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Neurogenesis and functional recovery by exposure to an enriched environment in rodent models of hypoxic-ischemic brain injury

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Objective: This study aimed to investigate the incidence and predictors of emergence from prolonged disorders of consciousness (DOC) during inpatient rehabilitation and to compare temporal dynamics and prognostic power between six neurobehavioral signs of the JFK Coma Recovery Scale-Revised (CRS-R) scores on emergence from DOC.

Methods: We retrospectively collected the data of 50 patients who were diagnosed with vegetative state(VS) or minimal state of consciousness(MCS) at admission. Subjects were divided into two subgroups that showed emergence from MCS(EMCS) during neurorehabilitation and that remained VS or MCS. We compared demographic and clinical variables to investigate the best prediction model of EMCS. Moreover, we analyzed the temporal dynamics of six CRS-R neurobehavioral signs which were assessed at intervals of one month during the neurorehabilitation, and identified the signs that significantly predicted EMCS.

Results: Out of 50 patients, 46% showed EMCS. The model incorporating shorter lag time from brain injury onset and absence of intra-axial lesion best predicted EMCS. Also, level of consciousness and total CRS-R score at admission individually showed significant prediction. Other variables such as sex, age at injury onset, cause of brain injury, hydrocephalus, ventriculoperitoneal shunt, cranioplasty, anticonvulsant medication, seizure, and education level did not predict EMCS. Among six signs of CRS-R, auditory subscale showed the most significant correlation to EMCS. Patients denoted slower but greater emergence from MCS in the communication subscale than the motor subscale.

Table1. Effects of the studied predictors on progress of consciousness during inpatient rehabilitation

Variable	EMCS (n=23)	DOC (n=27)	HR (95% CI)	*P* Value
Sex				
Male	16 (50)	16 (50)		
Female	7 (38.9)	11 (61.1)	0.44 (0.17, 1.15)	0.093
Age				
mean±SD	47.7 ± 18.4	41.2 ± 21.6	1.02 (0.99, 1.04)	0.115
median (range)	46 (14 – 81)	46 (6 – 76)		
Level of consciousness at admission				
PVS/UWS	4 (16)	21 (84)		
MCS	19 (76)	6 (24)	4.49 1.52,13.27)	0.007
Total CRS-R score at admission				
mean±SD	12.6 ± 3.8	6.1 ± 3.8	1.16 (1.06, 1.28)	0.002
median (range)	13 (6 – 19)	5 (1 – 15)		
Etiology				
TBI	14 (48.3)	15 (51.7)		
non TBI	9 (42.9)	12 (57.1)	0.8 (0.3, 1.9)	0.61
Injury Type (n=46)				
extra-axial hemorrhage	7 (87.5)	1 (12.5)		
intra-axial lesion	13 (34.2)	25 (65.8)	0.09 (0.03, 0.24)	<0.001
Lag Time (days)				
mean±SD	219.1 ± 232.3	321.5 ± 266.2	0.71 (0.59-0.84)	<0.001
median (range)	133(35-1105)	222(74-1113)		
Hydrocephalus				
Present	11 (40.7)	16 (59.3)		
Absent	12 (52.2)	11 (47.8)	1.77 (0.78, 4.06)	0.174
Presence of VP shunt				
Present	8 (50)	8 (50)		
Absent	15 (44.1)	19 (55.9)	1.28 (0.54, 3.04)	0.573
Cranioplasty (n=45)				
Present	10 (43.5)	13 (56.5)		
Absent	13 (48.1)	14 (51.9)	1.69 (0.73, 3.91)	0.218
Anticonvulsants				
Continue	15 (45.5)	18 (54.5)		
Discontinue/not taking	8 (47.1)	9 (52.9)	1.19 (0.5, 2.86)	0.694
Seizure				
Event	0 (0)	5 (100)		
Non event	23 (51.1)	22 (48.9)		0.997
Education (n=19)				
< 12yrs	3 (25)	9 (75)		
≥ 12yrs	20 (54.1)	17 (45.9)	1.95 (0.58, 6.6)	0.282

Conclusion: This study revealed that significant recovery of consciousness is observed in patients with prolonged DOC during neurorehabilitation. Shorter lag time and absence of intra-axial lesion were significant predictors for EMCS. Patients in DOC with evidence of higher auditory function were most likely to recover consciousness. These findings should be considered regarding assessment tools and rehabilitative programs that best evaluate and maximize the potential for recovery of consciousness.

Recent Publications

1. Lee, H. Y., Hong, J. S., Lee, K. C., Shin, Y. K., & Cho, S. R. (2015). Changes in hyolaryngeal movement and swallowing function after neuromuscular electrical stimulation in patients with dysphagia. Annals of rehabilitation medicine, 39(2), 199-209.

2. Lee, H. Y., Kim, S. W., & Kim, H. S (2014) Subacute Upper Abdominal Pain Diagnosed as Bilateral Diabetic Thoracic Polyradiculopathy - A Case Report. J Korean EMG Electrodiagn Med 16(2):75~79.

3. Kang, S. W., Choi, W. A., Won, Y. H., Lee, J. W., Lee, H. Y., & Kim, D. J. (2016). Clinical Implications of Assisted Peak Cough Flow Measured With an External Glottic Control Device for Tracheostomy Decannulation in Patients With Neuromuscular Diseases and Cervical Spinal Cord Injuries: A Pilot Study. Archives of physical medicine and rehabilitation, 97(9), 1509-1514.

Biography

Hoo Young Lee has her expertise in neurorehabilitation for traumatic brain injury and stroke. Her subspecialty in the clinic field is neuromodulation in acquired brain injury, cognitive rehabilitation therapy and pediatric rehabilitation. Her research areas include development of rehabilitation complexity scale in the ROK, neuromodulation, and enriched environment in adult mouse model in the context of neurorehabilitation. She has been in years of experience in clinic, research, and education in TBI Rehabilitation Center, National Traffic Injury Rehabilitation Hospital, Gyeonggi-do, South Korea and Department of Rehabilitation Medicine, Seoul St. Mary's Hospital, School of Medicine, The Catholic University of Korea, Seoul, South Korea. She in a Combined Program of Master's and Doctoral Degrees in Department of Medicine, The Graduate School of Yonsei University, Seoul, South Korea

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