

Commentary

Social Functioning can Improve Motor Recovery after Stroke

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Globally, stroke remains a leading cause of mortality and morbidity, with ischaemic stroke representing around two-thirds of all incident cases. Although reperfusion therapies represent a key step for minimizing brain damage, the impact of cerebral infarct in terms of residual impairment in physical, psychological, and social functioning remains high [1–5].

In an issue of the *Journal of Integrative Neuroscience*, the study by Dr. Chang and colleagues [6] aimed to evaluate the relationship between neuropsychological domains and motor recovery in patients with cerebral infarction. Among 37 patients with ischemic stroke, the Social Maturity Scale Social Quotient (SMSSQ) score in the Vineland Social Maturity Scale at one month and the change in the SMSSQ score at three months from stroke onset showed a statistically significant correlation with the change in motor function over the same period as assessed by the Modified Barthel Index [6]. Of note, a higher initial SMSSQ score and an improvement in SMSSQ score at follow-up correlated with a greater improvement in motor recovery. The Vineland Social Maturity Scale is a psychometric assessment tool designed to evaluate social and adaptive functions; a high SMSSQ score indicates good social capabilities, whereas a low score implies that social interaction with other people is difficult or minimal [6]. These findings emphasize and extend currently available experimental and clinical evidence about the benefits that social interaction may have for recovery after stroke.

In animal models, post-stroke isolation has been associated with a significant increase in infarct size and mortality [7]. Interestingly, mice paired with a healthy partner showed significantly lower mortality than mice paired with a stroke partner and enhanced behavioural recovery than either isolated mice or mice paired with a stroke partner [7]. Karelina *et al.* [8] explored the role of physical contact as a mediator of the beneficial effects of social interaction after stroke. In a rodent model with focal cerebral ischemia, pair housing reduced infarct volume and led to a recovery of locomotor activity when compared to social isolation [8]. However, among a mice pair housed in a cage separated by a grid partition that prevented physical contact, infarct vol-

ume was comparable to that of socially isolated mice, and locomotor activity did not fully recover [8]. Similarly, in an animal model of ischemia-reperfusion injury, rats in the enriched environment group exhibited smaller infarction volumes and significantly improved neurological functions as compared to rats in standard housing conditions [9].

The mechanisms underlying the social influences on stroke outcome are likely multifactorial and involve alterations in neuroendocrine and inflammatory responses [8,10,11], enhanced synaptic plasticity and neurogenesis [12], attenuation of astrogliosis [13], increased angiogenesis with the formation of new capillaries, and proliferation of endothelial cells in the ischemic penumbra [9].

In a clinical context, social support has been shown to influence both the extent and speed of recovery. Looking at performance in both mobility and activities of daily living, Glass *et al.* [14] found that patients with more social support improved far better than those with less support, and higher levels of support were predictive of a more rapid rate of recovery of functional status, even among patients with severe strokes. Patients with the least amount of social support normally recovered in the first month, but failed to maintain the improvement with a decline in functional status over time [14]. Conversely, continued improvement was observed after the first 6 weeks of recovery among patients receiving more support [14].

While there are some excellent studies investigating the impact of social support on functional outcomes, further research is warranted. The bidirectional relationship between cognitive abilities, personality, emotion, behaviour, social participation, and functional recovery after a stroke needs to be further explored. Development of dedicated tests, scales, tools, and protocols may more easily allow for performing a standardized, comprehensive assessment of multiple clinical domains.

In summary, environmental influences are being recognized for their potential to affect stroke outcomes, and social interaction can improve the recovery of stroke patients. This body of evidence may have huge implications for clinical practice: stroke patients will benefit from strategies aimed at enhancing social capabilities and skills to inter-



act with others, and areas of rehabilitation such as occupational therapy and social rehabilitation should be strengthened. Ballester *et al.* [15] investigated the effects of including social interaction in a virtual reality-based system for stroke rehabilitation. The multi-player virtual reality environment favoured social engagement and interaction among the players and added enjoyment during the task. After applying rehabilitation in the multiplayer environment, the motor improvement of the affected upper limb was greater compared to the recovery observed in the single-player environment [15].

