J. Tokyo Med. Univ., **67**(1) : 43-51, 2009

Computed tomography findings and diffusion-weighted magnetic resonance imaging of malignant lymphoma located mainly in the pancreas

Fumio KOTAKE[1)], Ritsuko UNO[2)], Yoshiko TAKAHASHI[1)]

[1)]Department of Radiology, Tokyo Medical University, Kasumigaura Hospital
[2)]Department of Radiology, Tokyo Medical University

Abstract

The treatment of pancreatic malignant lymphoma is different from that of pancreatic adenocarcinoma and autoimmune pancreatitis ; therefore, accurate diagnosis is critical. In the 4 cases of malignant lymphoma located mainly in the pancreas reported herein, we chiefly describe the imaging findings.

The subjects were 4 patients who histopathological diagnosis was obtained in all. Computed tomography (CT) examinations were performed with a 16-multi-detector row CT (MDCT) scanner. All scans of the upper abdomen were performed before and after administration of intravenous contrast material. Magnetic resonance imaging (MRI) was performed in 2 cases using a 1.5T superconductive MR system. Transverse sections were imaged by T1-weighted images (T1WI), T2-weighted images (T2WI), T2W half-Fourier acquisition single-shot turbo spin-echo (HASTE) imaging, and MR cholangiopancreatography (MRCP) images, and then chemical shift selective - diffusion-weighted (DW) images were performed using an echo planar imaging (b-values=0, 1,000 sec/mm^2). We set the region of interest in the center of the pancreatic tumor, and then measured the apparent diffusion coefficient (ADC) value.

The tumor was located in the head of the pancreas in 3 cases and the whole of the pancreas in one case. In the former 3 cases, the tumor was a formed mass with lobular margin ; however, in the latter case it showed a diffuse pattern with relatively smooth margins. The density within the tumor was uniform in 2 cases but the presence of necrosis was indicated in the other 2. The main pancreatic duct (MPD) showed no dilatation in one case and slight to moderate dilatation in the other 3 ; whereas the bile duct showed no dilatation in 2 cases and dilatation in the other 2. T1W images were lower in signal intensity than the parenchyma of the normal pancreas, and T2W images showed iso-signal intensity in one case and high signal intensity in the other. DW images in these 2 cases showed strong high signal intensity, and ADC values in both cases were as low as 0.56×10^{-3} mm^2/sec and 0.59×10^{-3} mm^2/sec.

CT is useful for diagnostic imaging of pancreatic malignant lymphoma, and in particular, diagnosis is possible when it shows a large homogeneous mass and a slight dilatation of the bile duct and MPD. However, for atypical cases of pancreatic malignant lymphoma, the ADC value is useful for diagnosis.

Introduction

Malignant lymphoma originating from organs or tissues other than lymph nodes is defined as extranodal malignant lymphoma. Extranodal malignant lymphoma arising from the abdominal organs occurs frequently in the stomach, small intestine, and large intestine, which contain physiological lymphoid tissue

Received July, 2, 2008, Accepted September, 14, 2008
Key words : Pancreas, Malignant lymphoma, Magnetic resonance imaging, Diffusion-weighted imaging, Apparent diffusion coefficient
Corresponding author : Fumio KOTAKE, Department of Radiology, Tokyo Medical University, Kasumigaura Hospital, 3-20-1 Ami-machi chuo, Inashikigun, Ibaraki 300-0395 Japan
Tel : 029-887-1161 (ext. 7120) Fax : 029-988-1512 E-mail : kotake@tokyo-med.ac.jp

in the submucosa. Primary malignant lymphoma of the pancreas, which does not contain lymphoid tissue, is extremely rare; it is reported to comprise 0.6% of extranodal malignant lymphoma[1], 2.2% of non-Hodgkin's lymphoma[2] and a small percentage of all pancreatic malignant tumors (1.5-1.8%)[3][4]. Diagnosis of primary malignant lymphoma of the pancreas is difficult, and there were no reports of preoperative diagnosis. With recent advances in diagnostic imaging; however, patients in whom pancreatic malignant lymphoma was suspected by preoperative diagnosis have been reported[5]. The treatment of pancreatic malignant lymphoma is different from that of pancreatic adenocarcinoma and autoimmune pancreatitis; therefore, accurate diagnosis is critical. We focus on that imaging findings of the present series of 4 cases of malignant lymphoma located mainly in the pancreas.

Materials and Methods

Subjects

The age of the 2 men and 2 women patients ranged from 32-93 years, and histopathological diagnosis was obtained in all 4 (Table 1). The chief complaint was jaundice in 2 cases and back pain in the other 2. Serum amylase level increased markedly in one case, slightly in 2 cases, and was in the normal range in one case. CA 19-9 was elevated in 2 cases, and the CEA level increased slightly in one case. Soluble interleukin-2 receptor (sIL-2R) was high in 3 cases, and in the normal range in one case. The diagnosis of malignant lymphoma was confirmed by nonsurgical biopsy of the pancreatic area in 3 cases and a neck lymph node (after discovery of the pancreatic tumor) in one case. Histopathological diagnosis revealed histiocytic sarcoma in one case and diffuse large B-cell lymphoma in the other 3 cases.

