The Role Of MRI In The Follow-Up Of Patients With Primary Gastric Lymphoma

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Abstract

Background: To determine the usefulness of magnetic resonance imaging (MRI) in the follow-up of patients with histologically proven gastric lymphoma.

Materials and Methods: Nineteen patients with biopsy proven primary lymphoma of the stomach were prospectively evaluated with MRI before and after treatment. We then compared the MR images of various sequences, including T1-weighted, T2 TSE, gadolinium-enhanced conventional and fat-suppressed gradient-echo sequences with the results of endoscopy and histology. Follow-up examinations were performed between three and twelve month intervals. Seven patients did not return after treatment and were evaluated before treatment only. MRI results were correlated with histology.

Results: MRI identified the presence of a gastric wall lesion (maximum thickness 1,3-6,2 cm) in seventeen patients. The lesions were completely resolved in follow-up MRI evaluation, while tumor recurrence was depicted in 3 patients and was also histologically proven. Four patients have not completed therapy yet and remain to be evaluated. In two patients no abnormal mural thickening was observed, whereas biopsies showed evidence

of lymphoma. Two follow-up examinations were excluded due to suboptimal stomach distension. The optimal sequences for visualizing mural gastric lesions were T1 weighted images with contrast enhancement and T1 weighted images with fat suppression and contrast enhancement.

Conclusion: Contrast-enhanced MR imaging is effective for the precise extent of the disease and the follow-up of patients with gastric MALT lymphoma, even though it cannot detect flat mural lesions.

INTRODUCTION

Primary gastric lymphoma is a rare tumor that constitutes about 5% of all gastric malignancies. It encompasses mainly the diffuse large cell lymphoma and the more recently recognized mucosa associated lymphoid tissue (MALT) lymphoma. The latter is usually of low grade histology, associated with the Helicobacter pylori and tends to remain localized for a long period of time.

Endoscopic ultrasonography (EUS) and recently spiral CT are performed for the follow-up of patients with gastric lymphoma. EUS in particular, can accurately determine the extent of mural invasion and is used to evaluate therapeutic management ($_1$). The advantage of spiral CT is its ability to determine extraserosal abdominal disease contributing to the detailed staging of the disease ($_2$). MRI is a method that can be performed in many institutions, without ionizing radiation and well tolerated by the patient.

Nevertheless, it is considered to be inadequate, mainly due to lack of visualization of flat abnormalities of the mucosal layer (which is also a disadvantage of CT imaging), as well as artifacts due to respiratory motion or peristalsis.

The present study was conducted in order to determine whether MRI could be included in the assessment of the extent of disease and the follow-up of patients with gastric lymphoma.

MATERIALS AND METHODS

PATIENTS' CHARACTERISTICS

Nineteen consecutive patients (14 men and 5 women) with histologically verified gastric lymphoma were prospectively enrolled and evaluated with an upper abdominal MR scan. Patients' age ranged between 21 to 86 years (median 57,7 years). Clinical and MRI follow-up was conducted every three to twelve months. Informed consent was obtained from all patients.

MRI TECHNIQUE

Images were obtained on a superconducting 1.5T MR unit (Philips Gyroscan ACS, The Netherlands) in all patients. Initially, unenhanced fast field-echo T1 weighted axial images on a 256x128 matrix were obtained with respiratory ordered phase-encoding and superior and inferior saturation pulses. Imaging parameters included TR:107-188ms, TE:3.9-4ms, one signal average. The slice thickness was 7-10mm with a 2-3mm interslice gap.T2 TSE images with fat suppression were acquired. Imaging parameters consisted of TR:1800ms, TE:80ms, one excitation and scan time:2 minutes and 2 sec. The matrix size was 256x171 and the section thickness 10mm with a 2mm interslice gap.

Gadopentetate dimeglumine (Magnevist, Schering AG, Germany) or gadodiamide (Omniscan, Nycomed Amersham, England) was administered at a dose of 0.1mmol/kg as a rapid hand-injected bolus, prior to the enhanced images. These consisted of T1 weighted images (early [1 min] and intermediate [3 min] post gadolinium images) (repetition time, 107 ms; spin echo time, 3.9 ms), with a matrix 256x128 and flip angle 80 degrees. T1 weighed sequence with fat suppression to reduce artifacts and delayed post contrast images (5 min) were also performed. Imaging parameters included TR:691ms, TE:4-6ms, scan time:59 sec-1 min and 51sec. Slice thickness and interslice gap was the same as above. For optimum quality these images were obtained during breath suspension. Patients fasted 6 hours prior to MRI examination. The oral contrast medium administered, was 750 ml 2% oral barium sulphate for the stomach distension and opacification. Patients were

instructed to drink 500 ml 30 minutes before the examination and 250ml immediately before the MR examination. Barium serves as a negative contrast agent for T1-weighted images and improves detection of gastric wall lesions ([3]).

