

Utilization of Intravascular Ultrasound to Assess Vascular Invasion in Pancreatic Cancer Post Chemoradiation Therapy

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Abstract

Surgery continues to be the principal treatment for patients with resectable pancreatic cancer. Computer tomography (CT) is the primary modality used to assess the tumor and its involvement with neighboring vasculature to determine resectability. Regrettably, CT as well as many other non-invasive imaging modalities cannot continuously differentiate between vascular invasion and compression. Intravascular ultrasound represents a modality that can be used as an adjunct to delineate tumour vascular involvement. This case represents a first report of IVUS being used post chemoradiation therapy to determine a patient's candidacy for resection.

Keywords: Pancreatic cancer; Intravascular ultrasounds (IVUS); Tumor invasion; Chemoradiation; Portal vein, Superior mesenteric vein (SMV)

Introduction

Pancreatic adenocarcinoma is one of the deadliest cancers known. It is the sixth most common cancer and fourth most common cause of cancer deaths [1]. Only a small percentage of people present with cancer isolated to the pancreas, leaving 80-90% of people with unresectable tumors on initial discovery [1,2]. While surgical resection remains the mainstay of curative therapy for pancreatic cancer, invasive tumor involving the surrounding vasculature is often a contraindication to surgery. Unfortunately, many noninvasive imaging modalities do not have sufficient resolution to distinguish between vascular invasion and compression, which is often the most important determinant whether the patient should seek a curative surgical procedure. The weight of this decision is further compounded by the fact that surgery has significant mortality and morbidity, and surgical discovery of posterior and lateral wall vascular invasion is only possible when such procedures are well advanced.

The conventional method for assessing pancreatic cancer and vascular involvement has been utilization of computed tomography (CT), which is 91% sensitive and 85% specific [1,3]. In most situations these numbers would suggest that CT is a very good test. But, in cases where initially vascular invasion was thought to be possible and neoadjuvant chemotherapy and/or radiation have been employed the diagnosis becomes much more difficult. Tumors may contract and mass effect on the vessel may resolve, but invasion may still be present. For these reasons definitive diagnosis of vascular invasion in a treated patient can be challenging. Other imaging modalities have been used as adjuncts to better define vascular association [1,4-6].

One such modality is intravascular ultrasound, or IVUS. This device has been available for decades and has sub-millimeter resolution. It provides a two-dimensional image from inside the lumen of the vessel. IVUS has been most commonly employed in assessing atherosclerotic plaque in coronary and peripheral arteries, though it is gaining favor in other areas. A few studies with small patient populations have established its use as an adjunct to evaluate vascular involvement in pancreatic cancer preoperative and intraoperative [7-14]. Most of these studies are older and utilized much larger probes, making the procedure risky and less favorable. The purpose of this report is to present a case that a small 5 French IVUS probe was employed in a

patient where vascular invasion could not be definitively diagnosed using noninvasive modalities after chemoradiation therapy.

Case

An 80-year female with a past medical history significant for hypertension and pancreatitis presented with a one-month history of mild right upper quadrant aching pain, which radiated to her back. She denied any fever, weight loss, anorexia, emesis or changes in bowel habits. An abdominal ultrasound revealed cholelithiasis, a hypoechoic mass in the head of the pancreas and a dilated pancreatic duct. ERCP with biopsy confirmed pancreatic adenocarcinoma. Furthermore, the patient's CA 19-9 was 43.3 U/ml. A CT scan of the abdomen demonstrated the pancreatic mass abutting the superior mesenteric vein near its confluence with the splenic vein presumed to be a mass effect. A fat plane was questionable. No obvious vascular invasion was appreciated on CT and the patient was considered a surgical candidate. The patient did not want to proceed with surgery at that time, but chose chemoradiation treatment. After a short period of the therapy, she decided to proceed with surgical intervention. It was decided to reassess her stage of disease after she completed three rounds of chemotherapy utilizing gemcitabine and 5-Fluorouracil as well as external beam radiation. A 3 month follow-up CT scan was performed to restage the cancer. The mass had decreased in size; however, there was progressive involvement of the fat plane along the right lateral aspect of the wall of the confluence of jejunal branches as they become the SMV. Vascular involvement could not be excluded by CT (Figure 1). The patient was scheduled for a percutaneous transhepatic intravascular ultrasound (IVUS) of the portal system to evaluate for tumor extension into the vessels in question.

