

# Bilateral Tension Pneumothoraces During Colonoscopy: A Case Report and Review of Literature

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*An 83-year-old man with metastatic esophageal and colon cancer underwent a therapeutic colonoscopy in an attempt to place a colonic stent to alleviate symptoms of severe bowel obstruction. Moderate sedation with intravenous propofol was provided during the case. During the procedure, the patient experienced bilateral tension pneumothoraces and subcutaneous emphysema of the neck and face. A needle decompression of the tension pneumothorax was performed emergently, and chest tubes were subsequently inserted bilaterally in the intensive care unit. Colonic perforation was highly suspected based on the clinical manifestations and procedural difficulties, although a diagnostic abdominal computed tomogra-*

*phy scan was never completed because of the family's desire to provide only comfort care. The patient died 24 hours after the event.*

*A literature search revealed that 10 cases of pneumothorax occurred following a colonoscopy. The purpose of this case report and review of the literature is to increase awareness of pneumothorax as an extremely rare but severe and often life-threatening complication of colonoscopy among anesthesia care providers. The mechanisms of pneumothorax development are also discussed.*

**Keywords:** Colonic perforation, colonoscopy, subcutaneous emphysema, tension pneumothorax.

Approximately 15 million colonoscopies are performed each year, and more than 40% of them are screening colonoscopies.<sup>1</sup> A colonoscopy is generally safe and well tolerated by patients, but a risk for complications still exists. Rare, but potentially severe, complications of colonoscopy are bowel perforation, postpolypectomy bleeding, postpolypectomy electrocoagulation syndrome, infections, gas explosion, hematoma, splenic rupture, acute appendicitis, ischemic colitis, and strangulation of hernias.<sup>2</sup>

Anesthesia care providers are often requested to provide monitored anesthesia care for esophagogastroduodenoscopy and colonoscopy. Anesthesia providers are involved in roughly one-third of these endoscopic procedures, and this rate is projected to increase to more than half of all procedures.<sup>3</sup> A heightened awareness by anesthesia providers of the potential for complications is crucial as the demand for such services increase.

## Case Summary

An 83-year-old male patient was hospitalized because of a bowel obstruction secondary to a tumor in the descending colon. The tumor was causing substantial obstruction and discomfort, contributing to an inability to flatulate or to have bowel movement. He had a history of esophageal cancer a year ago and was treated with chemotherapy and radiation therapy. He was experiencing a recurrence of metastasized esophageal and gastric malignancy. He was cachectic and had a jejunostomy tube for feeding. Before

the admission with do-not-resuscitate (DNR) status, he lived at home with hospice care. The patient and his family requested less aggressive treatment, opting for palliative care only. A gastroenterologist was consulted to place a colonic stent to relieve the obstruction and discomfort. Monitored anesthesia care was requested by the endoscopist for this procedure.

The morning of the procedure, the patient and his daughter were interviewed to collect a thorough medical and surgical history, and the most recent laboratory results were reviewed. The patient was informed and educated about a suspension of DNR status during the procedure. The risks of anesthesia were disclosed, and the patient and his daughter expressed their understanding. Consents for the procedure and anesthesia were obtained and signed by the patient. Before the initiation of anesthesia, standard monitors were applied, including noninvasive blood pressure (BP) monitor, electrocardiogram, pulse oximeter, and blood oxygen monitor via a simple face mask with end-tidal carbon dioxide (CO<sub>2</sub>) monitor. The initial vital signs of the case were BP of 109/79 mm Hg, heart rate of 108/min, respiratory rate of 18/min and oxygen saturation measured by pulse oximetry of 100% on 6 L/min via a simple face mask. Moderate sedation with a small dose of intravenous propofol infusion (25-50 µg/kg/min) was administered to maintain comfort, normal vital signs, and spontaneous ventilation without any airway device. Because of the large tumor and anatomical challenges, the endoscopist had a difficult time advancing

a colonoscope and spent more than an hour to identify the area of stricture. During the attempted placement of a colonic stent, the patient's BP increased to 174/119 mm Hg, heart rate to 122/min, and respiratory rate to 28 to 30/min. Shortly after this increase in vital signs, the plethysmograph waveform morphology changed to less defined from previously normal findings with good signals. His pulse oximeter reading remained between 98% and 100%, and the end-tidal CO<sub>2</sub> monitor detected adequate respiration and gas exchange at this point. Venous congestion that was evidenced by external jugular vein distention and erythema and purple discoloration of his neck and face were noted, and subcutaneous emphysema was palpated on the right side of his neck and face.

