Complicated Diverticulitis

Evidence Based Recommendations

Frederick A Moore MD

September 10, 2014
Complicated Diverticulitis

Evidence Based Recommendations

I have no financial disclosures
A Management Algorithm for Perforated Diverticulitis

Objectives

Provide a historical perspective on surgical management

Discuss current algorithm of surgical management

Debate definitive resection vs damage control vs laparoscopic lavage
Western Trauma Association Critical Decisions in Trauma: Management of complicated diverticulitis

Frederick A. Moore, MD, Ernest E. Moore, MD, Clay Cothren Burlew, MD, Raul Coimbra, MD, Robert C. McIntyre, Jr., MD, James W. Davis, MD, Jason Sperry, MD, and Walter L. Biffl, MD, Gainesville, Florida

J Trauma Acute Care Surg 2012

Position paper: management of perforated sigmoid diverticulitis

Frederick A Moore¹*, Fausto Catena², Ernest E Moore³, Ari Leppaniemi⁴ and Andrew B Peitzmann⁵

World Journal of Emergency Surgery 2013
Complicated Diverticulitis

Disease of industrial revolution - roller milling wheat ↓ fiber by 2/3 rds

Relatively rare & high associated M & M - small single center studies

100 years of case series - virtually all retrospective & expert opinion

Evolving management strategies - most remarkable over past 20 yrs
Acquired Diverticulitis of the Large Intestine

Mayo describes 4 resections of the colon for diverticulitis

Surg Gynecol Obstet 1907
Perforated Diverticulitis with Peritonitis

Primary resection too difficult in the acute setting
Stirring up the infection results in very high mortality
(pre-antibiotic era)
Perforated Diverticulitis with Peritonitis
Colostomy + Irrigation Distal Colon
± Delayed Resection

Primary resection too difficult in the acute setting
Stirring up the infection results in very high mortality
(pre-antibiotic era)
Compared numerous operations and concluded that best early mortality and long-term outcomes are achieved with Preliminary proximal colostomy

Resection at 3 - 6 months after inflammation resolved
Perforated Diverticulitis with Peritonitis

Three - Staged Procedure

1\textsuperscript{st} : Diverting Colostomy, Suture Closure & Drainage

2\textsuperscript{nd} : Definitive Resection & Colostomy at 3 - 6 months

3\textsuperscript{rd} : Colostomy Closure at 3 - 6 months
Acute Perforated Diverticulitis of the Sigmoid Colon
With Generalized Peritonitis

HIRAM H. BELDING III, MD, Riverside Calif

With IV Terramycin q 12 hour X 3 days

Safely resected diseased colon in 5 cases

Two - Staged Procedure (Hartmann’s Procedure)

1st : Resect & Colostomy
2nd : Delayed Colostomy Closure
Treatment of perforated diverticular disease of the colon.

Hinchey EJ, Schaal PG, Richards GK.

<table>
<thead>
<tr>
<th>Hinchey Classification</th>
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<tbody>
<tr>
<td>I</td>
<td>Pericolic abscess or phlegmon</td>
</tr>
<tr>
<td>II</td>
<td>Pelvic, intraabdominal, or retroperitoneal abscess</td>
</tr>
<tr>
<td>III</td>
<td>Generalized purulent peritonitis</td>
</tr>
<tr>
<td>IV</td>
<td>Generalized fecal peritonitis</td>
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WTA Complicated Diverticulitis Score

Modified Hinchey

<table>
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<th>Grade</th>
<th>Characteristic</th>
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<td>I A</td>
<td>Phlegmon with no abscess</td>
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<td>Phlegmon with abscess &lt; 4 cm</td>
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<td>II</td>
<td>Phlegmon with abscess &gt; 4 cm</td>
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<td>III</td>
<td>Purulent peritonitis (no hole in colon)</td>
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<tr>
<td>IV</td>
<td>Feculent peritonitis (persistent hole in colon)</td>
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</table>

Other Complications: Stricture or fistula
Surgical Treatment of Perforated Diverticulitis of the Sigmoid Colon

Jon M. Greif DO, Gregory Fried MD, Charles K. McSherry, MD.

Retrospective Review of 36 Case Series

821 case with Peritonitis

505
3 Staged
145 (29%) Died

316
2 Staged
39 (12%) Died

Selection Bias?
Advocates of Acute Resection

- ↓ mortality with better antibiotics & supportive care
- Will not miss colon cancer (~3% of cases)
- ↓ morbidity (20% fistula in nonresected patients)
Treatment of perforated sigmoid diverticulitis:
A prospective randomized trial

O. Kronborg

Br J Surg 1993

62 Peritonitis → 46 Purulent Peritonitis (Hinchey III)

Single Center
Denmark

21 3 Staged
0 Died

25 2 Staged
6(24%) Died
Multicentre, randomized clinical trial of primary versus secondary sigmoid resection in generalized peritonitis complicating sigmoid diverticulitis

G. Zeitoun, A. Laurent, F. Rouffet*, J.-M. Hay, A. Fingerhut‡, J.-C. Paquet‡, C. Peillon§ and the French Associations for Surgical Research

