

## CT Features of Carcinoma of the Pancreas: Relativity to Tumor Sites

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### — Abstract —

Twenty-one patients with carcinoma of the pancreas were analyzed regarding the propensities for hepatic metastasis, peripancreatic vascular invasion, peritoneal implantation, and ascites. Tumors were located at the head (n=5), neck (n=1), body (n=9), tail (n=5), and body and tail (n=1). For every parameter, the grade was scored and compared.

Liver metastases were present in 11 patients (52%) and frequently associated with carcinoma of the head. Vascular invasions of the celiac trunk, superior mesenteric, and splenic vessels were seen in 11 patients (52%). Eight out of nine patients with carcinoma of the body (89%) showed peripancreatic vascular involvement. Intraperitoneal tumor implantation was present in 16 patients (76%), which included all six patients with tail cancer. Ascites was seen in six patients (29%); carcinomas of the tail (40%) were slightly more prone to have ascites than those of the body (33%). None of the carcinomas of the head or neck was associated with ascites.

It was concluded that the high incidence of vascular invasion in carcinomas of the body was due to anatomical approximation to vascular structures and that the higher incidence of intraperitoneal seeding in carcinomas of the tail was due to anatomical basis of intraabdominal location.

**Index Words:** Pancreas, CT 770.1211  
Pancreas, neoplasms 770.321  
Pancreas, tumor behavior  
Pancreas, vascular invasion  
Pancreas, peritoneal implantation

### Introduction

Since most patients with pancreatic carcinoma have an unresectably disseminated disease at the time of presentation, a noninvasive diagnostic technique for reliably determining the primary lesion and extent of invasion is desirable. To date, CT has been considered useful for this purpose and is an accurate diagnostic measure of pancreatic carcinoma (1-5).

With dynamic CT after intravenous bolus injection of contrast material, sufficient anatomic detail is seen to permit evaluation of the major splanchnic vessels and therefore resectability on the basis of vascular involvement may be accurately assessed (6-8).

It is not the purpose of this study to assess the accuracy of CT in making a diagnosis or in determining the resectability of pancreatic carcinoma, but instead to evaluate the different spreading features of pancreatic carcinoma based on anatomic sites of

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이 논문은 1991년 3월 5일 접수하여 1991년 5월 1일에 채택되었음

Received March 5, accepted May 1, 1991

origin.

## Patients and Methods

From May 1989 to March 1990, 21 patients with carcinoma of the pancreas were reviewed to evaluate the unique spreading modes of these tumors according to each segment of origin in the pancreas. Patients included 16 men and five women aged 44-77 years (mean 63).

Five patients had cancers in the head, one in the neck, nine in the body, and five in the tail. One patient showed carcinoma involving both the body and tail. In three patients, the diagnosis of pancreatic carcinoma was confirmed by surgery. Fine-needle aspiration biopsy was performed in 11 patients either by US- or CT-guided method. Seven patients were diagnosed by a combination of clinical follow-up studies and imaging procedures (CT, ERCP).

To analyze the degree of hepatic metastases, vascular obstruction or encasement, peritoneal tumor implant, and/or ascites, each analytical parameter was classified from grade 0 to 3 (Table 1). The whole grading system was based on CT and no further diagnostic evaluation was performed.

The Kruskal-Wallis test was used to evaluate the statistical significance of the grading system according to the sites of tumors for each parameter. Vascular invasion was defined as either an obstruction or encasement of the peripancreatic arteries or veins (4, 9). When thickened prominent streaks showed crowding and an indistinct outline, it was regarded as an intraperitoneal implantation.

CT was performed with a GE CT/T 9800 Quick scanner (GE Medical System, Milwaukee). Scans were

made with 10mm-thick continuous sections. All scans were performed with intravenous administration of a bolus of 100ml of Rayvist 300 (Schering, Berlin, Germany). In one patient, MRI was studied with a GE Signa 1.5 T system (GE Medical System) to facilitate the evaluation of vascular invasion in carcinoma of the pancreatic body.

