MRI for Advanced Gastric Cancer

—Especially for Scirrhous Cancer of the Stomach—

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ABSTRACT

We conducted MRI examinations in 92 patients with advanced gastric cancer, and evaluated the clinical potential of MRI for diagnosis of scirrhous cancer of the stomach. The feature of scirrhous cancer of stomach by MRI are; 1) thickened gastric wall, 2) shortening of T1 and T2 values; and 3) clear contrast between the gastric mucosae and cancer areas found in the T1 and T2 weighted images (preservation of the mucosae). MRI for scirrhous cancer of the stomach is thought a useful image diagnosis as an adjunct method to gastric X-ray and gastric endoscopy.

Key words: MRI, Advanced gastric cancer, Scirrhous cancer

INTRODUCTION

X-ray examination and gastric endoscopy have been established as reliable methods for diagnosing advanced gastric cancer; however, they also have limitations. Conventional gastric endoscopy only provides images of the surfaces of the gastric mucosa and is of little use for information about submucosal tissue. Ultrasonic endoscopy has been recently developed as alternative to these routine examinations. This often provides meaningful tomographic images of the digestive tract wall and is becoming an extremely effective examination for diagnosing cancer extensions and lymph node metastasis[1-3]. MRI has also proven its worth in the clinic; its images show weights of hydrogen atoms and contrast between cancerous and surrounding tissues[4-6]. Scirrhous cancer of the stomach, in which the volume of submucosal fibrous tissues greatly increase, has been reported to

be readily visualized by the above methods[7]. In the present study, we conducted MRI examinations in patients with scirrhous cancer of the stomach and evaluated its usefulness for clinical diagnostics. The results are presented in this report.

MATERIAL AND METHODS

The subjects were 17 patients with advanced gastric cancer of Borrmann type IV (including 9 with scirrhous cancer of the stomach) selected from 92 cases diagnosed as advanced gastric cancer by X-ray examination and gastric endoscopy from August 1990 to August 1993 (Man: Woman=7:5, mean age=52.7 years old). Of 17 patients with gastric cancer of Borrmann type IV, cancer tissues were obtained with biopsies from 14 individuals; histopathological classification included 10 cases of poorly differentiated adenocarcinomas, 2 of mucinous adenocarcinomas, one of signet-ring cell carcinoma and one of unknown case (Table 1). Pretreatments before MRI examination were: fasting after dinner on the previous day, an intramuscular injection of an anticholinergic (an ampoule of Buscopan in principle) and oral administration of 5 g of a vesicant directly before the examination. All images in this study were obtained using a 0.5 T superconducting MR system (SMT-50 and MRH-500). Pulse sequences mainly employed were SE, including T1 weighted images with TR: 400~600 msec as well as TE: 30~35 msec and T2 weighted images with TR: 2000 msec together with TE: 85~95 msec. T1 and T2 values of the tumor locations were calculated using PD images taken simultaneously (TR: 2000 msec and

Table 1. *Summary of cases with Scirrhous cancer of the Stomach*

Cases	Sex	Age	Localizationn	Pathological Findings
1 Y. T.	M	39	MLU circ.	Poor. diff. adenoca.
2 S. N.	M	76	MLU circ.	Poor. diff. adenoca.
3 Y. M.	M	75	UML circ.	—
4 M. F.	F	44	MLU circ.	Poor. diff. adenoca.
5 D. S.	M	41	MU circ.	Signet-ring cell ca.
6 E. T.	F	68	LM circ.	Poor. diff. adenoca.
7 T. T.	M	52	MUL circ.	Poor. diff. adenoca.
8 T. A.	M	58	MUL circ.	Mucinous adenoca.
9 K. I.	F	37	ML circ.	Poor. diff. adenoca.
10 M. H.	F	55	ML circ.	Poor. diff. adenoca.
11 K. Y.	F	44	MLU circ.	Poor. diff. adenoca.
12 K. O.	M	58	MU circ.	Poor. diff. adenoca.
13 I. U.	M	42	MLU circ.	Mucinous adenoca.
14 H. S.	M	49	MLU circ.	Poor. diff. adenoca.

