

Advances in Ultra-High-Gradient MRI: High-Resolution Imaging for Accurate Diagnosis of Pancreatic Cystic Lesions

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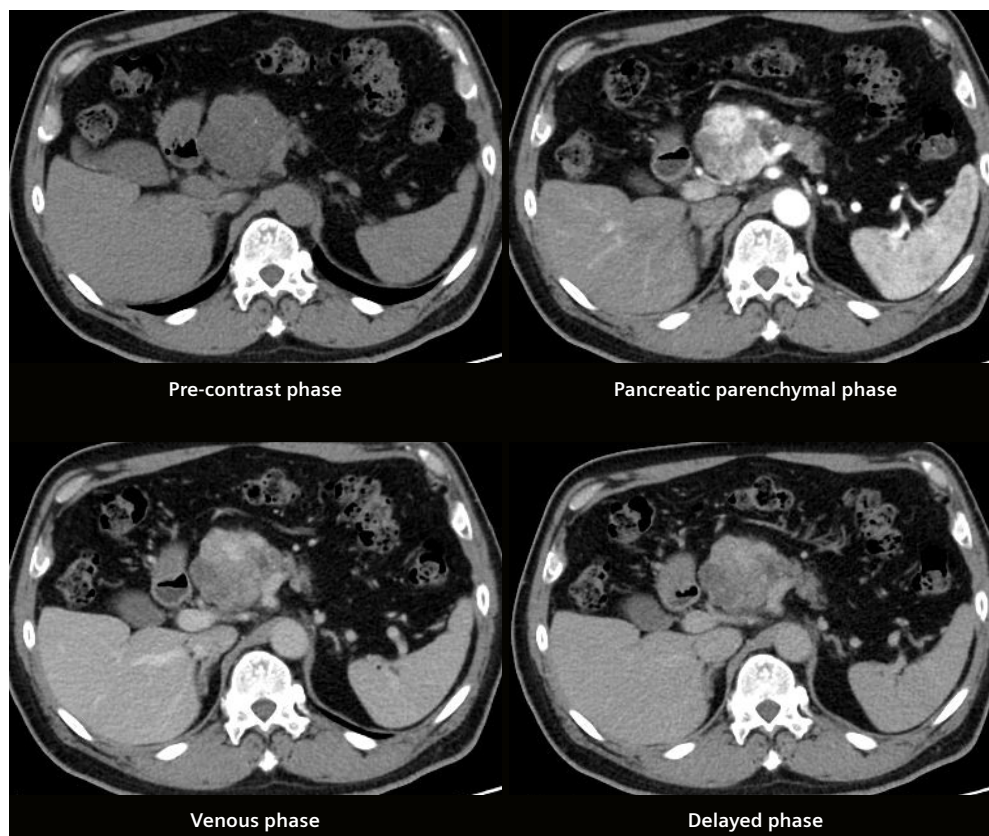
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Introduction

Pancreatic cystic lesions (PCLs) are relatively common in clinical practice, and the detection rate has been increasing with the widespread application of computed tomography (CT) and magnetic resonance imaging (MRI). These lesions encompass a broad spectrum of diseases with similar imaging features, ranging from non-neoplastic cysts and benign tumors to premalignant and frankly malignant neoplasms. Accurate diagnosis is therefore challenging. Benign lesions may be misinterpreted as malignancies, leading to over-

treatment, while early-stage cancer may be overlooked, delaying appropriate treatment. MRI possesses distinct advantages in the diagnosis of PCLs, owing to its non-invasiveness, its lack of ionizing radiation, its superior soft-tissue contrast, and its multiparametric imaging capabilities. Moreover, high-resolution MRI enabled by an ultra-high-gradient system and deep-learning reconstruction delineates subtle internal structures of PCLs and provides critical diagnostic clues.



1 Contrast-enhanced CT demonstrates a mass with punctate calcifications and heterogeneous hyperenhancement during the pancreatic parenchymal phase, with partial washout in later phases. This raised suspicions of a pancreatic neuroendocrine tumor.

At Peking Union Medical College Hospital, the pancreatic multidisciplinary team (MDT) combines clinical expertise, advanced imaging techniques, and complementary multi-modality information to enhance diagnostic accuracy. Here, we present a representative case from our hospital that illustrates how high-resolution MRI on the 3T MAGNETOM Cima.X served as a problem-solving tool for a challenging case.

Patient history

A 65-year-old male presented with occasional abdominal distension since May 2024, sometimes accompanied by right upper quadrant pain that resolved spontaneously. In May 2025, a chest CT performed during routine health screening incidentally revealed a hypodense lesion in the pancreatic head. Contrast-enhanced CT demonstrated a mass with punctate calcifications and heterogeneous hyperenhancement during the pancreatic parenchymal phase, with partial washout in later phases. This raised suspicions of a pancreatic neuroendocrine tumor (Fig. 1). PET/CT showed an increased maximum standardized uptake (SUVmax) value of 3.3, suggesting a low-grade malignant lesion.

