Surgery Open Digestive Advance 5 (2022) 100037

Contents lists available at ScienceDirect

Surgery Open Digestive Advance

journal homepage: www.elsevier.com

Original Article

Intrapancreatic accessory spleen: Findings on MR imaging and CT

Keivan Daneshvar Ghorbani[a,b,*], Frank Bergmann[d], Hans-Ulrich Kauczor[b], Markus W. Büchler[c], Lars Grenacher[b]

[a] Department of Diagnostic and Interventional Radiology, University of Bern, Bern 3010, Switzerland
[b] Department of Diagnostic and Interventional Radiology, University of Heidelberg, INF 110, Heidelberg 69120, Germany
[c] Department of General, Visceral and Transplantation Surgery, University of Heidelberg, INF 110, Heidelberg 69120, Germany
[d] Department of Pathology, University of Heidelberg, INF 224, Heidelberg 69120, Germany

ARTICLE INFO

Article History:
Received 5 December 2021
Revised 28 December 2021
Accepted 29 December 2021
Available online 12 January 2022

Keywords:
Pancreas
Intrapancreatic accessory spleen (IPAS)
Insulinoma
MRI
CT and SPECT-CT studies

ABSTRACT

Background: Although intrapancreatic accessory spleen (IPAS) are infrequently noticed radiologically, they have been reported up to 2, 8% in Autopsies. The aims of this study were to describe the imaging characteristics of IPAS using computed tomography (CT) and/or magnetic resonance imaging (MRI) to prevent an unnecessary surgery.

Materials and methods: During last 7 years, 5 consecutive patients with incidental intrapancreatic accessory spleen (IPAS) on the tail of pancreas which radiologically mimicked a neuroendocrine pancreatic tumor, surgically treated in our university hospital. Preoperative CT studies (4 of 5 patients) and MRI (2 of 5 patients, one patient had both CT and MR images), operation reports and pathological diagnoses were analyzed retrospectively. For each lesion, images were analyzed based on the characteristic signal intensities on MRI or density of the lesion on CT images and presence of contrast enhancement. Pathologic correlation was available for the lesions.

Results: The female-to-male ratio was 2:3, with a mean age of 56 years (age range, 42−72 years). Incidental lesion findings were due to imaging studies using magnetic resonance imaging and/or computed tomography. In all the patients there was just one lesion on the tail of pancreas. On all the MR images (2 of 5 patients), a focal pancreatic lesion that was in compared to the rest of pancreas hypointense on T1-weighted sequences were detected, these lesions were hyperintesne on T2-weighted sequences; and enhanced more than the pancreas tissue in contrast enhanced series; however, the lesions were with the same intensity in compared to spleen in all the sequences. The enhancement pattern of the lesion was evaluated as serpiginous on early postgadolinium sequences. On all CT studies (4 of all 5 patients), there were no detectable lesions on pre-contrast series; however, on all arterial and venous series lesions were hyperdens in contrast to the rest of pancreas. The lesions had the same density of spleen in all series. In both MRI and CT images there were No adenopathy in the abdomen. Tumor size was among min. 9 × 12 mm to max. 16 × 18 mm. Pathological findings were intrapancreatic accessory spleen (IPAS) in all the cases. One patient had a pathological finding of Leiomyoma of the stomach too.

Conclusion: Radiologists and Surgeons should be aware that an incidental finding of a subtle well-marginated, rounded solitary lesion on the tail of pancreas on the CT or MR images which matches the density/or intensity of the spleen on all phases/ or sequences could be an intrapancreatic accessory spleen (IPAS); Therefore, an IPAS has to be excluded in asymptomatic patients with a lesions in the pancreatic tail before unnecessary surgery.

Introduction

The intrapancreatic accessory spleen (IPAS) were first described by Halpert and Gyorkey [1]. In fact, in 3000 autopsies that is reported by him, 364 accessory spleens were found and 61 of them located in the tail of the pancreas. Though infrequently noticed radiologically, accessory spleens have been detected most commonly at the splenic hilum, with the pancreatic tail region being the second most common site [3] the other possible places are the gastrosplenic omentum, along the tail of the pancreas, and in the retroperitoneum posterior to the spleen [1−3]. Accessory spleens are congenital and consist of structurally normal splenic tissue. They range in size from a few