Imaging

Computed tomography (CT) examinations were performed with a 16-multi-detector row CT (MDCT) scanner (Somatom Sensation Cardiac 16; Siemens Medical Solutions, Erlangen, Germany); the parameters were as follows: rotation time 0.5 sec; detector collimation 16×0.75 mm; helical pitch 1.0; reconstructed section thickness 5.0 mm. All scans of the upper abdomen were performed before and after administration of intravenous contrast material.

Magnetic resonance imaging (MRI) was performed in case 1 and case 2 using a 1.5T superconductive MR system (Avanto; Siemens Medical Solutions). The maximum gradient strength was 45 mT/m. All MR images were obtained in the axial plane with a body and spine phased array coil for the body. T1-weighted images (T1WI) were obtained under the following conditions: 173/4.5/1(TR/TE/excitations); flip angle 90°; matrix 135×256; field of view (FOV) 300 mm; slice thickness/gap 5.0 mm/1.0 mm. T2-weighted images (T2WI) were obtained under the following condition: 4030/107/1 (TR/TE/excitations); echo train length 31; matrix 154×256; FOV 300 mm; slice thickness/gap 5.0 mm/1.0 mm. T2W half-Fourier acquisition single-shot turbo spin-echo (HASTE) imaging was performed using the following parameters; 1100/197/1 (TR/TE/excitations); echo train length 205; flip angle 171°; matrix 205×256; FOV 300 mm; slice thickness/gap 5.0 mm/1.0 mm. MR cholangiopancreatography (MRCP) images were obtained using a coronal thick-slab single slice turbo spin-echo sequence with the following parameters; 8000/899/1 (TR/TE/excitations); echo train length 256; flip angle 150°; matrix 256×256; FOV 250 mm; slab thickness 60 mm. Chemical shift selective - diffusion-weighted (DW) images were performed using an echo planar imaging sequence with the following parameters: 2600/76/6 (TR/TE/excitations); echo train length 51; matrix 144×192; FOV 400; slice thickness/gap 5.0 mm/1.0 mm and b-values were set at 0 and 1,000 sec/mm^2. We set the region of interest (ROI) in the center

Table 1 Clinicopathological characteristics of 4 patients with malignant lymphoma located mainly in the pancreas

	case 1	case 2	case 3	case 4
sex	man	woman	man	woman
age	32	59	93	70
chief complaint	back pain	jaundice	jaundice	back pain
WBC (4,000-8,500)	5,300/μl	5,000/μl	8,000/μl	5,600/μl
serum amylase (43-116)	61 U/I	139 U/I	1,224 U/I	156 U/I
CEA (<5)	1.7 ng/ml	1.3 ng/ml	5.7 ng/ml	1.3 ng/ml
CA19-9 (<37)	9.1 U/ml	830 U/ml	110,800 U/ml	not available
sIL-2R (124-499)	242 U/ml	5,300 U/ml	8,660 U/ml	15,000 U/ml
WHO classification	histiocytic sarcoma	diffuse large B-cell lymphoma	diffuse large B-cell lymphoma	diffuse large B-cell lymphoma

WBC: white blood cell count, CEA: carcinoembryonic antigen,
CA19-9: carbohydrate antigen 19-9, sIL-2R: soluble interleukin-2 receptor

of the pancreatic tumor, except for cystic lesions and necrosis, and then measured the apparent diffusion coefficient (ADC) value.

Results

Table 2 shows the CT findings. The tumor was located in the head of the pancreas in 3 cases and the entire pancreas in 1 case. In the former 3 cases, the tumor was a formed mass with lobular margin ; however, in the latter case it showed a diffuse pattern with relatively smooth margins. The tumors in all cases were large (maximum diameter : 7–12 cm). Tumor enhancement in early contrast CT was poor in all cases. The density within the tumor was uniform in 2 cases but the presence of necrosis was indicated in the other 2. The main pancreatic duct (MPD) showed no dilatation in one case and slight to moderate dilatation in the other 3 ; whereas the bile duct showed no dilatation in 2 cases and dilatation in the other 2. The portal and superior mesenteric veins within the tumor showed no narrowing in one case, but compression or narrowing was seen in 2 cases, and occlusion in one. Slight hepatomegaly and splenomegaly were seen in one case, but no such findings were noted in the other 3 cases. Swelling of the abdominal lymph nodes was observed in 2 of the 4 cases.

MRI was performed only in cases 1 and 2 (Table 3). T1W images were of low signal intensity compared with the parenchyma of the normal pancreas, and T2W images showed iso-signal intensity in one case and high signal intensity in the other. DW images in these 2 cases showed strong high signal intensity, and ADC values in both cases were low. MPD within the tumor showed mild narrowing in case 1, and mild narrowing and dilatation in case 2. The common bile duct (CBD) within the tumor showed narrowing in both cases.

