

## Management of iatrogenic colorectal perforation: From surgery to endoscopy

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### Abstract

Iatrogenic colon perforation is one the most pernicious complications for patients undergoing endoscopic screening or therapy. It is a serious but rare complication of colonoscopy. However, with the expansion of the indications for endoscopic therapies for gastrointestinal diseases, the frequency of colorectal perforation has increased. The management of iatrogenic colorectal

perforation is still a challenge for many endoscopists. The methods for treating this complication vary, including conservative treatment, surgical treatment, laparoscopy and endoscopy. In this review, we highlight the etiology, recognition and treatment of colorectal iatrogenic perforation. Specifically, we shed light on the endoscopic management of this rare complication.

**Key words:** Iatrogenic perforation; Colorectum; Surgery; Laparoscopy; Endoscopy

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**Core tip:** Iatrogenic colorectal perforation is one of the most pernicious complications for patients who undergo endoscopic screening or therapy. In this review, we highlight the etiology, recognition and treatment of colorectal iatrogenic perforation, including conservative treatment, surgical treatment and laparoscopy. The flying development of the endoscope and its surgical assistant accessories have improved the endoscopic clip closure procedure. It can remarkably decrease the rate of surgical reparation following iatrogenic perforation of the colon.

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### INTRODUCTION

Iatrogenic perforation of the colon and rectum is an avoidable complication of diagnostic tests or an unavoidable procedure of endoscopic treatment. In the past, the causes of iatrogenic perforation were

barium enema and diagnostic endoscopy. Recently, due to the expanded indications for endoscopic resection lesions, more colon perforation occurs after colonoscopy therapy. As a major cause, it is estimated that the frequency of iatrogenic perforation is 0.019%-0.8% and 0.10%-3% for diagnostic and therapeutic colonoscopy, respectively<sup>[1-4]</sup>. Perforation located at the colon can rapidly cause peritonitis and even sepsis. These complications imply high morbidity and mortality. Therefore, all endoscopists should pay more attention to prevent this kind of perforation and immediate treatment is needed once colon perforations occur. In this review, we highlight the etiology, recognition and treatment of colorectal iatrogenic perforation. Specifically, we shed light on the endoscopic management of this rare complication.

## ETIOLOGY

Colonoscopy is widely used during diagnosis and therapy in endoscopy. There has been an increasing number of patients undergoing this procedure. Consequently, the number of associated complications has also risen. In addition, older and less appropriate patients are receiving colonoscopies who are more vulnerable to iatrogenic colonoscopic injury. In the Iqbal *et al*<sup>[5]</sup> study, the perforation rates were higher at the rectosigmoid junction and the sigmoid colon (52%). The perforation rates in other sites of the colon were 17% (cecum), 14% (ascending colon), 7% (transverse colon), 8% (descending colon) and 1% (rectum), respectively. The perforation size was between 0.1 and 6.0 cm (average, 1.7 cm). Mechanical injury leads to the largest perforations, while electrocautery injury causes the smallest perforations. The patient risk factors were state of anticoagulation, extensive contamination, active malignancy, prior hospitalization history, delayed diagnosis and steroid usage. Electrocautery, polypectomy and mechanical injury caused the postoperative morbidity. Other factors which pose difficulty in colonoscopy and likely cause perforations include the existence of dense or wide-mouthed diverticula, incomplete bowel preparation, active hemorrhage and, the most important, the experience of endoscopists.

## DIAGNOSIS

With the different causes, sizes and sites of perforation, there are various complaints from patients, including non-pain, only localized instantaneous pain which happens suddenly, severe cramp-like pain and distension of the abdomen<sup>[5,6]</sup>. If there was a tiny perforation caused by snaring or the endoscopic knife application, the patient would not have symptoms or only local pain. In general, the frequency of these kinds of abdominal pain is remarkably higher in perforation caused by diagnostic endoscopy than surgical endoscopy. Abdominal roentgenogram provides a quick sign. Cho

*et al*<sup>[3]</sup> reported a lot of subdiaphragmatic free air in all cases of perforation caused by diagnostic endoscopy and in almost 45% of therapeutic perforation cases. Thus, abdominal roentgenogram is a cost-effective and useful method to detect the presence of subdiaphragmatic free air, with a positive predictive value of 92%<sup>[5]</sup>. However, sometimes subdiaphragmatic free air cannot be detected by abdominal roentgenogram. In this setting, computed tomography can offer great help in diagnosing the free air, micro-perforations and/or abscess. Patients who are clinically unstable or who exhibit peritonitis on physical examination warrant immediate exploration.

