

Colonoscopic perforation: Incidence, risk factors, management and outcome

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Author contributions: Lohsiriwat V performed the literature review, acquisition and analysis of data, and manuscript preparation.

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Received: October 11, 2009 Revised: November 9, 2009

Accepted: November 16, 2009

Published online: January 28, 2010

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Lohsiriwat V. Colonoscopic perforation: Incidence, risk factors, management and outcome. *World J Gastroenterol* 2010; 16(4): 425-430 Available from: URL: <http://www.wjgnet.com/1007-9327/full/v16/i4/425.htm> DOI: <http://dx.doi.org/10.3748/wjg.v16.i4.425>

Abstract

This review discusses the incidence, risk factors, management and outcome of colonoscopic perforation (CP). The incidence of CP ranges from 0.016% to 0.2% following diagnostic colonoscopies and could be up to 5% following some colonoscopic interventions. The perforations are frequently related to therapeutic colonoscopies and are associated with patients of advanced age or with multiple comorbidities. Management of CP is mainly based on patients' clinical grounds and their underlying colorectal diseases. Current therapeutic approaches include conservative management (bowel rest plus the administration of broad-spectrum antibiotics), endoscopic management, and operative management (open or laparoscopic approach). The applications of each treatment are discussed. Overall outcomes of patients with CP are also addressed.

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Key words: Colonoscopic perforation; Colonoscopy; Sigmoidoscopy; Complication; Postpolypectomy syndrome; Incidence; Risk factors; Treatment; Management; Outcome

INTRODUCTION

Colonoscopic perforation (CP) is widely recognized as one of the most serious complications following lower gastrointestinal endoscopies. Although CP is a rare complication, it is associated with a high rate of morbidity and mortality^[1-5]. This unpleasant complication could result in operation, stoma formation, intra-abdominal sepsis, prolonged hospital stay, and even death. This article describes an overview of incidence, risk factors, management and outcome of CP.

INCIDENCE

The incidence of CP could be as low as 0.016% of all diagnostic colonoscopy procedures^[6] and may be seen in up to 5% of therapeutic colonoscopies^[7,8]. Meanwhile, the incidence of CP following flexible sigmoidoscopy varies from 0.027% to 0.088%^[1,9-12]. Interestingly, rectal perforation during colonoscopic retroflexion was reported to be around 0.01%^[13]. The incidences of CP in some larger series (sample size > 30 000 cases) published from 2000 onwards are shown in Table 1^[2-4,9,14-18]. The most common site of colonic perforation is the rectosigmoid

Table 1 Incidence of CP, management and outcomes from recent series with sample size > 30 000 cases

Author	Year	Number of patients	CP rate	Death rate in CP cases	CPT rate in CP cases	Surgical treatment (%)
Araghizadeh <i>et al</i> ^[14]	2001	34 620	0.090	3.2	NA	74
Gatto <i>et al</i> ^[9]	2003	74 584	0.145	5.6	NA	NA
Korman <i>et al</i> ^[17]	2003	116 000	0.032	0.0	NA	95
Cobb <i>et al</i> ^[16]	2004	43 609	0.032	0.0	21.4	93
Lüning <i>et al</i> ^[4]	2007	30 366	0.115	8.6	40.0	100
Rabeneck <i>et al</i> ^[18]	2008	97 091	0.085	NA	NA	NA
Iqbal <i>et al</i> ^[2]	2008	258 248	0.070	7.0	36.0	92
Teoh <i>et al</i> ^[3]	2009	37 971	0.113	25.6	48.7	91
Arora <i>et al</i> ^[15]	2009	277 434	0.082	NA	NA	NA

CP: Colonoscopic perforation; CPT: Complication; NA: Not available.

colon^[1-4,17,19,20]. Several factors making this bowel segment vulnerable to being injured include a sharp angulation at either the rectosigmoid junction or the sigmoid-descending colon junction, and the great mobility of the sigmoid colon. A forceful insertion of an endoscope while having a sigmoid loop formation is the leading cause of anti-mesenteric bowel perforation due to an overextension of bowel by the shaft of the endoscope. Additionally, the sigmoid colon is commonly involved with diverticular formation^[17,21], and the muscular layer of the bowel wall may be thin or fragile due to previous inflammation (diverticulitis). Pelvic adhesions following previous pelvic operation or infection also contribute to a high incidence of sigmoid perforation^[2,7].

RISK FACTORS

There has been convincing evidence that therapeutic colonoscopies have a significantly higher rate of CP than diagnostic colonoscopies^[15,18,20,22]. The increased likelihood of CP in therapeutic endoscopy is because the perforation during therapeutic colonoscopy can occur not only through mechanisms that are similar to those seen for diagnostic colonoscopy (mechanical injury or barotrauma), but also through the fact that endoscopic interventions *per se* can cause perforation^[20]. Several investigators have reported that some endoscopic interventions are associated with an increased CP rate, including polypectomy for polyps larger than 20 mm^[23], pneumatic dilatation for Crohn's stricture^[24], the use of argon plasma coagulation^[23], endoscopic mucosal resection and endoscopic submucosal dissection for colorectal neoplasia^[8,26,27].

