

## ORIGINAL ARTICLE

## PERFORATED DIVERTICULITIS MANAGED BY LAPAROSCOPIC LAVAGE

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**Background:** Traditionally the management of acute diverticulitis complicated by perforation has been the Hartmann's procedure, which may be associated with significant morbidity and mortality and the unpleasantness of a colostomy. We present our early experience in managing perforated diverticulitis acutely by laparoscopic lavage and drainage.

**Methods:** A retrospective review was conducted of all patients with surgically confirmed perforated diverticulitis. Details concerning the nature of presentation, operative findings, postoperative course and medium-term progress were investigated.

**Results:** Fourteen patients with a mean age of 57.2 years were identified over a 3-year period. All patients presented with peritonitis and systemic sepsis. Ten patients had extraluminal gas on preoperative imaging. Laparoscopic lavage and drainage, without resection or stoma, was the initial management in all cases. Sigmoid diverticulitis was confirmed in all cases, complicated by Hinchey grade 3 purulent peritonitis in 10 patients, grade 2 contamination in 2 patients and grade 4 faeculent peritonitis in 2 patients. Eleven patients (79%) improved and were discharged following a median of 6.5 days (range, 5–32 days). Three patients did not improve and underwent acute resection. Eight patients have subsequently undergone elective resection without a stoma at a mean interval of 6 weeks, which was carried out laparoscopically in all but one case.

**Conclusion:** Laparoscopic lavage and drainage in the acute management of perforated acute diverticulitis may be a promising alternative to more radical procedures, including the Hartmann's procedure. Acute resection should still be carried out in patients found to have faecal peritonitis or who fail to improve following lavage.

**Key words:** diverticulitis, Hartmanns, Hinchey classification, laparoscopy, lavage, perforated viscus, peritonitis.

## INTRODUCTION

The ideal acute management of perforated diverticulitis has remained controversial over the past 50 years. The Hartmann's procedure, which involves sigmoid resection, closure of the rectal stump and proximal end-colostomy still remains the most widely practised management of patients presenting acutely with diverticulitis complicated by perforation.<sup>1</sup> However, this procedure involves a major laparotomy with significant morbidity and mortality and the unpleasantness of a colostomy. Furthermore, restoration of intestinal continuity involves another major operation with its own risks and technical difficulties. In reality many patients never undergo reversal and consequently live permanently with their colostomy.<sup>2,3</sup> In recent years small published series have emerged showing that many patients with perforated diverticulitis may be successfully managed in the acute setting by laparoscopic lavage and drainage, permitting the resection and anastomosis to be carried out electively without the need for a stoma (Table 1).<sup>4–6</sup> Encouraged by this we adopted laparoscopic lavage as our first-line management of all patients presenting

acutely with perforated diverticulitis from 2002, and now report our early experience with this management approach.

## PATIENTS AND METHODS

A retrospective review was conducted of all patients presenting over 3-year period to the Tweed or John Flynn hospitals (adjacent public and private hospitals on the New South Wales–Queensland border) with perforated diverticulitis. The inclusion criterion was all patients with surgically confirmed perforated diverticulitis. Perforated diverticulitis was suspected in any patient presenting with a history of acute severe left lower quadrant pain, overlying or generalized peritonitis, and significant systemic toxemia. A surgical registrar or consultant surgeon assessed all patients. In many cases perforated disease was supported by extraluminal gas on either computed tomography (CT) or erect plain chest radiographs; however, the decision to pursue operative management over conservative options (including percutaneous drainage) was based on the clinical findings of significant peritonitis and systemic sepsis. All such patients were initially managed by laparoscopy within 24 h of presentation.