The case was aborted immediately, and the patient was turned supine from a left lateral decubitus position. The hospital's rapid response team was called for extra assistance. The patient was emergently intubated with a video-assisted intubating device and a 7.0-mm endotracheal (ET) tube. During the intubation, subcutaneous emphysema was also evident inside his mouth, especially on his tongue and right cheek. The subcutaneous emphysema in the oral cavity made it challenging to place a laryngoscope blade and to advance the ET tube. The vocal cords were visualized on a video monitor, and the ET tube was successfully passed through his vocal cords on the first attempt. The end-tidal CO<sub>2</sub> was detected following intubation, but ventilation required a peak inspiratory pressure (PIP) of more than 40 cm H<sub>2</sub>O to deliver a tidal volume of 180 to 200 mL.

Because of notable abdominal distention and high peak airway pressure, bowel perforation and accumulation of insufflated air in the abdominal cavity were suspected. The endoscopist performed a needle decompression of the abdomen using a 14-gauge angiocatheter. The air released from the catheter was heard, but the high airway pressure was still present. Because of the clinical manifestations such as subcutaneous emphysema, tachycardia, hypotension, absence of audible breath sound on the right side, and high PIP, a tension pneumothorax was suspected. Needle decompression with 14-gauge angiocatheter into the right second intercostal space at the midclavicular line was performed by a member of the rapid response team. An immediate release of air from the thorax was observed. The patient demonstrated an improvement in PIP and vital signs, and facial venous congestion resolved almost instantly after the needle decompression. The patient demonstrated purposeful movements such as reaching to the ET tube with his arms and crossing his legs. The patient's vital signs were stable without any medication, and he was transferred to the intensive care unit (ICU).

A chest radiograph was ordered by an intensive care medicine physician; bilateral tension pneumothoraces were diagnosed and bilateral chest tubes were inserted

at bedside. Computed tomography (CT) of the chest and abdomen was ordered to rule out bowel perforation but was never completed because the family wished to give the patient comfort care without aggressive interventions and treatments. A few hours after the patient was admitted to the ICU, he exhibited clinical manifestations that indicated sepsis and septic shock. The patient died the following morning.

## Review of Literature

### Method of Literature Search

The literature search was conducted electronically in July 2016 by using MEDLINE EBSCO, PubMed, Cumulative Index to Nursing & Allied Health Literature (CINAHL), and Google Scholar. Reference lists of retrieved articles were used to identify other relevant articles. The search keywords were a combination of the following: *tension pneumothorax*, *subcutaneous emphysema*, *colonoscopy*, and *colonic perforation*. The inclusion of criteria for articles was full-text articles written in English and published in academic journals between 2000 and 2016. Ten case reports that matched search keywords and the inclusion criteria were retrieved. Eight articles presented the cases of a pneumothorax following or during a colonoscopy,<sup>4-11</sup> 1 article was a case report with a review of the literature,<sup>12</sup> and another included anesthetic considerations.<sup>13</sup>

### Published Case Reports

The details of the published case reports are summarized in the Table. Although most of the cases revealed bowel perforations, 3 case reports described development of pneumothorax without iatrogenic bowel perforations.<sup>4,8,10</sup> The case reported by Alabraba et al<sup>8</sup> was unique because a left-sided pneumothorax was caused by incarcerated bowel in the left hemithorax through a diaphragmatic defect. Hearnshaw et al<sup>4</sup> determined the cause of a right-sided tension pneumothorax to be the pulmonary disease and a Valsalva maneuver during colonoscopy due to an absence of bowel perforation and free subdiaphragmatic air shown in a chest radiograph. Pouramand and Shokoohi<sup>10</sup> concluded that their case of tension pneumothorax following a colonoscopy without presence of perforation was likely due to an air leak from a surgical anastomosis of previous rectal surgeries.

