Communication from the ASGE Standards of Practice Committee

GUIDELINE

Antibiotic prophylaxis for GI endoscopy

This is one of a series of statements discussing the use of GI endoscopy in common clinical situations. The Standards of Practice Committee of the American Society for Gastrointestinal Endoscopy (ASGE) prepared this document, and it updates a previously issued document on this topic.[1] *In preparing this guideline, MEDLINE and PubMed databases were used to search for publications between January 1975 and December 2013 pertaining to this topic. The search was supplemented by accessing the "related articles" feature of PubMed, with articles identified on MEDLINE and PubMed as the references. Additional references were obtained from the bibliographies of the identified articles and from recommendations of expert consultants. When few or no data were available from well-designed prospective trials, emphasis was given to results from large series and reports from recognized experts. Weaker recommendations are indicated by phrases such as "We suggest…" whereas stronger recommendations are stated as "We recommend…" The strength of individual recommendations was based on both the aggregate evidence quality (Table 1)*[2] *and an assessment of the anticipated benefits and harms.*

ASGE guidelines for appropriate use of endoscopy are based on a critical review of the available data and expert consensus at the time that the documents are drafted. Further controlled clinical studies may be needed to clarify aspects of this document. This guideline may be revised as necessary to account for changes in technology, new data, or other aspects of clinical practice and is solely intended to be an educational device to provide information that may assist endoscopists in providing care to patients. This document is not a rule and should not be construed as establishing a legal standard of care or as encouraging, advocating, requiring, or discouraging any particular treatment. Clinical decisions in any particular case involve a complex analysis of the patient's condition and available courses of action. Therefore, clinical considerations may lead an endoscopist to take a course of action that varies from the recommendations and suggestions proposed in this document.

Bacterial translocation of endogenous microbial flora into the bloodstream may occur during endoscopy because of mucosal (or deeper) trauma related to the procedure. Endoscopy-related bacteremia carries a small risk of localization of infection in remote tissues (ie, infective endocarditis [IE]). Endoscopy also may result in local infections in which a typically sterile space or tissue is breached and contaminated by an endoscopic accessory or by contrast material injection. This document is an update of the prior ASGE document on antibiotic prophylaxis for GI endoscopy,[1] discusses infectious adverse events related to endoscopy, and provides recommendations for periprocedural antibiotic therapy.

BACTEREMIA ASSOCIATED WITH ENDOSCOPIC PROCEDURES

Bacteremia can occur after endoscopic procedures and has been advocated as a surrogate marker for IE risk. However, clinically significant infections are extremely rare. Despite an estimated 14.2 million colonoscopies, 2.8 million flexible sigmoidoscopies, and perhaps as many upper endoscopies performed in the United States each year,[3] only approximately 25 cases of IE have been reported with temporal association to an endoscopic procedure.[4-6] There are no data demonstrating a causal association between endoscopic procedures and IE or that antibiotic prophylaxis prior to endoscopic procedures protects against IE. Finally, much of the existing data reflects estimated risk associated with conventional endoscopic techniques. There are no results available that confidently quantify bacteremia rates with newer endoscopic procedures such as per oral endoscopic myotomy, endoscopic submucosal dissection, or endoscopic mucosal resection.

Procedures associated with a high risk of bacteremia

The highest rates of bacteremia have been reported with esophageal dilation, sclerotherapy of varices, and instrumentation of obstructed bile ducts. The rate of bacteremia following esophageal bougienage was demonstrated to be 12% to 22% in 3 prospective trials.[7-9] Cultured organisms usually are commensal to the mouth. In 1 study, *Streptococcus viridans* was the organism isolated in 79% of cases.[7] Bacteremia may be more frequent with dilation of malignant strictures than with benign strictures.[8] Bacteremia also may be more frequent with passage of multiple dilators compared with a single dilation.[8]

Estimates of bacteremia associated with variceal sclerotherapy have been reported to be as high as 52%, with a mean of 14.6%.[10-13] Endoscopic variceal ligation, which

0016-5107/$36.00
http://dx.doi.org/10.1016/j.gie.2014.08.008

TABLE 1. GRADE system for rating the quality of evidence for guidelines[2]

Quality of evidence	Definition	Symbol
High	Further research is very unlikely to change our confidence in the estimate of effect.	⊕⊕⊕⊕
Moderate	Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.	⊕⊕⊕◯
Low	Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.	⊕⊕◯◯
Very low	Any estimate of effect is very uncertain.	⊕◯◯◯

has largely replaced sclerotherapy, has been associated with bacteremia rates of 1% to 25%, with a mean of 8.8%.[14-16]

Whereas ERCP in patients with non-obstructed bile ducts has been associated with a low rate of bacteremia of 6.4%, the incidence increases to 18% in the setting of biliary obstruction because of stones or strictures.[17]

Procedures associated with a low risk of bacteremia

Gastroscopy with or without biopsy is associated with rates of bacteremia up to 8%, with a mean of 4.4%.[18-20] The observed bacteremia usually is short lived (<30 minutes) and not associated with infectious adverse events. Rates of bacteremia associated with colonoscopy have been reported to be as high as 25%, with a mean of 4.4%.[17] Bacteremia is uncommon (6.3%) even with therapeutic colon procedures such as colonic stent insertion.[21] The rate of bacteremia with flexible sigmoidoscopy is < 1%.[22,23]

There are no data on the risk of bacteremia associated with device-assisted enteroscopy (eg, single-balloon and double-balloon enteroscopy, spiral enteroscopy), but it is likely small and comparable to that of routine upper and lower endoscopic procedures.

