

Pancreatic cystic neoplasm diagnosis: Role of imaging

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INTRODUCTION

Cystic pancreatic lesions could be frequently encountered during abdominal imaging studies.

The most common cystic pancreatic neoplasms are serous cystadenomas (SCAs), mucinous cystoadenomas (MCAs), intraductal papillary mucinous neoplasms (IPMNs), and solid pseudopapillary neoplasms. Imaging plays a crucial role in the management of cystic lesions of the pancreas, including lesion detection and characterization. The following imaging modalities are frequently used for the diagnosis and management of cystic pancreatic lesions.

IMAGING METHODS

Transabdominal conventional ultrasound (TUS) frequently represents the first imaging modality used in the evaluation of the pancreas because it is widely available, easy to perform, and has low costs. The accuracy and confidence of US remains low in cases of air distension of the digestive tube and sometimes in obese patients. The intravenous administration of contrast agent (contrast-enhanced US [CEUS]) could help both in the differentiation between a solid and a cystic lesion and also in determining whether enhancing septa or nodules are present within the cystic lesion.^[1]

Multidetector computed tomography (MDCT) is still considered the gold standard for the evaluation of focal solid lesions of the pancreas, whereas pancreatic cystic tumors are better investigated with magnetic resonance imaging (MRI).^[2-4] However, improvements in CT technology have expanded the capability of MDCT for the evaluation of pancreatic duct and cystic lesions, with a delineation of ductal dilation, thick septa, and mural nodules,^[5] making this technique suitable not only for staging cystic malignant pancreatic lesions, but also in differentiating benign from malignant cystic pancreatic lesions with an accuracy of 71%–84.2%.^[5,6] At the first diagnosis, at least a tri-phasic CT examination should be performed. In the follow-up, a biphasic technique can be sufficient, with an unenhanced and a venous phase. Unenhanced phase is necessary in order to evaluate the degree of enhancement of eventually present nodules to differentiate a mucin plug from an enhancing nodule.^[7] Different postprocessing images in a desired plane are needed to maximize the diagnostic yield of the scan and improve the visualization of pancreatic duct, allowing the determination of its communication with the cystic lesion,^[8] although with a slightly lower capacity than MRI.^[6,9]

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How to cite this article: Sarno A, Tedesco G, De Robertis R, Marchegiani G, Salvia R, D’Onofrio M. Pancreatic cystic neoplasm diagnosis: Role of imaging. *Endosc Ultrasound* 2018;7:297-300.

Access this article online	
Quick Response Code: 	Website: www.eusjournal.com
	DOI: 10.4103/eus.eus_38_18

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Received: 2018-06-22; **Accepted:** 2018-07-27; **Published online:** 2018-10-15

MR with colangiopancreatography represents the gold standard for the study of cystic pancreatic lesions. It helps in the detection of cystic lesional components and communication between the lesion and the main pancreatic duct, septations, and intracystic nodules. This is possible thanks to the superior soft-tissue and contrast resolution of MRI. This imaging method has some limitations related to its costs and to the possible motion and breathing artifacts due to a poor collaboration from the patient. The examination should always be performed after a fasting period of at least 4–6 h and an administration of oral superparamagnetic contrast material or pineapple juice that leads to an abolition of the gastroduodenal fluid signal in T2 weighted imaging (WI), which could impair the image quality.^[1,10]

PANCREATIC CYSTIC NEOPLASMS

SCA is defined as a benign lesion, and the malignant degeneration represented by serous cystadenocarcinoma is only a sporadic event. SCA is usually found in the pancreatic head, has no communication with the main pancreatic duct, and the most frequent pattern is the microcystic one (70%) represented by a solitary multilocular microcystic lesion with a honeycomb architecture because of the presence of multiple microcysts (<20 mm), thin wall, and thin multiple septa oriented toward the center of the lesion. Sometimes, a central solid portion containing calcifications (15%) could be found (central scar). The other patterns are the “extremely microcystic” (5%) that could be confused as a solid lesion at US because of the close proximity of the internal septa and the macrocystic pattern (25%) that, especially in the unilocular form, could be confused with MCAs. Doppler study could visualize a vessel in the fibrovascular central scar and with a CEUS, enhancement of the intralesional septations and of the central scar, when present, is demonstrated.^[11,12] On CT, SCA typically appears homogeneously hypodense, with honeycomb architecture and a hypodense central scar.^[13,14] On MRI, on T2WI, the cysts appear hyperintense, surrounded by hypointense septa and sometimes with a hypointense central scar; on T1WI, SCA appears homogeneously hypointense, with a lobulated shape and thin wall. The macrocystic type presents features that are indistinguishable from those of other macrocystic tumors of the pancreas, but the lobulated contours, together with the absence of wall enhancement and a wall thickness <2 mm, should suggest the correct

diagnosis.^[13-15] After contrast injection, both on MRI and CT, the vascularization of internal septa becomes clear, and when extremely microcystic, SCA may even mimic a solid hypervascular lesion.