Six of 10 cases were female patients. The patients were older than 70 years in 6 cases of 10. These characteristics are consistent with the literature review by Zeno and Sahn.<sup>12</sup> In most of the case reports, patients exhibited signs and symptoms of pneumothorax during or right after the procedure. Two case studies reported the onset of symptoms to be 1 hour after the colonoscopy.<sup>6,9</sup> A delayed onset of symptoms, 6 hours after the end of the procedure, was also reported by Alabraba et al.<sup>8</sup> In this case, pneumothorax was a result of an incarcerated loop of colon via a diaphragmatic hernia.<sup>8</sup> In almost all the

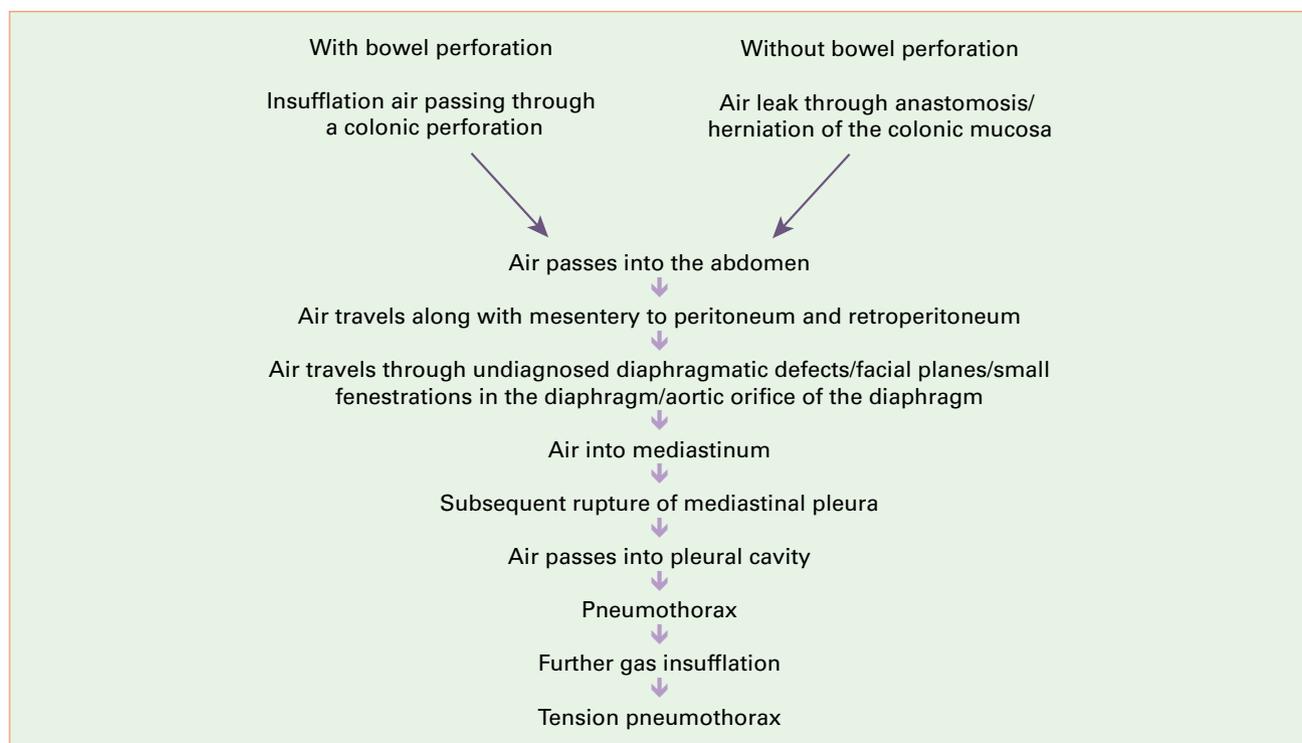
Author, year	Patient sex/age	Case description	Onset/signs and symptoms	Presence of bowel perforation	Treatment and outcome
Hearnshaw et al, <sup>4</sup> 2004	F/80	Had severe sigmoid diverticular disease The colonoscope was advanced only to 35 cm because of pain and the severity of disease; a 2-cm polyp at 20 cm was removed by a snare and coagulation.	<b>Onset:</b> During procedure <b>S/S:</b> Severe pain with abdominal distention, and the patient became hypoxic, cyanosed, and hypotensive. Difficult to ventilate after intubation; decreased lung sounds on the right side. Postintubation chest x-ray revealed a right tension pneumothorax.	No	<b>Treatment:</b> Exploratory laparotomy was performed, yet no bowel perforation was found. <b>Outcome:</b> Not discussed
Zeno & Sahn, <sup>12</sup> 2006	F/64	Had mechanical obstruction secondary to a large fecalith in sigmoid colon Colonoscopy performed in an attempt to remove the fecalith	<b>Onset:</b> During procedure <b>S/S:</b> Acute worsening of abdominal pain, and the procedure was immediately terminated. The vital signs were BP, 170/90 mm Hg, and O <sub>2</sub> saturation of 85%-90% on a 100% nonrebreather mask. Right-sided pneumothorax with contralateral shift and a large amount of free intraperitoneal air were found on x-rays.	Yes	<b>Treatment:</b> During an emergency laparotomy, large luminal defect in sigmoid colon was found. Left hemicolectomy with ostomy diversion was performed. <b>Outcome:</b> Discharged after 16 days of hospitalization
