



Adverse events during and after per-oral endoscopic myotomy: prevention, diagnosis, and management

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Per-oral endoscopic myotomy (POEM) has surfaced as an effective endoscopic treatment modality for achalasia cardia (AC). Promising results in short- and mid-term follow-up studies have increased the use of POEM for the management of AC. POEM can be safely performed in an endoscopy suite, and major adverse events (AEs) are uncommon. AEs encountered during POEM or during the perioperative period principally include insufflation-related AEs, mucosal injuries, bleeding, pain, and aspiration pneumonia. Most insufflation-related AEs do not require an active intervention and therefore should not be considered as AEs in the true sense. When management of AEs is required, most intraoperative AEs can be managed at the same time without untoward consequences. Occurrences of AEs lessen after completion of the learning curve. However, experience alone does not ensure “zero” incidence of AEs, and early recognition remains essential. Postoperative AEs, like leaks, delayed bleeding, and delayed mucosal perforations, may pose special challenges for diagnosis and management. There is no standardized classification system for grading the severity of AEs associated with POEM, resulting in wide variation in their reported occurrences. Uniform reporting of AEs is not only crucial to comprehensively analyze the safety of POEM but also for comparison with other established treatment modalities like Heller’s myotomy. GERD is an important long-term AE after POEM. Unlike the perioperative AEs, little is known regarding the intraoperative or patient-related factors that influence the occurrence of post-POEM GERD. Large prospective studies with long-term follow-up are required to determine the procedural factors associated with GERD after POEM. (*Gastrointest Endosc* 2018;87:4-17.)

Achalasia cardia (AC) is a neurodegenerative disorder characterized by aperistalsis and absence of lower esophageal sphincter relaxation. Graded pneumatic balloon dilatation and laparoscopic Heller’s myotomy have been the standard of treatment for AC. Per-oral endoscopic myotomy (POEM) has emerged as a welcome addition to the armamentarium for management of AC. The feasibility and safety of performing POEM in an endoscopy unit has been demonstrated in recent studies.^{1,2} Therefore, POEM

Abbreviations: AC, achalasia cardia; AEs, adverse events; MI, mucosal injury; POEM, per-oral endoscopic myotomy.

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procedures no longer require an independent operating theatre, which greatly facilitates the establishment of a POEM program.

The technique of POEM is relatively standardized and has been described in detail previously.^{3,4} In POEM, the endoscopist works inside a submucosal tunnel, now often referred to as the third space. Consequently, it is not surprising that gas-related events like pneumoperitoneum, retroperitoneal air, pneumothorax, and pneumomediastinum are frequently encountered during POEM.⁴ Rarely, pneumopericardium has also been reported during POEM.⁵ Other adverse events (AEs) associated with POEM include mucosal injuries (MIs), intraprocedural or delayed bleeding, postoperative pain, aspiration pneumonia, and delayed mucosal barrier failure. In early studies, all of these events were considered as procedure-related AEs. However, it is evident that most gas-related events and intraprocedural bleeding are inconsequential and do not require special intervention.^{3,6} In this article we comprehensively discuss the AEs during and after POEM.

INSUFFLATION-RELATED EVENTS OR AEs

Insufflation-related AEs are the most frequently described AEs with the POEM procedure (Fig. 1A-D).