## Results

### Size of tumor

The sizes of the pancreatic adenocarcinomas varied from 2.1cm to 9cm (mean 4.5cm). The mean diameters of the lesions in the head, body, and tail were 3.2cm, 5.3cm, and 4.4cm, respectively.

### Hepatic metastasis

Eleven patients showed liver metastases (52%). Carcinoma of the head had a slightly higher tendency of hepatic metastasis than that of the other segments (Fig. 1). No significant relation was found between severity and sites of tumors ( $p>0.05$ ) (Fig. 2).

### Vascular invasion

Vascular obstruction or encasement occurred in 11 patients (52%). Compared to other parts of the pancreas, the body was a significant predilection site for the tumors showing this feature (89%) (Fig. 3).

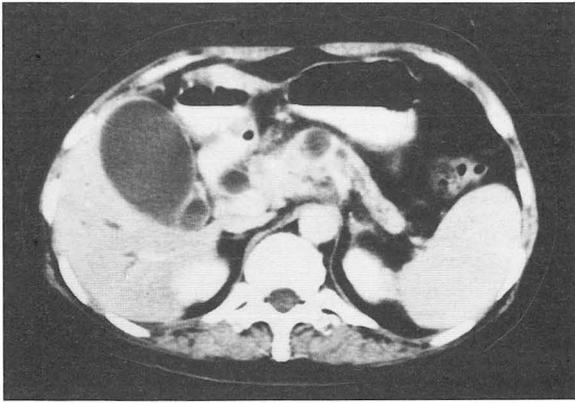
Patients with carcinoma of the body showed a more severe degree of vascular invasion than others ( $p<0.01$ ) (Fig. 4).

One case of carcinoma in the neck and one of the body and tail also presented with vascular invasion. None of the five patients with carcinoma of the pancreatic tail showed this pattern of tumor spread.

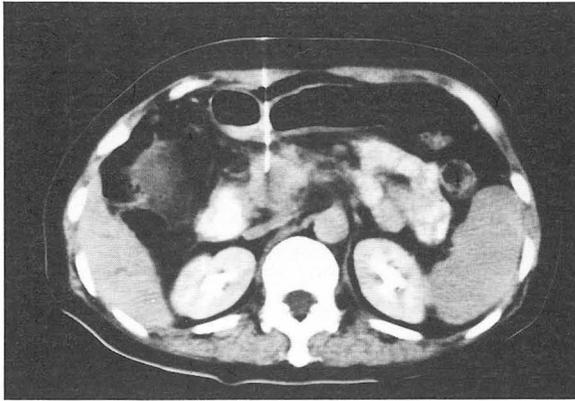
**Table 1.** Criteria of Grading Score on Each Parameter of Pancreatic Cancer

Grades	Analytic Parameter			
	Liver Metastasis	Vascular Encasement	Intraperitoneal Seeding	Ascites
0	(-)	(-)	(-)	(-)
1	1 - 3	1	minimal	minimal
2	4 - 10	2	moderate	moderate
3	11	3	severe	severe

Note: The number in vascular encasement means that of vascular group among celiac trunk, superior mesenteric artery of vein, or splenic arteries or veins.



a



b

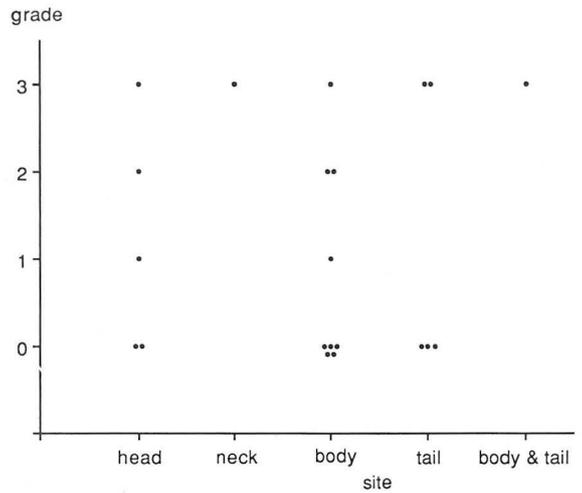
**Fig. 1.** Carcinoma of the head of pancreas. (a) Atrophy of the body and tail of the pancreas is shown. Note the dilated pancreatic duct. Distended GB and dilated intrahepatic duct are also seen. (b) Low density mass is seen in the head. Aspiration needle was penetrated through the mass.