The frequency of bacteremia after EUS, with or without FNA, is within the range of that for diagnostic upper endoscopy. Prospective studies in patients undergoing EUS-guided FNA (EUS-FNA) of cystic or solid lesions along the upper GI tract indicate a low prevalence of procedure-related bacteremia, ranging from 4.0% to 5.8%.[24-27] Similarly, EUS-FNA of solid rectal and perirectal lesions is associated with a low risk of bacteremia, with 1 study reporting a risk of 2%.[28]

Bacteremia associated with routine daily activity

Transient bacteremia occurs frequently during routine daily activity, often at rates exceeding those associated with endoscopic procedures. Brushing and flossing of teeth has been associated with rates of bacteremia of 20% to 68%, use of toothpicks with rates of 20% to 40%, and even activity that might be considered entirely physiologic, such as chewing food, with rates ranging from 7% to 51%.[29] Given the relative rarity with which most individuals undergo endoscopic procedures, the frequency and risk of endoscopy-related bacteremia is trivial compared with the frequency of bacteremia encountered with routine daily activity. This provides a strong rationale against routine administration of antibiotic prophylaxis for IE prior to endoscopic procedures.

ANTIBIOTIC PROPHYLAXIS FOR GI ENDOSCOPIC PROCEDURES

The purpose of antibiotic prophylaxis during GI endoscopy is to reduce the risk of iatrogenic infectious adverse events. Recommendations for antibiotic prophylaxis are summarized in Tables 2 and 3.

Prevention of IE

The 2007 American Heart Association (AHA) guidelines for prophylaxis of IE stated that the administration of prophylactic antibiotics solely to prevent IE was no longer recommended for patients undergoing GI endoscopy.[29] The AHA based its recommendations on several lines of evidence including (1) cases of IE associated with GI procedures are anecdotal, (2) no data demonstrate a conclusive link between GI procedures and the development of IE, (3) there are no data that demonstrate that antibiotic prophylaxis prevents IE after GI-tract procedures, (4) IE is more likely to be caused by bacteremia resulting from usual daily activities, and (5) an extremely small number of cases of IE may be prevented even if antibiotic prophylaxis were 100% effective.[29]

The AHA also delineated cardiac conditions associated with the highest risk of an adverse outcome from IE, including (1) prosthetic (mechanical or bioprosthetic) cardiac valves, (2) history of previous IE, (3) cardiac transplant recipients who develop cardiac valvulopathy, and (4) patients with congenital heart disease (CHD) including those with unrepaired cyanotic CHD including palliative shunts and conduits; those with completely repaired CHD with prosthetic material or devices, placed surgically or by catheter, for the first 6 months after the procedure; and those with repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or device.[29] For

TABLE 2. Prevention of infective endocarditis

Cardiac condition	Antibiotics
All cardiac conditions	Antibiotic prophylaxis is not indicated solely to prevent IE. ⊕⊕⊕○
Cardiac conditions associated with the highest risk of an adverse outcome from IE	For patients with these conditions who have established infections of the GI tract (such as cholangitis) and for those who receive antibiotic therapy to prevent wound infection or sepsis associated with a GI tract procedure, it is recommended that the antibiotic regimen include an antimicrobial agent active against enterococci, such as penicillin, ampicillin, piperacillin, or vancomycin. ⊕⊕○○
Prosthetic cardiac valve	
History of IE	
Cardiac transplant recipients who develop cardiac valvulopathy	
Patients with CHD	
Unrepaired cyanotic CHD including palliative shunts and conduits	
Completely repaired CHD with prosthetic material or device, placed surgically or by catheter, for the first 6 months after the procedure	
Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or device	

IE, Infective endocarditis; *CHD,* congenital heart disease.

patients with these cardiac conditions who have established infections of the GI tract in which enterococci may be part of the infecting flora (such as cholangitis) and particularly for those who are about to undergo an endoscopic procedure that may increase the risk of bacteremia (such as ERCP), the AHA suggests that inclusion of an agent active against enterococci in the concurrent antibiotic regimen may be reasonable.[29] Although GI tract infections often are polymicrobial, antibiotic coverage for enterococci is recommended, because only enterococci are likely to cause IE. However, the AHA reiterates that no studies have demonstrated that such therapy would prevent enterococcal IE.

Prevention of infections (other than IE)

Antibiotic prophylaxis may be useful for prevention of infections related to some endoscopic procedures and in specific clinical scenarios.

ERCP. ERCP with drainage is the treatment modality of choice for the management of acute cholangitis.[30] Patients with acute cholangitis should be treated with antibiotics, and additional single-dose ERCP prophylaxis is not recommended.

Cholangitis and sepsis are known adverse events of ERCP, occurring in up to 3% of cases.[31-38] Several studies have evaluated the role of antibiotic prophylaxis in preventing post-ERCP cholangitis. Although antibiotic prophylaxis has been shown to reduce the incidence of bacteremia associated with ERCP,[39,40] preprocedure antibiotic prophylaxis has not been shown to prevent cholangitis. A meta-analysis of 5 randomized, placebo controlled trials failed to show a decrease in the incidence of cholangitis and/or sepsis with routine antibiotic prophylaxis prior to ERCP.[41] Similar conclusions were drawn in a more recent review that included 7 trials and a total of 1389 patients.[42] However, some of the trials in this analysis included a mix of diagnostic and therapeutic procedures. A recent Cochrane systematic review that included 9 randomized clinical trials and 1573 patients concluded that prophylactic antibiotics reduced bacteremia and may prevent cholangitis and septicemia in patients undergoing elective ERCP.[43] However, in the subgroup of patients with uncomplicated ERCP, the effect of antibiotics was less pronounced.[43] More trials including patients with predicted incomplete biliary drainage are required to prove the effectiveness of prophylactic antibiotics in this setting.

