CT FINDINGS OF PANCREATIC ADENOCARCINOMA

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ABSTRACT

The computed tomographic findings of 18 patients with pancreatic adenocarcinoma were reviewed between January 1993 to December 1999 in King Chulalongkorn Memorial Hospital. The diagnosis of pancreatic adenocarcinoma was confirmed by surgical exploration and biopsy in 16 patients (89%), and fine – needle aspiration (FNA) of peritoneal fluid in 2 patients (11%). CT criteria for unresectable included sign of involvement of the major peripancreatic vessels, signs of distant lymph node metastases, or liver metastases.

All patients fulfilled the criteria of unresectability, was found in our series. CT findings of pancreatic adenocarcinoma including, hypodense pancreatic mass with inhomogeneous enhancement (100%), most commonly at pancreatic head (72%), main pancreatic duct dilatation (50%), IHD and/or CBD dilatation (61%), vascular invasion (72%), contiguous organ invasion (22%), metastases (44%), and adenopathy (72%).

IHD = Intrahepatic duct
CBD = Common bile duct

INTRODUCTION

Computed tomography (CT) is the dominant imaging modality used for the diagnosis and staging of pancreatic adenocarcinoma, with an overall accuracy of more than 90% for dynamic CT.[1,2] This high accuracy is in part due to the advanced stage of most tumors at initial presentation.[3]

Despite advanced imaging in the diagnosis of pancreatic adenocarcinoma, 5-year survival rates following surgery continue to be less than 5% in most series, regardless of the type of resection employed (pancreaticoduodenectomy-Whipple resection or total pancreatectomy).[4,5,6] Patients with tumors that did not encase major vessels, and with tumors that have not metastasized to lymph nodes had 5-year survival of 36% and 57% respectively.[7] Thus, whereas it is crucial to avoid unneccessary operation and resection in patients whose tumors have spread beyond the margin of the gland and thus are unresectable for cure, it is equally important to attempt resection in the small group of patients with potentially curable tumors.

Radiologic staging of pancreatic carcinoma is based on evaluation of tumor extension beyond the margin of the gland and an identification of distant metastases, particular to the liver and regional lymph nodes. Spiral CT has been reported to provide high quality images of the pancreas during a single breath hold,[8,9] with excellent resolution of fine detail such as the pancreatic duct.[10]

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The purpose of this paper is to report computed tomographic findings of pancreatic adenocarcinoma which can be used to identify resectable or unresectable cases.

MATERIALS AND METHODS

A retrospective series of 18 patients with pancreatic adenocarcinoma between January 1993 to December 1999 in King Chulalongkorn Memorial Hospital were reviewed. The diagnosis of pancreatic adenocarcinoma was confirmed by surgical exploration and biopsy in 16 patients (89%), and fine-needle aspiration (FNA) of peritoneal fluid in 2 patients (11%).

CT techniques

CT scan were performed with the CT Sytec 4000 (GE Medical Systems) in 17 cases and 1 case with the spiral CT (Siemen, Somatom Plus 4). All patients received 500 ml of 0.7% ionic water-soluble solution to opacify the stomach and small bowel. Noncontrast enhanced scans were obtained through the liver, pancreas and kidneys at 10 mm slice thickness in all patients. In 17 cases with conventional CT, intravenous contrast enhancement was achieved with 60% iodinated ionic or nonionic water-soluble contrast material administered by an injector at a rate of 1.5 ml/sec for a total of 100 ml. After complete contrast material injection, scans through liver, pancreas and kidney were performed at 10 mm contiguous slice thickness.

In 1 case with dual phase CT scan, intravenous contrast enhancement was performed with angiograffin administered by a rate for 1.5 ml/sec for a total of 100 ml. After intravenous contrast enhancement injection in 25 sec, a dynamic series of scans through the pancreas was performed at 5 mm slice thickness for arterial phase and a delayed for 85 sec after injection for venous phase.

