

**Original Research**

## Diagnostic value of MRI-DWI signal intensity value combined with serum PGI, PGII and CA199 in early gastric cancer

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**Abstract:** To explore the diagnostic value of MRI-DWI signal intensity value combined with serum PGI, PGII and CA199 in early gastric cancer. Sixty cases of gastric cancer patients admitted to our hospital from December 2019 to December 2020 were selected as the gastric cancer group and 80 cases of healthy volunteers who underwent physical examination in our hospital during the same period were selected as the healthy group. All the 60 patients underwent MRI-DWI examination, and the pathological diagnosis results were regarded as the gold standard. MRI-DWI images, MRI-DWI signal intensity values of patients with different degrees of gastric cancer differentiation. Serum PGI, PGII and CA199 levels of subjects in the two groups were compared. AUC was used to evaluate the diagnostic value of MRI-DWI signal intensity value combined with serum PGI, PG II and CA199 for early gastric cancer. In the healthy group, T1WI showed relatively uniform low signal intensity. While T2WI showed no significant increase in signal intensity. In the gastric cancer group. There was diffuse gastric wall thickening, local thickening or mass formation; T1WI and WATS showed slightly lower signal intensity in the lesion area. T2WI, FLAIR and B-TFE showed slightly uneven or moderately increased signal intensity. DWI showed limited diffusion, and the signal intensity increased uniformly or more uniformly, and the range of increase was clear. The signal intensity of MRI-DWI was  $89.12 \pm 8.14$  in patients with low differentiation,  $82.17 \pm 6.35$  in patients with moderate differentiation, and  $74.52 \pm 4.53$  in patients with high differentiation. There were significant differences in the signal intensity of MRI-DWI among the three groups, and the difference was statistically significant ( $F=12.214$ ,  $P < 0.05$ ). Serum PGI levels of subjects in the gastric cancer group were significantly lower than those in the healthy group, and the levels of PGII and CA199 were significantly higher than that in the healthy group, with statistical significance ( $P < 0.05$ ). The AUC, sensitivity and specificity of MRI-DWI signal intensity value and serum PGI, PGII and CA199 combined indexes in the diagnosis of gastric cancer were significantly higher than those of the independent indexes, with statistical significance ( $P < 0.05$ ). Conclusion: MRI-DWI signal strength value, serum PGI, PGII and CA199 levels are closely related to the occurrence and development of early gastric cancer. The combined detection and diagnosis efficiency is higher, which is helpful to improve the detection rate of early gastric cancer and is worthy of extensive clinical application.

**Key words:** Magnetic resonance imaging diffusion-weighted imaging; Pepsinogen I; Pepsinogen II; Carbohydrate antigen 199; Early gastric cancer.

### Introduction

Gastric cancer (gastric carcinoma) is a malignant tumor originating from the epithelium of the gastric mucosa (1) which occurs in any part of the stomach. Most of them are in the gastric sinuses, and large stomach bends, small stomach bends, and front and rear walls can be affected (2). The vast majority of gastric cancer is adenocarcinoma. Early gastric cancer patients usually have no special clinical symptoms, may appear abdominal discomfort, belching and other nonspecific symptoms, often similar to stomach ulcers. Gastritis and other stomach chronic disease symptoms are easily ignored which leads to the low diagnosis rate of early gastric cancer. Most patients diagnosed progress to middle and late, and are prone to metastasis, increasing the risk of mortality (3-4). At present, CT, gastroscopy is often used to diagnose gastric cancer, including CT examination (5) Gastroscope, as a gold standard, is widely used in the diagnosis of gastric mucosal lesions which is invasive and the patient acceptance is poor (6). Both

people have limitations. Magnetic resonance dispersion-weighted imaging (magnetic resonance imaging diffusion-weighted imaging, MRI-DWI) is an imaging technique based on flow effects, one of the elements of MRI imaging (7). MRI observed macroscopic blood flow phenomena, and DWI observed microscopic water molecular flow diffusion phenomena, and this technique presents structural changes within the tissue (8). With the further study of the clinical diagnosis of gastric cancer, the expression of tumor markers and pepsinogen (pepsinogen, PG) is significantly associated with the occurrence and development of gastric cancer (9). However, most of the research on gastric cancer is treatment, single diagnosis and postoperative nursing (10-12). The diagnostic effect of MRI-DWI combined with tumor markers and pepsinogen PG was less reported. Therefore, this study studied 60 patients with gastric cancer admitted to our hospital from December 2019 to December 2020, and aims to explore the diagnostic value of MRI-DWI signal strength combined with serum PGI, PGII, sugar antigen 199 (carbohydrate antigen 199,

CA199) for early gastric cancer, so as to improve the clinical detection effect of early gastric cancer, timely intervention and provide data support and theoretical reference. It is now reported below.