TABLE 3. Antibiotic prophylaxis and/or treatment to prevent local infections

Patient condition	Procedure contemplated	Goal of prophylaxis	Periprocedural antibiotic prophylaxis
Bile duct obstruction in absence of cholangitis	ERCP with complete drainage	Prevention of cholangitis	Not recommended ⊕⊕⊕⊕
Bile duct obstruction in absence of cholangitis	ERCP with incomplete drainage	Prevention of cholangitis	Recommended; continue antibiotics after procedure ⊕⊕⊕○
Solid lesion in upper GI tract	EUS-FNA	Prevention of local infection	Not recommended ⊕⊕⊕⊕
Solid lesion in lower GI tract	EUS-FNA	Prevention of local infection	Not recommended ⊕⊕⊕○
Mediastinal cysts	EUS-FNA	Prevention of cyst infection	Suggested ⊕⊕○○
Pancreatic cysts	EUS-FNA	Prevention of cyst infection	Suggested ⊕⊕○○
All patients	Percutaneous endoscopic feeding tube placement	Prevention of peristomal infection	Recommended ⊕⊕⊕⊕
Cirrhosis with acute GI bleeding	Required for all patients regardless of endoscopic procedures	Prevention of infectious adverse events and reduction of mortality	On admission ⊕⊕⊕⊕
Synthetic vascular graft and other nonvalvular cardiovascular devices	Any endoscopic procedure	Prevention of graft and device infection	Not recommended ⊕⊕⊕⊕
Prosthetic joints	Any endoscopic procedure	Prevention of septic arthritis	Not recommended ⊕⊕⊕○
Peritoneal dialysis	Lower GI endoscopy	Prevention of peritonitis	Suggested ⊕⊕○○

EUS-FNA, EUS-guided FNA.

Two factors may predict the benefit of antibiotic prophylaxis in patients undergoing ERCP. First, incomplete biliary drainage was predictive of 91% of all cases of sepsis in 1 study.[44] Antibiotic therapy may therefore have particular value where drainage achieved at ERCP is incomplete or achieved with difficulty, such as with hilar cholangiocarcinoma and primary sclerosing cholangitis.[44-46] Second, in 1 of the few trials that demonstrated benefit, prophylactic antibiotics were continued after the procedures for several days.[47] This strategy may reduce infectious adverse events in patients with inadvertent filling of pancreatic pseudocysts with contrast material during ERCP. However, few data exist on the risk of infection in these situations. Prophylactic antibiotics also may benefit patients with severe neutropenia (absolute neutrophil count <500 cells/μL) and/or advanced hematologic malignancy. These patients are at increased risk of sepsis after endoscopy,[48] and antibiotic prophylaxis is prudent, although this has not been studied in clinical trials.

A retrospective analysis of the role of antibiotics in preventing cholangitis in 11,484 patients undergoing ERCP has been published.[49] Over an 11-year period, the authors changed their practices sequentially, from administering antibiotics to all patients with evidence of biliary or pancreatic obstruction, immunosuppression, or need for therapeutic intervention (95% of all procedures), to limiting antibiotic administration to patients in whom endoscopic drainage was predicted to be incomplete (primary sclerosing cholangitis and hilar tumors) and those with immunosuppression (26% of all procedures). No difference was noted in infection rates, with infectious adverse events developing in 0.28% of the initial cohort and in 0.23% of the latter cohort. The overall rate of infection was 0.28% for all procedures. Multivariate analysis of clinical variables indicated that only patients with histories of liver transplantation were at significantly greater risk of developing infectious adverse events despite antibiotic use. Even in this group, the overall risk was low, with an infection rate of 1.2%. It is noteworthy that infections developed in 27 of 33 patients despite antibiotic prophylaxis.[49]

The role of antibiotic prophylaxis in patients undergoing ERCP who have pancreatic cystic lesions that communicate with the main pancreatic duct has not been studied. However, the incidence of infectious adverse events in this setting appears to be low, given that ERCP is commonly performed in patients with cystic lesions such as intraductal papillary mucinous neoplasms or pseudocysts without reports of cyst infections.

Acute cholecystitis is an adverse event of biliary self-expandable metal stent (SEMS) placement and results from obstruction of the cystic duct. The incidence of acute cholecystitis in this setting ranges from 1.9% to 12%.[50] Tumor involvement of the cystic duct orifice is a risk factor for acute cholecystitis after SEMS placement.[51] Theoretically, uncovered stents with their open interstices should permit sufficient gallbladder drainage to avoid cholecystitis. However, the incidence of cholecystitis was similar between covered and uncovered SEMS in 2 recent meta-analyses.[52,53] All reported cases of post-SEMS cholecystitis occurred in patients with malignant biliary obstruction.[50] It is known that malignancy creates higher-grade impedance to biliary flow than benign etiologies of biliary obstruction. Manipulation of the biliary tree during ERCP in patients with malignant biliary obstruction may introduce nonsterile bile and/or contrast material into the gallbladder. If drainage is limited by gallbladder-outflow obstruction (because of SEMS and/or cystic duct involvement) in addition to malignant distal biliary obstruction, acute cholecystitis may ensue. Prophylactic antibiotics administered in the periprocedural period have not been studied in this clinical scenario but may help prevent this adverse event.

EUS-FNA. Clinical infection or sepsis following EUS-FNA is infrequent.[27] There are scant data regarding the development of infectious adverse events after EUS-FNA of solid lesions. In 2 large series comprising a total of 672 patients undergoing EUS-FNA of a variety of solid lesions, sepsis developed in only 3 patients.[54,55] Thus, prophylactic antibiotics are not recommended prior to EUS-FNA of solid lesions.

