Iatrogenic Colonic Perforation: Repair Using Laparoscopic Technique

Lucia Miranda, MD, Anna Settembre, MD, Domenico Piccolboni, MD, Pietro Capasso, MD, and Francesco Corcione, MD

**Background:** Iatrogenic colonic perforation is a rare complication of colonoscopies. Nowadays, there are still no specific guidelines for the optimal management of these complications (open surgery with colonic resection and anastomosis or colonic diversion, primary repair, endoscopic clips, nonoperative management, and laparoscopic approach).

**Methods:** A retrospective analysis of 9 patients operated on for iatrogenic colonic perforations (February 2002 to August 2009) is reported. These were treated, in 6 cases, with laparoscopic colorrhaphy, in 2 cases with laparoscopic colonic resection and anastomosis (with 1 temporary ileostomy), and the last patient with laparoscopic Hartmann procedure.

**Results:** All patients underwent successful laparoscopic treatment, with no mortality.

**Conclusions:** Laparoscopic treatment of iatrogenic colonic perforations is a compromise between risks of nonoperative therapy and invasive surgery. According to our early experience, laparoscopic approach could be used as first choice in the management of these complications. Further studies are necessary for full validation of this approach.

**Key Words:** iatrogenic colonic perforation, laparoscopy, laparoscopic repair, laparoscopic technique


The incidence of major complications after diagnostic or therapeutic endoscopic procedures of the colon is low and iatrogenic colonic perforation is rare. Nevertheless, in the last 10 years, since screening for colorectal cancer has been implemented and more operative colonoscopies have been performed (polypectomy, colonoscopic submucosal dissection...), the rising number of colonoscopies has caused a greater number of such complications.1–3

The incidence is estimated in the range of 0.01% to 0.35% to 0.65% for diagnostic colonoscopy; during therapeutic procedures, the perforation risk range from 0.029% to 2.14% and has been reported in up to 3% in the various published series.1–7

Specific guidelines for the optimal management of these complications are not there yet. Traditionally, open surgery has been the standard of care (laparotomy and colonic resection and anastomosis or colonic diversion, or primary repair and peritoneal lavage and drainage).

Received for publication May 1, 2010; accepted February 28, 2011.
From the Department of General Surgery, Center of Laparoscopic and Robotic Surgery, Monaldi Hospital via L. Bianchi, Napoli, Italy.
Reprints: Lucia Miranda, MD, Department of General Surgery, Center of Laparoscopic and Robotic Surgery, Monaldi Hospital via L. Bianchi, Napoli, Italy (e-mail: lumira@email.it).
Copyright © 2011 by Lippincott Williams & Wilkins.
perforation covered by omentum and by many visceroparietal adhesions, and number 5 small perforation).

In all patients, nasogastric tube was inserted and broad spectrum intravenous antibiotics were administered; administration was started at perforation diagnosis and continued for 72 hours, except patient number 1 (48 h), number 2 (96 h), and number 3 (120 h).

**RESULTS**

Operative time ranged from 50 to 190 minutes (left hemicolectomy), mean 82 minutes (Table 2).

All patients underwent successful laparoscopic treatment (6 perforations treated by laparoscopic primary suture, 1 Hartmann procedure, and 2 colonic resection).

Patient number 3 had ileus for 3 days and fever for 4 days. Patient number 8 had wound infection in 2 trocar sites.

Patient number 2 complained against us and the endoscopists, and started a legal procedure after 1 year (despite successful restoration of intestinal continuity after Hartmann procedure performed 6 months later).

Postoperative stay ranged from 3 (patient number 1) to 9 days (patient number 3), mean 5.8 days.

---

**RESULTS**

Operative time ranged from 50 to 190 minutes (left hemicolectomy), mean 82 minutes (Table 2).

All patients underwent successful laparoscopic treatment (6 perforations treated by laparoscopic primary suture, 1 Hartmann procedure, and 2 colonic resection).

Patient number 3 had ileus for 3 days and fever for 4 days. Patient number 8 had wound infection in 2 trocar sites.

Patient number 2 complained against us and the endoscopists, and started a legal procedure after 1 year (despite successful restoration of intestinal continuity after Hartmann procedure performed 6 months later).

Postoperative stay ranged from 3 (patient number 1) to 9 days (patient number 3), mean 5.8 days.

