



An Unusual Case of Colon Perforation Presenting with Life-Threatening Pneumoperitoneum, Pneumothorax, Pneumomediastinum and Pneumopericardium after Sedation Colonoscopy

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This is a report on the anesthetic management of a patient who undertook screening colonoscopy under intravenous sedation and experienced a perforation over an invasive colonic tumor located at splenic flexure, resulting in pneumoperitoneum, pneumothorax, pneumomediastinum, and pneumopericardium. The patient recovered well after resection of the lesion through laparotomy. In this report, colonoscopy-related complications and pathophysiology as well as the anesthetic plan are discussed.

Key words: colonoscopy, colon perforation, pneumothorax, pneumoperitoneum, anesthesia

Introduction

Colonoscopy has become a very common and essential clinical technique for screening and management of the pathologies in the lower gastrointestinal tract without the need for invasive surgical interventions. However, colonoscopy carries certain procedural complications, including 0.01 – 0.1% risk of bowel perforation.¹ Once colon perforation develops, the overall mortality rate can be as high as 0.65%.² Iatrogenic colonic perforation may be caused by mechanical stress applied against the bowel wall or direct traumatic injury by the colonoscope. While

intraperitoneal perforation is typically manifested as abdominal pain with peritoneal sign, extraperitoneal perforation may present with pneumoretroperitoneum, pneumomediastinum, pneumopericardium, pneumothorax, and subcutaneous emphysema as air passes into the retroperitoneal space and diffuses along the fascial planes and great vessels.³ Computed tomography (CT) scanning and magnetic resonance imaging (MRI) are the standard imaging tools for the diagnosis of extraperitoneal colon perforation.⁴

Carbon dioxide (CO₂) is the most commonly used insufflation gas during colonoscopy because it is absorbed by the bowel mucosa approximately 100 times faster than air

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Received: March 10, 2020 Accepted: May 13, 2020

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and is rapidly eliminated through the lungs.⁵ Therefore, CO₂ insufflation significantly reduces bowel distension and improves peri-procedural abdominal pain and bloating.⁶ The use of CO₂ for insufflation of the bowel lumen also decreases the severity of pneumatic injury once bowel perforation happens during colonoscopy. Since air is less soluble than CO₂ in the body tissues, the symptoms of pneumatic injury or barotrauma can be more severe when mixed air is used for distension of colon during the procedure.

Recently, intravenous sedation during gastrointestinal endoscopic examination has become a very common anesthetic approach to improving patient comfort and anxiety. Appropriate sedation also enhances the quality of examination and operator's satisfaction during the procedure.⁷ However, anesthetic sedation during endoscopic examination may obscure early clinical signs of colon perforation and delay the diagnosis of pneumatic injury due to the leakage of insufflation gas.

Case Report

A 63-year-old man undertook screening colonoscopy for abdominal cramps. Air was insufflated into the colon due to an unexpected cutoff of CO₂ supply during the examination. After the procedure, severe acute abdominal pain developed with signs of hypoxia. Chest X-ray showed air outlining the mediastinum with upward extension along the trachea into the neck (Fig. 1). Abdominal CT scan confirmed the presence of massive pneumoperitoneum, pneumomediastinum, pneumopericardium, and pneumothorax (Fig. 2). Despite the successful insertion of pig-tail catheters into bilateral pleural spaces, the hemodynamics progressively deteriorated. The patient eventually showed signs of cardiopulmonary insufficiency, including tachycardia, tachypnea, desaturation, hypotension, and engorged jugular veins for which an emergency laparotomy was per-