Administration of antibiotics has been recommended before, and often for 3 to 5 days following, EUS-FNA of cystic lesions.[33] The main rationale for antibiotic prophylaxis is to prevent cyst infection. In 1 report, the rate of infectious adverse events after EUS-FNA was 14%; however, the number of cystic lesions in this series was small.[56] The benefit of prophylactic antibiotics before FNA of cystic lesions has not been evaluated in prospective, randomized studies. In a retrospective analysis of 603 patients undergoing EUS-FNA of pancreatic cysts, 90% of whom received antibiotic prophylaxis—most commonly a fluoroquinolone for 3 days after the procedure—infection developed in 1 patient.[57] The only comparative study to date that has assessed the impact of prophylactic antibiotics during EUS-FNA of pancreatic cysts was a retrospective analysis of 253 patients.[58] In this study, the incidence of infectious adverse events was very low (1 cyst infection in the antibiotic group and 1 fever episode in the non-antibiotic group), and antibiotics did not confer a protective effect against infections. Combined rates of infections and antibiotic-related adverse events were higher in patients who received prophylactic antibiotics (4.4% vs 0.6%; $P = .04$).

Infectious adverse events after EUS-FNA of mediastinal cysts do seem to occur more commonly. Multiple case reports and case series with limited numbers of patients reported infection of mediastinal cysts and mediastinitis after EUS-FNA, some occurring despite the use of antibiotic prophylaxis.[59,60]

The risk of bacteremia and infectious adverse events after EUS-FNA in the lower GI tract has not been studied widely. One prospective study addressed the risk of bacteremia and infectious adverse events after EUS-FNA of solid rectal and perirectal lesions in 100 patients who underwent a total of 471 FNAs.[28] Two patients developed bacteremia, and none developed signs or symptoms of infection.

The role of prophylactic antibiotics in patients undergoing various interventional EUS procedures (eg, pseudocyst drainage, biliary drainage, fine-needle injection of cysts and/or tumors, fiducial placement) has not been studied. Most interventional EUS studies have included patients who received periprocedural antibiotics and a short course of antibiotics thereafter, and postprocedural infections are uncommon by using this practice.[61-66]

Percutaneous endoscopic gastrostomy (PEG) or jejunostomy (PEJ). Patients undergoing PEG tube placement are vulnerable to infections because of age, compromised nutritional intake, immunosuppression, and underlying medical comorbidities. A Cochrane database systematic review of randomized, controlled trials evaluating the use of prophylactic antibiotics for PEG placement identified 12 eligible trials that included a total of 1271 patients.[67] A pooled analysis indicated a statistically significant reduction in the incidence of peristomal infection with administration of prophylactic antibiotics (odds ratio 0.36; 95% confidence interval, 0.26-0.50).[67] An antibiotic that provides optimal coverage of cutaneous organisms, such as cefazolin 1 g intravenously, should be administered 30 minutes before the procedure.[68] Where methicillin-resistant *Staphylococcus aureus* (MRSA) is endemic, decontamination in patients testing positive on preprocedure screening with culture of swabs from the nose, throat, perineum, and broken skin areas appears to be effective in reducing MRSA peristomal infection.[69]

The role of prophylactic antibiotics before placement of percutaneous endoscopic jejunostomy (PEJ) has not been studied. However, administration of antibiotics should offer protection against peristomal infections similar to those observed in patients who undergo PEG placement, especially given that adverse events including local infections, may be more common among patients undergoing PEJ.[70,71]

Cirrhosis with GI bleeding. A Cochrane database meta-analysis of 12 randomized, controlled trials including 1241 patients with GI bleeding in the setting of cirrhosis showed that antibiotic prophylaxis was associated with significantly lower overall mortality, mortality from bacterial infections, and overall incidence of bacterial infections. In addition, other outcomes such as rebleeding and length of hospital stay may be reduced.[72] Antibiotic therapy should be instituted at admission for patients with cirrhosis

and GI bleeding. Although oral norfloxacin is a common choice, 1 randomized, controlled trial indicated that intravenous ceftriaxone was superior to norfloxacin in preventing infections in the setting of variceal and nonvariceal GI tract bleeding in patients with cirrhosis.[73] Intravenous antibiotics also may be preferable in patients with active vomiting or hematemesis.

Endoscopy in patients with synthetic vascular grafts and other nonvalvular cardiovascular devices. The same rationale for not administering antibiotic prophylaxis for IE prior to GI endoscopic procedures applies to synthetic vascular grafts and other nonvalvular cardiovascular devices, such as pacemakers, defibrillators, coronary artery stents, peripheral vascular stents, and vena cava filters. There are no reported cases of vascular graft infection related to GI endoscopic procedures. In 2003, the AHA stated that there was no evidence that microorganisms associated with GI endoscopic procedures caused infection of nonvalvular cardiovascular devices, including synthetic vascular grafts, at any time after implantation.[74] Infections of these grafts are most often caused by staphylococci, gram-negative bacteria, or other microorganisms associated with implantation of the graft or resulting from wound or other active infections. The AHA does not recommend antibiotic prophylaxis after vascular graft or other nonvalvular cardiovascular device placement for patients who undergo GI endoscopic procedures. The AHA recently stated that antimicrobial prophylaxis is not recommended for any endoscopic procedures in patients with cardiovascular implantable electronic devices.[75]

Endoscopy in patients with orthopedic prostheses. Infection of prosthetic joints related to GI endoscopic procedures is extremely rare, with isolated case reports describing pyogenic arthritis after endoscopy.[76-79] In a survey of program directors of infectious disease fellowships, most respondents agreed that antibiotic prophylaxis is not indicated for patients with orthopedic prostheses undergoing GI endoscopic procedures. There was, however, an equal recommendation for and against antibiotics for patients undergoing colonic polypectomy within 6 months of prosthesis insertion.[80] Although the American Association of Orthopedic Surgeons released a statement in 2009 recommending antibiotic prophylaxis for all total joint replacement patients before any invasive procedure that may cause bacteremia, this statement was later withdrawn because of a lack of supporting clinical evidence.