Br J Surg 2000

103 Generalized Peritonitis (Hinchey III & IV)

Multicenter

48
3 Staged
10 (20%)
9 (18%)

55
2 Staged
13 (23%) *
1 (2%) *

Postop Peritonitis

Mortality

9 (18%)
13 (23%)

* P < 0.05
Perforated Diverticulitis with Peritonitis

Procedure of choice is segmental resection with colostomy

2 - Stage Hartmann’s Procedure
Only ~50% of colostomies are reversed

Colostomy reversal is a high morbidity procedure
Primary Resection With Anastomosis vs. Hartmann’s Procedure in Nonelective Surgery for Acute Colonic Diverticulitis: A Systematic Review


Dis Colon Rectum 2006

15 comparative studies published from 1984 – 2004
(13 retrospective, 2 prospective nonrandomized)
<table>
<thead>
<tr>
<th>Study</th>
<th>PRA</th>
<th>Hartmann’s Procedure</th>
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<td>Test for heterogeneity: Chi² = 20.10, df = 14 (P = 0.13), P = 30.4%</td>
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<td>Test for overall effect: Z = 3.17 (P = 0.001)</td>
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<table>
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<tr>
<th>OR (random)</th>
<th>95% CI</th>
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</thead>
</table>

| Diverticular Disease + Emergency OR |     |                      |             |          |             |      |
| O'Brien [26]  | 4/99 | 9/76                 | 29.95       | 0.24     | 0.09, 1.06  | 1990 |
| Seccacini [38] | 1/26| 3/7                  | 7.45        | 0.05     | 0.00, 0.61  | 1990 |
| Golzak [39]    | 5/32| 6/28                 | 23.66       | 0.69     | 0.18, 2.53  | 1990 |
| Schilling [39] | 1/33| 4/42                 | 5.05        | 0.79     | 0.08, 7.98  | 1990 |
| Blair [38]     | 3/33| 13/64                | 21.30       | 0.39     | 0.10, 1.49  | 1990 |
| Regenet [35]   | 3/27| 4/33                 | 16.39       | 0.91     | 0.18, 4.45  | 1990 |
| Subtotal (95% CI) | 230 |                      | 290         |          |             |      |
| Total events: 17 (PRA), 38 (Hartmann’s Procedure) |
| Test for heterogeneity: Chi² = 4.53, df = 5 (P = 0.48), P = 0% |
| Test for overall effect: Z = 2.04 (P = 0.041) |

<table>
<thead>
<tr>
<th>OR (random)</th>
<th>95% CI</th>
</tr>
</thead>
</table>

| Diverticular Disease + Hinchey >2 |     |                      |             |          |             |      |
| O'Brien [26]  | 2/7  | 7/5                  | 8.58        | 8.00     | 0.31, 206.37 | 1994 |
| Seccacini [38] | 0/3  | 1/3                  | 7.12        | 0.24     | 0.01, 8.62  | 1994 |
| Golzak [39]    | 5/32 | 6/28                 | 26.87       | 0.68     | 0.18, 2.53  | 1994 |
| Schilling [39] | 1/13| 4/42                 | 16.20       | 0.79     | 0.08, 7.98  | 1994 |
| Regenet [35]   | 3/27| 4/33                 | 29.33       | 0.93     | 0.18, 4.45  | 1994 |
| Subtotal (95% CI) | 111 |                      | 210         |          |             |      |
| Total events: 11 (PRA), 18 (Hartmann’s Procedure) |
| Test for heterogeneity: Chi² = 4.3, df = 5 (P = 0.49), P = 0% |
| Test for overall effect: Z = 1.55 (P = 0.12) |

<table>
<thead>
<tr>
<th>OR (random)</th>
<th>95% CI</th>
</tr>
</thead>
</table>

| Diverticular Disease + Abscess |     |                      |             |          |             |      |
| O'Brien [26]  | 2/7  | 1/5                  | 2.30        | 8.00     | 0.31, 206.37 | 1994 |
| Seccacini [38] | 0/6  | 1/15                 | 3.15        | 0.74     | 0.02, 8.01  | 1994 |
| Orega [26]    | 2/11 | 4/26                 | 6.37        | 0.17     | 0.02, 1.19  | 1994 |
| Hand [31]     | 0/3  | 0/3                  | 4.69        | 0.31     | 0.09, 1.06  | 1994 |
| Pengo [41]    | 1/11 | 8/43                 | 16.49       | 0.97     | 0.18, 5.40  | 1994 |
| Medico [31]   | 0/3  | 1/3                  | 5.40        | 1.05     | 0.19, 1.83  | 1994 |
| Goossens [29] | 2/184| 7/31                 | 2.74        | 0.24     | 0.01, 8.62  | 1994 |
| Schilling [39] | 1/13| 4/42                 | 10.95       | 0.04     | 0.01, 0.19  | 1994 |
| Blair [38]    | 3/33 | 4/33                 | 2.09        | 0.50     | 0.19, 7.98  | 1994 |
| Regenet [35]  | 3/27| 4/33                 | 11.28       | 0.91     | 0.16, 4.45  | 1994 |
| Subtotal (95% CI) | 366 |                      | 444         |          |             |      |
| Total events: 23 (PRA), 58 (Hartmann’s Procedure) |
| Test for heterogeneity: Chi² = 15.28, df = 10 (P = 0.12), P = 34.5% |
| Test for overall effect: Z = 2.41 (P = 0.02) |