The case was reviewed by the pancreatic MDT. Based on the patient's clinical history and the imaging findings, the possibility of a serous cystadenoma was suspected. High-resolution MRI was recommended for further clarification.

Imaging findings

High-resolution abdominal MRI and MRCP were performed on our 3T MAGNETOM Cima.X scanner. The ultra-high-gradient system provided unprecedented delineation of internal details:

- Axial high-resolution deep learning fat-saturated T2WI revealed a central stellate scar with fine honeycomb-like septations within the pancreatic head lesion. These were less clearly visualized on conventional T2WI (Fig. 2).
- The hypervascular nodular areas seen on CT corresponded to dense fibrous septa on MRI, producing a lace-like appearance that is consistent with a microcystic lesion rather than a solid tumor.
- High-resolution deep learning ZOOMit DWI demonstrated sharper lesion boundaries and internal heterogeneity than conventional DWI. Corresponding ADC maps showed diffuse high signal intensity, supporting the cystic nature of the lesion rather than a neuroendocrine tumor. The apparent diffusion restriction in hypervascular areas was attributed to the very dense septations, which leads to water diffusion within the small cells (Fig. 3).

Diagnosis and outcome

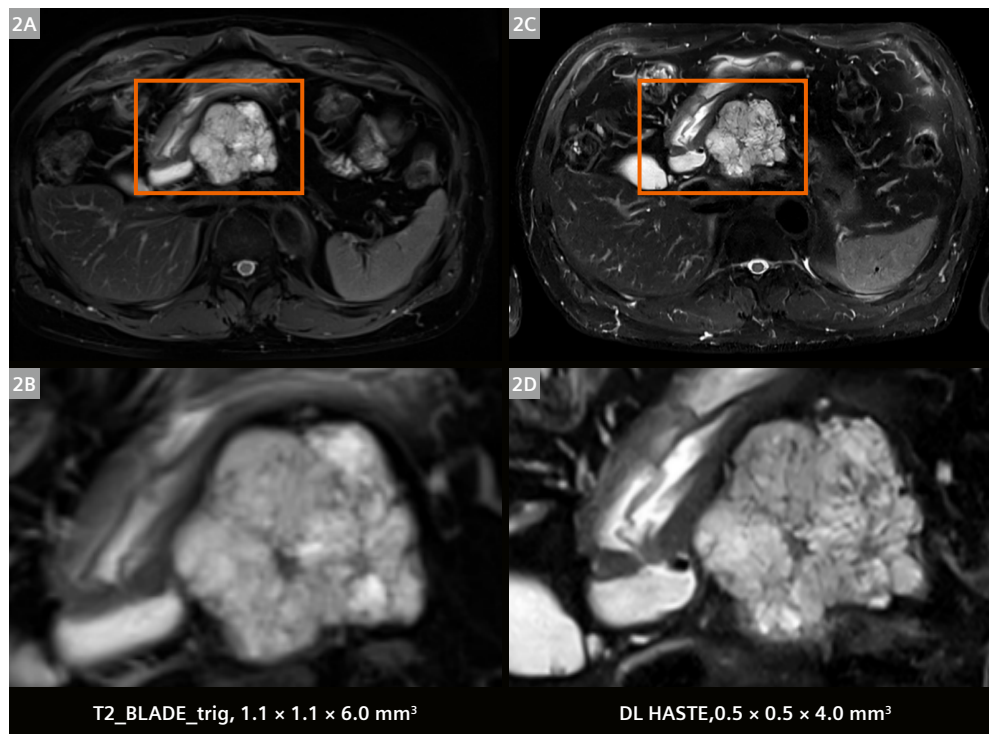
To further exclude malignancy, the patient underwent fine-needle biopsy with endoscopic ultrasound. The histopathology was negative for malignant cells. Finally, the patient was diagnosed with a benign serous cystadenoma of the pancreas. Surgical intervention was deemed unnecessary, and the patient was discharged.



