Role of EUS

This is one of a series of statements discussing the utilization of GI endoscopy in common clinical situations. The Standards of Practice Committee of the American Society for Gastrointestinal Endoscopy prepared this text. In preparing this guideline, MEDLINE *and PubMed databases were used to search publications through 2006 related to the role of endoscopic ultrasonography by using the keyword(s) "Endoscopic ultrasound" and each of the following: "Barrett's esophagus, esophageal cancer, gastric cancer, gastric lymphoma, rectal cancer, submucosal lesions, pancreaticobiliary disease, lymph nodes, mediastinal adenopathy, fecal incontinence and perianal disease, and therapeutic EUS. The search was supplemented by accessing the "related articles" feature of PubMed with articles identified on MEDLINE and PubMed as the references. Pertinent studies published in English were reviewed. Studies or reports that described less than 10 patients were excluded from analysis if multiple series with greater than 10 patients addressing the same issue were available. The recommendations were based on reviewed studies and were graded on the strength of the supporting evidence (Table 1).*[1]

Guidelines for appropriate utilization of endoscopy are based on a critical review of the available data and expert consensus. Further controlled clinical studies may be 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.

This guideline represents an updated review of the role of endoscopic ultrasonography.[2]

EUS combines 2 modalities: endoscopic visualization and high-frequency US. The ability to image the wall of the GI tract as a series of definable layers corresponding to histology, rather than as a single entity, is the basis for most indications for EUS. Other indications have emerged from the ability of EUS to provide detailed images of areas in immediate proximity to the GI tract and to guide needles precisely through the gut wall into surrounding structures.

The addition of endoluminal US offers a unique advantage over traditional endoscopy, allowing precise differentiation of the individual layers of the GI tract, and direct imaging of the surrounding organs and tissue.

EUS allows assessment of submucosal GI lesions, locoregional staging of GI malignancy, tissue diagnosis, and staging of pancreaticobiliary lesions, nonsmall-cell lung carcinoma, and mediastinal disease. In prospective trials, EUS has consistently been shown to have a significant impact on diagnosis and management.[3-5] EUS-guided FNA has emerged as an adjunctive modality during standard endosonography, allowing tissue diagnosis of submucosal lesions, extraluminal lesions, and/or lymph nodes. Furthermore, therapeutic uses for EUS have been described and are used on a limited basis in some institutions.

EUS has become firmly established as an adjunctive endoscopic imaging study for patients with previously identified lesions of the GI tract and surrounding organs. Multiple studies suggest that EUS is superior to CT for tumor (T) and lymph node (N) staging of luminal and pancreaticobiliary malignancies.[6,7] The ultimate choice of staging modalities is largely dependent upon patient selection and local expertise.

EUS continues to grow and develop, though relative lack of trained practitioners, high costs of EUS processors, and limited reimbursement relative to time spent per procedure are limiting factors. Image interpretation is more difficult than standard endoscopic visualization and requires extensive training to master.[4] Guidelines for competency[8] as well as quality indicators in EUS have been published.[9,10] EUS can be carried out with a low complication rate.[11]

INSTRUMENTATION

There are 3 basic echoendoscope designs: a radial array system, a curvilinear array system, and high-frequency catheter-based miniprobes. The radial systems use circumferential views that range from 270 to 360 degrees. Mechanical echoendoscopes utilize oblique-viewing optical systems and scan at frequencies from 5.0 to 20 MHz. Newer models scan electronically at frequencies ranging from 5.0 to 10 MHz, and Doppler capabilities are available. Curvilinear array transducers are generally electronic systems operating at 5.0 or 7.5 MHz and have color Doppler capability. The curvilinear array design also makes it possible to direct needle aspiration, biopsies, and fine needle injection (FNI) under ultrasonographic visualization. Therapeutic echoendoscopes with $\geq$ 3.8-mm channels allow

0016-5107/$32.00
doi:10.1016/j.gie.2007.05.026

TABLE 1. Grades of recommendation

Grade of recommendation	Clarity of benefit	Methodologic strength/ supporting evidence	Implications
1A	Clear	Randomized trials without important limitations	Strong recommendation; can be applied to most clinical settings
1B	Clear	Randomized trials with important limitations (inconsistent results, nonfatal methodologic flaws)	Strong recommendation; likely to apply to most practice settings
1C+	Clear	Overwhelming evidence from observational studies	Strong recommendation; can apply to most practice settings in most situations
1C	Clear	Observational studies	Intermediate-strength recommendation; may change when stronger evidence is available
2A	Unclear	Randomized trials without important limitations	Intermediate-strength recommendation; best action may differ depending on circumstances or patients' or societal values
2B	Unclear	Randomized trials with important limitations (inconsistent results, nonfatal methodologic flaws)	Weak recommendation; alternative approaches may be better under some circumstances
2C	Unclear	Observational studies	Very weak recommendation; alternative approaches likely to be better under some circumstances
3	Unclear	Expert opinion only	Weak recommendation; likely to change as data become available

Adapted from Guyatt G, Sinclair J, Cook D, et al. Moving from evidence to action: grading recommendations—a qualitative approach. In: Guyatt G, Rennie D, editors. Users' guides to the medical literature. Chicago: AMA Press; 2002. p. 599-608.

passage of larger-diameter devices, such as large-bore (10F) stents.

Catheter-based miniprobes may be passed through accessory channels of conventional endoscopes. Higher frequencies (>20 MHz) increase resolution, albeit with a decrease in the depth of imaging penetration, which consequently does not allow for adequate extraluminal visualization. The technology is particularly useful for assessment of mucosal or submucosal lesions and intraductal imaging. Because of the narrow width of the catheters, they may also be used to traverse GI luminal strictures that do not permit passage of a dedicated echoendoscope.

INDICATIONS

Indications for EUS can be divided into several categories: (1) evaluation of luminal GI malignancies; (2) evaluation of submucosal abnormalities; (3) evaluation of pancreatico-biliary disease; (4) evaluation of mediastinal disease; (5) evaluation of perianal disease; (6) evaluation of extraluminal abnormalities identified on other imaging studies; and (7) therapeutic applications.

EVALUATION OF LUMINAL GI MALIGNANCIES

Luminal GI cancers are staged by the TNM classification, which includes depth of invasion (T), presence or absence of locoregional lymph nodes (N), and presence or absence of distant metastases (M). The TNM staging for each malignancy has been described elsewhere.[12] EUS has been proven accurate in T and N staging of GI tumors that are within reach of the echoendoscope. EUS has been shown to be the most sensitive method for the regional staging of cancer of the esophagus, stomach, and rectum.[13] Whereas M staging is limited, malignant ascites, pleural effusions, liver metastases, and celiac lymph nodes can be safely sampled by using EUS-FNA. Staging information provided by EUS can aid in determining endoscopic or surgical resectability and need for neoadjuvant therapy.[14] Prospective data have shown EUS staging to alter clinical management and cost-effectiveness when compared to other staging modalities.[3,15-18]

BARRETT'S ESOPHAGUS AND ESOPHAGEAL CANCER

The principal role of EUS in evaluating patients with Barrett's esophagus (BE) and high-grade dysplasia (HGD) is to exclude the presence of occult cancer, submucosal invasion, and malignant lymphadenopathy. This is particularly important for the appropriate selection of patients when endoscopic management is considered.[19-23] There are limited data on the use of EUS in patients

with BE and HGD, and the reported accuracy for diagnosing occult invasive cancer is variable.[21,24] The routine application of EUS in BE with low-grade dysplasia or without dysplasia is not recommended because the risk of malignancy in these settings is negligible.

