Complications of upper GI endoscopy

This is one of a series of statements discussing the utilization of gastrointestinal endoscopy in common clinical situations. The Standards of Practice Committee of the American Society for Gastrointestinal Endoscopy prepared this text. In preparing this guideline, a MEDLINE literature search was performed, and additional references were obtained from the bibliographies of the identified articles and from recommendations of expert consultants. When little or no data exist from well-designed prospective trials, emphasis is given to results from large series and reports from recognized experts.

Guidelines for appropriate utilization of endoscopy are based on a critical review of the available data and expert consensus. Further controlled clinical studies are needed to clarify aspects of this statement, and revision may be necessary as new data appear. Clinical consideration may justify a course of action at variance to these recommendations.

Upper GI endoscopy is a very commonly performed procedure used as a diagnostic tool to evaluate patients with a wide range of problems and complaints. Complications related to diagnostic evaluations are rare. Based on a 1974 survey conducted by the American Society for Gastrointestinal Endoscopy, it was estimated that the overall complication rate based on over 200,000 esophagogastroduodenoscopy (EGD) examinations was 0.13% and carried an associated mortality of 0.004%. More current data for complication rates, specifically looking at diagnostic endoscopic examinations, are relatively understudied and prospective multicenter analyses have not been conducted in a systematic fashion. With the introduction of large multicenter databases, such as the CORI (Clinical Outcomes Research Initiative) project, better estimates of complications should be available in the future. However, although more accurate data may be obtained for immediate postprocedure complications, late complications may still be underestimated because of under-reporting. Rates of complications are critically dependent on the method of data collection (prospective/retrospective), definition of complication, and duration of follow-up.

Major complications related to diagnostic procedures can be broken down into cardiopulmonary complications, complications related to sedation, infectious complications, perforation, and bleeding.

CARDIOPULMONARY COMPLICATIONS/COMPLICATIONS RELATED TO SEDATION

Cardiopulmonary complications related to sedation and analgesia are the most common type of complication seen with diagnostic endoscopy, accounting for up to 46% of those reported in the above-mentioned ASGE survey were related to sedation. This approximates a more recently reported proportion of 40% as published in 1991 by ASGE in collaboration with the Food and Drug Administration. These complications range from minor changes in vital signs to myocardial infarctions, respiratory depression, and shock/hypotension. Additionally, with the introduction of pulse oximetry, a greater number of nonclinically relevant events have been reported. It is estimated that oxygen desaturation may occur in up to 70% of patients undergoing various endoscopic examinations; more severe desaturation occurs less commonly. Factors leading to oxygen desaturation include difficulty with intubation, which may be related to the size of the endoscope. Patient factors include age and history of cardiovascular/pulmonary disease. Complications may arise related to the procedure itself, such as vasovagal reflex secondary to the intubation process and/or to overinsufflation of air.

Judicious use of conscious sedation with appropriate monitoring equipment may help control the rate and severity of complications. The reader is referred to the ASGE documents regarding the appropriate use of conscious sedation and appropriate resuscitation equipment that should be maintained in an endoscopy lab.

Sedation-related complications are generally identified during the procedure. Appropriate management includes “basic life support” if necessary. Proper management requires the presence of resuscitation medications, including reversal agents and equipment in all areas where endoscopy is performed.

INFECTIOUS COMPLICATIONS

Infectious complications related to diagnostic endoscopy result either from the procedure itself or from the use of contaminated equipment. Transient bacteremia may occur during a diagnostic endoscopic procedure and is found more often for therapeutic procedures. The incidence is relatively low and the rate of bacterial endocarditis or other complications in patients
not at risk for endocarditis (e.g., normal cardiac valves) is extremely low and estimated to be 1 in 5 to 10 million. The reader is referred to the ASGE document regarding the use of antibiotic prophylaxis for those patients who are at risk for endocarditis because of valvular abnormalities. Uncommon complications include retropharyngeal and retroesophageal abscesses in patients who have had difficult intubations. This may be related to retropharyngeal trauma and/or nonclinically apparent perforations.

Issues related to contaminated equipment have been reviewed in the ASGE documents entitled Infection Control During Gastrointestinal Endoscopy; Guidelines for Clinical Application and Transmission. The reader is referred to these documents, for a discussion of appropriate cleaning procedures to prevent such contamination.

