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Iatrogenic Colonic Perforation due to Computed Tomographic Colonography

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Key Words

Computed tomographic colonography · Complication · Perforation · Pneumoperitoneum

Abstract

Although the complications of computed tomographic colonography (CTC) are very rare, CTC is associated with potential risk of colonic perforation. In the present report we describe two cases of colonic perforation secondary to CTC. In the first case with ascending colonic carcinoma, insertion of a rigid double-balloon catheter caused direct rectal wall perforation. In the second case with obstructive colonic carcinoma, pneumoperitoneum developed due to automated carbon dioxide insufflation. Both patients were asymptomatic after examination and recovered without any complications. Based on the findings of the current cases, we recommend that a soft-tip catheter be used for CTC, and suggest that colonic perforation can occur even with automatic insufflation, depending on patient characteristics.

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Introduction

Colorectal cancer (CRC) is one of the most common cancers worldwide. If detected at an early stage, CRC can often be successfully treated. Therefore, CRC screening has become increasingly important. Colonoscopy is currently the main examination method both for the investigation of symptomatic patients and for CRC screening. However, colonoscopy is

an invasive examination and has serious complications, such as bleeding, perforation and death [1].

Computed tomographic colonography (CTC) is increasingly used both for CRC screening and for patients with symptoms suggestive of CRC, as an alternative technique to colonoscopy. Compared with colonoscopy, one of the main advantages of CTC has been its superior safety profile. No deaths associated with CTC have been reported in the literature [2–6]. However, CTC also has some complications, such as colonic perforation or vasovagal reactions [2–6]. The most significant complication of CTC is colonic perforation; although its risk is very low, it can be associated with substantial morbidity [2–6]. To minimize complications arising from CTC, it is important to know the details of cases in whom those complications arise. However, only a few such cases have been reported in the literature [7–12]. Here, we describe two cases of colonic perforation secondary to CTC and present a brief review of the literature.

Case Reports

Case 1: Rectal Perforation due to a Rectal Catheter

An 83-year-old man with a medical history of lumbar canal stenosis was referred to Ishikari Hospital, Hokkaido, Japan, with anemia (hemoglobin 10.2 mg/dl). A computed tomography (CT) scan of the abdomen revealed focal thickening of the ascending colon that suggested colonic tumor. Colonoscopic examination revealed a tumor encircling the ascending colon. CTC was performed the next day to investigate the rest of the colon and for pre-operative examination of the colonic tumor. After a catheter tip had been sufficiently lubricated with jelly, a rigid double-balloon catheter, which is used mainly for double-contrast barium enema, was inserted through the anus to the rectum by an experienced nurse with the patient in the left lateral position. Insertion into the rectum was accomplished smoothly, without force, in one procedure. The patient did not complain of any abdominal discomfort. After an intrarectal balloon had been inflated, manual insufflation of carbon dioxide (CO₂) gas by means of a hand-held bulb was begun by a radiographer experienced in CTC.

Since abnormally high pressure was felt after insufflation of approximately 1 l, the procedure was paused and supine CT images were obtained. These images revealed extraluminal air in the perirectal fat and the retroperitoneum (fig. 1a, b). On CTC, rectal perforation was observed in the anterior wall of the upper rectum, which suggested that it had been created by catheter insertion (fig. 1a). Residual fluid in the rectum was discharged through the catheter and the examination was suspended. After the examination, the patient did not complain of abdominal pain, and his vital signs were stable. Physical examination revealed no lower abdominal tenderness on palpation. Therefore, he was treated conservatively with antibiotics, no oral intake and intravenous hyperalimentation.

The next day, the patient developed mild fever (37.6°C), but remained asymptomatic. On the second day after CTC, he was afebrile. Blood tests on the third day after CTC indicated that he had mild inflammation (C-reactive protein [CRP] levels were 5.18 mg/dl); however, CRP had decreased to 2.03 mg/dl on the fifth day after CTC. Ten days after CTC, colonoscopy was performed to evaluate the perforation site. An approximately 8-mm perforation was still present at the anterior wall of the rectum (fig. 1c). Therefore, two endoscopic clips were used to close the perforation site of the rectum. Twenty days after CTC, a CT scan revealed no free air around the rectum and colonoscopy showed closure of the perforation. Approximately 1 month after CTC, a laparoscopic ileocecal resection was performed to remove the

tumor. The postoperative course was uneventful, and the patient was discharged 1 month after surgery.

