

# High-B-Value Diffusion-Weighted MR Imaging of Gastric Cancer: By Segmented Breath-Hold Technique

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**Purpose:** To evaluate whether segmented breath-hold technique can be used in diffusion-weighted MR imaging (DW-MRI), and generate high-*b*-value images of gastric cancer through sensitivity encoding technique (ASSET) combined with multi-acquisition method.

**Materials and Methods:** Three ASSET DW-EPI sequences with different number of acquisitions (NEX=1, 2, 4) were performed in 16 patients on a 1.5T MR scanner (GE Signa EXCITE). All patients were proved pathologically advanced gastric cancer by endoscopic guided biopsy. When acquisition time exceeded 15 seconds, a function “pause” key was used to make the scan pause after the current TR complete. Then the patients took several breaths, and completed the rest scanning in another breath-hold. Depending on patients’ endurance time, the DW-MRI sequences were segmented into 1-3 breath-holds. Scan parameters include: TR/TE, 2575ms/65ms; matrix, 128×128; section thickness/intersection gap, 5mm/1mm; slice number, 12; FOV, 36cm×36cm. The *b* values were 0, 1000s/mm<sup>2</sup>, and the MPG pulses were placed in 3 directions. Two radiologists evaluated images according to the grade of artifacts and cancer-to-background CNR (CNR<sub>Ca-Bg</sub>). The artifacts were classified into 3 grades: grade 1, no obvious artifact; grade 2, obvious artifacts without influencing cancer identification and apparent diffusion coefficient (ADC) measurement; grade 3, obvious artifacts influencing cancer identification or/and ADC measurement. The ADCs of tumors and water in gastric lumen were measured.

**Results:** There was no statistical difference between single breath-hold sequence (sequence 1) and segmented breath-hold sequences (sequence 2 and 3) in ADC measurement of both water and tumors (*P*>0.05). Multi-acquisition with segmented breath-hold technique reduced EPI- and ASSET-related artifacts (*P*<0.01) and achieved higher CNR (*P*<0.01). Acceptable images for ADC measurement were obtained in all 16 cases with sequence 3, higher than that of sequence 1 (n=6) (*P*<0.01) and 2 (n=10) (*P*<0.01). The mean ADC of gastric cancer was  $1.14 \times 10^{-3} \text{mm}^2/\text{s} \pm 0.25$ .

**Conclusion:** Segmented breath-hold technique can be used in DW-MRI to allow more acquisitions. High quality and high-*b*-value DW-MRI of gastric cancer can be achieved through the combination of sensitivity encoding technique with multi-acquisition method.

Table 1 Parameters and image quality of DW-MRI sequences with different acquisition numbers (NEX)

Sequence	NEX	Imaging time (sec)	Breath-holds	Grade of artifacts			CNR <sub>Ca-Bg</sub>	ADC ( $\times 10^{-3} \text{mm}^2/\text{s}$ )	
				1	2	3		Cancer	Water
1	1	10	1	0	6	10	14.25±3.42	1.11±0.20	3.68±0.31
2	2	21	2	2	8	6	17.59±5.98	1.19±0.19	3.58±0.29
3	4	41	3	11	5	0	22.46±8.83	1.14±0.25	3.69±0.25
<i>P</i> value	—	—	—	<0.01			<0.01	>0.05	>0.05

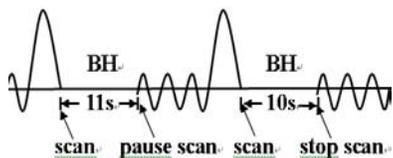


Fig.1 Diagram for breathing pattern of sequence 2. Scan time: 21sec in 2 breath-holds (BH)

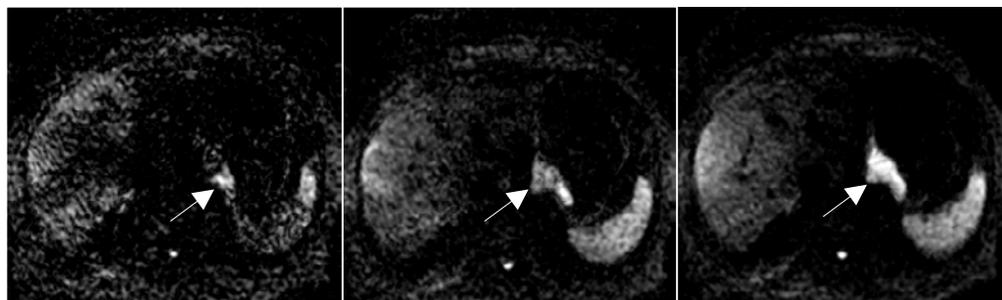


Fig.2 Demonstrating image quality of DW-MRI sequences with different NEXs. (c) NEX=4 showed more uniformity in tumor signal and less artifacts than (a) NEX=1 and (b) NEX=2.