CT scan interpretation

The 18 CT scans were reviewed retrospectively and the following 7 parameters were evaluated

1. Pancreatic mass (location, size, attenuation, enhancement)
2. Main pancreatic duct dilatation
3. Intrahepatic duct and common bile duct dilatation
4. Contiguous organ invasion (liver, stomach, root of the small bowel mesentery, duodenum)
5. Vascular invasion or tumor-vessel contiguity (tumor partially or completely surrounding a major extrapancreatic artery or vein ; tumor-vessels contiguity : tumor immediately contiguous with vessels with no intervening normal fat plane)
6. Metastasis (liver, lung, peritoneum)
7. Adenopathy

CT staging

The tumor was considered technically unresectable when CT revealed signs of involvement of the major peripancreatic vessels (superior mesenteric and splenic vessels, the portal vein, and the main hepatic artery), signs of distant lymph node metastases, or liver metastases.[11]

RESULT

Eighteen patients were evaluated by 17 conventional and 1 spiral thin-section contrast-enhanced CT, and all patients fulfilled the criteria for unresectability. The study population consisted of 10 women and 8 men, with a median age of 61 years (range : 51 to 72 years). The findings noted at histopathologic examination of the resected tumor specimens were adenocarcinoma. The tumor size was range from 2-17 cm. All pancreatic tumors were hypodensity lesion with inhomogeneous enhancement, located in the head of the gland in 13 tumors, the body in 4, the tail in 3, and the uncinate process in 4. (FIG. 1) Some

tumors were involved more than one location.

The most common findings was a pancreatic mass (100%), main pancreatic duct dilatation (50%), intrahepatic duct and/or common bile duct dilatation (61%) (FIG. 2) and extrapancreatic tumor extension. Extrapancreatic tumor extension encompassed the following findings : (1) tumor involvement of contiguous organs (22%), most commonly the stomach, mesentery, anterior abdominal wall, and duodenum. (FIG. 3) (2) vascular invasion or tumor–vessel contiguity, most often involving the superior mesenteric artery and vein, splenic vein, portal vein, inferior vena cava, common hepatic artery. (FIG. 4) Eight patients had metastases, most commonly in liver (33%) (FIG. 5), lung (11%), and the peritoneum (11%). Enlarged lymph nodes were identified on thirteen patients, including peripancreatic, periportal, celiac trunk, aortocaval, paraaortic, retrocaval, cardiophrenic lymph nodes. (FIG. 6) The results are summerized in Table I

TABLE I : CT FINDINGS

CT FINDINGS		No OF PATIENTS (%)
1.	TUMOR MASS	18 (100)
	- Hypodensiy lesion with inhomogenous enhancement	18 (100)
	- Location .... Head	13*
	Uncinate process	4*
	Body	4*
	Tail	3*
2.	MAIN PANCREATIC DUCT DILATATION	9 (50)
3.	IHD AND / OR CBD DILATATION	11 (61)
4.	CONTIGUOUS ORGAN INVASION**	4 (22)
5.	METASTASES	8 (44)
	- liver	6 (33)
	- lung	2 (11)
	- peritoneum	2 (11)
6.	VASCULAR INVASION / TUMOR-VESSEL CONTIGUITY	17 (94)
	- VASCULAR INVASION***	13 (72)
	- tumor - vessel contiguity	4 (22)
7.	ADENOPATHY****	13 (72)

* Number in location of the tumors which some of them had more than one location.

** stomach 2, mesentery 1, anterior abdominal wall 1, duodenum 1.

*** superior mesenteric artery 3, superior mesenteric vein 8, splenic vein 7, portal vein 1, inferior vena cava 1, common hepatic artery 1.

**** peripancreatic, periportal, celiac trunk, aortocaval, paraaortic, retrocaval, cardiophrenic lymph nodes.

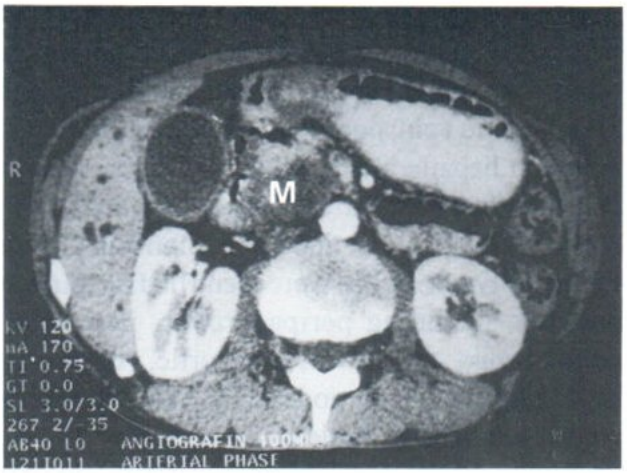

Fig. 1A. The arterial phase dynamic CT scan showed a 4 cm. low density lesion at pancreatic head. (M)