Ball et al, <sup>5</sup> 2006	F/77	Had hx of right hemicolectomy for appendiceal adenocarcinoma 3 years earlier Underwent diagnostic colonoscopy because of iron deficiency anemia	<b>Onset:</b> During procedure <b>S/S:</b> Acute shortness of breath and chest pain when the colonoscope was advanced to about the midtransverse colon. Extensive subcutaneous emphysema was evident on her face and neck. Decreased breath sounds bilaterally. Hypoxemia, O <sub>2</sub> saturation of 86% on room air. Bilateral tension pneumothoraces, pneumomediastinum, and pneumoperitoneum were apparent on chest x-ray.	Yes	<b>Treatment:</b> Exploratory laparotomy revealed a 5-mm posterior perforation at the site of the previous ileocolic anastomosis. The perforation was repaired. <b>Outcome:</b> Discharged from the hospital 12 days later without any complications
Lovisetto et al, <sup>6</sup> 2007	F/75	Had hx of right colon polypectomy 6 years earlier Underwent follow-up colonoscopy without ablative procedure or biopsy	<b>Onset:</b> 1 hour after procedure <b>S/S:</b> Severe and diffuse abdominal pain and tenderness, and early sign of peritoneal irritation in lower abdominal quadrants. X-rays showed pneumoperitoneum, gaseous overdistention of small and large intestines, left pneumothorax, and pneumomediastinum.	Yes	<b>Treatment:</b> Exploratory laparotomy showed perforated sigmoid diverticulum. The perforation was repaired, and a protective loop colostomy at the level of the descending colon was created. <b>Outcome:</b> Discharged home 8 days after operation
Marwan et al, <sup>7</sup> 2007	F/89	Underwent diagnostic colonoscopy because of iron deficiency anemia	<b>Onset:</b> During procedure <b>S/S:</b> Developed profound subcutaneous emphysema of the face, chest wall, and abdomen. No respiratory distress, abdominal pain, or shortness of breath. Normal vital signs, and O <sub>2</sub> saturation was 99% on room air. Distended tympanic abdomen on abdominal examination findings but no evidence of peritonitis. CT scan of chest, abdomen, and pelvis with oral contrast agent revealed right pneumothorax (occupying 20% of right thoracic cavity), pneumomediastinum, pneumoperitoneum, and pneumoretroperitoneum extending down to the perirectal planes in addition to extensive subcutaneous emphysema.	Yes	<b>Treatment:</b> Managed conservatively with IV fluids and antibiotics for 72 hours before gradual reintroduction of oral fluid and food. No intercostal drainage of the pneumothorax was performed. Follow-up chest x-ray showed resolving pneumomediastinum and resolution of the pneumothorax. <b>Outcome:</b> Made an uneventful recovery and was discharged from the hospital 7 days later

