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Pre- and postoperative diffusion tensor imaging in NPH

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Background

Diffusion tensor imaging (DTI) is an MR-based technique to characterize white matter. By conducting DTI quantifying fractional anisotropy (FA) in different regions of interest (ROIs) including the pyramidal tract pre- and postoperatively we tried to assess the correlation between decompression of pyramidal tract, reduction of ventricular size and clinical improvement in NPH.

Materials and methods

15 Patients with NPH were evaluated preoperatively and 3–6 months after implantation of a V-P-shunt with the adjustable proGAV by MR-DTI. By this method the fractional anisotropy (FA) can be quantified. The FA is a measure for random motion of water molecules, from no restriction = 0 = isotrop up to unidirectional fixated = 1 = anisotrop. On the one hand anisotropy in DTI depends on the amount of water (edema) in the brain tissue, on the other on compression or density of nerve fibre tracts. We determined as ROIs the FA in the region adjacent to the frontal horns and the region neighbouring the cella media, the pyramidal tract in the capsula interna and the brain stem, as well as in the nucleus caudatus and the subcortical white matter.

Results

In 1 patient unequivocal evaluation was not possible because of motion artifacts. Another patient developed transient hygroma with brain shift and thus needs a special assessment. In the remaining 13 patients shunting was followed by a clinical improvement of different grades in all cases. 3 of these patients did not reveal a reduction of ventricular size. Easy to interpret is the postoperative increase of FA in the vicinity of the frontal horns after shunting by the reduction of water content/edema, which is probably also the explanation for the increase in the subcortical white matter. More difficult is the interpretation of a significant decrease of FA in the capsula interna and the nuclei caudati and to a lesser extent also close to the cella media independent of ventricular restitution. Possibly the decompression of the fibre tracts allows a higher diffusity of water in these regions. In the brain stem we measured a decrease of FA in the cases with a reduction of the ventricular size but an increase in the 3 patients with unchanged width.

Conclusion

Although we could not prove in our little series a clear-cut correlation between FA, clinical improvement and ventricular reduction, the non-invasive method of DTI gives hope for the possibility of a better insight into the mechanisms of shifts of water content, decompression of the pyramidal tract after shunting, thus elucidating the pathophysiology of NPH.