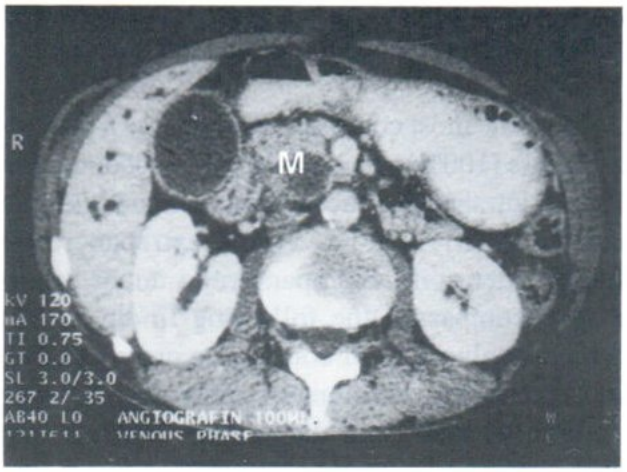

Fig. 1B. The venous phase dynamic CT scan revealed inhomogeneous enhancement of the pancreatic head mass. (M)

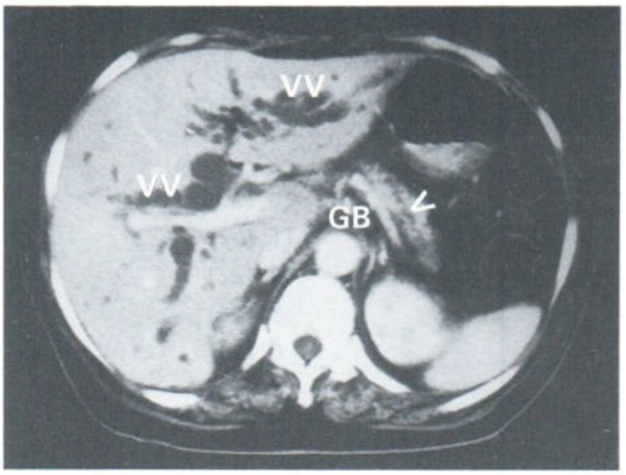

Fig. 2A. The CECT scan of the liver showed intrahepatic bile duct dilatation (VV) and main pancreatic duct dilatation (V) at the tail region. (Gb = gall bladder)

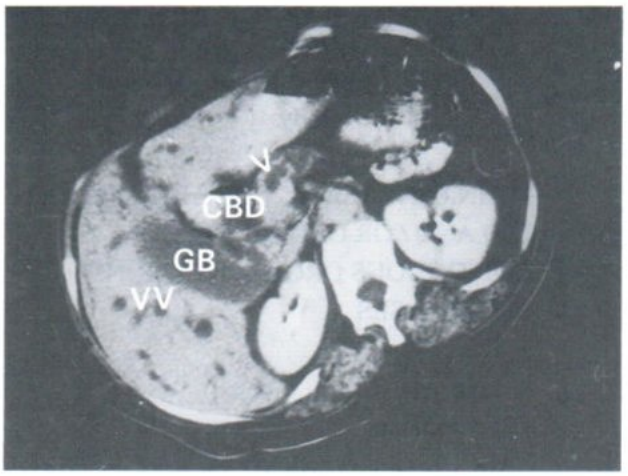

Fig. 2B. The CECT scan showed main pancreatic duc dilatation (V), dilated CBD and intrahepatic duct dilatation (VV) caused by pancreatic head adeno carcinoma which did not show in this figure.