Author, year	Patient sex/age	Case description	Onset/signs and symptoms	Presence of bowel perforation	Treatment and outcome
Alabraba et al, <sup>8</sup> 2008	M/46	Underwent colonoscopy because of rectal bleeding. Advancement of the colonoscope became difficult beyond the splenic flexure. The case was aborted because of abdominal discomfort. Discharged home after a satisfactory postprocedure examination.	<b>Onset:</b> 6 hours after procedure <b>S/S:</b> Development of chest pain and breathlessness 6 hours after discharge. Left-sided tension pneumothorax was seen on chest x-ray. The left lung failed reexpand after a chest tube insertion due to left-sided diaphragmatic hernia, which was revealed on CT of thorax.	No	<b>Treatment:</b> Laparotomy was performed to repair left-sided diaphragmatic hernia (5 cm in diameter). A loop of colon was incarcerated in the hernia. The loop of bowel was resected, and the hernia defect was closed. <b>Outcome:</b> The lung reexpanded 4 days later, and the patient was discharged home shortly afterward.
Ignjatović & Jović, <sup>9</sup> 2009	M/54	Underwent colonoscopy with electroresection of the sigmoid colon polyp. He was admitted because of bleeding from the polypectomy site. Bleeding was controlled by hemoclips and electrocoagulation.	<b>Onset:</b> 1 hour after procedure <b>S/S:</b> Shortness of breath, hoarseness, and face swelling; subcutaneous emphysema palpated on the thorax, neck, head, and cheek. The massive left-sided pneumothorax, the mediastinum shift to the right, subcutaneous emphysema, and gas under diaphragm and in retroperitoneal tissue were seen on the plain chest and abdominal x-rays.	Yes	<b>Treatment:</b> Urgent laparotomy was performed, and pneumoretroperitoneum and sigmoid colon perforation of 1.5 mm in diameter between 2 mesosigmoid layers were found. Partial sigmoidectomy (20 cm), both perforation site and basis of electroresection polyp was performed. <b>Outcome:</b> Discharged from the hospital 7 days afterward
Kipple, <sup>13</sup> 2010	M/78	Underwent colonoscopy with sigmoid polypectomy that morning at another facility. He was discharged home even though he was having increasing abdominal pain and swelling of the neck and anterior aspect of chest.	<b>Onset:</b> Shortly after procedure ended <b>S/S:</b> Increasing abdominal pain and swelling of the neck and anterior aspect of chest. Presented to ED 8 hours after discharge from the first facility with increasing abdominal pain and distention; swelling of his face, neck, and chest; and shortness of breath. Diminished the right lung sounds and rales on the left lung on auscultation. Soft abdomen with tenderness, some guarding in bilateral lower quadrants. No respiratory distress, cyanosis, or airway obstruction was noted. CT of abdomen without contrast revealed bilateral pneumothoraces with free air in mediastinum, peritoneal cavity, mesentery, and retroperitoneum. The retroperitoneal free air appeared to be tracking up to the mediastinum.	Yes	<b>Treatment:</b> Emergency laparotomy with repair of colonic perforation was performed. A perforation of the posterior sigmoid colon was discovered. The Hartmann procedure was performed. <b>Outcome:</b> On postoperative day 13, he was transferred to an inpatient rehabilitation facility, and 16 days later he was discharged home with nursing care; 3 months later, he returned to the hospital for Hartmann reversal procedure. The surgery went successfully, and he was discharged without any complications.

