Laparoscopic peritoneal lavage for perforated colonic diverticulitis: a systematic review
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Sunday, 29 November 2020

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Frédéric Ris, Geneva, CH

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Paris Tekkis, London, UK

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Roel Hompes, Amsterdam, NL

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Phil Quirk, Leeds, UK

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Des Winter, Dublin, IE

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Chris Cunningham, Oxford, UK

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Willem Bemelman, Amsterdam, NL

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Antonino Spinelli, Milano, IT

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Quentin Denost, Bordeaux, FR

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Eva Angenete, Göteborg, SE

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Michel Adamina, Winterthur, CH

Wrap-up  
Michel Adamina, Winterthur, CH

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Sunday, 29 November 2020

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Bruno Roche, Geneva, CH

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Alexander Herold, Mannheim, DE

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Beatrice Salviali, Milano, IT

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Joan Robert-Yap, Geneva, CH

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André d’Hoore, Leuven, BE

Wrap-up  
Alexander Herold, Mannheim, DE

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Opening and welcome  
Jochen Lange, St. Gallen, CH

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Philip Quirk, Leeds, UK

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Richard Cohen, London, UK

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Bruno Roche, Geneva, CH

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Willem Bemelman, Amsterdam, NL

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Karl Storz

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Jim Khan, Portsmouth, UK

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EAES presidential lecture: Strategies for lifelong learning and implementation of new technologies  
Andrea Pietrabissa, Pavia, IT

**Satellite Symposium**

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Raffaele Rosso, Lugano, CH

Enhanced recovery pathwaysreloaded – a practical guide to success  
Roberto Persiani, Roma, IT

Cancer at the extremes of age: are there any differences in handling youngsters and seniors  
Des Winter, Dublin, IE

Management pearls for early rectal cancer  
Roel Hompes, Amsterdam, NL

Ventral rectokey: indications, tricks of the trade, and long-term results  
Chris Cunningham, Oxford, UK

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Bbraun

Total neoadjuvant therapy for colon and rectum cancers  
Ronan O’Connell, Dublin, IE

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Quentin Denost, Bordeaux, FR

Timeline of surgery following neoadjuvant radiotherapy – balancing morbidity and efficacy  
Torbjörn Holm, Stockholm, SE

Poster award  
Michel Adamina, Winterthur, CH

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Wednesday, 2 December 2020

Place and outcome of total colectomy in the surgical armentarium  
Neil Mortensen, Oxford, UK

Kono 5 anastomosis and over the valve stricturoplasties: hope for better outcomes  
André D’Hoore, Leuven, BE

New drugs, old fears: state of the art management of IBD patients  
Gerhard Rogler, Zurich, CH

**Satellite Symposium**

Takeda

Do resection of the mesentery in Crohn’s & appendectomy in ulcerative colitis after the course of disease  
Christanne Buskens, Amsterdam, NL

The septic abdomen: getting out of misery and closing the case  
Marja Boermeester, Amsterdam, NL

Management strategies for patients with advanced colorectal cancers  
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Anastomotic leak in colorectal surgery: insights, perspectives, and practical strategies  
Antonino Spinelli, Milano, IT

Closing words  
Michel Adamina, Winterthur, CH

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Laparoscopic peritoneal lavage for perforated colonic diverticulitis: a systematic review

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Abstract

Aim This systematic review aimed to evaluate the efficacy, morbidity and mortality of laparoscopic peritoneal lavage for patients with perforated diverticulitis.

Method We searched PubMed, EMBASE, Web of Science, the Cochrane Library and CINAHL databases, Google Scholar and five major publisher websites without language restriction. All articles which reported the use of laparoscopic peritoneal lavage for patients with perforated diverticulitis were included.

Results Two prospective cohort studies, nine retrospective case series and two case reports reporting 231 patients were selected for data extraction. Most (77%) patients had purulent peritonitis (Hinchey III). Laparoscopic peritoneal lavage successfully controlled abdominal and systemic sepsis in 95.7% of patients. Mortality was 1.7%, morbidity 10.4% and only four (1.7%) of the 231 patients received a colostomy.

