Emergency Laparoscopic Sigmoidectomy for Perforated Diverticulitis with Generalised Peritonitis: A Systematic Review

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Key Words

Diverticulitis · Laparoscopy · Emergency surgery ·
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Abstract

Background: Laparoscopic sigmoidectomy for diverticulitis has initially been confined to the elective setting. However, open acute sigmoidectomy for perforated diverticulitis is associated with high morbidity rates that might be reduced after laparoscopic surgery. The aim of this systematic review was to assess the feasibility of emergency laparoscopic sigmoidectomy for perforated diverticulitis. **Methods:** We performed a systematic search of PubMed, EMBASE and CENTRAL. All studies reporting on patients with perforated diverticulitis (Hinchey III–IV) treated by laparoscopic sigmoidectomy in the acute phase were included, regardless of design. **Results:** We included 4 case series and one cohort study (total of 104 patients) out of 1,706 references. Hartmann's procedure (HP) was performed in 84 patients and primary anastomosis in 20. The mean operating time varied between 115 and 200 min. The conversion rate varied from 0 to 19%. The mean length of hospital stay ranged between 6 and 16 days. Surgical re-intervention was necessary in 2 patients. In 20 patients operated upon without defunctioning ileostomy, no anastomotic leakage was reported. Three

patients died during the postoperative period. Stoma reversal after HP was performed in 60 out of 79 evaluable patients (76%). **Conclusions:** Acute laparoscopic sigmoidectomy for the treatment of perforated diverticulitis is feasible in selected patients provided they are handled by experienced hands.

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Introduction

Perforated diverticulitis of the sigmoid colon with generalised peritonitis usually requires acute sigmoidectomy. This procedure is characterised by high morbidity (up to 80%) and mortality rates (15–35%) [1–5]. Currently, the preferred treatment modality for perforated diverticulitis is under debate. The most commonly used procedures for these patients presenting with generalised peritonitis are laparotomy and Hartmann's procedure (HP). However, an increasing number of patients are treated with sigmoidectomy and primary anastomosis or with laparoscopic peritoneal lavage alone [6, 7]. As laparoscopic lavage was not superior to sigmoidectomy with regard to long-term major morbidity and mortality, other strategies such as laparoscopic sigmoidectomy need to be investigated [8]. As elective laparoscopic sigmoidec-

tomy has several benefits compared to open surgery (e.g. less intra operative blood loss, faster recovery, shorter hospital stay and less abdominal wall complications), acute laparoscopic resection for perforated diverticulitis might have similar benefits [9, 10]. In recent times, the laparoscopic approach for generalised peritonitis is gaining acceptance for an increasing number of indications including appendicitis, cholecystitis, small bowel obstruction and perforated peptic ulcer [11].

In this systematic review of the literature, we aim to assess the feasibility of emergency laparoscopic sigmoidectomy for perforated diverticulitis with generalised peritonitis.

Methods

This systematic review was conducted in accordance to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [12].

Eligibility Criteria

We included all studies that reported on patients with acute perforated diverticulitis and purulent or faecal peritonitis (Hinchey III–IV), treated by laparoscopic sigmoidectomy with or without primary anastomosis. Studies reporting on patients with acute surgery for Hinchey I–II diverticulitis were not included, as acute surgery in these patients is not routinely indicated. Studies including various indications or surgical procedures were considered eligible only if separate outcomes for acute laparoscopic sigmoidectomy for diverticulitis were provided. If the patient population did not fully meet our criteria, a study was still considered for inclusion with a maximum of 10% non-adherence to the inclusion criteria. The minimum required reported outcomes were conversion rate, mortality and length of hospital stay.

Search Strategy and Study Selection

A systematic search was performed using PubMed, EMBASE (Ovid) and Cochrane Central Register of Controlled Trials (CENTRAL) on 29 November 2014 (online suppl. material S1; for all online suppl. material, see www.karger.com/doi/10.1159/000441150). The reference list of all included studies was hand searched for other relevant references. Two authors (S.V. and G.S.B.) independently screened all titles and abstracts for their relevance. From all studies that possibly fulfilled the inclusion criteria, the full-text version was retrieved and assessed. No language restriction was applied. Any disagreement was resolved by holding discussions or by requesting advice from a third author.