## MANAGEMENT

### Conservative management

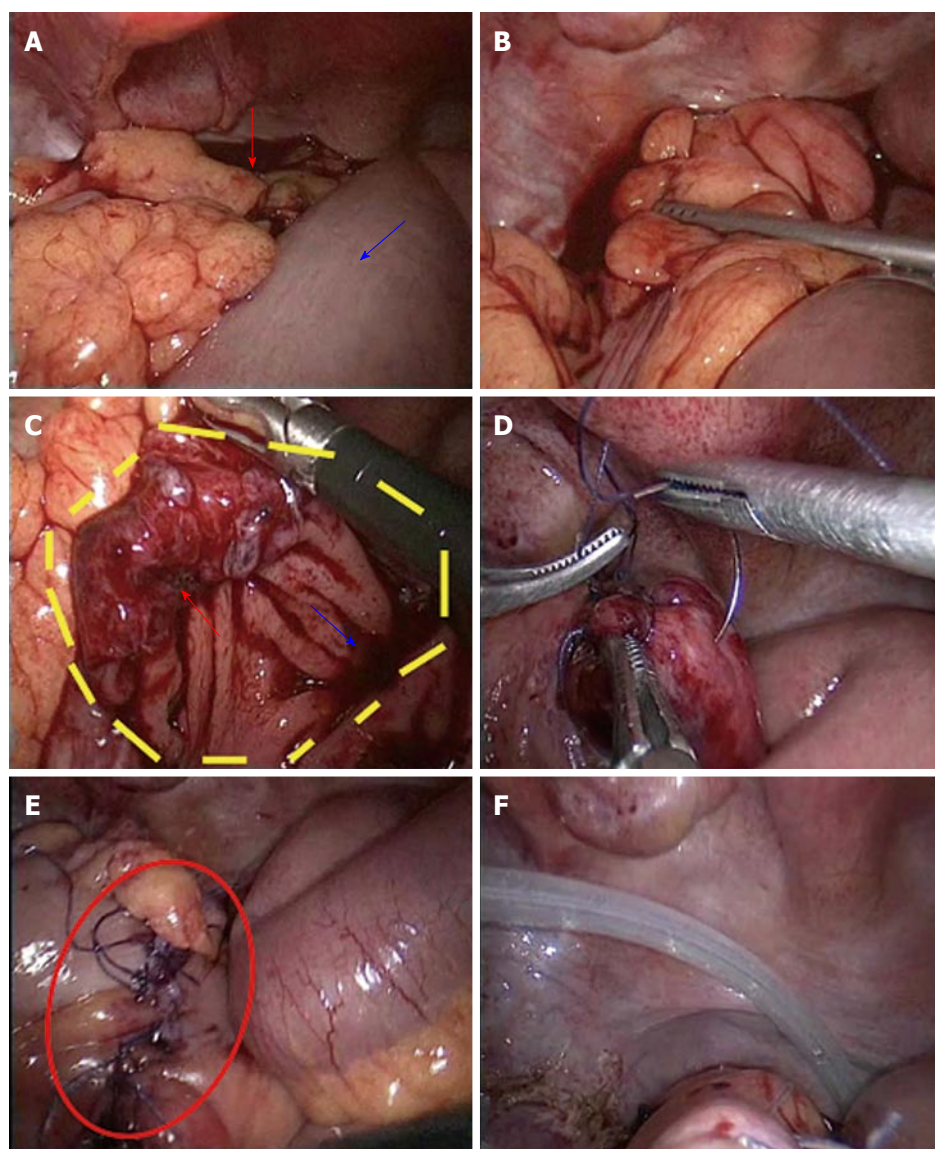
If a patient presents as subdiaphragmatic free air alone, it is not an indication for surgical reparation. Most patients who do not show signs of peritoneal irritation or abdominal sepsis have an ideal prognosis after being given intravenous antibiotic therapy, bowel rest and serial abdominal examinations<sup>[7]</sup>. Conservative management in appropriate patients results in a shorter length of hospitalization and lower morbidity. Iqbal *et al*<sup>[5]</sup> reported only one death among patients undergoing conservative treatment, a patient in the intensive care unit whose family refused surgery.

### Surgical management

Prompt abdominal surgery is usually recommended once perforation has occurred<sup>[8,9]</sup>. Immediate surgical intervention is not compulsory. Intraoperative findings determine the surgical management. Surgery may be primary closure or resection with primary anastomosis in cases of intra-abdominal contamination accompanied by normal tissues in order to limit the comorbidity. Due to the extensive contamination, poor tissue situation and a higher complication rate, stoma or fecal diversion after reparation is chosen. Iqbal *et al*<sup>[5]</sup> indicated that only two preoperative factors determined the type of procedure, the time after the perforation and mechanical injuries. Comparing patients who were diagnosed with perforation after 24 h, those within 24 h were more suitable for a primary closure because the latter was more likely to have extensive fecal contamination. Moreover, mechanical injury always induced larger perforations (average, 1.9 cm) which needs fecal diversion after resection. However, this type of injury cannot always be ascertained before surgery.

