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STUDIES ON THE COMPUTED TOMOGRAPHY OF THE PANCREAS IN PATIENTS OF LIVER CIRRHOSIS

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ABSTRACT

Computed tomography (CT) of the pancreas shows specific images in cases of pancreatitis or malignant tumors. However, precise analysis of CT images of the pancreas in other diseases or in normal individuals has not been made. After an extensive study on the pancreatic CT images of patients without liver cirrhosis, gall stones, diabetes mellitus, malignant tumors or pancreatitis, we reported that CT images of the outer margin or of the content of the pancreas can be divided into three types: smooth, fine-granule, and rough-granule. Since the CT values of the area surrounding rough granules were the same as those of fat, we concluded that the rough-granule type pancreas was rich in fat. We also reported that the incidence of the pancreas having rough-granule type content was low in lean individuals and high in obese ones.

In the present study, CT images of the pancreas in patients with liver cirrhosis were analysed according to our classification with special references to clinical features; the following results were obtained:

1) The incidence of the pancreas having a rough-granule type margin was higher than that in the control patients ($p<0.05$).

2) No significant differences were observed in the incidence of rough-granule type pancreas between lean patients and obese ones.

3) In the patients with rough-granule type pancreas, the blood glucose levels two hours after meal were higher than those in the patients with the other types of pancreas.

4) The incidence of rough-granule type pancreas in patients of liver cirrhosis with ascites was significantly lower than that of the rough-granule type pancreas in patients without ascites.

Keywords: Liver cirrhosis, Ascites, Hypertension, Pancreas, Computed tomography

INTRODUCTION

In the previous study,[1, 2] we reported that the margin and the content of the pancreatic images in computed tomography (CT) can be divided into three types, i.e., smooth, fine-granule, and rough-granule, and that the pancreas of the rough-granule type is considered to be rich in fat deposit because the CT values of the area surrounding rough granules were the

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same as those of fat. We also speculated[1,2] that the high incidence of rough-granule type pancreas observed in obese persons was due to high energy intake and high insulin levels. Since high insulin secretion was reported in patients of liver cirrhosis,[3] it was of interest to see whether or not the incidence of rough-granule type pancreas was high in such patients. In the present study, the relationship between our classification of CT images of the pancreas[2] and the clinical features in liver cirrhosis was investigated.

MATERIALS AND METHODS

A total of 406 persons (243 males, 163 females, mean age 53,5) without liver cirrhosis, diabetes mellitus, pancreatitis gall stones or malignant tumors were analysed as the control group. Forty-four patients with liver cirrhosis without special complications were analysed as the liver cirrhosis group (29 males, 15 females, mean age 51.7). Diagnosis of liver cirrhosis was confirmed by IGG test, CT scan, scintigram, ultrasound of the liver, and liver function tests. Clinical findings such as esophageal varices, ascites and telangiectasis were also taken into account for diagnosis of liver cirrhosis. Ideal body weight was calculated by the formula below:

$$(\text{Height} - 100) \times 0.9 = \text{Ideal body weight (kg)}$$

Persons whose body weights were less than 90% of the ideal body weight were classified as lean, and persons whose body weights were greater than 110% of the ideal body weights, as obese. Persons whose blood pressures were higher than 150 mmHg (systolic) and/or than 100 mmHg (diastolic) were classified into a high blood pressure group. All CT scans were obtained with a Toshiba 60A scanner (Tokyo, Japan) with a scanning time of 9 sec under 200 mA and 120 KVP. Slices of 1 cm thick were obtained at 0.5 cm intervals through the upper abdomen to include the area of the pancreas. Oral contrast material (2% Gastrografin in water) was given just before the examination in order to distinguish the pancreas image from those of the stomach and duodenum. In the CT scan of the pancreas, the margin and the content were classified into three types: I) smooth type, II) fine-granule (less than 2.5 mm in diameter) type, and III) rough-granule (larger than 2.5 mm in diameter) type as described previously.[2] Blood glucose levels were determined two hours after meal according to the method of Trinder.[4] Choline esterase, total cholesterol, and triglyceride in serum of all subjects in the fasting state were determined by corresponding kits (Choline esterase HA-Test Wako, Total cholesterol HA-Test Wako, and Triglyceride HA-Test Wako, respectively, Wako Pure Chemical Industries, LTD., Osaka, Japan) with an autoanalyzer (Hitachi 705, Hitachi, Japan). Statistical analysis was done by the χ^2 method.