Gallium scintigraphy was carried out in 3 cases and revealed intense accumulation of gallium in the mass of all 3 cases.

In case 1, a large tumor mass in the head of pancreas was observed, and its margin showed a lobular pattern on CT images (Fig. 1a). Necrosis was seen within the tumor, but there was no dilatation of the MPD or biliary tract ; therefore, the tumor findings differed from those in pancreatic adenocarcinoma. T1W images (Fig. 1b) and T2W images (Fig. 1c) showed low- and iso-signal intensity of the tumor, compared with the parenchyma of the normal pancreas. DW images showed a strong high signal intensity, and ADC values were low (0.56×10^{-3} mm^2/sec) (Fig. 1d). Gallium scintigraphy revealed intense accumulation of gallium corresponding

Table 2 CT findings of malignant lymphoma located mainly in the pancreas

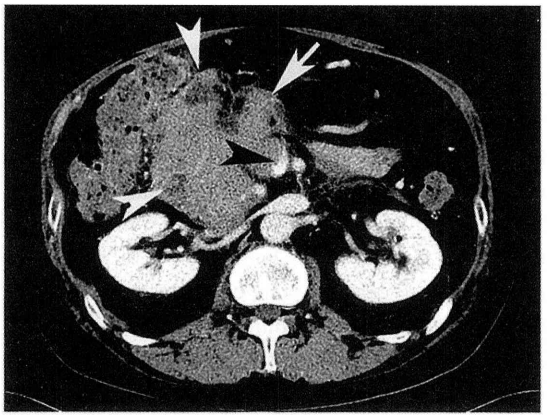
	case 1	case 2	case 3	case 4
location	head	entire pancreas	head	head
configuration	localized tumoral	diffuse enlarged	localized tumoral	localized tumoral
margin	irregular	smooth	irregular	irregular
maximum diameter	7 cm	12 cm	9 cm	9 cm
early contrast enhancement	poor	poor	poor	poor
necrosis	+	−	+	−
MPD dilatation	−	partial,mild	moderate	mild
bile duct dilatation	−	+	+	−
PV・SMV	compression, narrowing	no narrowing	narrowing	occlusion
hepato-splenomegaly	non	mild	non	non
lymphnode involvement	−	+	+	−

MPD : main pancreatic duct, PV : portal vein,
SMV : superior mesenteric vein

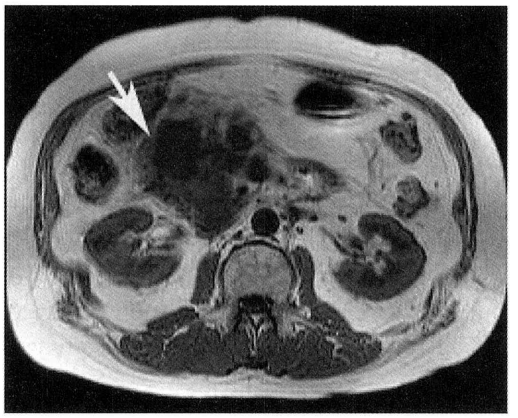
Table 3 MR findings of malignant lymphoma located mainly in the pancreas

	case 1	case 2
T1-weighted imaging	low signal intensity	low signal intensity
T2-weighted imaging	iso signal intensity	high signal intensity
Diffusion-weighted imaging	high signal intensity	high signal intensity
ADC value	0.56×10^{-3} mm^2/sec	0.59×10^{-3} mm^2/sec
MPD intumor	mild narrowing	mild dilatation and narrowing
CBD in tumor	mild narrowing	narrowing

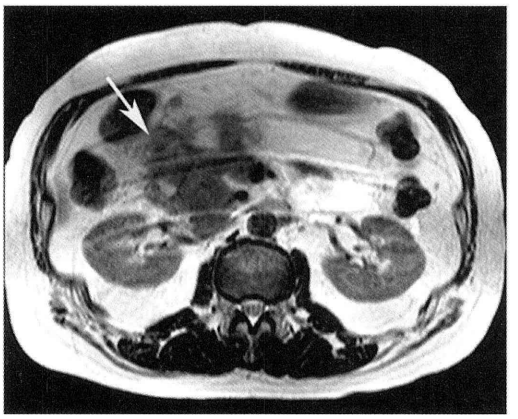
ADC value : apparent diffusion coefficient value,
CBD : common bile duct