Figure 1. P = number of deaths/total number

Favors PRA  Favors Hartmann's
## Mortality

<table>
<thead>
<tr>
<th>Study</th>
<th>Type</th>
<th>n</th>
<th>OR (random) 95% CI</th>
<th>Weight</th>
<th>OR (random) 95% CI</th>
<th>Year</th>
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<tbody>
<tr>
<td><strong>O2 Mortality</strong></td>
<td>Diverticular Disease</td>
<td></td>
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<tr>
<td>Drum [26]</td>
<td></td>
<td>2/3</td>
<td>2.05</td>
<td>0.00 (0.31, 206.37)</td>
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<td>O2 Mortality [26]</td>
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<td>0/25</td>
<td>3.15</td>
<td>0.13 (0.01, 2.88)</td>
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<tr>
<td>Underwood [39]</td>
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<td>2.72</td>
<td>0.74 (0.03, 20.81)</td>
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<td>Brown [32]</td>
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<td>Atwater [25]</td>
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<td>0.97 (0.10, 8.30)</td>
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<td>Hoit [31]</td>
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<td>2.43 (0.10, 56.39)</td>
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<td>1/26</td>
<td>4.61</td>
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<td>111</td>
<td></td>
<td>0.85 (0.49, 2.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total events: 11 (PRA), 18 (Hartmann's Procedure)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for heterogeneity: Chi² = 15.58, df = 10 (P = 0.12), P = 34.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 2.41 (P = 0.02)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Figure 1: P

- **Favors PRA**
- **Favors Hartmann's**

(number of deaths/total number)
### Surgical Complications

#### Wound Infections

<table>
<thead>
<tr>
<th>Study</th>
<th>PRA</th>
<th>Hartmann's</th>
<th>OR (random)</th>
<th>Weight %</th>
<th>OR (random)</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kourtesis [32]</td>
<td>3/23</td>
<td>2/10</td>
<td>12.49</td>
<td>60</td>
<td>0.60 [0.09, 4.29]</td>
<td>1988</td>
</tr>
<tr>
<td>Alaris [25]</td>
<td>0/34</td>
<td>6/26</td>
<td>5.65</td>
<td>0.5</td>
<td>0.05 [0.00, 0.85]</td>
<td>1989</td>
</tr>
<tr>
<td>Saccomani [38]</td>
<td>2/26</td>
<td>1/7</td>
<td>7.37</td>
<td>0.5</td>
<td>0.50 [0.04, 6.48]</td>
<td>1990</td>
</tr>
<tr>
<td>Gooszen [29]</td>
<td>1/32</td>
<td>4/29</td>
<td>9.52</td>
<td>0.1</td>
<td>0.19 [0.02, 1.85]</td>
<td>2001</td>
</tr>
<tr>
<td>Blair [28]</td>
<td>7/33</td>
<td>15/62</td>
<td>46.79</td>
<td>0.9</td>
<td>0.94 [0.31, 2.33]</td>
<td>2002</td>
</tr>
<tr>
<td>Regenbol [35]</td>
<td>2/27</td>
<td>9/33</td>
<td>18.18</td>
<td>0.21</td>
<td>0.04 [0.04, 1.09]</td>
<td>2003</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>175</td>
<td>166</td>
<td>100.00</td>
<td>0.42</td>
<td>0.20 [0.90]</td>
<td></td>
</tr>
</tbody>
</table>

Total events: 15 (PRA), 37 (Hartmann's)
Test for heterogeneity: \( \chi^2 = 5.43, \text{df} = 5 (P = 0.37), P = 7.9\% 

#### Postop Abscess/Peritonitis

<table>
<thead>
<tr>
<th>Study</th>
<th>PRA</th>
<th>Hartmann's</th>
<th>OR (random)</th>
<th>Weight %</th>
<th>OR (random)</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaris [25]</td>
<td>0/34</td>
<td>2/26</td>
<td>7.07</td>
<td>0.14</td>
<td>0.01 [0.01, 3.09]</td>
<td>1989</td>
</tr>
<tr>
<td>Holz [31]</td>
<td>3/99</td>
<td>8/76</td>
<td>36.14</td>
<td>0.27</td>
<td>0.07 [1.04]</td>
<td>1990</td>
</tr>
<tr>
<td>Madina [33]</td>
<td>1/3</td>
<td>0/3</td>
<td>5.21</td>
<td>4.20</td>
<td>0.12 [151.97]</td>
<td>1991</td>
</tr>
<tr>
<td>Blair [28]</td>
<td>1/33</td>
<td>3/64</td>
<td>12.65</td>
<td>0.64</td>
<td>0.06 [4.36]</td>
<td>2002</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>228</td>
<td>230</td>
<td>100.00</td>
<td>0.43</td>
<td>0.19 [0.97]</td>
<td></td>
</tr>
</tbody>
</table>