Case 2: Pneumoperitoneum due to Automated CO₂ Insufflation

An 86-year-old woman with hypertension was referred to Hokkaido Gastroenterology Hospital, Hokkaido, Japan, with an elevated serum carcinoembryonic antigen level (25.5 ng/ml). A CT scan of the abdomen revealed focal thickening of the transverse colon that suggested colonic tumor. Therefore, she was admitted for evaluation of suspected colonic cancer. Colonoscopic examination revealed an obstructive tumor in the transverse colon and no information on the proximal side of the obstruction. The examination was finished after a biopsy specimen had been obtained from the tumor for histological assessment.

On the same day, CTC was performed after colonoscopy to investigate the rest of the colon and for preoperative examination. A 24-French flexible double-balloon catheter was inserted into the rectum with the patient in the left lateral position, and automated colonic insufflation was performed by an experienced radiographer using an ENIMA CO₂ device (Horii). Distension pressure was set to 0–20 mm Hg. During insufflation, the patient was first placed in the right lateral decubitus position for delivery of 1.4 l of CO₂. She was then placed in the supine position until a total of approximately 2 l of CO₂ had been delivered. She was then rolled into the left decubitus position. Images were acquired in the supine and left decubitus positions. At the end of the examination, residual gas and fluid in the rectum was discharged through the catheter. The patient did not complain of abdominal pain during the examination.

When reviewing the first stack of axial images obtained in the supine position after examination, a substantial amount of free air in the peritoneal cavity was detected (fig. 2a). The patient's vital signs were stable. Physical examination revealed no abdominal tenderness on palpation. Therefore, she was treated conservatively with antibiotics, no oral intake and intravenous hyperalimentation. The next day, she developed mild fever (37.6°C), but remained asymptomatic. Blood tests 2 days after CTC showed that she had mild inflammation (white blood cell count and CRP levels were 10,630 μ l and 2.73 mg/dl, respectively); however, she remained asymptomatic. Approximately 2 weeks after CTC, a right hemicolectomy was performed to remove the tumor. No perforation site was detected in surgical findings. The postoperative course was uneventful, and the patient was discharged 1 month after the surgery. Based on pathological findings, no perforation site was detected; however, multiple air bubbles were observed in the tumor and the mesentery around the tumor, which indicated that pneumoperitoneum had occurred at the tumor site (fig. 2b, c).

Discussion

Although complications of CTC mainly occur during gas insufflation, direct rectal wall perforation due to catheter insertion should not be ignored as one possible cause of CTC complications. Burling et al. [3] reported nine case of colonic perforation due to CTC among 17,067 examinations in the United Kingdom. In one of these cases the cause of the perforation was direct traumatic insertion of the rectal catheter through the rectal wall. Thin flexible catheters should be selected for use in CTC, not the rigid types that are used for double-contrast barium enema, because the role of the rectal catheter in CTC is only the minimal flow of gas insufflation.

A double-balloon catheter was thought to be necessary for the examination of the first patient reported here because based on the patient's physical condition associated with ad-

vanced age, incontinence for gas insufflation was anticipated. Unfortunately, a thin flexible double-balloon catheter for CTC was not available at the time of the examination. An experienced nurse performed the catheter insertion in this case. She did not feel any resistance during the insertion procedure; however, rectal injury due to catheter insertion nonetheless occurred.

This type of injury may be related to the distance of catheter insertion. Anatomically, the puborectalis muscle forms a sharp curve approaching a right angle between the rectum and the anus. The tip of a catheter that is inserted through the anus will collide with the anterior rectal wall perpendicularly after approximately only 5 cm insertion [13]. Deep insertion of a rigid catheter in an elderly patient with a fragile rectal wall might cause damage to the rectal wall as in our case. ESGAR consensus [14] and ACR practice parameters [15] recommend a soft-tip (non-rigid) catheter for CTC; however, these guidelines are not widely recognized in Japan.

Perforation occurring during gas insufflation is associated with factors including those related to the insufflation technique and to individual patient characteristics [16]. In our second case, CTC was performed by an experienced radiographer, and the amount of automatic CO₂ gas insufflation was only 2.0 l. Therefore, we believe that the cause of perforation in this case was not due to the insufflation technique. Patients who have weakening of the colonic wall or colonic obstruction may be at greater risk of perforation due to CTC [16]. Active colitis (inflammatory bowel disease or acute diverticulitis), recent colonic surgery or deep colonic biopsy or polypectomy/mucosal resection prior to CTC are considered to weaken the colonic wall [16]. Any cause of colonic obstruction, for example obstructive CRC or inguinal hernias, and specifically left-sided hernias containing the sigmoid colon, may predispose a patient to perforation due to overdistension [12, 16].