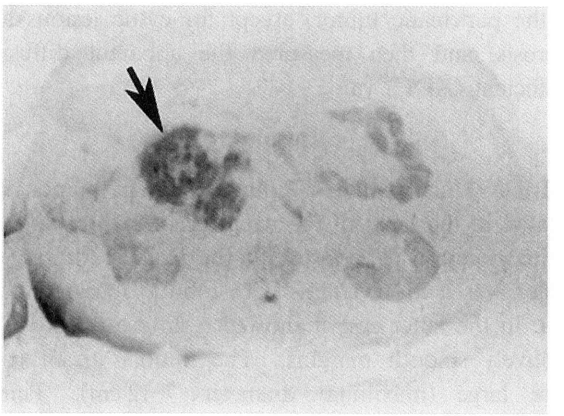
a



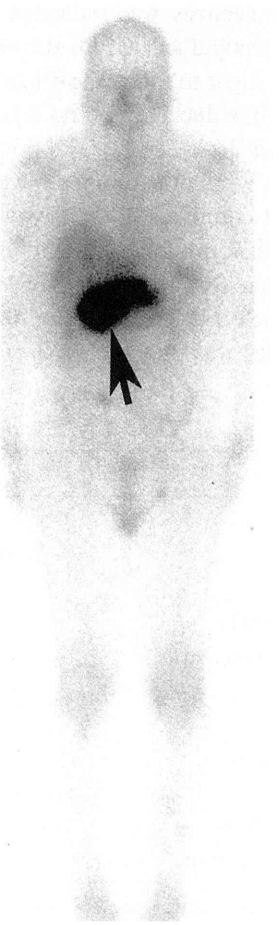
b



c



d



e

Fig. 1 Case 1 (32-year-old man)

a : Contrast-enhanced computed tomography

CT shows a large tumor and its lobular margin (arrow), and necrosis within the tumor (arrowhead) in the head of pancreas. The superior mesenteric vein is compressed and flat, but shows no occlusion (black arrowhead).

b : T1-weighted MR image

T1W image of the tumor in the head of pancreas is lower in signal intensity than that in the parenchyma of a normal pancreas (arrow).

c : T2-weighted MR image

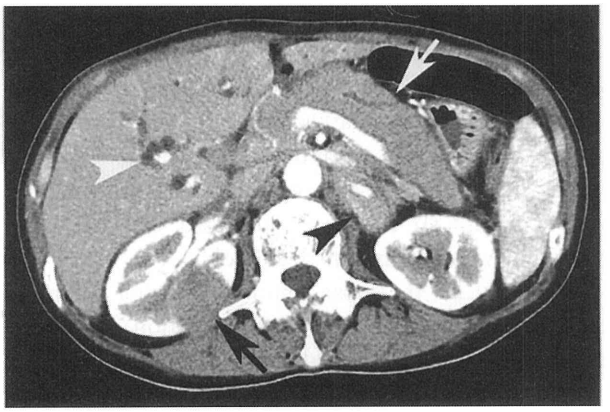
T2W image of the tumor shows iso-signal intensity (arrow).

d : Diffusion-weighted MR image (the monochrome reverse imaging)

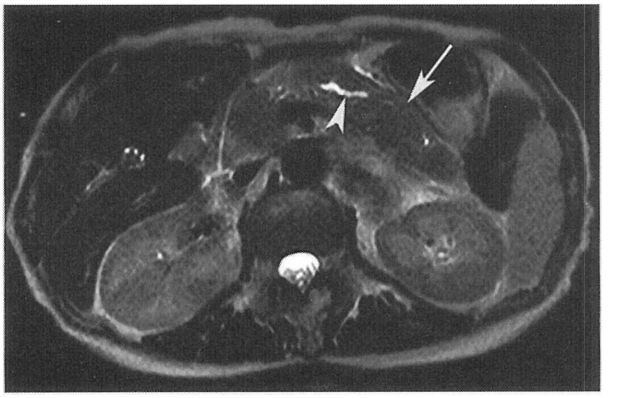
DW image of the tumor shows strong high signal intensity (arrow), and the ADC value is low (0.56×10^{-3} mm^2/sec).

e : Gallium 67 scintigraphy

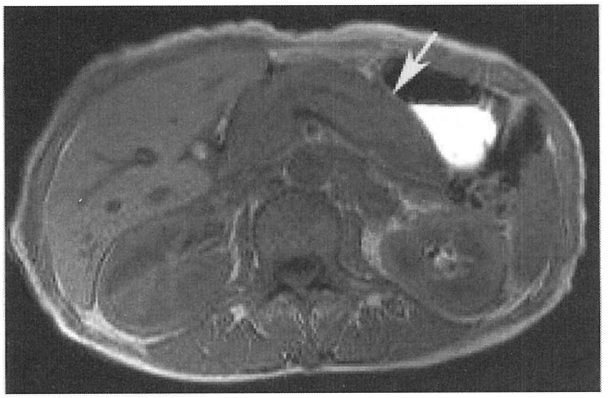
Intense gallium uptake is observed corresponding with the tumor area (black arrow).