Patients over 75 years of age also have an approximately 4-6 fold rise in the CP rate as opposed to younger patients^[9,18,20,28]. Possible explanations for an increased rate of CP in patients with advanced age include the fact that the elderly have a declining colonic wall mechanical strength as recognized in colonic diverticular diseases, and they often have a greater frequency of abnormal colorectal findings which may require endoscopic intervention.

The risk of perforation from colonoscopy is 2-4 times greater than that from flexible sigmoidoscopy^[4,9,20,29]. Pa-

tients with multiple comorbidities are also at greater risk of this perforation^[9,15]. These comorbidities include diabetes mellitus, chronic pulmonary disease, congestive heart failure, myocardial infarction, cerebrovascular disease, peripheral vascular disease, renal insufficiency, liver disease and dementia^[30-32].

Other risk factors for CP reported in the literature include a history of diverticular disease^[9] or previous intra-abdominal surgery^[17], colonic obstruction as an indication for colonoscopy^[15], and female gender^[29]. The difference in anatomy of the large intestine between males and females was demonstrated by Saunders *et al*^[33]. They found that women had a greater colonic length and a more mobile transverse colon, thus increasing the difficulty in performing colonoscopy in female patients.

PRESENTATION AND DIAGNOSIS

The most common clinical feature of CP is the visualization of an extra-intestinal structure during the endoscopic examination^[2]. However, CP patients could present with symptoms and signs of peritonitis (mainly abdominal pain and tenderness) within several hours after the completion of colonoscopy. Patients with CP from therapeutic colonoscopies tend to have a smaller size of the perforation and have a delay in presentation and diagnosis compared with diagnostic colonoscopies^[3,4,17]. When perforation is suspected, a plain roentgenogram of the abdomen should be taken to rule out intraperitoneal air. Other sophisticated investigations, such as computed tomography (CT) scanning, and magnetic resonance imaging, are also of great help to identify the free gas^[2]. Triple-contrast or double-contrast (intravenous and rectal) CT scanning is increasingly used in patients with a clinical suspicion of colonic perforation^[34-36], and in those with CP who are eligible for non-operative management^[37]. Water-soluble contrast enema is seldom performed to detect the perforation, or to confirm a concealed perforation. Practically, patients can be diagnosed and treated for CP on the basis of generalized peritonitis without the radiologic evidence of perforation.

A perforated site is typically a large anti-mesenteric tear of colonic wall if it is caused by the shaft of the endoscope. Furthermore, a smaller perforation can be

found in an injury from the tip of the endoscope, or in those related to endoscopic interventions such as polypectomy. Although perforations usually occur during the colonoscopic examination or within 24 h after the procedure^[1-3], delayed perforation of the colon and rectum has been reported^[38,39]. Physicians should therefore suspect a CP if a patient has fever, abdominal pain or distention following the colonoscopic examination, even if the patient presents with these symptoms several days after the procedure.

It is notable that postpolypectomy coagulation syndrome, also known as postpolypectomy syndrome or transmural burn syndrome, can mimic perforation by presenting with similar symptoms and signs^[40]. Postpolypectomy syndrome occurs when there is a transmural injury of the bowel wall at the site of excised polyp, caused by an overt electrical current or thermal injury^[41,42]. Without any obvious perforation, transmural bowel injury as well as serosal irritation results in a localized peritonitis, abdominal pain, fever and leukocytosis. Conventional radiography is often unremarkable in this setting. Meanwhile, CT scan may reveal focal mural thickening and pericolic fluid at the site of recent polypectomy as well as soft-tissue stranding of the pericolic fat, without any evidence of pneumoperitoneum or large hematoma^[43,44]. Conservative management, as described in the following section, is generally successful with good outcomes^[7,45].

MANAGEMENT

Management of CP remains a controversial issue as it can be effectively managed by both operative and non-operative strategies^[37,46,47]. Although most patients with CP promptly require open surgery, there is an increasing use of non-operative or laparoscopic approaches in selected patients^[48-53]. The viable options of CP management are discussed as follows.

Conservative treatment

Clearly, the choice between conservative and surgical management depends on clinical grounds. Conservative management is reserved for CP patients in good general condition and without any sign of peritonitis. This approach involves intravenous fluids, absolute bowel rest and intravenous administration of broad-spectrum antibiotics. If the conservative treatment is successful, patient's clinical appearance should improve gradually within 24-48 h. If this is not the case, complicated intra-abdominal infections (such as fecal peritonitis or intra-abdominal abscess) should be considered, and thus further investigation and management are imperative. Patients must be prepared to proceed to surgical management if clinical improvement is not maintained or when progressive intra-abdominal sepsis occurs. Overall success rate of conservative treatment for CP varies from 33% to 73%^[14,16,56]. A small perforation site caused by therapeutic colonoscopy has been shown to have a better success rate with medical treatment^[56]. Colonic stricture following conservative treatment of a colonoscopic perforation has been reported in the literature^[57],

but this can be safely managed by either endoscopic dilatation or surgery.