In our second case, a combination of factors was likely the cause for pneumoperitoneum, such as the patient's age, obstructive colonic carcinoma and pathological characteristics of the tumor. On the other hand, this patient underwent same-day colonoscopy before CTC, and thus it is not possible to exclude the possibility that pneumoperitoneum might have occurred at colonoscopy. However, in previous studies, perforation diagnosed at CTC was reported as a complication of CTC despite same-day colonoscopy having been performed previously [5, 6].

Table 1 summarizes the reported cases of colonic perforation due to CTC, including our two cases described here. To our knowledge, 35 cases with colonic perforation due to CTC have been reported in the literature [2–12, 17]. In this summary, the symptomatic perforation rate was 44.9%. Surgical treatment was required in just 37.8% of the patients, and no deaths were recorded. Our two patients also received conservative treatment and recovered without any complications. It is noteworthy that patients with asymptomatic perforation due to CTC might be treated conservatively rather than surgically. In contrast, reported cases of perforation at colonoscopy more often resulted in surgery, and death has rarely been reported [1].

In conclusion, complications of CTC are very rare, but CTC carries a potential risk of colonic perforation. A soft-tip catheter should be used for CTC and the distance of catheter insertion should be noted. According to a patient's specific condition, it is necessary to recognize that colonic perforation can happen even with automatic insufflation.

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Table 1. Summary of reported cases of colonic perforation due to CTC, including the two current cases

Age, years (n = 26)	47–87
Average	75
Sex (n = 24)	
Male	15
Female	9
Concomitant disease (n = 36)	
Yes ^a	25 (69.4%)
Diverticulosis	9
Colonic carcinoma	5
Inguinal hernia	5
Inflammatory bowel disease	4
Post colorectal surgery	2
No	11 (31.6%) ^b
Gas (n = 33)	
Room air	26 (78.8%)
CO ₂	7 (21.2%)
Insufflation method (n = 33)	
Manual	28 (84.9%) ^c
Automated	5 (15.2%)
Associated symptoms (n = 29)	
Symptomatic	13 (44.8%)
Abdominal pain	6
Abdominal discomfort	4
Abdominal pain with peritonitis	2
Unrecorded	1
Asymptomatic	16 (55.1%)
Treatment (n = 37)	
Surgery	14 (37.8%)
Conservative	23 (62.2%)
Clinical outcome (n = 37)	
Recovered	37 (100%)
Died	0 (0%)

^a Including overlapped data.

^b Including one case which had undergone a recent colonic biopsy [4].

^c Including one case which involving switching from automatic to manual insufflation [7].

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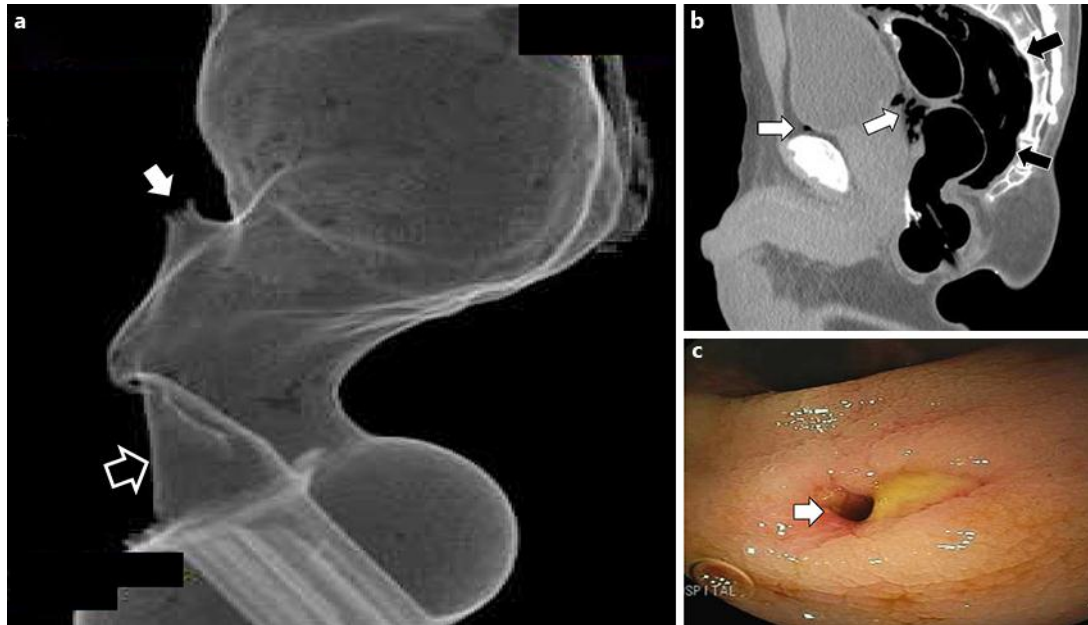


