Percutaneous needle decompression for tension pneumoperitoneum during GI endoscopy: a step-by-step guide (CME)

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Background and Aims: GI tract perforations during endoscopy can lead to serious adverse events such as tension pneumoperitoneum. In such cases, intraprocedural percutaneous needle decompression can be a life-saving technique, in addition to allowing procedure completion. The aim of this study is to review the indications for percutaneous needle decompression and provide a step-by-step procedural guide with case examples.

Methods: This review article and accompanying video review the technique for percutaneous needle decompression for pneumoperitoneum during endoscopy-related perforation, providing a step-by-step procedural guide illustrated with 2 case examples.

Results: In both case examples, intraprocedural needle decompression resulted in rapid normalization of hemodynamics and allowed time to safely complete the procedures after endoscopic closure of the perforation.

Conclusions: Early recognition of pneumoperitoneum followed by intraprocedural percutaneous needle decompression with a large-bore catheter can allow time for defect closure and procedure completion or can serve as a temporizing measure until surgical intervention. Endoscopists should be comfortable performing this lifesaving technique in cases of endoscopy-related perforation and/or pneumoperitoneum. (VideoGIE 2025;10:60-5.)

INTRODUCTION

Iatrogenic GI tract perforations during endoscopy are rare but can be life-threatening.[1] Tension pneumoperitoneum can occur as a result of perforation and is defined by hemodynamic or respiratory compromise from air accumulation in the peritoneum.[2] Tension pneumoperitoneum should be suspected in patients who develop marked abdominal distension and rigidity, elevated ventilatory pressures, and/or hypotension or shock from circulatory collapse.[3]

With the rise in advanced therapeutic endoscopic techniques, it is increasingly important for endoscopists to be able to recognize and manage endoscopy-related adverse events such as perforation. Therapeutic endoscopic procedures associated with high rates of perforation include endoscopic submucosal dissection (ESD), EMR of large lesions, and peroral endoscopic myotomy (POEM).[4,5] In addition, pneumoperitoneum can occur with third-space procedures of extended duration in the absence of full-thickness perforation.

Percutaneous needle decompression allows for immediate release of trapped intraperitoneal air and can be performed in cases of suspected or impending tension pneumoperitoneum. This technique can allow time for endoscopic closure in cases of perforation or serve as a temporizing measure prior to surgical intervention. It is important that endoscopists are comfortable performing this potentially life-saving technique.

Here we review the indications for percutaneous needle decompression and provide a step-by-step procedural guide with case examples.

Abbreviations: ESD, endoscopic submucosal dissection; GIST, GI stromal tumor; POEM, peroral endoscopic myotomy; STER, submucosal tunnel endoscopic resection.

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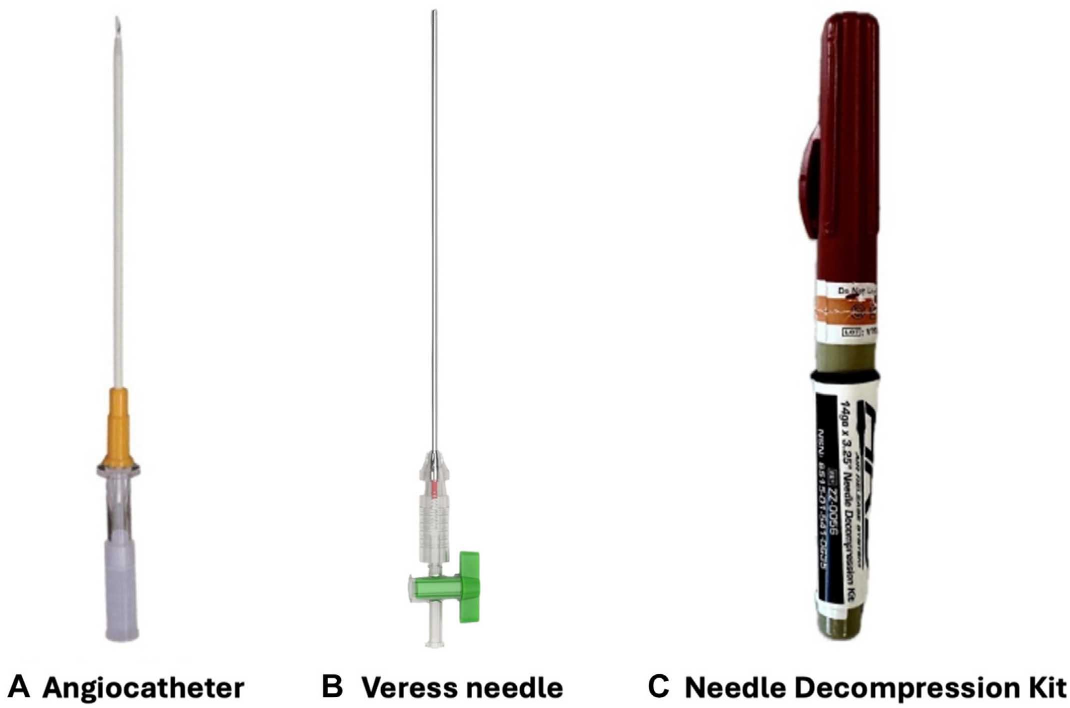