In esophageal cancer, EUS provides accurate staging that is superior to CT scanning and allows for stage-directed therapy. The role of endoscopy in the assessment and treatment of esophageal cancer has been addressed in another guideline.[25]

GASTRIC CANCER AND GASTRIC LYMPHOMA

Selection of an appropriate treatment strategy in patients with gastric cancer is dependent upon accurate tumor staging. Many studies have demonstrated superior accuracy of EUS over CT scanning, ranging from 71% to 88% (T stage) and 77% to 80% (N stage).[26-30] The accuracy of EUS in staging gastric cancer does not approach that of esophageal cancer because of the inherent difficulty with EUS in differentiating between the subserosa and serosal layers. Understaging, due to microscopic deposits, and overstaging, particularly of T2 tumors, due to tumor-associated fibrosis or inflammation, can occur.[31] CT is preferred for evaluating distant metastases.

EUS is important in the locoregional staging of gastric lymphoma and directly impacts choice of treatment. The accuracy of EUS ranges from 91% to 95% and 77% to 83% for T and N staging, respectively.[32,33] N-stage accuracy may be improved by EUS-FNA combined with flow cytometry and immunocytochemistry.[34] The endosonographic criteria for malignant lymph nodes are extrapolated from data on esophageal tumors.[25] EUS may predict response to *Helicobacter pylori* eradication.[35,36] EUS is also useful in assessing the surface spread (horizontal extension) of gastric lymphomas when surgery is contemplated. EUS-FNA of the gastric wall should be considered if EUS is abnormal but mucosal biopsy results are negative, and consideration should be given to sample-representative lymph nodes regardless of size because up to 25% of metastatic lymph nodes may be <3 mm.[37,38] EUS may be used for monitoring response to medical therapy (*H pylori* therapy or chemoradiation therapy), with disease regression manifesting as reduction in wall thickness, increase in wall echogenicity, normalization of wall layer pattern, and absence or reduction in the size or number of lymph nodes,[39-41] although this practice has been questioned.[42] There is no recommended surveillance program, but a follow-up EUS examination every 3 to 6 months for a period of 2 years should be considered after successful treatment because the risk of recurrence appears to be highest during this time interval.[33,43]

RECTAL CANCER

Preoperative EUS staging of rectal cancer is useful in determining the type of surgery and the need for neoadjuvant chemoradiation therapy in patients with advanced locoregional disease. The role of EUS in staging rectal cancer is considered in detail in another guideline.[44]

SUBEPITHELIAL (SUBMUCOSAL) LESIONS

EUS is an important diagnostic modality in the evaluation of subepithelial lesions, commonly referred to as submucosal lesions (SML), of the GI tract. For the purposes of this document, the term SML will be used. When an SML is identified, EUS is the diagnostic test of choice to assess the size, margins, layer of origin, and echotexture of the lesion, and to differentiate between an intramural and extramural lesion. An anechoic lesion is typical of a cystic structure, a hyperechoic lesion favors a fatty tumor (lipoma or liposarcoma), and a hypoechoic lesion in the fourth echolayer is typical of a leiomyoma or GI stromal tumor (GIST). Although these endosonographic findings are helpful in categorizing a lesion, they cannot determine absolutely the type of lesion or whether a lesion is benign or malignant. Based on the clinical context, a tissue diagnosis may be needed. However, correlation of EUS characterization and the final pathology matches in only 77% of SML cases.[45-47] EUS-guided FNA or core biopsy can help establish a tissue diagnosis and potentially characterize malignant risk. The diagnostic yield for EUS-FNA or core biopsy ranges from 80% to 92%.[48-50]

The most common SMLs encountered in the upper GI tract are GISTs.[51] Although they typically arise within the muscularis propria, establishing the layer of origin may be challenging. They are often found incidentally during endoscopy, and standard forceps biopsies are usually nondiagnostic. Tumor size exceeding 30 to 40 mm and irregular margins appear to be the most important endosonographic features of GISTs associated with an increased risk for malignancy.[52,53] There is less agreement on the value of other features, such as echogenic foci, cystic spaces, nonoval shape, heterogeneous echotexture, exophytic development, and ulcerated mucosa.[54,55] The cytomorphologic and immunohistochemical staining features of GISTs can be reliably diagnosed on cytologic material (cell blocks) and core tissue specimens from EUS-FNA or core biopsy (eg, trucut biopsy), respectively.[56-58] The typical immunohistochemical stains for diagnosing GIST are c-Kit (CD117), CD34, and smooth muscle actin. Positive staining for c-Kit is considered diagnostic of GIST. Other markers, such as desmin and S-100 protein, can differentiate GIST from smooth muscle tumors (leiomyoma, leiomyosarcoma, leiomyoblastoma) and schwannoma.[59] Although GIST can be diagnosed on FNA, assessment of malignant potential based on mitotic count requires histology and cannot be evaluated on cytologic specimens. It is also important to recognize that not all GIST are c-KIT positive.[57] A National Institutes of Health consensus conference developed guidelines on assessing the risk of malignant behavior of GIST.[60]

When endoscopic removal of an SML is considered, EUS should be performed to select suitable tumors by determining the layer of origin. Endoscopic resection of SMLs that arise from the muscularis propria or deeper carries a high risk of perforation. Catheter-based EUS (miniprobes) may be used when assessing small lesions.[61] Although EUS surveillance of patients with asymptomatic, small submucosal tumors without endosonographic signs of malignancy may be undertaken,[62] this approach has not been validated. The decision to perform surveillance and the frequency of such surveillance should be individualized, keeping in mind that rapid tumor enlargement is rare and poor patient compliance is common.

PANCREATICOBILIARY MALIGNANCIES

Pancreatic adenocarcinoma

Pancreatic cancer survival is poor, and surgical resection for attempted cure is possible in only up to 14% of all cases.[63] It is therefore important to stage pancreatic adenocarcinoma accurately in order to allow directed therapy (surgical resection vs palliative approaches). The use of EUS in the staging and management of pancreatic cancer is reviewed in another guideline.[64]

EUS can identify lesions not seen on CT or MRI and further characterize smaller lesions.[65] False-negative examinations may be seen in the setting of chronic pancreatitis, diffusely infiltrating carcinoma, prominent ventral/dorsal anlage, and recent acute pancreatitis.[66] The use of EUS for T and N staging has generally been found to be superior to other imaging techniques (helical CT, MRI), and staging sensitivity is greater than 90%.[67-72] However, the superiority of EUS over CT in determining resectability of pancreatic adenocarcinoma has not been established, and the 2 modalities are considered complementary.[73] EUS-FNA allows cytologic diagnosis, differentiation between adenocarcinoma, lymphoma, and neuroendocrine tumors, and allows for tissue sampling of malignant lymph nodes. In patients with unresectable disease, cytologic diagnosis is often required before institution of palliative chemoradiation therapy. Advantages compared to CT-guided FNA biopsy include the ability to sample smaller lesions, simultaneous lymph node sampling, and a lower incidence of peritoneal carcinomatosis.[74]

In retrospective studies, EUS has been shown to improve patient selection for resection.[75] EUS-FNA has also been found to be the most cost-effective test for pancreatic adenocarcinoma when compared with CT-guided FNA and surgical diagnosis.[8] However, because of the need for screening for distant metastatic disease, other forms of imaging cannot be abandoned in favor of EUS, and helical CT or PET scanning is still advised. Magnetic resonance imaging (MRI) and angiography may be useful adjunctive tests if the presence of vascular invasion cannot be determined on EUS. EUS should be considered in surgical candidates with localized disease.

