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RAPID COMMUNICATION

Clinical significance of main pancreatic duct dilation on computed tomography: Single and double duct dilation

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Abstract

AIM: To study the patients with main pancreatic duct dilation on computed tomography (CT) and thereby to provide the predictive criteria to identify patients at high risk of significant diseases, such as pancreatic cancer, and to avoid unnecessary work up for patients at low risk of such diseases.

METHODS: Patients with dilation of the main pancreatic duct on CT at Emory University Hospital in 2002 were identified by computer search. Clinical course and ultimate diagnosis were obtained in all the identified patients by abstraction of their computer database records.

RESULTS: Seventy-seven patients were identified in this study. Chronic pancreatitis and pancreatic cancer were the most common causes of the main pancreatic duct dilation on CT. Although the majority of patients with isolated dilation of the main pancreatic duct (single duct dilation) had chronic pancreatitis, one-third of patients with single duct dilation but without chronic pancreatitis had pancreatic malignancies, whereas most of patients with concomitant biliary duct dilation (double duct dilation) had pancreatic cancer.

CONCLUSION: Patients with pancreatic double duct dilation need extensive work up and careful follow-up since a majority of these patients are ultimately diagnosed with pancreatic cancer. Patients with single duct dilation, especially such patients without any evidence of chronic pancreatitis, also need careful follow-up since the possibility of pancreatic malignancy, including adenocarcinoma and intraductal papillary mucinous tumors, is still high.

INTRODUCTION

Diseases of the pancreas, such as pancreatitis and pancreatic cancer, are common, unfortunately, they are often more difficult to diagnose than those of other abdominal viscera[1,2].

Diagnostic methods for pancreatic diseases include blood chemical tests, such as lipase, amylase, etc, and imaging tests, such as abdominal ultrasound, endoscopic retrograde cholangiopancreatography (ERCP), magnetic resonance cholangiopancreatography (MRCP), computed tomography (CT), *etc*[1-4]. Among all the diagnostic modalities, CT has been used with increasing frequency in clinical practice to diagnose pancreatic diseases[5,6].

Unlike luminal gastrointestinal organs, such as the esophagus or the stomach, the pancreas is an organ that has two major parts: pancreatic parenchyma and a pancreatic duct system. Diseases of the pancreas may cause changes in the pancreatic parenchyma, such as acute pancreatitis, or changes in the pancreatic duct system, such as pancreatic cancer or changes in both pancreatic parenchyma and pancreatic duct, such as chronic pancreatitis[1-6].

The pancreatic duct system consists of the main duct and side branches[1,2]. In clinical practice, it is not uncommon to encounter CT reports of a dilated main pancreatic duct. However, the clinical significance of a dilated main pancreatic duct on CT is not very clear. In our review of literature, no prior study that specifically linked clinical outcome with dilation of the pancreatic duct noted on CT has been found. We conducted a retrospective study of the significance of a dilated main pancreatic duct on CT to provide predictive criteria to identify patients at high risk of significant diseases.

MATERIALS AND METHODS

This is a retrospective study performed at Emory

Table 1 Diagnoses in 77 patients with pancreatic duct dilation on CT

Diseases	*n*	%
Chronic pancreatitis	40	52
Pancreatic carcinoma	17	22
Idiopathic dilation	10	13
IPMT	2	3
Cholangiocarcinoma	2	3
Acute cholecystitis	2	3
CBD + PD stone	1	1
CBD stone	1	1
Pancreatic sarcoma	1	1
Cirrhosis	1	1
Total	77	100

IPMT: Intraductal papillary mucinous tumors; PD: pancreatic duct; CBD: common bile duct.