Total events: 9 (PRA), 20 (Hartmann's)
Test for heterogeneity: \( \chi^2 = 2.85, \text{df} = 5 (P = 0.72), P = 0\%

#### Stoma Complications (for PADS & Hartsmann's)

<table>
<thead>
<tr>
<th>Study</th>
<th>PRA</th>
<th>Hartmann's</th>
<th>OR (random)</th>
<th>Weight %</th>
<th>OR (random)</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaris [25]</td>
<td>0/5</td>
<td>3/26</td>
<td>9.72</td>
<td>0.61</td>
<td>0.03 [13.62]</td>
<td>1989</td>
</tr>
<tr>
<td>Holz [31]</td>
<td>2/29</td>
<td>8/76</td>
<td>36.04</td>
<td>0.63</td>
<td>0.13 [2.16]</td>
<td>1990</td>
</tr>
<tr>
<td>Gooszen [29]</td>
<td>3/32</td>
<td>7/28</td>
<td>43.69</td>
<td>0.31</td>
<td>0.07 [1.34]</td>
<td>2001</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>72</td>
<td>140</td>
<td>100.00</td>
<td>0.51</td>
<td>0.20 [1.36]</td>
<td></td>
</tr>
</tbody>
</table>

Total events: 8 (PRA), 18 (Hartmann's)
Test for heterogeneity: \( \chi^2 = 1.21, \text{df} = 3 (P = 0.75), I^2 = 0\%
Test for overall effect: \( Z = 1.34 (P = 0.18)\)

Favors PRA  Favors Hartmann's
Obvious Select Bias – Hard to Extrapolate But

Emergency PRA has low rate of anastomosis leak (6%)

PRA and Hartmann’s had similar operative time

All Hinchey >2 subset: equal mortality (14.1% vs 14.4%)
Practice Parameters for Sigmoid Diverticulitis

Janice Rafferty, M.D., Paul Shellito, M.D., Neil H. Hyman, M.D.,
W. Donald Buie, M.D., and the Standards Committee of The American Society of
Colon and Rectal Surgeons

Dis Colon Rectum 2006

Perforated Diverticulitis with Peritonitis

Alternatives are **Hartmann’s procedure** or **PRA** with or without
intraoperative lavage.

The role proximal diversion remains unsettled.
# Laparoscopic Lavage for Perforated Diverticulitis: A Population Analysis

Ailín C. Rogers, M.B., B.Ch., B.A.O.¹,² • Danielle Collins, M.D.¹
Gerald C. O’Sullivan, F.R.C.S.I.¹,† • Desmond C. Winter, M.D., F.R.C.S.I.¹,²


<table>
<thead>
<tr>
<th>Authors</th>
<th>No. of patients</th>
<th>Study design</th>
<th>Country</th>
<th>Length of stay, d</th>
<th>Complication n (%)</th>
<th>Mortality n (%)</th>
</tr>
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<tbody>
<tr>
<td>O’Sullivan et al</td>
<td>8</td>
<td>Case series</td>
<td>Ireland</td>
<td>10</td>
<td>2 (25)</td>
<td>0</td>
</tr>
<tr>
<td>Aouad et al</td>
<td>1</td>
<td>Case report</td>
<td>France</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Taylor et al</td>
<td>12</td>
<td>Case series</td>
<td>Australia</td>
<td>7</td>
<td>1 (12)</td>
<td>0</td>
</tr>
<tr>
<td>Mutter et al</td>
<td>10</td>
<td>Case series</td>
<td>France</td>
<td>9</td>
<td>1 (10)</td>
<td>0</td>
</tr>
<tr>
<td>Galleano et al</td>
<td>4</td>
<td>Case series</td>
<td>Italy</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Myers et al</td>
<td>92</td>
<td>Cohort study</td>
<td>Ireland</td>
<td>8</td>
<td>5 (4)</td>
<td>3 (3)</td>
</tr>
<tr>
<td>Bretagnol et al</td>
<td>24</td>
<td>Cohort study</td>
<td>France</td>
<td>12</td>
<td>2 (8)</td>
<td>0</td>
</tr>
<tr>
<td>Franklin et al</td>
<td>40</td>
<td>Case series</td>
<td>USA</td>
<td>3</td>
<td>2 (5)</td>
<td>0</td>
</tr>
<tr>
<td>Mazza et al</td>
<td>25</td>
<td>Case series</td>
<td>France</td>
<td>14</td>
<td>3 (12)</td>
<td>0</td>
</tr>
<tr>
<td>Lam et al</td>
<td>6</td>
<td>Case series</td>
<td>Belgium</td>
<td>11</td>
<td>3 (50)</td>
<td>0</td>
</tr>
<tr>
<td>Favuzza et al</td>
<td>7</td>
<td>Case series</td>
<td>USA</td>
<td>8</td>
<td>2 (28)</td>
<td>0</td>
</tr>
<tr>
<td>Jaffer et al</td>
<td>1</td>
<td>Case report</td>
<td>UK</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Karoui et al</td>
<td>35</td>
<td>Case series</td>
<td>France</td>
<td>8</td>
<td>2 (17)</td>
<td>0</td>
</tr>
<tr>
<td>Lippi et al</td>
<td>13</td>
<td>Case series</td>
<td>Italy</td>
<td></td>
<td>2 (15)</td>
<td>3 (23)</td>
</tr>
<tr>
<td>White et al</td>
<td>35</td>
<td>Case series</td>
<td>Australia</td>
<td>14</td>
<td>12 (34)</td>
<td>0</td>
</tr>
<tr>
<td>Huscher et al</td>
<td>1</td>
<td>Case report</td>
<td>Italy</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>This study</td>
<td>427</td>
<td>Population</td>
<td>Ireland</td>
<td>10</td>
<td>60 (14)</td>
<td>17 (4)</td>
</tr>
</tbody>
</table>