TE: 35 msec) and based on calculation images of T1 and T2 consisted of three different pulse sequence images. Thickness of the slices ranged 5～10 mm, and the slice direction used was an arbitrary inclination including transverse, sagittal and coronal scans. Against scan modes with longer TRs, ECG or pulmonary gait was concomitantly used at the measurements. Tumor areas are based on the TNM classification of International Union Against Cancer (Union Internationale Contre le Cancer, UICC).

RESULTS

Figure 1 shows MRIs of a patient with gastric cancer of Borrmann type IV at the Middle third and Lower third areas. As indicated by the arrows, the cancer region in the T1 weighted image (Fig. 1-A) revealed a similar signal intensity as that on the liver, and a higher signal intensity than that on the liver in the T2 weighted image (Fig. 1-B). Based on these two images, it is difficult to dis-

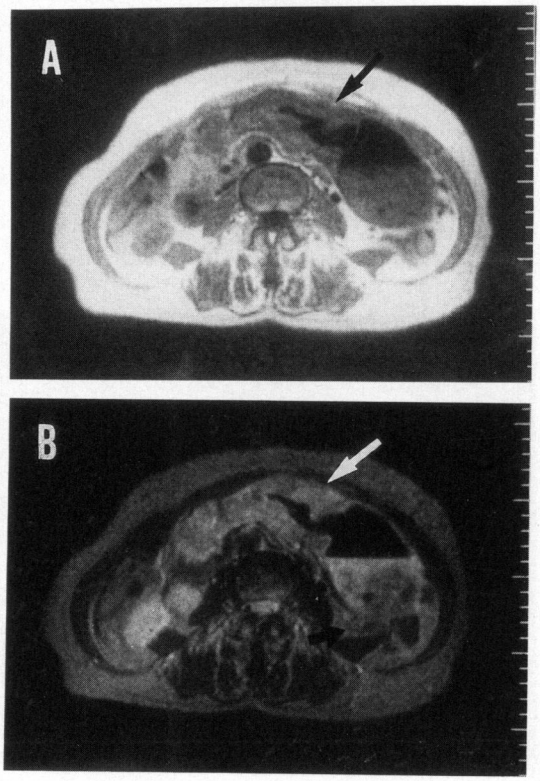

Fig. 1 MRI of gastric cancer of Borrmann type IV.
A: T1 weighted image by SE
B: T2 weighted image by SE

tinguish between the mucosal surface and submucosal tissue.

Figure 2 indicates a patients with scirrhous cancer of the stomach at the Upper third and Middle third areas. The gastric X-ray photograph (Fig. 2-A) shows hardening of all wall sides at the Upper third and Middle third areas, and the CT (Fig. 2-B) also indicates a thickened gastric wall.

