High-Resolution CINE MRI for the Visualization of Arachnoid Adhesions

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Arachnoid adhesions are a common underlying cause for the development of idiopathic syringomyelia by causing CSF flow blockages. There is no direct geometrical relation between the location of the syringomyelia and the responsible arachnoid adhesion. For minimization of the trauma during the surgical intervention, the precise identification of the location of the culprit adhesion appears mandatory. Although MRI has been shown to visualize CSF flow blockages by phase-contrast flow imaging, the direct visualization of the arachnoid membranes with sufficient image quality has not been reported. The major hurdles for direct visualization of the arachnoid membranes are the required high spatial resolution in combination with the need for cardiac phase resolved imaging to avoid motion blur introduced by the pulsatile CSF flow. The aim of this study was to evaluate the value of cardiac gated cine steady state free precession MRI for pre- and postoperative direct visualization of arachnoid adhesions in the spinal subarachnoid space in patients with idiopathic syringomyelia.

Methods and Materials

9 patients with idiopathic syringomyelia were enrolled in this study. All patients underwent a conventional MRI protocol at 1.5T comprising high-resolution multi-spin echo images in sagittal orientation for visualization of the syringomyelia, followed by a cardiac-gated phase-contrast cerebrospinal fluid flow acquisition (PC-CSFF) for assessment of the CSF flow blockages. For direct visualization of the arachnoid membranes, the patients were subsequently transferred to a 3T system, in which a stack of three high-resolution (250µmx500µmx3000µm (FHxAPxRL – sagittal; RLxAPxFH – axial)) retrospectively triggered cardiac phase resolved (30 phases) images (HR-CINE) of the spine in sagittal and axial orientation were acquired applying an SSFP technique (TE/TR/α=3.1/6.2ms/50°). All data was received by the central 8-elements (2x4) of the posterior section of a 32 channel cardiac coil. Acquisition time per stack was 4:09 minutes for a heart rate of 60bpm. In 5 patients, who underwent microsurgical adhesiolysis, the MRI examination was repeated within 3days after surgery.

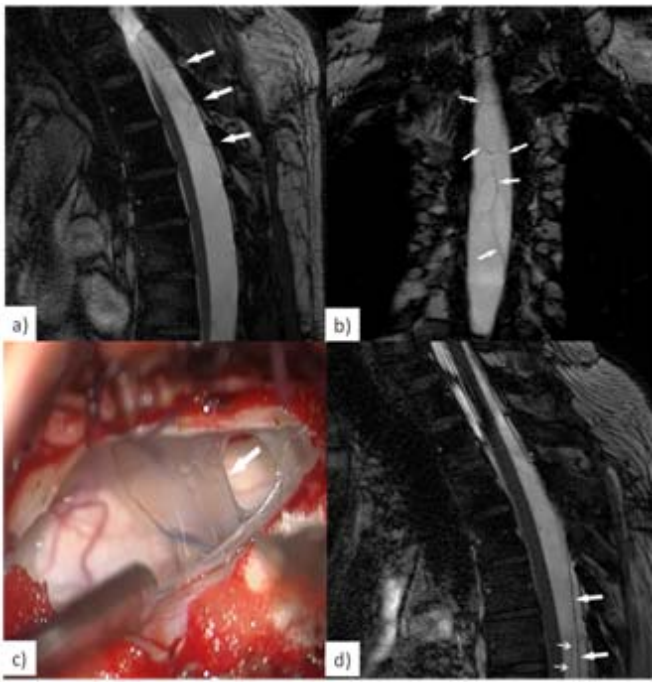

Figure 1: Pre- (a,b) and post-operative (d) appearance of the arachnoid adhesion in sagittal (a,d) and coronal (b) orientation. c) shows the intropeative situation.

Results

The MRI examination could be completed in all patients. The HR-CINE technique at 3T enabled a high resolution visualization of the arachnoid adhesions preoperatively as well as after surgical decompression in all patients (Fig. 1). Arachnoid adhesions detected by this technique could be verified intra-operatively. The direct comparison of the HR-CINE images with the PC-CSFF images revealed that not all arachnoid adhesions detected caused a complete blockage of the CSF flow.

Discussion

The application of high resolution cardiac gated MRI enables the direct visualization of arachnoid adhesions in idiopathic syringomyelia patients. Its pre- and post-interventional application appears meaningful for improved interventional planning as well as for improved outcome control of the surgical procedure.