Endoscopy in immunocompromised patients and patients with neutropenia. Patients with severe neutropenia (absolute neutrophil count <500 cells/μL) and advanced hematologic malignancies are at increased risk for bacteremia and sepsis after GI endoscopy.[48] The protective effect of prophylactic antibiotics in this patient population has not been studied. However, this practice seems logical, especially in patients undergoing endoscopic procedures that are associated with a high risk of bacteremia. There are no data regarding whether patients with immunocompromised status but normal neutrophil counts (eg, organ transplant recipients, patients with HIV) are at increased risk for GI endoscopy–related infections, and routine administration of prophylactic antibiotics in this setting is not recommended. There is insufficient evidence to recommend for or against administration of antibiotic prophylaxis before routine endoscopic procedures in patients with severe immunosuppression (absolute neutrophil count <500 cells/μL, advanced hematologic malignancies, bone marrow transplantation), so the decision to use antibiotic prophylaxis in these scenarios must be individualized.

Endoscopy in patients receiving peritoneal dialysis. Peritonitis in patients undergoing continuous ambulatory peritoneal dialysis can result from translocation of microorganisms across the bowel wall,[81] and GI endoscopic procedures in patients undergoing continuous ambulatory peritoneal dialysis can lead to peritonitis.[82,83] A retrospective study found that the risk of peritonitis after colonoscopy without antibiotic prophylaxis was 6.3%.[84] Colon biopsy or polypectomy did not appear to further increase the risk. No peritonitis occurred in patients who were given prophylactic antibiotics, although the difference was not statistically significant. The International Society for Peritoneal Dialysis recently issued a position statement indicating that antibiotics such as ampicillin (1 g) plus a single dose of an aminoglycoside, with or without metronidazole, given intravenously immediately before a GI endoscopic procedure may lower the risk of peritonitis.[81] An acceptable alternative is administration of prophylactic antibiotics intraperitoneally the night before a GI endoscopic procedure.[81] Importantly, the International Society for Peritoneal Dialysis recommended that the abdomen be emptied of fluid before any procedure involving the abdomen or pelvis, including colonoscopy.[81] It is important to note that these recommendations were based on observational studies alone.

RECOMMENDATIONS

1. We recommend against the routine administration of antibiotic prophylaxis solely for prevention of IE. (⊕⊕⊕○)
2. We suggest that patients with high-risk cardiac conditions (Table 2) and established GI tract infections in which enterococci may be part of the infecting bacterial flora should receive antibiotic coverage. (⊕⊕○○)
3. We recommend against antibiotic prophylaxis before ERCP when obstructive biliary tract disease is not suspected or complete biliary drainage is anticipated. (⊕⊕⊕⊕)
4. We recommend that antibiotic prophylaxis be administered before ERCP in patients who have had liver transplantation or who have known or

suspected biliary obstruction, where there is a possibility of incomplete biliary drainage. Antibiotics that cover biliary flora such as enteric gram-negative organisms and enterococci should be used and continued after the procedure if biliary drainage is incomplete. (⊕⊕⊕◯)

5. We recommend against antibiotic prophylaxis before diagnostic EUS or EUS-FNA of solid lesions of the GI tract. (⊕⊕⊕◯)
6. We suggest antibiotic administration prior to EUS-FNA of mediastinal cysts. (⊕⊕◯◯)
7. We suggest administration of prophylactic antibiotics before EUS-FNA of pancreatic or peripancreatic cysts. (⊕⊕◯◯)
8. We recommend administration of parenteral cefazolin (or an antibiotic with equivalent microbial coverage) to all patients before PEG/PEJ tube placement. (⊕⊕⊕⊕)
9. We recommend that all patients with cirrhosis admitted with GI bleeding should have antibiotic therapy instituted at admission with intravenous ceftriaxone (or an antibiotic with equivalent microbial coverage [eg, oral norfloxacin] in patients allergic to or intolerant of ceftriaxone). (⊕⊕⊕⊕)
10. We recommend against administration of antibiotic prophylaxis before GI endoscopic procedures for patients with synthetic vascular grafts or other nonvalvular cardiovascular devices (eg, implantable electronic devices). (⊕⊕⊕⊕)
11. We recommend against antibiotic prophylaxis for patients with orthopedic prosthesis undergoing any GI endoscopic procedure. (⊕⊕⊕◯)
12. We suggest administration of antibiotic prophylaxis before endoscopy of the lower GI tract in patients undergoing continuous ambulatory peritoneal dialysis. (⊕◯◯◯)

DISCLOSURES

K. Chithadi is a consultant for Boston Scientific. M. Khashab is a consultant for Boston Scientific and Olympus America and received research support from Cook Medical. All other authors disclosed no financial relationships relevant to this article.

Abbreviations: AHA, American Heart Association; ASGE, American Society for Gastrointestinal Endoscopy; EUS-FNA, EUS-guided FNA; IE, infective endocarditis; MRSA, methicillin-resistant Staphylococcus aureus; PEJ, percutaneous endoscopic jejunostomy; SEMS, self-expandable metal stent.