Endoscopic closure of the perforation

With recent advances in endoscopic technology (such as better optics, and availability of multichannel endoscopy and intraluminal endoclipping) as well as increasing experience of endoscopic interventions^[58-60], many endoscopists have been encouraged to perform the endoscopic closure of CP since the first successful endoscopic repair of CP was reported in 1997^[61]. However, this approach requires not only high endoscopic skill but also appropriate endoscopic devices. In general, the size of the perforation suitable for endoscopic closure is less than 10 mm, but some reports showed successful endoscopic repairs of the perforation larger than 10 mm^[52,62]. To overcome the problems of closing large defects, novel endoscopic closure devices have been designed such as detachable endoscopic snares and special metal rings in conjunction with endoscopic clips^[63].

Any endoscopic repair should be performed with as little air insufflation as possible because a distended lumen often makes it difficult to close the perforation site. Moreover, an extensive air insufflation not only leads to further fecal spillage into the intraperitoneal space but also causes massive pneumoperitoneum, which can compromise the cardiopulmonary system of CP patients^[62]. After having endoscopic repair, patients should be given intravenous broad-spectrum antibiotics and a clear liquid diet until bowel movement returns and any evidence of peritonitis disappears. Intensive monitoring and serial abdominal examinations are also essential. A review of 75 reported cases of CP repaired by endoclipping, by Trecca *et al*^[62] in 2008, showed a success rate of 69%-93%. Early recognition of the perforation, prompt complete endoscopic repair, and good bowel preparation are keys to the success of endoscopic treatment for CP.

Operative treatment

Surgical management is recommended in those with diffuse peritonitis, those with clinical deterioration under non-surgical treatment, or those with a concomitant colonic pathology that requires surgery, such as colorectal cancer. A wide range of surgical options have been described to manage CP depending on the patient's condition, the size of the perforation, the underlying pathology of the large intestine, the quality of bowel preparation, the time between injury and diagnosis, and the surgeon's preference. Feasible choices of the operation are described as follows.

Simple closure of the perforation: This surgical approach is appropriate in the case of small colonic perforation (< 50% of bowel circumference), without significant fecal contamination and concomitant intestinal pathology requiring bowel resection. Oversewing of the perforation has been carried out in 25%-56% of immediate perforations, and the leakage rate following primary repair was extremely low^[1-4,64].

Bowel resection with or without intestinal continuity:

Bowel resection including the perforation site is required when the perforation site is large, or when primary closure of the perforation could compromise the lumen, or when there is concomitant colon pathology requiring bowel resection, such as severe colonic stricture, large sessile polyp or colorectal cancer. In the absence of significant intra-abdominal contamination, bowel resection and anastomosis can be performed with acceptable morbidity. However, when faced with extensive tissue inflammation or fecal peritonitis, bowel resection without anastomosis should be considered. An extensive study of 165 iatrogenic CP cases by Iqbal *et al*^[2] in 2008 found that patients being diagnosed with CP within 24 h after the colonoscopic examination were more likely to have minimal peritoneal contamination and, thus, tended to undergo primary repair or resection with anastomosis. Conversely, patients presenting after 24 h were more likely to have feculent contamination and to receive a stoma formation. Furthermore, patients with blunt injuries were more likely to receive a stoma than those with polypectomy and thermal perforations.

Another issue under discussion is the role of laparoscopic surgery for CP^[49,50,62,65,66]. With advanced laparoscopic techniques such as intracorporeal suturing, laparoscopic repair of CP is becoming widely practiced and acceptable. A small comparative study by Bleier *et al*^[67] showed that a laparoscopic approach to CP resulted in less postoperative complications, decreased length of hospital stay, and a shorter incision length compared to an open method. However, an inability to laparoscopically localize the perforation site or doubt about the security of the repair should prompt conversion to laparotomy^[50].

OUTCOME

Patients with CP could have a remarkably high morbidity and mortality rate depending on their existing medical conditions, nature of the perforation, methods of CP management, experience of the care team and hospital setting. The 30-d morbidity and mortality rates are 21%-53% and 0%-26%, respectively^[1-4,16]. The average length of hospital stay in CP patients is 1-3 wk^[1,3,5,68].

Surgical site infection is the most common complication, while cardiopulmonary complications and multiple organ failure are the leading causes of death^[1,2]. Some investigators have suggested that predisposing factors for poor outcomes of CP patients include a large perforation site, a delayed diagnosis, extensive peritoneal contamination, poor bowel preparation, corticosteroid use, anticoagulants or anti-platelet therapy, prior hospitalization, advanced age of patients, and severe comorbid diseases^[2,3,69,70].

CONCLUSION

Colonoscopic perforation is a rare complication following lower gastrointestinal endoscopies; however, it is asso-

ciated with a high rate of morbidity and mortality. Special precautions should be taken during therapeutic endoscopy and while performing colonoscopic examination in patients with advanced age or those with several comorbidities. Management of patients with CP should be individualized based on patients' clinical grounds and their underlying diseases, nature of the perforation, and concomitant colorectal pathologies.

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