Communication from the ASGE Training Committee

CORE CURRICULUM

ASGE American Society for Gastrointestinal Endoscopy

Core curriculum for EUS

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Developed by the American Society for Gastrointestinal Endoscopy Training Committee

This is one of a series of documents prepared by the American Society for Gastrointestinal Endoscopy Training Committee. This curriculum document contains recommendations for training curricula intended for use by endoscopy training directors, endoscopists involved in teaching endoscopy, and trainees in endoscopy. It was developed as an overview of the performance and training of EUS and to serve as a guide to published references, videos, and other resources available to the trainer. Specifics on quality metrics and competency assessment are separate topics that are beyond the focus of this curriculum.

EUS is a minimally invasive endoscopic modality that allows for the acquisition of real-time, high-resolution images of luminal and extraluminal structures. EUS-guided FNA or fine-needle biopsy (FNB) sampling allows the endoscopist to safely and effectively access regions in proximity of the GI tract that were only previously accessible by percutaneous or surgical means. The ability to provide accurate tumor staging and rapid tissue acquisition has led to physician reliance on EUS services throughout the world and has brought this technology to the forefront at most academic and nonacademic centers. In addition, EUS is evolving as a conduit for therapeutic interventions, such as drainage, tumor ablation, and ductal access.

GOALS OF TRAINING

Trainee

Before initiating training in EUS, fellows are expected to be experienced in diagnostic and therapeutic upper endoscopy (EGD) and colonoscopy.

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Faculty

Programs dedicated to teaching EUS should have at least 1 faculty member who is experienced in performing EUS (with both radial and linear echoendoscopes). The ideal environment also provides the trainee with interaction with a multidisciplinary team including surgeons, oncologists, pathologists, radiologists, and radiation oncologists. This approach will provide a framework to understand how the endosonographer can play a vital role in patient management.

Facilities

EUS is typically an outpatient procedure and can be performed in either a hospital-based endoscopy unit or an ambulatory surgery/endoscopy center. An EUS processor, radial and linear echoendoscopes, catheter-based EUS probes (optional), and EUS needles are the basic equipment necessary to perform the procedure. In addition, knowledge of proper processing of tissue specimens, by either endoscopy staff or cytopathology staff, is necessary to ensure quality outcomes.

Endoscopic experience

The training program should be able to provide a breadth of cases including but not limited to staging of luminal GI malignancies (esophageal, gastric, rectal), evaluation of benign and malignant pancreatobiliary disease, and the evaluation of subepithelial GI lesions.[1] A basic list of structures that trainees should become proficient in evaluating with EUS is shown in Table 1.

A growing number of therapeutic applications for EUS have emerged (eg, celiac plexus neurolysis, transmural access and drainage, tumor ablation). Exposure to these newer modalities may be program dependent. Thus, trainees wishing to enhance their training may need to seek out other opportunities for hands-on experience if their program does not offer exposure to these interventional EUS techniques.

TABLE 1. Basic structures and pathology in EUS

Organ	Structures	Pathology
Esophagus	Normal wall layers	Esophageal cancer staging
		Subepithelial lesions
Stomach	Normal wall layers	Gastric cancer staging
		Subepithelial lesions
Duodenum	Normal wall layers	Subepithelial lesions, polyps
Ampulla	Normal appearance	Ampullary polyps/masses
Pancreas	Normal parenchyma	Parenchymal changes
		Solid masses
		Cystic lesions
	Normal ducts	Ductal changes
Biliary tree (intrahepatic, extrahepatic, cystic duct)	Normal appearance	Presence of stones, sludge
		Dilation
		Strictures
		Wall thickening
		Masses
		Foreign bodies (stents)
Gallbladder	Normal appearance	Stones, sludge, wall thickening Pericholecystic fluid
		Polyps/masses
Anorectum	Normal wall layers	Rectal cancer staging
	Internal and external anal sphincters	Sphincter abnormalities
		Fluid collections
		Subepithelial lesions

Other Structures	Mediastinum	Abdomen	Pelvis
Lymph nodes	Posterior	Celiac	Perirectal
	Inferior	Perigastric	Left iliac
	Aortopulmonary window	Gastrohepatic ligament	
		Portahepatis	
		Peripancreatic	
Vascular structures	Aorta	Aorta	Iliac arteries and veins
	Pulmonary artery	Celiac artery	
	Azygous vein	SMA	
		Splenic artery	
		Gastroduodenal artery	
		Portal vein	
		SMV	
		Splenic vein	
		IVC	
		Hepatic veins	
Non-GI organs	Heart (left atrium)	Liver	Urinary bladder
	Lungs	Spleen	Prostate, seminal vesicles, urethra
	Trachea	Kidneys	Uterus, vagina
	Bronchi	Left adrenal gland	

SMA, Superior mesenteric artery; *SMV*, superior mesenteric vein; *IVC*, Inferior vena cava.