Conclusion There have been no publications of high methodological quality on laparoscopic peritoneal lavage for patients with perforated colonic diverticulitis. The published papers do, however, show promising results, with high efficacy, low mortality, low morbidity and a minimal need for a colostomy.

Keywords Diverticulitis, colonic, laparoscopy, peritonitis, peritoneal lavage

Introduction

Peritonitis caused by perforated diverticulitis is a particularly serious condition and is classified according to Hinchey [1] into purulent (Hinchey III) or faecal (Hinchey IV). It is commonly treated by sigmoid resection with or without a colostomy. These operations are characterized by a high mortality [2,3] and morbidity [4]. In many patients, the stoma is never reversed.

Several recent articles have reported laparoscopic peritoneal lavage, drainage and antibiotic treatment as an alternative to acute colonic resection [5–7]. The authors concluded that laparoscopic peritoneal lavage was safe and effective treatment, with a low mortality, low morbidity and without the need for a stoma.

This systematic review evaluates the efficacy, mortality and morbidity of laparoscopic peritoneal lavage for patients presenting with perforated colonic diverticulitis.

Method

The following databases were searched: PubMed, EMBASE (OVID version), Web of Science, the Cochrane library, CINAHL databases, Google Scholar and the ScienceDirect (Elsevier), LWW-journals@OVID (Lippincott Williams & Wilkins), HighWire (Society journals), SpringerLink and Wiley/Blackwell publisher website search engines. All searches were performed without language restriction. Two combinations of key words were constructed. These were applied to all databases taking into account the terminological differences between them. The first one consisted of a combination of diverticulitis AND laparoscopy AND lavage. The second consisted of the combination of diverticulitis AND peritonitis AND laparoscopy. Two reviewers (BT and HS) independently screened titles and abstracts for their relevance. All articles that reported the use of laparoscopic peritoneal lavage for patients with perforated diverticulitis were included except for commentaries and correspondence. The bibliographies of all included articles were then searched for relevant references. References citing all included articles were finally retrieved. Data extraction
and quality assessment were independently conducted by two reviewers (BT and HS). Disagreements were reconciled by discussion.

**Results**

The search produced 411 publications, of which 28 were considered relevant to the topic (Fig. 1). Three articles [8–10] and three abstracts [11–13] were excluded because of the double publication of results as were nine publications including comments and correspondence [14–22]. Thirteen remaining articles were selected for further data analysis.

**Quality assessment**

There were no randomized controlled trials. There were two prospective cohort studies [5,7], nine retrospective case series [6,23–30] and two case reports [31,32]. In the selected papers, different variables on patient characteristics and ‘materials and methods’ were reported. All publications gave figures on conversion, failure of lavage, mortality, morbidity and the number of colostomies and secondary resections performed. Confirmation of diverticular colonic disease was usually acquired by colonoscopy or a double contrast barium- or water-soluble contrast enema. Only five studies reported on the length of patient follow up [5,6,23–25] (Table 1). A meta-analysis could not be performed, but a summary of the data is presented below, with pooled estimates and averages where possible.

**Patient characteristics**

The thirteen included publications reported 231 patients with acute colonic diverticulitis who were treated by laparoscopic peritoneal lavage. The majority (77%) had purulent peritonitis (Hinchey III). The male:female ratio was 1.7:1. Four articles stated the ASA grades in a total