Figure 1. Needles for decompression of pneumoperitoneum: **A,** Large-bore angiocatheter (14-gauge × 3.25 in.; BD, Franklin Lakes, NJ, USA). **B,** Veress needle (Mölnlycke, Gothenburg, Sweden). **C,** Needle decompression kit (ARS 14-gauge × 3.25 in.; North American Rescue, Greer, SC, USA).

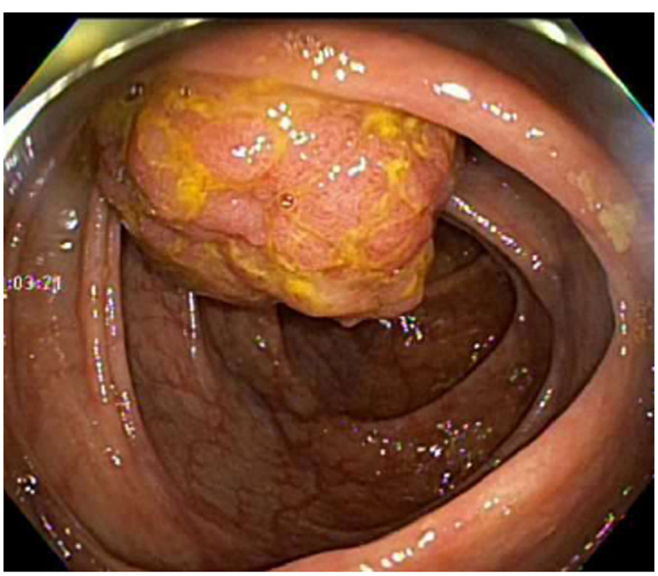

Figure 2. A 4.5-cm lesion is seen in the ascending colon during colonoscopy.

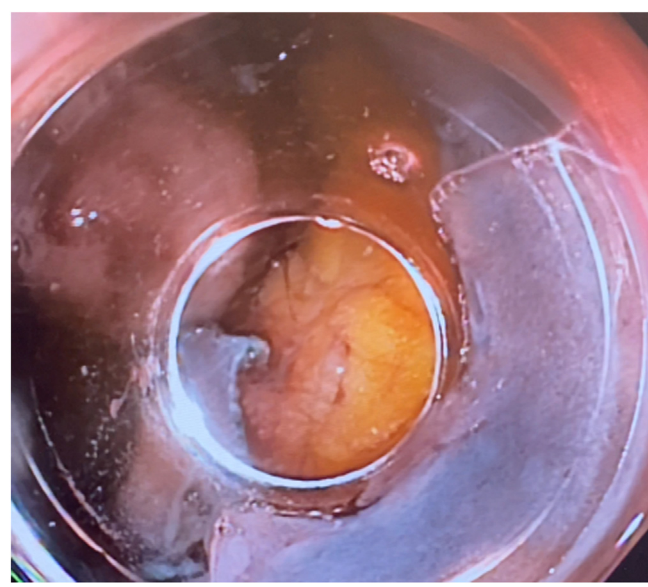

Figure 3. A full-thickness defect with visible intraperitoneal fat is visualized during endoscopic submucosal dissection.