REFERENCES

1. Banerjee S, Shen B, Baron TH, et al. Antibiotic prophylaxis for GI endoscopy. Gastrointest Endosc 2008;67:791-8.
2. Guyatt G, Oxman AD, Akl EA, et al. GRADE guidelines: introduction-GRADE evidence profiles and summary of findings tables. J Clin Epidemiol 2011;64:383-94.
3. Seeff LC, Richards TB, Shapiro JA, et al. How many endoscopies are performed for colorectal cancer screening? Results from CDC's survey of endoscopic capacity. Gastroenterology 2004;127:1670-7.
4. Sekino Y, Fujisawa N, Suzuki K, et al. A case of recurrent infective endocarditis following colonoscopy. Endoscopy 2010;(42 suppl 2):E217.
5. Yu-Hsien L, Te-Li C, Chien-Pei C, et al. Nosocomial acinetobacter genomic species 13 TU endocarditis following an endoscopic procedure. Intern Med 2008;47:799-802.
6. Malani AN, Aronoff DM, Bradley SF, et al. Cardiobacterium hominis endocarditis: two cases and a review of the literature. Eur J Clin Microbiol Infect Dis 2006;25:587-95.
7. Zuccaro G Jr, Richter JE, Rice TW, et al. Viridans streptococcal bacteremia after esophageal stricture dilation. Gastrointest Endosc 1998;48:568-73.
8. Nelson DB, Sanderson SJ, Azar MM. Bacteremia with esophageal dilation. Gastrointest Endosc 1998;48:563-7.
9. Hirota WK, Wortmann GW, Maydonovitch CL, et al. The effect of oral decontamination with clindamycin palmitate on the incidence of bacteremia after esophageal dilation: a prospective trial. Gastrointest Endosc 1999;50:475-9.
10. Camara DS, Gruber M, Barde CJ, et al. Transient bacteremia following endoscopic injection sclerotherapy of esophageal varices. Arch Intern Med 1983;143:1350-2.
11. Cohen LB, Korsten MA, Scherl EJ, et al. Bacteremia after endoscopic injection sclerosis. Gastrointest Endosc 1983;29:198-200.
12. Brayko CM, Kozarek RA, Sanowski RA, et al. Bacteremia during esophageal variceal sclerotherapy: its cause and prevention. Gastrointest Endosc 1985;31:10-2.
13. Snady H, Korsten MA, Waye JD. The relationship of bacteremia to the length of injection needle in endoscopic variceal sclerotherapy. Gastrointest Endosc 1985;31:243-6.
14. Lin OS, Wu SS, Chen YY, et al. Bacterial peritonitis after elective endoscopic variceal ligation: a prospective study. Am J Gastroenterol 2000;95:214-7.
15. Berner JS, Gaing AA, Sharma R, et al. Sequelae after esophageal variceal ligation and sclerotherapy: a prospective randomized study. Am J Gastroenterol 1994;89:852-8.
16. da Silveira Rohr MR, Siqueira ES, Brant CQ, et al. Prospective study of bacteremia rate after elastic band ligation and sclerotherapy of esophageal varices in patients with hepatosplenic schistosomiasis. Gastrointest Endosc 1997;46:321-3.
17. Nelson DB. Infectious disease complications of GI endoscopy: part I, endogenous infections. Gastrointest Endosc 2003;57:546-56.
18. Liebermann TR. Bacteremia and fiberoptic endoscopy. Gastrointest Endosc 1976;23:36-7.
19. Norfleet RG, Mitchell PD, Mulholland DD, et al. Does bacteremia follow upper gastrointestinal endoscopy? Am J Gastroenterol 1981;76:420-2.
20. O'Connor HJ, Hamilton I, Lincoln C, et al. Bacteremia with upper gastrointestinal endoscopy—a reappraisal. Endoscopy 1983;15:21-3.
21. Chun YJ, Yoon NR, Park JM, et al. Prospective assessment of risk of bacteremia following colorectal stent placement. Dig Dis Sci 2012;57:1045-9.
22. Goldman GD, Miller SA, Furman DS, et al. Does bacteremia occur during flexible sigmoidoscopy? Am J Gastroenterol 1985;80:621-3.
23. Llach J, Elizalde JI, Bordas JM, et al. Prospective assessment of the risk of bacteremia in cirrhotic patients undergoing lower intestinal endoscopy. Gastrointest Endosc 1999;49:214-7.
24. Barawi M, Gottlieb K, Cunha B, et al. A prospective evaluation of the incidence of bacteremia associated with EUS-guided fine-needle aspiration. Gastrointest Endosc 2001;53:189-92.
25. Levy MJ, Norton ID, Wiersema MJ, et al. Prospective risk assessment of bacteremia and other infectious complications in patients undergoing EUS-guided FNA. Gastrointest Endosc 2003;57:672-8.
26. Janssen J, Konig K, Knop-Hammad V, et al. Frequency of bacteremia after linear EUS of the upper GI tract with and without FNA. Gastrointest Endosc 2004;59:339-44.