Total: 768 Patients from 17 studies
Laparoscopic peritoneal lavage for generalized peritonitis due to perforated diverticulitis

E. Myers¹, M. Hurley², G. C. O’Sullivan³, D. Kavanagh¹, I. Wilson² and D. C. Winter¹

1257 Patient Admitted For Diverticulitis over 7 years

100 (7%) had Peritonitis + Evidence Free Air on X-ray or CT

Resuscitated

3rd Generation Cephalosporin + Flagyl

Taken Emergently to OR for Laparoscopy
100 Laparoscopic Assessment

92 Hinchey II/III

3 Died

92 Lavage/Drained

2 Non-resolution

88 Resolved

1 IR Drainage

9 Hartman's

2 Recurrences over 36 month follow-up
Damage control strategy for the management of perforated diverticulitis with generalized peritonitis: laparoscopic lavage and drainage vs. laparoscopic Hartmann’s procedure

Song Liang - Karla Russek - Morris E. Franklin Jr.

<table>
<thead>
<tr>
<th></th>
<th>LLD</th>
<th>LHP</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Patients</td>
<td>47</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>OR Time (minutes)</td>
<td>100 ± 40</td>
<td>182 ± 55</td>
<td>0.001</td>
</tr>
<tr>
<td>Blood Loss (ml)</td>
<td>34 ± 21</td>
<td>210 ± 17</td>
<td>0.01</td>
</tr>
<tr>
<td>Conversion</td>
<td>2 %</td>
<td>15 %</td>
<td>0.05</td>
</tr>
<tr>
<td>Complications</td>
<td>4 %</td>
<td>13 %</td>
<td>0.05</td>
</tr>
<tr>
<td>Mortality</td>
<td>0 %</td>
<td>2.4%</td>
<td>ns</td>
</tr>
<tr>
<td>Hospital Stay (days)</td>
<td>6.6 ± 2.4</td>
<td>16.6 ± 10</td>
<td>0.01</td>
</tr>
<tr>
<td>Colostomy Closure</td>
<td>na</td>
<td>72%</td>
<td>na</td>
</tr>
<tr>
<td>Elective Resection</td>
<td>45%</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>
Early experience with laparoscopic lavage for perforated diverticulitis

H. A. Swank¹, I. M. Mulder², A. G. M. Hoofwijk³, S. W. Nienhuijs⁴, J. F. Lange² and W. A. Bemelman¹, on behalf of the Dutch Diverticular Disease Collaborative Study Group

Laparoscopic lavage  n = 38

Sepsis controlled  n = 31

Complete recovery  n = 30

Death from bowel obstruction (patient receiving palliative care)  n = 1

Recurrent diverticulitis, sigmoid resection  n = 3

Sepsis not controlled, reintervention required  n = 7

Reintervention  n = 5

Hartmann’s procedure  n = 3

Diverting stoma  n = 1

Closure of perforation  n = 1

Death from multiple organ failure  n = 2

Sepsis controlled  n = 5

Complete recovery  n = 4

Death from aspiration  n = 1

Contraindicated in:

- Stage IV
- Stage III
- Major Comorbidity
- Immunosuppression
- High CRP

Br J Surg 2013

Renato Costi · François Cauchy · Alban Le Bian · Jean-François Honart · Nicolas Creuze · Claude Smadja


Used Rectal Contrast CT scanning to rule out stage IV disease

Nonoperative Rx

Successful

44
Extradigestive air at CT scan

3
Haemodinamically instable and/or diffuse CM extravasation

Emergency surgery

41
Haemodinamically stable and no diffuse CM extravasation

2
Received surgery within 24 hours $\$

39
Received conservative treatment $^a$ (studied population)

36
Did not need emergency surgery (successful management)

3
Needed delayed emergency surgery (unsuccessful management)

1
Sigmoidectomy/primary anastomosis/derivative colostomy

2
Surgical drainage

3

17
Underwent elective surgery ($^\text{0-stage-management}$)

19
Did not undergo elective surgery ($^\text{1-stage-management}$)

7
Needed radiological drainage
Management of Complicated Diverticulitis

<table>
<thead>
<tr>
<th>Clinical Dx, Lab Testing, SIRS Severity, Peritonitis, Plain X-rays</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Access, Fluid Bolus, Antibiotics</td>
</tr>
</tbody>
</table>