The technique involved umbilical Hasson cannulation under general anaesthesia in a supine position. Two additional 5-mm ports were placed in the right-upper and right-lower quadrants. The site of colonic inflammation, presence of diverticulae and nature and extent of any peritoneal contamination were recorded according to the Hinchey *et al.* classification for perforated diverticulitis (Table 2).<sup>7</sup> (Grades 1 and 2 refer to walled off pericolic and pelvic suppuration, respectively, whereas grades 3 and 4 refer

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**Table 1.** Published reports of management of perforated diverticulitis by laparoscopic lavage, drainage and antibiotic therapy

Author	Country	No. patients	Mean age (years)	Average Hinchey score	Average length of stay (days)
O'Sullivan <i>et al.</i> <sup>5</sup>	Ireland	8	57	3	10
Franklin <i>et al.</i> <sup>4</sup>	USA	18	62	2–3	7.5
Faranda <i>et al.</i> <sup>6</sup>	France	18	54	3–4	8

Survival rate was 100% and the failure of treatment was nil.

to purulent and faeculent peritonitis, respectively.) The inflamed colon was inspected for the presence of a perforative defect. Peritoneal lavage was carried out in all quadrants and pelvis using at least 3 L of warmed saline until clear return achieved. One or two 15-Fr soft silicon closed suction drains were positioned adjacent to the inflamed colon, pelvis and in any other area of significant contamination. Postoperative management included admission to a high dependency unit and i.v. ampicillin, gentamicin and metronidazole for at least 5 days before being changed to oral equivalents. Peritoneal drains were removed once any drainage had become serous, generally on the third postoperative day. Liquid oral intake was permitted after 24 h if the patient's sepsis had improved, and solid intake was commenced after the passage of flatus. Reoperation with resection of the diseased segment was considered if a patient's condition deteriorated or progressed poorly.

## RESULTS

One hundred and forty-two patients were admitted with acute diverticulitis between February 2002 and December 2005. Fourteen of these were identified as having perforated diverticulitis (9.8%). The median age of this subgroup was 57.2 years (range, 36–86 years). Several patients suffered from comorbid diseases, with a third being American Society of Anesthesiologists grade 3 or higher. There were 8 men and 6 women. Five patients had known sigmoid diverticulosis from previous colonoscopy. All 14 patients were acutely unwell with significant systemic sepsis. Nine patients had generalized peritonitis whereas five patients had left lower quadrant peritonitis. The median temperature and pulse were 37.7 (range, 36.7–39.6) and 92 (range, 72–135) respectively, with a median leucocytosis of 15 300 (range, 7400–33 000). Extraluminal gas was observed in 10 of 12 patients who had undergone preoperative imaging. This was evident as gross free gas on erect chest radiographs in five patients and as generalized pneumoperitoneum in two patients in whom only an abdominal CT scan had been obtained. Localized pericolic extraluminal gas was seen on CT in the remaining three patients.

All 14 patients underwent laparoscopy where perforated sigmoid diverticulitis was confirmed in all cases. According to the Hinchey *et al.* classification, two patients had grade 2 disease (walled off pelvic suppuration); 10 patients had grade 3 disease

(suppurative peritonitis), whereas two patients with faeculent peritonitis had grade 4 disease (Table 2).<sup>7</sup>

All patients were initially managed by laparoscopic lavage without resection or diversion. Eleven patients (79%) responded well to this management and were discharged without further unplanned intervention including six of the seven patients in whom widespread free gas had been seen on their preoperative imaging. However, three patients (19%) did not settle with lavage alone and required reoperation. An 86-year-old woman with grade 4 faeculent peritonitis underwent a Hartmann's procedure on the fifth postoperative day for deterioration that followed transient improvement, but survived and was discharged after 32 days. A 78-year-old woman, also with faecal peritoneal contamination, made little progress following lavage and consequently underwent a Hartmann's procedure on the second day and was discharged 12 days later. A 39-year-old obese man with grade 3 suppurative peritonitis underwent open resection with anastomosis on the third postoperative day as he still had significant tenderness and fever, and was discharged from hospital after 12 days.

The median length of stay was 6.5 days (range, 5–32 days).

Abdominal drains were typically removed on the third postoperative day. Drainage of serofibrinous fluid was observed in all cases with no faeculent material in any patient. Although no chronic colocutaneous fistulas developed at drainage sites in any patient, one patient who underwent early colonoscopy 4 days following laparoscopy was noted to have a small amount of gas bubbling from the drain site during the procedure. The usual practice of the department is to delay colonoscopy until 6 weeks after an admission for complicated diverticulitis, but colonoscopy was carried out before discharge on this occasion as there were genuine concerns of poor outpatient compliance based on the patient's previous history. No adverse sequelae followed, and the patient was discharged on the sixth postoperative day.