## Materials and Methods

### General information

We selected 60 patients with gastric cancer admitted to our hospital from December 2019 to December 2020, 37 men, 23 women in age; 42~70, average age  $57.64 \pm 6.92$ ; 10 lesions: gastric, 42 gastric sinuses, 8 cardia; differentiation: 14 low differentiation, 19 and 27 with high differentiation. Sixty patients with gastric cancer were treated as the gastric cancer group, and another 80 volunteers who had the health examination in the hospital at the same time were selected as the health group. All 60 patients underwent MRI-DWI and underwent pathological diagnosis. All patients and their families were fully aware of the study and signed informed consent. This study was approved by the ethics committee of the court.

### Include the standards and exclusion criteria

Inclusion criteria: 1. All patients were diagnosed with gastric cancer through gastroscopy and pathology; 2. no history of radiotherapy, chemotherapy and immunotherapy for gastric cancer before entering the study; 3. the clinical data were complete; 4. good compliance and no mental illness or consciousness disorders; and 5. no other malignant tumors. Exclusion criteria: 1. serious lesions or dysfunction with heart, liver, and kidney organs; 2. blood, immune and neurological diseases; 3. infectious or infectious diseases; 4. aneurysms; and 5. pregnant and lactating women.

### MRI-DWI check method

All patients examined fasting and breathing training before 7 hours, checked muscular injection of alkali (Jiangsu Huayang Pharmaceutical Co., Ltd., Chinese medicine H32020834) 10 minutes ago, and told the patient to drink 1 L of warm water for 5 minutes to keep the stomach full. The patient took the flat position, performed an MRI-DWI scan with Siemens superconducting 1.5T MRI scanner and 8 through the abdominal coil. General MRI scan includes [1] T1W1: TR=213ms, TE=4.6ms, FOV=375, The thickness is 8.0/0.8mm, Matrix is  $256 \times 512$ ; [2] Air shear T2W1: TR=2500ms, TE=100ms, FOV=375, The thickness is 8.0/0.8mm, Matrix is  $400 \times 512$ ; [3] Air screen cross shear pressure grease SPAIR: TR=416ms, TE=80ms, FOV=375. The thickness is 8.0/0.8mm, The Matrix is  $256 \times 512$ , TSE factor =59; [4] Air screen cross shear T1W1-Wats: TR=148ms, TE=5.7ms, FOV=375, The thickness is 8.0/0.8mm, Matrix is  $304 \times 512$ ; [5] B-TFE crown position: TR=3.6ms, TE=1.8ms, FOV=375, The thickness is 8.0/0.2mm, The Matrix is  $256 \times 256$ , TFE Factor =171.

The DWI scan adopts the plane echo imaging (echo planer imaging, EPI) sequence with the following parameters: the dispersion weighted coefficient b value is  $0,600s/mm^2$ , TR=2280ms, TE=58ms, FOV=375, RFOV=70%, with a matrix of  $128 \times 256$ , a total of 2 excitations, and a scan time of the 20s.

Save and upload the collected images to the Siemens

Syngo workstation for processing. See the film by three experienced imaging physicians, observed the gastric wall thickness, signal strength value, and measured DWI performance diffusion coefficient (apparent diffusion coefficient, ADC) value, and mass location. A circular maximum area of interest with a diameter greater than 10mm, but not beyond the normal gastric wall or lesion range is selected, and the phantom and necrotic areas are avoided.

### Serum PGI, PGII, CA199 level detection method

Serum PGI, PGII, CA199 levels were tested for all 140 subjects. All patients fasted for 12 hours before collecting blood samples. The gastric cancer group collected 3ml, on the morning of the hospital collected 5ml, on the morning of the physical examination, rotating at 2500 r/min, the upper serum after 10 minutes, and placed in the  $-70^\circ C$  refrigerator for the test. Serum PGI, PGII levels were measured by enzyme-linked immunoadsorption and CA199 levels by a fully automated biochemical analyzer (Hitachi, 7600 model). Medical Reference Range: PGI:50.0-130.0g/L; PGII: 0-1.0g/L; CA199: <37. 0 U/L.

