

acute GI bleeding.³⁰ Air embolism is a rare but potentially fatal AE of EGD that has been described and warrants awareness,^{31,32} especially if air (rather than carbon dioxide) insufflation is used intraprocedurally.

Predictors of periendoscopic cardiopulmonary AEs are as follows:

- Age ≥ 65 years.⁹
- Obesity.^{33,34}
- Hypertension.³⁴
- Diabetes.³⁴
- Coronary artery disease,^{9,34} in particular, EGD performed within 30 days of an acute myocardial infarction is associated with increased cardiopulmonary AEs of 1% to 8%, with most AEs being transient and/or mild.³⁵
- Higher American Society of Anesthesiologists scores, which have been correlated with greater risk of serious AEs after EGD, with odds ratios (ORs) of 1.54 (95% confidence interval [CI], 1.31-1.82), 3.90 (95% CI, 3.27-4.64), and 12.02 (95% CI, 9.62-15.01) for scores of II, III, and IV/V, respectively.³⁶
- Monitored anesthesia care, which has been correlated with a higher risk (.09% vs 0%, $P < .05$) of cardiorespiratory arrest compared with conscious sedation, although this may be confounded by patient selection.²⁸

Although obstructive sleep apnea has been postulated to be associated with a higher risk of cardiopulmonary AEs, a meta-analysis of over 3000 patients did not demonstrate this as a risk factor.³⁷ The addition of capnography to standard monitoring has been shown to significantly reduce the incidence of clinically significant hypoxemia (OR, .53; 95% CI, .35-.81) in a meta-analysis including 3088 patients.³⁸ Endoscopists and anesthesiologists should be aware of these risk factors when performing EGD and should counsel their patients accordingly.

EGD WITH MANAGEMENT OF FOREIGN BODY AND/OR IMPACTION

Overview

GI foreign bodies and/or impactions frequently require urgent or emergent EGD.³⁹ Given that obstructions and impactions occur most often at sites of angulation or narrowing,³⁹ mucosal tears, ulcerations, and/or full-thickness perforations resulting from the ingested foreign body itself are all possible. They are, in fact, more common than AEs attributable to the performance of EGD, occurring in up to 15% of cases.^{40,41} Aspiration and respiratory compromise are also possible. Therefore, a thorough clinical evaluation for signs of any evidence of respiratory compromise is crucial before attempting to perform upper endoscopy. Furthermore, care should be taken during endoscopic evaluation and management of impactions, given that 80% of presenting patients will have an underlying lesion or condition such as a ring, eosinophilic esophagitis (EoE), strictures (benign or malignant), or a mass.⁴²

Bleeding

In a large retrospective analysis of over 900 patients with ingested foreign bodies, the rate of bleeding was 2.6%, with almost all of these being self-limited.⁴³ In this study, the use of a through-the-scope instrument (rather than using the push technique, in which gentle central pressure is applied to a soft bolus in the absence of significant resistance to displace it distally) was associated with a higher rate of periprocedural AEs, including bleeding.⁴³ However, this may possibly be a reflection of larger foreign bodies requiring the use of such instruments. In a recent multicenter randomized trial of 342 patients with food bolus impactions, the use of a soft, oblique, cap-assisted approach was associated with a significantly lower risk of mucosal tears and bleeding compared with a conventional approach (.0% vs 7.6%).⁴⁴

Perforation

The risk of perforation during endoscopic management of impactions or obstructions appears to be highest in the esophagus compared with the stomach or small intestine.⁴¹ Several retrospective studies reported rates of perforation from .4% to 3.3%.^{41,43,45-48}

Several procedure-related variables have been associated with a higher overall risk of perforation in this population:

- Increasing time between presentation and endoscopic management^{45,47}: Although the optimal timing for performing EGD on these patients has not been well established, EGD within 24 hours of presentation should be considered when the site of the bolus is suspected to be esophageal.
- Larger (≥ 3 cm) foreign body size.⁴⁷
- Presence of an ingested bone.⁴⁷
- Use of an endoscopic instrument to retrieve or extract a bolus⁴³: however, other studies demonstrate the equivalence of instrument-assisted techniques to the push technique as described above, and selection bias may play a role in interpreting these data^{46,48}; hence, an optimal strategy is not well established.
- Use of an overtube can very rarely cause perforation at the level of the hypopharynx, cricopharyngeus, or esophagus.^{49,50}

Infection

Aspiration pneumonia is the most common infectious AE related to EGD performed for management of a foreign body or impaction. In a retrospective cohort of 173 patients, the combined incidence of immediate and delayed aspiration pneumonia was over 6% (4.6% immediate, 1.7% delayed).⁴² In a large retrospective series of over 900 patients, the incidence of delayed aspiration pneumonia was 1.8%.⁴³ In a separate multicenter study of 214 patients, the risk was shown to be similar, at 3%.⁴¹ However, it should be noted that in this study, 24% of