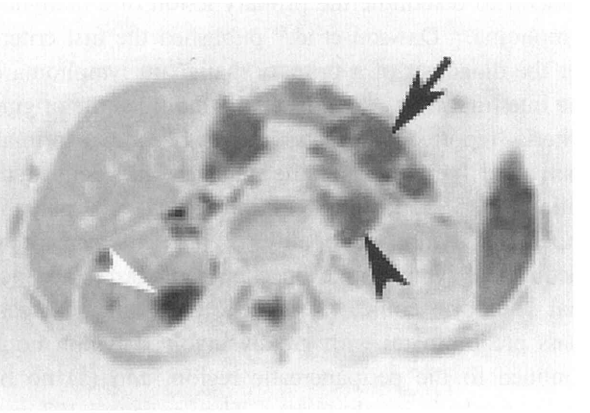
a



c



b



d

Fig. 2 Case 2 (59-year-old woman)
a : Contrast-enhanced computed tomography
CT shows diffuse swelling and relatively smooth margin of the pancreas (arrow). A slight dilatation of MPD in the body of the pancreas and dilatation of the intrahepatic duct (arrowhead) is observed. A mass in the right kidney (black arrow) and swelling of the paraaortic lymph node (black arrowhead) is also observed.
b : T1-weighed MR image
T1W image of the pancreas is of low signal intensity (arrow).
c : T2-weighted half-Fourier acquisition single-shot turbo spin-echo MR image
MPD in the body of pancreas shows partial slight dilatation (arrowhead), and MPD in the head and tail of pancreas shows narrowing (arrow).
d : Diffusion-weighted MR image (the monochrome reverse imaging)
DW image of the head and tail of the pancreas shows strong high signal intensity (black arrow), and that of the ventral body of pancreas shows high signal intensity. The mean ADC value of the head and tail of the pancreas is low (0.59×10^{-3} mm^2/sec). DW images of the mass of the right kidney (arrowhead) and swelling of the paraaortic lymph nodes (black arrowhead) are also strong high-intensity signals.

with the tumor area (Fig. 1e). From the above-mentioned image findings, the tumor was suspected to be a malignant lymphoma, although serum sIL-2R levels were normal. Histopathological diagnosis of a biopsy specimen of the tumor revealed histiocytic sarcoma.

In case 2, the pancreas showed diffuse swelling and a relatively smooth margin on CT images (Fig. 2a). A slight dilatation in certain segments of the MPD was observed in the body of the pancreas, but there was no dilatation of the MPD in the head or tail of the pancreas ; however, dilatation of the biliary tract was seen. The above findings are similar to those of autoimmune pancreatitis, but malignant lymphoma was suspected due to the presence of a mass in the right kidney and swelling of the paraaortic lymph node. T1W images (Fig. 2b) and T2W images showed low- and high-signal intensity of the tumor, respectively. Although HASTE images revealed a slight dilation of some segments of the MPD in the body of the pancreas, narrowing of the MPD in the head and tail of the pancreas was observed (Fig. 2c). DW images showed strong high signal intensity in the head and tail of the pancreas, and high signal intensity in the ventral body of the pancreas. Furthermore, DW images of the mass in the right kidney and the paraaortic lymph nodes showed high signal intensity (Fig. 2d). The mean ADC values in the head and tail

of the pancreas were low (0.59×10^{-3} mm^2/sec), and the ADC values in the right renal mass and paraaortic lymph nodes were also low. Based on the above image findings and high serum sIL-2R levels, the tumor was considered to be a malignant lymphoma. Histopathological diagnosis on the based on biopsy specimen of the tumor revealed diffuse large B-cell lymphoma.

Discussion

Primary malignant lymphoma of the pancreas is a rare disease. Tucheck et al.[4] reported that 7 of 379 (1.8%) cases with histologically proven pancreatic malignancies were found to be malignant lymphoma. It is often difficult to determine the primary lesion of a malignant lymphoma. Dawson et al.[6] published the first criteria for the diagnosis of a primary malignant lymphoma of the intestinal tract. Behrns et al.[7] modified the original criteria reported by Dawson et al.[6] for a primary malignant lymphoma of the pancreas and defined the following 5 applicable conditions: (1) no palpable superficial lymphadenopathy, (2) no enlargement of mediastinal lymph node on chest radiograph, (3) normal leukocyte count, (4) at celiotomy, the pancreatic mass predominates with grossly involved lymph nodes confined to the peripancreatic region, and (5) no hepatic or splenic involvement. They reviewed 107 cases of pancreatic involvement by non-Hodgkin's lymphoma, and 12 cases (11 %) of them were regarded to be primary pancreatic lymphoma. However, when a huge mass involving the pancreas is discovered after progression of malignant lymphoma, it is difficult to determine whether the mass represents a primary lesion of the pancreas or is due to malignant lymphoma arising from other organs[8–10]. Although the frequency of primary pancreatic malignant lymphoma is lower than that of secondary pancreatic malignant lymphoma, it is appropriate to regard the mass as a primary pancreatic malignant lymphoma when the tumor is located mainly in the pancreas and spreads from the pancreas[1)11]. Since the tumors in the 4 cases we described spread from the pancreas, they were diagnosed as primary malignant lymphoma of the pancreas.