### Observation indicators

Observation indicators included 1. Comparison of the MRI-DWI image features between the two groups of research subjects. 2. Comparison of MRI-DWI signal strength values of different degrees of differentiation of gastric cancer. 3. Serum PGI, PGII, CA199 level comparison between the two groups. 4. MRI-DWI signal strength value combined with serum PGI, PGII, CA199 level in the diagnosis of early gastric cancer.

### Statistical processing

The data was analyzed using SPSS 22.0 statistical software. Among them, the measurement data meeting normal distribution is represented by mean  $\pm$  standard difference ( $\pm s$ ), the t-test was used between-group comparison and variance analysis is used; count data cases (n) or percentage (%), and the data comparison adopts  $\chi^2$  test.  $x$  The diagnostic value was evaluated using the area (Area under curve, AUC) under the subject working feature (Receiver Operating Characteristics, ROC) curve. The difference is statistically significant when  $P < 0.05$ .

## Results

### General information

The general data such as gender, age, and body mass index (Body Mass Index, BMI) were not statistically significant ( $P > 0.05$ ). See Table 1.

### Comparison of the MRI-DWI image features between the two groups of study subjects

Health group: T1WI showed uniform moderate low signal intensity and T2WI signal intensity is not significant.

Gastric cancer group: diffuse thickening, local thickening or mass formation, T1WI, Wats showed the lesion area and the intensity of T2WI, FLAIR and B-TFE. DWI display all show that the diffusion is limited, the signal intensity is uniform, more uniform increase,

**Table 1.** Comparison of the general data of the two groups of research subjects

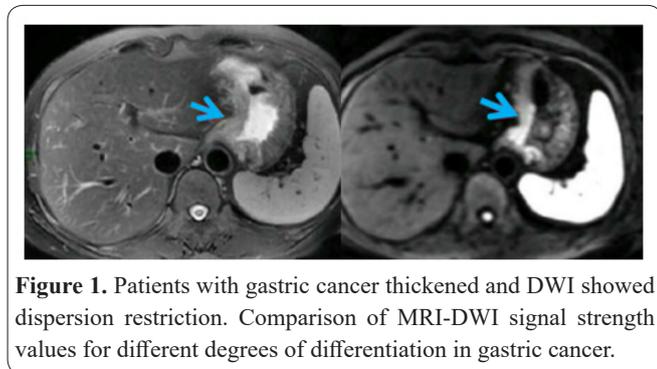
		Gastric cancer group (n = 60)	Health group (n = 80)	Statistical values	The P value
Gender	Male	37	49	1.568	0.154
	Female	23	31		
Average age (year of age)		57.65±6.91	57.64±6.93	1.252	0.272
BMI (kg/m. <sup>2</sup> )		22.84±2.36	22.78±2.41	0.874	0.312
Focus site	Gastric body	10	-	-	-
	Gastric sinus	42	-		
	Ben diac	8	-		
Degree of differentiation	Low differentiation	14	-	-	-
	Medium differentiation	19	-		
	High differentiation	27	-		

**Table 2.** Comparison of serum PGI, PGII, CA199 levels between the two groups.

	Gastric cancer group (n = 60)	Health Group (n = 30)	The t value	The P value
PGI (g / L)	39.61±8.32	121.59±20.33	16.142	0.000
PGII (g / L)	14.52±6.26	9.54±5.25	8.252	0.002
CA199 (U / mL)	131.41±40.11	18.42±5.12	15.024	0.000

**Table 3.** Comparison of MRI-DWI signal strength values combined with serum PGI, PGII, CA199 for diagnosis of early gastric cancer and pathological results.

Diagnosis mode	Pathology		Total
	Positive	Negative	
The MRI-DWI signal strength values were combined with the serum PGI, PGII, CA199	Positive	55	55
	Negative	5	5
Total	60	60	60



**Figure 1.** Patients with gastric cancer thickened and DWI showed dispersion restriction. Comparison of MRI-DWI signal strength values for different degrees of differentiation in gastric cancer.