* Corresponding author at: Department of Diagnostic and Interventional Radiology, University of Bern, Bern 3010, Switzerland.
E-mail address: keivan.daneshvar@insel.ch (K.D. Ghorbani).

https://doi.org/10.1016/j.soda.2021.100037

millimeters to several centimeters, may be single or multiple, and may enlarge after splenectomy (5). Accessory spleens as well as IPAS are benign lesions, and they do not usually require treatment unless they have been associated with a blood disease such as idiopathic thrombocytopenic purpura [14]. It is therefore essential to diagnose it using the least invasive means possible. An intrapancreatic spleen can mimic a hypervascular endocrine tumour on contrast-enhanced CT and MRI scans, as in our patients. Because 30 and 40% of endocrine tumours of the pancreas are non-functioning, normal hormone levels do not automatically point toward the diagnosis of a benign lesion. Technical advances have led to an improvement in the quality of CT and MRI. The aims of this study are to review our experience in the imaging characteristic of intrapancreatic accessory spleen (IPAS) on the tail of pancreas which radiologically mimicked a neuroendocrine pancreatic tumor and surgically treated in our university hospital. Here we have evaluated the preoperative imaging of lesion in patients using computed tomography (CT) and/or magnetic resonance imaging (MRI), considering the enhancement characteristics and relative conspicuity of IPAS to pancreatic enhancement on the different phases of CT or MR images and evaluate the correlation between pathological results.

Materials and methods

Patient selection

Over a 7-year period, our institutional database was searched for patients who had been operated on with an intrapancreatic accessory spleen (IPAS) on the tail of the pancreas, which radiologically mimicked a neuroendocrine pancreatic tumor. CT and/or MR images, as well as surgical reports, were used to localize the tumor's location, and pathology reports were used to confirm the diagnosis. 5 patients were surgically treated in our university hospital for incidental IPAS on the tail of the pancreas, primarily misdiagnosed as neuroendocrine tumor. Preoperative CT (4 of 5 patients) and MRI (2 of 5 patients, one patient had both MRI and CT) studies were reviewed retrospectively. Images were analyzed for each lesion based on the presence of enhancement on CT studies or the characteristic signal intensities on MR images. For the lesions, pathologic correlation was available.

CT

Four patients were scanned with multi detector scanners, and one of them also had an MRI. CT studies were carried out in our university clinic using the CT scanner Somatom Definition (Siemens Medical Solutions, Erlangen, Germany) or the 256-slice Brilliance iCT (Philips Medical Systems) as dedicated multiphase examinations of the pancreas using a hydro protocol with water- and drug-induced distension of the stomach and duodenum (1−1.5 l tap water and N - butylscopolaminiumbromide from Boehringer-Ingelheim [15,16]. Unenhanced scans were initially obtained (2.5 mm collimation, 10 mm slice thickness, 15 pitch, 120 kV, 100 mAs). Bolus tracking at the celiac trunk level was then performed with 130 ml of contrast medium (Ultravist 370, iopromide; Schering, Germany) injected into the antecubital vein at a rate of 5 ml/s. Arterial phase imaging was performed 4−8 s after reaching the trigger point (60 HU). A second breath-hold acquisition (venous phase) was obtained approximately 120 s after the start of the contrast material injection. Both scans were taken with the following parameters: 2.5 mm collimation, 15 mm pitch, 120 kV, 130 mAs, and 3 mm reconstructed slice thickness (Table 1).

Table 1
Hydro protocol for the evaluation of pancreas using water- and drug-induced distension of the stomach and duodenum

Specific anatomic region	Pancreas
Application	Evaluate or r/o mass
Reference Source	Hydrospiral CT of the pancreas in thin section technique. Radiologe 1996; 36: 397−405.
Scanner Used	Siemens Somatom Definition 64
KV/Effective mAs	120/ 130
Detector Collimation (mm)	2.5
Slice thickness (mm)	5 mm Thick and 0.6 mm thin
Pitch	15
Oral contrast	1−1.5 liters tap water
IV drug	N - butylscopolaminiumbromide
IV contrast volume and type	130 ml of Ultravist 370
Injection rate	5 cc/s
Scan delay (sec)	Arterial: around 4−8 s; Venous: 120 s after injection

