Imaging Evaluation of Pancreatic Cancer

Myra Kay Feldman, MD*, Namita Sharma Gandhi, MD

KEYWORDS

• Pancreatic cancer • Pancreatic imaging • Computed tomography • MRI
• Resectability • Structured radiologic reports

KEY POINTS

- Imaging techniques available for the diagnosis, staging, and management of pancreatic neoplasms include computed tomography (CT), PET-CT, MRI, and endoscopic ultrasound (EUS).
- Specialized imaging protocols tailored for evaluation of the pancreas are essential for optimal lesion detection and accurate staging and management of pancreatic neoplasms.
- Biphasic (or dual-phase) multidetector CT is the preferred imaging modality for staging and assessing the resectability of pancreatic adenocarcinoma.
- MRI is nonionizing, has a higher contrast resolution, and is used to evaluate pancreatic neoplasms if the primary tumor is not visible with CT or if patients have a contraindication to contrast-enhanced CT.
- Structured radiologic reporting with standardized terminology and format is critical to ensure that all information needed to stage and plan treatment of pancreatic adenocarcinoma is communicated to the multidisciplinary team.

INTRODUCTION

Pancreatic cancer is the tenth most common cancer in the United States, with an estimated 48,960 new cases reported in 2015. It is currently the fourth leading cause of cancer-related deaths in the United States.[1] The best hope for cure of pancreatic ductal adenocarcinoma (PDA), the most common form of pancreatic cancer, includes complete surgical resection as part of a multimodality treatment plan. However, it has been estimated that only 15% to 20% of patients present with resectable disease.[2] Patients with complete, incomplete, or margin-positive resection (R0, no residual disease; R1, residual microscopic disease; or R2, residual macroscopic disease, respectively) have progressively decreasing survival rates.[3]

Imaging studies are critical for the detection, characterization, initial staging, management, and monitoring of pancreatic cancer cases. Diagnostic imaging of the

Section of Abdominal Imaging, Imaging Institute, Cleveland Clinic, 9500 Euclid Avenue A21, Cleveland, OH 44195, USA
* Corresponding author.
E-mail address: feldmam2@ccf.org

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pancreas has traditionally posed a challenge to the radiologist because of the subtle imaging appearance of some tumors, especially those that are smaller than 2 cm and those that do not cause a border deformity of the pancreas. Dedicated pancreatic imaging protocols tailored to optimize pancreatic lesion conspicuity and highlight the ductal and peripancreatic anatomy are crucial for accurate determination of resectability. As such, the National Comprehensive Cancer Network (NCCN) has established guidelines for the imaging modalities and imaging protocols used to evaluate PDA.[4]

Treatment of pancreatic cancer requires a multidisciplinary approach. Ideally, assessing resectablility with imaging and subsequent treatment decisions should be made at a high-volume center of excellence with a multidisciplinary team. Recently, a structured radiologic report using standardized nomenclature and formatting has been endorsed by radiologic and clinical specialties to appropriately communicate essential information required to accurately stage and manage pancreatic cancer. Although the use of this form of reporting is not yet universal, it has been shown to add significant value to the care of patients with PDA.[5]

This article reviews the major imaging modalities used to evaluate pancreatic neoplasms, with an emphasis on pancreatic imaging protocols. We describe the imaging appearance of solid pancreatic neoplasms, and the imaging criteria used to stage and determine resectability for PDA. An approach to standardized radiologic reporting is also reviewed.

IMAGING TECHNIQUES AND PROTOCOLS

Computed tomography (CT) and MRI are the first-line imaging modalities used to evaluate pancreatic neoplasms. The role of PET remains unclear, but this modality is most commonly used to assess for the presence of extrapancreatic metastatic disease. Endoscopic ultrasound (EUS) plays an important role in guiding fine-needle aspiration (FNA) or biopsy. Endoscopy in the evaluation of pancreatic cancer is covered in detail elsewhere in this issue. A summary of the indications, advantages, and disadvantages of each imaging modality is provided in **Table 1**.

Computed Tomography

Pancreatic protocol dual-phase CT is recommended by the NCCN guidelines as the preferred imaging study for the initial evaluation of PDA (**Table 2**).[4] CT is more widely available than MRI and is less costly. Furthermore, the spatial resolution of CT is much better than MRI allowing for more accurate assessment of subtle perivascular disease. A dual-phase study should be performed even if a single-phase standard CT scan is available, unless there is evidence of metastatic, nonresectable disease on the standard CT scan.[5] Dual-phase imaging is performed in the pancreatic (late arterial) and portal venous phases of contrast enhancement. Conspicuity of PDA is greatest in the pancreatic phase (**Fig. 1**); therefore, this phase is used to delineate the primary tumor and to evaluate arterial involvement by the tumor. The portal venous phase images are used to evaluate venous involvement by the tumor and to identify distant spread of disease.[6] Unenhanced imaging is not helpful in the initial staging of pancreatic cancer. Intravenous contrast should be injected via a power injector at a rate of at least 3.5 to 5 mL/s. The timing of imaging after contrast injection varies among scanners and is typically determined in one of two ways. Scans can be performed at a fixed time delay after contrast administration (typically 35–80 seconds for late arterial phase depending on scanner speed and 65–80 seconds for portal venous phase).[7] This method is plagued by suboptimal enhancement in some patients because of variations in circulation. Alternatively, automated bolus tracking software can trigger scans