SCIENTIFIC RESEARCH

COMPUTED TOMOGRAPHY IMAGING FEATURES OF SMALL (≤ 3 CM) SOLID PSEUDOPAPILLARY TUMORS OF THE PANCREAS

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SUMMARY

Background: Solid pseudopapillary tumors (SPTs) of the pancreas is a low-grade malignant tumor, accounting for only 1–2.5% of all pancreatic tumors. In particular, small (≤ 3 cm) SPTs do not often have typical computed tomography (CT) features, making them easily misdiagnosed with other solid tumors and eventually affecting the choice of treatment method.

Purpose: To describe CT features of small (≤ 3 cm) SPTs.

Materials and Methods: This is a retrospective, descriptive cross-sectional study. SPT patients were admitted under the following inclusion criteria: (1) SPTs were pathologically verified at the University Medical Center Ho Chi Minh City from April 2016 to April 2022, (2) SPTs had maximal diameter ≤ 3 cm on preoperative CT scans.

Results: 10 small SPTs have atypical imaging (100%), a slight preference for the body region (40%), round shape (50%), solid components (100%), sharp margin and smooth border (90%), encapsulation (0%), peripheral calcification (30%), enhancement weaker than that of the adjacent pancreatic parenchyma during the arterial phase (90%), heterogeneous enhancement pattern (60%), no biliary or pancreatic ductal dilatation, no metastatic disease.

Conclusions: The CT features of small SPTs are atypical. They appear as purely solid tumors and should be differentiated from other solid tumors.

Keywords: *Computed tomography, solid pseudopapillary tumor, small (≤ 3cm) solid pseudopapillary tumor.*

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I. INTRODUCTION

A solid pseudopapillary tumor (SPT) of the pancreas is an exocrine pancreatic tumor, a low-grade malignant tumor, a rare neoplasm accounting for only 1–2.5% of all pancreatic tumors [1-3]. The tumors often present with non-specific symptoms and remain difficult to give the preoperative diagnosis [4]. Because of the development of diagnostic imaging tools, many cases of SPTs have been diagnosed based on computed tomography [5].

SPTs are classified as typical or atypical. The typical SPTs have at least three out of four features: sharp margin, mixed solid and cystic components, peripheral calcification, and enhancement weaker than that of the adjacent pancreatic parenchyma during the arterial phase. When tumors do not have encapsulation and/ or peripheral calcification, the typical SPTs must have these features: sharp margin, mixed solid and cystic components, and enhancement weaker than that of the adjacent pancreatic parenchyma during the arterial phase. Those tumors which are not in these cases are classified as atypical ones6. The CT imaging features of small SPTs are atypical and easily misdiagnosed with other solid tumors, affecting the choice of treatment method [6].

There is little research on computed tomography imaging about of SPTs because of their rarity, especially small (≤ 3 cm) SPTs. Therefore, this study aims to describe the computed tomography imaging features of small (≤ 3 cm) solid pseudopapillary tumors.

II. MATERIALS AND METHODS

This is a retrospective, descriptive cross-sectional study.

Patient Selection: Patients who are diagnosed with SPTs were admitted under the following inclusion criteria: (1) SPTs were verified pathologically at the University Medical Center of Ho Chi Minh City from 04/2016 to 04/2022, (2) SPTs had maximal diameter ≤ 3 cm on preoperative CT scans.

Exclusion criteria: Patients had undergone pancreatic surgery before undergoing CT scanning.

The computed tomography features investigated included tumor location, shape, components, border, margin, encapsulation, calcification, distribution of calcification, contrast enhancement feature in the arterial phase, contrast enhancement pattern, typical or atypical CT imaging, and other indirect features such as pancreatic duct dilatation and common bile duct dilatation.

Research Method: CT examinations were performed on either 64-slice or 128-slice (SOMATOM® Definition AS+, Siemens Healthineers AG, Erlangen, Germany) scanners with patients in the supine position. The scanning parameters that were used to train the model: CARE Dose4D and CARE kV ON, pitch 1.0. CT examinations were performed with multiphase images (non contrast, arterial, venous phase) after the administration of intravenous contrast material (Xenetix® 300 mgI/ml, Guerbet SA, Villepinte, France; Ultravist® 300 mgI/ml, Bayer AG, Leverkusen, Germany; Omnipaque™ 300 mgI/ml, GE Healthcare Inc., Chicago, United States). The arterial phase was 30-35 seconds and the venous phase was 60-70 seconds after the IV contrast injection.