MR imaging techniques

Two of the five patients had MR imaging of the pancreas (one had both MRI and CT), which revealed a lesion on the tail of the pancreas that radiologically resembled a neuroendocrine pancreatic tumor. The research was carried out in our University Clinic using a 1.5-T MR Scanner (Avanto, Siemens Medical Solutions, Erlangen, Germany). The patients were placed in the scanner, and a phased-array coil was firmly placed across the abdomen to prevent excessive abdominal excursion during breathing; additionally, drug-induced peristalsis in the surrounding bowel using N - butylscopolaminiumbromide (from Boehringer-Ingelheim, Germany) reduces movement artefacts. Initially, coronal, sagittal, and axial localizer imaging were performed. With a section thickness of 10 mm and an intersection gap of 15 mm, localizer images were obtained. T1-weighted imaging was performed initially without and then with frequency-selective fat suppression (104-181/4−7 [repetition time msec/echo time msec]). T2-weighted HASTE (800/68), transversal and coronal without fat suppression were the next two sequences. During breath holding, T1-weighted imaging with frequency-selective fat suppression was used after intravenous contrast media (Magnevist or Gadovist) injection. Because in-phase images have better anatomic resolution than out-of-phase images, an echo time of 1.49 msec was chosen. Out-of-phase imaging accentuates chemical shift artifacts, resulting in poor image quality (Table 2).

Image analysis

CT and MR images were retrospectively reviewed by two observers to compare imaging findings (by L.G. and K.D.Gh.) Images from all MR sequences were interpreted collectively. The morphologic appearance of the IPAS and contrast enhancement patterns and signal intensity features were noted. The signal intensity of the lesion was evaluated as hypointense, isointense and hyperintense, compared to those of the pancreas and spleen, on all sequences. The enhancement pattern of the lesion was evaluated as homogenous,

Table 2
The MRI Protocol of pancreas. Note—Gd = gadolinium

Sequence	Repetition time msec/echo time msec
coronal, sagittal and axial localizer	15/5
Axial T1-weighted fl2D / fl3D, (without/ with fat suppression)	104-181/4−7
T2-weighted HASTE transversal and coronal (without fat suppression)	800/68
Axial T1-weighted fl3D transversal and coronal Gd-enhanced (with fat suppression)	

heterogeneous and serpiginous. Serpiginous enhancement was defined as the enhancement pattern of the spleen that is seen in early postgadolinium sequences. Lesion size was determined. The results of CT and MR imaging were then compared with the results of surgery and histopathologic study).

.

Results

Patient characteristics

The female-to-male ratio was 2:3, with a mean age of 56 years (age range, 42−72 years). Incidental lesion findings were due to imaging studies using magnetic resonance imaging and/or computed tomography (Table 3). In all the patients there was just one lesion on the tail of pancreas without any significant neuroglycopenic symptoms (dizziness, sweating, headache and confusion).

Surgical treatment and outcome

Tumor size was among min. 9 × 12 mm to max. 16 × 18 mm. Left distal pancreatectomy were carried out in all patients and in 3 of 5 patient accompanied by splenectomy. The mortality rate was 0. Pathological findings were intrapancreatic accessory spleen (IPAS) in all the cases.

Discussion

Intrapancreatic accessory spleen has been described in previous case reports (1, 2). Accessory spleens are found in up to 30% of unselected autopsy cases and consist of structurally normal splenic tissue (1). They range in size from few millimeters to several centimeters, may be single or multiple. They are found commonly near the splenic hilum. Halpert and Gyorkey (1) reported one in every six accessory spleens to be located in the pancreatic tail. At CT and MR imaging, IPAS are diagnosed by their characteristic location and appearance similar to the spleen on nonenhanced and contrast material −enhanced images (2, 4, 5). The radiologic findings of IPAS are helpful tools to avoid unnecessary surgical approaches.

Clinical feature

The patients have any significant neuroglycopenic symptoms (dizziness, sweating, headache and confusion). Accessory spleens as well as IPAS are benign lesions, and they do not usually require treatment.

Histologic features

The Spleen is made up of red pulp with areas of white pulp. The red pulp is highly vascular and is composed of large, branching sinuses, with the areas filled with phagocytic and blood cells, known as splenic cords. The white pulp has composed of three parts: periarteriolar lymphoid sheaths (T cells), lymphoid nodules (B cells), and the marginal zone. The spleen has two major physiologic functions. It is a component of the reticuloendothelial system as well as a part of the immune system. Accessory spleens are congenital and consist of structurally normal splenic tissue (1).

