Ultra-fast MR imaging of the female plevis at 3.0T with with Sense and FAS

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Introduction: The increase in signal-to-noise (SNR) at 3.0 Tesla allows to either increase spatial resolution or to shorten scan time.

In this study we investigated 3.0 T´s potential for the development of an ultra-fast T2-weighted TSE pulse sequence (3T-FAST) for MR imaging of the female pelvis. Aim was to find out if this pulse sequence maintained diagnostic image quality as compared to a standard pulse sequence and allowed for clinically useful pelvic MR imaging.

Material and methods:

In a prior study we had transferred our routine 1.5T T2-weighted TSE pulse sequence to the 3.0 T surroundings. We have shown that this 3T-SP (TR/TE 2705ms/80ms; 0.7 x 1 x 4mm measured voxel size; FOV 360 mm; 4.03 min scan time; CLEAR; Philips Gyroscan Intera 3T, Philips Medical Systems, Best, The Netherlands) is equivalent to a routine 1.5T sequence.

3T-FAST was designed as single-shot T2-weighted TSE-pulse-sequence which -in order to reduce energy deposition at 3.0T- was combined with SENSE (SF3) and Flip angle sweep technique (FAS 75°). The use of FAS 75° required an adaptation of the contrast parameters (TR/TE 4933/100 ms). Spatial resolution (0.7x1.0x4 mm) was kept identical as compared to 3T-SP whereas scan time was drastically reduced to 39 s with 3T-FAST.

We performed a prospective intraindividual comparative trial on 33 patients who were examined twice at 3.0 T within on day in a randomized order.

Patients were referred with the suspicion of carcinoma of the cervix, ovarian cancer, myomas, uterine malformation and endometriosis. I.v. n-butyl-scopolamine was given to all patients prior to the study in order to reduce peristalsis.

Two radiologists analyzed the examinations in consensus with regard to tissue contrast (visualization of zonal anatomy of the uterus and/or delineation of pathologic findings) rated on a 3 point-scale (3 = 3T-FAST better; 2 = 3T-FAST equal; 1= 3T-FAST worse than 3T-SP). In addition, we performed quantitative contrast measurements. Analysis of image quality comprised level of artifacts (rated on a five point scale: 1 = no artifacts; 5 = non-diagnostic study), visual signal to noise ratio (rated on a 3 point scale) and detail delineation (rated on a 3 point scale).

Results:

3T-FAST was technically succesful for all 33/33 cases. All 33/33 3T-FAST MRI studies were of diagnostic image quality. Motion artifacts were significantly reduced with 3T-FAST as compared to 3T-SP ($p<10^{-3}$). The qualitative contrast analysis revealed comparable contrasts for the zonal anatomy (22/22) and between solid tumors and muscle (27/27) and cystic tumors (12/12) and muscle whereas 3T-FAST showed significantly higher contrast between bladder and muscle (33/33) as well between ovarian cysts and ovarian stroma (15/15) as compared to 3T-SP. The quantitative analysis confirmed these findings. Tissue contrast for the zonal anatomy was 0.39 (+/- 0.12) for 3T-FAST as compared to 0.38 (+/- 0.13) for 3T-SP. Contrast between solid tumors and muscle was 0.31 (+/- 0.19) for 3T-FAST as compared to 0.3 (+/- 0.23) for 3T-SP. Contrast between bladder and muscle was 0.74 (+/- 0.07) for 3T-FAST as compared to 0.64 (+/- 0.08) for 3T-SP ($p<10^{-3}$). Contrast between ovarian cysts and ovarian stroma was 0.32 (+/- 0.08) for 3T-FAST as compared to 0.26 (+/- 0.08) for 3T-SP ($p = 0.025$). The delineation and detectability of pathological disorders was rated equal (39/39) for 3T-FAST and 3T-SP. Final MR imaging diagnoses were identical for all 33/33 patients.

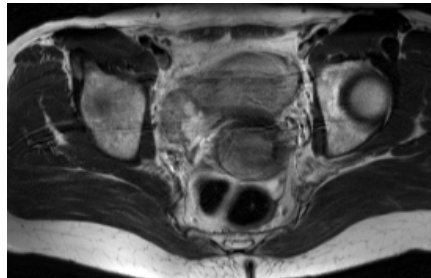**Figure 1 a:** Patient with ovarian cancer at 3T-FAST
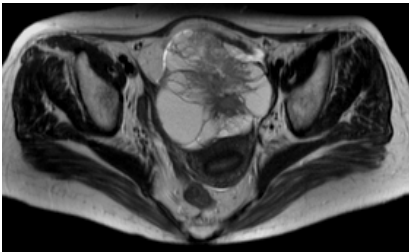
Figure 1b: Patient with ovarian cancer at 3T-SP
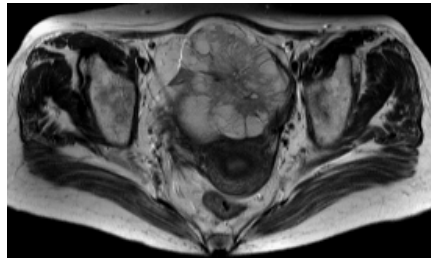
Figure 2 a: Patient with carcinoma of the cervix at 3T-FAST

Figure 2b: Patient with carcinoma of the cervix at 3T-SP

Conclusion FAS und SENSE allow for ultra-fast MR imaging at 3.0T maintaing the diagnostic confidence as provided by a standard pulse sequence. Therefore, 3T-Fast seems to be advantageous for pelvic MR imaging of incooperative patients (and possibly patients with contraindications for i.v. n-butyl-scopolamine) and.

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