PARAMETERS

The MR studies were evaluated according to their potential to detect the presence of abnormal mural thickening or enhancement. Patients were divided into three categories, according to the imaging pattern of the gastric lymphoma observed: 1. Flat superficial lesions which may produce focal thickening of the gastric wall with or without ulceration, 2. Polypoid pattern with intraluminal protrusion into the gastric lumen, and 3. Diffuse underlying infiltration with longitudinal extension, confined or not to the submucosa and lamina propria. The specific location and extent of the tumor, as well as the possible enlargement of regional lymph nodes were addressed. The results of the MRI examinations were correlated with histopathological findings from endoscopy. Patients were staged according to the Lugano staging system (Table I).

Figure 1

Table I: Lugano Staging System

Stage I	Confined to GI tract (single primary or multiple, noncontiguous)
Stage II	Extending into abdomen II_1: local nodal involvement II_2: distant nodal involvement
Stage III	Penetration of serosa to involve adjacent organs or tissues
Stage IV	Disseminated extranodal involvement or concommitant supradiaphragmatic nodal involvement

RESULTS

A total of 35 follow-up MR examinations were performed in 19 patients. Initially, MRI identified the presence of a gastric wall lesion in 17 of the 19 patients (Tabe II). The superficial ulcerative type of lesion was documented in 5 patients. Nodular masses projecting into the lumen (type II) were observed in 7 patients. Five patients displayed a diffuse pattern (type III) on imaging studies. Two patients had pathologically documented flat superficial lesions that the MR examinations were unable to detect (Table III). Follow-up MRI examinations of four patients who had not yet completed treatment by April of this year are not included. Seven patients were evaluated before therapy, but subsequently did not return for post-treatment MRI evaluation. Complete resolution of the previously observed lesion, was documented in all patients with follow-up examinations, while tumor recurrence was observed in three patients, which was also histologically proved. Extraserosal invasion was not depicted in any patients since a smooth low density band was observed around the gastric wall in all patients in out-of-phase gradient echo images.

The signal intensity of gastric MALT lymphoma was intermediate on T1-weighted images, homogeneous in small tumors and heterogeneous in larger masses (Fig.1). After intravenous contrast administration the mucosa enhances intensely, whereas tumor infiltration demonstrates moderate enhancement (Fig. 2,3). Finally, regional or widespread lymphadenopathy was detected in one case.

Figure 2

Table II: Patients Characteristics, Mr Findings, Optimal Mr Sequence And Endoscopic Results

Case #	Age	sex	Exam #	Type of lesion	Optimal MR Sequence	Endoscopy results	Histology results
1*	58	F	2/6/00	I	T1+gd	Positive	Positive
2	65	M	22/9/99	II	T1+gd	Positive	Positive
			11/12/99	Regression	T1+gd	Regression	Regression
			20/6/00	Recurrence[1]	T1+gd	Positive	Positive
			8/1/01	Regression	T1spir	Regression	Regression
3	57	M	3/2/00	III	T1gd	Negative	Positive
			19/4/00	II	T1+gd	Negative	Positive
			22/1/02	Excluded from study group	Suboptimal distension	Negative	Regression
4*	61	M	7/2/00	III	T1+gd	Negative	Positive
5	58	M	10/9/99	III	T1+gd	Negative	Positive
			17/11/99	II	T1spir+gd	Negative	Positive
			2/2/00	Regression	T1spir+gd	Regression	Regression
			2/5/00	Recurrence[1]	T1gd+gd	Negative	Positive
			22/1/02	Regression	T1spir+gd	Regression	Regression
6	57	M	8/12/99	II	T1+gd	Positive	Positive
			13/4/00	Regression	T1+gd	Regression	Regression
			6/9/00	Recurrence[1]	T1spir+gd	Positive	Positive
			19/701	Regression	T1spir+gd	Regression	Regression
7	60	M	2/12/99	III	T1spir+gd	Negative	Positive
			21/11/00	Regression	T1spir+gd	Negative	Regression
8	73	M	29/11/99	II	T1+gd	Positive	Positive
			20/11/00	Regression	T1+gd	Regression	Regression
9*	75	F	12/2/01	I	T1spir+gd	Positive	Positive
10*	86	M	30/3/01	I	T1+gd	Positive	Positive
11*	39	F	13/3/01	I	Not detected	Positive (superficial lesion)	Positive
12	72	M	3/5/01	I	T1spir+gd	Positive	Positive
			21/9/01	Regression	T1spir+gd	Regression	Regression
13*	29	M	29/11/00	II	T1spir+gd	Positive	Positive
14	70	M	3/1/01	I	T1spir+gd	Positive	Positive
			13/5/02	Excluded from study group	Suboptimal distension	Regression	Regression
15*	45	F	23/11/00	II	T1+gd	Positive	Positive
16**	69	M	12/2/02	I	Not detected	Positive (superficial lesion)	Positive
17**	50	M	27/12/01	III	T1spir+gd	Negative	Positive
18**	52	M	8/11/01	II	T1spir+gd	Positive	Positive
19**	21	F	8/4/02	II	T1spir+gd	Positive	Positive