The patient was taken to the angiography suite. Under ultrasound

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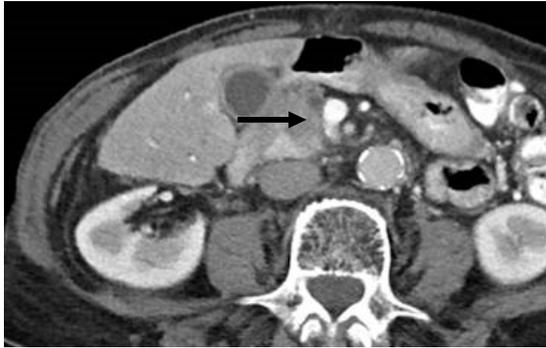


Figure 1: Questionable invasion of the SMV and jejunal branches status post chemo/radiation.

guidance, a 21-gauge AccuStick needle (Boston Scientific, Marlborough, Mass.) was introduced into a branch of the right portal vein, the needle stylet was removed and a portogram was performed to confirm position. With a 0.018 inch Nitinol guidewire a 6 French Pinnacle Destination Sheath (Terumo Medical Corp. Somerset, NJ) was placed. Using a 4 French angled Glidecath catheter (Terumo Medical Corp. Somerset, NJ) inserted into the sheath, venography of the portal system was performed to delineate the superior mesenteric (SMV), jejunal venous branches and the splenic vein (Figure 2). Upon confirmation of the jejunal branch confluence with the superior mesenteric vein, the sheath was then advanced into the jejunal branch. With a 0.014 inch Command Guide Wire (Abbott Laboratories. Abbott Park, IL), a 5 French intravascular ultrasound (IVUS) probe (Eagle Eye, Volcano Corp. San Diego, CA.) was advanced over wire and through the sheath to the level of L5.

Ultrasound imaging was performed of the jejunal branch and the superior mesenteric vein. The probe was retracted at intervals of 0.5 cm and spot images were obtained with the IVUS and with fluoroscopy (Figures 3-5). Real time video of a pull-back ultrasonogram was also performed. As in previous studies, vascular invasion was considered positive when the echogenic wall of the vein was reduced to less than 0.5 mm. There was complete obliteration of the echogenic wall of the jejunal branch in question seen on CT as it converged with the SMV. The surgeons at our institution required at least a 0.5 cm distal cuff of healthy SMV wall to anastomose with the proximal SMV or portal vein. Due to the findings using IVUS the patient was not considered a surgical candidate.

The procedure was terminated when it was determined the patient was not resectable. The IVUS was removed and a mixture of 1 g Avitene collagen powder (Bard inc. Murray Hill, NJ), 3 ml normal saline and 3 ml iodinated contrast was backloaded into a 3 ml syringe. The syringe was attached to the sheath dilator. The intrahepatic tract was embolized while withdrawing the sheath.

Discussion

Surgical resection continues to be the only potentially curative treatment for pancreatic cancer [15]. Often, the key determinant is the level and type of vascular involvement. Evaluation of the tumor and the involvement of these vessels is critical in determining resectability [16]. Even after thorough assessment only 15-20% of patients are considered candidates for surgery. Many of these patients may be found to have microscopic margins at the time of surgery [17].

Furthermore, the most common surgical treatment for pancreatic head or body resection in the setting of pancreatic adenocarcinoma is the Whipple procedure, which has a 18-25% 5 year survival rate.

The diagnosis of vascular invasion can be problematic. There is no consensus on optimal pre operative imaging assessment of vascular infiltration in patients with pancreatic cancer [3,6,18,19]. Vascular involvement has been reported between 21-64% depending on the population investigated [5,20].

