Intraductal papillary mucinous tumors and mucinous cystic tumors of the pancreas: imaging

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Abstract Most cystic lesions of the pancreas are non-neoplastic and inflammatory in nature. However, approximately 5%-15% of cystic pancreatic masses may be neoplastic. Among the cystic neoplasms are the mucin-producing tumors, both the intraductal papillary mucinous neoplasms and the mucinous cystic neoplasms. Their imaging features on contrast-enhanced computed tomography (CT) and magnetic resonance imaging (MRI) can assist in the differentiation of these lesions. The imaging findings of both intraductal papillary mucinous neoplasm and mucinous cystic neoplasm are reviewed with attention to CT and MRI.

Key words Pancreas · Neoplasm

Introduction

The most common etiology of cystic pancreatic masses is an inflammatory pseudocyst. Neoplastic masses account for 5%-15% of cystic pancreatic masses and include the serous and mucinous tumors. Recognition and differentiation of these tumors is important due to the malignant potential or the malignant nature of the mucinous lesions. Included among the mucinous tumors are the intraductal papillary mucinous tumors (IPMTs) and the mucinous cystic neoplasms. The imaging findings of these mucinous tumors are reviewed, with a focus on computed tomography (CT) and magnetic resonance (MR) imaging.

Intraductal papillary mucinous tumors

Intraductal papillary mucinous tumors (IPMTs) account for 1% of exocrine pancreas tumors. Approximately two thirds of patients are male, with a peak incidence in the sixth decade. These tumors are further classified by location in the pancreatic duct into main-duct, branch-duct, and combined tumors. The neoplastic tissue lines the pancreatic duct and produces large amounts of mucin, leading to ductal dilation, cyst formation, or both. Pathologically, these tumors range from dysplasia to carcinoma.

The imaging findings of the IPMTs were first reported by Itai and co-workers in 1986. The findings seen on CT or MR primarily reflect the sequelae of profuse mucin production. The underlying neoplastic epithelium may not be visible on radiographic evaluation. In tumors originating from the main pancreatic duct, there is dilation of the main pancreatic duct that may be diffuse (Fig. 1) or segmental in nature, with possible associated dilation of the branch ducts. Segmental dilation of the main pancreatic duct may lead to a cystic appearance. When the tumor is located in the head of the pancreas, upstream dilation may be seen. Ductal dilation is caused by either expansion of the duct by the copious mucin produced by the tumor or by obstruction of the duct by mucin. There may be associated atrophy and fibrosis of the pancreatic parenchyma. Calcification may be deposited in the mucin, which can be demonstrated on CT.

Branch-duct tumors are most commonly seen in the head and uncinate process, but can be seen in all portions of the pancreas. They are usually lobular in configuration, with multiple communicating areas of cystic dilation of the branch ducts (Fig. 2). These areas of branch-duct dilation communicate with the main pancreatic duct, which may be normal in caliber or mildly dilated. These tumors may have a unilocular or multilocular appearance, with the multilocular form more common in one study. The cysts that are formed may be macrocystic or microcystic in size, with the macrocystic form more common. When unilocular, the differential diagnosis is that of a pancreatic pseudocyst.
with ductal communication. When multilocular, microcystic forms may appear similar to serous cystadenomas and macrocystic forms may appear similar to mucinous cystic tumors. Typically, the mucinous cystic tumors have a smooth outer contour, whereas the branch-duct IPMT is lobular in contour.\textsuperscript{10}

Evaluation of suspected IPMT includes direct endoscopic visualization, which may reveal mucus protruding from a patchulous papilla.\textsuperscript{1,7,11} Imaging evaluation of IPMT has included both contrast-enhanced CT and MRI with MR cholangiopancreatography (MRCP). On imaging, the findings of main-duct IPMT may be indistinguishable from chronic pancreatitis with ductal dilation and pancreatic atrophy. Frequently, these patients also have a history of pancreatitis.\textsuperscript{2} However, demonstration of a major or minor papilla bulging into the duodenum by CT or MR is felt to be pathognomonic for IPMT (Fig. 3).\textsuperscript{6,10} In one study, the area of maximal dilation of the main duct, as demonstrated by MRCP, correlated with the site of the main neoplastic lesion.\textsuperscript{12}

Evaluation by endoscopic retrograde cholangiopancreatography (ERCP) may be limited by the copious mucin production.\textsuperscript{1} By ERCP, filling defects may be seen (Fig. 4a), representing either mucin or tumor, and differentiation between these two etiologies may be difficult. However, MR imaging with MRCP is better at visualization of the ducts and distinction of mucin and tumor.\textsuperscript{7,9,13-16} On T2-weighted MR images, mucin is bright and isointense to pancreatic ductal fluid (Fig. 4b), whereas tumor is of low signal intensity relative to the bright fluid and mucin of the distended duct. Evaluation of the source images from the MRCP is necessary, because the maximal intensity projection reconstructions may obscure small tumors.\textsuperscript{5,14} On both contrast-enhanced MR and CT, the nodules enhance with contrast administration (Fig. 5). In one study of CT evaluation of IPMT, intraductal masses larger than 3 mm were seen by CT with 3- or 5-mm slice collimation.\textsuperscript{10} In histopathologic studies with MR, when nodules were present on pathologic examination, MR visualized the nodules in 80\%–100\% of cases.\textsuperscript{1,2,17} There are varying reports regarding the correlation of nodules visualized by MR as a predictor of malignant behavior.\textsuperscript{12,17} In addition, due to the presence of mucin in the duct, complete filling of the pancreatic duct may not be possible on ERCP.\textsuperscript{12} MRCP will demonstrate the portions of the duct not visualized on ERCP.\textsuperscript{3}

Visualization of the cystic mass and communicating duct is variable by ERCP, due to obstruction of the duct...