<p>Pouramand &amp; Shokoohi,<sup>10</sup> 2013</p>	<p>F/84</p>	<p>Had surgical hx of hemorrhoidectomy in 1951 and 2 rectal surgeries in 1949. Underwent outpatient diagnostic colonoscopy</p>	<p><b>Onset:</b> Shortly after procedure ended  <b>S/S:</b> Abdominal pain, chest pain, and shortness of breath. Altered mental status and persistent tachycardia were noted. RR of 32/min and O<sub>2</sub> saturation of 88% on room air. On ED arrival, she was awake but confused, complaining of abdominal pain, chest pain, and shortness of breath. BP of 105/60 mm Hg, RR of 125/min, and O<sub>2</sub> saturation 91% on nonrebreather mask. No breath sound on the right side, and normal breath sound on the left. Soft abdomen with mild suprapubic tenderness, no distention, no peritoneal sign. Subcutaneous emphysema was palpated on her neck and anterior aspect of chest. Chest x-ray revealed a right tension pneumothorax with major left-sided cardiac shift; no evidence of intestinal structures in the chest. CT of abdomen revealed a pneumoperitoneum.</p>	<p>No</p> <p><b>Treatment:</b> Sent to ICU for observation and underwent conservative nonsurgical management  <b>Outcome:</b> Discharged home 7 days later without any complication</p>
<p>Yang et al,<sup>11</sup> 2016</p>	<p>M/51</p>	<p>Underwent colonoscopy with endoscopic mucosal resection (EMR) of rectal adenoma. For the wound hemostasis, 2 hemoclips were used after EMR.</p>	<p><b>Onset:</b> After EMR  <b>S/S:</b> Sudden dyspnea with acute development of subcutaneous emphysema of the neck, posterior chest wall, and anterior and lateral abdominal walls. Supplemental O<sub>2</sub> therapy did not improve the dyspnea. Bilateral pneumothoraces were shown on an emergency chest x-ray, and bilateral pneumothoraces, pneumomediastinum, pneumoperitoneum, and pneumoretroperitoneum extending to the presacral space were revealed on CT of chest, abdomen, and pelvis.</p>	<p>Yes</p> <p><b>Treatment:</b> Conservative treatment with IV fluids and antibiotics, and gradual reintroduction to oral fluids and food  <b>Outcome:</b> Discharged home without any complication</p>

**Table. Summary of Published Case Reports**

Abbreviations: BP, blood pressure; CT, computed tomography scan; ED, emergency department; hx, history; IV, intravenous; O<sub>2</sub>, oxygen; RR, respiratory rate; S/S, signs and symptoms; x-ray, x-ray film.



**Figure.** Mechanisms of Pneumothorax Development During and Following Colonoscopy<sup>5,7-10,12</sup>

cases, the initial symptoms were acute severe worsening abdominal and chest pain, dyspnea, and subcutaneous emphysema on the face, neck, chest, and abdomen. In a case report by Kipple,<sup>13</sup> the patient was earlier discharged from an outpatient gastrointestinal facility although he was already complaining of increasing abdominal pain and swelling of his neck and anterior aspect of the chest. Eight hours later, he came to an emergency department with increasing abdominal pain, dyspnea and swelling of his face, neck, and chest.<sup>13</sup>

In 7 of 10 cases reported, surgical intervention was required, and 3 cases were successfully managed conservatively. One of the medically managed cases did not have a bowel perforation. Fortunately, 9 cases had positive patient outcomes, and the patients were eventually discharged. The outcome was not discussed in the case study by Hearnshaw et al.<sup>4</sup>

## Discussion

Bowel perforation is one of the most serious complications of a therapeutic and diagnostic colonoscopy. The incidence of perforation is 0.01% to 0.1% for a screening colonoscopy and 0.17% to 18% for a therapeutic colonoscopy, such as polypectomy and Crohn disease stricture dilation.<sup>2</sup> A retrospective cross-sectional study with a sample size of 80,118 cases indicated that the risk factors for bowel perforation were increased age, female gender, lower body mass index, low plasma albumin level, ICU patient, inpatient setting, and Crohn disease as an indication for colonoscopy.<sup>14</sup>