Computed tomography remains the initial modality when evaluating pancreatic cancer; however, other imaging modalities (MRI, PET, endoscopic ultrasound) have provided alternative methods to further assess this form of cancer [21-27]. Intravascular ultrasound has seen tremendous use in coronary and endovascular interventions. Several studies have expanded its utilization in the area of hepatobiliary disease [10,13,14]. An early pioneer of IVUS, Kaneko et al. [28] demonstrated IVUS could detect intraportal thrombus and invasion that was missed by CT. The group has used IVUS in the staging of pancreatic cancer and development of 3D reconstructions using the imaging modality [4]. These early reports used IVUS by trans



Figure 2: Angiography of jejunal venous branches, the SMV and portal veins via percutaneous access.

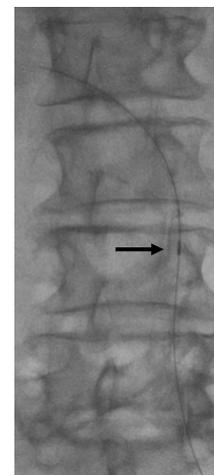


Figure 3: Tip of IVUS at confluence of jejunal branches and SMV.

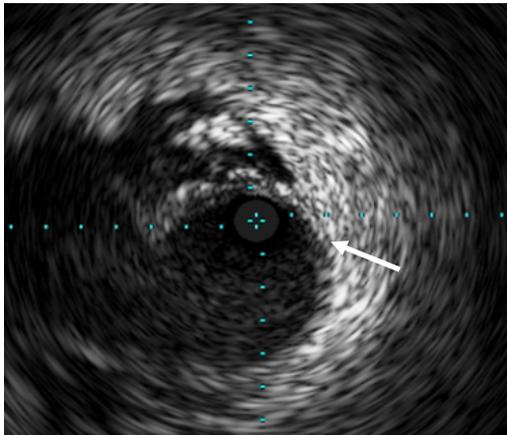


Figure 4: Intact wall of jejunal venous branches.

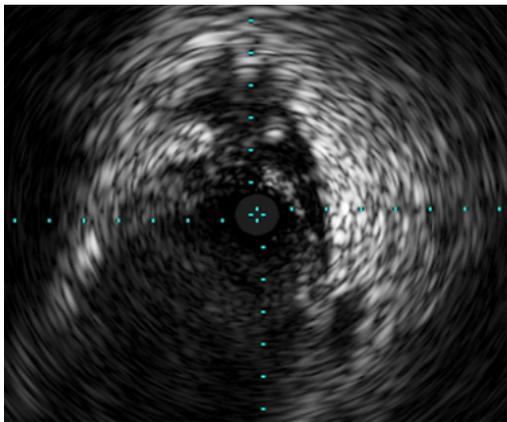


Figure 5: Wall invasion at confluence of jejunal branches and SMV.

mesenteric catheterization route. Further technique advancements allow it to be done percutaneously through transhepatic [12,13] and trans femoral access [14].

Several reports have developed criteria for vascular invasion, which include loss of the echoic band of the portal hypoechoic tumor, the tumor mass blended with venous wall and tumour extension into the vascular lumen [9-12,28]. The specificity and sensitivity of this modality is greater than 95% and 90%, respectively [8,28]. It has been reported that the limitations of IVUS are the examination of only the SMV and portal vein without arterial evaluation; however, one study performed a feasibility study of intra-arterial ultrasound in patients with pancreatic cancer. They found the information about the arterial involvement more detailed and the trans-femoral vessel approach easier than the transhepatic approach [14]. In either case, the IVUS probe should be placed into the vessel in question as the ability to resolve detail becomes equivalent to CT at 1 cm or greater.

IVUS continues to validate its utility as an adjunct in the evaluation of vascular invasion in pancreatic cancer, and the modern smaller probe sizes have been shown to be safe, effective and with a resolution superior to CT. Either venous or arterial lumens can be assessed. This case represents a first report of a 5 French IVUS probe being used post chemoradiation therapy to determine a patient's candidacy for resection. This form of imaging should be considered when other

imaging modalities continue to provide equivocal results concerning vascular involvement.

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