PERCUTANEOUS NEEDLE DECOMPRESSION: PROCEDURAL METHODS

Indications for percutaneous needle decompression

1. Suspected or impending tension pneumoperitoneum during endoscopy associated with perforation.
2. Pneumoperitoneum associated with third-space procedures of extended duration even in the absence of a full-thickness perforation.

Materials needed

1. Needle for decompression: although no standard of care has been established for which needle to use for decompression of pneumoperitoneum, use of the following needle types has been reported:

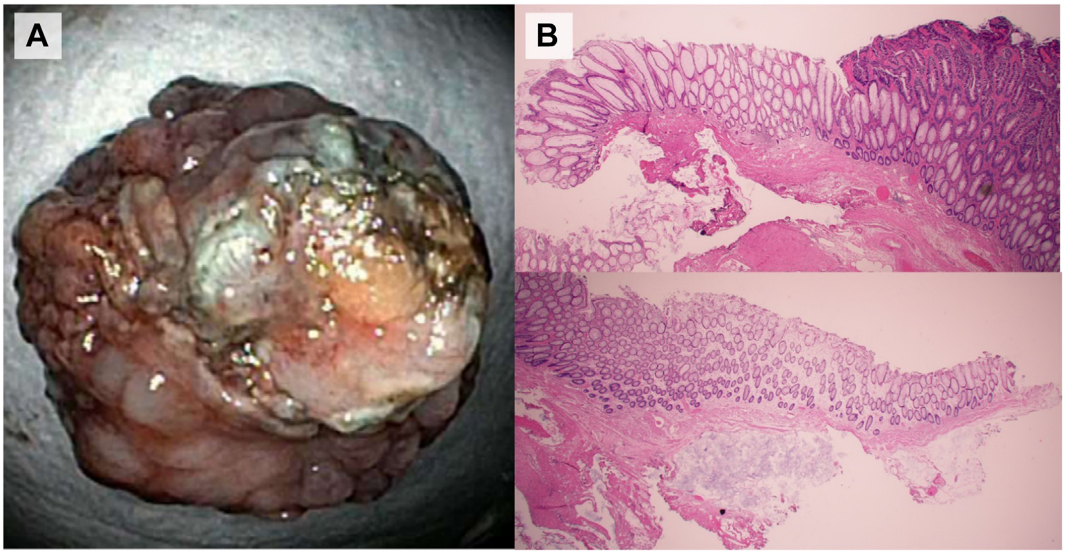

Figure 4. A, Resected specimen. **B,** Final histopathology showing well-differentiated adenocarcinoma with superficial submucosal invasion (SM1) and negative deep and lateral margins (H&E, orig. mag. x4).

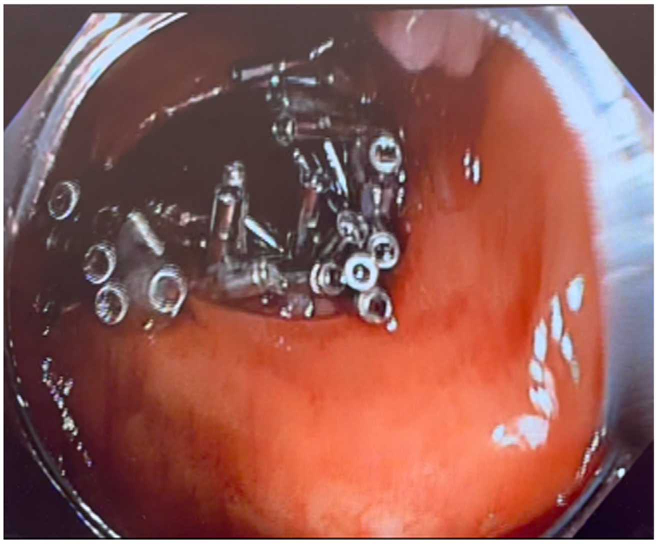

Figure 5. Defect closure is achieved using multiple through-the-scope Endoclips.

a. Large bore (14- or 16-gauge) venous catheter or angiocatheter (Fig. 1A).
b. Veress needle (Mölnlycke, Gothenburg, Sweden) (Fig. 1B).
   i. This needle is commonly used for insufflation of the abdomen during laparoscopic procedures. It features a beveled needle tip with a spring-loaded stylet that covers the needle tip once the needle has penetrated the abdominal wall, thus shielding the needle tip from visceral organs. The Veress needle comes in 2 lengths: 120 and 150 mm.
c. Needle decompression kit (Fig. 1C).

