Fast spin echo images with parallel imaging and short echo train length in the assessment of uterine cervical cancer: can we back to the conventional spin echo contrast again?

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Purpose

The purpose of this study was to improve the contrast of fast spin echo (FSE) sequences in patients with uterine cervical cancer. We evaluated FSE sequences using parallel imaging and short echo train length (ETL) for image quality, cervical cancer detection, and signal intensity measurements.

Materials and Methods

Two healthy volunteers and thirteen patients with cytology positive cervical cancer were imaged at 1.5T system (Symphony, Siemens Medial Systems) and a 12 channel CP body-array coil. (1) Volunteer study: Axial FSE images (TR/TE 2500/78) with GRAPPA (Generalized Autocalibrating Partially Parallel Acquisitions) (RF: Reduction factor 3) were obtained using ETL of 1, 3, 5, 7, and 9. The quality of the images was evaluated for normal anatomy and artifact. The contrast ratio was calculated using the formula [(SI1-SI2) / (SI1+SI2)/ 2] (SI: signal intensity). As a result, the best ETL was determined for the patient study. (2) Patient study: FSE images (TR/TE 2500/78) with GRAPPA (RF 2 or 3) using ETL 3 were obtained in the axial or sagittal planes. These images were compared with our routine FSE images with GRAPPA (RF2) using ETL 9 (TR/TE 3500-4000/80). The quality of each image set was evaluated for cancer detection and staging, contrast of the tumor, and artifact. As a quantitative analysis, the contrast ratio was calculated. Other parameters included matrix size was 179-256 x 256-512, FOV of 25-28 cm and 5 mm section thickness with 20% of intersection gap for all volunteer and patient studies.

Results

(1) Volunteer study: For qualitative assessment, the best contrast was obtained with ETL 1 in one study and with ETL 3 in one study. Table 1 summarized the study and the contrast ratio of cervical mucosa/ stroma. As in the qualitative assessment, the best contrast was seen on ETL 1 images in one and on ETL 3 in one. Because of the shorter examination time (3min vs. 10min.), less motion artifact, and less chemical shift artifact, we decided ETL 3 as practical in patient study. (2) Patient study: Of thirteen patients with cervical cancer, three were not detected on both ETL 3 and routine 9 images. In ten patients, MR staging with ETL 3 and 9 images completely corresponded (6 stage Ib, 1 stage IIa, and 3 stage IIb). Chemical shift artifact was more obvious in ETL 3 images. For qualitative assessment, ETL 3 images provided better tumor contrast than ETL 9 images in 11 of 13 patients (Fig.1). For quantitative analysis, the contrast ratio of cervicalcancer/ stroma was not statistically significant between ETL 3 and 9 images (0.77 vs. 0.78). The contrast ratio of tumor/ striated muscle was higher in ETL 3 images than in ETL 9 images (0.66 vs. 0.69, $p<0.02$).

Conclusion

FSE images with GRAPPA using ETL 1 provided excellent tissue contrast. For practical use, ETL 3 was recommended because of the shorter examination time (3 min) and less artifact. For qualitative assessment, the contrast of cervical cancer/ stroma was better in ETL 3 images than in routine ETL 9 images, however, the contrast ratio was not statistically significant. The contrast ratio of tumor/ striated muscle was higher in ETL 3 images than in ETL 9 images. FSE with GRAPPA using short ETL provides high contrast mages of less magnetization transfer effect and less J-coupling, like conventional spin echo like images. These may be useful tool for the assessment of cervical cancer.

Figure 1. Cervical cancer; ETL 3 vs. 9 Left: ETL 3 Right: ETL 9

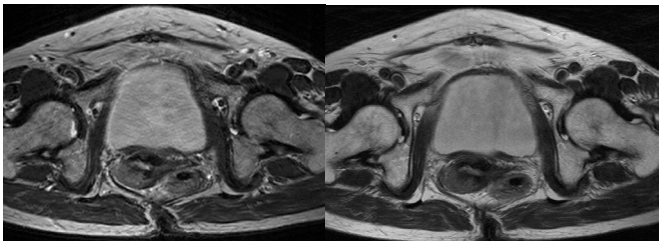

Table 1. The contrast ratio of cervical stroma/ stroma in the volunteer study

	ETL1	3	5	7	9
Volunteer 1	0.87	1.12	1.02	1.02	0.96
Volunteer 2	1.19	1.00	1.07	1.02	0.99
Exam. Time (min)	10	3	2	1.5	1