between treatment of the AAA and elective resection for diverticular disease <sup>1</sup>. This preliminary experience shows that the combination of two minimally invasive surgical methods, laparoscopic and endovascular surgery, can allow good and durable results in clinical settings which are potentially difficult to treat with a fully conventional surgical approach.

The rationale for considering LALA for the treatment of perforated diverticulitis with purulent peritonitis is that, open resection, in this setting, is associated with a significant mortality and morbidity, about one third of the patients undergoing Hartmann's operation will not have their stoma reversed <sup>15-17</sup> and a purulent peritonitis is mostly due to a small perforation covered by

the omentum or small bowel adhesions <sup>23</sup>. Further advantages of LALA over urgent resection in this setting consist of avoiding laparotomy and stomas, with their related complications, reduction of postoperative pain and the theoretical reduction of intraperitoneal adhesions, thus facilitating a laparoscopic approach to resection, should this become eventually indicated later. Initial results of LALA for the treatment of Hinchey III peritonitis were very encouraging with respectively 100 % success without any need for further interventions and 95% success in the earliest reports <sup>24,25</sup>. However, recent trials on LALA vs resection for the treatment of perforated diverticulitis with purulent peritonitis have yielded conflicting results. The DILALA trial, while still ongoing concerning his primary endpoint, reoperation within 12 months, has shown a superposable outcome between LALA and Hartmann's operation in terms of mortality, morbidity and need for re-intervention at 12 weeks, with a significant advantage of LALA in terms of length of operation and post-operative stay in the hospital <sup>17</sup>. The SCANDIV trial did not show a significant difference between LALA and resection in the incidence of severe complications at 90 days. However, LALA was associated with a significantly higher incidence of need for reoperation (20%) compared to resection (6%) <sup>17</sup>. Furthermore, LALA missed a carcinoma in 5% of the patients and, according to these results, the study's con-

clusion was that LALA cannot be recommended for the treatment of perforated diverticulitis<sup>16</sup>. Finally, in the LADIES trial, recruitment in the LALA arm was terminated early by the safety monitoring committee because of an increased event rate in the LALA group itself<sup>15</sup>. Irrespective to the trials' short and long term results of LALA alone, we would not recommend it as a curative and definitive treatment of diverticulitis with purulent peritonitis, due to the association with an AAA and the unacceptable risks of septic complications of the aortic graft, should an iterative episode of diverticulitis or perforation occur. For this reason also, we always performed a leukocyte scintigram after LALA and before EE of the AAA, in order to exclude any bacterial growth on the aortic wall potentially at risk of infecting the aortic graft. We also scheduled colonoscopy just before the planned resection, in order to proceed to resection itself expeditiously in any case, should a perforation occur or not: in this series no perforation was observed after colonoscopy.

Although reported in 20% of the patients at 90 days<sup>16,26</sup>, no mortality, morbidity, early or late recurrence of diverticulitis after LALA were observed in this series. This is probably due to the relatively short interval between LALA and elective resection, thus reducing the probability of a recurrence of diverticular disease related complications.

At resection, both carried by open surgery or laparoscopy, no special inflammatory adhesions were observed, complicating or prolonging the operation, as testified by the mean duration of both procedures, which was within the reported standards of resections for cancer<sup>27</sup>.

In two patients, severe coronary artery disease were detected at systematic preoperative coronary angiography and could be successfully treated by PCI, before EE. Both patients did not exhibit a clinical history of coronary artery disease. The less invasive LALA as initial method of treatment of peritonitis in the acute setting, may have protected these two patients from major post-operative cardiac complications. Systematic search for significant, asymptomatic CAD seems valuable in vascular patients before treating peripheral vascular lesions<sup>21,22</sup>. Combination of modern, minimally invasive treatments, LALA, EE and PCI allowed an effective management of potentially difficult clinical situations. The absence of hemorrhagic complications after both EE and resection in patients under dual antiplatelet treatment, following PCI, underscores the overall safety of operating without stopping this treatment<sup>28</sup>.

Suprarenal fixation of aortic endografts and use of snorkel technique when dealing with pararenal AAA, allowed complete exclusion of AAA itself and the absence of type I endo-leak, according to the standards and most recent results of endovascular AAA exclusion<sup>29</sup>.

LIMITATIONS: The small number of included patients and the relatively short period of follow-up. Further studies based on larger patients' cohorts and longer follow-up should validate these preliminary results.

CONCLUSION: LALA may be safe and effective as a bridge treatment before elective EE and resection of the colon, in patients with a Hinchey III purulent peritonitis associated with an AAA.

## Riassunto

SCOPO DELLO STUDIO: Il lavaggio/drenaggio laparoscopico e la resezione chirurgica sono, entrambi, riconosciuti metodi di trattamento della diverticolite perforata del colon con una peritonite purulenta (Stadio III di Hinchey). Nel caso in cui questa sia associata ad un aneurisma dell'aorta addominale, il lavaggio/drenaggio laparoscopico potrebbe essere un interessante trattamento "ponte" dello stato settico, prima di procedere all'esclusione endovascolare dell'aneurisma e alla resezione del colon-sigma. Vengono qui riportati i risultati del lavaggio/drenaggio, prima del trattamento in elezione dell'aneurisma mediante esclusione endovascolare, seguito dalla resezione del colon.

MATERIALI E METODI: Sette pazienti con una diverticolite perforata associata ad una peritonite purulenta (Hinchey III) e ad un aneurisma dell'aorta addominale non complicato, del diametro medio di 6 cm, sono stati trattati mediante lavaggio/drenaggio laparoscopico, seguito dal trattamento stadiato dell'aneurisma mediante esclusione endovascolare seguito, a sua volta, dalla resezione del colon. La durata media del follow-up, dopo il completamento di tutte le procedure chirurgiche, è stata di 28 mesi. I criteri di valutazione principali sono stati la mortalità e morbilità di ciascuna procedura, le complicanze correlate con ciascuna procedura e con la patologia non trattata nell'intervallo tra un trattamento e l'altro, i risultati a distanza e le complicanze tardive di ciascun trattamento. I criteri di valutazione secondari sono stati la durata dell'intervento di resezione del colon, la lunghezza della degenza ospedaliera, dell'intervallo tra ciascuna procedura e del tempo complessivo richiesto per il trattamento di entrambe le patologie.

RISULTATI: La mortalità post-operatoria è stata assente. La morbilità è consistita in una fistola sigmoideo-vescicale 18 giorni dopo la risoluzione della peritonite e della sepsi, che non ha impedito l'esclusione endovascolare dell'aneurisma ed una ritardata cicatrizzazione di un accesso femorale per il trattamento endovascolare dell'aneurisma (28%). Nessuna complicanza relativa alla patologia non trattata è stata osservata nell'intervallo tra un trattamento e l'altro. Non si è verificata alcuna complicanza tardiva di ciascuna delle due patologie trattate. In media, l'intervallo tra il lavaggio/drenaggio e l'esclusione dell'aneurisma e tra quest'ultima e la resezione del colon è stato, rispettivamente di 19 e 18 giorni.

Complessivamente, entrambe le patologie sono state trattate, mediamente, dopo 37 giorni dal lavaggio drenaggio (estremi 24-61 giorni).

CONCLUSIONI: Il lavaggio/drenaggio laparoscopico potrebbe essere un efficace trattamento "ponte" della peritonite e dello stato settico, prima della esclusione endovascolare e della resezione, nei pazienti con una diverticolite perforata e peritonite purulenta associata ad un aneurisma non complicato dell'aorta addominale.

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