Interventional EUS

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Endoscopic ultrasonography (EUS) began as a modality that combined high frequency high resolution sonographic imaging with endoscopy to help diagnose pancreaticobiliary disease and stage gastrointestinal cancers. Because the GI tract is a topographic cylinder diagnostic echoendoscopes had a radial design. The radial scanning geometry provided a circumferential view of the GI wall and adjacent structures. However, the drawback of this particular endoscope design was the inability to intervene when pathology was identified. The development of curvilinear array (CLA) echoendoscopes made it possible to perform diagnostic fine needle aspiration of masses, lymph nodes, and cystic lesions. This initial interventional FNA procedure has now led to the development of a variety of new interventional therapeutic techniques, all based on transluminal access using an EUS guided fine needle:

- FNA Cytology
- Celiac block/neurolysis
- Pseudocyst drainage
- Cyst ablation
- Failed ERCP access
- Implantation of Fiducials
- FNI Biologics
- Pelvic Abcesses

**FNA Cytology**

EUS guided FNA began in 1991 and is now an established widespread diagnostic technique. The most common indications for EUS-FNA are diagnosis of pancreatic masses, adenopathy, pancreatic cysts, and submucosal masses.

EUS has an accuracy of near 85% for diagnosing pancreatic masses, better than other alternatives. For this reason EUS-FNA has become the preferred diagnostic test for pancreatic masses. The clinical utility of EUS-FNA in pancreatic masses is that it gives patients and physicians confidence in their treatment decisions, is necessary to initiate chemotherapy or radiation in non-surgical candidates, and might help diagnose etiologies other than adenocarcinoma. Surgeons might argue that EUS-FNA is not helpful in young patients who will undergo resection regardless of the results of the FNA.

EUS FNA of mediastinal lymph nodes clearly impacts patients with lung cancer. Diagnosis of metastatic disease in contra-lateral lymph nodes avoids unnecessary surgery in patients with lung cancer. A combination of endobronchial ultrasound and EUS has been proposed as an alternative to mediastinoscopy for the staging of lung cancer.

Pancreatic cysts are being increasingly diagnosed as abdominal imaging techniques improve. The clinical dilemma with pancreatic cysts is to distinguish mucinous pre-malignant cysts from serous cysts and to distinguish malignant mucinous cysts from non-malignant cysts. Identification of mural nodules and the assay of CEA from cystic fluid provide a diagnostic accuracy of 80%. Although this is not as high as one would wish it is still the best diagnostic method for helping guide clinical management.

The most common etiology of a submucosal mass is a GIST. Cytological material is not sufficient for diagnosis. A tru-cut biopsy would be preferable. A tru-cut biopsy needle for EUS guided biopsy has been developed. This technique is still not perfected. However, it does provide the ability to diagnose diseases such as lymphoma or GIST when EUS-FNA has failed.
Celiac Blockade (CB)/Celiac Plexus Neurolysis (CPN)

Afferent pain fibers from the pancreas and other visceral organs travel through the celiac plexus, a network of neural fibers and multiple ganglia located anterior and slightly superior to the origin of the celiac artery from the aorta. CPN refers to the lysis of these neurons using chemical agents such as alcohol or phenol, whereas CB refers to neural blockade with a local anesthetic (some times with the addition of steroids). EUS guided CB or CPN is easy to perform and CPN can be performed when staging cancers of the pancreas. The EUS approach likely avoids the extremely low but present risk of spinal cord injury associated with the posterior radiological approach, EUS guided CPN is similar to radiologic CPN for pain control. It is only mildly to moderately effective in pain relief but appears to have some role in palliating pain in patients with pancreatic cancer. CPN should not be used in benign disease. CB has been tried for pain control in benign disease but despite some early enthusiasm it does not appear to be very effective.

Pseudocyst Drainage

Transgastric and transduodenal endoscopic techniques for pseudocyst drainage were developed prior to the development of EUS. These techniques rely on the presence of a visible endoluminal bulge. Upon the development of CLA echoendoscopes, EUS was readily adapted as a method for guiding the initial puncture or incision through the wall of the GI tract. The advantage of using EUS guidance is the ability to avoid intervening vessels, the ability to access pseudocysts that produce no visible bulge, assessment of the internal cyst contents prior to drainage, and measurement of the distance between the GI tract and the pseudocyst. The challenge with performing EUS guided drainage is that the angle of access with the EUS scope is more tangential than the angle obtained with a duodenoscope and accessories for pseudocyst drainage are better suited for use with the duodenoscope. Endoscopists often initiate the drainage with the EUS instrument and switch to the duodenoscope once the initial puncture has been performed. Technical success of pseudocyst drainage with EUS guidance is nearly 100% with long-term success of over 80%. Complication rates are near 20% and include bleeding, infection, perforation, and pancreatitis.