University Hospital, a tertiary care facility in Atlanta, Georgia. The radiology information system IDXRAD (IDX system, Burlington, Vermont) was used, and character string "dilated pancreatic duct" was searched. Patients at Emory University Hospital, who underwent abdominal CT in 2002, were included in the search. Each patient's clinical course and ultimate diagnosis were reviewed by abstraction of computer database records using Powerchart (Cerner Corp, North Kansas City, MO). All CTs were performed with oral and intravenous contrast. For intravenous contrast, 150 mL of Omnipaque (Amersham Health, Princeton, NJ) was given. Detailed information about oral contrast administration was not documented in the CT reports. All patients received helical CT, and images were obtained at 2.5-5 mm increments.

All the patients had more than one abdominal CTs during the study. The first CT scan showing pancreatic duct dilation was used for this study. The presence or absence of a pancreatic mass on the CT scan was reviewed for each patient. Liver function tests within 30 d of CT scan were also reviewed.

While there are no strict criteria for diagnosis of main pancreatic duct dilation, generally if the main pancreatic duct measures greater than 3 mm in the head and 2 mm in the body or tail of the pancreas, it is considered enlarged at Emory University Hospital. For diagnosis of bile duct dilation, a common bile duct measuring greater than 6 mm is considered enlarged in a patient who has a gallbladder. When the gallbladder is absent or the patient is an elderly, a few mm more is considered within normal limits (up to 10 mm in selected cases). The diagnosis of pancreatic cancer was based on pathology, cytology or autopsy. The diagnosis of chronic pancreatitis was made based on CT findings at clinical presentation including pancreatic atrophy, parenchymal calcifications and ductal dilation. If patients did not have any identifiable pancreatic, liver or biliary diseases, the dilation was considered to be idiopathic, even though those patients might have other significant diseases, such as gastric cancer or renal failure.

Fisher's exact test was used to evaluate the differences in percentage of malignancy between patients with single duct dilation and those with double duct dilation (the definition of single and double duct dilation was described in the Results section). A statistical computer program ELTS (ELTS, Chicago, IL) was used to generate these values. The Student's t test (Microsoft Excel, Microsoft Widows, 1997) was used to test the difference in mean age between patients with single duct dilation and double duct dilation. A P value of less than 0.05 was considered statistically significant.

Table 2 Diagnoses in 51 patients with pancreatic single duct dilation

Diseases	*n*	%
Chronic pancreatitis	37	73
Idiopathic dilation	8	15
Pancreatic carcinoma	2	4
IPMT	2	4
Pancreatic sarcoma	1	2
Acute cholecystitis	1	2
Total	51	100

RESULTS

Seventy-seven patients, including 47 male and 30 female, were identified with a report of a dilated main pancreatic duct on CT during this study. The mean age of the patients was 58 years. The majority were patients with chronic pancreatitis and/or pancreatic cancer (Table 1). Based on careful review of the CT reports, the patients were divided into two groups: (1) patients with only main pancreatic duct dilation (single duct dilation) and (2) patients with concomitant biliary duct dilation (double duct dilation).

Isolated main pancreatic duct dilation (single duct dilation, SDD)

Among the 77 patients, 51 had SDD. In these patients, the common bile duct (CBD) and the intrahepatic bile ducts (IHBD) were not dilated. Most of the patients in this group had chronic pancreatitis. The second most common diagnosis for this group was idiopathic dilation (Table 2). About one-third of patients with SDD and without chronic pancreatitis had pancreatic malignancy.

Main pancreatic duct dilation and concomitant biliary dilation (double duct dilation, DDD)

The remaining 26 patients had DDD. These patients had concomitant CBD and/or IHBD dilation. Most of the patients in this group had pancreatic cancer, followed by chronic pancreatitis (Table 3). No patient diagnosed with pancreatic cancer had co-existent chronic pancreatitis.

Pancreatic mass

Seventeen patients had pancreatic mass identified by CT, including 12 patients in the DDD group and five in the SDD group. Among the fifteen patients in the DDD group who had pancreatic cancer, four did not have a discrete pancreatic mass identified on CT, but had a prominence of the pancreatic head.

