Original Investigation

Intraductal Papillary Mucinous Neoplasms of the Pancreas: Correlation of Helical Computed Tomography (CT) Features With Pathologic Findings

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Rationale and Objectives: Intraductal papillary mucinous neoplasms (IPMNs) are precancerous lesions of the pancreas. Computed tomography (CT) has been recommended to screen the malignant potential of IPMNs. However, data evaluating the use of CT to differentiate categories of IPMN based on disease progression are limited. This study aimed to explore the correlation between CT characteristics and pathology in IPMN associated with invasive carcinoma.

Materials and Methods: A total of 31 patients with intraductal papillary mucinous carcinoma (IPMC) treated at one local regional hospital in Shanghai, China, were enrolled in this study. Patients were divided into two groups based on invasion component and characterized as follows: group A, an invasive component of less than 50% (IPMC-I); and group B, with invasion of 50% or greater and defined as pancreatic ductal adenocarcinoma associated with IPMN (PDAC-IPMN). First, we analyzed the imaging information of the 31 patients retrospectively. Then, we compared the imaging differences between the two groups.

Results: Fifteen patients with IPMC-1 and 16 patients with PDAC-IPMN were identified. There was no statistically significant difference in sex, age, lesion location, radiologic type, tumor size, mural nodule size, and lymphatic metastasis between the two groups. However, the arterial increased CT values were significantly different between the two groups ($P < .01$), with values of 29.2 ± 12.4 HU for group A and 14.2 ± 8.8 HU for group B. The venous increased CT values were 44.6 ± 12.0 HU for group A and 28.4 ± 12.3 HU for group B, and these were significantly different between the two groups ($P < .01$). In group A, 13 cases (86.7%) were classified as T1 or T2 stage, and in group B, eight cases (50.0%) were classified as T1 and T2 stage. There was a statistically significant difference in tumor classification between group A and group B patients ($P < .05$).

Conclusions: IPMC-I and PDAC-IPMN have different characteristics in CT imaging, and we demonstrated that CT scans based on blood supply and lymphatic metastasis could be used to evaluate and potentially screen for variation in IPMC disease outcomes.

Key Words: Pancreas; intraductal papillary mucinous neoplasms; computed tomography; CT scan.

INTRODUCTION

Pancreatic intraductal papillary mucinous neoplasms (IPMNs) originate from the ductal epithelium with papillary proliferation and dilation of the main pancreatic duct or its major branches (1,2). IPMN is recognized as a premalignant lesion, which may progress from an adenoma to a carcinoma (3). Histologically, IPMNs are divided into four categories: IPMNs with (1) low-grade dysplasia, (2) moderate-grade dysplasia, (3) high-grade dysplasia, and (4) IPMNs associated with invasive carcinomas (4). Several studies have reported that approximately 4%–10% of individuals with IPMN develop pancreatic ductal adenocarcinoma (PDAC) (5–7). There is emerging evidence suggesting that biological behavior and long-term survival differ between patients diagnosed with IPMNs associated with invasive carcinomas and patients diagnosed with PDAC associated with IPMN (7–10).

According to the 2012 International Consensus Guidelines for the management of IPMNs and mucinous cystic neoplasm of the pancreas, computed tomography (CT) is recommended to screen the malignant potential of IPMNs and to distinguish IPMNs from other types of lesions (11). However, data that demonstrate that ability of CT to differentiate between

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IPMNs associated with invasive carcinomas and PDAC-associated IPMNs are limited. Compared with ultrasound, spiral CT and magnetic resonance imaging (MRI) can provide a clearer image. The diagnostic performance of multidetector CT and MRI for identifying the malignant potential of pancreatic IPMNs was similar (12). MRI has the advantages of no radiation and multiparameter imaging, but is expensive and takes a long time to scan. Spiral CT, with fewer relative contraindications and scanning speed and other characteristics, usually as the first line inspection, so we choose the spiral CT as a research tool for further research.

The purpose of this study was to assess and compare CT results of surgically resected IPMNs associated with invasive carcinomas and PDAC-associated IPMN of the pancreas, and to determine if CT is an appropriate tool for screening purposes.