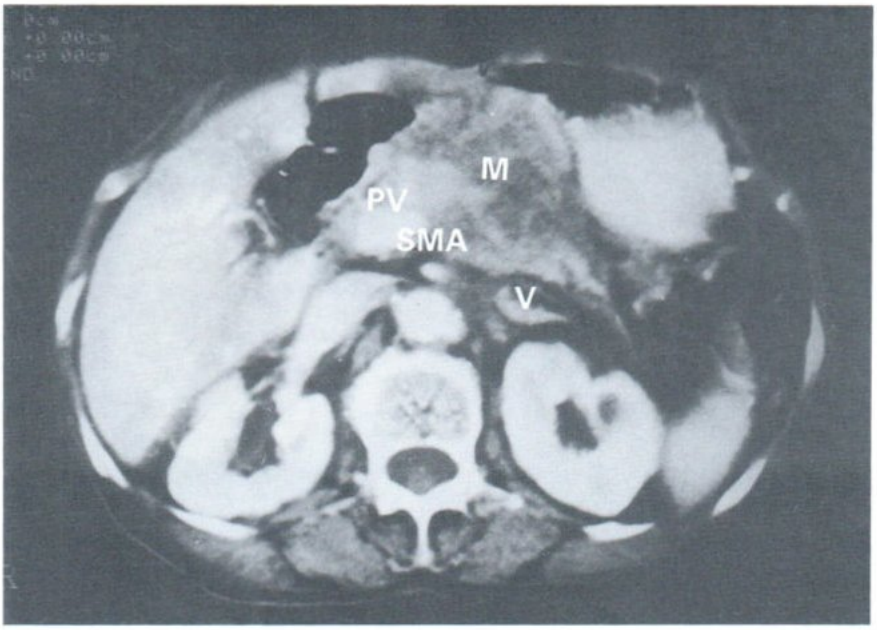

Fig. 3. The CECT scan showed a large inhomogeneous enhanced mass at body and tail of pancreas (M) encased SMA, portal vein (PV) and involved posterior wall of stomach (V).
SMA = Superior Mesenteric Artery

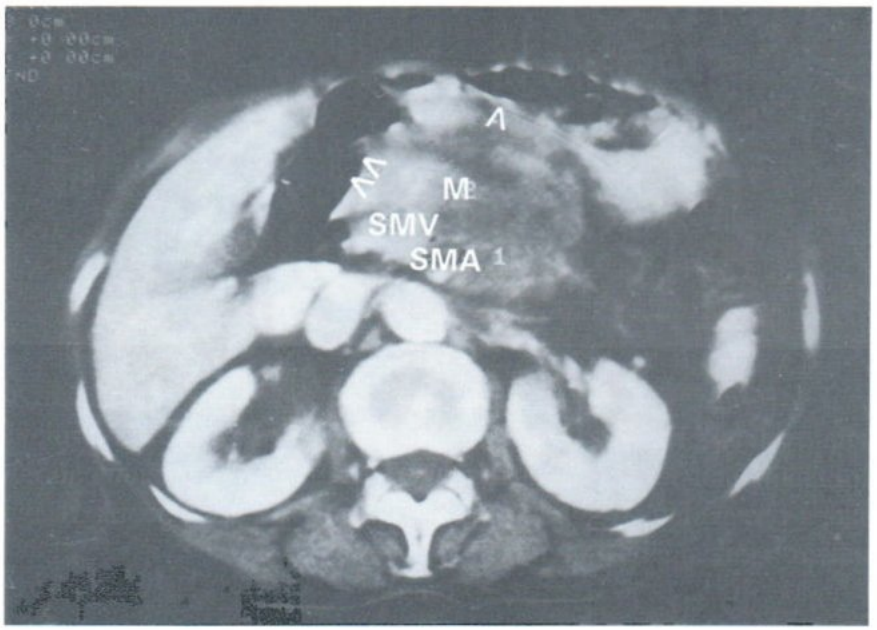

Fig. 4. The CECT scan showed a 6 cm. Inhomogeneous enhanced mass (M) at pancreatic body encased SMA, SMV and posterior wall of stomach (Λ) and medial wall of duodenum (ΛΛ) involvement due to loss of intervening fat plane.

