

Predict Metastatic and Benign Lymph Nodes in Patients with Gastric Carcinoma by Using Diffusion-Weighted Imaging

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INTRODUCTION: Gastric cancer is one of the leading cause of cancer-related death despite the decline in incidence during last 30 years [1]. Accurate assessment of metastatic local lymph nodes prior to surgery may provide an important element in determining appropriate therapeutic strategies [2]. Various imaging technologies including computed tomography (CT) and magnetic resonance imaging (MRI) have been used to determine metastatic lymph nodes before operation. However, no acceptable consensus has been reached [3]. Diffusion-Weighted imaging (DWI) has increasingly been used to identify and characterize various diseases. A representative apparent diffusion coefficient (ADC) value can be produced to provide quantitative assessment [4, 5]. In recent studies, DWI was used to distinguish metastatic lymph nodes from benign nodes in head and neck malignant tumors and rectal cancer [6]. However, to our knowledge no prior study has attempted to assess whether ADC values can be used to identify benign and metastatic lymph nodes in gastric cancer. Therefore, the purpose of this study is to prospectively determine the diagnostic accuracy of DW imaging for predicting metastatic lymph nodes in gastric cancer with histopathology as a reference standard.

MATERIALS AND METHODS: The prospective study was approved by our institutional review board (IRB). All patients gave written informed consent. Between October 2010 and March 2011, the final cohort included 28 patients (22Male and 6Female; mean-age 64years; 43-81) who had gastric carcinoma and underwent clinical routine MRI and DWI using 1.5-T MR system (Signa Excite-HD, GE Healthcare, Milwaukee, WI, USA) before surgery. The morphologic criteria of each node (≥ 5 mm) were recorded, including short-axis diameter, border irregularity, and enhanced patterns. Apparent Diffusion Coefficient (ADC) value of lymph node was calculated by equation of $S=S_0 \exp(-b \cdot ADC)$. Lymph nodes were resected at surgery and thereafter were submitted for histopathological analyses on a nodal group basis. The concordance of nodule location and size between MR findings and pathologic examinations was ensured in consensus by the pathologist and one of the radiologists based on the same published criteria for nodal grouping. Lesion by lesion, receiver operating characteristic (ROC) curve was performed to evaluate ability of morphologic criteria and ADC values in predicting metastatic nodes with histopathology as a reference standard.

RESULTS: The histopathological analyses identified 42 metastatic and 34 benign nodes which were matched exactly with nodes visualized on MRI and DWI. Median ADC values of metastatic nodes was lower ($1.28 \times 10^{-3} \text{ mm}^2/\text{sec}$; interquartile ranger, 1.20 to 1.31) than that of benign (1.55; 1.47 to 1.73) nodes ($P<0.001$). With cut-off ADC value of 1.39, DWI showed great diagnostic accuracy in determining metastatic nodes with sensitivity of 85.7%, specificity of 79.4%, positive predictive value of 83.7% and negative predictive value of 81.8%. Adding ADC values with combined morphologic criteria had the greatest predictive power (AUC, 0.889) compared to DWI (0.857) or anatomic MRI alone.

Table1: Comparison in Diagnostic Performance of ADC Values on DWI, Enhanced Patterns, short-axis Diameter and Border Irregularity

	AUC (95% CI)	Sensitivity	Specificity	PPV	NPV
ADC value [†]	0.857(0.807 to 0.970)	85.7%	79.4%	83.7%	81.8%
Enhanced patterns [*]	0.742(0.628 to 0.835)	57.1%	91.2%	88.9%	63.3%
Short-axis Diameter [§]	0.610(0.491 to 0.720)	73.8%	52.9%	66.0%	62.1%
Border Irregularity [‡]	0.529(0.406 to 0.650)	51.4%	54.6%	55.9%	55.0%

[†]=different from short-axis D and border irregularity $P<0.05$; ^{*}=different from border irregularity $P<0.05$; [§]=different from ADC $P<0.05$; [‡]=different from ADC and enhanced patterns $P<0.05$

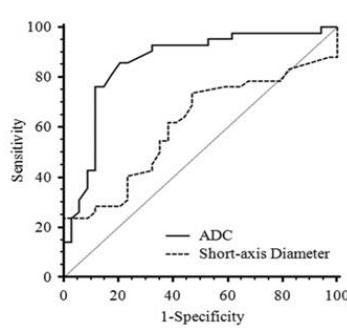


Figure 1. ROC analysis for ADC values on DWI and short-axis diameter to distinguish metastatic lymph nodes from benign lymph nodes. The AUC for ADC is 0.857 (95% CI, 0.807 to 0.970) and for short-axis diameter is 0.610 (95% CI, 0.491 to 0.720). The difference in AUC is 0.247 (95% CI, 0.108 to 0.386) ($P=0.0005$).

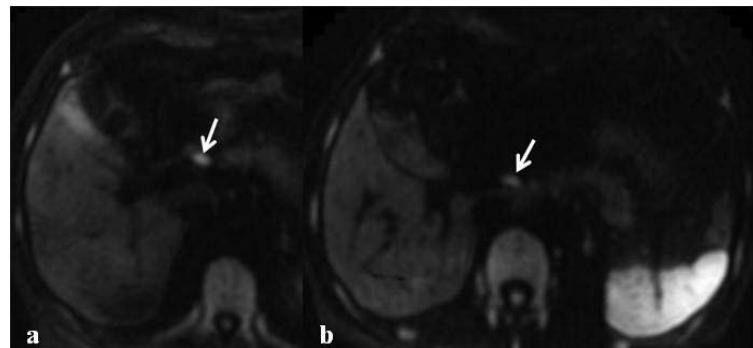


Figure 2. (a) Transverse DW ($b=400 \text{ sec/mm}^2$) imaging in a 65-year-old man shows one metastatic lymph node confirmed histopathology has increased signal intensity with ADC value of $1.13 \times 10^{-3} \text{ mm}^2/\text{sec}$. (b) Transverse DW ($b=400 \text{ sec/mm}^2$) imaging in a 60-year-old man shows one benign lymph node confirmed histopathology with ADC value of $1.48 \times 10^{-3} \text{ mm}^2/\text{sec}$.

CONCLUSIONS: In conclusion, we demonstrated that ADC values can serve as a great predictive factor to distinguish malignant and benign lymph nodes in gastric cancer, superior to the conventional morphologic criteria. Especially, DWI combined with anatomic MRI provided more accurate performance in identification of sub-centimeter nodal metastases in patients with gastric cancer. From a clinical standpoint, accurate preoperative assessment of lymph node metastases may facilitate the surgery of lymphadenectomy with decreased risk of complication.

References:

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