Imaging and Screening of Pancreatic Cancer

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KEYWORDS

• Pancreatic cancer • Pancreatic neuroendocrine tumor • Pancreatic ductal adenocarcinoma • Cancer screening • Hereditary tumor predisposition syndromes • Precursor lesions • Familial pancreatic cancer syndrome

KEY POINTS

- Pancreatic cancer screening is not recommended for the general population; the low disease prevalence drives down the positive predictive value of even the best imaging examinations.
- Screening for pancreatic ductal adenocarcinoma is recommended for patients with an increased lifetime risk.
- Screening for pancreatic neuroendocrine tumors is recommended for those patients with multiple endocrine neoplasia type 1, tuberous sclerosis complex, and Von Hippel Lindau disease.
- MR imaging, magnetic resonance cholangiopancreatography (MRCP), endoscopic ultrasound, and multidetector computed tomography (MDCT) can all be used for pancreatic cancer screening.

INTRODUCTION

Pancreatic neoplasms can be split into 2 broad categories—neoplasms of the exocrine cells and ductal system, and neoplasms of the endocrine islet cells. Pancreatic ductal adenocarcinoma (PDAC) is by far the most common type of exocrine neoplasm, and indeed the most common type of neoplasm of the pancreas overall. The American Cancer Society estimates there were 53,070 new cases of PDAC in 2016. Unfortunately, PDAC carries a poor prognosis; it is estimated to be the third leading cause of cancer deaths in 2017, after lung and colorectal cancers. Risk factors for PDAC seen in the general population are nonspecific and include advancing age, fatty infiltration associated with obesity, cigarette smoking, new-onset diabetes, and chronic pancreatitis. Although these risk factors are common, the average lifetime risk of developing pancreatic cancer remains low at 1.5%.[1] Even though the disease caries high morbidity and mortality, screening for PDAC is not recommended for the general population because the low incidence of the disease drives down the positive predictive value of even high sensitivity assays.[2] In the general population, screening may even result in a small loss of net life expectancy related to unnecessary surgical mortality risks from false-positive diagnoses.[3,4]

Certain populations are at higher than normal risk for the development of PDAC, including those with precursor lesions such as intraductal papillary mucinous neoplasms (IPMN) of the pancreas, and those with predisposing genetic conditions including familial atypical multiple mole melanoma, Peutz-Jeghers syndrome, and hereditary breast–ovarian cancer, to name a few. In these high-risk populations with a higher prevalence of the disease, screening is recommended because PDAC that is discovered earlier may be potentially curable. Successful screening has been defined

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by the International Cancer of the Pancreas Screening Consortium as the detection and treatment of T1N0M0 margin negative PDAC or high-grade dysplastic precursor lesions including pancreatic intraepithelial neoplasia, IPMN with high-grade dysplasia, and mucinous cystic neoplasm with high-grade dysplasia.[4]

Pancreatic neuroendocrine tumors are a diverse group of tumors originating from the endocrine cells of the pancreas, with subtypes including insulinomas, gastrinomas, glucagonomas, somatostatinomas, and VIPomas. These tumors can be symptomatic causing hormonal phenomena like hypoglycemia or Zollinger-Ellison syndrome and, when they are symptomatic, they are often found with imaging when they are very small. Asymptomatic tumors, in contrast, are most often found incidentally and are commonly large at presentation. As a group, neuroendocrine tumors are rare, making up less than 3% of all pancreatic tumors. The current overall incidence is 5.86 per 100,000 cases per year.[5] Given their low incidence, screening for neuroendocrine tumors is also not recommended for the general population. However, as with exocrine neoplasms, there are certain genetic conditions that predispose to neuroendocrine tumors, including multiple endocrine neoplasia type 1 (MEN1), Von Hippel Lindau syndrome, and others, for which screening is recommended to minimize morbidity and mortality.[6]

IMAGING MODALITIES

Multiple imaging modalities can be used to detect pancreatic masses including multidetector computed tomography (MDCT) and MR imaging, magnetic resonance cholangiopancreatography (MRCP), and endoscopic ultrasound (EUS). A summary of the relative performance of these modalities for detection of particular imaging features is found in **Table 1**.

Multidetector Computed Tomography

The most sensitive MDCT examination is a triple phase, pancreatic protocol examination. Three phases of contrast are obtained: the arterial phase at 30 seconds, the pancreatic parenchymal phase at 45 seconds, and the portal venous phase at 60 to 70 seconds. Overall, for the detection of solid pancreatic masses, the pancreatic protocol MDCT is greater than 90% sensitive and 99% specific.[7] However, for the detection of small tumors less than 2 cm sensitivity decreases to approximately 77%,[8] possibly because of the tendency for small tumors to be isodense rather than hypodense to the surrounding pancreatic parenchyma.[9] For the detection of small cystic pancreatic masses, MDCT has inferior performance compared with MR imaging, MRCP, or EUS.[10] In the evaluation for malignant features of larger cystic masses, pancreatic protocol MDCT detects septae with 94% sensitivity, mural nodules with 71% sensitivity, and main duct communication with 86% sensitivity.[11] An additional feature of MDCT is the ability to detect calcification within a lesion, which can be more difficult with MR imaging, MRCP, or EUS.

One drawback of pancreatic protocol MDCT is radiation dose exposure, driven largely by the multiple phases of contrast enhancement required for the evaluation. As a result, screening with MR imaging–MRCP rather than MDCT has generally been recommended.[4] More recently, however advances in dual energy CT (DECT) technology have reestablished CT as a reasonable screening option. DECT allows for a 2-fold decrease in radiation dose through use of virtual non–contrast-enhanced sequences and low kilovolt images that enhance the soft tissue contrast between hypoattenuating PDAC and the surrounding pancreatic parenchyma (**Fig. 1**).[12–15] DECT also allows for the possibility of decreased doses of intravenous contrast while maintaining or even possibly improving diagnostic interpretability.[16,17]

Table 1
Performance of screening modalities for detection of specific features

Detection of Feature	MDCT	MR Imaging and MRCP	EUS
Small solid lesion	++	++	+++
Cyst septa	+++	+++	+++
Cyst mural nodules	++	+++	+++
Cyst MPD communication	++	+++	+++
Other	+ Calcification	+ No radiation	– Invasive

Abbreviations: EUS, endoscopic ultrasound; MDCT, multidetector computed tomography; MPD, main pancreatic duct; MRCP, magnetic resonance cholangiopancreatography.