---

**TABLE 1. Patients, indication for colonoscopy, site and size of perforation, symptoms, time perforation- surgical treatment. Patients, Site and Size of Perforation, Symptoms, Time Perforation-Surgery**

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (y), Sex</th>
<th>Indication for Colonoscopy</th>
<th>Site</th>
<th>Elapsed Time Between Perforation and Surgical Treatment</th>
<th>Symptoms and Signs</th>
<th>Size of Perforations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>54, M</td>
<td>Polypectomy</td>
<td>Transverse-hepatic flexure</td>
<td>Suspected immediately by endoscopist; 4 h</td>
<td>Progressive abdominal pain and distension</td>
<td>About 5-6 mm</td>
</tr>
<tr>
<td>2</td>
<td>60, F</td>
<td>Screening for bleeding</td>
<td>Rectosigmoid region</td>
<td>Diagnosed after 18 h (coming from other hospital); 20 h</td>
<td>Abdominal pain and distension, moderate peritonitis, and leukocytosis (18,000 wbc)</td>
<td>3 cm, irregular margins</td>
</tr>
<tr>
<td>3</td>
<td>54, F</td>
<td>Diverticulosis</td>
<td>Sigmoid</td>
<td>Diagnosed immediately by endoscopist (visualization of extraintestinal tissue); 2 h</td>
<td>Progressive abdominal pain and distension</td>
<td>1 cm</td>
</tr>
<tr>
<td>4</td>
<td>65, F</td>
<td>Screening for bleeding</td>
<td>Sigmoid</td>
<td>Suspected after 6 h; 8 h</td>
<td>Abdominal pain and progressive distension</td>
<td>1 cm</td>
</tr>
<tr>
<td>5</td>
<td>58, M</td>
<td>Polypectomy</td>
<td>Descending-sigmoid region</td>
<td>Suspected after 6 h; 9 h</td>
<td>Abdominal distension, progressive abdominal pain after 3 h, and leukocytosis (15,000 wbc)</td>
<td>About 5-6 mm</td>
</tr>
<tr>
<td>6</td>
<td>62, M</td>
<td>Follow up after right colectomy</td>
<td>Sigmoid</td>
<td>Diagnosed immediately by endoscopist (visualization of extraintestinal tissue); 1 h</td>
<td>Abdominal pain and distension</td>
<td>2.5 cm</td>
</tr>
<tr>
<td>7</td>
<td>65, F</td>
<td>Recurrent abdominal pain, bleeding, and diverticulosis</td>
<td>Sigmoid</td>
<td>Suspected after 6 h; 8 h</td>
<td>Abdominal pain and distension, mild local peritonitis, and leukocytosis (14,000 wbc)</td>
<td>Diverticular perforation About 5-6 mm</td>
</tr>
<tr>
<td>8</td>
<td>60, M</td>
<td>Research of primary tumor in patient with solitary hepatic metastasis</td>
<td>Rectosigmoid region (stenotic neoplastic lesion)</td>
<td>Diagnosed immediately by endoscopist; 3 h</td>
<td>Abdominal pain and progressive distension, leukocytosis (15,500 wbc)</td>
<td>Large perforation (3 cm), irregular margins near the malignant neoplasm (intraoperative histologic examination)</td>
</tr>
<tr>
<td>9</td>
<td>80, F</td>
<td>Recurrent bleeding</td>
<td>Sigmoid region</td>
<td>Diagnosed immediately by endoscopist; 2 h</td>
<td>Immediate abdominal distension and pain</td>
<td>Large perforation (2.5 cm)</td>
</tr>
</tbody>
</table>
The postoperative course was uneventful in the other cases. After 40 days, ileostomy closure was performed in patient number 8. At 6 (case number 9) and 12 months follow-up, the patients were in good clinical conditions.

## DISCUSSION

Iatrogenic colonic perforation is the most serious complication of diagnostic and therapeutic colonoscopy. In this event, morbidity and also mortality are much increased if bacterial intra colonic load spreads into the peritoneal cavity with peritoneal contamination that can quickly progress to peritonitis and generalized sepsis. In the last decade, the growing number of diagnostic and operative colonoscopies, have determined an increasing rate of colonic perforation.1–3,9,10

In literature, the incidence of iatrogenic perforation is low and can range from 0.002% to 0.66% for diagnostic colonoscopy, whereas during therapeutic procedures, the perforation risk ranges from 0.029% to 2.14% and may achieve 3%.2,6,8,10,16

The mortality risk, in various published series, has ranged from 0.01% to 0.34%, whereas mortality in patients with perforation can achieve 25.6%.2,4,6,8,10,12–16

All surgeons and endoscopists agree that a prompt and appropriate treatment is required, but as this complication is rare, in the last 10 years the treatment has evolved and more options are possible. At present, the optimal management is still debated and remains controversial.