Statistical Analysis: Data were entered and analyzed by descriptive statistics on Stata 14.0 software. Qualitative variables were described by frequency and percentage. Data are shown as mean values ± SDs for normal distribution or median and interquartile range (IQR) if data are not normally distributed. The results are presented in tables.

III. RESULTS

There were 33 cases with the histopathological results as SPTs, 10 cases out of 33 cases have small (≤ 3 cm) SPTs CT imaging, including 8 females and 2 males, with a mean age of 37.1 ± 9.4 (from 27 to 37 years old). All these 10 patients had the tumors classified as atypical based on their CT features.

Table 1. *Computed tomography imaging features of SPTs:*

	Features	SPTs (≤ 3 cm) (%)
Location	Uncinate Process	0 (0)
	Head	3 (30)
	Neck	2 (20)
	Body	4 (40)
	Tail	1 (10)
Shape	Round	5 (50)
	Oval	4 (40)
	Lobulated	1 (10)
Components	Purely Solid	10 (100)
	Mixed solid and cystic	0 (0)
	Purely Cystic	0 (0)
Margin	Indistinct	1 (10)
	Sharp	9 (90)
Border	Irregular	0 (0)
	Smooth	9 (90)
	Indistinct	1 (10)
Presence of encapsulation		0 (0)
Presence of calcification		3 (30)
Distribution of calcification	Absent	7 (70)
	Internal	0 (0)
	Peripheral	3 (30)
Enhancement during the arterial phase	Isoattenuation	1 (10)
	Hypoattenuation	9 (90)
	Hyperattenuation	0 (0)
Contrast enhancement pattern	No enhancement	0 (0)
	Weak enhancement, homogeneous	6 (60)
	Weak enhancement, heterogeneous	4 (40)
Common bile duct dilatation		0 (0)
Pancreatic duct dilatation		0 (0)
Metastasis		0 (0)

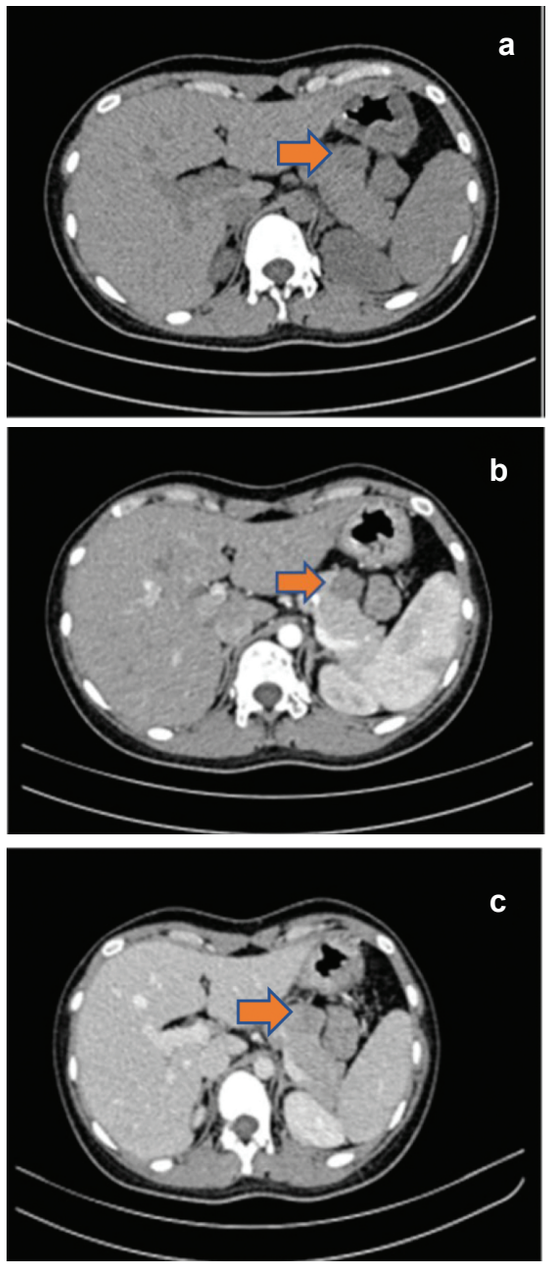

Figure 1. *Atypical CT imaging features of small (≤ 3 cm) solid pseudopapillary tumors.*

(a) Precontrast phase: no calcification was noted; (b) Arterial phase: the small SPT (arrow) appeared as a purely solid mass having a sharp border and no encapsulation and displaying weaker enhancement than the adjacent pancreatic parenchyma; (c) Venous phase: gradual contrast enhancement of the mass was observed.