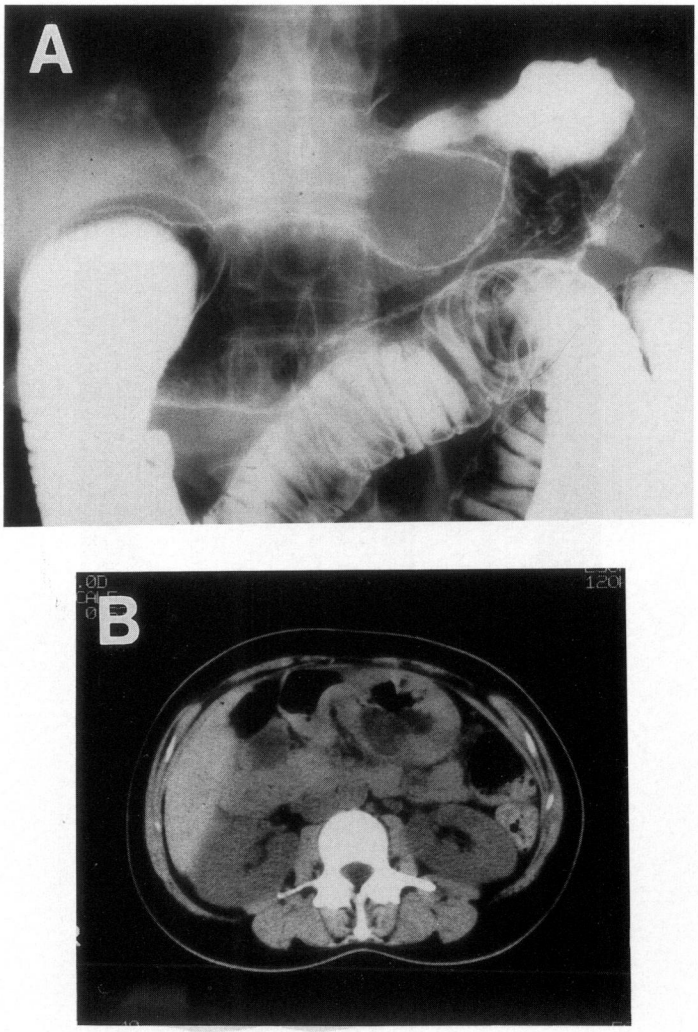

Fig. 2 Scirrhous cancer of the stomach (case 5).
A: Gastric double contrast X-ray photograph
B: Computed Tomography

In the T1 weighted image (Fig. 3-A) of the same patient, the gastric cancer area shows similar or lower signal intensity than that of the liver, and the surrounding adipose tissue and gastric mucosa reveal higher signal intensities. Thus, it is easy to differentiate between the mucosa and cancer region. Also in the T2 weighted image (Fig. 3-B), the cancer area infiltrated under the mucosa showed a lower signal while the mucosa revealed a higher signal, presenting a clear contrast.

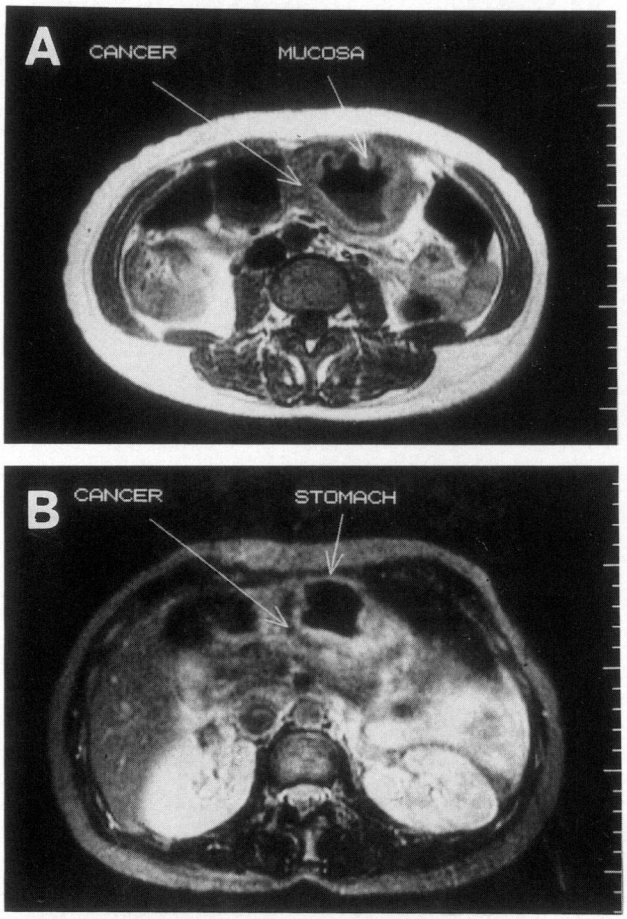

Fig. 3 MRI of scirrhous cancer of the stomach (case 5).
A : T1 weighted image by SE
B : T2 weighted image by SE

Fig. 4 shows a patient with scirrhous cancer of the stomach at the Upper third~Lower third areas. The gastric X-ray photograph (Fig. 4-A) and the CT (Fig. 4-B) indicate both hardening and thickening of the wall throughout the gastric area. In the T1 weighted images of the same slice position in the same patient (Fig. 5-A and 5-B), the tumor region showed a similar signal and the mucosa revealed higher signal intensities. In the T2 weighted images (Fig. 5-C and 5-D), the tumor area disclosed lower signal and the mucosa showed higher signal intensities. Both these findings allow clear differentiation between the sites.