The mechanisms of perforation consist of 3 types of trauma: barotrauma, mechanical trauma, and therapeutic-associated trauma.<sup>2,5,7,14</sup> Barotrauma results from excessive insufflation pressure of air or CO<sub>2</sub> used for luminal distention for visualization.<sup>2</sup> Air insufflation is the most widely used insufflation method for colonoscopy. Although the maximal pressure produced by colonoscopy air pump is approximately 300 to 375 mm Hg and a flow rate of 2 to 3 L/min, sustained intraluminal air pressure is usually 9 to 57 mm Hg due to air leakage.<sup>15</sup> The pneumatic force required for colonic mucosal rupture to occur is 226 ± 14 mm Hg.<sup>5,13</sup> Mechanical trauma accounts for 32% to 63% of colonic perforation, and it is due to direct pressure from the colonoscope to the colonic wall.<sup>2,13</sup> Therapeutic-associated trauma results from therapeutic procedures such as electrocautery resection of polyps and stent placement for strictures secondary to benign and malignant tumors.<sup>2,9</sup>

Most bowel perforations are detected during the procedure or within 24 hours, and the diagnosis is made with an abdominal radiograph or CT scan for suspected cases.<sup>2,9</sup> Late perforations should be considered when a patient experiences abdominal pain and distention, circumscribed peritonitis, fever, and/or leukocytosis. Surgical intervention is required with generalized peritonitis, sepsis, hemodynamic instability, suspicion of poor bowel preparation, and a large defect.<sup>2</sup> The mortality rate of bowel perforation is relatively high, and a recent retrospective review over 16 years with a sample size of 132,259 cases revealed that the 30-day mortality rate of a colonic perforation is 19%.<sup>16</sup>

Pneumothorax as a potentially life-threatening complication of colonoscopy is not yet widely recognized by anesthesia care providers and other healthcare professionals. Through a literature review by Zeno and Sahn,<sup>12</sup> only 9 reported cases were identified between 1975 and 2005. Pneumothorax development during and following colonoscopy (Figure) has been described as having a variety of mechanisms based on pathophysiologic findings and injury type of each case. The mechanisms of pneumothorax development secondary to colonoscopy can be summarized as follows. The insufflation air escapes through a colonic perforation. Without an actual bowel perforation, the air passes through the previous surgical anastomosis or colonic mucosa herniation. This eventually leads to pneumoperitoneum and pneumoretroperitoneum. From there, air will travel into the mediastinum through undiagnosed diaphragmatic defects, continuous facial planes, small fenestrations in the diaphragm, or an aortic orifice of the diaphragm. Once pneumomediastinum has developed, air will be forced into the pleural cavity because of a subsequent rupture of the mediastinal pleura. Consequently, pneumothorax will result.<sup>5,6,8-10,12</sup>

### Anesthesia Implications

Although pneumothorax is extremely rare, it is essential to be aware of pneumothorax as a potential complication of colonoscopy. Through the literature review, there were 3 cases identified in which pneumothorax occurred without the presence of iatrogenic bowel perforation; however, it is more common to have a bowel perforation as a cause of pneumothorax development. Anesthesia care providers should be knowledgeable of high-risk patient populations, pathology, and type of procedures for bowel perforations related to colonoscopy.

In case of an emergency, it is prudent to have emergency airway equipment and medications readily available. Anesthesia care providers should be as close to the patient and his or her airway as possible. It is best to avoid positioning the patient away from the anesthesia machine at all costs.

Vigilance is key to recognition of a subtle change in the patient's status. Colonoscopy usually is performed in the dark to enhance visualization of the monitor screen for the endoscopist; this makes it harder for the anesthesia provider to assess the patient. More frequent and thorough assessment may be required in such situations.

### Conclusion

Pneumothorax and tension pneumothorax following a colonoscopy is an extremely rare but severe and often life-threatening complication. An increased awareness of potential complications of endoscopic procedures is needed in the anesthesia professional community because of the dramatic increase in the utilization of anesthesia services

for these procedures. It is crucial that anesthesia care providers are educated that pneumothorax is a potential complication of colonoscopy and that they can recognize complications early to yield desirable patient outcomes.

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### DISCLOSURES

The author has declared no financial relationships with any commercial entity related to the content of this article. The author did not discuss off-label use within the article.