Therapeutic Applications of Endoscopic Ultrasound

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KEYWORDS

• Therapeutic • Endoscopic ultrasound • Fine needle injection • Oncology • Fiducial placement • Celiac plexus neurolysis

KEY POINTS

- Endoscopic ultrasound (EUS) technology has evolved over the last few decades from a diagnostic modality to one that serves as a platform for multiple therapeutic interventions.
- A few EUS-guided therapeutic techniques (eg, anti-tumor agent injection, EUS-guided ablation, and EUS-guided brachytherapy) appear promising in selected patients with cancer.
- Further large prospective randomized trials are needed to evaluate the safety, efficacy, and feasibility of some of these interventions.
- Techniques such as celiac plexus neurolysis for analgesia, EUS-guided endoscopic retrograde cholangiopancreatography for difficult-to-access bile ducts obstructed by tumor or due to difficult anatomy, EUS guided gold fiducial placement to guide radiation therapy and delivery of antitumor agents are just some of the therapeutic applications of EUS in patients with cancer.
- In this dynamic, constantly evolving field of interventional endoscopy, newer minimally invasive therapeutic options for patients with cancer will continue to develop, and several of these will likely be EUS-based interventions.

INTRODUCTION

Endoscopic ultrasound (EUS) has been widely used and is now considered the diagnostic procedure of choice for tissue sampling of pancreatic tumors. It is also used routinely for staging and diagnosis of many gastrointestinal and biliary lesions. EUS-guided fine needle aspiration (FNA) has emerged as a minimally invasive, safe, and accurate technique for tissue sampling. With the development of the linear array EUS echoendoscopes and FNA techniques, various management options have emerged for therapeutic applications of EUS in patients with cancer. Various therapeutic applications of EUS, such as EUS-guided ablation, celiac plexus neurolysis (CPN), EUS-guided brachytherapy and ablation, EUS-guided fiducial marker placement, EUS-guided bile duct access, and delivery of antitumor agents, are discussed in this article.

CPN and Celiac Plexus Block

Intractable abdominal pain is commonly seen in patients with chronic pancreatitis and pancreatic cancer. Celiac plexus block (CPB) and CPN, respectively, have been used to decrease the pain and opiate requirements in such patients. Before the advent of EUS, computed tomography (CT) -guided paraspinal and transabdominal approaches were used but serious complications like paraplegia and pneumothorax were reported. EUS guidance provides better delineation of celiac anatomy and is safe and effective. When compared with CT, EUS provides a more targeted approach, providing better delineation

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of the anatomy because of the proximity of the transducer to the celiac plexus and the ability to perform the procedure with real-time imaging.[1] CPN is a chemical splanchnicectomy of the celiac plexus leading to ablation of the pain transmitting afferent nerve fibers from the intra-abdominal viscera. Three techniques of EUS-guided CPN have been reported: traditional or bilateral CPN, broad plexus neurolysis, and celiac ganglion neurolysis (CGN).[1] In the traditional and most commonly used technique for EUS-CPN, using a 19-gauge or 22-gauge needle, a mixture of bupivacaine (0.25%–1%) and ethanol (95%–99%) is injected anterior to the celiac trunk. Sahai and colleagues[2] have demonstrated the efficacy of bilateral injection compared with unilateral CPN with mean pain reduction of 70% versus 46% respectively. In the bilateral EUS-CPN approach, injection is performed on both sides of the celiac trunk as compared to a central single injection with the traditional approach. In broad celiac plexus neurolysis, the entire injection is given anterior and caudal to the superior mesenteric artery.[3] In CGN, direct injection of the ganglion is performed and this has been reported to be highly effective in patients with pancreatic cancer and chronic pancreatitis.[4] **Fig. 1** demonstrates celiac ganglion neurolysis. Suzuki and colleagues[5] reported 94% pain relief in 17 patients undergoing direct ganglia injection.

Celiac plexus block (CPB) involves injection of steroid with an anesthetic agent into the celiac plexus region, whereas CPN involves using a sclerosant agent such as alcohol with an anesthetic agent. Absolute alcohol is reserved for use in patients with unresectable pancreatic cancer because of its effect of inducing fibrosis.[6] In a recent randomized multicenter trial of EUS-CGN versus EUS-CPN in upper abdominal cancer, EUS-CGN was found to be superior to EUS-CPN in pain relief.[7]

In a meta-analysis of 6 studies with a total of 221 patients of EUS-guided CPB in chronic pancreatitis, CPB was effective in alleviating chronic pancreatitis pain in 51.46% of patients. For pancreatic cancer, analysis of 5 relevant studies with a total of 119 patients revealed EUS-CPN to be effective in alleviating pain in 72.54% of patients.[8] Although CPN may not improve survival, it has been associated with improved pain control and reduced narcotic use thereby leading to decreased constipation.[9] Commonly reported complications of CPN have been transient hypotension, diarrhea, increase in abdominal pain, and abscess formation. Three cases of postblock empyema have been reported possibly because of infection tracking into the chest from the celiac plexus.[4,10–12] No major neurologic complications have been reported with CPN. One case of fatality has been reported by Gimeno-Garcia and colleagues[13] after CPN.

Thus CPN and CPB can be considered in carefully selected patients with poorly controlled abdominal pain secondary to pancreatic cancer and chronic pancreatitis, respectively.

EUS-guided Brachytherapy

Advanced pancreatic cancer can be controlled locally with the help of radiation therapy. Some of the radiation therapies include fractional external beam radiation therapy with chemotherapy, interstitial brachytherapy, and image-guided radiotherapy. Interstitial brachytherapy has been used conventionally to control malignancies of the prostate, breast, and brain. Brachytherapy has been considered to have potential therapeutic effect in patients with unresectable pancreatic cancer and in a case of paraaortic lymph node metastasis of pancreatic cancer.[14,15] This technique involves radioactive seeds implanted directly into the tumor followed by local emission of gamma rays, thus leading to tissue

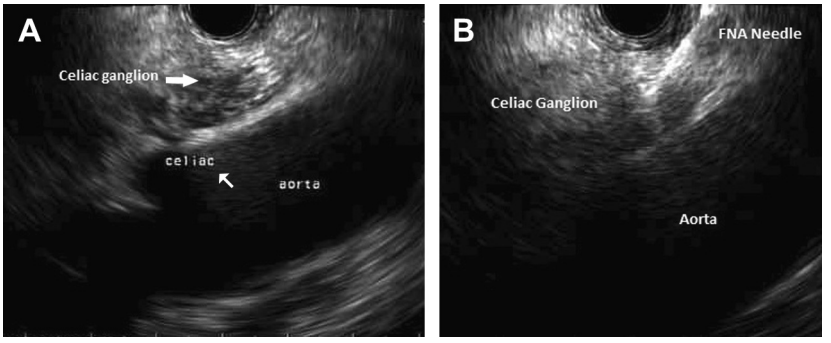

Fig. 1. Celiac ganglion neurolysis. (*A*) The celiac axis ganglion. (*B*) EUS-guided FNI into the celiac ganglion.