**Intraperitoneal seeding**

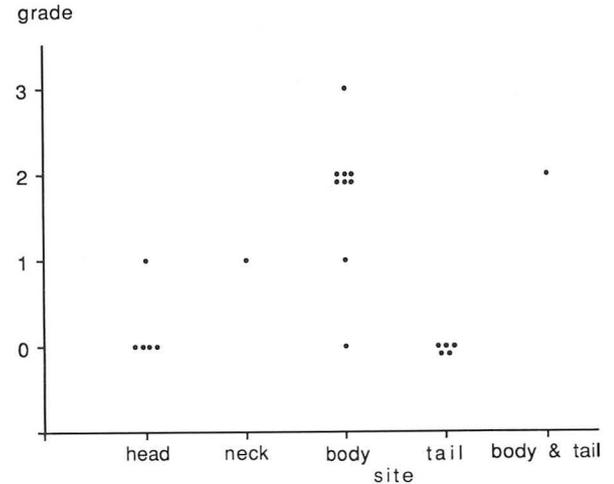
Sixteen patients were found to have peritoneal implantation (76%). All the five patients with carcinoma of the tail showed this type of tumor spread (Fig. 5). The head of the pancreas was the second most frequent site showing this feature. One patient with carcinoma of the neck and one of the body and tail also showed peritoneal seeding. Patients with carcinoma of the tail registered more severe degree of this feature than others ( $p < 0.05$ ) (Fig. 6).

**Ascites**

Six out of 21 patients had ascites (29%) at the time of initial presentation. No ascites was seen in carcinoma of the head and neck. No correlation between



**Fig. 2.** Distribution of Grading Score for Liver Metastasis according to the Sites of Tumor.



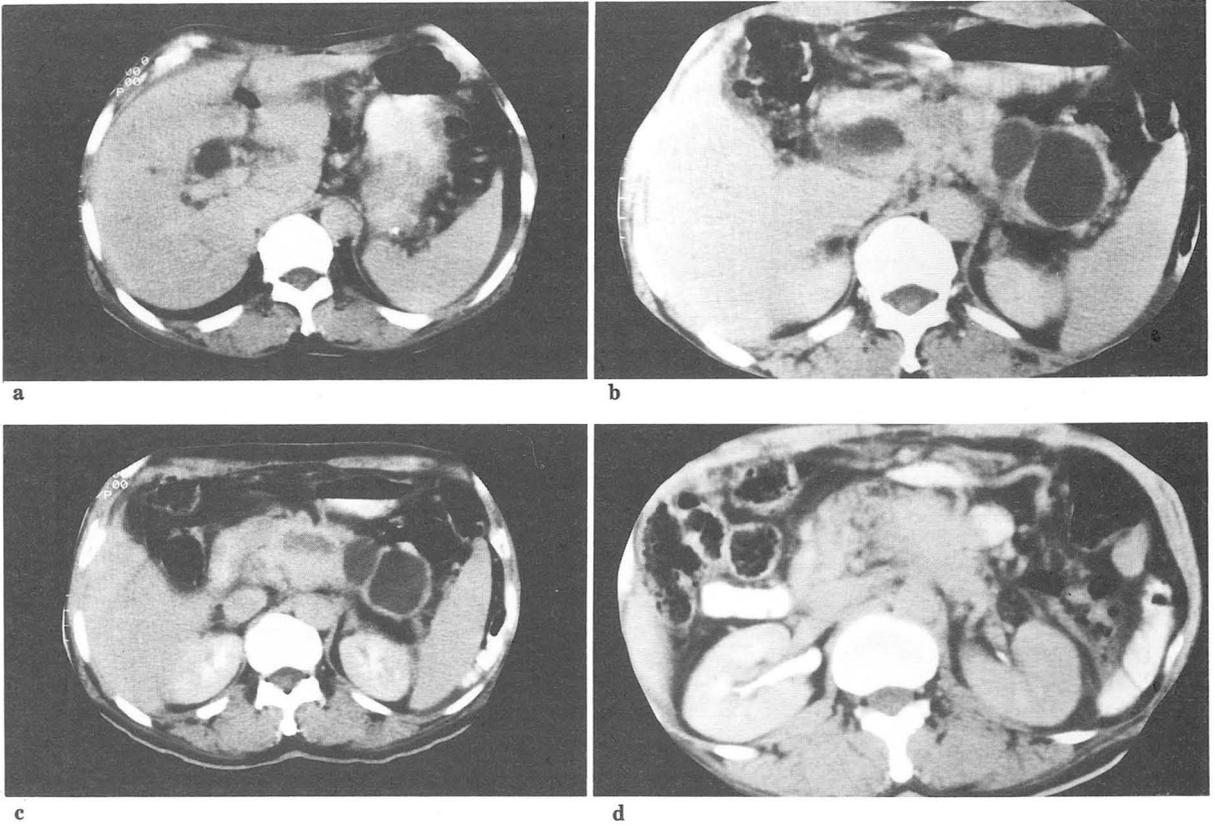
**Fig. 3.** Distribution of Grading Score for Vascular Invasion.