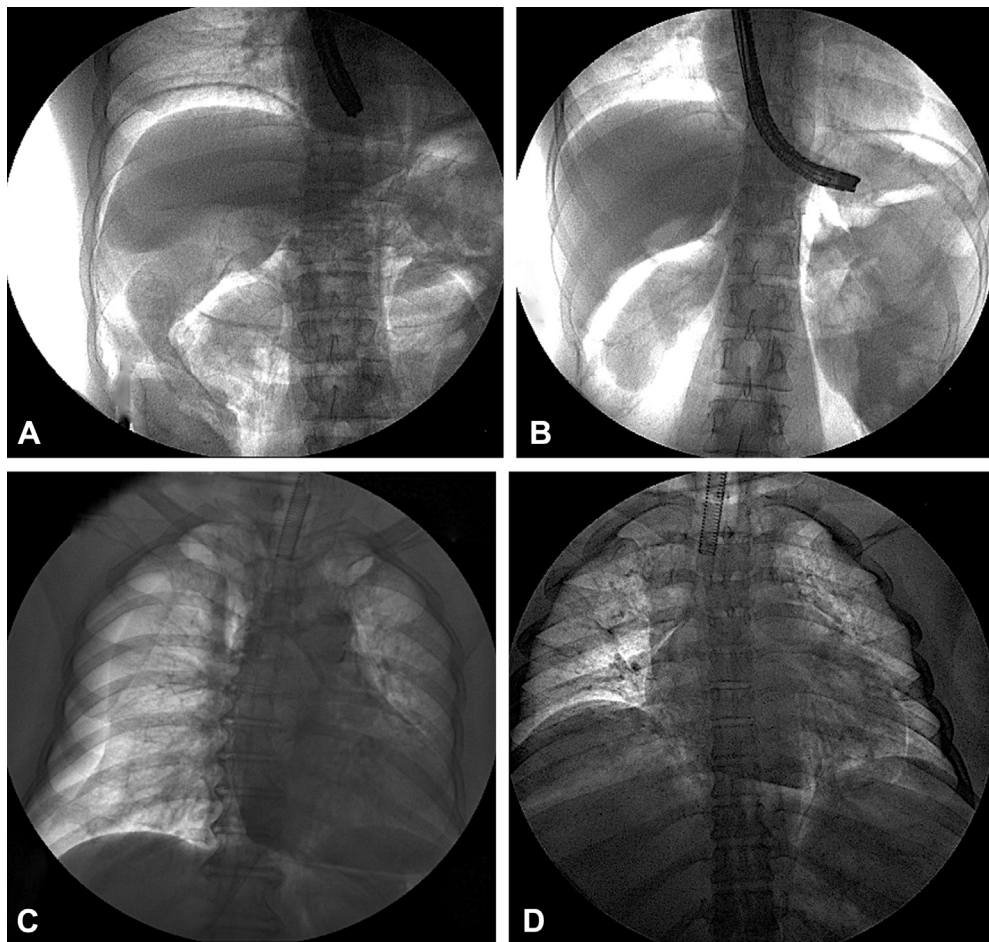


Figure 1. Insufflation-related adverse events during per-oral endoscopic myotomy. **A**, Rim of air between the superior surface of the liver below and dome of diaphragm above suggestive of pneumoperitoneum. **B**, White rim of air surrounding right kidney suggestive of retroperitoneal CO₂. **C**, Gas in the pleural cavity causing collapse of right lung suggestive of capnothorax. **D**, Thin rim of air surrounding cardiac tissue suggestive of pneumopericardium.

These insufflation-associated AEs include subcutaneous emphysema (7.5%), pneumothorax (1.2%), pneumomediastinum (1.1%), and pneumoperitoneum (6.8%).⁷ The incidence of gas-related events is variable in different studies depending on the definition used for AEs, gas used for insufflation (air or CO₂), and the modality used to diagnose them.^{6,8,9}

The use of air instead of CO₂ resulted in unexpectedly high occurrences of gas-related AEs in earlier studies.^{9,10} In 1 study, room air was used in 52% of patients, and insufflation-related AEs included pneumomediastinum (48%), pneumoperitoneum (37%), subcutaneous emphysema (28%), and pneumothorax (17%).¹⁰ CO₂ has a higher diffusion capacity and gets quickly absorbed as compared with air. Therefore, it is imperative to use CO₂ for insufflation during the entire POEM procedure.

High incidence of gas-related events has been reported in settings routinely using CT postprocedure.^{6,10} In 1 study post-POEM CT detected pneumomediastinum and/or pneumoperitoneum in 53.7% and subcutaneous emphysema in 29.6% patients.¹¹ In another prospective study the

incidence of pneumomediastinum and pneumoperitoneum was 85.7% and 66.7%, respectively. However, only 6% of patients required specific interventions.⁶ Likewise, a postoperative contrast study usually reveals small pneumoperitoneum with no bearing on subsequent management (Fig. 2).^{12,13} It is evident that most of these events have no clinical significance, and routine postoperative CT or contrast study cannot be recommended.

The definition of insufflation-related AEs needs to be standardized. In a large multicenter study the frequency of insufflation-related AEs was only 1.6% after excluding incidentally detected capno-events.¹⁴ Currently, only those gas-related events requiring an intervention should be categorized as AEs.

The occurrence of insufflation-related AEs cannot be completely prevented. However, they can be minimized by following certain steps. Use of CO₂ instead of air for insufflation and positive pressure ventilation are the most important measures to reduce the occurrences of gas-related AEs. In addition, use of a low-flow gas tube, creating a wider submucosal tunnel, and conscious efforts

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