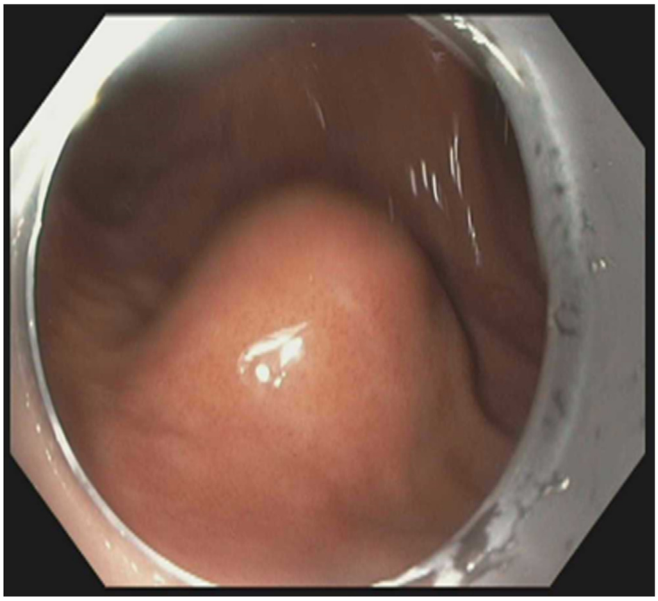

Figure 6. A 25-mm subepithelial GI stromal tumor is seen in the gastric body during upper GI tract endoscopy.

d. Note that needles with multiple holes are preferred because of the predisposition of single-hole needles to become blocked easily, for instance, if the catheter tip touches or aspirates the outer portion of the intestine.

2. Saline-filled syringe.
3. Sterilizing solution for skin.
4. US (if available)—bedside US can be considered to mitigate the potential risk of visceral organ injury during needle insertion. Additionally, it can determine whether a tense abdomen is due to a true pneumoperitoneum

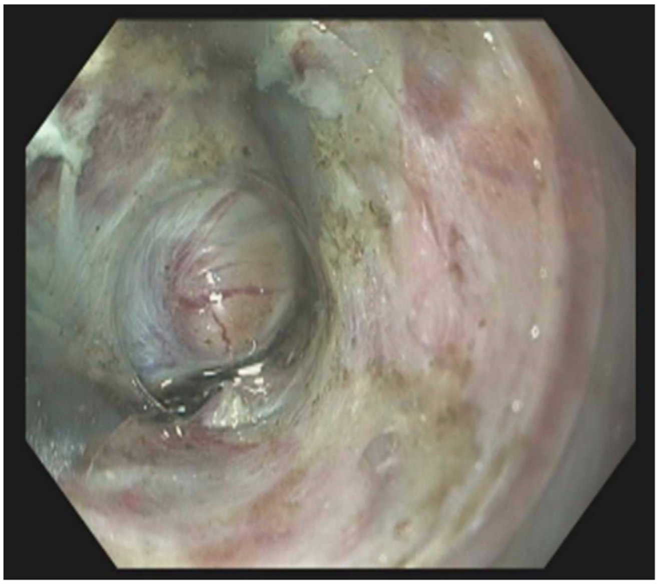

Figure 7. View of the lesion in the submucosal tunnel.

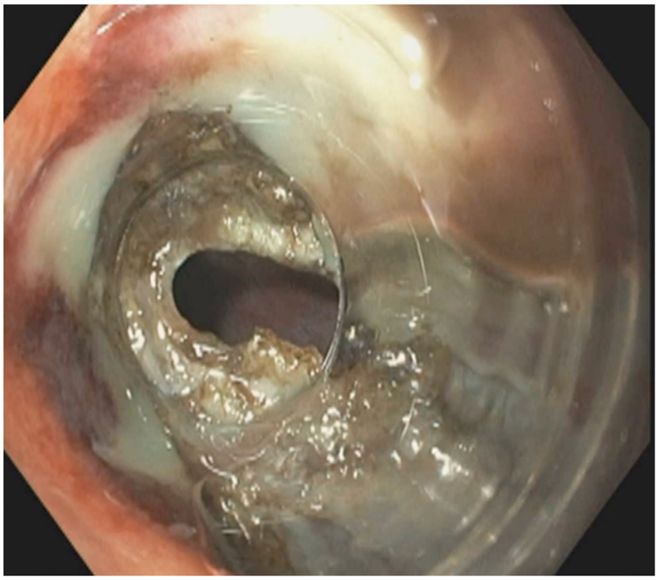

Figure 8. Full-thickness resection is performed to completely excise the lesion.