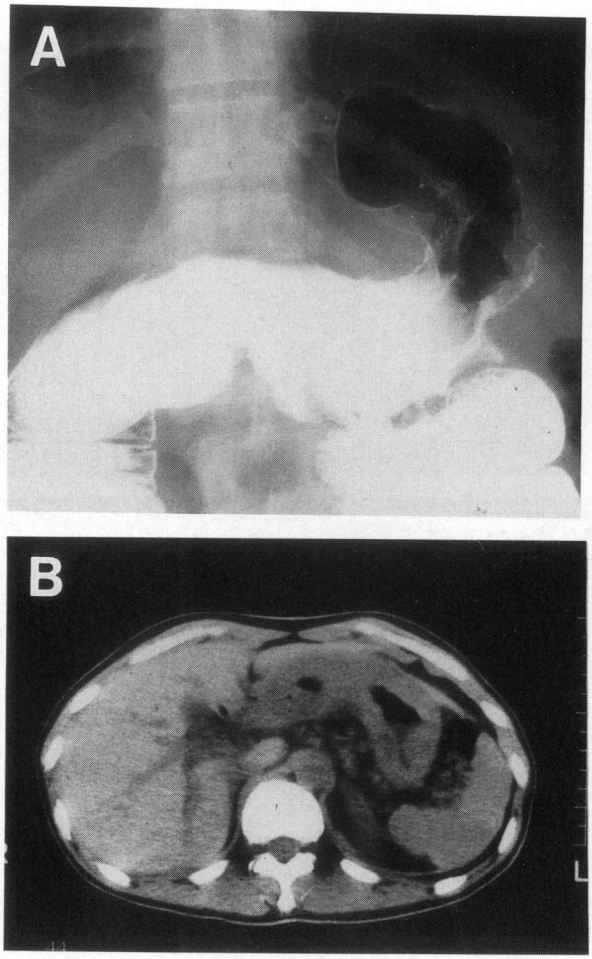

Fig. 4 Scirrhous cancer of the stomach (case 11).
A: Gastric X-ray photography
B: Computed Tomography

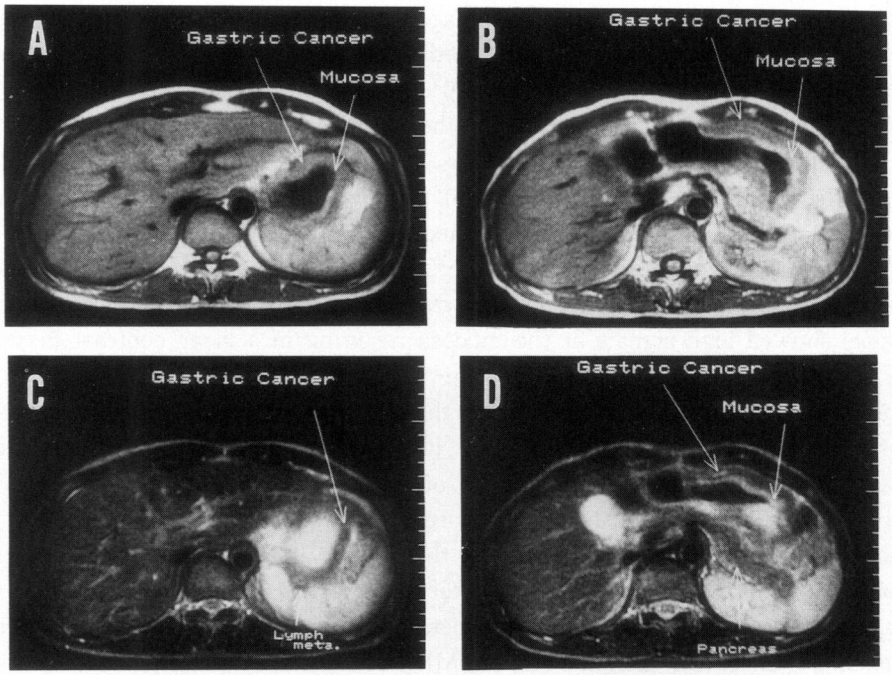

Fig. 5 MRI of scirrhous cancer of the stomach (case 11).
A: T1 weighted image by SE
B: T2 weighted image by SE