TABLE 2. Core technical, nontechnical, and cognitive skills for training in EUS

Technical skills	Nontechnical skills	Cognitive skills
• Pass the echoendoscope safely through the upper and lower GI tract to the target locations	• Communicate effectively with the patient and other consulting services (eg, surgery, oncology, palliative care) to manage the patient as part of a multidisciplinary team	• Understand the indications, contraindications, and potential adverse events for EUS and tissue acquisition for benign and malignant diseases
• Interrogate luminal and extraluminal structures as detailed in Table 1	• Evaluate the patient's cardiovascular risk and fitness for upper or lower endoscopy, in consultation with the anesthesia specialist in selected cases	• Appreciate the role of EUS in the workup of both GI and non-GI malignancies including the TNM classification and use of FNA or fine-needle biopsy sampling for tissue procurement
• Manipulate imaging processor to obtain high-quality image resolution	• Obtain informed consent by explaining the risks and benefits of the procedure and expected outcomes	• Know the difference between the major types of echoendoscopes and choose the appropriate modality based on the indication
• Perform safe and effective tissue sampling	• Review cross-sectional or radiographic imaging studies pertinent to the planned procedure	• Understand the principles of endosonography including acoustic coupling, image manipulation through gain and frequency differences, and Doppler imaging
• Be familiar with advanced EUS techniques and when pursuing these may be appropriate	• Communicate effectively with the endoscopy assistant, cytotechnologist, and cytopathologist during the procedure	• Be familiar with the available needle types, the mechanical aspects of each, and methods for tissue acquisition including use of the stylet and suction techniques
	• Generate a detailed procedure report with accurate description of findings, interventions, and type of needles/devices used	• Understand the tissue processing techniques, interpretation of pathology including those with a "nondiagnostic" result, and indications for resampling and/or additional supplementary studies

TRAINING PROCESS

Core technical, nontechnical, and cognitive skills for training in EUS are listed in Table 2 and discussed further below.

Equipment

Basic principles. As with any endoscopic procedure, understanding the basic tenets of how the relevant equipment works and how images are obtained is essential. Trainees are expected to understand the process through which US images are generated via sound waves. Additionally, it is essential to comprehend the relationship between sound wave frequency, depth of penetration, and implications on EUS imaging. Trainees should also understand the principles of Doppler imaging because this is used in most studies in which vascular structures need to be defined.

Imaging devices and accessories. Echoendoscopes are available in 2 major designs: radial array and curvilinear array. Trainees should gain experience in the use of both types of echoendoscopes in identifying normal anatomic structures as well as luminal and extraluminal pathology in the mediastinum, abdomen, and pelvis. In addition, trainees must understand how imaging differs with respect to each modality, the limitations of each, and which imaging modality to choose when proceeding with an EUS evaluation.[2,3,4,5]

EUS trainees must learn the principle of acoustic coupling and how the presence of a fluid medium is often necessary to optimize the image. They should have an appreciation of the focal length of the instrument and the need to image from an appropriate distance. Trainees are expected to learn how to use a disposable balloon to this effect. They should be able to identify the appropriate balloon to be used for their selected scope, be able to place it accordingly, and learn techniques to appropriately de-aerate the balloon.

Trainees are expected to understand the various mechanical aspects of the EUS needle, including how to advance and withdraw the needle and the sheath, appropriate use of stylet and suction, and proper safe handling. In addition, the trainee should be aware that different types of EUS needles are available and the indications, contraindications, and techniques for use.

Basic techniques

Passage of the echoendoscope. Maneuvering both the radial and linear echoendoscope through the GI tract is much more challenging than a standard forward-viewing endoscope. The trainee should have a detailed understanding of the construction of the tip of the echoendoscope and relation of the location of the optics to the transducer.

When training in EUS, emphasis should be placed on the safe passage of the echoendoscope across vital structures in the oropharynx and upper GI tract. Trainees should learn to safely intubate the esophagus, traverse the esophagus and gastroesophageal junction, and

maneuver through the pylorus and duodenal sweep. Trainees should become familiar with techniques in rectal and sigmoid intubation and should appreciate the risks associated with tissue acquisition in this region. In addition, trainees should have exposure to patients with surgically altered anatomy and understand the variations in technique that may be required for safe and effective performance of EUS in this patient population.

EUS image generation and manipulation. In learning EUS, the trainee's understanding of the various features of the US processor used to generate the highest quality image is critical. Image manipulation and fine-tuning is achieved via the use of various processor functions. Trainees should have a clear understanding of how to improve image quality by adjustment of amplification (gain) and time (gain) compensation. Detailed examination of a target lesion can also be enhanced by manipulating the frequency and by using functions for magnification, zooming, and isolating a particular zone of the field.