Ampullary tumors

EUS staging of ampullary tumors may be of benefit. The role of EUS for this indication is discussed in another guideline.[76]

Biliary tumors

Cancers of the biliary tract (gallbladder carcinoma and cholangiocarcinoma) can be staged by EUS, although the data are considerably limited compared to pancreatic malignancy. EUS and EUS-FNA have been shown to be useful in the tissue diagnosis of cholangiocarcinoma and benign bile duct strictures in patients with negative ERCP brushings.[77] The addition of intraductal EUS to ERCP can help further delineate biliary strictures and improve the differentiation of benign from malignant disease.[78,79]

Neuroendocrine tumors

Neuroendocrine tumors (NETs) of the pancreas are rare, neuropeptide-producing tumors suspected on the basis of clinical presentation and relevant neuropeptide assays. They may be functioning (associated with neuropeptide-related symptoms) or nonfunctioning, and are classified by the predominant neuropeptide (insulin, gastrin, glucagon, vasoactive intestinal peptide, somatostatin, etc). The only curative treatment option is surgical resection; thus, preoperative localization of the tumor is critical to management. Localization of the tumor is often difficult by standard imaging studies (US, CT, MRI). EUS can localize these often small (<1 cm) tumors with a high degree of accuracy. In prospective studies, EUS localized a NET in 82% to 93% of patients.[80,81] Studies that compare EUS directly with somatostatin receptor scintigraphy, CT, and MRI for the localization of NETs also show EUS to have the greatest sensitivity for tumor detection.[82,83] Localization of gastrinomas tends to be lower, particularly if found in the duodenum, where the sensitivity has been reported to be as low as 50%.[84]

Several other factors make EUS attractive in the assessment of NETs. In addition to tumor localization, EUS can also provide a tissue diagnosis by means of FNA. EUS-FNA becomes particularly useful in cases where tumors are small (0.5-1 cm), or if they are nonfunctioning. Furthermore, studies have shown that specificity in diagnosis is improved with the addition of EUS-FNA.[85] EUS has been shown to be cost-effective compared to other imaging modalities.[86]

BENIGN PANCREATICOBILIARY DISEASES

Chronic pancreatitis

EUS has been proven to be useful in the diagnosis of chronic pancreatitis (CP). The use of endoscopy in CP has been reviewed in a separate guideline.[87] Briefly, characteristic findings include focal or diffuse changes in the pancreatic parenchyma (echogenic foci or stranding, small

cystic cavities, lobularity, heterogeneous parenchyma, calcifications) and/or pancreatic duct (dilation, irregularity, hyperechoic walls, side-branch ectasia, echogenic foci, or stones).[88,89] Parenchymal inhomogeneity, echogenic foci or stranding, and hyperechoic pancreatic duct borders are the most common findings.[85] Changes visible on EUS may typically be absent on conventional imaging such as CT, abdominal US, and ERCP.

Although debate exists as to the criterion standard for the diagnosis of chronic pancreatitis, diagnostic EUS compares favorably to histologic data, pancreatic function testing, and other imaging modalities, including ERCP.[90-92] EUS findings in CP may be operator dependent, and a long learning curve may be required, but among experienced experts, interobserver agreement is quite high.[93] Despite this, the diagnosis of mild forms of CP may remain uncertain. EUS may be most reliable when it is clearly positive (>5 criteria; high specificity and positive predictive value) or negative (<2 criteria; high sensitivity and negative predictive value).[85]

Acute pancreatitis

EUS has been shown to be useful for identifying the presence of bile duct stones in cases of acute gallstone pancreatitis and subsequently for selection of patients for ERCP.[94-98] However, EUS does not offer the therapeutic advantages that ERCP offers; thus, its role may be as an alternative in patients with an intermediate risk of choledocholithiasis and as an alternative to MRCP. A recent Canadian decision analysis found that EUS was more cost-effective than either ERCP or MRCP in both severe and nonsevere acute biliary pancreatitis.[99] EUS may also provide valuable information in the evaluation of idiopathic recurrent acute pancreatitis. Although ERCP has been advocated for the investigation of idiopathic acute pancreatitis, it carries with it a complication rate much higher than EUS, and EUS may be a better first test. Studies of EUS in this setting have demonstrated a yield of 30% to 80%. Findings have included gallstones, microlithiasis or sludge, pancreas divisum, mucinous tumors, pancreatic neoplasms, and chronic pancreatitis.[100]

Autoimmune pancreatitis

Autoimmune pancreatitis is an increasingly described fibroinflammatory condition that can be difficult to distinguish clinically and radiographically from pancreatic cancer.[101] Cross-sectional imaging of the entity has been described; CT findings include diffuse enlargement of the pancreas with a low-density, capsule-like rim. MRI findings include delayed enhancement and a diffusely decreased signal intensity. EUS has become an important means of diagnosis.[102] EUS features suggestive of autoimmune pancreatitis include diffuse, hypoechoic pancreatic enlargement, and/or focal masses. Vascular invasion and peripancreatic lymphadenopathy similar to that of pancreatic cancer may be seen. Common bile duct strictures are common. EUS-FNA reveals a lymphocytic or plasma cell infilitrate in up to 73% of patients.[102] Trucut core biopsy techniques have been used to diagnose autoimmune pancreatitis and may improve the diagnostic yield compared to standard FNA.[103]

Cystic lesions of the pancreas

Pancreatic cystic lesions represent a heterogeneous collection of entities that may be benign or malignant. EUS can be used both for characterization of these lesions and to guide drainage of benign inflammatory lesions. A more complete discussion of the role of endoscopy and EUS in the diagnosis and management of pancreatic cystic lesions is detailed in another guideline.[104]

Suspected choledocholithiasis

When choledocholithiasis is suspected, EUS has a sensitivity of >90% for the detection of common bile duct stones.[105,106] These results compare favorably to ERCP and are superior to transabdominal US, without the inherent risk of postprocedural pancreatitis. EUS has also been shown to be a cost-effective initial screening study, in lieu of ERCP, for patients with a low or intermediate risk of bile duct stones.[107] Controlled trials of EUS and MRCP have shown EUS to have a comparable or higher accuracy in the diagnosis of obstructive jaundice and detection of choledocholithiasis.[108,109] A recent systematic review suggests that EUS be reserved for the evaluation of patients with an intermediate risk of choledocholithiasis.[110] EUS does not have the therapeutic capacity of ERCP for stone removal. While the precise role of EUS for evaluation of suspected choledocholithiasis remains to be defined, algorithms have been developed that incorporate its use into clinical practice.[111-113]