**PERFORATION**

Perforation of the upper GI tract related to diagnostic endoscopy is relatively low. In the above-mentioned 1974 ASGE survey, the perforation rate was 0.03% and with a mortality rate of 0.001%. Predisposing factors to perforations include the presence of anterior cervical osteophytes, Zenker’s diverticulum, esophageal strictures, and malignancies. Although uncommon, perforations of the esophagus are associated with a relatively high mortality rate that approximates 25%. Pain is the most common and reproducible symptom related to perforation. Fever, crepitance, chest pain, pleuritic chest pain, leukocytosis, and pleural effusion may also be present. Perforations with associated air dissection may be diagnosed by plain radiograph of the neck and/or chest. If a perforation is suspected, this may be localized by use of contrast media. Water-soluble contrast is usually used initially. If a site of perforation cannot be determined, barium or CT scan may be used in a repeat examination. A negative study does not rule out a perforation, however.

The approach to a patient with a perforation depends on the state of health of the individual, the site of the perforation, and the overall prognosis. In selected patients, early recognition may allow medical management with nasogastric suction, intravenous antibiotics, and parenteral hyperalimentation. Perforations related to endoscopy are best approached in cooperation with surgical colleagues. Surgical management is required for larger perforations when the pleural space is involved and for failure to respond to medical management.

**BLEEDING**

Significant bleeding is a rare complication of diagnostic upper endoscopy. Bleeding may be more likely in individuals with thrombocytopenia and/or coagulopathy. However, diagnostic upper endoscopy appears to be safe in patients with platelet counts as low as 20,000. Biopsies should be performed with caution below this level and platelet transfusions should be considered. Mallory-Weiss tears occur in <0.1% of diagnostic endoscopies and are usually not associated with significant bleeding.

**COMPLICATIONS OF UPPER GASTROINTESTINAL DILATION**

Determining the exact incidence of complications is difficult due to the low frequency and a lack of large studies comparing various methods of dilation. The most commonly observed complications of dilation of strictures are perforation, pain, hemorrhage, and bacteremia/sepsis.

**BENIGN PEPTIC ESOPHAGEAL STRICTURES**

In the 1974 survey of members of the American Society for Gastrointestinal Endoscopy the complication rate for dilation of the esophagus with mercury filled dilators was 0.4%. The most common complication in the group using mercury-filled dilators was bleeding.

Most centers currently use either wire-guided, polyvinyl dilators (e.g., Savary-Gilliard) or balloon dilators. In comparative trials, there is no evidence that push dilators result in a higher rate of perforations when dilating benign esophageal strictures. In a recent article comparing various dilating systems, all perforations occurred with blind passage of Maloney dilators through complex strictures. There were no perforations when using balloon dilators or wire-guided Savary-type dilators. Blind passage of mercury-filled dilators or the use of metal olives may be associated with higher rates of perforation.

Severe pain, bleeding, and bacteremia (including endocarditis or CNS infection) are other complications associated with esophageal dilation.

Caustic strictures may be at greater risk of perforation due to the greater length and luminal compromise that are characteristic for these lesions. In a 25-year review of dilating caustic esophageal strictures, perforation was noted to occur in 17% of patients.

**ACHALASIA**

Pneumatic dilation of achalasia may be associated with a lower risk of complications when a graded dilation technique with low-compliance balloons is used. It is suggested to start dilation with a 30-mm balloon. Nonresponders should then undergo dila-
tion with a 35-mm balloon and subsequently a 40-
mM balloon if needed. Avoiding inflation pressures greater than 11 psi may be associated with fewer complications.

Prevention of dilation-related perforation may be possible by limiting dilation to less than 15-mm diameter. Two studies describing perforation rates of 4 and 6.7% were associated with dilation to greater than 15 mm.

**MALIGNANT ESOPHAGEAL STRICTURES**

The rate of perforation for dilating malignant esophageal strictures is higher than for benign strictures. The literature defines a rate of approximately 10% based on several studies.

Two studies evaluating the treatment of esophageal strictures occurring after radiation treatment of esophageal cancer demonstrated a perforation rate of 2% to 6.5% per person. Dilation of a radiation stricture was not associated with a higher rate of perforation when compared with dilation of a malignant stricture that did not receive radiation.

**GAstrIC OUTLET OBSTRUCTION**

Studies report success with balloon dilation with a low complication rate. The rate of perforation varies from 0% to 6.7%. It appears as though perforations occur with attempts to dilate the gastric outlet to greater than 15-mm diameter.

There is no evidence at present that the use of dilating balloons is associated with a lower rate of complications as compared with wire-guided, push-type dilators.

