

Relationship between corpus callosum injury and impaired consciousness in hypoxic-brain injury

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Objectives

We investigated the relationship between injury of the corpus callosum and impaired consciousness in patients with hypoxic-ischemic brain injury (HI-BI) by using diffusion tensor tractography (DTT).

Methods

We recruited 18 patients with HI-BI who showed impaired consciousness and 20 normal control subjects. The fractional anisotropy (FA) and fiber number (FN) values were estimated for the entire corpus callosum (CC) and for each of the five regions within the CC (regions I, II, III, IV, and V). Patients' scores on the Glasgow Coma Scale (GCS) and the Coma Recovery Scale-Revised (CRS-R) were also evaluated.

Results

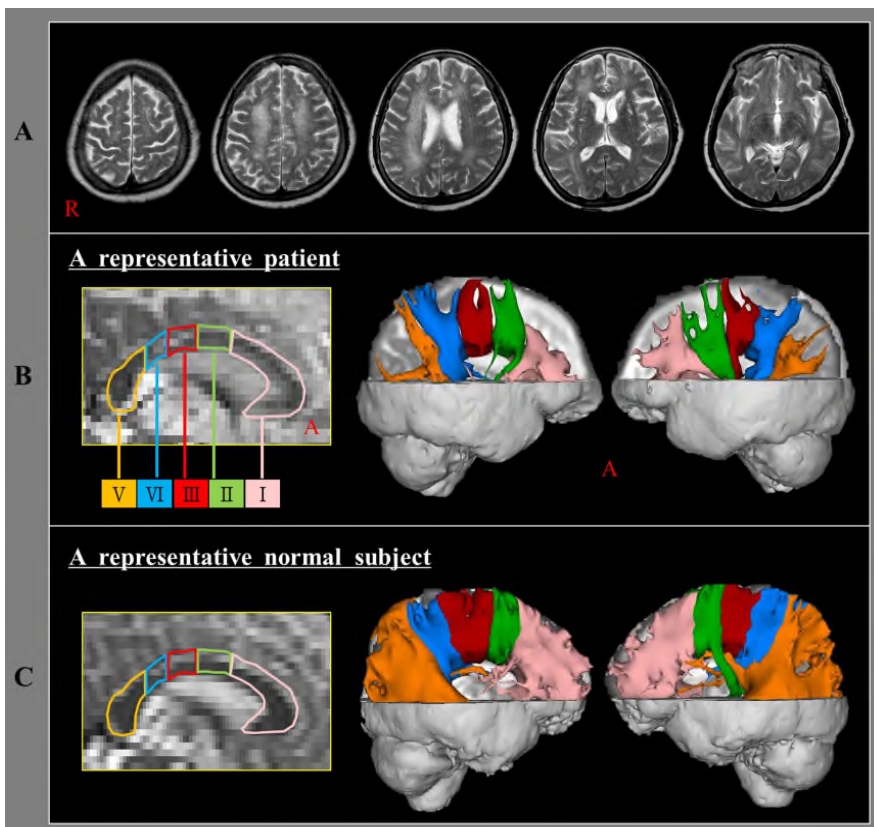
The FA and FN values for the entire CC and for the five regions of the CC in the patient group were lower than those of the control group ($p < 0.05$). No correlations were detected between GCS or CRS-R scores and the FA or FN DTT parameters of the CC (entire CC and regions I, II, III, and IV) ($p > 0.05$), or between GCS scores and the FA value of region V ($p > 0.05$). However, there was a strong positive correlation between GCS score and the FN value of CC region V ($r = 0.723$, $p < 0.05$). In addition, there was a moderate positive correlation between CRS-R score and FA value ($r = 0.598$, $p < 0.05$) and a strong positive correlation between CRS-R score and FN value ($r = 0.734$, $p < 0.05$) in CC region V.

Conclusions

We detected a close relationship between injury of region V (splenium) of the CC and impaired consciousness in patients with HI-BI. Our results suggest that an injured splenium of the CC could be an appropriate target for neurointervention or neurorehabilitation in patients with impaired consciousness following HI-BI.

Acknowledgment

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean Government(MSIP) (No. 2018R1A2B6000996).



(A) T2-weighted brain magnetic resonance images of a representative patient (45-year-old male) at one month after hypoxic-ischemic brain injury onset. (B, C) Results of diffusion tensor tractography (DTT) for the entire corpus callosum (CC) and each of the five regions of the CC (region I, pink; II, green; III, red; IV, sky blue; V, orange) of (B) the same patient and (C) a normal subject (49-year-old male). All five regions of the CC in both hemispheres of the patient show the presence of injury when compared to the results for the normal subject.

Table 1. Demographic data of the patient and control groups.

	Patient group	Control group
Number (male:female)	18 (12:6)	20 (10:10)
Mean age (years)	45.12 ± 17.07	51.21 ± 10.23
GCS	9.22 ± 3.19	
CRS-R	14.88 ± 7.65	
Mean duration from HI-BI onset to DTI (months)	6.29 ± 5.39	

Values indicate mean ± standard deviation, HI-BI: hypoxic-ischemic brain injury, GCS: Glasgow Coma Scale, CRS-R: Coma Recovery Scale-Revised, DTI: diffusion tensor imaging.

Demographic data of the patient and control groups.

Table 2. Comparison of diffusion tensor tractography parameters for the entire corpus callosum and for each of the five regions of the corpus callosum.

	DTT parameters	Patient group	Control group	<i>p</i> value
Entire CC	FA	0.30 ± 0.06	0.49 ± 0.02	0.01*
	FN	10985.67 ± 3310.88	12835.91 ± 1639.41	0.03*
R I	FA	0.28 ± 0.06	0.42 ± 0.02	0.01*
	FN	3280.88 ± 1178.27	6524.41 ± 927.16	0.01*
R II	FA	0.28 ± 0.06	0.43 ± 0.02	0.01*
	FN	1770.24 ± 818.00	2171.13 ± 1144.03	0.01*
R III	FA	0.29 ± 0.06	0.45 ± 0.02	0.01*
	FN	1736.65 ± 679.01	2763.31 ± 409.81	0.01*
R IV	FA	0.30 ± 0.08	0.45 ± 0.02	0.01*
	FN	2077.47 ± 892.32	3276.21 ± 760.69	0.01*
R V	FA	0.30 ± 0.08	0.50 ± 0.02	0.01*
	FN	3260.94 ± 1106.37	5042.95 ± 962.88	0.01*

DTT: diffusion tensor tractography, CC: corpus callosum, FA: fractional anisotropy, FN: fiber number,

R: region.

Values indicate mean ± standard deviation

*: indicates a significant difference between the patient and control groups, $p < 0.05$

Comparison of diffusion tensor tractography parameters for the entire corpus callosum and for each of the five regions of the corpus callosum.