Data Extraction and Analysis

Data extraction and assessment were independently conducted by 2 authors (S.V. and G.S.B.). Any disagreement was resolved by holding discussions or by requesting advice from a third author. The extracted data were presented in separate tables for study characteristics, patient demographics and outcomes. The following information was retrieved from each study: first author, year of publication, study design, number of participants, gender, age,

Fig. 1. Study inclusion flow chart.

American Society of Anaesthesiologists (ASA) classification, surgical procedure (HP or primary anastomosis with or without ileostomy), and Hinchey classification [13]. The retrieved outcomes were duration of surgery, conversion rate, length of hospital stay, morbidity, mortality and stoma reversal rate.

The quality of included studies was assessed using a modified version of the Downs and Black checklist [14]. This checklist can be used for both randomised and non-randomised studies, and studies are scored for reporting, external validity, internal validity bias, internal validity confounding and power on a total of 27 items. We adjusted this checklist as only non-comparative studies were included in this review what makes multiple items not relevant.

Results

Search

The search identified a total of 1,706 references after exclusion of 802 duplicates. After searching titles and abstracts, 28 were considered relevant and evaluated as full text. After careful review of the full text, another 23 were excluded; this resulted in including only 5 studies for this review (fig. 1). Five studies were excluded because they presented results of a combined group with acute diver-

Table 1. Included studies and study design

Author	Country	Total number of patients, n	Hinchey III–IV and acute sigmoidectomy, n	Study design
Agaba et al. [38], 2009	USA	7	7	Case series
Böttger et al. [39], 2007	Germany	166	13	Prospective case series
Chouillard et al. [40], 2007	France	31	31	Prospective case series
Liang et al. [41], 2012	USA	88	41	Retrospective cohort
Pugliese et al. [42], 2004	Italy	103	12	Retrospective case series

Table 2. Patient demographics

	Patients, n	Gender (male/female), n	Age, years (range)	ASA, n				Procedure, n		Hinchey classification, n		
				I	II	III	IV	HP	PA	II	III	IV
Agaba et al. [38], 2009	7	5/2	49.6 (42–57)	0	1	6	0	7	0	0		7
Böttger et al. [39], 2007	13	7/6	60 (43–83)	2	5	5	1	5	8	0		13
Chouillard et al. [40], 2007	31	14/17	62 (24–91) ^a	12	8	6	5	31	0	0	22	9
Liang et al. [41], 2012	41	23/18	63.4 (15.2) ^b	3	23	9	6	41	0	3	31	7
Pugliese et al. [42], 2004	12	6/6	59 (35–71) ^a		12	0	0	0	12	0	12	0
Total	104	55/49		66	26	12		84	20	3		101

Data in median (range), unless stated otherwise. ^a mean (range); ^b mean (SD).

ticulitis and other indications without separate data [15–19]. Two studies reported the results of resection for right-sided diverticulitis [20, 21], 3 reported results mixed with acute open sigmoidectomy [22–24], 2 mixed with laparoscopic lavage [25, 26] and 4 presented data mixed with delayed or elective sigmoidectomies [27–30]. Seven studies included only those patients with Hinchey I–II peritonitis or presented mixed group of patients [31–37].

Quality Assessment

Details of the 5 included studies are presented in table 1 [38–42]. These studies comprised one comparative cohort study and 4 case series. The comparative cohort study compared laparoscopic HP with laparoscopic lavage, of which only the resection group was included in the present review [41]. No randomised clinical trials or other study designs comparing acute open with acute laparoscopic sigmoidectomy could be identified.

The quality of the included studies was assessed using our adjusted version of the Downs and Black checklist [14]. The used items are listed and scored in online supplementary table S1 with 9 items on reporting, 4 items external validity and 6 items internal validity, resulting in

a maximum score of 19. All included studies scored between 9 and 14 points, and the different items are summarised in online supplementary figure S1.

The studies by Chouillard et al. [40] and Liang et al. [41] scored best with 14 and 13 points respectively, especially on reporting and internal validity. None of the studies had an open sigmoidectomy control group; 2 did not report any follow-up; the other 3 reported only the stoma reversal rate with an unknown length of follow-up and unclear or no description of the loss to follow-up.