**PEG COMPLICATIONS**

Minor complications associated with PEG placement occur in 13% to 43% of patients and include tube occlusion, maceration from leakage of gastric contents around the tube, and peristomal pain. Major complications, reported in 0.4% to 8.4% of procedures, include infection, bleeding, perforation, ileus, injury of internal organs, tumor seeding, and death. Procedure-related mortality has been reported to range from 0% to 2%, with 30-day mortality in the range of 6.7% to 26%, often related to patient comorbidities.

Infectious complications of PEG include wound infections, abscess, peritonitis, necrotizing fasciitis, and aspiration pneumonia. Peristomal wound infections occur at the site of PEG insertion through the abdominal wall in up to 41% of patients. However, use of antibiotic prophylaxis has been demonstrated to significantly reduce the risk of peristomal infections and is cost-effective. Several authors have reported cases of necrotizing fasciitis, which has been theorized to be related to failure to make the abdominal incision large enough to allow for appropriate wound drainage.

Risk factors for necrotizing fasciitis include diabetes mellitus, atherosclerosis, alcoholism, malnutrition, immunosuppression, and older age. Signs of necrotizing fasciitis include high fevers, cellulitis, skin edema, and subcutaneous emphysema, though a high index of suspicion is often required for making the diagnosis. Treatment includes surgical debridement and antibiotics. Despite these measures, mortality ranges from 30% to 70%.

Patients may develop aspiration pneumonia at the time of PEG placement because neurologic sequelae of stroke and dysphagia are common indications for a PEG. Whether these patients aspirate during the procedure itself, or aspirate their own secretions or feeds, is difficult to ascertain. Pneumoperitoneum is typically a benign occurrence, which has been reported in up to 38% of patients undergoing uncomplicated PEG.

Bleeding can result from injury to gastric or abdominal wall vessels. Gastric tears may occur during PEG placement. Because PEG placement involves the essentially blind placement of a needle through the abdominal wall and into the stomach, injury to internal organs, such as the liver and colon, can occur. Numerous authors have reported cologastrocutaneous fistulae. These fistulae can remain silent until the original PEG tube is exchanged for a replacement tube. In the chronic setting, prompt removal of the tube has been recommended as the fistula is reported to heal within hours. Optimal management of colonic perforation in the acute setting is poorly studied, though surgery should be considered in patients with clinical evidence of perforation or severely malnourished patients who are at risk for poor wound healing.

Feeding tubes may also migrate and become impacted in the abdominal wall. This “buried bumper syndrome” is believed to result from excessive traction on the internal PEG bolster. Ischemic necrosis of the gastric epithelium occurs, with resultant erosion of the internal bolster through the gastric wall. Signs include resistance to flow through the tube and immobility of the tube. Endoscopically, the PEG may not be visible. Treatment involves removal of the tube and placement of a new tube. Some have advocated avoiding direct contact between the internal bolster and the gastric mucosa. Although it is important to maintain apposition of the gastric wall to the abdominal wall until the fistula tract is mature, the external bumper can be subsequently loosened in an attempt to avoid this complication.
Many PEGs are placed for dysphagia secondary to head and neck cancers. Several reports raise concern of potential facilitation of metastases as some patients have metastases develop at the PEG insertion site. It is unclear whether this results from hematogenous spread or through transport of exfoliated tumor cells by the feeding tube. One final complication to note is accidental tube dislodgement. Use of an abdominal binder after placement may prevent accidental PEG removal. With early dislodgement, peritonitis may develop because there is not a mature fistulous tract. If a mature tract is present (greater than 1 month), then a suitable replacement tube should be inserted as soon as possible. Foley catheters are readily available and effective. However, care must be taken to prevent duodenal obstruction by the balloon. Therefore, an external bolster should be improvised. In patients in whom it is unclear whether or not the track is mature, confirmation of correct replacement tube location should be confirmed with contrast injection and fluoroscopy.

Although placement of a PEG/JET has the same complications as PEG, these tubes may be more prone to clogging (4%-18%), unintentional removal (11%-18%), and tube migration (6%). Wolfson et al. have reported tube dysfunction in 53% of 75 patients during 275 days of follow-up. Nevertheless, the reduced risk of aspiration (estimated relative risk reduction of 91% in a single observational study) appears to justify use in carefully selected patients.

**COMPLICATIONS OF ENDOSCOPIC FOREIGN BODY RETRIEVAL**

Complications directly attributable to the endoscopic removal of foreign bodies are very rare, and when complications occur it is difficult to determine whether the cause was the endoscope or the foreign object itself. Nonetheless, endoscopic foreign body retrieval and meat disimpaction have been associated with complications in up to 8% of cases.