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References

- [1] Da Ros V, Scaggiante J, Sallustio F, Lattanzi S, Bandettini M, Sgreccia A, *et al.* Carotid Stenting and Mechanical Thrombectomy in Patients with Acute Ischemic Stroke and Tandem Occlusions: Antithrombotic Treatment and Functional Outcome. *AJNR. American Journal of Neuroradiology*. 2020; 41: 2088–2093.
- [2] Lattanzi S, Coccia M, Pulcini A, Cagnetti C, Galli FL, Villani L, *et al.* Endovascular treatment and cognitive outcome after anterior circulation ischemic stroke. *Scientific Reports*. 2020; 10: 18524.
- [3] Divani AA, Majidi S, Barrett AM, Noorbaloochi S, Luft AR. Consequences of stroke in community-dwelling elderly: the health and retirement study, 1998 to 2008. *Stroke*. 2011; 42: 1821–1825.
- [4] Lattanzi S, Rinaldi C, Cagnetti C, Foschi N, Norata D, Broggi S, *et al.* Predictors of Pharmacoresistance in Patients with Post-Stroke Epilepsy. *Brain Sciences*. 2021; 11: 418.
- [5] Lattanzi S, Trinka E, Turcato G, Rinaldi C, Cagnetti C, Foschi N, *et al.* Latency of poststroke epilepsy can predict drug resistance. *European Journal of Neurology*. 2022; 29: 2481–2485.
- [6] Chang MC, Park SW, Lee BJ, Park D. Relationship between recovery of motor function and neuropsychological functioning in cerebral infarction patients: the importance of social functioning in motor recovery. *Journal of Integrative Neuroscience*. 2020; 19: 405–411.
- [7] Venna VR, Xu Y, Doran SJ, Patrizz A, McCullough LD. Social interaction plays a critical role in neurogenesis and recovery after stroke. *Translational Psychiatry*. 2014; 4: e351.
- [8] Karelina K, Norman GJ, Zhang N, DeVries AC. Social contact influences histological and behavioral outcomes following cerebral ischemia. *Experimental Neurology*. 2009; 220: 276–282.
- [9] Zhang X, Chen XP, Lin JB, Xiong Y, Liao WJ, Wan Q. Effect of enriched environment on angiogenesis and neurological functions in rats with focal cerebral ischemia. *Brain Research*. 2017; 1655: 176–185.
- [10] DeVries AC, Craft TKS, Glasper ER, Neigh GN, Alexander JK. 2006 Curt P. Richter award winner: Social influences on stress responses and health. *Psychoneuroendocrinology*. 2007; 32: 587–603.
- [11] Lattanzi S, Norata D, Divani AA, Di Napoli M, Broggi S, Rocchi C, *et al.* Systemic Inflammatory Response Index and Futile Recanalization in Patients with Ischemic Stroke Undergoing Endovascular Treatment. *Brain Sciences*. 2021; 11: 1164.
- [12] Han X, Wang W, Xue X, Shao F, Li N. Brief social isolation in early adolescence affects reversal learning and forebrain BDNF expression in adult rats. *Brain Research Bulletin*. 2011; 86: 173–178.
- [13] Buchhold B, Mogoanta L, Suofu Y, Hamm A, Walker L, Kessler C, *et al.* Environmental enrichment improves functional and neuropathological indices following stroke in young and aged rats. *Restorative Neurology and Neuroscience*. 2007; 25: 467–484.
- [14] Glass TA, Matchar DB, Belyea M, Feussner JR. Impact of social support on outcome in first stroke. *Stroke*. 1993; 24: 64–70.
- [15] Rubio Ballester B, Bermúdez I, Badia S, Verschure PFMJ. Including Social Interaction in Stroke VR-Based Motor Rehabilitation Enhances Performance: A Pilot Study. *Presence*. 2012; 21: 490–501.