*Pretreatment MR examinations available only

**Follow-up MR examinations still pending.

1 Recurrence was documented in 3 patients.

Figure 3

Table III: Pattern Of Primary Gastric Lymphoma

TYPE	MRI PICTURE	# OF PATIENTS ON MRI	ENDOSCOPY RESULS	HISTOLOGY RESULTS
TYPE I	FLAT SUPERFICIAL LESIONS WITH FOCAL SUBMUCOSAL INFILTRATION	5	7	7
TYPE II	POLYPOID PATTERN WITH PROTRUSION INTO GASTRIC LUMEN	7	7	7
TYPE III	DIFFUSE SUBMUCOSAL INFILTRATION AND LONGITUDINAL EXTENSION	5	0	5

Figure 4

Figure 1: Transverse T1-weighted image. A large mass of intermediate signal intensity is demonstrated arising mainly in the corpus of the stomach.

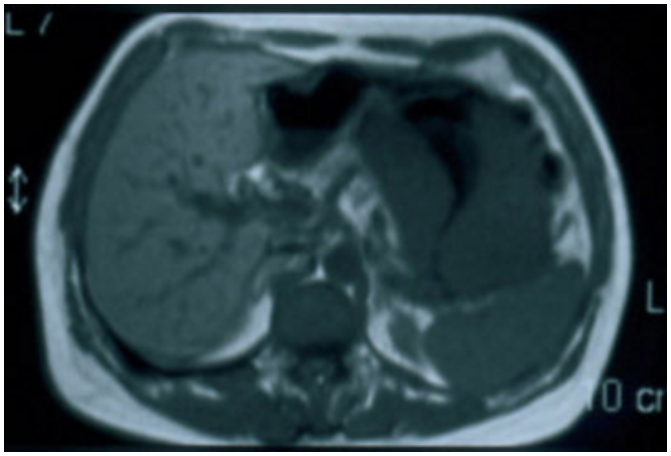


Figure 5

Figure 2: On the immediate post-gadolinium image it displays moderate heterogeneous enhancement. Note the low signal intensity areas within the mass that represent necrosis and that were not visible on pre-contrast image (same patient as Fig.1).

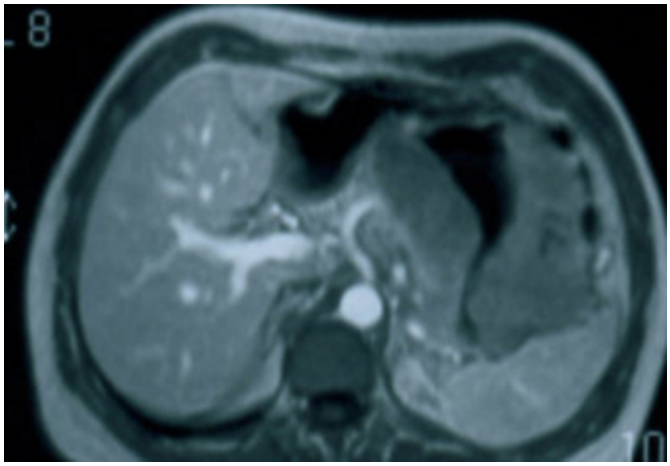
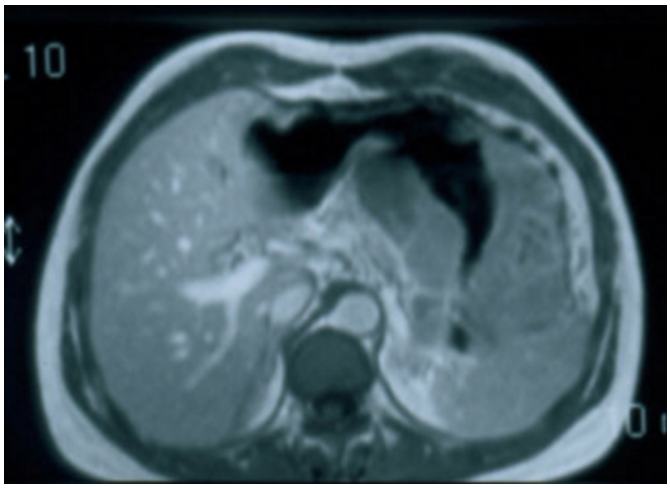