Evaluation of fecal incontinence

Rectal EUS is capable of visualization of the internal and external anal sphincters and surrounding structures. This allows characterization of perianal disease, such as fistulae and abscesses, and assessment of sphincter integrity in fecal incontinence. The accuracy of EUS in the assessment of perianal disease has been documented in several studies and compares favorably with MRI and CT.[114,115] Both MRI and EUS appear to have excellent accuracy when compared to examination-under-anesthesia (EUA) and may be complementary to EUA in defining perianal disease.[116]

EUS has also proven extremely useful in the assessment of fecal incontinence.[117] Defects in the internal and external anal sphincters appear as hypoechoic breaks or discontinuity within the normally hypoechoic internal sphincter and/or more hyperechoic external sphincter. Because of high accuracy in the detection of sphincter defects and better patient tolerance,[118] EUS has largely supplanted electromyography in this regard. Sensitivity

for identifying sphincter defects is greater than 90% in several studies.[119,120] Comparisons with MRI have shown mixed results,[121,122] but both modalities appear useful. In addition to the detection of sphincter defects, EUS may also be useful in the prediction of the response after sphincteroplasty. Endosonographic evidence of defect closure correlates with improvement in symptoms.[120]

Evaluation of mediastinal disease

EUS-FNA is a safe and accurate method for obtaining a tissue diagnosis in patients with mediastinal adenopathy. The role of EUS for evaluation of mediastinal adenopathy is considered in another guideline.[123]

Miscellaneous

Miscellaneous applications of EUS include staging of colonic tumors where transanal endoscopic microsurgery may be contemplated[124] and evaluation of large colorectal adenomatous polyps before considering endoscopic resection.[125] Finally, EUS can be valuable in the evaluation of extraluminal abnormalities seen on other imaging studies, including hepatic lesions, ascites, left adrenal lesions, and duplication cysts.[126-128]

Evaluation of lymph nodes

The assessment of regional and distant lymph nodes in patients with a malignancy is critical in the staging process. EUS features suggestive of malignant lymph nodes include size $\geq$ 1 cm, hypoechoic and homogeneous echo pattern, rounded shape, and well-defined borders.[129-131] Although no single feature is diagnostic, the likelihood of malignancy increases in the presence of multiple features. These endosonographic criteria for malignant lymph nodes are extrapolated from data derived from esophageal malignancies and may not be applicable to all malignant lymph nodes. Use of EUS-FNA enhances the ability to differentiate benign from malignant infiltration and should be considered in all patients when results would alter treatment.[132-136]

THERAPEUTIC EUS

In addition to its well established diagnostic roles, EUS is emerging as a useful tool for therapeutic purposes. Its use in guiding transmural drainage of pancreatic pseudocysts is well documented and reviewed in another guideline.[104] Other uses of EUS include celiac plexus block for pain from chronic pancreatitis, and celiac plexus neurolysis for pancreatic cancer pain,[137] fine-needle injection,[138] and EUS-guided cholangiopancreatography.[139] Celiac plexus block and neurolysis can provide effective pain relief in patients with pancreatic cancer. Two prospective trials have shown that pain improves in 78% to 88% of patients.[140,141] The efficacy of celiac plexus block is less established in chronic pancreatitis pain, but up to 50% of patients have a short-term response, and the EUS-guided approach may be more effective than CT-guided blocks in this patient population.[142]

SUMMARY

Barrett's esophagus

- The role of EUS in evaluating patients with BE and HGD is to exclude the presence of occult cancer, submucosal invasion, and malignant lymphadenopathy (1C).
- The routine application of EUS in BE with low-grade dysplasia or without dysplasia is not recommended (3).

Esophageal cancer

- In esophageal cancer, EUS provides accurate locoregional staging that is superior to CT scanning (1C+).
- Preoperative EUS staging of esophageal cancer is cost effective and can guide preoperative management (1C+).

Gastric cancer and lymphoma

- EUS is useful in the locoregional staging of gastric carcinoma and lymphomas (1C+).
- EUS may be used to monitor response to therapy with disease regression in gastric lymphoma (1C).

Rectal cancer

- EUS is accurate in the preoperative locoregional staging of rectal cancer (1C+).
- Preoperative EUS staging of rectal cancer is cost effective and can guide preoperative management (1C+).

Submucosal lesions

- When a submucosal lesion is identified, EUS should be considered to further characterize the lesion (1C).
- EUS-FNA or core biopsy can help establish a tissue diagnosis and potentially characterize malignant risk (1C+).
- EUS should be performed before consideration of endoscopic removal of SML (3).

Pancreatic cancer

- Pancreatic adenocarcinoma can be accurately identified, staged, and diagnosed by EUS and EUS-FNA (1C+).
- Neuroendocrine tumors can be localized and sampled by EUS (3).

Chronic and acute pancreatitis

- EUS is the most sensitive imaging study for the detection of structural changes of chronic pancreatitis (1C).
- EUS has been shown to be useful for identifying the presence of bile duct stones in cases of acute gallstone pancreatitis and in selecting patients for ERCP at intermediate risk for choledocholithiasis (1C).

Autoimmune pancreatitis

- EUS, EUS–FNA, and EUS core biopsy can help establish the diagnosis of autoimmune pancreatitis (3).

Pancreatic cystic lesions

- EUS is useful for the characterization of the morphology of pancreatic cystic lesions (1C).
- EUS can be used to guide drainage of benign inflammatory lesions (3).

Fecal incontinence and perianal disease

- Internal and external anal sphincter defects can be accurately identified by EUS in the evaluation of fecal incontinence (1C).
- EUS may be used for the identification and characterization of abscesses and perianal fistulae (3).

Choledocolithiasis

- EUS is highly accurate in the detection of choledocolithiasis and has fewer complications than ERCP (1C).

Mediastinal lymphadenopathy

- EUS-FNA is a safe and accurate method for obtaining a tissue diagnosis in patients with mediastinal adenopathy (1C+).

Lymph nodes

- Use of EUS and EUS-FNA to differentiate benign from malignant lymph nodes should be considered in patients when results would alter treatment (1C+).

Therapeutic EUS

- EUS-guided celiac neurolysis can provide significant reduction of pancreatic cancer pain (1C).