Trainees should be able to measure target lesions and include appropriate annotations such as labels and arrows. Trainees should also be able to appropriately capture, store, and retrieve images for documentation and review.

Tissue sampling

The success of EUS-guided FNA or FNB sampling is not only dependent on the ability to perform safe and effective tissue acquisition, but also on the ability of the endosonographer to handle tissue specimens appropriately. Attention should be placed on the indications for tissue sampling, contraindications, and potential adverse events.

Tools and techniques. Numerous needles are available to obtain both cytologic specimens and histologic specimens (ie, tissue cores). Trainees are expected to understand the advantages and limitations of each needle type and thus choose the appropriate needle for a given target lesion. Trainees should learn the differences between FNA needles and the various types of core biopsy (FNB) needles available. An emphasis should be placed on optimal technique for needle insertion, including EUS visualization of the needle tip at all times, avoidance of intervening vascular and ductal structures, and representative sampling from multiple locations throughout the lesion. In addition, trainees should understand the relevant issues regarding the use of a stylet and suction syringe during tissue acquisition. An emphasis should be placed on the technical aspects of tissue acquisition and tissue handling as well as on collection of an adequate tissue specimen with a minimal number of passes.

Specimen handling. Once tissue has been obtained from the target lesion, appropriate handling of the specimen is essential for proper cytopathologic evaluation and interpretation. Trainees should participate in the tissue handling process, including the delivery of tissue from the needle to a slide and/or a preservative solution, in addition to the preparation of smears, fixation (alcohol or air-dried), and staining for rapid on-site specimen interpretation, if available. Trainees *must* also understand when supplementary studies such as flow cytometry, tumor marker analysis, immunohistochemical staining, and cytogenetics may be necessary and how to appropriately handle tissue specimens for these tests.

Documentation. It is essential that the endoscopist provides the cytopathologist with relevant clinical information to allow accurate interpretation of the cytology specimens in an appropriate context. The requisition form accompanying the specimen should document pertinent patient history and radiologic/endoscopic findings. A description of the lesion, including location, size, and whether it is solid, cystic, or necrotic, is also extremely helpful for the cytopathologist. Finally, for extraluminal lesions, noting the route by which the needle was inserted to obtain a specimen (eg, transduodenal or transgastric) is important.

Interpretation. When a diagnosis is not possible from a cytopathologic analysis of the tissue specimen, the trainee must understand the nomenclature used to describe the specimen. Terms such as "atypical," "suspicious," "negative," and "nondiagnostic" may not indicate an absence of malignancy. Thus, the trainee should gain appreciation that in the appropriate clinical context, it may be necessary to pursue repeat tissue sampling.

Management of adverse events

Trainees must familiarize themselves with potential adverse events related to the performance of EUS, such as endoscope trauma and perforation and those related to FNA or FNB sampling, such as infection, bleeding, and site-specific inflammation (eg, pancreatitis, bile peritonitis).[6] Emphasis should be placed on techniques to minimize these risks in addition to the recognition and management of adverse events.

Advanced EUS

Diagnostic techniques. Trainees should recognize that other diagnostic devices are available that are designed to complement and enhance standard diagnostic imaging with radial and linear echoendoscopes. Catheter probes can be advanced through the accessory channel of standard endoscopes for the evaluation of small mucosal or submucosal lesions. Catheter probes can similarly be used during ERCP for evaluation of strictures and lesions of either the bile duct or pancreatic duct. EUS elastography and contrast-enhanced endosonography are modalities that provide the endosonographer with information regarding stiffness and microvasculature, respectively, of the target lesion and surrounding tissue. They may aid in differentiating benign and malignant lesions that are difficult to diagnose by EUS tissue sampling. Exposure to these modalities may be program-dependent and/or endoscope

manufacturer-dependent. Thus, trainees wishing to enhance their training may need to seek other opportunities for hands-on experience.

Therapeutic techniques. Given the proven utility and safety of diagnostic EUS, a growing number of therapeutic applications have emerged in the field of interventional EUS. These include celiac plexus blockade/neurolysis, fiducial placement, pseudocyst drainage, transmural access, ablation of neoplasms, and vascular interventions.[7,8,9,10]

Trainees seeking experience in therapeutic techniques are expected to have achieved considerable skill in basic diagnostic EUS and FNA/FNB sampling techniques. In addition, EUS-guided drainage and transmural access procedures may require the use of fluoroscopy and ERCP techniques. Trainees who desire exposure to these therapeutic applications in interventional EUS are advised to seek additional training at specialized centers.

SUMMARY

This EUS core curriculum was developed as an overview of the key components of the procedure and is meant to serve as a platform for education, training, and practice. By providing information to endoscopy trainers about the common practices used by experts in performing EUS, the American Society for Gastrointestinal Endoscopy hopes to improve the teaching and performance of EUS.

DISCLOSURES

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Abbreviation: FNB, fine-needle biopsy.

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