P 3-3

Relationship between duration cardiac arrest and injury of the ARAS

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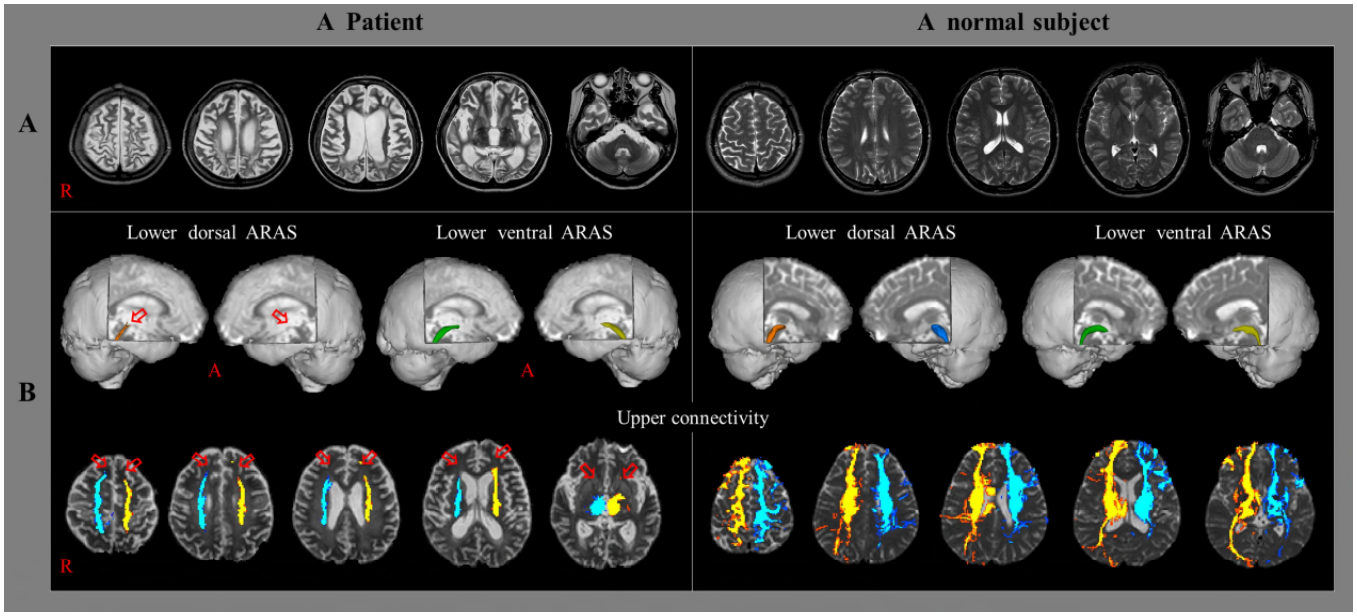
Objectives
We investigated the relationship between the duration of cardiopulmonary resuscitation (CPR) and the severity of injury of the ascending reticular activating system (ARAS) in patients with hypoxic-ischemic brain injury (HI-BI) after cardiac arrest by using diffusion tensor tractography (DTT).

Methods
Fifteen consecutive patients with HI-BI after cardiac arrest and 15 control subjects were recruited. Clinical status was evaluated by determining Glasgow coma scale (GCS), coma recovery scale-revised (CRS-R), and mini-mental state examination (MMSE) values. Three portions (lower dorsal, lower ventral, and upper portions) of the ARAS were reconstructed via DTT, and fractional anisotropy (FA) and tract volume (TV) values were determined. Results: The FA and TV values for the three portions of the ARAS were significantly different between the patient and control groups ($p > 0.05$). CPR duration was significantly negatively correlated with GCS ($r = -0.629$, $p < 0.05$), moderately negatively correlated with CRS-R ($r = -0.597$, $p < 0.05$) and moderately negatively correlated with MMSE ($r = -0.526$, $p < 0.05$). In contrast, among the DTT parameters, only the TV value of the lower dorsal ARAS showed a moderately negative correlation with CPR duration ($r = -0.464$, $p < 0.05$).

Conclusions
We detected close relationships between CPR duration and injury severity in the lower dorsal ARAS in patients with HI-BI after cardiac arrest. Our results suggest that DTT-based analysis of the ARAS could be useful in patients with HI-BI after cardiac arrest.

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 one representative patient (42-year-old male) who show hypoxic-ischemic brain injury lesions at one month after cardiac arrest and a representative normal subject (49-year-old male) (B) Results of diffusion tensor tractography (DTT) for the ascending reticular activating system (ARAS) of the same patient and normal subject. The lower dorsal and upper ARAS reveal injury (red arrows) in both hemispheres of the patient compared to those (red arrows) of the normal subject.

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

	Patient group	Control group
Age	40.8 ± 15.1	44.4 ± 12.7
Sex (Male:Female)	9:6	8:7
Time	20.1 ± 13.8	
GCS	10.00 ± 5.07	
CRS-R	13.67 ± 9.59	
MMSE	8.27 ± 11.35	

Values are presented as numbers or as means ± standard deviation; GCS: Glasgow coma scale; CRS-R: coma recovery scale-revised; MMSE: mini-mental state examination.

Demographic characteristics of the patient and control groups.

Table 2. Comparison of diffusion tensor tractography parameters in the patient and control groups.

Duration of cardiopulmonary	Clinical scores		
	GCS	CRS-R	MMSE
		DTT parameters	*p* value
Lower dorsal ARAS	FA	0.40 ± 0.04 (0.44 ± 0.03)	0.001*
	TV	220.48 ± 66.07 (351.39 ± 99.49)	0.000*
Lower ventral ARAS	FA	0.39 ± 0.04 (0.41 ± 0.03)	0.014*
	TV	95.71 ± 67.62 (207.93 ± 84.40)	0.000*
Upper ARAS	FA	0.28 ± 0.06 (0.34 ± 0.05)	0.000*
	TV	5513.25 ± 2322.32 (12024.18 ± 4935.95)	0.000*

DTT: diffusion tensor tractography, ARAS: ascending reticular activating system, FA: fractional anisotropy, TV: tract volume.

Values represent mean ± standard deviations for patients; control means ± standard deviation are enclosed in brackets.

*: significant differences between patient and control groups, $p<.05$.

Comparison of diffusion tensor tractography parameters in the patient and control groups.