Radiologic features

Incidental tumor finding was achieved by means of magnetic resonance imaging and/or computed tomography. On the MR images (2 of 5 patients), a focal pancreatic lesion that was in compared to the rest of pancreas hypointense on T1-weighted sequences were detected, these lesions were hyperintense on T2-weighted sequences; and enhanced more than the pancreas tissue in contrast enhanced series (Case 1); however, the lesions were isointense in compared to spleen in all the sequences. The enhancement pattern of the lesion was evaluated as serpiginous. Serpiginous enhancement was defined as the enhancement pattern of the spleen that is seen in early postgadolinium sequences. On all CT studies (4 of all 5 patients), there were no detectable lesions on pre-contrast series; however, on all arterial and venous series lesions were hyperdens in contrast to the rest of pancreas (Cases 2-3). The lesions had the same density of spleen in all series. In both MRI and CT images there were No adenopathy in the abdomen.

SPECT-CT

Some authors have mentioned that the confirmation can be obtained by means of scintigraphy [6]; however the only reliable diagnostic method is direct sampling from the lesion. 3 mL of pyrophosphate would be administered to the patient; 30 min later, a blood sample would be taken and red blood cells isolated, labled with 120 MBq of Tc-99m, then would be heated at 49.5 ° during 10 min and cooled and reinjected into the patient. Heat-damaged red blood cells would be captured by the reticuloendothelial system cells of the spleen in the same way of damaged cells. Axial images would be performed 1 h after injection. In case of IPAS, the image would show a marked uptake in the mass, which confirms the diagnosis of intrapancreatic accessory spleen [4,5].

Differential diagnosis

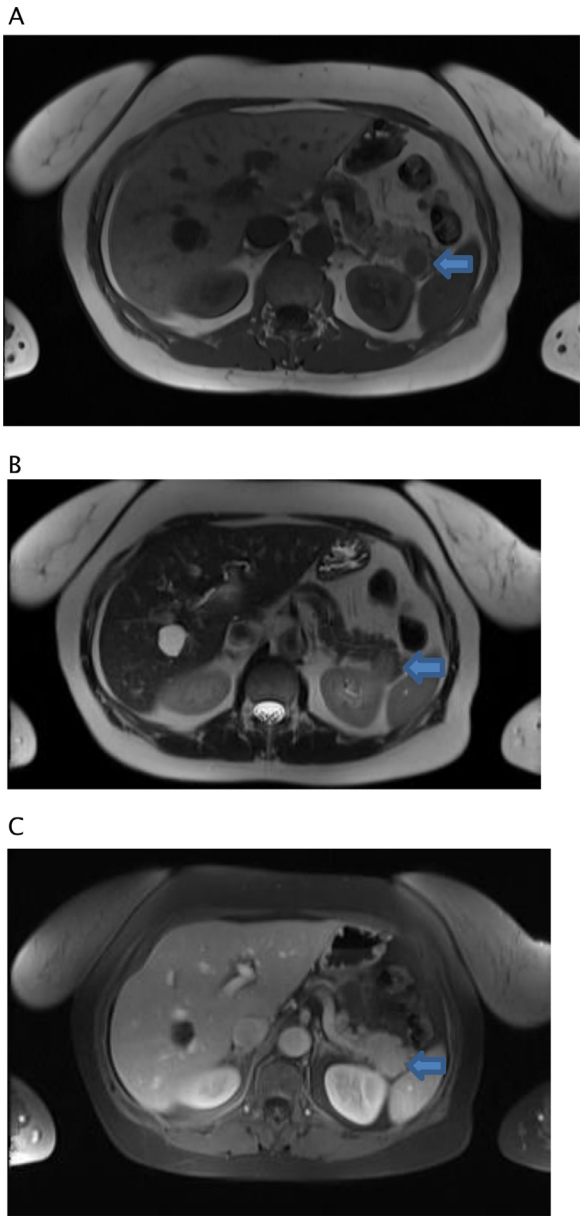
The IPAS is of intermediate to mildly hyperintense signal intensity, similar to that of the adjacent spleen on all MRI sequences. IPAS appear as a solid enhancing mass. The list of differential diagnosis of such a lesion include:

1 Solid and papillary epithelial neoplasm
2 Islet cell tumors
3 Pancreatic adenocarcinoma
4 Metastases.

Solid and papillary epithelial neoplasms are an uncommon, low-grade malignancy that occurs predominantly in young female patients [7]. Several synonyms have been used for this tumor, including papillary epithelial neoplasm [9] and solid and cystic acinar-cell tumor. MR imaging demonstrate the heterogeneity of T1 and T2 signal intensities associated with hemorrhage and cystic degeneration.