### Laparoscopic management

With the emergence and development of minimally invasive surgery over the last few decades, laparoscopic colonic repair has been increasingly adopted for colorectal perforation repair<sup>[10-12]</sup>. In the past, laparotomy was usually selected as the treatment approach for iatrogenic colon perforation and most patients under-



**Figure 1** Laparoscopic management of iatrogenic colorectal perforation with endoscopic assistance. A: Laparoscopic examination of iatrogenic colorectal perforation: blue arrow, small bowel dilation; red arrow, perforation location; B: Explore and make sure of the perforation location; C: Expose the perforation: blue arrow, anal side; red arrow, opposite side; D: Suture the perforation; E: Effective closure of the perforation; F: Place a drainage tube.

went colostomy<sup>[13,14]</sup>. Unfortunately, ileostomy and colostomy are associated with a significant decrease in patient quality of life and require another operation to restore intestinal continuity<sup>[15]</sup>. Several doctors have therefore proposed either a primary repair of the colorectal perforation or a segmental colectomy with primary anastomosis. The improvement of laparoscopic techniques boosts the practice of laparoscopic repair for colon perforations more widely<sup>[16]</sup>. In the Zhang *et al*<sup>[4]</sup> study, their experience in laparoscopic direct suturing of colon perforations indicated that laparoscopic primary perforation repair was a safe and feasible repair method. Compared to an open method, patients who underwent laparoscopic repair had a significantly shorter total incision length ( $16 \pm 15$  mm vs  $163 \pm 54$  mm), shorter overall length of stay ( $5.1 \pm 1.7$  d vs  $9.2 \pm 3.1$  d) and fewer perioperative complications (two vs

five)<sup>[17]</sup>. Thus, their data suggest it is rational to regard laparoscopic therapy as the initial approach for repairing iatrogenic colorectal perforation.

### Endoscopic management

Despite the fact that laparoscopy is effective in resolving colorectal iatrogenic perforation, recent advances of endoscopic techniques have made it possible to handle iatrogenic perforations by applying mini-invasive procedures. Endoscopy can assist laparoscopy to close the perforation (Figure 1). Repairing the perforation alone with endoclips has been well described in related studies since 1997<sup>[18]</sup>. In addition, large or difficult intestinal perforations can be treated with a combined application of endoclips and endoloops<sup>[19]</sup>. In the recent study by Kim *et al*<sup>[20]</sup>, 115285 diagnostic colonoscopies were performed with a total of 27 iatrogenic colon



perforations (incidence of 0.02%). Endoscopic closure of the perforation site was attempted in 16 patients, with success in 13 patients. This suggests that immediate endoscopic closure with clips can be performed for diagnostic perforations as well as therapeutic colonoscopy-associated perforations.

Jovanovic *et al*<sup>[21]</sup> reported that endoscopic closure of colonic perforations could be performed when the perforation is < 1 cm. Few authors<sup>[22,23]</sup> have used the endoclips to treat perforations > 1 cm. Trecca *et al*<sup>[22]</sup> reported 2 perforations > 3 cm that were managed by using endoclips successfully. In the Velchuru *et al*<sup>[24]</sup> case report, the perforation was 3 cm in size and 7 clips were used to close the defect. The patient was discharged on the second day. The number of clips used depends on the size of the perforation. Endoscopic closure of an iatrogenic colonic perforation at colonoscopy is feasible as the prepped colon contains minimal contamination. Considering the technical challenge of endoclip application, an experienced endoscopist is the most important factor, as well as the site and size of the perforation. Clip closure was reported to be successful in 69.2% to 92.6% of cases<sup>[25,26]</sup>.

However, there have also been some limitations in the treatment of colorectal perforation by endoscopic clips. It is hard to evaluate the degree of closure after an endoscopic clip reparation. If the endoscopic clip closure is incomplete, it would develop to limited leakage, which may result in the abdominal symptoms again. In these cases, minor symptoms make it difficult to decide whether or not to operate. The proper management may be delayed until the optimal period. Moreover, delayed complications can develop due to extra-luminal contaminants or intermittent minor leakage. The Cho *et al*<sup>[3]</sup> study indicates that peritoneal abscess formation developed in 50% of cases after a large perforation repaired by endoscopic clips. After colorectal perforation, the decision to perform surgery or endoscopic closure should be made promptly, within 24 h. The high risk clinical factors within 24 h after a colon perforation include a large perforation, leukocytosis, fever, severe abdominal pain and large peritoneal free gas and these should also be identified within 24 h.

## CONCLUSION

In conclusion, iatrogenic colorectal perforation is one of the most pernicious complications for patients undergoing endoscopic screening or therapy. Its management is still a challenge for many endoscopists. The methods of treating this complication are varied and include conservative treatment, surgical treatment and laparoscopy. With the development of endoscopy and its assistant accessories, using endoscopic clips to repair the iatrogenic perforation could remarkably decrease the possibility of undergoing additional surgery. For patients with a high risk of complications after endoscopic clip reparation, an early decision regarding additional surgery such as laparoscopy is also significant.

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