BLADE in sagittal T2-weighted imaging of the cervical spine: value for spinal cord lesions

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INTRODUCTION:

Up to now, Periodically Rotated Overlapping ParallEL Lines with Enhanced Reconstruction (PROPELLER) or BLADE imaging has been proposed either to reduce motion artifacts in uncooperative patients, in cardiac or abdominal imaging or to reduce geometric distortions in echo planar imaging. Sagittal T2-weighted images of the cervical spine are prone to several kinds of artifacts such as flow artifacts (vessles, CSF), motion artifacts (swallowing), and truncation artifacts – even in cooperative patients. In a recent study we were able to show that using the BLADE technique a significant reduction of all those artifacts is possible. Although the depiction of the spinal cord was superior in the BLADE sequence, the diagnostic reliablity to detect spinal cord lesions could not be judged due to the low number of spinal cord lesion included in that study. Therefore, the aim of this study was to evaluate if BLADE is equivalent to turbo spin echo (TSE) regarding the detection of spinal cord lesions.

METHODS:

Sagittal T2-weighted TSE sequences with conventional rectilinear k-space trajectory ("TSE") were compared to TSE sequences with BLADE trajectory ("BLADE") in 25 patients (14 men, 11 women; 12-86 years old, mean: 50 years) with spinal cord lesions. The findings included myelopathy (n=13), MS (n=10), and vitamine B12 deficiency (n=2) and were proven by clinical symptoms, additional clinical workup and follow up examinations. Both sequences were applied with identical spatial resolution (FOV: 250 mm x 250 mm, matrix size: 384 x 384, slice thickness: 3 mm) and nearly identical parameters for TR (3000-3560 ms) and TE (112-113 ms). The TSE sequence was performed with flow compensation and a head-feet phase encoding direction to reduce motion artifacts. All examinations were done on clinical 1.5 T scanners (Magnetom Avanto; Siemens) using a combination of head, neck, and spine array coil elements.
Image sharpness, diagnostic reliability for the depiction of the spinal cord, delineation of the dura as well as contrast of spinal cord lesions were graded by 2 independent readers on a scale from 1 to 5 (1: excellent, 2: good, 3: moderate, 4: fair, but still diagnostic, 5: non-diagnostic). All evaluations were done blinded to the imaging technique and blinded to clinical informations or other imaging material. Results for TSE and BLADE were compared using the Wilcoxon test – for each individual reader as well as for means of both readers. P-values < 0.05 were considered statistically significant.

RESULTS:

In 16 of 25 patients image sharpness was better in the BLADE sequence, in 4 patients BLADE and TSE were equivalent. The diagnostic reliability for the depiction of the spinal cord was graded higher with BLADE in 13 patients and higher with TSE in 4 patients, the delineation of the dura was better with BLADE in all patients. A total of 37 spinal cord lesions were detected which were confirmed by additional sequences (T2-weighted TSE sequences in transverse orientation). Lesion contrast was rated superior in BLADE for 15 lesions, identical in BLADE and TSE for 10 lesions (see Fig. 1), and superior in TSE for 12 lesions. Spinal cord lesions were missed or lesion contrast was graded as non-diagnostic by both readers in 2 lesions with BLADE and in 5 lesions with TSE.
For all criteria the mean gradings of both readers for all patients and lesions yielded better results with BLADE (Fig. 2), the differences between BLADE and TSE were statistically significant for the criteria image sharpness and delination of the dura. Diagnostic reliability for the depiction of the spinal cord just missed statistical superiority of BLADE (P=0.056), there was no statistical difference between BLADE and TSE for the lesion contrast (P=0.368).

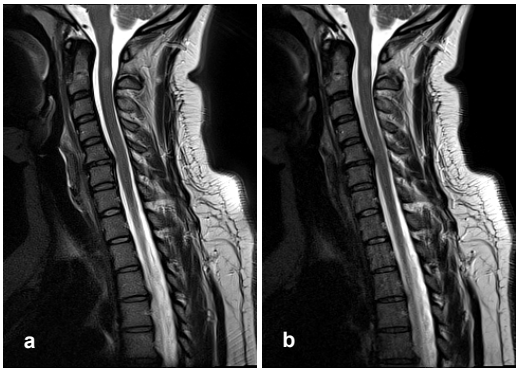

Fig. 1: BLADE (a) and TSE (b) in a 21-year-old female patient with MS: equivalent lesion contrast in both sequences.

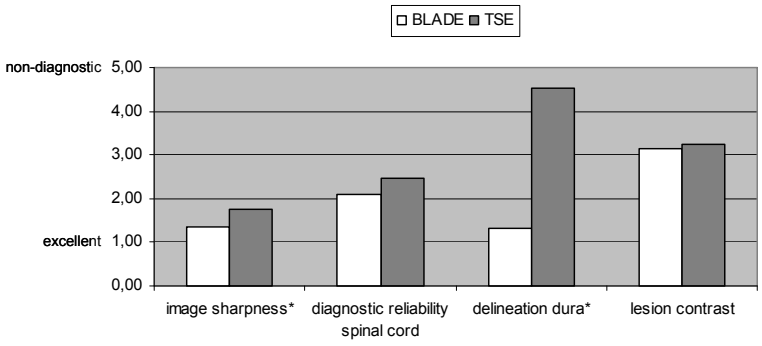

Fig. 2: Results of the visual evaluation on a scale from 1 (excellent) to 5 (non-diagnostic): means of 2 independent readers (*: P<0.05, Wilcoxon test).

CONCLUSION:

According to our current and our previous results the BLADE technique (with appropriately adjusted measurement parameters) can be routinely applied for sagittal T2-weighted imaging of the cervical spine instead of a TSE technique with rectilinear k-space trajectory. If TSE is still used as the routine technique, BLADE is recommended to be applied additionally in unclear cases – or vice versa: if BLADE is applied and lesion detection is unclear, a TSE sequence might be helpful in some cases.