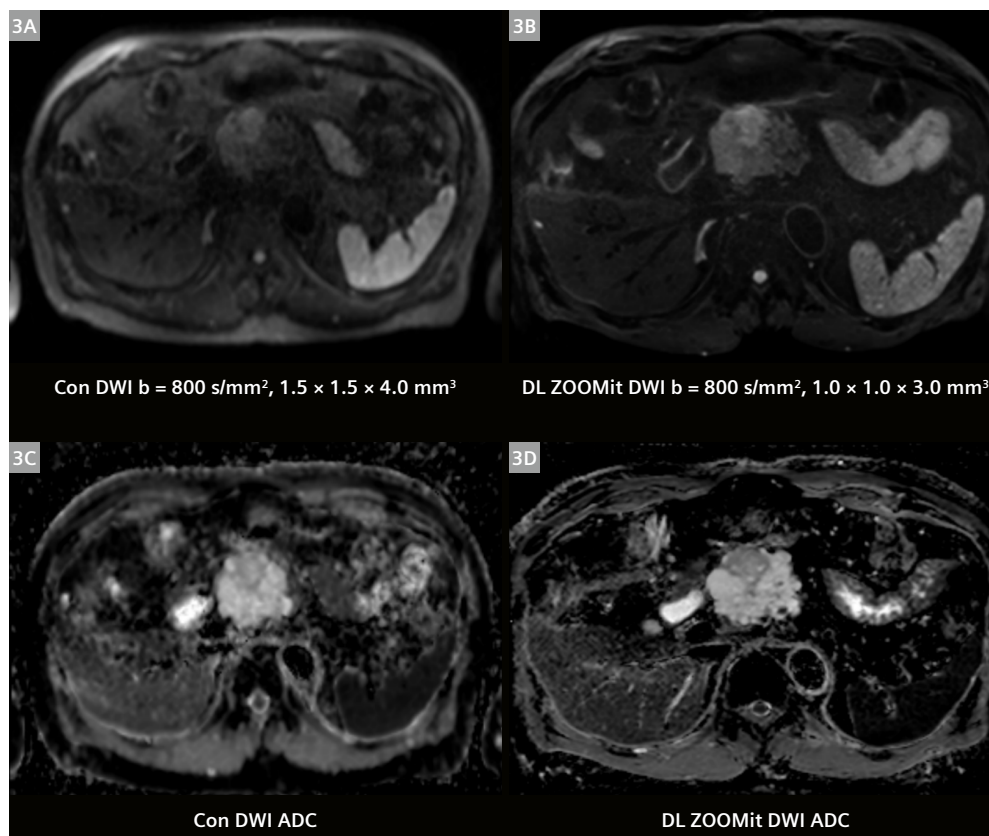
“As a pancreatic surgeon, I frequently encounter patients with cystic lesions who are deeply anxious about potential malignancy. While surgical excision is sometimes necessary, the ability to accurately identify benign lesions and intervene only when appropriate is equally critical. The ultra-high gradient strength and deep learning reconstruction of MAGNETOM Cima.X deliver high-resolution T2WI and DWI that are superior to conventional MRI, providing surgeons with the confidence to avoid overtreatment and to recognize early malignant changes when present. Such imaging advances are invaluable for clinical decision-making.”

Professor Xianlin Han

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- 2** Axial high-resolution deep learning fat-saturated T2WI (**2C, D**) reveals a central stellate scar with fine honey-comb-like septations within the pancreatic head lesion. These were less clearly visualized on conventional T2WI (**3A, B**).



- 3** High-resolution deep-learning ZOOMit DWI (**3B**) demonstrates sharper lesion boundaries and internal heterogeneity than conventional DWI (**3A**). Corresponding ADC maps (**3C, D**) show diffusely high signal intensity, supporting the cystic nature of the lesion rather than a neuroendocrine tumor.

	Con T2WI axial	HR T2WI axial	Con DWI	HR DWI
Field of view (mm ³)	360 × 360	380 × 309	380 × 309	300 × 208
Matrix	320 × 320	384 × 269	128 × 128	150 × 150
Spatial resolution (mm ³)	1.1 × 1.1 × 6.0	0.5 × 0.5 × 3.0	1.5 × 1.5 × 4.0	1.0 × 1.0 × 3.0
Slices	25	48	38	48
Echo time (ms)	85	89	56	50
Repetition time (ms)	2390	666	2000	2400
Averages	1	1	1, 4	1, 8
Diffusion gradients	–	–	3	3
B values (s/mm ²)	–	–	50, 800	50, 800
Bandwidth (Hz/pixel)	710	420	2298	1960
Acquisition time (min:s)	3:00	0:42	2:04	3:20
Fat suppression	SPAIR	SPAIR	SPAIR	Fat saturation
DL reconstruction	--	On	--	On
Sequence	BLADE	HASTE	SE-EPI	ZOOMit SE-EPI
Scanner	MAGNETOM Skyra	MAGNETOM Cima.X	MAGNETOM Skyra	MAGNETOM Cima.X
Interpolation	Off	On	On	On
Resp. control	Trigger	Breath-hold	Trigger	Trigger
Acceleration factor	2	4	2	2
Acceleration mode	GRAPPA	GRAPPA	SMS, GRAPPA	GRAPPA

Table 2: Examination protocol

Con = conventional; HR = high resolution; DL = deep learning

Discussion

This case demonstrates the critical role of high-resolution MRI in the differential diagnosis of pancreatic cystic lesions. Conventional CT and MRI may suggest solid or malignant tumors, whereas high-resolution MRI – enabled by the MAGNETOM Cima.X with a 200 mT/m amplitude and a 200 T/m/s slew rate – allows confident identification of key features with a smaller voxel size (e.g., axial T2WI 0.5 × 0.5 × 3 mm³ vs. 1.1 × 1.1 × 6 mm³) and a short

acquisition time (e.g., cor T2WI in 18 seconds within one breath-hold vs. 3–4 minutes). These features include stellate scars, fine septations, internal hemorrhage, and mural nodules. These subtle imaging features form the basis for distinguishing benign cystic lesions from pre-malignant or malignant lesions, directly influencing patient management.



Bowen Wu, Radiographer



Yitong Lu, Radiographer



Professor Liang Zhu, M.D.

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