Liver tests

All patients had liver function tests done within 30 d of the CT, which found abnormal liver in 22 patients. Among

Table 3 Diagnoses in 26 patients with pancreatic double duct dilation

Diseases	*n*	%
Pancreatic carcinoma	15	58
Chronic pancreatitis	3	12
Cholangiocarcinoma	2	8
Idiopathic dilation	2	8
CBD+PD stone	1	4
CBD stone	1	4
Cirrhosis	1	4
Acute cholecystitis	1	4
Total	26	100

Table 4 Comparison of single duct dilation and double duct dilation

	SDD	DDD	*P*
Number	51	26	
Age (mean yr)	55	65	> 0.05
Diagnosis: *n* (%)			
Benign	46 (90)	9 (35)	< 0.05
Malignant	5 (10)	17 (65)	< 0.05

SDD: Single duct dilation; DDD: Double duct dilation.

the 22 patients, 15 had DDD while the other 7 had SDD. Among the 7 patients with SDD, 5 had elevated alkaline phosphatase only.

Follow-up

As mentioned in the Methods section, all patients had more than one abdominal CT in this study. Repeated CTs were generally obtained 3-6 mo after the initial CT. Although there were changes from the original radiology, such as a mass enlargement (cancer) or mass diminution (inflammation), the main diagnosis of chronic pancreatitis or pancreatic cancer, remained the same at the follow-up CT. The five patients with SDD and pancreatic head mass were proven to have inflammatory masses at follow-up. Two patients with SDD were proven to have intraductal papillary mucinous tumors (IPMT).

Statistical analysis

Comparison was performed between patients with SDD and patients with DDD. Patients with DDD had a significantly higher incidence of pancreatic cancer than those with SDD (17/26, 65% *vs* 5/51, 10%) (Table 4). Patients with DDD also had a much higher incidence of abnormal liver tests than those with SDD (15/26, 58% *vs* 7/51, 14%). IPMT was only presented in 2 patients with SDD but in no patients with DDD.

DISCUSSION

The most interesting finding of this study is that the majority of patients with SDD had benign pancreatic diseases. In contrast, more than half of the patients with DDD had malignant diseases. Among the patients with DDD who had pancreatic cancer, about one-fourth (4/15) did not have a discrete pancreatic mass identified on CT. Another interesting finding is that patients with SDD had a high possibility of pancreatic malignancy if there was no evidence of chronic pancreatitis.

CT has been used in clinical practice for more than two decades[5,6]. It has become an established diagnostic procedure in a variety of common gastrointestinal disorders and an important tool in clinical practice. CT is a major modality in diagnosis of pancreatic diseases, including pancreatitis and pancreatic cancer[5,6]. Pancreatic duct width measurements are now used as one of the major criteria for diagnosing certain pancreatic diseases[5-7]. Although there are no official guidelines for diagnosis of dilation of pancreatic duct, recognition of pancreatic duct dilation on CT is not difficult. Published studies have shown that the normal width of the pancreatic duct in a healthy adult is slightly different in the head, body and tail of the pancreas[5-7]. Although the width may be affected by age, variation should not be greater than 1mm in each part of the pancreas[7,8]. The width of the main pancreatic duct is similar in population groups studied, such as in Europe, Asia, and America[9-12]. Furthermore, it is believed that bile duct dilation may occur after cholecystectomy, however, there are no enough data to support this. Although seven patients in this study, four in the SDD group and three in the DDD group, had documented histories of cholecystectomy, we did not see any effect of cholecystectomy in this study.

Although pancreatic duct dilation alone does not always provide accurate information to distinguish the normal from the diseased pancreas, chronic pancreatitis and pancreatic cancer are the two most common diseases causing main pancreatic duct dilation[5-7].

