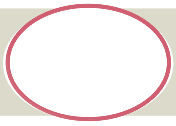

of knowledge on EUS-associated AEs, specific screening eligibility criteria were not required to be met for a study to be considered for inclusion. This decision was made given the variable amounts and quality of evidence available describing each separate EUS-guided technique. However, studies were generally considered for inclusion based on design in the descending order of the following: meta-analyses, randomized controlled trials (RCTs), prospective observational studies, retrospective observational studies, and case series or reports, with study size, study quality, and study recency factoring into the decision.

In the first round of screening, we screened titles and abstracts and assigned studies to a designation of "possibly include" or "exclude" considering the above criteria. Any abstract labeled with the decision to possibly include the citation resulted in the study being included in the second round. After the title and abstract screen, we made the decision on whether to cite studies included in the second round in the final review document based on the above criteria. Data on AEs were then extracted from the full-text studies selected for inclusion and presented according to each EUS-guided procedure type.

Of 3619 initial citations identifi

TABLE 1. Summary of estimated common adverse event ranges for EUS-guided procedures

EUS-guided procedure type	Perforation (%)	Hemorrhage (%)	Infection (%)	Other/specific (%)	Risk factors for adverse events
Routine EUS (with or without FNA/fine-needle biopsy sampling)	.02-.08[5-9]	.13-.69*;[5,7,10,13,14]	.4-1.7%†;[13,31,111]	Pancreatitis: .44-.92‡;[5,13]	Perforation[7,9-11]: trainee involvement, operator inexperience, older patient, history of difficult esophageal intubation, presence of esophageal malignancy, cervical spine osteophytes Hemorrhage[15-21]: antiplatelets, anticoagulants, low-molecular-weight heparins, lower GI FNA/fine-needle biopsy sampling, fiducial placement Infection[29,32]: sampling of pancreatic cyst or mediastinum Pancreatitis[33]: fiducial placement
Pancreatic fluid collection management	0-5[44,47,51,53,112]	1-12[47,51-53,55]	0-24[44-47,56]	Stent migration: 0-20[44,46,47,53,60] Stent occlusion: 0-17.7[44,46,47,62]	Perforation[56]: [illegible]65A69osequ pla-3323rhage

limited bleeding, in the calculation of these overall rates. These rates have been largely supported by more contemporary studies as well. For instance, a 2020 retrospective study reported a significant bleeding risk of 0.18% after routine EUS-FNA/FNB in over 1600 patients.[10] A separate 2020 retrospective study reported a bleeding rate of .13% associated with routine FNA in over 3000 procedures, with all events classified as mild and therefore of uncertain clinical significance.[7] A 2014 retrospective study of over 3000 patients undergoing EUS-FNA of pancreatic masses reported a clinically significant bleeding rate of .23%.[14]

Neither the number of passes nor the needle gauge appear to be associated with the incidence of bleeding after FNA.[13] Higher rates of bleeding have been reported in patients on antiplatelet and/or anticoagulant medications[15-17] or prophylactic doses of low-molecular-weight heparins,[18] procedures performed in the lower GI tract compared with the upper GI tract,[19] and placement of fiducials to guide radiation therapy in cases of pancreatic cancer.[20,21] Furthermore, sampling of the liver has been associated with bleeding and/or subcapsular hematoma in .6% to .9% of patients.[22,23] According to current ASGE guidance, EUS with FNA/FNB is considered

high risk for bleeding and should be performed in patients on anticoagulation or antithrombotic agents only after careful consideration of both the indication for the procedure and the medical indication for the underlying anticoagulation medication(s).[24] The decision to interrupt any antiplatelet and/or anticoagulant agents should carefully incorporate the subsequent risk of thrombotic events and may benefit from a multidisciplinary review.

be used to drain PFCs, including plastic stents (PSs), fully covered self-expandable metal stents (SEMSs), and

the ASGE guideline on the role of endoscopy in the diagnosis and treatment of inflammatory PFCs.[63]

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EUS-guided direct transmural biliary access (EUS-BD technique) has historically been used as a rescue technique in the setting of failed ERCP[64] but has more recently become increasingly common as a primary

with non–EUS-guided endoscopic management, EUS-guided therapy affords the advantage of being able to directly visualize the injection of coils and/or cyanoacrylate into selected varices. A 2020 meta-analysis of 11 studies reported a pooled overall AE rate of 14% with EUS-guided variceal therapy, with a significant difference demonstrated between AE rates for cyanoacrylate injection alone (21%) and cyanoacrylate injection with coiling (10%).[93] Of note, some input data informing these pooled AE rates were derived from studies in which overall AE rates were reported per patient over multiple EUS sessions, making these rates more challenging to interpret.[94] A separate 2020 meta-analysis included 23 studies and reported a pooled distant embolism rate of 5.6% (including pulmonary embolism) and a pooled periprocedural and early recurrent bleeding rate (within 120 hours) of 7.0%.[95] Other common AEs associated with this technique include self-limited abdominal pain in 3.2% to 12.5% of procedures,[96-99] self-limited fever in 3.3% to 4.7% of procedures,[97,99] and bacteremia of uncertain clinical significance in 1.6% to 2.5% of procedures.[94,97,100]

-C D M

EUS has rapidly become a viable alternative to percutaneous, surgical, or other endoscopic approaches for palliation through decompressive therapy for patients with gastric outlet or small-bowel obstruction, regardless of the etiology. EUS-GE and enteroenterostomy both use placement of a LAMS from the stomach or small bowel to the bowel distal to the obstruction. A 2021 meta-analysis of 5 studies assessing 659 patients reported a pooled overall AE rate of 10.7% with EUS-GE, with a major AE rate of 3.7%.[101] A 2020 meta-analysis of 12 studies assessing 285 patients reported a similar pooled overall AE rate of 12%.[102] The most common associated AE is stent maldeployment into the peritoneum resulting in perforation, occurring in up to 6.8% to 10% of procedures.[103-106] This outcome varies in terms of severity, often managed endoscopically and other times requiring surgical intervention and rarely leading to mortality.[103,105] Other common AEs associated with EUS-GE include stent occlusion because of ingrowth, reported in 4.2% of procedures,[104] and bleeding, reported in 3.8% of procedures.[105]

-C D D D

The ongoing development of novel EUS-guided procedures continues to evolve at a rapid pace. Given this, there are several EUS-guided techniques for which widespread experience and reliable estimates of AE rates are both lacking to date, including, but are not limited to, EUS-guided transgastric ERCP[107] and EUS-directed transenteric ERCP,[108] EUS-guided radiofrequency ablation of pancreatic lesions,[109] and EUS-guided portal pressure gradient measurement.[110] As the experience level with these novel techniques (and others) continues to grow and higher-quality data are acquired, more reliable estimates of AE incidence will become available.

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This document highlights several important areas within the field of EUS for which further high-quality research is needed to bolster the strength of recommendations for future EUS-related guidelines. Below is a brief outline of these specific areas.

- *P.edic . fAE .* Limited evidence is available regarding patient- and procedure-level predictors of AEs for routine EUS and more advanced EUS-guided techniques (Table 1). Dedicated efforts to reliably elucidate these independent predictors (ideally through prospective population-level cohort studies and clinical trials) are needed, especially for newer techniques.
- *An ibi ic . h la i f . anc.ea ic c d.ainage.* The question of whether antibiotic prophylaxis is required for those undergoing pancreatic cyst drainage is highly relevant. Current ASGE guidance recommends routinely administering antibiotic prophylaxis in this population,[30] with newer evidence suggesting a limited benefit to this practice. However, given that most contemporary studies assessing this question are

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