Table 3
Data of 5 IPAS patients (sex, age, location and size of tumor as well as type of operation)

Patient	Sex	Age	Size of lesion mm	Pre operative data	Location of lesion	Operation
1	M	49	13 × 14	incidentaloma	Tail of Pancreas	Left sided pancreatic resection
2	M	42	11 × 12	incidentaloma	Tail of Pancreas	Left sided pancreatic resection and splenectomy
3	F	57	12 × 15	incidentaloma	Tail of Pancreas	Left sided pancreatic resection
4	F	60	16 × 18	incidentaloma	Tail of Pancreas	Left sided pancreatic resection and splenectomy
5	M	72	9 × 12	incidentaloma	Tail of Pancreas	Left sided pancreatic resection and splenectomy



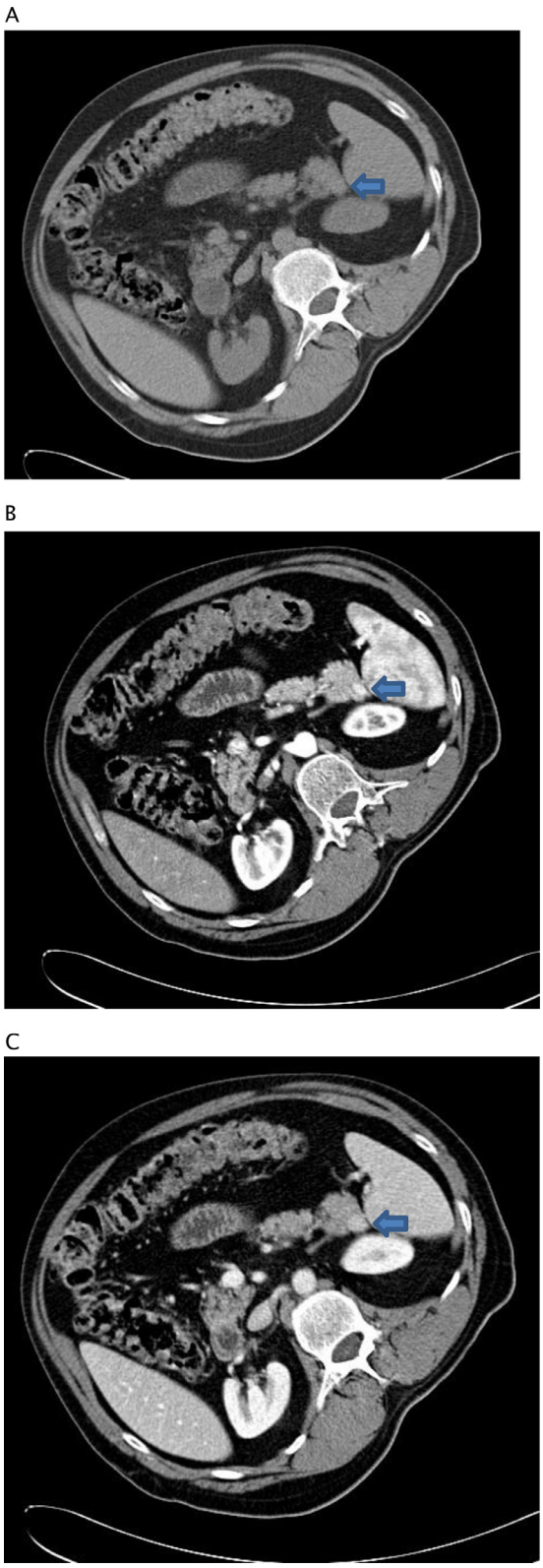
Case 1. 60-year-old woman with IPAS.

(A) Axial T1-weighted fl2D shows a relatively large hypointense in compare to pancreas and isointense in compare to spleen (blue arrow).

(B) Axial T2- weighted HASTE shows a homogeneously isointense Lesion in compare to spleen (blue arrow).

(C) Axial T1-weighted FATSAT gadolinium-enhanced image shows the same lesion (blue arrow).

