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EUS-Guided Fiducial Placement: Role and Use in Clinical Practice



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CASE REPORT

A 55 year old man developed abdominal pain and underwent an abdominal CT scan with IV contrast. An ill-defined 4x3cm pancreatic head/genu mass was seen. The patient was referred for an endoscopic ultrasound (EUS). EUS revealed a large, hypoechoic, solid mass in the pancreatic head with abutment of the superior mesenteric vein (SMV) and the portal vein (PV). There was also a small degree abutment of the superior mesenteric artery (SMA). EUS-guided core biopsy was positive for adenocarcinoma. The patient was given a stage of T4N0M0 pancreatic cancer and underwent chemotherapy with FOLFIRINOX.

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Radiation therapy was consulted given the small amount of abutment of the SMA by the tumor and requested that gastroenterology place fiducial markers in the tumor at this location to help precisely target radiation therapy. On EUS the lesion manifested as a modestly hypoechoic solid lesion. (Figure 1) Using a preloaded EUS fiducial system, 4 gold fiducial markers were placed into the tumor under EUS and fluoroscopic guidance via a transgastric approach. (Figures 2 and 3) The patient tolerated the procedure well and there were no adverse events. The patient was referred back to radiation oncology for treatment.

Discussion

Fiducial markers are used throughout medicine as a means of precisely localizing structures for diagnosis, treatment, imaging, and other uses. In gastroenterology, fiducial markers are almost always placed via EUS.

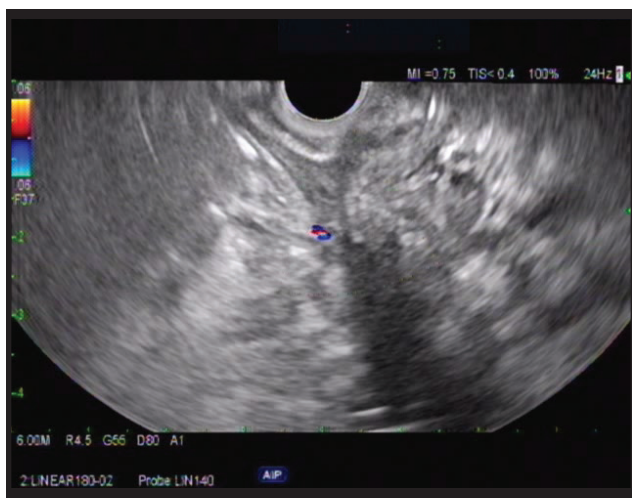


Figure 1. 7.5MHz EUS image of fiducial needle advanced into pancreatic mass. The mass is only moderately hypoechoic, which is somewhat unusual for a pancreatic adenocarcinoma.



Figure 2. 7.5MHz EUS image of a fiducial manifesting as hyperechoic object (arrow) after deployment into the lesion.

EUS allows precise placement of fiducial markers in tumors of the chest, abdomen, and pelvis as well as in lymph nodes in many locations. The fiducial markers can be left in place in patients with incurable disease or removed at the time of surgery along with the target organ or structure.

The use of EUS to place fiducial markers started over a decade ago.¹ Early studies used fiducial markers designed to be placed by radiologists or radiation oncologists and modified them for use in 19 gauge EUS needles. A variety of off-label approaches to keep the fiducials in the FNA needle until the precise time they were to be deployed were developed, often involving the use of bone wax to seal the tip of the needle after the fiducials were loaded.