Patient Demographics

We included a total of 104 patients (range 7–41) who underwent acute laparoscopic sigmoidectomy for diverticulitis from 5 different studies as shown in table 2. The mean age varied from 49–69 years in the included studies (range 23–95). Most patients were categorised as ASA classification II or III. Liang et al. [41] included 3 patients with Hinchey II peritonitis in their analysis along with 38 Hinchey III–IV patients. Böttger et al. [39] and Pugliese et al. [42] both included patients with Hinchey I–II peritonitis as well, but reported separate data for the Hinchey III–IV subgroup that could be included in this review.

Table 3. Clinical outcomes

Author	Patients, n	Duration of surgery, min	Conversion rate, n (%)	Length of stay, days (range)	Stoma reversal rate, n/n (%)
Agaba et al. [38], 2009	7	154 (136–193)	0	6 (5–10)	7/7 (100)
Böttger et al. [39], 2007	13	115 (80–175) ^a	0	9 (5–28)	Unknown
Chouillard et al. [40], 2007	31	125 (55–250)	6 (19.4)	12 (5–25) ^a	27/31 (87)
Liang et al. [41], 2012	41	182.9 (54.7) ^b	6 (14.6)	16.3 (10.1) ^b	26/41 (72)
Pugliese et al. [42], 2004	12	200 (175–210)	2 (16.7)	10 (7–14) ^a	NA
Total	104		14 (13.5)		60/79 (75.6)

Data in mean (range), unless stated otherwise. ^a Median (range); ^b mean (SD). NA = Not applicable.

Table 4. Postoperative complications

	Complications, n (%)					
	all (n = 104)	Agaba (n = 7)	Böttger (n = 13)	Chouillard (n = 31)	Liang (n = 41)	Pugliese (n = 12)
Intraoperative morbidity						
Urethric injury	2	–	–	1	–	1
Bowel injury	2	–	–	–	2	–
Bleeding	1	–	–	1	–	–
Total	5 (4.8)	0	0	2 (6.5)	2 (4.9)	1 (8.3)
Postoperative morbidity						
Wound infection	7	–	–	3	3	1
Pneumonia	6	–	1	1	2	2
Abscess	3	–	–	3	–	–
Sepsis with organ failure	3	–	1	–	2	–
Myocardial infarction	2	1	–	1	–	–
Prolonged ileus	1	1	–	–	–	–
Fascial dehiscence	1	–	–	–	1	–
Cerebral oedema metastases	1	–	1	–	–	–
Stoma retraction	1	–	–	1	–	–
Anastomotic leakage	0	NA	–	NA	NA	–
Total	22 (21.2)	2 (28.6)	2 (15.4)	7 (22.6)	8 (19.5)	3 (25.0)
Surgical re-intervention	2 (1.9)	–	–	2 (6.5)	–	–
Mortality	3 (2.9)	0	1 (7.7)	1 (3.2)	1 (2.4)	0

NA = Not applicable.

The type of resection varied between studies with a majority of HPs (84) over sigmoidectomy with primary anastomosis without ileostomy (20). In 3 studies, all patients underwent HP [38, 40, 41], and in one study, both Hartmann's and primary anastomosis were performed [39]. In the remaining study, all patients had a primary anastomosis, but patients with faecal peritonitis were not considered eligible for this approach and therefore excluded [42].

Postoperative Outcomes

The postoperative outcomes are summarised in table 3. The mean operating time varied between 115 and 200 min with ranges between 55 and 250 min. The conversion rate varied from 0 to 19%. Intraoperative complications were reported in 5 patients (5%) as shown in table 4. Other frequent reasons for conversion were difficult exposure in 5, synchronous cancer in 2, and anastomotic difficulty in 2.

Postoperative complications were reported in 22 (21%) patients. Three patients died during the postoperative period (mortality rate 2.9%), one due to postoperative myocardial infarction, one uncontrolled sepsis and one from cerebral oedema from metastasised lung carcinoma after recovering from the sepsis. Two (2%) patients required surgical re-intervention for stoma revision and a surgical abscess drainage. In all, 20 patients with primary anastomosis without ileostomy, no anastomotic leakage occurred. The mean length of hospital stay was between 6 and 16 days with a range of 5–28 days.

Data on stoma reversal were reported in 79 of 84 patients who underwent a HP; continuity was restored in 60 out of these 79 evaluable patients (75.9%). The available data did not allow for a meaningful comparison between primary anastomosis and HP with regard to postoperative outcomes.

Discussion

This systematic review indicates that in selected patients, laparoscopic sigmoidectomy is feasible in Hinchey III and IV diverticulitis. This is reflected by an acceptable conversion rate, a low re-intervention rate, a low morbidity rate, and a low mortality rate.