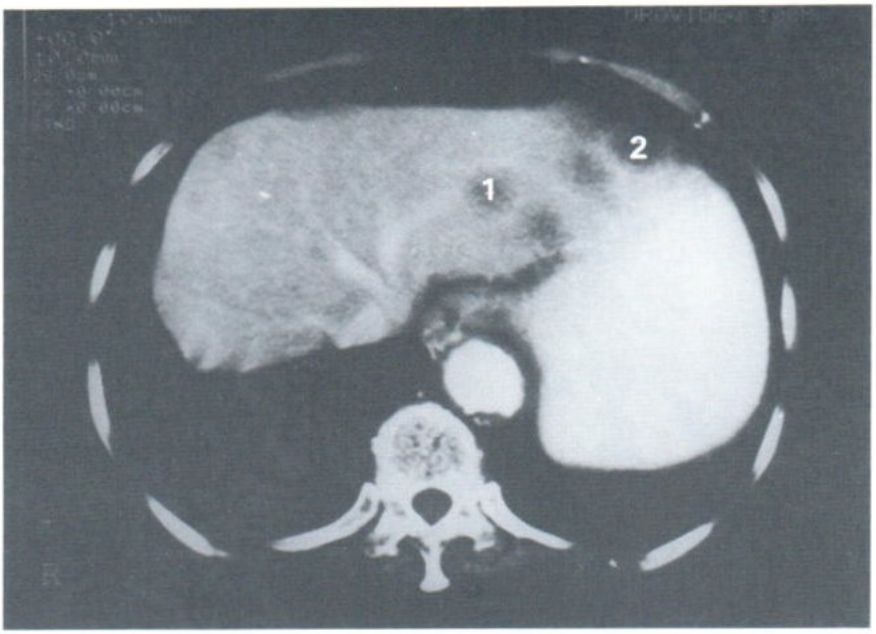

Fig. 5. The CECT scan revealed multiple low density lesions in both hepatic lobes, liver metastasis from pancreatic adenocarcinoma. (1, 2)

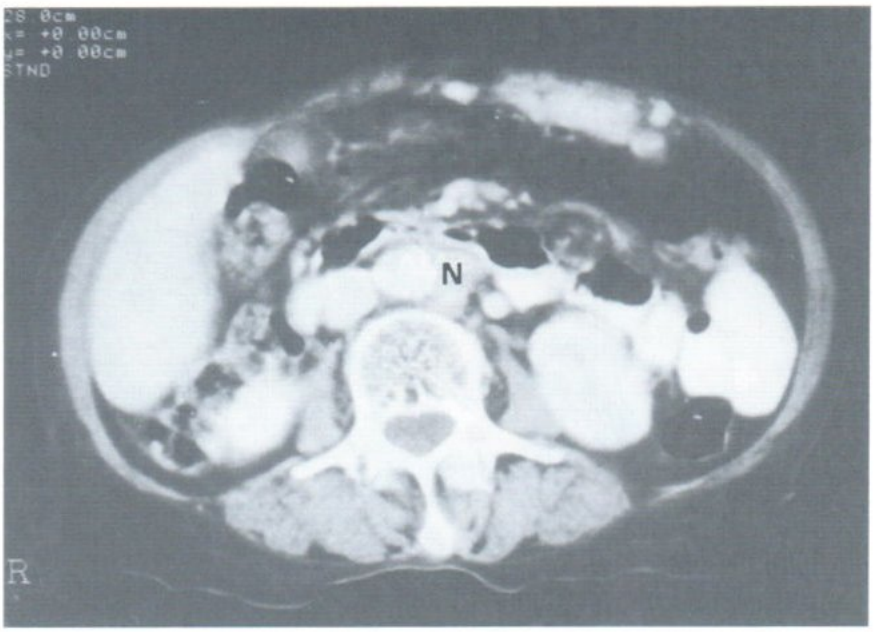

Fig. 6. The CECT scan showed a 2 cm. Left para aortic lymph node (N), lymphatic spreading of pancreatic adenocarcinoma.