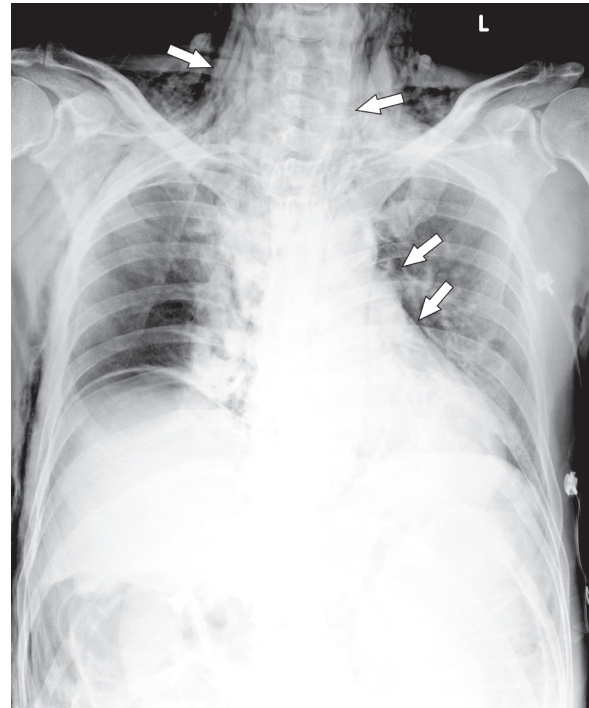


Fig. 1 Chest radiograph showing an air outlining of the mediastinum (white arrows) with upward extension along the trachea into the neck.

formed. General anesthesia was induced by titration administration of intravenous induction agents (ketamine 50 mg, propofol 30 mg, and midazolam 3 mg), followed by endotracheal intubation with positive pressure ventilation. Anesthesia was maintained by volatile sevoflurane (1 – 2% v/v in mixed oxygen). An arterial line was established in the left radial artery for continuous monitoring of arterial pressure, cardiac output, and volume status. The airway pressure was continuously monitored to avoid the development of tension pneumothorax during positive ventilation. Laparotomy revealed a perforation of the colon at splenic flexure, where an invasive colon tumor was located. Excision of the tumor with primary anastomoses and a diverting colostomy were performed. The patient was transferred to the intensive care unit for postoperative care and ventilatory support after the operation. The patient was successfully weaned from mechanical ventilation on postoperative Day 6 and discharged from the hospital one week later.

Discussion

The types of gases used for bowel insufflation (i.e., air vs. CO₂) during colonoscopy is an important determinant of hemodynamic stability after iatrogenic bowel perforation. Air requires more time to be absorbed and may induce rapidly progressive life-threatening events. Severe pneumothorax, pneumoperitoneum, and pneumopericardium can lead to severe cardiopulmonary compromise.

Decompression through thoracentesis, tube thoracostomy, or pigtail catheter insertion for pneumothorax management is very important before positive pressure ventilation.⁸ Tension pneumothorax can occur if air accumulates in the pleural space. Intraoperative airway pressure monitoring is mandatory in the management of pneumothorax that aims at maintaining adequate ventilation and oxygenation by reducing inspiratory pressure, tidal volume, respiratory rate, positive end-expiratory pressure (PEEP), optimal inspiratory time, and oxygen saturations as well as through permissive hypercapnia.⁸

Pneumopericardium is a very rare situation resulting from extraperitoneal pneumatic injury due to bowel perforation during colonoscopy. Patients with mild pneumopericar-

dium are frequently asymptomatic. If air keeps accumulating in the pericardial space, cardiac tamponade and cardiogenic shock can occur.⁹ Symptomatic pericardial effusions can be treated with pericardiocentesis or surgical pericardiotomy drainage.⁹ In this case, the main considerations of anesthesia were to maintain adequate cardiac output during anesthetic induction by slow titration of the induction agents and intensive hemodynamic monitoring with an arterial line. It is also important to keep a relatively high heart rate and stroke volume throughout the perioperative period. Therefore, we administered ketamine for anesthetic induction with adequate fluid loading in this case. Mechanical ventilation could further exacerbate leftward septal shift and impair left ventricle filling through increasing pulmonary vascular resistance and decreasing right ventricular outflow, thereby potentially worsening systemic hypotension.¹⁰ Maintaining spontaneous ventilation or avoiding a large tidal volume and a high peak airway pressure will likely minimize the impact of positive ventilation on systemic hemodynamics.

