

Overview of Endoscopic Ultrasound (EUS)

Ultrasound (ultrasonography) is a test in which high-frequency sound waves are bounced off the body's internal tissues, and the echoes are then converted into a type of picture called a sonogram.¹ Endoscopic ultrasound (EUS) goes a step further by combining ultrasound technology with endoscopy.

An EUS examination (also called endoluminal endosonography) is performed by endoscopically inserting a small ultrasound transducer into a sedated patient's mouth or rectum. This internal vantage point provides more detailed pictures of the digestive tract, including the esophagus, stomach, small bowel and colon as well as surrounding tissues and organs such as the pancreas, gallbladder, liver and spleen.² Unlike conventional endoscopy, which can only see the innermost lining, EUS imaging is able to visualize all five layers of tissue that comprise the GI wall, namely the mucosa, deep mucosa, submucosa, muscularis propria and serosa or surrounding adventitia.³ From a clinical perspective, this means that an abnormality below the GI tract's surface lining—such as a growth that was detected during a prior endoscopy or under x-ray—can be further evaluated with EUS, helping the physician better understand the abnormality's nature and prescribe the best treatment option.²

Because EUS can be used to visualize other organs outside the digestive tract, endoscopic ultrasound is also useful in diagnosing diseases of the pancreas, bile duct and gallbladder as well as staging a variety of cancers. In addition, EUS as a visual guidance tool has proved useful in applications such as tissue sample collection using fine needle aspiration (FNA) and administration of certain therapies, such as the treatment of some cysts.²

Imaging Modalities

Endoscopic ultrasound is performed using either an ultrasound probe, which is passed through the channel of a standard endoscope, or with an echoendoscope with an ultrasound transducer built into its tip.³ Because of its closer, internal vantage point, EUS can deliver enhanced imaging resolution compared to conventional ultrasound, which is conducted transcutaneously. In addition, an echoendoscope can maneuver in unique imaging planes and remove intraluminal air, which often obscures imaging during conventional ultrasound.³

There are two main EUS imaging modalities, including curvilinear and radial. Curvilinear array (CLA) instruments create ultrasound images parallel to the axis of the insertion tube. This orientation facilitates real-time ultrasonographic guidance of interventions such as fine needle aspiration (FNA),³ allowing the physician to view simultaneously the needle and the target area of interest on the video monitor. Real-time viewing allows the physician to proceed directly from observation to puncture, and with the addition of Doppler functionality (which can pinpoint anechoic structures), the physician can also identify and avoid vascular structures, making it easier to select the optimum puncture position and direction.⁴

Radial instruments produce ultrasonographic images perpendicular to the axis of the insertion tube, usually in a full 360 degrees, creating cross-sectional viewing planes similar to those generated by CT. Because of their viewing orientation, radial instruments are used mainly for diagnostic examination.³

Clinical Applications

Endoscopic ultrasound is a well-established imaging modality and plays an important role in digestive disease diagnosis and cancer staging. Via curvilinear array technology, EUS has been able to advance its role in interventional applications,³ and the advent of EUS-guided FNA to obtain tissue samples serves as an advanced, minimally invasive alternative to exploratory surgery.⁵ Physicians can also use EUS to guide pseudocyst drainage, injections and painkilling treatments.⁵ By delivering pain medication to patients via direct injection to the target site inside the body, the medication can be administered without damaging surrounding tissues. This technique may hold promise as well for treating malignant tumors as research clinicians explore ways to inject cancer-fighting agents directly into malignancies.⁶

As an important imaging modality in diagnostic, therapeutic and interventional applications, EUS can be used by physicians to help:

- Stage gastrointestinal and other cancers, such as esophageal, gastric, rectal and pancreatic cancers⁷
- Evaluate patients with Barrett's esophagus with high-grade dysplasia⁷
- Detect common bile duct stones (EUS is less invasive than conventional ERCP)⁵
- Evaluate masses in the gut wall⁵
- Diagnose diseases of the internal organs⁵
- Collect fluid samples from the abdominal cavity⁵

History and Role of EUS

Originally developed by Olympus,⁴ endoscopic ultrasound systems were first introduced in the 1980s to support the early detection of pancreatic cancer, which was difficult to diagnose using external modalities.⁸ Applications for EUS continued to expand, and the technology is now used to assess digestive diseases and a host of other conditions,⁸ including gastric, esophageal, pancreatic and rectal cancers as well as neuroendocrine tumors, common bile duct stones, pancreatitis and enlarged lymph nodes, among others.⁵ The capacity to sample lymph nodes has extended the role of EUS to other diseases, such as the nodal staging of non-small-cell lung cancer. This vital role of EUS-FNA in lung cancer staging has led to the use of endobronchial ultrasound (EBUS) and EBUS-guided FNA.³

References

1. MedicineNet.com. "Definition of Ultrasound/Ultrasonography." Accessed 7/14/11 at <https://www.medterms.com/script/main/art.asp?articlekey=5897>
2. American Society for Gastrointestinal Endoscopy (ASGE). "Media Backgrounder, Endoscopic Procedures." Accessed 7/14/11 at <http://www.asge.org/PressroomIndex.aspx?id=548>
3. American Society for Gastrointestinal Endoscopy (ASGE). "Technology Status Evaluation Report, Echoendoscopes." *Gastrointestinal Endoscopy* 2007;66:435-442. Accessed 7/14/11 at <http://www.asge.org/assets/0/78/88/26B8D208-3F84-4AB4-B020-7BC98BF7A52B.pdf>
4. Olympus America Inc. "EUS EXERA, Experience the New Era of Excellence in EUS." Accessed 7/14/11 at https://www.olympusconnect.com/download_brochures/b_eusexera.pdf
5. Mayo Clinic. "Endoscopic Ultrasound." Accessed 7/14/11 at <http://www.mayoclinic.org/endoscopic-ultrasound/about.html>
6. Medical Physics Web. "Olympus introduces combined endoscopic ultrasound processor." Accessed 7/14/11 at <http://medicalphysicsweb.org/cws/article/newsfeed/37819>
7. American Society for Gastrointestinal Endoscopy (ASGE). "Role of EUS." *Gastrointestinal Endoscopy* 2007;66:425-431. Accessed 7/14/11 at <http://www.asge.org/WorkArea/showcontent.aspx?id=4186>
8. Olympus America Inc. "Olympus Announces the Global Launch of the Universal Endoscopic Ultrasound Center EU-ME1." Accessed 7/14/11 at <http://www.olympus-global.com/en/news/2009a/nr090216eume1e.html>