versus overinsufflation in the intestinal tract by the endoscope.

Procedure steps

1. Sterilize the skin surface where the needle will be inserted and attach the catheter to a saline-filled syringe.
2. Insert the needle into the abdominal wall. Recommended needle entry sites are as follows:
   a. Two centimeters directly below the umbilicus or in the left or right lower quadrants to avoid solid organ injury (eg, liver or spleen).[3]
   b. Left upper quadrant in the midclavicular line (preferred for esophageal procedures).
3. Slowly advance the needle into the peritoneum until air release occurs, which will be noted by air bubbles within the fluid-filled syringe.
4. Once appropriate position of the needle has been confirmed, remove the needle but leave the catheter in place.
5. Confirm the catheter is still in place by reattaching the saline-filled syringe, which should again demonstrate air bubbles if in the appropriate position.
6. The catheter can remain in place until the procedure is completed and/or the defect is closed.

General procedural considerations

Early consultation with surgery is recommended in case needle decompression is unsuccessful or the perforation is unable to be closed endoscopically. Potential adverse events of needle decompression include bleeding, bowel or organ perforation if bowel distension and adhesions are present (although this is less likely to occur in supine patients with large amounts of intraperitoneal air), and failure to improve condition, necessitating further intervention. Additionally, CO_2 insufflation should be used in all procedures of long duration, advanced endoscopic resection, and third-space procedures.

CASE EXAMPLES

Case 1

A 79-year-old man with a history of heart failure with preserved ejection fraction, coronary artery disease with percutaneous coronary intervention 1 year prior, and atrial fibrillation on apixaban was found to have a 4.5-cm lesion in the ascending colon (Fig. 2). Pathology revealed well-differentiated adenocarcinoma. He was initially referred to colorectal surgery; however, he was determined to be a nonsurgical candidate due to the presence of multiple comorbidities. After multidisciplinary discussion, the decision was made to pursue endoscopic submucosal dissection (ESD).

During ESD, a full-thickness defect was noted with visible peritoneal fat (Fig. 3). The patient developed progressive abdominal distension and elevated peak ventilatory pressures. The decision was made to perform percutaneous needle decompression for tension pneumoperitoneum. A 16-gauge venous catheter with an attached saline-filled syringe was inserted a few centimeters from the umbilicus and slowly advanced. Immediate release of gas followed that was evidenced by air bubbles within the fluid-filled syringe (Video 1, available online at www.videogie.org). The peak ventilatory pressures and abdominal distention improved. The decision was made to continue ESD with the percutaneous catheter remaining in place.

ESD was continued and the lesion was successfully resected (Fig. 4A). The remainder of the defect was closed using 23 through-the-scope Endoclips (Cook Medical,