The uptake of emergency laparoscopic surgery for acute diverticulitis has been slow. In the American ACS-NSQIP database between 2005 and 2009, only 7.6% of 1,946 emergency sigmoid resections for diverticulitis have been performed by laparoscopy [27]. Despite the limited evidence and practise, the guideline of the European Association of Endoscopic Surgeons (EAES) states that ‘in Hinchey stage IV, colonic resection can be performed laparoscopically or by open surgery, depending on the clinical stability of the patient, even if the evidence is still too weak for a specific recommendation’ [43]. This statement was supported in the Dutch national guidelines, but no statement was made in any other international guideline on diverticulitis [44].

One of the main concerns for the application of laparoscopic surgery in generalised peritonitis is the risk of damage to the distended and vulnerable small bowel. A recent systematic review reported a 64% success rate of laparoscopic treatment in 2005 patients with small bowel obstruction. About 10% of the conversions were due to iatrogenic injury and 7.6% due to inadequate exposure [45]. Even a small bowel diameter greater than 4 centimetres was not considered to be an absolute contraindication for laparoscopy [46].

Many surgeons still regard general peritonitis and especially faecal peritonitis as a contraindication for a laparoscopic approach. One of the reasons is related to a hypothetical risk of increased bacteraemia and hypercapnia due to the pressure of the pneumoperitoneum [47, 48]. This theory has neither been proven nor disproven, but the experience gained with laparoscopic treatment in abdominal sepsis of various causes does not support this hypothesis [11].

Laparoscopic lavage as a minimally invasive approach to perforated diverticulitis has been discussed extensively, in contrast to the option of laparoscopic Hartmann’s or laparoscopic sigmoidectomy with primary anastomosis [43]. Laparoscopic sigmoidectomy can be an alternative in those patients not eligible for laparoscopic lavage, such as those with faecal peritonitis or an immune deficiency, or when initial lavage has failed.

Limitations

The available evidence for emergency laparoscopic sigmoidectomy for the treatment of perforated diverticulitis is limited, as shown by this systematic review. The available evidence is of low quality, as it is based on small non-randomised case series without any open control group. The baseline characteristics of the participants in these studies are heterogeneous and there is a large variety in reported outcome variables. All studies included consecutive patients during a set period of time in a single hospital. The proportion of patients treated open and by laparoscopy during this period is unknown and therefore, no insight in patient selection is provided. It seems likely that these laparoscopic procedures were performed on a selected group of patients and by a dedicated laparoscopic team. Therefore, these results cannot be extrapolated unconditionally to the general population in less dedicated hospitals.

The overall morbidity rate of 21% and mortality rate of 3% is low compared to the reported morbidity rates of 40–80% and mortality rates of 15–35% in high-quality studies on open surgery [2–5]. These low rates may be the result of laparoscopic surgery, but is likely to be influenced by a publication and selection bias. Potential parameters of selection bias are age, Hinchey grade and ASA grade. This is reflected by a lower mean age in the included studies (50–63 years) compared to 65–73 years in randomised studies on open surgery for perforated diverticulitis [2, 22]. Less clear differences are found for Hinchey and ASA grade, with 80% Hinchey III and 88% ASA I–III in this review compared to 76–83% Hinchey III

and 74% ASA I–III patients in previous randomised trials [2, 22].

A majority of patients in this review had laparoscopic HP, while 20% had primary anastomosis without ileostomy. The reported stoma reversal rate following HP is high (80%), compared to 45% in a systematic review of case series [49]. The initial laparoscopic approach is likely to facilitate stoma reversal, because of less adhesion formation. In addition, all reversals were performed laparoscopically. The reversal rate in the present review is comparable to a reported 82% for laparoscopic reversal in a study by Carus et al. [50]. Because laparoscopic reversal is less invasive and associated with lower morbidity, it is likely that more patients will be evaluated as fit for surgery.

Conclusions

The limited evidence in this review shows that emergency laparoscopic sigmoidectomy for the treatment of perforated diverticulitis with generalised peritonitis is feasible in selected patients and in experienced hands. High-quality prospective studies are needed to provide proof of possible benefits of acute laparoscopic sigmoidectomy compared to open sigmoidectomy for perforated diverticulitis.

Disclosure Statement

None declared.

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