tumor site and degree of ascites was found ( $p > 0.05$ ) (Fig. 7).

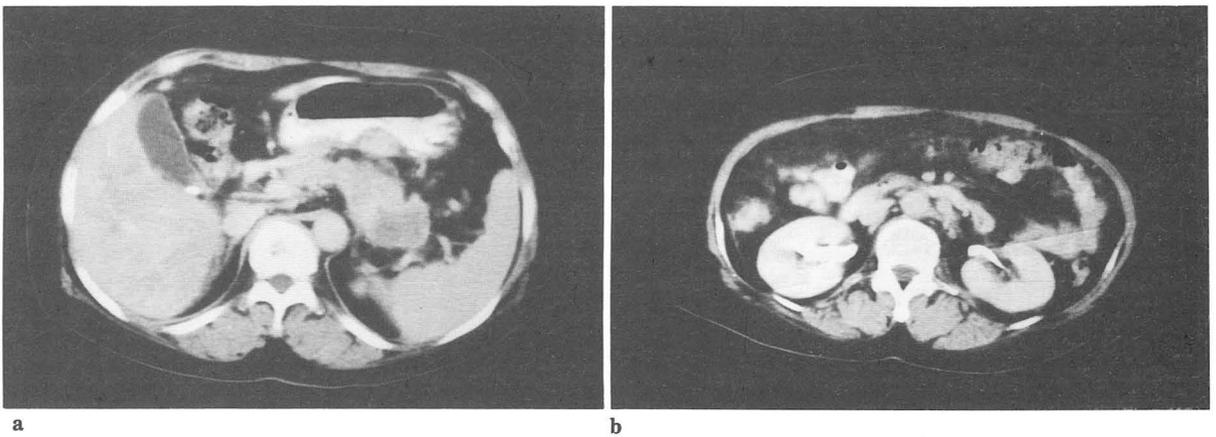
**Discussion**

Most pancreatic tumors originate in the head of the pancreas (10). Since the common bile duct courses directly through it, patients with tumors in this area often have jaundice early. Patients with cancer of the neck, body, or tail frequently present later because of the relative absence of vital structures in this vicinity (11).

A considerable number of patients with carcinoma



**Fig. 4.** Carcinoma of the body of the pancreas. (a) Prominent and dilated perigastric vessels in the gastrosplenic ligament, suggesting perigastric varix because of obstruction of the splenic vein. (b) The splenic vein is obliterated. Pancreatic pseudocyst is appeared in the distal part. (c) 1cm below (b), carcinoma of the body is seen with some necrosis within the mass. (d) Enhancement of superior mesenteric artery is clearly seen as thickened vascular pedicle with retropancreatic tumor extension.