In patients presenting with symptoms of extraperitoneal colon perforation during or after colonoscopy, early recognition of the type of gas used for insufflation is very important to predict the extent of iatrogenic pneumatic

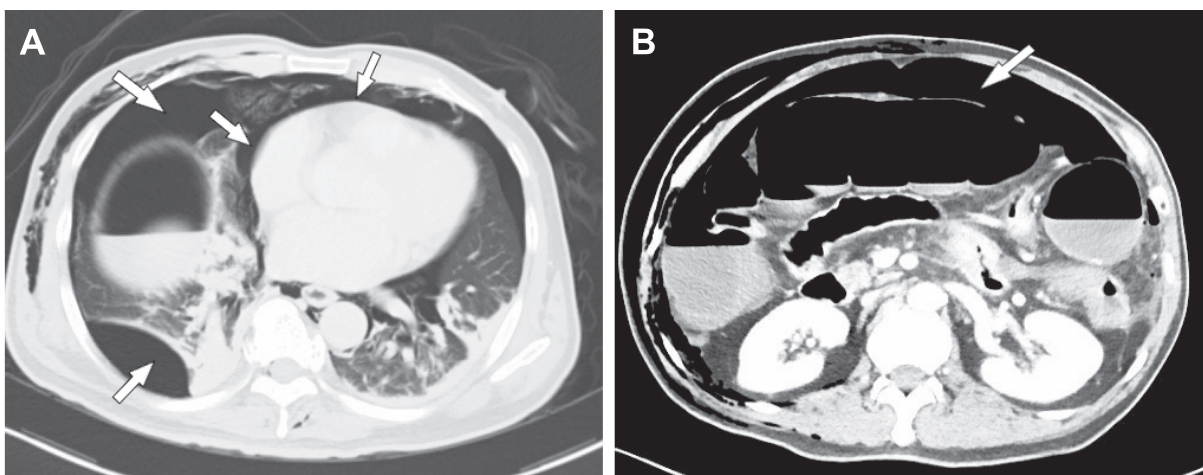


Fig. 2 Computed tomography scanning of the (A) chest, and (B) abdomen for diagnosis of extraperitoneal colon perforation. Note massive air collections in the mediastinum, pericardium, pleural spaces, peritoneum, and colon (white arrows).

injury. When air is insufflated instead of CO₂, the anesthesia team should check for signs of pneumothorax or cardiac tamponade before induction of anesthesia. The main anesthetic goals are to maintain adequate cardiac output and avoid compromising right ventricular outflow.

References

1. Stock C, Ihle P, Sieg A, et al: Adverse events requiring hospitalization within 30 days after outpatient screening and nonscreening colonoscopies. *Gastrointest Endosc* 2013;77:419-29. doi: 10.1016/j.gie.2012.10.028.
2. Askar C, Cathy J. B, Bassam D, et al: Polypectomy techniques, endoscopist characteristics, and serious gastrointestinal adverse events. *J Surg Oncol* 2014;110:207-13. doi: 10.1002/jso.23615.
3. Tiwari A, Sharma H, Qamar K, et al: Recognition of extraperitoneal colonic perforation following colonoscopy: a review of the literature. *Case Rep Gastroenterol* 2017;11:256-64. doi: 10.1159/000475750.
4. Lohsiriwat V: Colonoscopic perforation: incidence, risk factors, management and outcome. *World J Gastroenterol* 2010;16:425-30. doi: 10.3748/wjg.v16.i4.425.
5. Sugiyama T, Araki H, Ozawa N, et al. Carbon dioxide insufflation reduces residual gas in the gastrointestinal tract following colorectal endoscopic submucosal dissection. *Biomedical Report* 2018;8:257-63. doi: 10.3892/br.2018.1044.
6. Bretthauer M, Lynge AB, Thiis-Evensen E, et al: Carbon dioxide insufflation in colonoscopy: safe and effective in sedated patients. *Endoscopy* 2005;37:706-9. doi: 10.1055/s-2005-870154.
7. Triantafillidis JK, Merikas E, Nikolakis D, et al. Sedation in gastrointestinal endoscopy: current issues. *World J Gastroenterol* 2013;19:463-81 doi: 10.3748/wjg.v19.i4.463.
8. Paramasivam E, Bodenham A: Air leaks, pneumothorax, and chest drains. *Continuing Education in Anesthesia Critical Care and Pain* 2008;8:204-9. doi: 10.1093/bjaceaccp/mkn038.
9. Uluçam MZ: An extremely rare combination: pneumopericardium, pneumoperitoneum, and subcutaneous emphysema-a case report. *Cardiol Ther* 2013;2:103-10. doi: 10.1007/s40119-012-0008-6.
10. O'Connor CJ, Tuman KJ: The intraoperative management of patients with pericardial tamponade. *Anesthesiology Clin* 2010;28:87-96. doi: 10.1016/j.anclin.2010.01.011.