Emergency OR

- yes
- no

Peritonitis
Severe Sepsis

Free Air on Plain X-rays or CT scan?
Nonoperative Management of Perforated Diverticulitis With Extrapleural Air Is Safe and Effective in Selected Patients

Ville J. Sallinen, M.D., Ph.D. · Panu J. Mentula, M.D., Ph.D. · Ari K. Leppäniemi, M.D., Ph.D.

Dis Colon Rectum 2014; 57: 875–881

Helsinki, Finland
Management of Complicated Diverticulitis

Clinical Dx, Lab Testing, SIRS Severity, Peritonitis, Plain X-rays

IV Access, Fluid Bolus, Antibiotics

Septic Shock

yes no

Emergency OR

Pre-operative Optimization

OR

ICU

2-3 hours
Management of Complicated Diverticulitis

Clinical Dx, Lab Testing, SIRS Severity, Peritonitis, Plain X-rays

IV Access, Fluid Bolus, Antibiotics

Emergency OR

Septic Shock yes no

Pre-operative Optimization

OR

Septic Shock yes no

Damage Control
The Septic Abdomen and Sepsis

- Infection
- SIRS
- Sepsis
- Severe Sepsis

Intra-Abdominal Infection

Think
Damage Control

Abdominal Catastrophe

Septic Shock
Joined New Surgery Department in August 2006

Chair - Barbara Bass
Sepsis in major killer in surgical ICU
Rationale for Damage Control in Trauma

“The Bloody Vicious Cycle”

- Shock & Exsanguination
  - Coagulopathy
  - Hypothermia
  - Acidosis
  - Contact Activation
  - Clotting Factor Deficiencies

- Iatrogenic Factors
  - Cellular Shock

- Massive Transfusion

- Pre-Existing Diseases

- Tissue Injury

- Pre-existing Diseases

- Massive Transfusion
The Persistent Septic Shock Cycle

Abdominal Infection

- Microthrombosis
- Cellular Shock
- Endothelial Leak

Septic Shock & MOF

Excessive Proinflammation

- Vasodilation, Hypotension & Myocardial Depression
- Endothelial Activation
- DIC

Contact Activation
Break the **Persistent Septic Shock Cycle**

- **Abdominal Infection**
- **Micro-thrombosis**
- **Cellular Shock**
- **Endothelial Leak**
- **Septic Shock & MOF**
- **Excessive Proinflammation**
  - **Vasodilation, Hypotension & Myocardial Depression**
  - **Endothelial Activation**
  - **DIC**

**Prevent Acute Kidney Injury**
Acute kidney injury is surprisingly common and a powerful predictor of mortality in surgical sepsis

Laura E. White, MD, Heitham T. Hassoun, MD, Azra Bihorac, MD, Laura J. Moore, MD, R. Matt Sailors, Bruce A. McKinley, PhD, Alicia Valdivia, and Frederick A. Moore, MD, Houston, Texas


### Table 4. Severity of AKI and Outcomes in Surgical Sepsis

<table>
<thead>
<tr>
<th></th>
<th>No AKI, 85 (35%)</th>
<th>Risk, 48 (30%)</th>
<th>Injury, 35 (22%)</th>
<th>Failure, 78 (48%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilator-free days</td>
<td>25 ± 1</td>
<td>21 ± 1*</td>
<td>21 ± 2*</td>
<td>15 ± 1**†</td>
</tr>
<tr>
<td>Dialysis-free days</td>
<td>28 ± 0</td>
<td>27 ± 1</td>
<td>25 ± 2*</td>
<td>19 ± 1**†</td>
</tr>
<tr>
<td>ICU-free days</td>
<td>21 ± 1</td>
<td>17 ± 1*</td>
<td>17 ± 2</td>
<td>12 ± 1**†</td>
</tr>
<tr>
<td>Secondary infections, n (%)</td>
<td>6 (7)</td>
<td>5 (10)</td>
<td>4 (11)</td>
<td>18 (23)*</td>
</tr>
<tr>
<td>Early MOF, n (%)</td>
<td>1 (1)</td>
<td>5 (10)*</td>
<td>5 (14)*</td>
<td>21 (27)*****</td>
</tr>
<tr>
<td>Late MOF, n (%)</td>
<td>1 (1)</td>
<td>2 (4)</td>
<td>1 (3)</td>
<td>7 (9)*</td>
</tr>
<tr>
<td>ICU mortality (%)</td>
<td>1</td>
<td>4</td>
<td>11*</td>
<td>28**†</td>
</tr>
<tr>
<td>Hospital mortality, n (%)</td>
<td>2</td>
<td>4</td>
<td>26***</td>
<td>36***</td>
</tr>
<tr>
<td>Discharged home, n (%)</td>
<td>52 (63)</td>
<td>18 (39)*</td>
<td>14 (54)</td>
<td>19 (38)*</td>
</tr>
</tbody>
</table>

* p < 0.05 versus no AKI.
** p < 0.05 versus risk.
† p < 0.05 versus injury by t test.
‡ p = 5.0 × 10^{-7} by χ² test.