REFERENCES

1. Guyatt G, Sinclair J, Cook D, et al. Moving from evidence to action. Grading recommendations-a qualitative approach. In: Guyatt G, Rennie D, editors. Users' guides to the medical literature. Chicago: AMA press; 2002. p. 599-608.
2. American Society for Gastrointestinal Endoscopy. Role of endoscopic ultrasonography. Gastrointest Endosc 2000;52:852-9.
3. Nickl NJ, Bhutani MS, Catalano M, et al. Clinical implications of endoscopic ultrasound: the American Endosonography Club Study. Gastrointest Endosc 1996;44:371-7.
4. Harewood GC, Kumar KS. Assessment of clinical impact of endoscopic ultrasound on esophageal cancer. J Gastroenterol Hepatol 2004;19:433-9.
5. Harewood GC. Assessment of clinical impact of endoscopic ultrasound on rectal cancer. Am J Gastroenterol 2004;99:623-7.
6. Tierney WM, Kochman ML, Scheiman JM. Computed tomography versus endoscopic ultrasonography for staging of pancreatic cancer. Ann Intern Med 2005;142:590-1.
7. Zhang X, Watson DI, Lally C, et al. Endoscopic ultrasound for preoperative staging of esophageal carcinoma. Surg Endosc 2005;19: 1618-21.
8. Eisen GM, Dominitz JA, Faigel DO, et al. Guidelines for credentialing and granting privileges for endoscopic ultrasound. Gastrointest Endosc 2001;54:811-4.
9. Jacobson BC, Chak A, Hoffman B, et al. Quality indicators for endoscopic ultrasonography. Gastrointest Endosc 2006;63:S35-8.
10. Faigel DO. Quality, competency and endosonography. Endoscopy 2006;38:S65-9.
11. Adler DG, Jacobson BC, Davila RE, et al. Complications of EUS. Gastrointest Endosc 2005;61:8-12.
12. American Joint Committee on Cancer. AJCC cancer staging manual, sixth edtion. New York: Springer-Verlag; 2002.
13. Savides TJ, Master SS. EUS in rectal cancer. Gastrointest Endosc 2002; 56:S12-8.
14. Yanai H, Matsumoto Y, Harada T, et al. Endoscopic ultrasonography and endoscopy for staging depth of invasion in early gastric cancer: a pilot study. Gastrointest Endosc 1997;46:212-6.
15. Harewood GC, Wiersema MJ, Nelson H, et al. A prospective, blinded assessment of the impact of preoperative staging on the management of rectal cancer. Gastroenterology 2002;123:24-32.
16. Harewood GC, Wiersema MJ. Cost-effectiveness of endoscopic ultrasonography in the evaluation of proximal rectal cancer. Am J Gastroenterol 2002;97:874-82.
17. Harewood GC, Wiersema MJ. A cost analysis of endoscopic ultrasound in the evaluation of esophageal cancer. Am J Gastroenterol 2002;97:452-8.
18. Harewood GC, Wiersema MJ. A cost analysis of endoscopic ultrasound in the evaluation of pancreatic head adenocarcinoma. Am J Gastroenterol 2001;96:2651-6.
19. Hirota WK, Zuckerman MJ, Adler DG, et al. The role of endoscopy in the surveillance of premalignant conditions of the upper GI tract. Gastrointest Endosc 2006;63:570-80.
20. Savoy AD, Wallace MB. EUS in the management of the patient with dysplasia in Barrett's esophagus. J Clin Gastroenterol 2005;39:263-7.
21. Larghi A, Lightdale CJ, Memeo L, et al. EUS followed by EMR for staging of high-grade dysplasia and early cancer in Barrett's esophagus. Gastrointest Endosc 2005;62:16-23.
22. Owens MM, Kimmey MB. The role of endoscopic ultrasound in the diagnosis and management of Barrett's esophagus. Gastrointest Endosc Clin N Am 2003;13:325-34.
23. Scotiniotis IA, Kochman ML, Lewis JD, et al. Accuracy of EUS in the evaluation of Barrett's esophagus and high-grade dysplasia or intramucosal carcinoma. Gastrointest Endosc 2001;54:689-96.
24. Falk GW, Catalano MF, Sivak MV Jr, et al. Endosonography in the evaluation of patients with Barrett's esophagus and high-grade dysplasia. Gastrointest Endosc 1994;40:207-12.
25. Jacobson BC, Hirota W, Baron TH, et al. The role of endoscopy in the assessment and treatment of esophageal cancer. Gastrointest Endosc 2003;57:817-22.
26. Shimoyama S, Yasuda H, Hashimoto M, et al. Accuracy of linear-array EUS for preoperative staging of gastric cardia cancer. Gastrointest Endosc 2004;60:50-5.
27. Chen CH, Yang CC, Yeh YH. Preoperative staging of gastric cancer by endoscopic ultrasound: the prognostic usefulness of ascites detected by endoscopic ultrasound. J Clin Gastroenterol 2002;35:321-7.
28. Ganpathi IS, So JB, Ho KY. Endoscopic ultrasonography for gastric cancer: does it influence treatment? Surg Endosc 2006;20:559-62.
29. Polkowski M, Palucki J, Wronska E, et al. Endosonography versus helical computed tomography for locoregional staging of gastric cancer. Endoscopy 2004;36:617-23.
30. Habermann CR, Weiss F, Riecken R, et al. Preoperative staging of gastric adenocarcinoma: comparison of helical CT and endoscopic US. Radiology 2004;230:465-71.
31. Willis S, Truong S, Gribnitz S, et al. Endoscopic ultrasonography in the preoperative staging of gastric cancer: accuracy and impact on surgical therapy. Surg Endosc 2000;14:951-4.
32. Palazzo L, Roseau G, Ruskone-Fourmestraux A, et al. Endoscopic ultrasonography in the local staging of primary gastric lymphoma. Endoscopy 1993;25:502-8.
33. Caletti G, Fusaroli P, Togliani T. EUS in MALT lymphoma. Gastrointest Endosc 2002;56:S21-6.
34. Ribeiro A, Vazquez-Sequeiros E, Wiersema LM, et al. EUS-guided fine-needle aspiration combined with flow cytometry and immunocytochemistry in the diagnosis of lymphoma. Gastrointest Endosc 2001; 53:485-91.
35. Sheu BS, Shiesh SC, Wang JT, et al. Clinical application of 20 MHz endosonography and anti-Helicobacter pylori immunoblots to predict regression of low-grade gastric MALToma by H. pylori eradication. Helicobacter 2003;8:36-45.