Merkle et al.[12], investigated 85 patients (51 men and 34 women) with pancreatic malignant lymphoma, and found that the tumors occurred across a wide age range (mean age: 56, range: 23–89 years). The symptoms observed in the disease were abdominal pain (83%) and jaundice (37%)[13]. Increase in serum amylase and CA19-9 were observed in 68.1% and 45.5% of patients, respectively, but neither CEA nor AFP increased[14]. Serum sIL-2R levels increased in patients with lymphoproliferative malignancies, and this finding was useful in the diagnosis; in contrast, Pavlidis et al.[15] reported that serum sIL-2R levels in non-Hodgkin's lymphoma increased in 85% of the patients but were normal in 15%. The present 4 cases showed a wide age range of 32–93 years. Two cases in which the first symptom was jaundice also showed a marked increase in CA19-9, and pancreatic cancer was initially suspected. CEA increased slightly in one case, but there was no increase in AFP. Serum sIL-2R levels increased markedly in 3 cases, but were normal in one case.

CT is by far the most common imaging technique used in the detection and characterization of primary pancreatic lymphoma. Salvatore et al.[16] investigated the site of onset and size of tumor in 60 patients with primary pancreatic lymphoma. The site of onset in the pancreas was the head in 32 patients (53%), the body in 6 patients (10%), the tail in 7 patients (12%), the head and body in 5 patients (8%), the body and tail in 6 patients (10%), and the entire pancreas in 4 patients (7%). The tumor size ranged from 1.5–14 cm, and $\geq$60% patients had a diameter of 6 cm or more. Based on the past that $\geq$60% patients of pancreatic adenocarcinoma had a diameter of 4–6 cm[17], the number of cases with pancreatic malignant lymphoma tended to be large compared with the number of cases of pancreatic adenocarcinoma. Prayer et al.[18] described the presence of a homogeneous pancreatic mass with a diameter of 7 cm or more strongly suggests non-Hodgkin's lymphoma. Merkle et al.[12] reported that pancreatic malignant lymphoma has 2 morphologic patterns in CT findings: a localized tumoral form and a diffuse enlarged form. The present 4 cases showed a pattern of localized tumoral form in the head of pancreas in 3 cases and diffuse enlarged form in one case. In all cases, the tumor size was large, with a maximum diameter of 7–12 cm, but necrosis within the tumor was observed in 2 cases. Differential diagnosis of the tumor from pancreatic adenocarcinoma is complicated because of necrosis within the tumor, which has also been reported in some literature[19)20)]. Based on dynamic CT findings, it has been reported that the tumor mass often indicates a hypovascular lesion, and that dilatation of the CBD and caudal MPD is in slight proportion with the large size of the lesion[12]. However, some literature have reported that the above-mentioned dilation was similar between pancreatic malignant lymphoma and pancreatic adenocarcinoma[21)22)]. Early contrast enhancement in our 4 cases showed poor contrast. Dilatation of the bile duct was observed in 2 cases; dilatation of the MPD was slight in 2 cases but similar to that observed in pancreatic adenocarcinoma in one case. With regard to the portal vein and superior mesenteric vein within the tumor, 2 cases showed compression and narrowing, and 1 case showed occlusion. The finding of occlusion in the portal vein and superior mesenteric vein was also reported in some literature[10)13)]. When dilatation of the

bile duct and MPD is severe, and necrosis within the tumor and occlusion of the portal vein and superior mesenteric vein are seen, it is difficult to accurately diagnose pancreatic malignant lymphoma only by CT findings.

Gallium scintigraphy carried out in 3 cases revealed intense uptake in all cases. Such patients would be diagnosed having a pancreatic malignant lymphoma based on typical CT findings, intense gallium uptake on scintigraphy, and high serum sIL-2R levels, but because gallium uptake and high serum sIL-2R levels are also observed in autoimmune pancreatitis, careful attention should be paid to the diagnosis[23].