No major morbidity or mortality occurred.

Colonoscopy was carried out in 10 patients at a median of 7 weeks (range 4 days to 14 weeks) following discharge to exclude underlying neoplasia. (Not carried out in the three patients who required acute resections where histopathology confirmed benign disease.) No malignancy was shown and sigmoid diverticulosis was confirmed in all cases.

Eight of 10 patients who settled following laparoscopic lavage have subsequently undergone elective sigmoid resection following a mean interval of 7 weeks without the need for a stoma. All resections were attempted laparoscopically following bowel preparation, but in one case the resection was completed by open surgery because of difficulties with old adhesions. Typically weak inflammatory adhesions were seen between the sigmoid and the pelvic sidewall, which either peeled away or were dealt with by harmonic shears. There were no anastomotic leaks or other major morbidities. Histopathology confirmed diverticular disease in all cases. Two patients aged 44 and 46 years have thus far declined the offer of elective resection. They have both had colonoscopies

**Table 2.** Hinchey classification of perforated diverticulitis

Hinchey classification	Grade	No. patients in this series
Abscess		
Pericolic	1	Nil
Pelvic	2	2
Peritonitis		
Purulent	3	10
Faeculent	4	2

to exclude neoplasia and remain well without further abdominal problems at 2 and 15 months, respectively.

## DISCUSSION

Henri Hartmann initially described the operation of sigmoid colectomy, descending colon end-stoma and closed rectal stump in the treatment of rectosigmoid cancer in 1921.<sup>8</sup> However, it became better known for the treatment of perforated sigmoid diverticulitis during the 1970s with the emergence of data that showed a reduction in mortality when the inflamed colon was resected rather than left *in situ*.<sup>9</sup> Although there are proponents of other surgical options, it still remains the most widely carried out operation for perforated sigmoid diverticulitis today.<sup>1</sup>

Although this approach achieves removal of the diseased segment and avoids the risk of anastomotic breakdown, it has the disadvantages of being a major procedure often carried out after-hours, which either commits the patient to a second difficult restorative operation or in many cases leaves a permanent stoma, possibly poorly placed under emergent conditions.<sup>10</sup> Indeed, despite genuine initial intentions of reversal, up to 70% of patients end up with a permanent stoma following the Hartmann's procedure.<sup>2,3</sup>

In recent years, authors from the USA and Europe have shown through small retrospective series that excellent results can be achieved when acute perforated diverticulitis is treated in the acute setting by laparoscopic lavage and drainage. Franklin *et al.* from Texas reported their experience with 18 patients who were treated by laparoscopic lavage and drainage after being admitted with perforated diverticulitis.<sup>4</sup> All patients had peritonitis associated with pyrexia and leucocytosis. All responded to lavage without resection, with an average length of stay of 7.5 days. Similarly, O'Sullivan *et al.* from Ireland describe successful resolution of generalized purulent peritonitis arising from perforated diverticulitis in eight patients.<sup>5</sup> All patients were found to have widespread free suppuration at laparoscopy (Hinchey grade 3). Faranda *et al.* from France describe their experience with 18 patients.<sup>6</sup> Sixteen had Hinchey grade 3 purulent peritonitis, whereas 2 patients had Hinchey grade 4 faecal peritonitis. Their approach included the routine use of fibrin glue applied to the inflamed segment, with patent perforative defects identified and closed by suture in four cases. All patient responded without the need for acute resection and 15 patients have since gone on to have elective resections, which have been completed laparoscopically without a stoma in all but one case.

Critical to understanding the rationale for conservative surgery in perforated diverticulitis is appreciating that in most cases the resultant peritonitis is purulent (Hinchey grade 3) rather than faeculent (Hinchey grade 4).<sup>5</sup> A patent communication between the colonic lumen and the peritoneal cavity usually cannot be found as the site of the original perforation has become sealed by the inflammatory process.<sup>5</sup> This is in contrast to perforated peptic ulcers for instance, where there is commonly an obvious incisive perforation that requires a suture.<sup>6</sup> The observed toxæmia may be largely due to the peritoneal suppuration rather than the inflamed colon itself. The often-dramatic improvement observed in most patients of this series within the first 24 h following lavage supports this concept. Acute resection of the colon in such patients would appear excessive.