36. Sackmann M, Morgner A, Rudolph B, et al. Regression of gastric MALT lymphoma after eradication of Helicobacter pylori is predicted by endosonographic staging. MALT Lymphoma Study Group. Gastroenterology 1997;113:1087-90.
37. Caletti G, Fusaroli P, Togliani T, et al. Endosonography in gastric lymphoma and large gastric folds. Eur J Ultrasound 2000;11:31-40.
38. Bertoni F, Zucca E. State-of-the-art therapeutics: marginal-zone lymphoma. J Clin Oncol 2005;23:6415-20.
39. Levy M, Hammel P, Lamarque D, et al. Endoscopic ultrasonography for the initial staging and follow-up in patients with low-grade gastric lymphoma of mucosa-associated lymphoid tissue treated medically. Gastrointest Endosc 1997;46:328-33.
40. Sackmann M, Morgner A, Rudolph B, et al. Regression of gastric MALT lymphoma after eradication of Helicobacter pylori is predicted by endosonographic staging. MALT Lymphoma Study Group. Gastroenterology 1997;113:1087-90.
41. Puspok A, Raderer M, Chott A, et al. Endoscopic ultrasound in the follow up and response assessment of patients with primary gastric lymphoma. Gut 2002;51:691-4.
42. Di Raimondo F, Caruso L, Bonanno G, et al. Is endoscopic ultrasound clinically useful for follow-up of gastric lymphoma? Ann Oncol 2007; 18:351-6.
43. Heise W. Gastric lymphomas: aspects of follow-up and after-care. Recent Results Cancer Res 2000;156:69-77.
44. Davila RE, Rajan E, Adler D, et al. The role of endoscopy in the diagnosis, staging, and management of colorectal cancer. Gastrointest Endosc 2005;61:1-7.
45. Polkowski M, Butruk E. Submucosal lesions. Gastrointest Endosc Clin N Am 2005;15:33-54.
46. Brand B, Oesterhelweg L, Binmoeller KF, et al. Impact of endoscopic ultrasound for evaluation of submucosal lesions in gastrointestinal tract. Dig Liver Dis 2002;34:290-7.
47. Kojima T, Takahashi H, Parra-Blanco A, et al. Diagnosis of submucosal tumor of the upper GI tract by endoscopic resection. Gastrointest Endosc 1999;50:516-22.
48. Hunt GC, Rader AE, Faigel DO. A comparison of EUS features between CD-117 positive GI stromal tumors and CD-117 negative GI spindle cell tumors. Gastrointest Endosc 2003;57:469-74.
49. Ando N, Goto H, Niwa Y, et al. The diagnosis of GI stromal tumors with EUS-guided fine needle aspiration with immunohistochemical analysis. Gastrointest Endosc 2002;55:37-43.
50. Fu K, Eloubeidi MA, Jhala NC, et al. Diagnosis of gastrointestinal stromal tumor by endoscopic ultrasound-guided fine needle aspiration biopsy–a potential pitfall. Ann Diagn Pathol 2002;6:294-301.
51. Chak A. EUS in submucosal tumors. Gastrointest Endosc 2002;56: S43-8.
52. Palazzo L, Landi B, Cellier C, et al. Endosonographic features predictive of benign and malignant gastrointestinal stromal cell tumours. Gut 2000;46:88-92.
53. Chak A, Canto MI, Rosch T, et al. Endosonographic differentiation of benign and malignant stromal cell tumors. Gastrointest Endosc 1997; 45:468-73.
54. Rosch T, Kapfer B, Will U, et al. Accuracy of endoscopic ultrasonography in upper gastrointestinal submucosal lesions: a prospective multicenter study. Scand J Gastroenterol 2002;37:856-62.
55. Nickl NJ. Gastrointestinal stromal tumors: new progress, new questions. Curr Opin Gastroenterol 2004;20:482-7.
56. Rader AE, Avery A, Wait CL, et al. Fine-needle aspiration biopsy diagnosis of gastrointestinal stromal tumors using morphology, immunocytochemistry, and mutational analysis of c-kit. Cancer 2001;93: 269-75.
57. Gu M, Ghafari S, Nguyen PT, et al. Cytologic diagnosis of gastrointestinal stromal tumors of the stomach by endoscopic ultrasound-guided fine-needle aspiration biopsy: cytomorphologic and immunohistochemical study of 12 cases. Diagn Cytopathol 2001;25:343-50.
58. Levy MJ, Wiersema MJ. EUS-guided Trucut biopsy. Gastrointest Endosc 2005;62:417-26.
59. Davila RE, Faigel DO. GI stromal tumors. Gastrointest Endosc 2003;58: 80-8.
60. Fletcher CD, Berman JJ, Corless C, et al. Diagnosis of gastrointestinal stromal tumors: a consensus approach. Hum Pathol 2002;33:459-65.
61. Buscarini E, Stasi MD, Rossi S, et al. Endosonographic diagnosis of submucosal upper gastrointestinal tract lesions and large fold gastropathies by catheter ultrasound probe. Gastrointest Endosc 1999; 49:184-91.
62. Melzer E, Fidder H. The natural course of upper gastrointestinal submucosal tumors: an endoscopic ultrasound survey. Isr Med Assoc J 2000;2:430-2.
63. Niederhuber JE, Brennan MF, Menck HR. The National Cancer Data Base report on pancreatic cancer. Cancer 1995;76:1671-7.
64. Baron TH, Mallery JS, Hirota WK, et al. The role of endoscopy in the evaluation and treatment of patients with pancreaticobiliary malignancy. Gastrointest Endosc 2003;58:643-9.
65. Howard TJ, Chin AC, Streib EW, et al. Value of helical computed tomography, angiography, and endoscopic ultrasound in determining resectability of periampullary carcinoma. Am J Surg 1997;174: 237-41.
66. Bhutani MS, Gress FG, Giovannini M, et al. The No Endosonographic Detection of Tumor (NEST) Study: a case series of pancreatic cancers missed on endoscopic ultrasonography. Endoscopy 2004;36:385-9.
67. Gress F, Hawes RH, Savides TJ, et al. Role of EUS in the preoperative staging of pancreatic cancer: a large single-center experience. Gastrointest Endosc 1999;50:786-91.
68. Tierney WM, Kochman ML, Scheiman JM. Computed tomography versus endoscopic ultrasonography for staging of pancreatic cancer. Ann Intern Med 2005;142:590-1.
69. DeWitt J, Devereaux B, Chriswell M, et al. Comparison of endoscopic ultrasonography and multidetector computed tomography for detecting and staging pancreatic cancer. Ann Intern Med 2004;141: 753-63.
70. Brugge WR, Lee MJ, Kelsey PB, et al. The use of EUS to diagnose malignant portal venous system invasion by pancreatic cancer. Gastrointest Endosc 1996;43:561-7.
71. Ahmad NA, Kochman ML, Lewis JD, et al. Endosonography is superior to angiography in the preoperative assessment of vascular involvement among patients with pancreatic carcinoma. J Clin Gastroenterol 2001;32:54-8.
72. Mertz HR, Sechopoulos P, Delbeke D. EUS, PET, and CT scanning for evaluation of pancreatic adenocarcinoma. Gastrointest Endosc 2000; 52:367-71.
73. Dewitt J, Devereaux BM, Lehman GA, et al. Comparison of endoscopic ultrasound and computed tomography for the preoperative evaluation of pancreatic cancer: a systematic review. Clin Gastroenterol Hepatol 2006;4:717-25.
74. Micames C, Jowell PS, White R, et al. Lower frequency of peritoneal carcinomatosis in patients with pancreatic cancer diagnosed by EUS-guided FNA vs. percutaneous FNA. Gastrointest Endosc 2003; 58:690-5.
75. Erickson RA, Garza AA. Impact of endoscopic ultrasound on the management and outcome of pancreatic carcinoma. Am J Gastroenterol 2000;95:2248-54.
76. American Society for Gastrointestinal Endoscopy. The role of endoscopy in ampullary and duodenal adenomas. Gastrointest Endosc 2006;64:849-54.
77. Fritscher-Ravens A, Broering DC, Knoefel WT, et al. EUS-guided fine-needle aspiration of suspected hilar cholangiocarcinoma in potentially operable patients with negative brush cytology. Am J Gastroenterol 2004;99:45-51.
78. Vazquez-Sequeiros E, Baron TH, Clain JE, et al. Evaluation of indeterminate bile duct strictures by intraductal US. Gastrointest Endosc 2002;56:372-9.
79. Domagk D, Poremba C, Dietl KH, et al. Endoscopic transpapillary biopsies and intraductal ultrasonography in the diagnostics of bile duct strictures: a prospective study. Gut 2002;51:240-4.