DISCUSSION

One of the characteristics of scirrhous cancer of stomach is that the fundamental structure of the layer is preserved because the cancer area is diffusely infiltrated under the gastric mucosa[8], whereas, in most cases of advanced gastric cancer, the mucosal structure within the extension areas of the cancer is completely destroyed. These altered tissues appear on the X-ray CT as constant diffuse thickening of the wall[9], and on ultrasonic endoscopy as thickening of the entire wall accompanied mainly by thickening of the 3rd～4th layers among the 5-layer structure in the wall[10]. On the other hand, the thickening is the only information provided by the X-ray CT, and it is quite difficult to distinguish pathological changes from histological changes such as edematous tissue or the wall thickening accompanied fibrosis by ultrasonic endoscopy[3]. Alterations in MR images provide an index of histological changes of lesion[7]. Patients with scirrhous cancer of the stomach show extremely fibrous lesions under the mucosa which are reported to have relaxation (T1 and T2 values) quite distinct from

those observed in patients with advanced gastric cancer[7]. Winkler, M. L. *et al*[10]. actually reported a case, who demonstrated extremely thickened gastric wall together with a low signal intensity under MRI; they diagnosed the case as diffusely infiltrating gastric cancer. In the present study, we conducted MRIs on 92 patients with advanced gastric cancer (including 9 patients with scirrhous cancer of the stomach). We confirmed that the low signals from the thickened gastric walls were characteristics of scirrhous cancer of the stomach. Specifically, these were somewhat low signals in the T1 weighted images and extremely low signals in the T2 weighted images. Furthermore, both the T1 and T2 weighted images showed high signals at the mucosa resulting in a clear contrast between the cancer sites and mucosa (Fig. 3 and 5). Advanced gastric cancers revealed similar signal intensities to those from the liver in the T1 weighted images and higher intensities than those from the liver in the T2 weighted images. The images from both differed from those of scirrhous cancer of the stomach but were difficult to distinguish from the tumor sites from the mucosae (Fig. 1). These MRI findings also disclosed that the T1 and T2 relaxation times in scirrhous cancer of the stomach were shorter than in advanced gastric cancers. In the study of advanced gastric cancer mentioned above, Winkler *et al*[10]. found a thickened wall of the stomach in the MRI, and pointed out an extremely short T2 relaxation time (18 msec) of the cancer site resulting from the marked fibrous change of the gastric wall. This finding was also confirmed by evaluating the T1 and T2 values measured basing on calculation images of T1 and T2 in the case. In concrete, advanced gastric cancers generally showed longer values of T1 (482 ± 78.2 msec) and T2 (82.5 ± 19.6 msec) than those of normal livers (T1: 387.7 ± 49.8 msec, T2: 60.7 ± 8.3 msec), while scirrhous cancer of the stomach revealed shorter values, averaging 351.2 ± 72.5 msec for T1 and 45.0 ± 22.2 msec for T2. These results were most noticeable in tissues with extreme fibrosis of the organs[11,12]. Therefore, we conclude that MRI feature for scirrhous cancers of the stomach are the following: 1) thickened gastric wall observed in T1 and T2 weighted images; 2) shortening of T1 and T2 values; and 3) clear-cut contrasts of the high signal intensity mucosae against the low signal intensity cancer areas. MRI still has a few drawbacks for diagnosis of gastric cancers; 1) respiration artifact; especially from the cardia of the stomach adjacent to the diaphragma; make it difficult to image lesions under 2 cm in many cases; 2) resolution similar to that of the CT scan and therefore no better for detecting early gastric cancers; and 3) extreme valiability with the individual patient, especially in cases with longer TRs. However, these problems may be resolved in the near future by development of the analytical software.

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