Could any of the patients in this series been successfully treated by antibiotics perhaps assisted by radiological drainage without needing surgery at all? In other words, were the patients in this series really the usual candidates for a Hartmann's resection? The

decision to pursue immediate operative management was based on the findings of a patient rendered acutely unwell by peritonitis and systemic sepsis. Extraluminal gas was identified in all but two patients who had undergone preoperative imaging, being gross free gas in 7 out of 10 cases. At surgery, all but two patients were found to have widespread peritoneal contamination by either sup-puration or faeces. It would generally not be considered appropriate care to manage such patients conservatively.

Management of perforated diverticulitis by lavage and drainage without resection is not new. As early as the 1960s a unique prospective audit on the management practices of general surgeons carried out by the Royal Australasian College of Surgeons in Australia and New Zealand (1967–1970) showed that 40% of patients with perforated acute diverticulitis were managed by open lavage and drainage, with a very favourable mortality compared with resection.<sup>10</sup> The simplicity and speed of this over more radical procedures was appreciated.

The additional advantages of the laparoscopic approach are that it readily permits confirmation of the diagnosis, which helps minimize the risk of inappropriately placed incisions if unexpected pathologies are seen. Apart from the obvious attraction of avoiding a stoma, other benefits include sparing patients the established poorer outcomes when major bowel surgery is carried out under after-hours emergency conditions.<sup>11</sup> In the present study it was found that abdominal signs could continue to be monitored after laparoscopy. This assists in the identification of poorly responding patients who might need acute resection. Once settled, resection of the diseased segment should still be carried out, but can instead be carried out electively for the benefit of both patient and surgical team. This approach permits a thorough preoperative work-up including colonoscopy, bowel preparation and comorbidity improvement and ultimately improved results. The possibility of the resection being carried out laparoscopically is also better preserved. Laparoscopic resections were carried out in seven of eight patients in this series who have thus far undergone planned interval surgery (ileostomies were not used). Evidence for the advantages of laparoscopic colon resection over open surgery continues to grow, particularly for benign disease.<sup>12</sup>

Simple lavage alone will not work in all situations, however. The presence of faeculent rather than the more common purulent peritonitis resulted in a poor response to lavage alone and both patients who were found to have peritoneal faecal material required reoperation and resection of their perforated colon. (Other authors have reported successful outcomes in such patients provided the perforation is found and repaired.) Resection should also be considered in any patient who is not making significant progress. In the present series, lack of significant improvement by the second postoperative day prompted consideration of reoperation.

There is much published work that argues against surgical options that involve retaining the diseased colon. Fifty-eight papers published between 1957 and 1984 regarding the operative management of perforated diverticulitis were reviewed by Krukowski and Matheson.<sup>9</sup> Although several of these reported good results from conservative surgical options, the mortality overall appeared lower in studies reporting removal of the inflamed segment. The practice of resectional intervention became the accepted management of perforated diverticulitis. Why then should this paradigm now be challenged? The difference is that before the laparoscopic era, when the majority of papers recommending acute resection were written, all patients unwell enough to warrant surgical intervention underwent laparotomy. Removal

of the inflamed colon after already committing the patient to a full laparotomy added little extra to the convalescence and avoided the risk of reoperation. The widespread availability of laparoscopy now gives surgeons another option. It is relatively rapid, straight forward and suitable for registrars. Most importantly, it provides a minimally invasive way to distinguish patients who may need acute resection (faecal peritonitis or not settling) versus those who do not. Rather than replacing the Hartmann's procedure, it adds to the armamentarium.

### CONCLUSION

Although larger comparative series are needed before firm conclusions regarding efficacy and safety can be made, laparoscopic lavage and drainage carried out well in the initial management of perforated diverticulitis in this small series of consecutive patients, the majority of whom were unwell enough to require surgical intervention, were spared a Hartmann's resection. Furthermore, it readily permits confirmation of the diagnosis and extent of contamination, which may aide in identifying those patients who should undergo acute resection, including those with faeculent peritonitis or failed improvement postoperatively. Following resolution, all patients should undergo elective resection of the diseased segment after proper work-up.

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