### Table 1 Quality assessment of the included articles.

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>N</th>
<th>Study design</th>
<th>Study type</th>
<th>Confirmation of diverticular disease</th>
<th>Length of follow up in months</th>
</tr>
</thead>
<tbody>
<tr>
<td>O’Sullivan, 1996</td>
<td>Ireland</td>
<td>8</td>
<td>Case series</td>
<td>Retrospective</td>
<td>C/BE</td>
<td>12–48</td>
</tr>
<tr>
<td>Aouad, 1997</td>
<td>France</td>
<td>1</td>
<td>Case report</td>
<td>Retrospective</td>
<td>GE</td>
<td>NR</td>
</tr>
<tr>
<td>Faranda, 2000</td>
<td>France</td>
<td>18</td>
<td>Case series</td>
<td>Retrospective</td>
<td>BE</td>
<td>(4)</td>
</tr>
<tr>
<td>Da Rold, 2004</td>
<td>Italy</td>
<td>7</td>
<td>Case series</td>
<td>Retrospective</td>
<td>NR</td>
<td>6–70 (38)</td>
</tr>
<tr>
<td>Taylor, 2006</td>
<td>Australia</td>
<td>14</td>
<td>Case series</td>
<td>Retrospective</td>
<td>C</td>
<td>NR</td>
</tr>
<tr>
<td>Mutter, 2006</td>
<td>France</td>
<td>10</td>
<td>Case series</td>
<td>Retrospective</td>
<td>GE</td>
<td>NR</td>
</tr>
<tr>
<td>Galleano, 2007</td>
<td>Italy</td>
<td>4</td>
<td>Case series</td>
<td>Retrospective</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Lippi, 2007</td>
<td>Italy</td>
<td>5</td>
<td>Case series</td>
<td>Retrospective</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Myers, 2008</td>
<td>Ireland</td>
<td>92</td>
<td>Cohort study</td>
<td>Prospective</td>
<td>C/BE</td>
<td>12–84 (36)</td>
</tr>
<tr>
<td>Franklin, 2008</td>
<td>USA</td>
<td>40</td>
<td>Case series</td>
<td>Retrospective</td>
<td>NR</td>
<td>1–168 (96)</td>
</tr>
<tr>
<td>Jaffer, 2008</td>
<td>UK</td>
<td>1</td>
<td>Case report</td>
<td>Retrospective</td>
<td>BE</td>
<td>NR</td>
</tr>
<tr>
<td>Bretagnol, 2008</td>
<td>France</td>
<td>24</td>
<td>Cohort study</td>
<td>Prospective</td>
<td>C</td>
<td>NR</td>
</tr>
<tr>
<td>Favuzza, 2009</td>
<td>USA</td>
<td>7</td>
<td>Case series</td>
<td>Retrospective</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

Values in parentheses are mean follow-up periods.
NR, not reported; C, colonoscopy; BE, barium enema; GE, gastrografin enema.
of 86 patients [6,7,24,28]. Of these, 24 were classified as ASA grade 1, 42 as grade 2, 15 as grade 3 and 5 as grade 4. Forty-six of 189 (24%) patients were reported to have had a previous history of colonic diverticular disease in six studies [5–7,24,26,32], and eight reported that 173/187 (93%) patients had generalized peritonitis [5,6,23–26,30,31]. Abdominal computed tomography prior to surgery was mandatory in four studies [6,25,27,30], was never used in one [24], and not reported in eight. Eleven articles reported the presence of free abdominal air, which was present in 156/225 (69%) patients (Table 2).

**Treatment**

Between two and five trocars were used for the laparoscopic procedure and the volume of irrigant used varied from 3 to 25 l. Warmed saline solution was generally used, but in one institute, the additional diluted iodine and heparin were administered [6]. In some institutions, adhesions were left intact [5,7,27] while others divided adhesions and searched for the perforation which was either glued or sutured [6,24,25]. Nearly all patients were given one or two drains (closed suction or nonsuction) at the end of the procedure. The mean operating time was 70 min (range 40–150 min) for 69 patients from four studies [6,24,25,28]. All patients received antibiotics which were usually given intravenously pre- and postoperatively and changed to oral medication after 4–7 days. Eleven articles reported the mean hospital stay which was 8.5 days (range: 4–35 days) [5,7,23–28,30–32].

**Outcome**

Table 3 provides an overview of the pooled data on conversion, failure of lavage, mortality, morbidity, the number of colostomies and secondary resections. Eighty-seven (38%) of the 231 patients underwent delayed elective resection of the diseased portion of the colon usually laparoscopically. Recurrent diverticulitis was reported in 5/128 patients who did not undergo secondary resection. Follow-up periods were given as a mean in four studies with a weighted mean total of 48 months for 153 patients [5,6,24,25].

