Introduction

Colonic perforation may occur either as a sequelae of various colorectal diseases or as a complication of colonoscopy. Perforation associated with severe acute appendicitis, diverticulitis, or colorectal cancer is an example of disease related perforation. Toxic megacolon accompanying such conditions as severe ulcerative colitis or clostridium colitis may also lead to colonic perforation. Diagnostic and therapeutic colonoscopy is another principal cause of colonic perforation. Although the incidence of perforation associated with colonoscopy is only 0.05-0.39%, it is of importance because surgical intervention may be necessary for the management of colonoscopy-related perforation. In addition, recent advent of endoscopic submucosal dissection (ESD) resulted in high incidence of perforation although the indication for endoscopic therapy of colorectal neoplasm has been expanded. Understanding of the clinical characteristics of colonic perforation and its management is becoming more important as colonoscopic procedures become more diverse and aggressive. In this paper, colonic perforation associated with colonoscopy will be reviewed, especially from the viewpoint of endoscopic management of perforation.

Incidence of Perforation

The incidence of colonoscopy-related perforation is reported to be 0.05-0.39%. Rectosigmoid colon is the segment where perforation occurs most commonly. Old age, female, comorbidity, diverticulosis, and polypectomy were reported to be risk factors for colonoscopy-related perforations.

Recently, ESD has been introduced for the resection of large colorectal neoplasm, which was complicated with high incidence of colonic perforation ranging from 1.4 to 10.0%. Large tumor size, presence of submucosal fibrosis, and laterally spreading tumor type were reported to be risk factors for colorectal ESD associated perforations. Furthermore, cecum and ascending colon appear to be more susceptible to perforation during ESD compared to rectum.

Mechanism of Perforation

Several mechanisms may be involved in colonoscopy-related colonic perforation, which include blunt trauma
on colonic wall, unintentional endoscopic resection, and excessive thermal injury. In general, blunt trauma is the main cause of diagnostic colonoscopy associated perforation. Perforations from blunt trauma are usually large (over 2 cm). They occur commonly in rectosigmoid area because they develop when colonoscope is pushed without resolution of looping at the rectosigmoid colon or when colonoscope is retroflexed immoderately.5

Unintentional endoscopic resection and excessive thermal injury are related to perforations during therapeutic colonoscopy such as endoscopic mucosal resection or ESD. Perforation resulted from unintentional endoscopic resection is generally small and more common in the right colon.5 Thermal injury-related perforation, in general, is also small.5 Thermal injury-related perforation may not be detected often during colonoscopic procedure because only excessive transmural burn is evident without overt perforation right after endoscopic mucosal resection. Therefore, thermal injury-related perforation is usually diagnosed after the completion of colonoscopic procedure.

Diagnosis of Perforation

Colonoscopy-related perforation may be classified into endoscopically proven perforation and radiologically proven perforation based on the diagnostic process.16 An endoscopically proven perforation refers to colonic mural defect detected during colonoscopy procedure. It may be accompanied by observable intraabdominal organ or fat tissue through the mural defect if the perforation is large enough. A “target sign”, white center (muscularis propria and/or serosa) with surrounding blue area (indigo carmine stained submucosa), at the post-resection colon ulcer site or at the resection side of resected specimen may be helpful in determining the probability of small perforation.17

A radiologically proven perforation is defined as a pneumoperitoneum or a pneumoretroperitoneum shown on a simple abdominal X-ray or as extraluminal air density or abscess at the site of the therapeutic procedure. Endoscopically proven perforations may be accompanied by radiological evidence of perforation. However, some radiologically proven perforations do not show endoscopic evidence of perforation. Therefore, they may be diagnosed only after the completion of colonoscopy procedure.

Management of Perforation

1. Surgical Management

Surgery has been the mainstay of management of colonic perforation. Recently, endoscopic clipping has been introduced and conservative management has been feasible in many perforation cases. However, surgery is still indicated in case of large perforations, generalized peritonitis, aggravating peritonitis, ongoing sepsis, and concomitant colorectal pathology such as large advanced neoplasm which is difficult to resect by endoscopic techniques.5

2. Endoscopic Management

Endoscopic management of colonic perforation has progressed significantly since the first report of clip application by Yoshikane et al.18 Through-the-scope clips have been used in clinical practice for decades of years with satisfactory success rate for the management of colonoscopy-related perforation.16 They are especially use-
ful in the closure of small perforations such as those developing after endoscopic mucosal resection or ESD of colorectal tumors. Large perforations may not be closed by through-the-scope clips only. In those cases, combination of clips and detachable snare (endoloop) can be useful in the endoscopic closure. Recently, over-the-scope clips were reported to be useful for the management of large gastrointestinal perforations.

For the successful endoscopic management of colonic perforations, adequate supportive measures should be provided with timely endoscopic clipping. They include nothing per os, immediate intravenous antibiotics, and needle decompression of tension pneumoperitoneum. Tension pneumoperitoneum may lead to respiratory and circulatory compromise and air embolism through the portal venous system. Therefore, urgent decompression through the abdominal wall puncture by a large-bore needle is important. In addition, to avoid serious peritonitis by the leakage of fecal material through the perforation site, endoscopists should remove all the residual feces, if possible, before the trial of endoscopic resection of colorectal tumors.

Despite recent progress of endoscopic management of colonoscopy-related perforations, some perforations still need surgical interventions. In a colonoscopy-related perforation study, of the 38 patients with perforations, 29 (76%) improved without surgery. However, surgical intervention was necessary in 6 (100%) of 6 endoscopically evident perforations in which endoscopic closure by clipping was not successful. Radiologically proven perforations, that is, delayed perforations whose perforation site was not detected during colonoscopy procedures required surgical interventions in 2 (20%) of 10 patients. In another colorectal ESD study, micro-perforations which were detected radiologically after the completion of ESD required longer hospital stay although they could be managed conservatively. Based on these studies, immediate endoscopic clipping appears to be important to avoid the surgery in the management of colonoscopy-related perforations although it is not absolutely imperative.

Conclusions

Colonoscopy-related perforations can be managed endoscopically if they can be closed by endoscopic clipping during colonoscopy. Therefore, cautious management by intense medical therapy with endoscopic clipping may be warranted in colonoscopy-related perforations if they are not clinically deteriorated. Emergency surgery should be performed if patients show clinical deterioration.

References