Figure 6

Figure 3: Late post-gadolinium axial image. Intense enhancement is observed, as well as larger areas of necrosis are displayed (same patient as Fig. 1).



DISCUSSION

Primary gastric lymphoma is an unusual gastric malignancy with a prolonged period of localized disease. It develops from lymphoid cells in the lamina propria and submucosa (type I). If the lesion grows mainly toward the mucosa, a polypoid or nodular form may occur (type II). Submucosal extention causes gastric wall thickening which may be focal or diffuse, depending on the extent of longitudinal infiltration. The lesion that extends through the propria muscular layer results in an extraluminal mass ([4,5,6]).

This is an uncommon manifestation of gastric MALT

lymphoma, occurring more often in the rest of the GI tract. A typical feature of this disease is that distensability of the stomach is maintained, despite lymphoid infiltration and gastric wall thickening ([7]). Furthermore, outlet obstruction is uncommon, with diffuse infiltration and longitudinal extension (type III) ([8]). The diagnosis is established with biopsy and histological examination. The therapeutic management of gastric lymphoma involves the elimination of helicobacter pylori (in hp positive patients) with antibiotics ([9]). A series of therapeutic measures such as the administration of chlorambucil or intravenous chemotherapy or in certain cases, radiotherapy and even, gastrectomy are considered ([9]). Normal gastric wall anatomy is depicted with contrast-enhanced MRI. The mucosal-submucosal layer enhances substantially, while the muscular layers show minimal enhancement. The three-zone appearance of NHL is composed of high-intensity mucosa, intermediate submucosal tumor infiltration and a low-intensity proper muscular layer ([6]). When the latter is not visualized, tumor infiltration of the muscular layer has probably occurred. The three-zone appearance may be proved useful in differentiating a submucosal tumor from a mucosal lesion. Enhancement is most intense on images obtained 1-5 minutes after intravenous injection, which reflects the retention of contrast in the interstitial space and increased extracellular fluid that is a feature of tumors or inflammation ([10,11]). Enhanced images enabled us to distinguish between a submucosal neoplastic process from a mucosal one.

The optimal sequence, in our study, was T1 contrast-enhanced, whereas T1 with fat suppression and gadolinium enhancement was slightly less sensitive.

The long acquisition time and the fact that many patients are unable to suspend their respiration for the required time results in motion artifacts that degrade the diagnostic quality of the sequence with fat suppression. This is probably the reason for the slightly lower sensitivity rate of this sequence in our study group. An advantage of MRI is that extraserosal extension can be evaluated. A smooth low signal intensity band observed in out-of-phase gradient echo imaging is caused by a signal void caused by a chemical shift artifact and a signal loss caused by a phase cancellation artifact between fat and water. Disruption of the band is detected in extraserosal invasion by neoplastic gastric disease ([5]). In our study MRI correctly identified gastric lesions in seventeen of the nineteen patients (89.5%). The extent and severity of the disease in these patients were correctly determined, according to the results of endoscopy and histology. Even though EUS is effective in evaluating gastric wall pathology it cannot detect pathology around the gastric cavity ([12]). Spiral CT in addition to the detection of gastric wall lesions, is effective in determining extraluminal disease ([13]). The benefits of MRI include multiplanar images which are useful in bypassing the partial volume effect which is unavoidable with axial CT sections, multiple types of parameters, which increase the detection rate of lesions and lack of ionizing radiation, which is an important factor considering that long term follow-up is clearly indicated. In this study, we have shown the potential of MRI in the follow-up of patients with gastric lymphoma. Comparison with other modalities, such as spiral and multislice CT scanning and EUS will be needed to establish the role of MRI in the clinical practice.

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