**Fig. 5.** Carcinoma of the tail with peritoneal infiltration. (a) Low density mass in the pancreatic tail is seen. (b) Moderate degree of peritoneal implantation is shown as prominent streaks of soft tissue density in the gastrocolic ligament.

grade

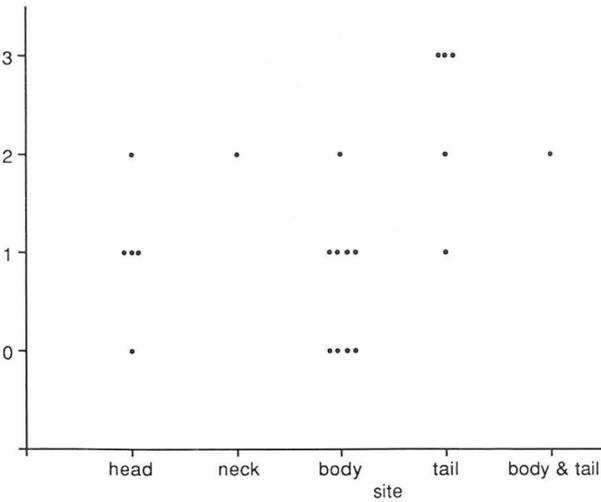


Fig. 6. Distribution of Grading Score for Intraperitoneal Implantation.

grade

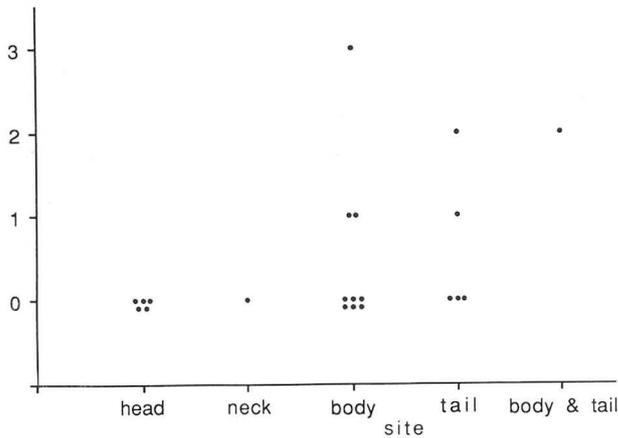
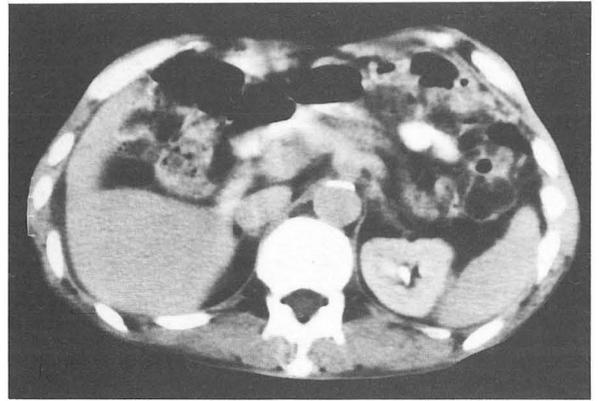


Fig. 7. Distribution of Grading Score for Ascites.

of the tail displayed early intraperitoneal seeding and patients with that of the body showed frequent vascular invasion in our series serves to highlight a previously underemphasized patterns of carcinoma of the pancreas by the anatomic sites of tumors.