To select the optimal treatment, we must consider the type of perforation, the quality of bowel preparation, the time from perforation, the different colonic pathology, the level of peritoneal contamination, and patient’s clinical conditions.

The mechanisms of colonic perforation are various: in diagnostic colonoscopy, they are mechanical and perforations are usually large because of direct laceration caused by the tip of the endoscope, by lateral pressure of a loop, by over insufflation, or they can occur in a pathologic area of the colon. In therapeutic colonoscopy, lesions are usually small and generally due to ischemia caused by electric or thermal injury.

The patient who undergoes colonoscopy, usually have mechanical preparation by polyethylene glycol electrolyte solution 12 to 18 hours before the examination. The intracolonic bacterial load is markedly decreased.

These peculiarities are at the root of the treatment evolution in the last decade.

Traditionally, laparotomy with bowel resection and anastomosis, or colonic diversion have been preferred. In the last years, many authors have advocated primary repair of colonic perforation.

Although surgery remains the standard of care, nonoperative management is suggested as well.

In fact, for small perforations, especially those occurring during therapeutic colonoscopy and in very selected patients, asymptomatic and/or without signs of peritoneal irritation during the observation, with optimal colon preparation, the patients can be managed without

<p>| TABLE 2. Radiological Findings, Surgical Treatment, Operative Time |
|---------------------------------|-------------------------------------------------|------------------|</p>
<table>
<thead>
<tr>
<th>Radiologic Studies, Laboratory</th>
<th>Surgical Procedure</th>
<th>Operative Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Abdominal x-ray: free intraperitoneal air (8,500 wbc)</td>
<td>Laparoscopic primary suture (1-layer stitches), and protection by omentum, copious lavage, and 1 drainage in Douglas</td>
<td>50</td>
</tr>
<tr>
<td>2 CT scan: free intraperitoneal air, retroperitoneal air, and local fluid collection. Leukocytosis (18,000 wbc)</td>
<td>Laparoscopic resection with 2 cm margin from the perforation with laparoscopic linear stapler and terminal colostomy (Hartmann’s procedure), copious lavage, and 1 drainage in Douglas</td>
<td>90</td>
</tr>
<tr>
<td>3 Not performed (9,500 wbc)</td>
<td>Laparoscopic primary suture (1-layer stitches), and protection by omentum, copious lavage, 1 drainage in Douglas, and 1 near the perforation</td>
<td>65</td>
</tr>
<tr>
<td>4 CT scan: free intraperitoneal air, minimal fluid collection. Leukocytosis (15,500 wbc)</td>
<td>Laparoscopic primary suture (1-layer stitches), and protection by omentum, copious lavage, and 1 drainage in Douglas</td>
<td>50</td>
</tr>
<tr>
<td>5 Abdominal x-ray: free intraperitoneal air. Leukocytosis (15,000 wbc)</td>
<td>Laparoscopic primary suture, (1-layer stitches), copious lavage, and 1 drainage in Douglas</td>
<td>60</td>
</tr>
<tr>
<td>6 Not performed (9,500 wbc)</td>
<td>Laparoscopic primary suture (2-layer stitches) and protection by omentum, copious lavage, and 1 drainage in Douglas</td>
<td>65</td>
</tr>
<tr>
<td>7 CT scan: free intraperitoneal air, retroperitoneal air, and local fluid collection. Leukocytosis (14,000 wbc)</td>
<td>Diagnostic laparoscopy, copious lavage, laparoscopic descending-sigmoid resection and anastomosis, and 1 drainage in Douglas. (definitive treatment of diverticular disease)</td>
<td>120</td>
</tr>
<tr>
<td>8 Not performed (15,500 wbc)</td>
<td>Diagnostic laparoscopy, copious lavage, laparoscopic left hemicolectomy and ileostomy, and 1 drainage in Douglas. (definitive treatment of pathology)</td>
<td>190</td>
</tr>
<tr>
<td>9 CT scan: free intraperitoneal air (10,500 wbc)</td>
<td>Laparoscopic repair with linear stapler, copious lavage, 1 drainage in Douglas</td>
<td>50</td>
</tr>
</tbody>
</table>

CT indicates computed tomography; WBC, white blood cells.
surgery. They should be kept fasting for bowel rest, with nasogastric tube and broad-spectrum intravenous antibiotics.\textsuperscript{4,6,9,12,13} Strict monitoring of peritonitis signs should avoid the risk of missing the right time for surgery.