27. Early DS, Acosta RD, Chandrasekhara V, et al. Adverse events associated with EUS and EUS with FNA. Gastrointest Endosc 2013;77:839-43.
28. Levy MJ, Norton ID, Clain JE, et al. Prospective study of bacteremia and complications with EUS FNA of rectal and perirectal lesions. Clin Gastroenterol Hepatol 2007;5:684-9.
29. Wilson W, Taubert KA, Gewitz M, et al. Prevention of infective endocarditis: guidelines from the American Heart Association: a guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group. Circulation 2007;116:1736-54.
30. Khashab MA, Tariq A, Tariq U, et al. Delayed and unsuccessful endoscopic retrograde cholangiopancreatography are associated with worse outcomes in patients with acute cholangitis. Clin Gastroenterol Hepatol 2012;10:1157-61.
31. Kapral C, Muhlberger A, Wewalka F, et al. Quality assessment of endoscopic retrograde cholangiopancreatography: results of a running nationwide Austrian benchmarking project after 5 years of implementation. Eur J Gastroenterol Hepatol 2012;24:1447-54.
32. Andriulli A, Loperfido S, Napolitano G, et al. Incidence rates of post-ERCP complications: a systematic survey of prospective studies. Am J Gastroenterol 2007;102:1781-8.
33. Barkay O, Khashab M, Al-Haddad M, et al. Minimizing complications in pancreaticobiliary endoscopy. Curr Gastroenterol Rep 2009;11:134-41.
34. Colton JB, Curran CC. Quality indicators, including complications, of ERCP in a community setting: a prospective study. Gastrointest Endosc 2009;70:457-67.
35. Masci E, Toti G, Mariani A, et al. Complications of diagnostic and therapeutic ERCP: a prospective multicenter study. Am J Gastroenterol 2001;96:417-23.
36. Ismail S, Kylanpaa L, Mustonen H, et al. Risk factors for complications of ERCP in primary sclerosing cholangitis. Endoscopy 2012;44:1133-8.
37. Loperfido S, Angelini G, Benedetti G, et al. Major early complications from diagnostic and therapeutic ERCP: a prospective multicenter study. Gastrointest Endosc 1998;48:1-10.
38. Bilbao MK, Dotter CT, Lee TG, et al. Complications of endoscopic retrograde cholangiopancreatography (ERCP). A study of 10,000 cases. Gastroenterology 1976;70:314-20.
39. Sauter G, Grabein B, Huber G, et al. Antibiotic prophylaxis of infectious complications with endoscopic retrograde cholangiopancreatography: a randomized controlled study. Endoscopy 1990;22:164-7.
40. Niederau C, Pohlmann U, Lubke H, et al. Prophylactic antibiotic treatment in therapeutic or complicated diagnostic ERCP: results of a randomized controlled clinical study. Gastrointest Endosc 1994;40:533-7.
41. Harris A, Chan AC, Torres-Viera C, et al. Meta-analysis of antibiotic prophylaxis in endoscopic retrograde cholangiopancreatography (ERCP). Endoscopy 1999;31:718-24.
42. Bai Y, Gao F, Gao J, et al. Prophylactic antibiotics cannot prevent endoscopic retrograde cholangiopancreatography–induced cholangitis: a meta-analysis. Pancreas 2009;38:126-30.
43. Brand M, Bizos D, O'Farrell P Jr. Antibiotic prophylaxis for patients undergoing elective endoscopic retrograde cholangiopancreatography. Cochrane Database Syst Rev 2010:CD007345.
44. Motte S, Devière J, Dumonceau JM, et al. Risk factors for septicemia following endoscopic biliary stenting. Gastroenterology 1991;101:1374-81.
45. De Palma GD, Galloro G, Siciliano S, et al. Unilateral versus bilateral endoscopic hepatic duct drainage in patients with malignant hilar biliary obstruction: results of a prospective, randomized, and controlled study. Gastrointest Endosc 2001;53:547-53.
46. Bangarulingam SY, Gossard AA, Petersen BT, et al. Complications of endoscopic retrograde cholangiopancreatography in primary sclerosing cholangitis. Am J Gastroenterol 2009;104:855-60.
47. Byl B, Devière J, Struelens MJ, et al. Antibiotic prophylaxis for infectious complications after therapeutic endoscopic retrograde cholangiopancreatography: a randomized, double-blind, placebo-controlled study. Clin Infect Dis 1995;20:1236-40.
48. Bianco JA, Pepe MS, Higano C, et al. Prevalence of clinically relevant bacteremia after upper gastrointestinal endoscopy in bone marrow transplant recipients. Am J Med 1990;89:134-6.
49. Cotton PB, Connor P, Rawls E, et al. Infection after ERCP and antibiotic prophylaxis: a sequential quality-improvement approach over 11 years. Gastrointest Endosc 2008;67:471-5.
50. Saxena P, Singh VK, Lennon AM, et al. Endoscopic management of acute cholecystitis after metal stent placement in patients with malignant biliary obstruction: a case series. Gastrointest Endosc 2013;78:175-8.
51. Isayama H, Kawabe T, Nakai Y, et al. Cholecystitis after metallic stent placement in patients with malignant distal biliary obstruction. Clin Gastroenterol Hepatol 2006;4:1148-53.
52. Saleem A, Leggett CL, Murad MH, et al. Meta-analysis of randomized trials comparing the patency of covered and uncovered self-expandable metal stents for palliation of distal malignant bile duct obstruction. Gastrointest Endosc 2011;74:321-7, e1-3.
53. Almadi MA, Barkun AN, Martel M. No benefit of covered vs uncovered self-expandable metal stents in patients with malignant distal biliary obstruction: a meta-analysis. Clin Gastroenterol Hepatol 2013;11:27-37, e1.
54. Williams DB, Sahai AV, Aabakken L, et al. Endoscopic ultrasound guided fine needle aspiration biopsy: a large single centre experience. Gut 1999;44:720-6.
55. Eloubeidi MA, Tamhane A, Varadarajulu S, et al. Frequency of major complications after EUS-guided FNA of solid pancreatic masses: a prospective evaluation. Gastrointest Endosc 2006;63:622-9.
56. Wiersema MJ, Vilmann P, Giovannini M, et al. Endosonography-guided fine-needle aspiration biopsy: diagnostic accuracy and complication assessment. Gastroenterology 1997;112:1087-95.
57. Lee LS, Saltzman JR, Bounds BC, et al. EUS-guided fine needle aspiration of pancreatic cysts: a retrospective analysis of complications and their predictors. Clin Gastroenterol Hepatol 2005;3:231-6.
58. Guarner-Argente C, Shah P, Buchner A, et al. Use of antimicrobials for EUS-guided FNA of pancreatic cysts: a retrospective, comparative analysis. Gastrointest Endosc 2011;74:81-6.
59. Diehl DL, Cheruvattath R, Facktor MA, et al. Infection after endoscopic ultrasound-guided aspiration of mediastinal cysts. Interact Cardiovasc Thorac Surg 2010;10:338-40.
60. Annema JT, Veselic M, Versteegh MI, et al. Mediastinitis caused by EUS-FNA of a bronchogenic cyst. Endoscopy 2003;35:791-3.
61. Khashab MA, Dewitt J. EUS-guided biliary drainage: Is it ready for prime time? Yes! Gastrointest Endosc 2013;78:102-5.
62. Khashab MA, Fujii LL, Baron TH, et al. EUS-guided biliary drainage for patients with malignant biliary obstruction with an indwelling duodenal stent (with videos). Gastrointest Endosc 2012;76:209-13.
63. Khashab MA, Kim KJ, Tryggestad EJ, et al. Comparative analysis of traditional and coiled fiducials implanted during EUS for pancreatic cancer patients receiving stereotactic body radiation therapy. Gastrointest Endosc 2012;76:962-71.
64. Shah JN, Marson F, Weilert F, et al. Single-operator, single-session EUS-guided anterograde cholangiopancreatography in failed ERCP or inaccessible papilla. Gastrointest Endosc 2012;75:56-64.
65. Khashab MA, Valeshabad AK, Modayil R, et al. EUS-guided biliary drainage by using a standardized approach for malignant biliary obstruction: rendezvous versus direct transluminal techniques (with videos). Gastrointest Endosc 2013;78:734-41.
66. Khashab MA, Varadarajulu S. Endoscopic ultrasonography as a therapeutic modality. Curr Opin Gastroenterol 2012;28:467-76.
67. Lipp A, Lusardi G. Systemic antimicrobial prophylaxis for percutaneous endoscopic gastrostomy. Cochrane Database Syst Rev 2006:CD005571.
68. Jain NK, Larson DE, Schroeder KW, et al. Antibiotic prophylaxis for percutaneous endoscopic gastrostomy: a prospective, randomized, double-blind clinical trial. Ann Intern Med 1987;107:824-8.