MCA is considered a malignant lesion that could degenerate into cystadenocarcinoma. Its typical aspects are that of a single lesion without communication with the main pancreatic duct and located in the body or tail of the pancreas. MCAs are usually unilocular or oligolocular (≤ 6 cysts) ball-rounded cystic lesion, with inhomogeneous content, irregular thick wall, and, occasionally, peripheral calcifications. Internal irregular septations and/or mural nodules are an important characteristic of this lesion. On US, the echogenic content represented by mucin or hemorrhage could impair the detection of those components. In this context, the use of CEUS significantly improves the detection rate of septa and parietal nodules. In the unenhanced CT, mucinous cystadenoma may present with a hypodense or slightly hyperdense content, due to the presence of variable amount of mucin and hemorrhage. Owing to the inhomogeneous density, during dynamic study, the vascularization of thin septa and small nodules is not always easily detectable.^[5,13,16] MRI is the preferred second-line examination for the characterization of a suspect MCN; despite this, CT plays a fundamental role for staging of MCN. On T2WI, MCA typically appears as a grossly round, inhomogeneous hyperintense lesion with irregular thick wall, internal hypointense septa, and mural nodules. Due to mucinous content, on T1WI, it may show variable signal intensity, ranging from hypointensity to slight hyperintensity.^[17] After contrast administration, the enhancing wall, septa, and nodule are the characteristic features. Sometimes, septa and nodules may be seen only on T2WI and not on CE images.^[18]

IPMNs are a group of exocrine mucin-producing tumors that usually involve the head and the body of the gland, in patients in their sixth or seventh decade. A fundamental characteristic of this lesion is the communication with the main pancreatic duct. It is considered a benign lesion that could degenerate into a malignant one, especially for the main duct type and the mixed type. Imaging appearance of IPMN is that of a focal or diffuse dilation of the main pancreatic duct in case of a main duct IPMN and/or that of a uni- or multi-locular cystic dilation of its side branches in case of a mixed type or branch type. US has two major limitations that hamper the diagnosis of IPMN:

it could not demonstrate the communication with the main duct and fails in the evaluation of numerosity of lesions. Thus, the detection of a cystic lesion of the pancreas should always be followed by MDCT or preferably MRI. Harmonic imaging must be used to improve accuracy as it could help in the differentiation of solid and fluid components. Furthermore, CEUS has an important role and could identify enhancing solid nodules, internal vegetations, and enhancing septa. Sometimes, CEUS is better than other imaging modalities in depicting inclusion vascularization thanks to the real-time evaluation and the high spatial resolution, but obviously we have to consider the same limitations of conventional US such as meteorism, body habitus, and expertise of operator. The presence of mural nodules, thick septa, and Wirsung's duct dilation >10 mm is highly suggestive of malignancy. In case of IPMNs, thin-section helical CT may be helpful to evaluate the involvement or the communication with the main pancreatic duct, thanks to the two-dimensional curved reformations.^[5] MR with MRCP still remains the imaging of choice to diagnose pancreatic cystic lesions that involve or communicate with the main pancreatic duct. On T2WI, a focal or diffuse dilation of the main pancreatic duct may be seen, with or without intraductal solid hypointense nodules. Side-branch IPMN appears as single unilocular or multilocular cystic lesion, uni- or multi-focal, with grape-like clusters, better studied at MRCP.^[19,20] On T1WI, hemorrhagic foci of IPMN may be seen. After contrast administration, enhancing septa and mural nodules could be seen. DWI also helps in the evaluation of cystic lesions and, in particular, high b values are useful to detect hyperintense small solid portions within cystic masses.

Solid pseudopapillary tumor is a rare low-grade malignant pancreatic tumor that occurs mainly in females at a mean age of 20–30 years. It is a solitary lesion without communication with the main pancreatic duct. It is a well-defined round lesion with a heterogeneous aspect due to hemorrhage, necrosis, and cystic degeneration. The US appearance has no typical findings and consists of a solid hypoechoic mass with well-defined margins. In rare cases, an upstream dilated main duct could be found if lesion is located in the pancreatic head. CEUS could show a characteristic capsule rim enhancement due to the presence of a pseudocapsule of compressed normal pancreatic parenchyma. On unenhanced CT, it appears as a heterogeneously hypodense lesion for the presence both of solid and cystic components but also

hyperdense areas due to hemorrhagic foci. Solid areas are usually located in the periphery, instead cystic ones are located centrally.^[21,22] Lamellar calcifications may be present.^[23,24] After the administration of contrast medium, both on CT and MRI, the thick capsule and solid areas show gradual enhancement from pancreatic to venous phases, while the hemorrhagic, necrotic, and cystic areas appear avascular. The same heterogeneous pattern is observed on MRI, with a variable T1 and T2 signal intensities. The identification of hemorrhagic foci, hyperintense on T1WI and homogeneously or inhomogeneously hypointense on T2WI, is a typical but not pathognomonic feature.^[24]

CONCLUSIONS

Cystic pancreatic lesions are increasingly detected during imaging examinations. Imaging characterization is important for guiding the correct management. MR could be considered the reference for the noninvasive diagnosis of cystic pancreatic lesions. Considering the completely noninvasive features of MR and the high diagnostic accuracy in cystic lesion detection and characterization, this examination has to be considered before EUS evaluation because of the possible noninvasive accurate and definitive diagnosis of lesions not requiring further cytological confirmation (*e.g.*, pancreatic serous cystadenoma). Moreover, in case of US detection of small cystic pancreatic lesion during TUS examinations, it is absolutely better to proceed directly to an MR examination, avoiding radiation exposition and double examinations (CT plus MRI) that are often required after a CT study.

Conflict of interest

There are no conflicts of interest.

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