Case reports of pancreatic malignant lymphoma examined using MRI are comparatively rare. In MRI, the tumor shows non-specific findings of low signal intensity on T1W images and slightly high signal intensity on T2W images[12)24)]. However, MRCP is useful for evaluation of the bile duct and MPD within the tumor. Nasu et al. (2004)[25] reported that DW images performed with parallel imaging technique provide artifact-reduced images and allow high b-value DW imaging, and these techniques have been rapidly applied to abdominal examination. Matsuki et al.[26] reported that pancreatic adenocarcinoma in 8 cases showed high signal intensity on DW images, and that ADC values were $1.44\pm0.20\times10^{-3}$ mm^2/sec. In the present study, the 2 cases evaluated using DW imaging showed high signal intensity, and ADC values in both cases were low (0.56×10^{-3} mm^2/sec and 0.59×10^{-3} mm^2/sec). Our search of the literature identified no reports of ADC values in pancreatic malignant lymphoma. However, in patients with cerebral malignant lymphoma, it has been reported that the entire tumor is visualized with high signal intensity by DW imaging because malignant lymphoma in the brain has a higher cell density[27]. The ADC value of cerebral malignant lymphoma is reduced significantly to 0.58×10^{-3} mm^2/sec and can be distinguished from gliomas and metastasis[28]. Also in the craniocervical region, it has been reported that the ADC value of malignant lymphoma was only 0.66×10^{-3} mm^2/sec and can be distinguished from carcinoma (1.13×10^{-3} mm^2/sec) and benign solid tumor (1.56×10^{-3} mm^2/sec)[29]. Since malignant lymphoma has been reported to have a low ADC value, measurement of the ADC value is considered useful in the diagnosis of pancreatic malignant lymphoma. In particular, the ADC value is considered important for differential diagnosis between atypical cases of the pancreatic malignant lymphoma (showing high CA19-9 level and dilatation of the bile duct and MPD) and pancreatic adenocarcinoma. Difficulty in differentiating between pancreatic malignant lymphoma showing a diffuse enlarged form and autoimmune pancreatitis has been reported when CT and conventional MRI are used alone[30], but the ADC value ($1.22\pm0.11\times10^{-3}$ mm^2/sec) in our 3 patients with autoimmune pancreatitis was higher compared with values in pancreatic malignant lymphoma, which suggests the usefulness of ADC values in this differentiation.

Conclusions

CT is useful for imaging diagnosis of pancreatic malignant lymphoma, and in particular, diagnosis is possible when it shows a large homogeneous mass and a slight dilatation of the bile duct and MPD. However, in atypical case of the pancreatic malignant lymphoma, the ADC value is useful for diagnosis.

References

1) Freeman C, Berg JW, Cutler SJ : Occurrence and prognosis of extranodal lymphomas. Cancer **29** : 252-260, 1972
2) Webb TH, Lillemoe KD, Pitt HA, Jones RJ, Cameron JL : Pancreatic lymphoma. Is surgery mandatory for diagnosis or treatment ? Ann Surg **209** : 25-30,1989
3) Reed K, Vose PC, Jarstfer BS : Pancreatic cancer : 30 year review (1947 to 1977). Am J Surg **138** : 929-933, 1979
4) Tuchek JM, De Jong SA, Pickleman J : Diagnosis, surgical intervention, and prognosis of primary pancreatic lymphoma. Am Surg **59** : 513-518, 1993
5) Masui T, Katayama M, Kobayashi S, Shimizu S : MR imaging of primary malignant lymphoma of the pancreas. Radiat Med **23** : 213-215, 2005
6) Dawson IMP, Cornes JS, Morson BC : Primary malignant lymphoid tumors of the intestinal tract. Report of 37 cases with a study of factors influencing prognosis. Br J Surg **49** : 80-89, 1961
7) Behrns KE, Sarr MG, Strickler JG. Pancreatic lymphoma : is it a surgical disease ? Pancreas **9** : 662-667, 1994
8) Glazer HS, Lee JK, Balfe DM, Mauro MA, Griffith R, Sagel SS : Non-Hodgkin lymphoma : Computed tomographic demonstration of unusual extranodal involvement. Radiology **149** : 211-217, 1983
9) Tanaka T, Matsugu Y, Koide K, Miura Y, Ichiba Y, Dohi K : Malignant lymphoma of the pancreas. Dig Dis Sci **41** : 402-404, 1996
10) Battula N, Srinivasan P, Prachalias A, Rela M, Heaton N : Primary pancreatic lymphoma ; diagnostic and therapeutic dilemma. Pancreas **33** : 192-194, 2006
11) Van Beers B, Lalonde L, Soyer P, Grandin C, Trigaux JP, De Ronde T, Dive C, Pringot J : Dynamic CT in pancreatic lymphoma. J Comput Assist Tomogr **17** : 94-97, 1993
12) Merkle EM, Bender GN, Brambs HJ : Imaging finding in pancreatic lymphoma : differential aspects. AJR **174** : 671-675, 2000