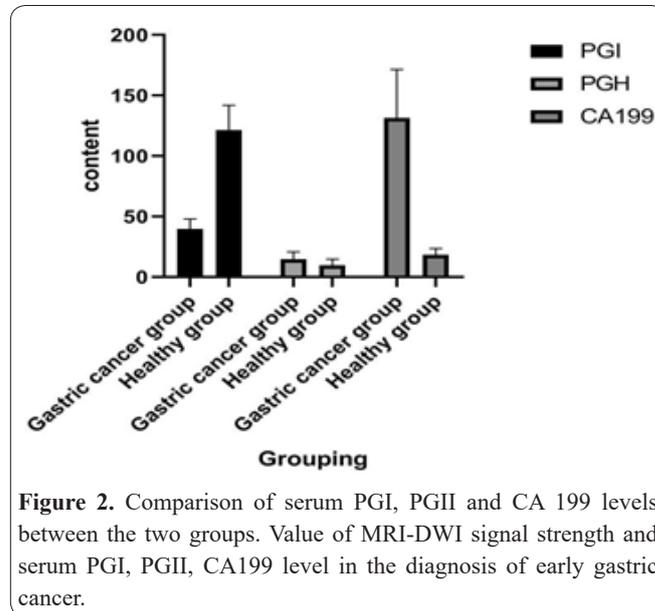
and the increased range is clear (Figure 1).

Of the 60 patients with gastric cancer, low differentiated patients (n=14) MRI-DWI was 89.12 ± 8.196, 14,82.17 ± 6.35, 74.52 ± 4.53, and significant differences between MRI-DWI signal strength values in three groups (F=12.214, P <0.05), indicating increased MRI-DWI signal strength values with the occurrence and progression of gastric cancer.

**Serum PGI, PGII, CA199 levels were compared between the two groups**

Serum PGI levels were significantly lower than in the healthy group and significantly higher than in the health group, and the differences were statistically significant (P <0.05). See Table 2.

With the pathological diagnosis results as the gold standard, 55 gastric cancers were detected combined with serum PGI, PGII, CA199, with 5 missed cases, and the diagnostic sensitivity was 91.67% (55 / 60), as shown



**Figure 2.** Comparison of serum PGI, PGII and CA 199 levels between the two groups. Value of MRI-DWI signal strength and serum PGI, PGII, CA199 level in the diagnosis of early gastric cancer.

in Table 3. The AUC, sensitivity and specificity of the MRI-DWI signal strength values of the MRI-DWI and serum PGI, PGII, CA199 were significantly higher than the independent indicators, and the differences were statistically significant (P <0.05). See Table 4.

**Discussion**

Gastric cancer is a common malignant tumor in the digestive system, with a high incidence of morbidity and mortality (13). Early gastric cancer cells are mainly infiltrated in the mucosa and submucosa, clinical symp-

**Table 4.** Comparison of MRI-DWI signal strength value and serum PGI, PGII, CA199 level for the diagnosis of early gastric cancer.

Diagnosis mode	AUC (95%CI)	truncation value	Sensitivity	Special homogeneity
<b>MRI-DWI.</b>	0.875 (0.742-0.932)	0.812	87.63%	70.91%
<b>PGI.</b>	0.741 (0.635-0.858)	70.786	71.62%	83.74%
<b>PGII.</b>	0.742 (0.625-0.843)	0.754	72.54%	81.14%
<b>CA199.</b>	0.763 (0.658-0.876)	37.12	74.25%	84.76%
<b>Union</b>	0.937 (0.894-0.973)	0.852	91.67%	95.17%

Note: Combination refers to the MRI-DWI signal strength value and serum PGI, PGII, CA199 combination index.

toms are atypical, so it is difficult to attract the attention of patients, leading to some patients have entered the middle and advanced stage, resulting in poor clinical efficacy and prognosis (14). Therefore, an early clear diagnosis is important to delay the progress of gastric cancer and improve patient prognosis. Gastroscopy is the main way of clinical diagnosis of gastric cancer, but it is an invasive operation, and the patient needs preoperative intestinal preparation, which limits the universality of its clinical application. MRI-DWI is an imaging technique that detects the diffusion function of water molecules in living tissues and reflects the micro-movement state of water molecules. Which can significantly compare tumor lesions and surrounding normal tissues, and is widely used in the clinical screening and diagnosis of malignant tumors such as liver cancer and breast cancer (15). In recent years, clinical oncology research has found that serum markers are fast and non-invasive (16). However, one or more serum markers have been found for specific diagnoses of gastric cancer. Therefore, joint diagnosis may help to further improve the diagnosis effect of early gastric cancer. Based on this study, by exploring the strength of MRI-DWI signal and serum PGI, PGII, CA199 combined diagnosis of early gastric cancer, this study provides a theoretical basis for improving the clinical detection effect and timely intervention.