**Discussion**

Patients with acute colonic diverticulitis present with differing severity of disease. The Hinchey classification is often used to categorize these patients and some subsequent modifications have been published since it was described [1,33,34]. The recommended treatment for patients with purulent or faecal peritonitis (Hinchey III and IV) is an urgent sigmoid resection [35]. In this situation, a Hartmann’s procedure is favoured by most surgeons although colonic resection with a primary anastomosis with or without a defunctioning colostomy is also feasible [36,37]. Regardless of the selected strategy, emergency operations for patients with acute perforated diverticulitis are associated with substantial morbidity (up to 44%) [4] and mortality. In a recent prospective analysis of 200 patients who underwent emergency resection for acute diverticulitis, the mortality was 27% [2], whilst another recent publication on the

<table>
<thead>
<tr>
<th>Author, year</th>
<th>N</th>
<th>Hinchey classification</th>
<th>Age</th>
<th>Generalized peritonitis</th>
<th>Free air</th>
</tr>
</thead>
<tbody>
<tr>
<td>O’Sullivan, 1996</td>
<td>8</td>
<td>0 0 8 0</td>
<td>57</td>
<td>50–67</td>
<td>5 7</td>
</tr>
<tr>
<td>Aouad, 1997</td>
<td>1</td>
<td>0 0 1 0</td>
<td>37</td>
<td>1 0</td>
<td>1</td>
</tr>
<tr>
<td>Faranda, 2000</td>
<td>18</td>
<td>0 0 16 2</td>
<td>54</td>
<td>37–74</td>
<td>8 11</td>
</tr>
<tr>
<td>Da Rold, 2004</td>
<td>7</td>
<td>1 1 5 0</td>
<td>65</td>
<td>45–95</td>
<td>5 7</td>
</tr>
<tr>
<td>Taylor, 2006</td>
<td>14</td>
<td>0 2 10 2</td>
<td>57</td>
<td>36–86</td>
<td>8 9</td>
</tr>
<tr>
<td>Mutter, 2006</td>
<td>10</td>
<td>0 0 10 0</td>
<td>60</td>
<td>38–76</td>
<td>9 3</td>
</tr>
<tr>
<td>Galleano, 2007</td>
<td>4</td>
<td>0 2 2 0</td>
<td>68</td>
<td>60–79</td>
<td>2 1</td>
</tr>
<tr>
<td>Lippi, 2007</td>
<td>5</td>
<td>0 2 3 0</td>
<td>80</td>
<td>72–90</td>
<td>NR</td>
</tr>
<tr>
<td>Myers, 2008</td>
<td>92</td>
<td>0 25 67 0</td>
<td>63</td>
<td>39–94</td>
<td>61 92</td>
</tr>
<tr>
<td>Franklin, 2008</td>
<td>40</td>
<td>0 5 32 3</td>
<td>60</td>
<td>28–99</td>
<td>26 40</td>
</tr>
<tr>
<td>Jaffer, 2008</td>
<td>1</td>
<td>0 1 0 0</td>
<td>50</td>
<td>1 0</td>
<td>Local</td>
</tr>
<tr>
<td>Bretagnol, 2008</td>
<td>24</td>
<td>0 5 18 1</td>
<td>56</td>
<td>26–82</td>
<td>11 16</td>
</tr>
<tr>
<td>Favuzza, 2009</td>
<td>7</td>
<td>0 1 6 0</td>
<td>49</td>
<td>55–66</td>
<td>5 0</td>
</tr>
<tr>
<td>Total/Mean/Range</td>
<td>231</td>
<td>1 44 178 8</td>
<td>60</td>
<td>26–99</td>
<td>173</td>
</tr>
</tbody>
</table>

NR, not reported; Local, local peritonitis in all patients; Local/Gen, local or generalized peritonitis in all patients.
incidence of perforated diverticulitis in the UK reported a mortality of 24% [3]. Furthermore, reversal of Hart- 
mann’s procedure is not performed in 25–70% of the patients [38–42], thus compromising the quality of life and leading to increasing costs. This may be attributable to the fact that reversal is associated with a high morbidity and even mortality [43].

This systematic review identified 231 patients with acute colonic diverticulitis who were treated by laparo- 
soscopic peritoneal lavage, drainage and antibiotics. Abdominal and systemic sepsis was successfully controlled using this minimal invasive strategy in 95.7% of the patients, with minimum mortality (1.7%), morbidity (10.4%) and incidence stoma formation (1.7%). A delayed elective laparoscopic resection was feasible in most patients, but, significantly, those who did not undergo subsequent resection had a long recurrence free follow- 
up period.