In 2010, Park et al. reported on EUS guided fiducial placement in 50 patients with pancreatic cancer without the assistance of fluoroscopy. It should be noted that these authors attempted the procedure in 57 patients, but only had 50 successes. The authors used sterile water injection to pass the fiducials through a 19 gauge needle. The authors felt that fluoroscopy placement was not required for safe fiducial placement.² Also in 2010, Ammar et al. reported on a series of 13 patients undergoing EUS guided fiducial placement via 22 gauge needles, showing that the smaller needle size could potentially allow access to placing fiducials at a wider range of locations than allowed by the stiffer 19 gauge needle.³

Little has been written about the adverse events

of EUS guided fiducial placement, likely because only a few centers have significant familiarity and experience with this technique. Sanders et al. reported on 51 patients with pancreatic cancer who underwent EUS guided fiducial placement prior to stereotactic body radiotherapy (SBRT). In this study, one patient developed post-procedure pancreatitis but this patient also underwent EUS guided celiac plexus neurolysis in the same session, so it is unclear if the pancreatitis was due to the fiducial placement, the neurolysis or some combination thereof.⁴ Drahdam et al. reported on a large series of 514 patients who underwent EUS guided fiducial placement and noted that minor bleeding was seen in two patients and two fiducials migrated as noted on follow up CT scans, further arguing for the safety of this technique.⁵

While most papers on EUS guided fiducial placement focus on pancreatic adenocarcinoma, other have reported placement into the prostate, the celiac ganglia, other pancreatic tumors, and other sites.^{6,7,8,9,10}

Few comparative trials of different types of fiducials placed via EUS exist. Khasab published a comparative study of traditional 5mm long, 0.8mm wide fiducials versus coiled fiducials measuring 10mm x 0.35mm. The authors looked at technical success, adverse events, visibility of fiducials and migration of fiducials after placement via different needle types (19 gauge and 22 gauge). Thirty-nine patients with pancreatic cancer underwent EUS-guided placement of 103 different types of fiducials (77 traditional fiducials versus 26

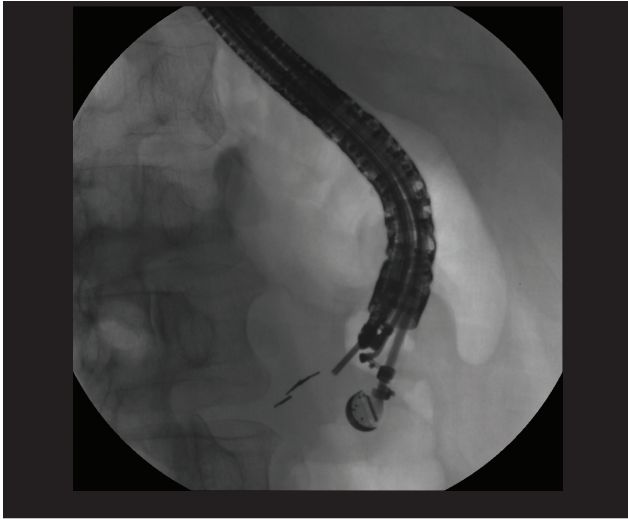


Figure 3. Fluoroscopic image of linear echoendoscope after deployment of 5 fiducials.

coiled fiducials). The mean number of fiducials that were placed in each patient was 2.66 (standard deviation 0.67) for the 19g needle and 2.60 (standard deviation 0.70) for the 22g needle ($P = .83$). There were no adverse events. The authors felt that the visible of the traditional fiducials was superior to that of the coiled fiducials. The rate of migration was not significantly different between traditional and coiled fiducials.¹¹

Recent years have seen the development of preloaded EUS fiducial needle systems as opposed to loading fiducials into existing off-the-shelf FNA needles. These preloaded devices provide an all-in-one needle kit to simplify ordering, as most GI labs do not have experience in purchasing fiducial markers. It is unknown if the preloaded devices work any better than traditional hand loaded devices, but they appear to be time and labor saving devices given the reduced need for set-up prior to the procedure.

One factor that has hampered the widespread use of EUS guided fiducials is that many endosonographers did not receive training in this technique as fellows. Furthermore, many institutions do not routinely utilize fiducials for GI tumor therapy (depending on the type of radiation therapy being delivered) so even high volume endosonographers may have only limited experience with this technique.

Overall, EUS guided fiducial placement appears to be a simple, effective, and safe technique to place fiducial markers into a variety of lesions to help precisely target therapy, most commonly radiation therapy. ■

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