Fig. 1. **a** CT air-contrast enema image showing the obvious perforation site (white arrow) in the anterior wall of the upper rectum and the rectal catheter tip (black arrow). **b** Sagittal CT image showing extraluminal bubbles (white arrows) in the pelvis and a large quantity of free air (black arrows) posterior to the rectum. **c** Colonoscopy showing an approximately 8-mm hole (white arrow) in the anterior wall of the rectum.

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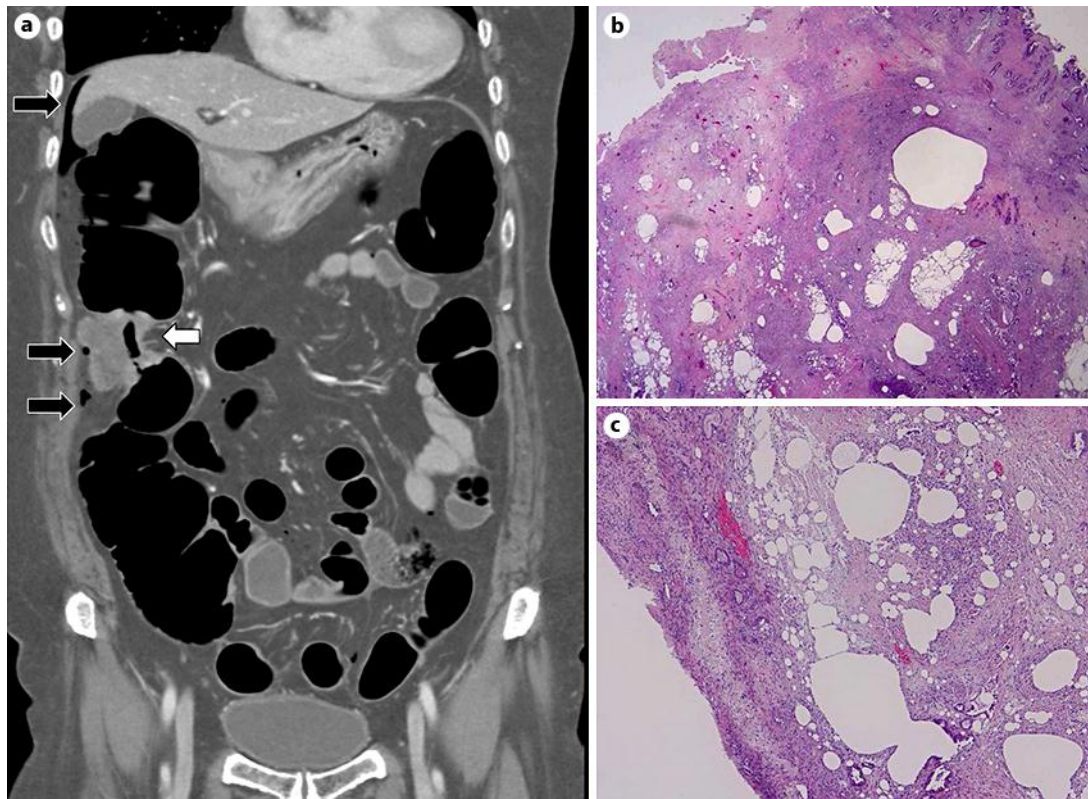


Fig. 2. **a** Coronal CT image showing a colonic tumor in the transverse colon (white arrow); extraluminal gas was observed not only around the tumor but around the liver as well (black arrows). **b, c** In pathological findings, multiple air bubbles were observed in the colonic carcinoma (**b**) and the mesentery around the tumor (**c**).