80. Anderson MA, Carpenter S, Thompson NW, et al. Endoscopic ultrasound is highly accurate and directs management in patients with neuroendocrine tumors of the pancreas. Am J Gastroenterol 2000; 95:2271-7.
81. Ardengh JC, de Paulo GA, Ferrari AP. EUS-guided FNA in the diagnosis of pancreatic neuroendocrine tumors before surgery. Gastrointest Endosc 2004;60:378-84.
82. Zimmer R, Ziegler K, Bader M. Localization of neuroendocrine tumors of the upper GI tract. Gut 1994;35:471-5.
83. Ardengh JC, Rosenbaum P, Ganc AJ, et al. Role of EUS in the preoperative localization of insulinomas compared with spiral CT. Gastrointest Endosc 2000;51:552-5.
84. Rosziewship, Amoyal P, Amoyal G. Localization of gastrinomas by endoscopic ultrasonography in patients with Zollinger Ellison syndromes. Surgery 1995;117:629-35.
85. Sahai AV. EUS and chronic pancreatitis. Gastrointest Endosc 2002;56: S76-81.
86. Bansal R, Tierney W, Carpenter S, et al. Cost effectiveness of EUS for preoperative localization of pancreatic endocrine tumors. Gastrointest Endosc 1999;49:19-25.
87. Adler DG, Lichtenstein D, Baron TH, et al. The role of endoscopy in patients with chronic pancreatitis. Gastrointest Endosc 2006;63:933-7.
88. Sahai AV, Zimmerman M, Aabakken L, et al. Prospective assessment of the ability of endoscopic ultrasound to diagnose, exclude, or establish the severity of chronic pancreatitis found by endoscopic retrograde cholangiopancreatography. Gastrointest Endosc 1998;48:18-25.
89. Catalano MF, Lahoti S, Geenen JE, et al. Prospective evaluation of endoscopic ultrasonography, endoscopic retrograde pancreatography, and secretin test in the diagnosis of chronic pancreatitis. Gastrointest Endosc 1998;48:11-7.
90. Buscail L, Escourror J, Moreau J, et al. Endoscopic ultrasonography in chronic pancreatitis: a comparative prospective study with conventional ultrasonography, computed tomography and ERCP. Pancreas 1995;10:251-7.
91. Sideridis K, Michael H, Patel P, et al. Endoscopic findings in surgically proven chronic pancreatitis [abstract]. Gastrointest Endosc 2002;56:4.
92. Kahl S, Glasbrenner B, Leodolter A, et al. EUS in the diagnosis of early chronic pancreatitis: a prospective follow-up study. Gastrointest Endosc 2002;55:507-11.
93. Wallace MB, Hawes RH, Durkalski V, et al. The reliability of EUS for the diagnosis of chronic pancreatitis: interobserver agreement among experienced endosonographers. Gastrointest Endosc 2001;53:294-9.
94. Materne R, Van Beers BE, Gigot JF, et al. Extrahepatic biliary obstruction: magnetic resonance imaging compared with endoscopic ultrasonography. Endoscopy 2000;32:3-9.
95. Kondo S, Isayama H, Akahane M, et al. Detection of common bile duct stones: comparison between endoscopic ultrasonography, magnetic resonance cholangiography, and helical-computed-tomographic cholangiography. Eur J Radiol 2005;54:271-5.
96. Chotiprasidhi P, Scheiman JM. Suspected choledocholithiasis: EUS, magnetic resonance cholangiopancreatography, or intraoperative cholecystectomy? Gastrointest Endosc 2002;56:951-5.
97. Chak A, Hawes RH, Cooper GS, et al. Prospective assessment of the utility of EUS in the evaluation of gallstone pancreatitis. Gastrointest Endosc 1999;49:599-604.
98. Liu CL, Lo CM, Chan JK, et al. Detection of choledocholithiasis by EUS in acute pancreatitis: a prospective evaluation in 100 consecutive patients. Gastrointest Endosc 2001;54:325-30.
99. Romagnuolo J, Currie G. Noninvasive vs. selective invasive biliary imaging for acute biliary pancreatitis: an economic evaluation by using decision tree analysis. Gastrointest Endosc 2005;61:86-97.
100. Yusoff IF, Raymond G, Sahai AV. A prospective comparison of the yield of EUS in primary vs. recurrent idiopathic acute pancreatitis. Gastrointest Endosc 2004;60:673-8.
101. Chari ST, Smyrk TC, Levy MJ, et al. Diagnosis of autoimmune pancreatitis: the Mayo Clinic experience. Clin Gastroenterol Hepatol 2006;4: 1010-6.
102. Farrell JJ, Garber J, Sahani D, et al. EUS findings in patients with autoimmune pancreatitis. Gastrointest Endosc 2004;60:927-36.
103. Levy MJ, Reddy RP, Wiersema MJ, et al. EUS-guided trucut biopsy in establishing autoimmune pancreatitis as the cause of obstructive jaundice. Gastrointest Endosc 2005;61:467-72.
104. Jacobson BC, Baron TH, Adler DG, et al. The role of endoscopy in the diagnosis and the management of cystic lesions and inflammatory fluid collections of the pancreas. Gastrointest Endosc 2005;61:363-70.
105. Buscarini E, Tansini P, Vallisa D, et al. EUS for suspected choledocholithiasis: do benefits outweigh costs? A prospective, controlled study. Gastrointest Endosc 2003;57:510-8.
106. Kohut M, Nowakowska-Dulawa E, Marek T, et al. Accuracy of linear endoscopic ultrasonography in the evaluation of patients with suspected common bile duct stones. Endoscopy 2002;34:299-303.
107. Canto MF, Chak A, Stellato T, et al. Endoscopic ultrasonography versus cholangiography for the diagnosis of choledocolithiasis. Gastrointest Endosc 1998;47:439-48.
108. de Ledinghen V, Lecesne R, Raymond JM, et al. Diagnosis of choledocholithiasis: EUS or magnetic resonance cholangiography? A prospective controlled study. Gastrointest Endosc 1999;49:26-31.
109. Aube C, Delorme B, Yzet T, et al. MR cholangiopancreatography versus endoscopic sonography in suspected common bile duct lithiasis: a prospective, comparative study. Am J Roentgenol 2005; 184:55-62.
110. Sahai AV, Mauldin PD, Marsi V, et al. Bile duct stones and laparoscopic cholecystectomy: a decision analysis to assess the roles of intraoperative cholangiography, EUS, and ERCP. Gastrointest Endosc 1999;49:334-43.
111. Eisen GM, Dominitz JA, Faigel DO, et al. An annotated algorithm for the evaluation of choledocholithiasis. Gastrointest Endosc 2001;53: 864-6.
112. Canto MI, Chak A, Stellato T, et al. Endoscopic ultrasonography versus cholangiography for the diagnosis of choledocholithiasis. Gastrointest Endosc 1998;47:439-48.
113. Erickson RA, Garza AA. EUS with EUS-guided fine-needle aspiration as the first endoscopic test for the evaluation of obstructive jaundice. Gastrointest Endosc 2001;53:475-84.
114. Schratter-Sehn AU, Lochs H, Vogelsang H, et al. Endoscopic ultrasonography versus computed tomography in the differential diagnosis of perianorectal complications of Crohn's disease. Endoscopy 1993; 25:582-6.
115. Orsoni P, Parthet M, Portier F, et al. Prospective comparison of endosonography, magnetic resonance imaging and surgical findings in anorectal fistula and abscess complicating Crohn's disease. Br J Surg 1999;86:360-4.
116. Schwartz DA, Wiersema MJ, Dudiak KM, et al. A comparison of endoscopic ultrasound, magnetic resonance imaging and exam under anesthesia for evaluation of Crohn's perianal fistulas. Gastroenterology 2001;121:1064-72.
117. Hill K, Fanning S, Fennerty MB, et al. Endoanal ultrasound compared to anorectal manometry for the evaluation of fecal incontinence: a study of the effect these tests have on clinical outcome. Dig Dis Sci 2006;51:235-40.
118. Enck P, von Giesen HJ, Schafer A, et al. Comparison of anal sonography with conventional needle electromyography in the evaluation of anal sphincter defects. Am J Gastroenterol 1996;91:2539-43.
119. Schafer R, Heyer T, Gantke B, et al. Anal endosonography and manometry: comparison in patients with defecation problems. Dis Colon Rectum 1997;40:293-7.
120. Savoye-Collet C, Savoye G, Koning E, et al. Anal endosonography after sphincter repair: specific patterns related to clinical outcome. Abdom Imaging 1999;24:569-73.
121. Rociu E, Stoker J, Eijkmans MJ, et al. Fecal incontinence: endoanal US versus endoanal MR imaging. Radiology 1999;212:453-8.
122. Malouf AJ, Williams AN, Halligan S, et al. Prospective assessment of accuracy of endoanal MR imaging and endosonography in patients with fecal incontinence. Am J Roentgenol 2000;175:741-5.