In this study, we retrospectively reviewed all patients with main pancreatic duct dilation reported during the study. In general, chronic pancreatitis was the most common disease in this group. Fifty-two percent (40/77) of patients had chronic pancreatitis and 22 percent of patients (17/77) had pancreatic carcinoma. The dilation of main pancreatic duct in patients with pancreatic cancer may be slightly more prominent than that in patients with chronic pancreatitis. But, it is impossible to differentiate these two diseases based only on the degree of main pancreatic duct dilation.

However, patients with concomitant biliary duct dilation, either involving the common bile duct (CBD) or involving the intra-hepatic ducts, had more than a 60% chance of having pancreatic cancer. Patients with SDD also had a 35% chance of having pancreatic malignancy if there was no chronic pancreatitis.

There is sparse information in the literature about the significance of a dilated main pancreatic duct on CT. In contrast, a study of intra-operative ultrasound indicated that pancreatic duct dilation, stricture or invasion of the superior mesenteric vein, and common bile duct dilation may help to establish a diagnosis of malignancy[13]. One study from Japan found the presence of a dilated pancreatic duct to be a sign of high risk for pancreatic cancer by transabdominal ultrasound, but did not evaluate any correlation with dilation of the biliary ducts as in this study[14].

MRCP is rapidly gaining acceptance as a useful noni-

nvasive tool for evaluation of the pancreatic duct. Several studies have been published comparing it to ERCP in diagnostic yield[15-19]. None of these studies has conclusively validated the predictive power of MRCP in evaluation of a dilated pancreatic duct.

Dilation of the main pancreatic duct and biliary duct could be caused by a luminal stricture in the distal bile duct in many, if not in all of the cases. If this assumption is true, our results can be compared to studies of the so called "double duct sign"[20-22]. The double duct sign is defined as coexistent and adjacent stenosis of the main pancreatic and CBD as seen on ERCP. Initially, the double duct sign was thought to predict the presence of pancreatic carcinoma with a specificity approaching 100%. Recently, a study indicated that the specificity of the double duct sign in predicting the presence of pancreatic cancer appears to be lower than previously reported[22]. In this study, the specificity of the double duct sign for pancreatic cancer was 85%. In our study, the specificity of the DDD for pancreatic cancer is 82%, approaching that of the ERCP study and reflecting the similarity of the imaging findings.

There are limitations as with all retrospective studies. It is possible that not all patients with main pancreatic duct dilation could be captured by the computer search either because the character string did not appear as searched in the report or because the dilation was not reported. It is unclear whether only cases of isolated main pancreatic duct dilation were missed or if cases of double duct dilation were also missed. How this would impact the results of the study is unknown. All patients in this study were followed up and repeated CTs were performed for most of the patients. The chance of missing pancreatic cancer is very low in these patients. In addition, the degree of dilation of the main pancreatic duct is rarely reported objectively in millimeters, over- or under-reported cases may occur as inter-observer variability.

Two-third of patients with SDD had chronic pancreatitis; the next most common diagnosis was idiopathic dilation in 15%. CT and ERCP as well as clinical presentations were used to diagnose chronic pancreatitis in this study. For the 10 patients with idiopathic dilation, chemical tests to rule out subtle chronic pancreatitis were not performed. We do not know the etiology of the pancreatic duct dilation in these patients. The mean age of those patients was 63 years, advanced age may not be a contributing factor. The dilation of the main pancreatic duct for these patients was stable on follow-up CTs. Patients with IPMT of the pancreas may present with SDD[23], we had 2 such patients in the SDD group.

In conclusion, we emphasize that although high resolution CT images bring us very important information about the pancreas, there is still no combination of criteria, including clinical and multi-modality imaging, which can reliably distinguish between pancreatic cancer and chronic pancreatitis. Close follow-up in patients with main pancreatic duct dilation on CT is necessary. There are two groups of patients with high risk of pancreatic malignancy: patients with DDD, and patients with SDD but without chronic pancreatitis. Therefore, repeated CTs or other imaging tests, such as ERCP, are necessary in these patients if the initial CT does not show a pancreatic mass.

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