All continuous variables expressed as mean ± SEM.
Damage Control
Pre-operative Optimization

- Secure airway / vascular access
- Volume resuscitation
- Broad spectrum anti-microbials
- Blood products as necessary
- Vasopressors as necessary
- Correct Electrolytes
Damage Control Laparotomy

Complete by 6 hours

- Source control
- Resect & Debride Dead Bowel
- Close Holes to Limit Contamination
- Hemorrhage Control/Pack
- Limited Irrigation/Drain
- Temporary abdominal closure

“Perforectomy”
Damage Control
Post-operative Optimization

- Resuscitation
- Ventilator support
- Coagulopathy correction
- Rewarming
- Monitoring for ACS
- Surviving Sepsis Campaign
Damage Control
Second Operation

- Re-opening of laparotomy
- Pack removal
- Further resection/debridement
- Ostomy vs Bowel Anastomosis
- Feeding tubes, drains
- Close Fascia vs Wound Vac
Management of Colon Wounds in the Setting of Damage Control Laparotomy: A Cautionary Tale

Delayed Anastomosis = 12% leak

Primary repair of civilian colon injuries is safe in the damage control scenario

Delayed Anastomosis = 13% leak
Damage Control Laparotomy and the Open Abdomen: Is There an Increased Risk of Colonic Anastomotic Leak

Mickey M Ott, MD, Patrick Norris, PhD, Bryan Collier, DO, Oliver L. Gunter MD, William Riordan, MD, Jose Diaz, MD, Vanderbilt University Medical Center

Delayed Anastomosis = 27% leak

Safety of Performing Delayed Anastomosis During Damage Control Laparotomy for Destructive Colon Injuries

Carlos Ordenez, MD, Luis Pino, MD, Marisol Badiel, MD, John Loaiza, BSc, Jaun Carlos Puyana, MD, Fundaciñon Valle del Lili Department of Surgery and Critical Care

Delayed Anastomosis = 8% leak
51 Patients with emergent laparotomy for generalized peritonitis Hinchey III (n = 40) and IV (n = 11)

51 patients with emergent laparotomy for generalized peritonitis Hinchey III (n = 40) and IV (n = 11)

- **Damage Control**
  - 6 patients with suture only
  - 1 patient with limited resection
- **Second Look**
  - 3 patients with suture only
  - 3 patients with PRA
- **Follow-up (mean 24 months)**
  - 46 patients alive (90%)
  - 1 patient underwent elective resection for stenosis
  - 2 patients were cured

43 patients alive (84%)

- 40 patients alive without stoma (93% of surviving; 78% intent to treat)
- 1 patient persists ileostomy
- 5 patients ileostomy closed
- 1 patient persisting ileostomy
- 6 patients discharged with PAD
- 6 patients discharged with HP
- 11 patients discharged with HP
- 4 patients died
- 6 patients Hartmann reversal
- 3 patients died from underlying disease
- 2 patients persisting colostomy
Traditional Management of Patients with an Abdominal Infection and Septic Shock

Septic Abdomen

→ Operating Room

→ Definitive Operation

→ Vasopressors in OR

→ Early Death or AKI → MOF
Paradigm Shift in Management of Patients with an Abdominal Infection and Septic Shock

Septic Abdomen
  ↓
Operating Room
  ↓
Definitive Operation
  ↓
Vasopressors in OR
  ↓
Early Death or AKI
  → MOF

Septic Abdomen
  ↓

Resuscitation:
  ↓
Volume/Antibiotics
  ↓
Operating Room
  ↓
Damage/Source Control
  ↓
SICU Resuscitation
  ↓
Prevent AKI & Live
Establish a Benchmark

We queried the 2005 - 2007 NSQIP dataset & our prospective sepsis database to identify patient with:

1) Severe sepsis/septic shock (same definitions)
2) Emergency colon surgery

Primary endpoint: 30 day mortality
## Results

<table>
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* Actual vs. Predicted mortality p < 0.0001
** ACS vs. NSQIP mortality p = 0.06
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67% of our ACS patients underwent damage control
Management of Complicated Diverticulitis

Clinical Dx, Lab Testing, SIRS Severity, Peritonitis, Plain X-rays

IV Access, Fluid Bolus, Antibiotics

Septic Shock

Emergency OR

Pre-operative Optimization

OR

Laparoscopy

Low Risk

Lavage & Drain

Damage Control
Management of Complicated Diverticulitis

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Lavage & Drain

Definitive Resection

High Risk

Immunocompromised

Severe co-morbidity

Worsening MOF from sepsis

Stage IV disease
What is a Definitive Resection

**proximal margin** - back to normal colon

no diverticula in the anastomosis

**distal margin** - rectum

**ureteral stents** - selective

**intraoperative colon lavage** - does not work

**omentoplasty of suture line** - does not work
Factors to Consider after Definitive Resection

Severity of Disease
- Hinchey 1
- Hinchey 2
- Hinchey 3
- Hinchey 4

Patient Presenting Physiology
- Stable
- Tachycardia
- Hypotensive
- Septic Shock