Additional techniques may decrease the risks associated with foreign body removal. The risk of aspiration or mucosal injury may be reduced by the use of an esophageal overtube. Esophageal overtubes have been associated with bleeding and perforation, and these risks should be weighed against the benefits of overtube use in each case. Mucosal injury from the removal of sharp objects can be limited by removing the object such that the point is trailing and by using an overtube. A latex hood fitted over the end of the endoscope may also be beneficial in protecting the mucosa from laceration. Blind passage of bougies or use of papain (meat tenderizer) to dislodge meat impaction should be avoided due to the significant risk of perforation. Endoscopically, it may be possible to gently push an esophageal food bolus into the stomach, particularly if the endoscope can be maneuvered around the bolus under direct vision.

To assess for mucosal lacerations, bleeding, and the presence of underlying pathology (present in most esophageal food impactions), reinsertion of the endoscope after foreign body clearance should be performed. Most mucosal injuries can be treated conservatively and bleeding that is not self-limited can be treated with standard endoscopic techniques. Failure of endoscopic removal occurs in less than 5% of cases and surgery should be considered.

**COMPLICATIONS IN THE TREATMENT OF ESOPHAGEAL MALIGNANCIES**

Injection of sclerosants such as ethanol directly into the tumor to achieve tumor necrosis may damage normal tissues because of tracking of the sclerosant along tissue planes leading to perforation and the development of fistulae.

Thermal methods to apply heat energy directly to the tumor include bipolar cautery, laser, and argon plasma coagulation. Major complications include perforation and the development of fistulae in up to 10%. Minor complications include pain, edema, and treatment-induced strictures.

Photodynamic therapy (PDT) complications are similar to the other ablative techniques (bleeding, perforation, fistulae, strictures) but also include sun photosensitivity. Dysphagia may initially worsen after PDT requiring hospital admission for intravenous fluids, and PDT has been associated with atrial fibrillation and the development of pleural effusions.

Esophageal endoprostheses made of plastic or a self-expanding metal material have been used to re-establish luminal patency. The plastic stents have been replaced by the self-expanding metal stents due to the significantly lower complication rates. Postdeployment complications occur in 20% to 40% and include stent migration, hemorrhage, food impaction, and tumor ingrowth or overgrowth. Death is seen in 3% because of exsanguinating hemorrhage, aspiration, and perforation. Chest pain after insertion occurs in approximately 20%. Pretreatment with chemoradiotherapy has been reported to increase the incidence of complications by some authors but not others. An antireflux stent is now available that may decrease reflux symptoms, but whether it will decrease the risk of aspiration is unknown.

Endoscopic techniques and patient education may be useful in avoiding or managing complica-
tions. Blind bougienage of malignant strictures should be avoided.\textsuperscript{120} Expandable stents are preferable to nonexpandable plastic stents.\textsuperscript{128} Stent occlusion caused by tumor ingrowth can be avoided by use of a covered stent, and overgrowth treated with thermal ablative techniques or insertion of another stent.\textsuperscript{130,136} Laser, APC, or PDT-induced strictures can be treated with dilation or placement of a stent.\textsuperscript{123,125,126} Patients with stents that cross the GE junction should keep the head of the bed raised to 30 degrees and avoid eating for several hours before retiring. Patients undergoing PDT are at risk for phototoxicty and need to use sunscreen and avoid direct sunlight exposure for up to 6 weeks.\textsuperscript{121}

**COMPLICATIONS OF ENDOSCOPIC HEMOSTASIS: ENDOSCOPIC VARICEAL SCLEROTHERAPY**

Treatment of esophageal varices by sclerotherapy (EVS) is acknowledged to have several potential complications. These may be local (esophageal) and/or systemic. The overall rate of complications is difficult to ascertain because endoscopic series have varied by technique, sclerosant, and follow-up.\textsuperscript{137} The overall complication rate has been estimated to be between 35% to 78%, with a mortality rate of 1% to 5%.\textsuperscript{138,139}