13) Saif MW : Primary pancreatic lymphomas. JOP **7** : 262-273, 2006
14) Tanaka M, Kosaka A, Katsuta K : A case of malignat lymphoma of the pancreas ; review of literature. Mie Medical Journal **44** : 79-82, 1994
15) Pavlidis AN, Kalef-Ezra J, Bourantas LC, Lambrou A, Mavridis A : Serum tumor markers in non-Hodgkin's lymphomas and chronic lymphocytic leukemia. Int J Biol Markers **8** : 14-20,1993
16) Salvatore JR, Cooper B, Shah I, Kummet T : Primary pancreatic lymphoma : a case report, literature review, and proposal for nomenclature. Med Oncol **17** : 237-247, 2000
17) Ward EM, Stephens DH, Sheedy PF : Computer tomographic characteristics of pancreatic carcinoma : an analysis of 100 cases. Radiographics **3** : 547-565, 1983
18) Prayer L, Schurawitzki H, Mallek R, Mostbeck G : CT in pancreatic involvement of non-Hodgkin lymphoma. Acta Radiol **33** : 123-127, 1992
19) Teefey SA, Stephens DH, Sheedy PF : CT appearance of primary pancreatic lymphoma. Gastrointest Radiol **11** : 41-43, 1986
20) Sata N, Kurogochi A, Endo K, Shimura K, Koizumi M, Nagai H : Follicular lymphoma of the pancreas : A case report and proposed new strategies for diagnosis and surgery of benign or low-grade malignant lesions of the head of the pancreas. JOP **8** : 44-49, 2007
21) Shtamler B, Bickel A, Manor E, Shahar MB, Kuten A, Suprun H : Primary lymphoma of the head of the pancreas. J Surg Oncol **38** : 48-51, 1988
22) Jones WF, Sheikh MY, McClave SA : AIDS-related non-Hodgkin's lymphoma of the pancreas. Am J Gastroenterol **92** : 335-338, 1997
23) Saegusa H, Momose M, Kawa S, Hamano H, Ochi Y, Takayama M, Kiyosawa K, Kadoya M : Hilar and pancreatic Gallium-67 accumulation is characteristic feature of autoimmune pancreatitis. Pancreas **27** : 20-25, 2003
24) Semelka RC, Ascher SM : MR imaging of the pancreas. Radiology **188** : 593-602, 1993
25) Nasu K, Kuroki Y, Kuroki S, Murakami K, Nawano S, Moriyama N : Diffusion-weighted single shot echo planar imaging of colorectal cancer using a sensitivity-encoding technique. Jpn J Clin Oncol **34** : 620-626, 2004
26) Matsuki M, Inada Y, Nakai G, Tatsugami F, Tanikake M, Narabayashi I, Masuda D, Arisaka Y, Takaori K, Tanigawa N : Diffusion-weighted MR imaging of pancreatic carcinoma. Abdom Imaging **32** : 481-483, 2007
27) Okamoto K, Ito J, Ishikawa K, Sakai K, Tokiguchi S : Diffusion-weighted echo-planar MR imaging in differential diagnosis of brain tumors and tumor-like conditions. Eur Radiol **10** : 1342-1350, 2000
28) Stadnik TW, Chaskis C, Michotte A, Shabana WM, Van Rompaey K, Luypaert R, Budinsky L, Jellus V, Osteaux M : Diffusion-weighted MR imaging of intracerebral masses ; comparison with conventional MR imaging and histologic findings. Am J Neuroradiol **22** : 969-976, 2001
29) Wang J, Takashima S, Takayama F, Kawakami S, Saito A, Matsushita T, Momose M, Ishiyama T : Head and neck lesions : characterization with diffusion-weighed echo-planar MR imaging. Radiology **220** : 621-630, 2001
30) Kotake F, Iwashiro R, Takahashi Y, Ito M, Mizokami Y : The usefulness of IgG4 and apparent diffusion coefficient value for the diagnosis of a case of autoimmune pancreatitis. J Tokyo Med Univ **66** : 263-269, 2008

膵臓を主に占拠した悪性リンパ腫のCT所見と拡散強調MR像

小竹文雄[1)]　宇野利津子[2)]　高橋佳子[1)]

[1)]東京医科大学霞ヶ浦病院放射線科
[2)]東京医科大学放射線医学講座

膵悪性リンパ腫は膵癌や自己免疫性膵炎とは治療法が異なるため、的確な診断が要求される。今回、4例の膵臓を主に占拠した悪性リンパ腫を経験したので画像所見を中心に報告する。

対象は病理組織学的診断の得られた4症例である。CT装置は16列検出器型CTを使用しヨード造影剤投与前と投与後の撮像をした。MRI装置は1.5Tを使用しT1強調像、T2強調像、HASTE像、MRCPを撮影した後、CHESS法による拡散強調像 (b factor＝0, 1,000 sec/mm^2) を撮像した。その後、病変部のADC値を測定した。

膵悪性リンパ腫の部位は膵頭部が3例で、膵全体が1例であった。膵頭部の3例は腫瘤を形成し、辺縁は分葉状であったが、膵全体の1例はびまん性に認められ、辺縁が比較的整であった。腫瘍内は2例で均一であったが、他の2例には壊死が認められた。主膵管は拡張なしが1例で、他の3例は軽度から中等度の拡張が認められた。胆管は拡張なしが2例で、拡張ありが2例であった。MRIのT1強調像では正常膵実質に比べ低信号で、T2強調像では1例が等信号で他の1例は高信号であった。拡散強調像では2例とも高信号となり、ADC値は0.56×10^{-3} mm^2/secと0.59×10^{-3} mm^2/secで両者とも低い値を呈した。

膵悪性リンパ腫の画像診断はCTが有用で大きな均一な腫瘤が認められ、胆管や主膵管の拡張が軽度の場合は診断は可能である。しかし、非典型例ではADC値測定が診断に有用となる。

〈キーワード〉 膵臓、悪性リンパ腫、MRI、拡散強調画像、見かけの拡散係数