69. Thomas S, Cantrill S, Waghorn DJ, et al. The role of screening and antibiotic prophylaxis in the prevention of percutaneous gastrostomy site infection caused by methicillin-resistant Staphylococcus aureus. Aliment Pharmacol Ther 2007;25:593-7.
70. Maple JT, Petersen BT, Baron TH, et al. Direct percutaneous endoscopic jejunostomy: outcomes in 307 consecutive attempts. Am J Gastroenterol 2005;100:2681-8.
71. Maple JT. Direct percutaneous endoscopic jejunostomy in the obese: proceed with caution. Gastrointest Endosc 2008;67:270-2.
72. Chavez-Tapia NC, Barrientos-Gutierrez T, Tellez-Avila F, et al. Meta-analysis: antibiotic prophylaxis for cirrhotic patients with upper gastrointestinal bleeding—an updated Cochrane review. Aliment Pharmacol Ther 2011;34:509-18.
73. Fernandez J, Ruiz del Arbol L, Gomez C, et al. Norfloxacin vs ceftriaxone in the prophylaxis of infections in patients with advanced cirrhosis and hemorrhage. Gastroenterology 2006;131:1049-56; quiz 1285.
74. Baddour LM, Bettmann MA, Bolger AF, et al. Nonvalvular cardiovascular device-related infections. Circulation 2003;108:2015-31.
75. Baddour LM, Epstein AE, Erickson CC, et al. A summary of the update on cardiovascular implantable electronic device infections and their management: a scientific statement from the American Heart Association. J Am Dent Assoc 2011;142:159-65.
76. Scott NA, Tweedle DE. Pyogenic arthritis of the knee following Nd:YAG laser destruction of an esophageal cancer. Gastrointest Endosc 1990;36:545-6.
77. Vanderhooft JE, Robinson RP. Late infection of a bipolar prosthesis following endoscopy: a case report. J Bone Joint Surg Am 1994;76:744-6.
78. Zimmerli W, Trampuz A, Ochsner PE. Prosthetic joint infections. N Engl J Med 2004;351:1645-54.
79. Steckelberg JM, Osmon DR. Prosthetic joint infections. Infections associated with medical devices. 3rd ed. Washington (DC): American Society of Microbiology Press; 2000. p. 173-209.
80. Meyer GW, Artis AL. Antibiotic prophylaxis for orthopedic prostheses and GI procedures: report of a survey. Am J Gastroenterol 1997;92:989-91.
81. Piraino B, Bernardini J, Brown E, et al. ISPD position statement on reducing the risks of peritoneal dialysis–related infections. Perit Dial Int 2011;31:614-30.
82. Poortvliet W, Selten HP, Raasveld MH, et al. CAPD peritonitis after colonoscopy: follow the guidelines. Neth J Med 2010;68:377-8.
83. Yip T, Tse KC, Lam MF, et al. Colonic diverticulosis as a risk factor for peritonitis in Chinese peritoneal dialysis patients. Perit Dial Int 2010;30:187-91.
84. Yip T, Tse KC, Lam MF, et al. Risks and outcomes of peritonitis after flexible colonoscopy in CAPD patients. Perit Dial Int 2007;27:560-4.

Prepared by:
ASGE STANDARDS OF PRACTICE COMMITTEE
Mouen A. Khashab, MD
Krishnavel V. Chithadi, MD
Ruben D. Acosta, MD
David H. Bruining, MD
Vinay Chandrasekhara, MD
Mohamad A. Eloubeidi, MD
Robert D. Fanelli, MD, SAGES Representative
Ashley L. Faulx, MD
Lisa Fonkalsrud, BSN, RN, CGRN, SGNA Representative
Jenifer R. Lightdale, MD, MPH, NAPSGHAN Representative
V. Raman Muthusamy, MD
Shabana F. Pasha, MD
John R. Saltzman, MD
Aasma Shaukat, MD, MPH
Amy Wang, MD
Brooks D. Cash, MD, Committee Chair

This document is a product of the Standards of Practice Committee. This document was reviewed and approved by the Governing Board of the American Society for Gastrointestinal Endoscopy.