Toractography of callosal dysgenesis

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Abstract

Diffusion tensor imaging (DTI) is a unique MR technique to analyze diffusion anisotropy of the brain. The purpose of this study is to visualize and analyse the neural anatomy in patients with callosal dysgenesis. DTI of the brain was performed in 10 patients by a 1.5T MRI system using a 6-axes single-shot echo planer imaging (EPI). Deterioration collection software was employed for the EPI technique. Tractography was generated with our original software. Probst's bundle was clearly illustrated by tractography. The tracts running through anterior commissure were independent of Probst's bundles. Tractography is useful to analyze in vivo brain structures.

Introduction

The largest commissure in the central nervous system is the corpus callosum connecting the cerebral hemisphere. The other two are anterior and hyppocampal commissures. The degree of callosal dysgenesis is determined by the time of the injury to the developing brain and is conventionally subdivided into three categories: agenesis, hypogenesis and hypoplasia.[1,2] Furthermore, Callosal agenesis is recently reclassified: complete commissural agenesis, calloso-hyppocampal agenesis, and isolated callosal agenesis.[3] Although central parts of commissures could be assessed using conventional MR images, precise morphology of commissural fibers buried in the white matter has been mystery. However, diffusion-tensor tractography, one of newer MRI tools, can provide more pertinent insights into tissue structure and orientation.[4-6] Our purpose of this study is to illustrate imaging findings of tractography in patients with callosal dysgenesis.

Materials and methods

We retrospectively analysed the MRI studies including tractography of 10 patients with callosal dysgenesis to assess the commissural fibers and the other associated morphological changes of the brain. 1. Analysis of the commissural and association fibers (one-ROI method): The seeds are placed in the midline structures such as corpus callosum (if any), anterior comissures, interthalamic adhesions and fornices, as well as Probst's bundles and corticospinal tracts. These tracts are assessed visually with emphasis on the presence of inter-commissural fibers. 2. Analysis of the interhemispheric connectivity (two-ROI method): Seeds and targets are placed in each side of hemispheres. Then, the presence of interhemispheric fibers is assessed visually.

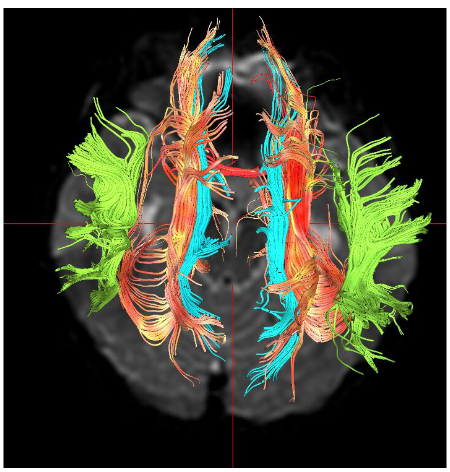

Fig. Tractography of callosal agenesis (top view) Inhomogeneous red: Probst's bundles., Red: Anterior commissure, Blue-Green: Cingulum, Green: Superior longitudinal fasciculus

Results

1. No compensatory inter-commissural fibers was depicted. 2. In a few patients with callosal dysgenesis, compensatory hypertrophy of the anterior commissure was found. In patients with callosal hypogenesis, commissural tracts originated from the posterior hemispheres formed partial Probst's bundles and went through incomplete corpus callosum.

Discussion

Clinical symptomatology in patients with callosal dysgenesis may be subtle. Increased other commissural pathways, an increased bilateral representation of function in the brain, an increased use of ipsilateral pathways, and the use of behavioral cross-cuing have also been proposed to compensate for absence of the corpus callosum.[7] In this study, the first hypothesis was examined using tractography. Some commissural fibers in the Probst's bundle of acallosal-strain mice project to the opposite hemisphere over the ventral hippocampal commissure.[8] Such inter-commissural fibers, however, were not demonstrated by tractography in human brains. Only in a few patients, compensatory hypertrophy of the anterior commissure was found. Cons of our study are as follows: First, in tractography, neurofibers which actually exist may be underestimated because of the fundamental "crossing-fibers' problem". Second, tractography can only show direct connectivity so that multi-synaptic compensation of interhemispheric association may not be depicted by the simple one- or two-ROI methods.

Conclusion

Neurofibers in patients with callosal dysgenesis were demonstrated by tractography. No compensatory inter-commissural fibers was depicted. In patients with hypogenesis (partial agenesis) of corpus callosum, commissural tracts originated from the posterior hemispheres formed partial Probst's bundles and went through incomplete corpus callosum. Tractography can provide physiological connection of neurofibers and is a potent tool to analyze the brain anomalies in vivo.

References

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