IV. DISCUSSION

In our study, small SPTs affected women more than men, female to the male ratio is 4/1, and the result is similar to the studies of Jee Hyun Baek, and Riccardo De Robertis [5, 6]. This finding suggests that SPTs have relations to female sex hormones. Supporting this hypothesis, the study of Isabella Tognarini et al. concluded that estrogen-derived molecules could affect the development of SPT cells [7].

Patients diagnosed with small SPTs in our study had an average age of 37.1 ± 9.4 (from 27 to 37 years old), which is consistent with the study of Riccardo De Robertis5. According to the literature, patients with SPTs are often affected at a young age, very rarely in elderly people [8]. Some studies found that 85-90% of SPTs were related to point mutations in exon 3 of the CTNNB1 gene, which usually occurs at a young age and the reason for this point mutation is unknown2. Accordingly, the age being less than 50 years may be one of the features that help to distinguish small SPT from pancreatic adenocarcinoma [9].

The results in our study are quite similar to the study of Jee Hyun Baek and colleguages with 12 cases of small SPTs (≤ 3 cm). In that research, all small SPTs had atypical imaging features (100%), tumors usually located in the tail of the pancreas (66.7%), had round (50%) or oval shape (42%), solid components (100%), smooth border (92%), sharp margin (67%), no encapsulation (75%), some cases of calcification (25%), weak (100%) and heterogeneous (41.7%) contrast enhancement, no dilatation of pancreatic duct (75%) [6].

The results of the study of Riccardo De Robertis and assistants with 41 cases of SPTs ≤ 3 cm in size, tumors are usually located in the pancreatic body (43.9%), solid components (51.2 %), sharp margin (80.5%), no pancreatic duct dilatation (86.7%), no common bile duct dilatation (100%) 5. In the study of Trinh Hong Son that including 35 SPTs, 2 cases were small in size (≤ 3 cm), and both had atypical CT features: purely solid masses without capsule or calcification, and having mild contrast enhancement [10]. The fibrous histopathological results of small SPTs with microscopic imaging are clusters of solid cells with uniform structure, fibrous area, papillary arrangement with prominent hyalinized fibrovascular, and no encapsulation. Therefore, CT imaging features of small SPTs do not have encapsulation like those of large SPTs. Our work and the previous studies found that small SPTs often have solid components, which is atypical for SPTs in general, facilitating the need to differentiate them from other solid pancreatic tumors (such as neuroendocrine tumors and adenocarcinomas), which helps to choose the appropriate treatment and to prognosticate the patients. Surgery is the chosen method for the treatment of SPTs, and preserving pancreatic functional surgery can be considered, with a good prognosis after surgery, specifically, the 1-year, 3-year, and 5-year survival after surgery are 99.4%, 97.5%, and 96.9%, respectively [11].

Pancreatic neuroendocrine tumors often present as solid masses with sharp margins; however, they usually enhance stronger than the surrounding pancreatic tissue in the arterial phase [12], while the small (≤ 3 cm) ones usually enhance less than surrounding pancreatic tissue in the arterial phase. Pancreatic adenocarcinomas can mimic SPTs as they appear as solid tumors demonstrating poor contrast enhancement through CT phases. Nevertheless, several imaging features are more suggestive of pancreatic adenocarcinomas, such as an indistinct border, surrounding fatty infiltration, dilatation of the pancreatic duct and common bile duct due to compression, and metastasis [6,13].

Our study has some recognized limitations, including being a retrospective study with a small sample size, owing to the fact that small SPTs are so rare.

V. CONCLUSION

Small SPTs (≤ 3 cm) usually affect young women and have atypical CT features. They often contain solid components, and need to be differentiated from other solid pancreatic tumors such as neuroendocrine tumors or adenocarcinomas. The CT enhancement pattern which is weaker than the adjacent pancreatic parenchyma during the arterial phase can help differentiate small SPTs from pancreatic neuroendocrine tumors. Other CT imaging features, such as a The CT enhancement pattern, which is weaker than the adjacent pancreatic parenchyma during the arterial phase, can help differentiate small SPTs from pancreatic neuroendocrine tumors. Other CT imaging features, such as a sharp margin, no surrounding fatty infiltration, and no compression causing dilation of the

pancreatic duct and common bile duct, are more suggestive of small SPTs than pancreatic adenocarcinomas. sharp margin, no surrounding fatty infiltration, and no compression causing dilation of the pancreatic duct and common bile duct are more suggestive of small SPTs than pancreatic adenocarcinomas.

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