Figure 1 shows a typical case of the pancreas with smooth margin and content. Figure 2 shows a typical case of the pancreas with fine-granule type margin and content. Figure 3 shows a typical case of the pancreas with rough-granule type margin and content.

RESULTS

1. Pancreas types in patients of liver cirrhosis and in controls in relation to body weight.

As shown in Table 1, the incidence of rough-granule type pancreas tended to increase in cirrhotic patients. Furthermore, the close relationship between the rough-granule type pancreas and obesity observed in the control group, largely disappeared in the liver cirrhosis group.

Fig. 1 CT scan of pancreas with smooth margin and content

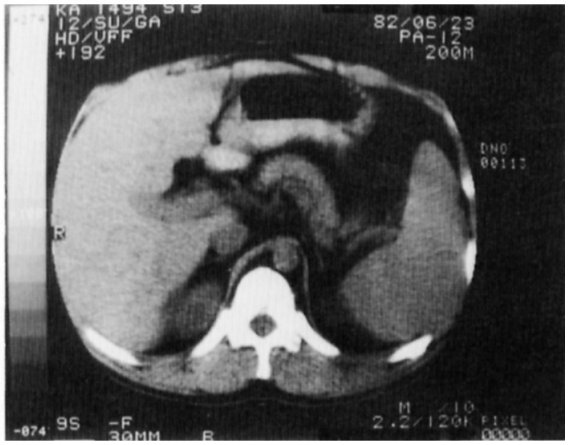

Fig. 2. CT scan of pancreas with fine-gnanular margin and content

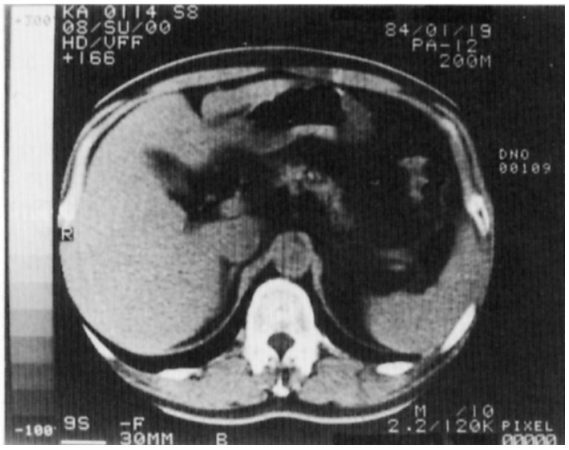

Fig. 3. CT scan of pancreas with rough-granular margin and content

2. Pancreas types in patients of liver cirrhosis and in controls in relation to blood pressure.

In the control group, the incidence of the pancreas with rough-granule type margin and content in individuals with hypertension was significantly higher than that in individuals without hypertension. In the liver cirrhosis group, the incidence of rough-granule type was high regardless of the absence of hypertension.

Table 1. Pancreas types in the liver cirrhosis group and in the control group in relation to body weight

Pancreas type**		Patients in the liver cirrhosis group				Patients in the control group			
		Lean	Normal	Obese	Total	Lean	Normal	Obese	Total
Margin	I	1	1	1	3	7	17	16	40
	II	3	13	11	27	55	136	113	304
	III	1	8	5	14	2	21	39	63
		(20.0%)	(36.4%)	(29.4%)	(31.8%)	(3.1%)	(12.1%)	(23.2%)	(15.3%)
					*		*		
Content	I	0	1	1	2	3	9	6	18
	II	4	17	14	35	59	157	131	347
	III	1	4	2	7	2	8	31	41
		(20.0%)	(18.2%)	(11.8%)	(15.9%)	(3.1%)	(4.5%)	(18.5%)	(10.1%)
					*				

