MR Diffusion Tensor Imaging in the Evaluation of Transplantation of Degradable Scaffold Seeded with Neural Stem Cells to Acutely Injured Canine Spinal Cord

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Purpose: Using MR diffusion tensor imaging (DTI) to observe the effect of transplantation of degradable scaffold seeded with neural stem cells to acutely injured canine spinal cord.

Materials and methods: Eighteen adult canines with left spinal cord hemisection at the level of T13. They were divided into 4 groups: stem cell group (transplanted with scaffold seeded with neural stem cells, 7 dogs), scaffold group (transplanted with scaffold only, 5 dogs), control group (no transplantation postinjury, 5 dogs), and sham-operation group (no injury, 1 dog). They were examined with a 1.5 T MR scanner by diffusion tensor imaging five times sequentially: prior to injury, 1 week after injury, 1 week after transplantation(that is, 2 weeks after injury), 4 weeks after transplantation, and 8 weeks after transplantation, respectively. DTI was performed with single shot fast spin echo pulse sequence with 13 diffusion directions, TR12 681ms, TE 69.1ms, ETL 84, slice thickness 5mm, interslice gap 0mm, FOV 16cm, NEX 4, matrix 128×128, b=500s/mm^2, scan time 11 minutes 50 seconds. The apparent diffusion coefficient (ADC) values and fractional anisotropy (FA) values were measured in both side of the spinal cord.

Results: Before injury, the ADC values and FA values of both side of the spinal cord were not significantly different. After injury, the ADC values of the injured spinal cord increased and FA values decreased comparing with that of the pre-injured spinal cord. Four weeks after injury, the ADC and FA values of both side of the spinal cord were significantly different in the control group, but were not significantly different in the scaffold group and stem cell group.

Conclusion: DTI can provide useful information of spinal cord injury and regeneration in experimental spinal cord injury.

Key words: Spinal cord injury; Neural stem cells; Transplantation; Diffusion tensor imaging

Table 1 Mean ADC values of different groups in different periods (×10^{-3} mm^2/s)

Group	Side	Prior to injury	1 week after injury	After transplantation			*F* value	*P* value
				1 week	4 weeks	8 weeks		
control	Left	1.10±0.02	1.25±0.38	-	1.54±0.23	1.36±0.28	0.725	0.611
group	Right	1.00±0.06	1.13±0.05	-	1.28±0.25	1.22±0.07	2.191	0.187
scaffold	Left	1.09±0.11	1.24±0.31	1.38±0.06	1.21±0.06	1.33±0.14	2.150	0.128
group	Right	1.03±0.04	1.25±0.25	1.30±0.15	1.20±0.16	1.25±0.11	2.668	0.076
stem cell	Left	1.11±0.16	1.29±0.19	1.30±0.17	1.23±0.18	1.39±0.32	1.759	0.170
group	Right	1.14±0.15	1.23±0.09	1.26±0.26	1.15±0.22	1.36±0.24	0.974	0.440

Table 2 Mean FA values of different groups in different periods

		Prior to injury	1 week after injury	After transplantation			*F* value	*P* value
				1 week	4 weeks	8 weeks		
control	Left	0.54±0.06	0.27±0.14	-	0.18±0.43	0.28±0.03	5.820	0.029*
group	Right	0.53±0.05	0.37±0.11	-	0.24±0.02	0.32±0.03	5.602	0.032*
scaffold	Left	0.40±0.08	0.27±0.10	0.26±0.04	0.29±0.04	0.28±0.04	1.697	0.206
group	Right	0.42±0.07	0.33±0.03	0.26±0.05	0.25±0.04	0.27±0.05	10.315	0.000*
stem cell	Left	0.45±0.09	0.19±0.04	0.28±0.12	0.34±0.18	0.25±0.04	6.314	0.001*
group	Right	0.44±0.10	0.28±0.03	0.29±0.02	0.40±0.13	0.23±0.03	3.136	0.033*

* The difference among groups is statistically significant by ANOVA.

Table 3 The difference between bilateral spinal cord at 4 weeks after transplantation

Group	ADC value		FA value	
	t value	*P* value	*t* value	*P* value
control group	17.667	0.036*	3.667	0.170
scaffold group	1.259	0.335	0.804	0.506
stem cell group	0.900	0.434	0.957	0.409