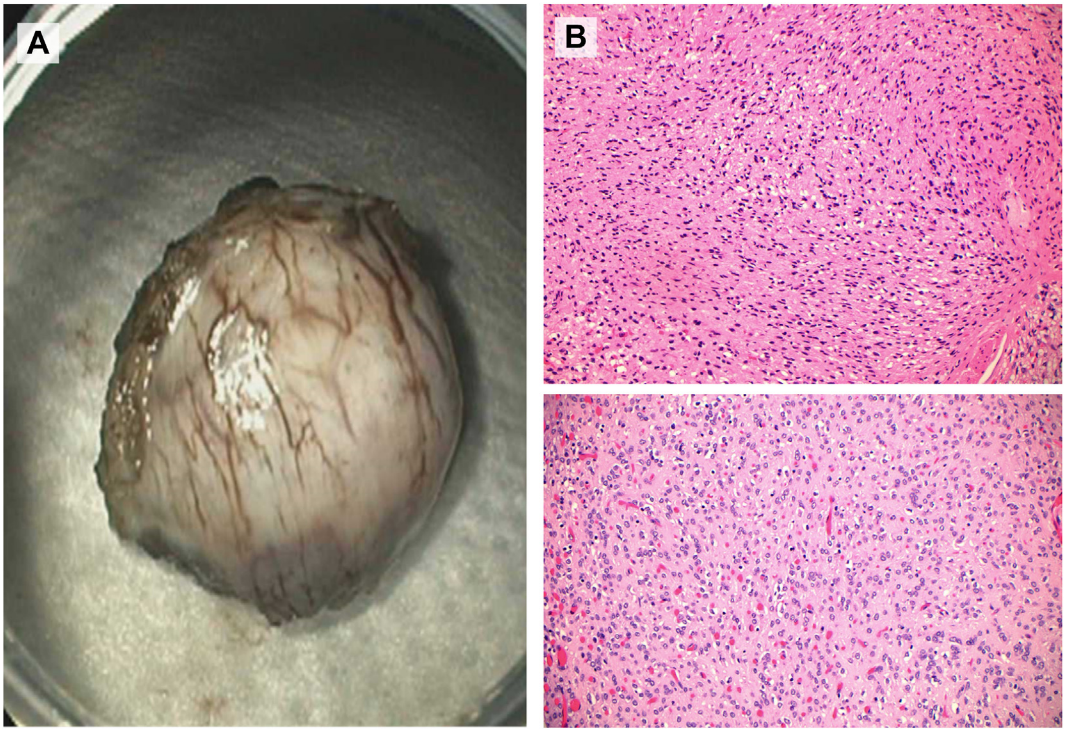

Figure 9. A, View of the GI stromal tumor (GIST) after full-thickness resection. **B,** Histopathology showing a spindle (top) and epithelioid type (bottom) GIST with a focal positive margin (high-power field). H&E, orig. mag. x4.

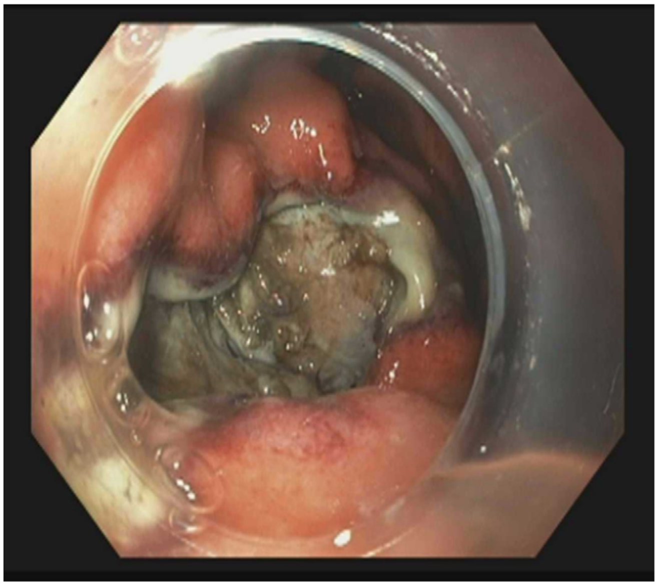

Figure 10. View of postresection defect.

Bloomington, Indiana, USA) placed in a zipper fashion (Fig. 5). The total procedure duration was 229 minutes.

The final histopathology revealed well-differentiated adenocarcinoma with superficial submucosal invasion (SM1) and negative deep and lateral margins (Fig. 4B). There was no evidence of lymphovascular invasion, perineural invasion, or tumor budding.