MRI-DWI is more sensitive than conventional MRI scanning for tissue structure detection, whose principle mainly is that the tissue structure and cell density are judged by observing the tumor lesion signal intensity and combined with the water molecular dispersion state which can reflect the early normal tissue composition and pathological state. Tang, et al (17) was found that DW-MRI observed four signal characteristics of gastric cancer: uniform high signal, internal high signal, external low signal (two-layer type), high-low-high signal (three-layer sandwich type), and mixed type. Zhang et al, (18) have shown that all gastric cancer exhibits high signaling on DWI compared to adjacent normal gastric walls. On DWI, 69.6% of cancers exhibit three-layer sandwich signatures, high inner and outer signals, and low in the middle layer. In comparison with the pathology, the low signal strength represents the intrinsic muscle layer, and it is speculated that the scattering distribution of the cancer cells has less damage and less restriction. The results of this study show that The normal group showed a relatively uniform moderate and low signal strength, DWI in the gastric cancer group, The signal strength is uniform and more even higher, And the signal intensity value increases with the decrease of lesion differentiation, It indicates that the MRI-DWI

signal strength values are significantly different in normal gastric wall tissue and diseased tissue, The main manifestations of gastric cancer is increased signal intensity, And is negatively associated with the degree of differentiation, The analysis is that the low differentiated lesion tissue characteristics showed increased tumor plate thickness, cell density and cytometry, The proportion of the nucleus and the cytoplasm increases, These changes cause a reduced intracellular gap, Water molecular dispersion restriction in the tissue, Make the tissue T2 relaxation time extended, Increase the MRI-DWI signal strength value. Similar to the Tang L, Xiao P research findings.

PG is an inactive precursor of pepsin, which can be divided into PGI, PGII subgroups according to their biochemical properties. PGI, PGII is mainly released by gastric bottom line mucus neck cells and main cells, which are very stable in the blood. Therefore, serum level can reflect the functional status of the gastric mucosa and is gradually used in the clinical diagnosis of early gastric cancer (19). The study shows that the occurrence and development mechanism of cancer is complex and biological characteristics, including tumor markers reflecting the presence of the tumor can indicate the nature of the tumor (20). CA199 is a class of glycoproteins with significantly elevated levels in malignant tumors like the gastrointestinal, hepatobiliary, and pancreas (21). However, it lacks organ specificity, so it is mostly used as an auxiliary indicator of a gastric cancer diagnosis. Shen et al, (22) show that serological testing is an effective method of screening gastric cancer. Serum test results show that in <health group in PGI, G-17 group,> health group in PGII gastric cancer group, and the combination of different markers can improve diagnostic efficiency. Yin et al, (23) showed that serum CEA, CA199 expression was significantly higher than in healthy controls. The results showed that both serum PGI levels were significantly lower than healthy groups and significantly higher than healthy groups, suggesting a significant reduction in serum PGI level and elevated PGII, CA199 levels could assist in the diagnosis of gastric cancer. ROC results show that independent index diagnosis of early gastric cancer sensitivity and specificity is low, and three and MRI-DWI signal strength joint detection, sensitivity, specificity and AUC, significantly improve a single detection means and detection of single marker diagnosis early gastric cancer effect is not ideal, misdiagnosis and missed diagnosis risk is the higher joint diagnosis, MRI-DWI signal strength value and serum index combined diagnosis can effectively improve the diagnosis efficiency of early gastric cancer, higher accuracy. In addition, this study found that MRI-

DWI signal strength value combined with serum PGI, PGII, CA199 diagnosis of early gastric cancer 5 cases, the analysis reason is that MRI-DWI scanning contrast, MRI signal and patients' abdominal breathing artifacts will affect the imaging results and signal intensity value, and serum index also has certain uncontrollable factors, resulting in false-negative results. There have been many studies on gastric cancer, especially the genetic studies of gastric cancer (24-29). But like other abnormalities and diseases, a comprehensive genetic study (30) is needed.

Gastric carcinoma is a malignant tumor inventing from the epithelium of the gastric mucosa. It has a high mortality rate in many countries in East Asia. *Helicobacter pylori* is an infectable pathogen and is involved in its etiology (31-33). The expression of tumor markers and pepsinogen (PG) is significantly related to the occurrence and development of gastric cancer (34-35). The diagnostic value of CA199 has already been studied in Esohoseal cancer (36).

To sum up, MRI-DWI signal intensity value and serum PGI, PGII, CA199 levels are closely related to the occurrence and progress of early gastric cancer. Higher MRI-DWI signal intensity value, decreased serum PGI expression and increased PGII, CA199 expression all contribute to the diagnosis of early gastric cancer, with higher joint detection and diagnosis efficiency, which is of guiding significance for the diagnosis of early gastric cancer, and is worthy of extensive clinical application. However, there are fewer samples, and we need to expand the sample content and multicenter test data.

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