DISCUSSION

Dynamic CT currently is the imaging modality of choice for diagnosis and staging of pancreatic carcinoma. It has an accuracy of 72% in predicting tumor resectability and an accuracy of virtually 100% in predicting tumor unresectability.[12] Many patients were found unresectable at laparotomy due to locally advanced diseases because of vascular encasement not well demonstrated by preoperative CT.[13] Most symptomatic patients with pancreatic carcinoma had unresectable tumors at the time of initial clinical presentation. 18 (100%) patients in this study had unresectable tumors by CT criteria and 44% of these patients had 3 to 5 CT criterias of unresectability, indicating widespread disease. It should be emphasized that the CT findings of a pancreatic mass are nonspecific, even when ancillary criteria of unresectability are present. Focal pancreatitis, other types of pancreatic neoplasms, particularly nonfunctioning islet cell carcinoma, metastases, and lymphoma, and variations in size and shape of the normal pancreas can mimic the CT appearance of pancreatic adenocarcinoma.[2]

In our 18 cases with radiologic findings, all (100%) tumors were hypoattenuating. This is not significantly different from the results reported previously by Freeney et al,[1] although their study population was primarily composed of patients with unresectable tumors (154 of 161 patients). In that series, 83% of tumors displayed focal area of hypoattenuation compared with the normal pancreas. The relative attenuation of the tumor to the pancreas is related to its vascularity compared with that of the surrounding pancreas. This relative attenuation is therefore a function of the presence of underlying parenchymal disease in the pancreas and changes as a function of time after intravenous contrast administration. Pancreatic adenocarcinoma also tends to incite a local fibrotic tissue response. Presumably, the blood supply to the tumor is frequently lesser than that to normal pancreas, and this difference accounts for relative tumor hypoattenuation. It seems likely that tumors that are isoattenuating to the pancreas at routine spiral scanning may become hypo-attenuating relative to the pancreas during the arterial phase and their conspicuity would subsequently be increased.[14] Secondary signs other than a focal mass are usually helpful in the diagnosis of pancreatic cancer. These signs include pancreatic and common bile duct dilatation and atrophy of the pancreas distal to the tumor. A high degree of suspicion for a malignant neoplasm must be present in the case of atypical pancreatic masses that may be isoattenuating and detected only as a bulge in the pancreatic contour, without evidence of pancreatic or bile duct dilatation.[3]

Spiral CT with overlapping reconstruction intervals every 4 mm has been shown to increase the detection of small lesions in the liver compared with that of contiguous 8 mm transaxial imaging.[15] However, in addition to lesion detection, it is necessary to characterize these focal abnormalities. Accurate assessment of tumor size was aided by obtaining overlapping axial reconstruction every 4 mm.

Because the pancreas is an extremely vascular organ and has a rich arterial supply, arterial phase scanning would likely have been more optimal for pancreatic tumor evaluation but less optimal for detection of liver metastases. Dual-phase arterial and portal phase scanning of the pancreas and liver, respectively, will likely prove advantageous for staging pancreatic neoplasm.[14] With arterial phase scanning of the pancreas, attenuation differences between tumor and the normal pancreas may be increased, rendering the tumor more conspicuous. In this study, 1 case of dual phase CT scan showed a 4 cm hypodense mass as compared to normal enhancing pancreatic parenchyma in arterial phase at pancreatic head and the uncinate process and inhomogeneous enhancement in portal venous phase.

Further progress in preoperative tumor staging for pancreatic ductal adenocarcinoma should be directed toward improving the detection of small pancreatic tumors and assessing early metastatic disease.

CONCLUSION

CT findings of pancreatic adenocarcinoma in our series included, hypodense pancreatic mass with inhomogeneous enhancement (100%), location most commonly at head (72%), main pancreatic duct dilatation (50%), IHD and/or CBD dilatation (61%), vascular invasion (72%), contiguous organ invasion (22%), metastases (44%), and adenopathy (72%). All of our cases are unresectable tumor. CT scan provides the preoperative information for appropriate surgical planning. Spiral CT scan is very helpful in detection small pancreatic tumors and detail of extension of disease.

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