Patient Co morbidities
- Healthy
- HTN
- DM
- Immunosuppression
- Malnourished
- Advanced Organ Failure

Hospital/Situational Factors
- Tertiary Care Center/well staffed
- Community Hospital/poorly staffed
- Experienced Ancillary Staff
- Off Hours Operation/Equipment Issues

Surgeon Factors
- Specialized/High Volume
- Inexperienced/Low Volume

Operative Intervention
- PRA no Stoma
- PRA + Stoma
- Hartmann’s Procedure
Management of Complicated Diverticulitis

Clinical Dx, Lab Testing, SIRS Severity, Peritonitis, Plain X-rays
- IV Access, Fluid Bolus, Antibiotics
  - Emergency OR
    - yes: Septic Shock
    - no: CT Scan
      - Grade III/IV
      - Grade II
      - Grade I A/B
  - OR
    - yes: Septic Shock
    - no:
      - Laparoscopy
        - Low Risk
          - Lavage & Drain
        - High Risk
          - Definitive Resection

Pre-operative Optimization
- Damage Control
Management of Complicated Diverticulitis

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Definitive Resection

Grade III/IV

Laparoscopy

High Risk

Immunocompromised

Severe co-morbidity

Worsening MOF

Stage IV disease

CT Scan
Results from percutaneous drainage of Hinchey stage II diverticulitis guided by computed tomography scan


1 Department of Surgery, University Hospital Geneva, Rue Micheli-du-Crest 24
2 Department of Radiology, University Hospital Geneva, Rue Micheli-du-Crest 2
Management of Complicated Diverticulitis

Clinical Dx, Lab Testing, SIRS Severity, Peritonitis, Plain X-rays

IV Access, Fluid Bolus, Antibiotics

Emergency OR

CT Scan

Grade III/IV

Grade II

Grade I A/B

IR Drain

Laparoscopy

Low Risk

High Risk

Definitive Resection

Lavage & Drain

Successful

Observation

Damage Control

Pre-operative Optimization

Septic Shock

yes

no

yes

no

yes

no

yes

no

no

no

Home

Fail

Successful

Observation

yes

no

CT Scan

Emergency OR

IV Access, Fluid Bolus, Antibiotics

Clinical Dx, Lab Testing, SIRS Severity, Peritonitis, Plain X-rays

ED

ED
Observation

NPO

NG tube if symptomatic

Broad spectrum IV antibiotics

Monitor PE, SIRS Severity and WBC

Start diet & PO antibiotics when return of bowel function, resolution of abdominal tenderness & leukocytosis

DC home when tolerating diet on a total 14 day course of antibiotics (\textcolor{green}{? shorter duration}).
Management of Complicated Diverticulitis

**ED**

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Emergency OR ➔ no ➔ CT Scan

- **CT Scan**
  - Grade III/IV ➔ IR Drain
  - Grade II ➔ Observe
  - Grade I A/B ➔ Observe

Laparoscopy ➔

- Low Risk ➔ IR Drain ➔ observe
- High Risk ➔ Definitive Resection ➔ observe

Pre-operative Optimization ➔

- Damage Control ➔ yes ➔ Septic Shock ➔ Emergency OR ➔ no ➔ CT Scan
- no ➔ no ➔ Septic Shock ➔ Emergency OR ➔ no ➔ CT Scan

Successful ➔ Home

Fail ➔ Home
Follow-up

Return to clinic if symptoms recur

Return to clinic at 6 weeks for exam

If inflammation resolved  →  ? schedule colonoscopy
Risk of colon cancer after computed tomography-diagnosed acute diverticulitis: is routine colonoscopy necessary?

Ville Sallinen · Panu Mentula · Ari Leppäniemi

Helsinki, Finland
Surg Endosc 2014

633 CT Scan Dx Acute Diverticulitis

97 Emergency OR
- 7 Colon Cancer

536 No OR
- 394 Colonoscopy
- 17 (2.7%) Colon Cancers
  - 16 Abscesses (11% of all abscesses)
  - 1 Pericolic Air

142 No Colonoscopy
Elective Prophylactic Resection After Complicated Diverticulitis

Persistent or recurrent symptoms

Immunocompromised host

Anatomic deformity including a stricture or fistula.
Management of Complicated Diverticulitis

Clinical Dx, Lab Testing, SIRS Severity, Peritonitis, Plain X-rays

IV Access, Fluid Bolus, Antibiotics

Septic Shock yes no

Emergency OR yes no

CT Scan

Grade III/IV

Grade II

Grade I A/B

IR Drain yes no

Observe

Fail

Successful

Lavage & Drain

Definitive Resection

Low Risk

High Risk