Cyst Ablation

EUS guided cyst ablation has been proposed as a treatment alternative to surgery. Similar to alcohol injection for ablation of thyroid cysts EUS guided injection of alcohol into cysts has been performed. The technique requires repeated injection and aspiration of the cyst with alcohol using an FNA needle. Surgical resection of cysts that have been treated using this novel technique shows partial ablation of the epithelium lining the cyst. Reports with this technique have been limited and when alcohol is used as the ablating agent it appears to ablate only one third of treated cysts at least as assessed by abdominal imaging. The use of paclitaxel, a more viscous and hydrophobic agent appears to improve the ablation rate to nearly 80%. However, it should be pointed out that these are pilot studies. The inability to identify the cyst on abdominal imaging should not be equated with complete eradication of the cystic epithelium, and there are no long-term studies assessing the side effects or the efficacy of this treatment. Residual cystic epithelium might still be at risk for progression to malignancy even though the cyst is no longer visible. Pancreatitis associated with cyst ablation has been reported.

Failed ERCP Access

Percutaneous transhepatic cholangiography (PTHC) is the traditional method for biliary access when ERCP fails in accessing the bile duct. Rendezvous procedures can then be performed to place an internal biliary stent. The ability
to access the biliary system using a needle via a transduodenal choledochal puncture or a transgastric intrahepatic duct puncture with EUS guidance provides another alternative to PTHC. EUS also allows endoscopists to access the pancreatic duct in an antegrade direction, something that cannot be achieved using percutaneous techniques. There have been several small series in the literature that have reported a high technical success rate near 95% for biliary access and 81% for pancreatic access. However, this procedure should still be performed with extreme caution because the complication rate is near 20%, which appears to be higher than PTHC. Complications include pneumoperitoneum, bleeding, cholangitis, pancreatitis, and sliced guidewires.

Placement of Fiducials/Radiation Seeds

Small radiotherapy seeds or fiducials can be backloaded into the tip of EUS needles. These needles can then be guided into pancreatic masses or other malignancies adjacent to the GI tract to enable radiation therapy with stereotactic radiation or radiation seeds. EUS guided fiducial placement is being increasingly utilized in the United States for cyberknife therapy of pancreatic cancers.

Fine Needle Injection of Biological Agents

EUS guided needles can also be used to administer chemotherapeutic agents or biological agents to gastrointestinal cancers. A number of pilot studies have been performed with fine needle injection of a variety of agents into pancreatic cancers. Since pancreatic cancer is often a systemic disease it is unclear how effective these therapies will be. The results of controlled trials with EUS guided fine needle injection of an attenuated adenoviral vector that incorporates the tumor necrosis factor (TNF) gene under control of a radiation inducible promoter are eagerly awaited.

Drainage of Pelvic and Other Abscesses

EUS guided drainage techniques similar to those used for EUS guided drainage of pseudocysts have been reported for drainage of pelvic and even mediastinal abscesses. In these limited reports the success rate has been 75 to 100%. EUS might provide access to abscesses that cannot be accessed by percutaneous radiologic approaches.

Future Applications of Interventional EUS

Interventional EUS techniques have blossomed in the past decade. Endoscopic interventions for GI bleeding have remained static for nearly two decades. Endoscopic therapy relies on the identification of indirect stigmata of submucosal arterial vessels. Theoretically EUS imaging could enable the imaging of these vessels and more guided therapy. Animal experiments have shown the feasibility of this approach. However, it has not been tested in humans. Small series have reported the utility of EUS in special cases of GI bleeding. Another potential application of EUS could be to guide incision during natural orifice transluminal endoscopic surgery (NOTES). Animal experiments indicate that EUS could be used to perform safe NOTES incisions at sites other than the anterior gastric wall. EUS has also been used in animal experiments for transgastric access into the gallbladder and expandable yoyo stents have been implanted to create a cholecystogastric fistula. These animal experiments and others will likely lead to new clinical applications in the near future.

References

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