* $p<0.05$

** I : smooth type; II : fine-granule type; III : rough-granule type

Table 2. Pancreas types in the liver cirrhosis group and in the control group in relation to hypertension

Pancreas type**		Patients in the liver cirrhosis group		Patients in the control group	
		With hypertension	Without hypertension	With hypertension	Without hypertension
Margin	I	0	3	15	25
	II	12	15	103	201
	III	6	8	30	32
		(33.3%)	(30.8%)	(20.3%)	(12.4%)
				*	
Content	I	1	1	4	14
	II	14	21	122	225
	III	3	4	22	19
		(16.1%)	(15.4%)	(14.9%)	(7.4%)
				*	

* $p<0.05$

** See Table 1.

3. Pancreas types in patients of liver cirrhosis in relation to clinical profiles.

In the liver cirrhosis group, glucose levels after meal, total cholesterol, triglyceride, and choline esterase activities in blood were analysed in relation to pancreas types. Among them, only blood glucose levels two hours after meal appeared to be closely related to the pancreas types; the incidence of rough-granule type pancreas was significantly higher than that of the pancreas of the other types (Table 3).

4. Pancreas types in patients of liver cirrhosis in relation to ascites.

As shown in Table 4, the incidence of rough-granule type pancreas in patients with ascites was significantly lower than that in patients without ascites ($p<0.05$).

Table 3. Pancreas types in the liver cirrhosis group in relation to their laboratory data

Pancreas Type**		No.	Blood glucose (mg/ml)	Total cholesterol (mg/dl)	Triglyceride (mg/dl)	Cholin esterase (mU/ml)
Margin	I	3	128	167	86	3864
	II	27	129 ± 30 *	151 ± 61	156 ± 71	3877 ± 1105
	III	14	179 ± 20	158 ± 52	86 ± 44	3869 ± 1106
Content	I	2	119	146	99	3718
	II	35	134 ± 31 *	153 ± 71	105 ± 71	3915 ± 1074
	III	7	175 ± 12	194 ± 39	135 ± 46	3891 ± 912

* $p<0.05$
** See Table 1.

Table 4. Pancreas types in the liver cirrhosis group in relation to ascites

Pancreas type**		Patients	
		With ascites	Without ascites
Margin	I	2	1
	II	9	18
	III	2	12
		(15.4%)	(38.7%)
		*	
Content	I	1	1
	II	12	23
	III	0	7
		(0%)	(22.6%)
		*	

* $p<0.05$
** See Table 1.

DISCUSSION

The rough-granule type pancreas is considered to be rich in fat tissue because the CT value of the low density area surrounding rough granules was −80, which is equal to that of fat tissue. Autopsy studies have shown that the percentage of lipomatous pancreas was high in cirrhotic patients.[5] Tracy et al. reported that atherosclerosis which was accelerated by hypertension[6] caused fat deposit in the pancreas.[7] Therefore, it is possible that the high incidence of rough-granule type pancreas in hypertensive persons in the control group was due to atherosclerosis in the pancreas. However, this intimate relation between hypertension and high incidence of rough-granule type pancreas was disproved in cirrhotic patients because of a large increase in the incidence of rough-granule type pancreas even in patients without hypertension (Table 2). Proietto et al. reported that blood insulin levels in cirrhotic patients were high regardless of body constitution,[3] probably due to reduced uptake of insulin in the liver.[8] This high insulin level may partially be responsible for the increase in the incidence of lipomatous pancreas in cirrhotic patients because insulin increases fat synthesis. One report stated that in cirrhotic patients with disturbed carbohydrate tolerance, high insulin levels were associated with hyperglycemia after glucose loading.[9] The intimate relation between rough-granule type pancreas and blood glucose levels two hours after meal observed in the present study suggests that insulin plays a part in the pathogenesis of lipomatous pancreas. It is noted that the incidence of rough-granule type pancreas in cirrhotic patients with ascites was very low (Table 4). This is probably due to an increase in lipolysis because of nutritive disturbance in such patients.

The present results suggest that high insulin levels in the blood play an important role in the pathogenesis of lipomatous pancreas in patients with liver cirrhosis although many problems remain unsolved in this region.

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