Smaller lesions may demonstrate less heterogeneity, and nonenhanced CT or MR images of these small lesions may appear similar to those seen in IPAS. Pancreatic adenocarcinoma has a peak age of incidence in the 7th decade of life [11]. Presenting symptoms and signs may include pain, loss of appetite, fatigue, weight loss, jaundice, nausea and vomiting. Pancreatic adenocarcinomas mainly occur in the head of the pancreas [11]. The lesions may be iso- to hypoattenuating on nonenhanced CT studies and in contrast enhanced CT and MRI studies are hypovascular [12]. T1WI are usually iso- to hypointense. Although T2WI can range from hypo- to slightly hyperintense, they appear mainly hypointense on T2WI [13]. It's mandatory to include pancreatic adenocarcinoma in the differential diagnosis but should be considered low on the list (pancreatic adenocarcinoma in a young patient located in the pancreatic tail would be unusual) [8].

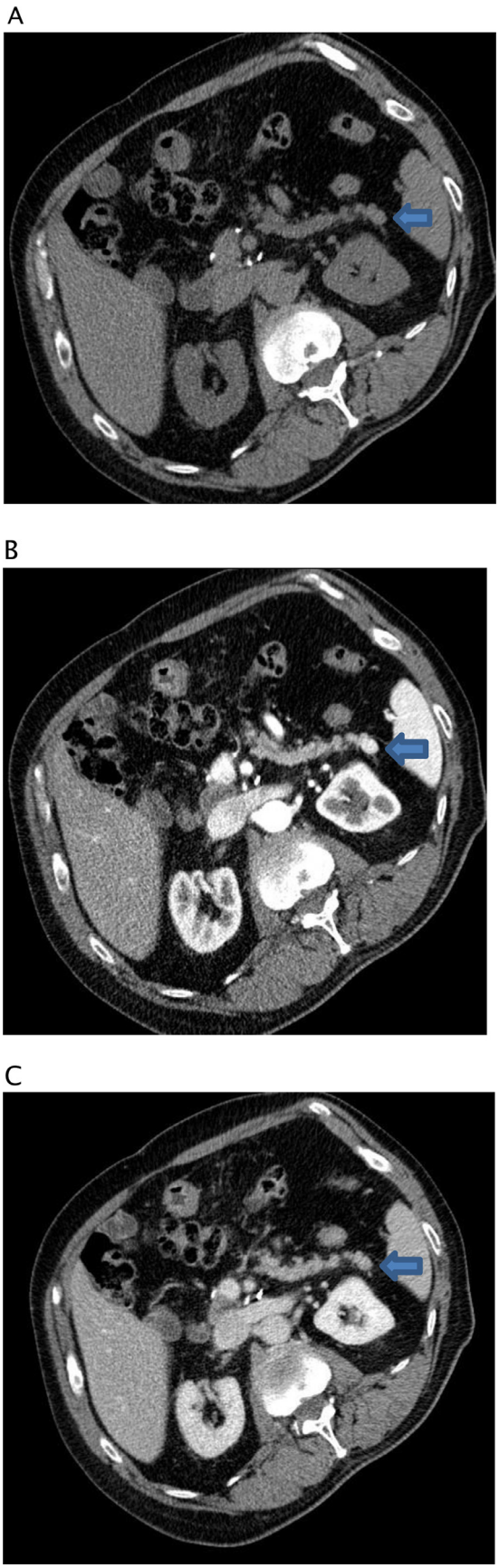


Case 2. 49-year-old man with IPAS. CT studies show a small relatively enhanced pancreatic lesion on the tail of pancreas caused by IPAS and it has the same density as the spleen in all the series (blue arrow).

(A) axial non contrasted axial series.

(B) axial arterial phase.

(C) axial venous phase.



Case 3. 72-year-old man with IPAS. CT studies show a small relatively enhanced pancreatic lesion on the tail of pancreas caused by IPAS and it has the same density as the spleen in all the series (blue arrow).
(A) axial non contrasted axial series.
(B) axial arterial phase.
(C) axial venous phase.