METHODS

From March 2011 to March 2015, a total of 126 patients with pathologic IPMNs were diagnosed at one local regional hospital in Shanghai, China. Of these patients, 77 underwent preoperative triple-phase multidetector CT examinations, followed by surgical resection of the pancreas within 1 month after CT scanning, and a histopathologic diagnosis of IPMN and concomitant PDAC. All of the postoperative patients were followed up for 6 months to 3 years after surgery, and no recurrences or metastasis occurred within this time period.

Pathologic Diagnosis

Histopathology of pancreatic specimens from the 77 patients following surgery was determined by consensus of two specialists in digestive system pathology in this hospital. IPMNs were characterized as low-grade dysplastic ($n = 20$), moderate-grade dysplastic ($n = 16$), high-grade dysplastic ($n = 10$), or IPMNs associated with invasive carcinomas ($n = 31$), based on the 2010 World Health Organization (WHO) classification (13). IPMNs associated with invasive carcinomas were then subcategorized into invasive intraductal papillary mucinous carcinoma (IPMC-I) or PDAC-associated IPMN, labeled as group A ($n = 15$) and group B ($n = 16$), respectively (Table 1). Tumors defined as IPMC-I had an invasive component of <50%, whereas tumors with >50% invasive component and moderate to high-grade dysplasia were classified as PDAC-associated IPMNs (7). We did not include PDAC with separate IPMN (eg, IPMN apart from the invasive carcinoma without continuity) in this study.

CT Scanning

All patients in this study underwent abdominal CT examination with a multidetector CT machine (Siemens SOMATOM Emotion) after a 4-hour fast followed by consumption of 700–800 mL of water over a 30-minute period. CT scanning was performed with 120 kVp, 140–180 mAs, and 0.5-second rotation speed. The data were reconstructed at 1-mm intervals (0.25-mm overlap). A scout topogram was acquired, followed by arterial and venous phase images, obtained before, 35 seconds, and 85 seconds after injection of contrast agent. The nonionic iodine contrast material iohexol (300 mg/mL) was administered by a power injector at a rate of 2.5–3.0 mL/s.

TABLE 1. Patient Demographics and Intraductal Papillary Mucinous Neoplasm (IPMN) Pathologic Characteristics

Total ($n = 31$)	
Age	63.0 ± 7.2
Sex (Male:Female)	2.4:1
Location, *n* (%)	
Head	18 (58.1)
Body	8 (25.8)
Tail	5 (16.1)
Radiologic type, *n* (%)	
Main duct type	28 (90.3)
Branch duct type	1 (3.2)
Mixed type	2 (6.5)
Degree of invasion, *n* (%)	
IPMC-I	15 (48.4)
IPMN associated with an invasive carcinoma	16 (51.6)
T stage, *n* (%)	
T1, T2	21 (67.7)
T3, T4	10 (32.3)
Lymphatic metastasis, *n* (%)	6 (19.4)

IPMC-I, intraductal papillary mucinous carcinoma.

Image Analysis

Two abdominal radiologists in this hospital read the CT scans without prior knowledge of IPMN diagnosis. Data recorded included tumor location, size, calcification, presence or absence of mural nodules and their size, reinforcement degree, lymph node metastasis, vascular invasion, maximum diameter of the pancreatic duct and cystic tumor, T staging, lymphonodus metastasis staging, and catheter type based on international consensus standards divided into the main duct type, branch duct type, and mixed type (14).

Tumor staging was reviewed according to the seventh edition of the American Joint Committee on Cancer (15). In the T1 stage, the tumor is less than 2 cm in maximum diameter and confined to the pancreas, whereas in the T2 stage, the tumor is greater than 2 cm in maximum diameter and is still confined to the pancreas. In the T3 stage, there is pancreatic tissue around the local tumor invasion or tumor invasion occurs in the duodenum and/or common bile duct, but there is no infringement of the celiac and superior mesenteric artery. In the T4 stage, there is tumor invasion of the celiac and/or duodenal artery. Finally, progression to lymph node metastases occurs when the lymph short diameter is >5 mm, or just a necrotic lymph node whatever lymph node size.

Ethical Approval

This retrospective study was approved by the hospital review board, and this study was approved by the research ethics