Laparoscopic peritoneal lavage seems to provide adequate control of the acute inflammatory episode in most patients, but it failed to do so in 10 (4.3%) of the 231 patients [26,30]. Two of these required a Hart- 
mann’s resection for faecal peritonitis and two underwent open resection and primary anastomosis for purulent peritonitis. Four of five patients with pelvic abscess formation inadequately treated by laparoscopic peritoneal lavage underwent radiological drainage and one had a Hartmann’s resection [5,7,30]. One other patient had an early recurrence necessitating surgery 3 weeks later [27]. The overall mortality (1.7%) was low. Two patients died of multiorgan failure, one because of pulmonary embo-

At present, in most institutions, a delayed elective laparoscopic resection is advised after resolution of an attack of acute diverticulitis. The current practice of elective resection after two episodes of acute diverticulitis has, however, recently been challenged [44] and was not applied in the institute that reported most of the patients treated by laparoscopic peritoneal lavage reported in this review. In this study, no patient underwent a subsequent elective resection and excellent results were obtained during long-term follow up [5].

The studies published on this topic have mostly been retrospective, nonconsecutive and of low methodological quality. Inclusion and publication bias may partially have been responsible for the favourable results. The pooling of data from heterogeneous studies, as has been done in this review, can also lead to bias.

The thirteen selected articles indicate that laparo-
soscopic peritoneal lavage, for patients with peritonitis caused by perforated diverticulitis, is an effective and safe treatment that may be preferable to colonic resection. There appears to be a general consensus, however, that laparoscopic peritoneal lavage should not be used for patients with Hinchey grade IV diverticulitis [5,7,23,24,26,27]. Other patients who may not benefit from laparoscopic peritoneal lavage include those with pelvic abscess formation. This is consistent with the observation that half of the patients who had a failure of lavage had a pelvic abscess.

There have been different reactions to this new approach. Some remain skeptical [21], whilst others indicate a preparedness to change practice [18] or to reconsider current management of complicated

### Table 3 Pooled outcome data for laparoscopic peritoneal lavage in 231 patients.

<table>
<thead>
<tr>
<th>Author, year</th>
<th>N</th>
<th>Conversion to laparotomy</th>
<th>Lavage failure</th>
<th>Mortality</th>
<th>Morbidity</th>
<th>Stoma</th>
<th>Secondary resection</th>
</tr>
</thead>
<tbody>
<tr>
<td>O’Sullivan, 1996</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aouad, 1997</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Faranda, 2000</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Da Rold, 2004</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Taylor, 2006</td>
<td>14</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0*</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Mutter, 2006</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Galleano, 2007</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Lippi, 2007</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Myers, 2008</td>
<td>92</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Franklin, 2008</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Jaffer, 2008</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Bretagnol, 2008</td>
<td>24</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Favuzza, 2009</td>
<td>7</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>231</td>
<td>1</td>
<td>10</td>
<td>4</td>
<td>24</td>
<td>4</td>
<td>87</td>
</tr>
<tr>
<td>Percentage</td>
<td>0.4</td>
<td>4.3</td>
<td>1.7</td>
<td>10.4</td>
<td>1.7</td>
<td>37.7</td>
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</tbody>
</table>
diverticulitis as a result of the publication by Myers et al. [20]. Laparoscopic peritoneal lavage is recommended for selected patients with perforated diverticulitis by the European Association for Endoscopic Surgery (grade of recommendation C) [45] and has been included in a proposed management algorithm for patients with acute colonic diverticulitis [32]. Others, however, believe that this technique warrants further investigation in a controlled prospective setting [14,46].

As laparoscopic peritoneal lavage may be an important new treatment for patients with peritonitis caused by perforated diverticulitis, it is important to establish its value in randomized controlled trials. Such a trial randomizing patients with purulent diverticulitis to either lavage or resectional surgery will start at the end of 2009.

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**Author contributions**

Conception and design: BT, JS, JH, WB. Analysis and interpretation: BT, HS. Data collection: BT, HS, JS. Writing the article: BT, JS. Critical revision of the article: BT, JH, WB. Final approval of the article: BT, JH, WB. Statistical analysis: BT, HS. Obtained funding: not applicable. Overall responsibility: BT, WB.

**References**