Hematogenous metastases to the pancreas are not often and usually present in advanced disease. It may mainly occur in patients with melanoma, breast carcinoma, and bronchogenic carcinoma [11]. The imaging findings are similar to those of pancreatic adenocarcinoma [10]. Renal cell carcinoma metastases may demonstrate a hypervascular appearance. The hyperintensity / hyperdensity of islet cell tumor is a key feature that helps differentiate it from IPAS and other pancreatic neoplasms. Hypervascular metastases to the pancreas may mimic features of IPAS. A characteristic feature of autoimmune pancreatitis in MR images is the late enhancement. The key feature of IPAS is an incidental solitary lesion on the tail of pancreas with the same density and /or signal intensity, similar to that of the adjacent spleen on all CT and/or MRI sequences.

Conclusion

Radiologists and Surgeons should be aware that an incidental finding of a subtle well-marginated, rounded solitary lesion on the tail of pancreas on the CT or MR images which matches the density/ or intensity of the spleen on all phases/ or sequences could be an intrapancreatic accessory spleen (IPAS); Therefore, an IPAS has to be excluded in asymptomatic patients with a lesion in the pancreatic tail before unnecessary surgery.

Declaration of Competing Interest

None.

References

[1] Halpert B, Gyorkey F. Lesions observed in accessory spleens of 311 patients. Am J Clin Pathol 1959;32:165–8.
[2] Harris GN, Kase DJ, Bradnock H, Mckinley MJ. Accessory spleen causing a mass in the tail of the pancreas: MR imaging findings. AJR Am J Roentgenol 1994;163:1120–1.
[3] Herédia V, Altun E, Bilaj F, Ramalho M, Hyslop BW, Semelka RC. Gadolinium- and superparamagnetic-iron-oxide-enhanced MR findings of intrapancreatic accessory spleen in five patients. Magn Reson Imag 2008;26:1273–8.
[4] Dodds WJ, Taylor AJ, Erickson SJ, Stewart ET, Lawson TL. Radiologic imaging of splenic anomalies. AJR Am J Roentgenol 1990;155:805–10.
[5] Chung SY, Ryo Y, Pinsky S. Evaluation of a patient with splenosis by various imaging modalities. J Natl Med Assoc 1986;78:458–63.
[6] Ohtomo K, Furui S, Onoue M, et al. Solid and papillary epithelial neoplasm of the pancreas: MR imaging and pathologic correlation. Radiology 1992;184:567–70.
[7] Buetow PC, Buck JL, Pantongrag-Brown L, Beck KG, Ros PR, Adair CF. Solid and papillary epithelial neoplasm of the pancreas: imaging-pathologic correlation in 56 cases. Radiology 1996;199:707–11.
[8] Hamoudi AB, Misugi K, Grosfeld JL, Reiner CB. Papillary epithelial neoplasm of pancreas in a child: report of a case with electron microscopy. Cancer 1970;26:1126–34.
[9] Richards ML, Gauger PG, Thompson NW, Kloos RG, Giordano TJ. Pitfalls in the surgical treatment of insulinoma. Surgery 2002;132:1040–9.
[10] Friedman AC, Dachman A. Pancreatic neoplasms and cysts radiology of the liver, biliary tract, and pancreas eds.. St Louis, Mo: Mosby–Year Book; 1994. p. 807–934.
[11] Semelka RC, Kroeker MA, Shoenut JP, Kroeker R, Yaffe CS, Micflikier AB. Pancreatic disease: prospective comparison of CT, ERCP, and 1.5-T MR imaging with dynamic gadolinium enhancement and fat suppression. Radiology 1991;181:785–91.
[12] Ichikawa T, Haradome H, Hachiya J, et al. Pancreatic ductal adenocarcinoma: preoperative assessment with helical CT versus dynamic MR imaging. Radiology 1997;202:655–62.
[13] Targarona EM, Espert JJ, Balague C, et al. Residual splenic function after laparoscopic splenectomy: a clinical concern. Arch Surg 1998;133:56–60.
[14] Halpert B, Gyorkey F. Lesions observed in accessory spleens of 311 patients. Am J Clin Pathol 1959;32:165–8.
[15] Richter GM, Simon C, Hoffmann V, De Bernardinis M, Seelos R, Senninger N, Kauffmann GW. Hydrospiral CT of the pancreas in thin section technique (in German). Radiologe 1996;36:397–405.
[16] Bidet AC, Dreyfus-Schmidt G, Mas J, Combe J, Milleret P, Bidet R. Diagnosis of splenosis: the advantages of splenic scintiscanning with Tc 99m heat-damaged red blood cells. Eur J Nucl Med 1986;12:357–8.