123. Jacobson BC, Hirota WK, Goldstein JL, et al. The role of EUS for evaluation of mediastinal adenopathy. Gastrointest Endosc 2003;58: 819-21.
124. Stergiou N, Haji-Kermani N, Schneider C, et al. Staging of colonic neoplasms by colonoscopic miniprobe ultrasonography. Int J Colorectal Dis 2003;18:445-9.
125. Hurlstone DP, Brown S, Cross SS, et al. Endoscopic ultrasound miniprobe staging of colorectal cancer: can management be modified? Endoscopy 2005;37:710-4.
126. Crowe DR, Eloubeidi MA, Chhieng DC, et al. Fine-needle aspiration biopsy of hepatic lesions: computerized tomographic-guided versus endoscopic ultrasound-guided FNA. Cancer 2006;108:180-5.
127. Eloubeidi MA, Seewald S, Tamhane A, et al. EUS-guided FNA of the left adrenal gland in patients with thoracic or GI malignancies. Gastrointest Endosc 2004;59:627-33.
128. Chen VK, Eloubeidi MA. Endoscopic ultrasound-guided fine-needle aspiration of intramural and extraintestinal mass lesions: diagnostic accuracy, complication assessment, and impact on management. Endoscopy 2005;37:984-9.
129. Catalano MF, Sivak MV Jr, Rice T, et al. Endosonographic features predictive of lymph node metastasis. Gastrointest Endosc 1994;40:442-6.
130. Faigel DO. EUS in patients with benign and malignant lymphadenopathy. Gastrointest Endosc 2001;53:593-8.
131. Schmulewitz N, Wildi SM, Varadarajulu S, et al. Accuracy of EUS criteria and primary tumor site for identification of mediastinal lymph node metastasis from non-small-cell lung cancer. Gastrointest Endosc 2004;59:205-12.
132. Bhutani MS, Hawes RH, Hoffman BJ. A comparison of the accuracy of echo features during endoscopic ultrasound (EUS) and EUS-guided fine-needle aspiration for diagnosis of malignant lymph node invasion. Gastrointest Endosc 1997;45:474-9.
133. Savides TJ, Perricone A. Impact of EUS-guided FNA of enlarged mediastinal lymph nodes on subsequent thoracic surgery rates. Gastrointest Endosc 2004;60:340-6.
134. Stelow EB, Lai R, Bardales RH, et al. Endoscopic ultrasound-guided fine-needle aspiration of lymph nodes: the Hennepin County Medical Center experience. Diagn Cytopathol 2004;30:301-6.
135. Vazquez-Sequeiros E, Wiersema MJ, Clain JE, et al. Impact of lymph node staging on therapy of esophageal carcinoma. Gastroenterology 2003;125:1626-35.
136. Vazquez-Sequeiros E, Levy MJ, Clain JE, et al. Routine vs. selective EUS-guided FNA approach for preoperative nodal staging of esophageal carcinoma. Gastrointest Endosc 2006;63:204-11.
137. Levy MJ, Wiersema MJ. Endoscopic ultrasound-guided pain control for intra-abdominal cancer. Gastroenterol Clin North Am 2006;35:153-65.
138. Gan SI, Thompson CC, Lauwers GY, et al. Ethanol lavage of pancreatic cystic lesions: initial pilot study. Gastrointest Endosc 2005;61:746-52.
139. Mallery S, Matlock J, Freeman ML. EUS-guided rendezvous drainage of obstructed biliary and pancreatic ducts: report of 6 cases. Gastrointest Endosc 2004;59:100-7.
140. Wiersema MJ, Wiersema LM. Endosonography-guided celiac plexus neurolysis. Gastrointest Endosc 1996;44:656-62.
141. Gunartanam NT, Sarma AV, Norton ID, et al. A prospective study of EUS-guided celiac plexus neurolysis for pancreatic cancer pain. Gastrointest Endosc 2001;54:316-24.
142. Gress F, Schmitt C, Sherman S, et al. A prospective randomized comparison of endoscopic ultrasound and computed tomography guided celiac plexus block for the management of chronic pancreatitis. Am J Gastroenterol 1999;94:900-5.

Prepared by:
ASGE STANDARDS OF PRACTICE COMMITTEE
S. Ian Gan, MD
Elizabeth Rajan, MD
Douglas G. Adler, MD
Todd H. Baron, MD, Chair
Michelle A. Anderson, MD
Brooks D. Cash, MD
Raquel E. Davila, MD
Jason A. Dominitz, MD, MHS
M. Edwyn Harrison III, MD
Steven O. Ikenberry, MD
David Lichtenstein, MD
Waqar Qureshi, MD
Bo Shen, MD
Mark Zuckerman, MD
Robert D. Fanelli, MD, SAGES Representative
Kenneth K. Lee, MD, NAPSGHAN Representative
Trina Van Guilder, RN, SGNA Representative
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.