This approach minimizes morbidity and mortality of bowel surgery. Immediate operative repair is mandatory if minimal signs of peritonitis or changes in the clinical status occur.

These options (primary repair or nonoperative treatment) are possible in patients with a good colon preparation. In a prepared colon, the intracolonic bacterial load is markedly decreased and the amount of peri toneal contamination should be minimized.

Endoscopic clipping to close perforation has been suggested for small (≤10 mm) parietal defects. The endoscopic repair must be carried out immediately, therefore, endoscopic clipping is feasible only if the endoscopist recognize the perforation during colonoscopy.\textsuperscript{13-15,17,18}

Owing to the small number of patients, these data must be interpreted with caution.\textsuperscript{17,18}

Even in these cases, strict monitoring of initial peritonitis signs is recommended to avoid the possibility of a delay in surgical treatment.

Recently, some authors have suggested that the use of laparoscopic technique could be safe and effective in management of iatrogenic colonic perforation, but there are still few reports on laparoscopic access for management of iatrogenic colonic perforation.\textsuperscript{5-8,19-26}

Hansen et al\textsuperscript{8} treated 11 patients by laparoscopy, and they reported only 21 further cases in whom laparoscopic treatment was attempted. In a review, we found only 44 more patients in whom laparoscopic repair was performed (most cases are reported by Rumstad and Schilling,\textsuperscript{19} Bleier et al,\textsuperscript{2} and Rotholtz et al\textsuperscript{26}, respectively, 12, 11, and 14 cases with no morbidity and mortality).\textsuperscript{20-25}

Our experience consists of 9 patients, with iatrogenic colonic perforation, approached laparoscopically without intraoperative and postoperative mortality and only little morbidity.

In our opinion, laparoscopic approach is a good choice for the management of colonic perforation because it allows to explore the entire abdomen and the colon, to identify the perforation (directly or with the help of intraoperative colonoscopy). The repair can be carried out with a simple colorrhaphy (1 or 2-layer stitches), or with a tangential resection.

The timing of diagnosis and immediate surgery is important to avoid peritoneal contamination and to have more chances to perform a primary colonic repair.

We used to perform 1-layer suture, however, double layer has been performed in patient number 6, because of a large perforation with bleeding from suture line.

We also can use a linear stapler to close more quickly a large defect in antimesenteric side; (patient number 9, a large defect was closed more expeditiously with stapler).

If primary colonic suture is impossible because of the condition of the colon, and peritoneal contamination, laparoscopic resection or a colonic diversion like Hartmann procedure (patient number 2) can be successfully carried out laparoscopically with all the advantages of minimally invasive surgery. The level of peritoneal contamination and colon conditions suggest the choice between bowel resection, ileostomy, or colonic diversion.

Surgical procedure should be identical to that used in open repair, and follow to surgeon’s experience.

In 2 patients (number 7-diverticular disease- and number 8-colonic cancer-), we selected a definitive treatment of their pathology.

In case of difficulty, laparoscopy can be converted to an open procedure.

During laparoscopy, it is necessary to copiously irrigate the abdomen, (we used to perform lavage with 6 to 8 L of saline solution), and visualize the exact site of perforation through a wide mobilization of the colon, that is mandatory if the site of perforation is in the retroperitoneum.

Conservative treatment, preferred by some authors in very selected patients, is the real noninvasive treatment,\textsuperscript{4,6,9,12,13} but it is not without risks.

Failure of conservative treatment or delay in performing surgical approach may cause serious complications, requiring more extensive surgical procedures with increased risk of peritoneal infection, poor outcome, major morbidity, and also mortality caused by sepsis.\textsuperscript{4,10,16,17}

Laparoscopic surgical repair of iatrogenic colonic perforations is a good choice to minimize morbidity and mortality; this treatment is safer than nonoperative treatment, and entails less invasiveness and complications than open surgery. This approach was the best strategy for our patients.

Moreover, colonic perforation is one of the most frequent causes of legal problems for the endoscopists, and laparoscopic treatment is interesting also to avoid the negative psychological impact of major surgery.

CONCLUSIONS

Laparoscopic treatment of iatrogenic colonic perforations is a good compromise between the potential risks of nonoperative strategy and more invasive surgery and could be used as first step in the management of these complications. It has been a feasible option in our patients.

We think that laparoscopic approach can be performed in all cases, as an initial procedure, in these complications. Conversion to laparotomy is always possible.

An open surgery approach is in our opinion preferable if bowel distention due to peritonitis, precludes a safe access and surgical treatment.

Further studies are necessary to achieve full validation of this approach.

REFERENCES