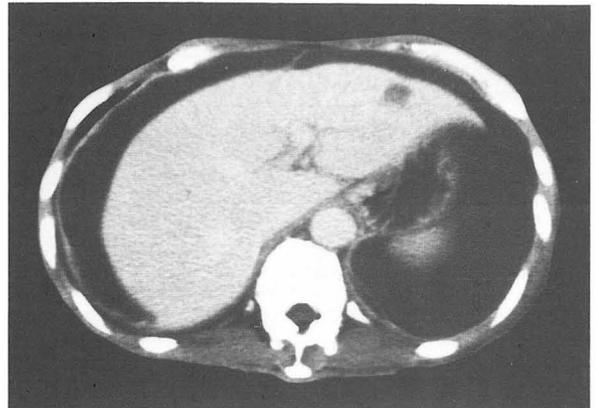
Anatomically, the neck of the pancreas extends forwards, upwards, and to the left from the head and merges into the body. Its posterior surface is apposed with the superior mesenteric vessel and the beginning of the portal vein. The posterior surface of the body is in contact with the origin of the superior mesenteric artery and is intimately related to the splenic veins. The tail of the pancreas points to the splenic hilum and is contained within two layers of



a



b



c

Fig. 8. No visible mass in pancreas. (a) See the thickened celiac trunk like club. (b) Superior mesenteric artery is also encased. No mass is detected in pancreas on CT. (c) Focal hepatic metastasis is seen in the lateral segment of left lobe.

the splenorenal ligament together with the splenic vessels (12, 13).

Because of the anatomical closeness of the neck and body of the pancreas, carcinomas arising in these

areas are considered to have an early and frequent tendency to invade adjacent vascular structures including the celiac trunk, superior mesenteric artery or vein, and/or splenic veins (Fig. 4, Fig. 8). Because the number of cases of the neck of the pancreas was limited, it is difficult to explain a higher incidence of vascular invasion, but patients with carcinoma of the body showed statistically significant feature of vascular invasion ( $p < 0.01$ ).

The low incidence of vascular invasion in carcinoma of the head may partly be due to early presentation as jaundice. It may also be due to the predominant lymphatic drainage of this region into the periduodenal lymphatics (9).

Since the tail of the pancreas is located intraabdominally, carcinomas arising in this part showed a frequent and severe degree of intraperitoneal tumor infiltration.

Even if the primary tumor of the pancreas is not shown on initial CT, the evidence of nearby vascular invasion, along with other associated findings such as distal atrophy of the pancreas or infiltration of peripancreatic fat, may suggest that the origin might be either the neck or body of the pancreas (Fig. 8).

A similar conclusion could be made for carcinoma of the tail of the pancreas, although none of our patients showed this appearance of intraperitoneal implantation without primary tumor in the pancreas.

In conclusion, carcinomas arising in the body of the pancreas showed a significantly higher trend and degree of vascular invasion to the peripancreatic region and lesions in the tail invariably presented intraperitoneal infiltration because of its anatomical location.

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〈국문요약〉

췌장선암의 CT소견 : 암병소와의 관련성

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췌장선암 21명의 환자를 대상으로 간전이, 췌장주위 혈관침윤, 복막침습, 복수의 호발정도를 각 부위별 췌장암과의 관계를 분석하였다. 췌두부는 5명, 경부 1명, 체부 9명, 미부 5명이었고 1예는 췌부와 미부를 동시에 침윤한 췌장암이었다. 또한 각 분석점에 대해 심한 정도를 보기위해 grade를 나누어 비교하였다.

간전이는 11명(52%)에서 보였고 췌두부암에서 보다 높은 빈도를 보였다. 주위혈관침윤은 11명(52%)에서 나타났다. 체부암 환자 9명중 8명에서(89%) 혈관침윤을 보였다. 복막내 중앙침습은 16명(76%)에서 있었으며 미부에서 생긴 췌장암은 모두 이 소견을 보였다. 복수는 6명(29%)에서 보였고 미부암에서 (40%) 체부암에 비하여(33%) 약간 높은 빈도를 나타냈다. 두부나 경부에서 발생한 췌장암에서는 복수의 소견이 없었다.

저자들은 췌부암에서 높은 빈도로 주위 혈관침윤을 보이는 이유는 해부학적인 인접함 때문이고 또 미부암에서 높은 빈도의 복막침습을 보인것은 미부가 복강내 장기이기 때문인것으로 결론지었다.

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