It has been estimated that ulcerations secondary to EVS occur in 50% to 78%.\textsuperscript{140,141} Significant bleeding can occur in 6% of these patients.\textsuperscript{141} Most of these ulcers are asymptomatic but can be diagnosed by endoscopy 4 to 7 days after an EVS session. Ulcer formation does not appear to correlate with the choice of sclerosant or injection technique. They may occur more often if sclerotherapy sessions are conducted in closely timed (<1 week) sessions.\textsuperscript{142,143} Therefore elective EVS sessions for variceal eradication should be planned on a weekly or greater interval. Unfortunately, it does not appear that antisecretory therapy (H\textsubscript{2}RAs, PPIs) or sucralfate prevent ulcer formation.\textsuperscript{144-147} Omeprazole may be effective in healing these ulcerations.\textsuperscript{148,149}

Esophageal perforation may occur acutely in 2% to 5% of patients shortly after EVS.\textsuperscript{150} Delayed perforation is known to occur, but the incidence is unknown. Early diagnosis may be difficult because 25% to 50% of patients undergoing EVS have chest pain develop. However, this symptom usually abates within 24 to 48 hours.\textsuperscript{151}

Esophageal stricture formation can occur weeks to months after EVS sessions in 2% to 20% of patients.\textsuperscript{152,153} This can be diagnosed by upper gastrointestinal series and/or endoscopy. When EVS is performed with paravariceal injection with polidocanol, stricture formation appears to correlate with the number of EVS sessions and the amount of sclerosant used.\textsuperscript{154} There are no data on other sclerosant use and technique affecting stricture formation. Treatment is similar to that of benign peptic strictures, with endoscopic dilation.

Up to 5% of patients may experience aspiration pneumonia after EVS.\textsuperscript{153-156} This complication usually occurs during emergent sessions for variceal bleeding. The endoscopist should have a low threshold for airway protection (endotracheal intubation) in patients with altered mental status and/or significant hematemesis. Other commonly reported complications related to EVS include pleural effusion and bacterial peritonitis.

**ENDOSCOPIC BAND LIGATION**

Endoscopic band ligation (EBL) has emerged as the preferred endoscopic intervention for the treatment of esophageal varices. This is in part because of its favorable side effect profile as compared with EVS. Esophageal ulcer formation is seen in 5% to 15% and there is a lower tendency for ulcer-related bleeding than EVS.\textsuperscript{153,155-158} Perforation has been reported in 0.7% of 284 patients in 5 randomized trials.\textsuperscript{153,155-157} These perforations were associated with use of an overtube for facilitating multiple endoscope passes. Overtube use for this purpose is now discouraged and with multibanding devices, generally unnecessary. However, passing the overtube over an esophageal bougie may decrease the rate of perforation. Esophageal stricture formation as a consequence of EBL is rare. No strictures were reported in 8 randomized trials.\textsuperscript{153,155-158} Only single cases have been presented in the literature.\textsuperscript{159,160} The true incidence of this complication is unknown.

Aspiration pneumonia was seen in 1% of patients among 7 randomized trials.\textsuperscript{153,155-158} These 7 trials showed a bacterial peritonitis rate of 4%. The overall mortality attributable to the acute complications of ligation in prospective trials is 1%.

**ENDOSCOPIC NONVARICEAL HEMOSTASIS**

Endoscopic hemostasis of nonvariceal bleeding is most often achieved by injection and/or thermal electcoagulation. Injection of sclerosants (traditionally used for sclerotherapy) may lead to tissue necrosis and rarely perforation.\textsuperscript{161} The most commonly used injection agent is epinephrine. No perforations have been reported in patients treated with epinephrine injection for bleeding ulcers in randomized trials. However, tissue necrosis and ulceration may occur with decreased arterial blood flow to the injected site.\textsuperscript{162,163}

Endoscopic thermal hemostasis may be achieved by bipolar or multipolar electrocoagulation (MPEC),
heater probes, or laser. Randomized controlled trials using MPEC have reported rates of perforation between 0% and 2%.\textsuperscript{164,165}

Induction of bleeding is a relatively common complication of electrocoagulation, occurring in up to 5% of cases.\textsuperscript{164,165} Usually this can be controlled during the endoscopic procedure.

Hemostasis using a heater probe has similar rates of perforation as MPEC. However, repeat treatment when performed within 24 to 48 hours of the initial session is associated with up to 4% risk of perforation.\textsuperscript{166} Recurrent bleeding rates are similar to that of MPEC.

**SUMMARY**

Endoscopic complications will inevitably occur if an endoscopist does many procedures. Knowledge of potential complications and their expected frequency can lead to improved risk-benefit analysis by physicians and patients as well as true informed consent by patients. Early recognition of complications and prompt intervention may minimize patient morbidity.

**REFERENCES**

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