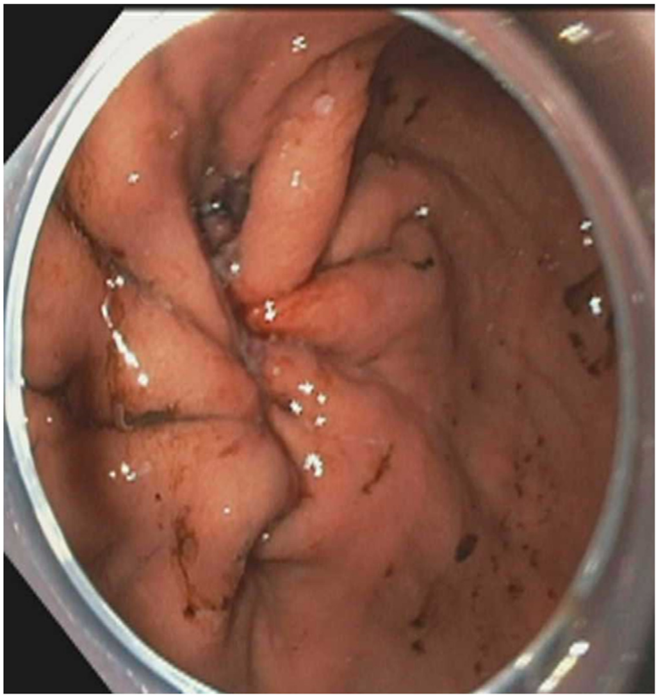

Figure 11. Defect closure performed with endoscopic suturing.

The patient was admitted for observation after the procedure. His vital signs remained stable and as such did not require monitoring in the intensive care unit. The patient received intravenous antibiotics for 24 hours and was discharged with a 3-day course of oral antibiotics. He was able to tolerate oral intake at the time of discharge. There were no delayed procedural adverse events.

Case 2

A 77-year-old man with a history of obstructive sleep apnea and hypertension was incidentally found to have a lesion in the gastric body (Fig. 6) on a CT scan. EUS revealed a 25-mm subepithelial lesion originating from the muscularis propria, with fine-needle biopsy confirming a GI stromal tumor (GIST). The decision was made to proceed with submucosal tunnel endoscopic resection (STER).

First, submucosal injection was performed 4 to 5 cm proximal to the lesion to create the tunnel entry point. A mucosal incision was made and submucosal tunneling was performed until the lesion was identified (Fig. 7). The lesion was dissected from the attached muscularis propria fibers within the submucosal tunnel. Because of the nature of the lesion, full-thickness resection needed to be performed in order to complete the resection (Fig. 8). This led to progressive abdominal distension and elevated peak ventilatory pressures. The decision was made to perform percutaneous needle decompression for pneumoperitoneum. A 16-gauge venous catheter was inserted through the abdominal wall followed by immediate air escape as evidenced by air bubbles within the syringe. Ventilatory pressures and abdominal distension quickly improved. Full-thickness resection of the GIST was continued and the lesion was successfully resected (Fig. 9A). The defect (Fig. 10) was closed using the endoscopic suturing device (OverStitch, Apollo Endosurgery, Austin, Tex, USA) (Fig. 11).

The final histopathology report confirmed a spindle and epithelioid-type GIST with a focal positive margin that was unable to be further clarified by the pathologist, but otherwise the remaining margins were negative (Fig. 9B). The mitotic rate was low ($<1/mm^2$).

The patient was admitted for observation after the procedure and did not experience any abdominal pain or further adverse events. He remained hemodynamically stable and was discharged the following day. There were no delayed adverse events. The case was discussed in a multidisciplinary fashion at a tumor board conference and a plan was made for surveillance EGD in 6 months given the low-risk pathologic features (low mitotic rate and low histologic grade).

CONCLUSIONS

With the rise in advanced therapeutic endoscopic techniques, it is important for endoscopists to recognize and manage procedural adverse events, such as pneumoperitoneum from perforation.

Early recognition of pneumoperitoneum followed by intraprocedural percutaneous needle decompression with a large-bore catheter can allow time for defect closure and procedure completion or can serve as a temporizing measure until surgical intervention. Additionally, when used in cases of tension pneumoperitoneum, this technique can prevent the development of severe adverse events such as abdominal compartment syndrome or hemodynamic collapse that carry high morbidity and mortality. Lastly, this technique can minimize postprocedure pain when intraprocedural pneumoperitoneum occurs. Endoscopists should be comfortable performing this life-saving technique in cases of endoscopy-related perforation and/or pneumoperitoneum.

DISCLOSURE

Mohammad Bilal is a consultant for Boston Scientific, STERIS, and a paid speaker for Cook Endoscopy. All other authors have no personal or financial conflicts of interest to disclose.

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