Mapping cortical projections after stroke in rat brain with *in vivo* manganese-enhanced MRI

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Loss of function after stroke may be caused by injury to axonal projections while neuronal cell bodies are preserved. Manganese-enhanced MRI (MEMRI) has recently been applied as a tool for *in vivo* mapping of neuronal tracts. Paramagnetic Mn^{2+}, a Ca^{2+} analogue, can be taken up by neurons and then transported transsynaptically. In this study, we applied MEMRI to map neuronal projections from the sensorimotor cortex in healthy and ischemic rat brains. Transient focal cerebral ischemia was induced in adult male Wistar rats by 90 minutes occlusion of the right middle cerebral artery. After a survival period of 1 or 2 weeks, 0.5 µl 1 M isotonic $MnCl_2$ solution was injected into the spared ipsilesional sensorimotor cortex. $MnCl_2$ was also injected in control rats. MRI measurements were performed 2 days prior to and 2 days after injection of $MnCl_2$. Multi-echo, multi-slice T_2-weighted images were acquired to localize the ischemic lesion at 2 days prior to injection. A multi-slice T_1-weighted spin-echo sequence was used to identify manganese-enhanced brain regions at 2 days after injection.
The cortico-striato-nigral pathway of the sensorimotor network in rat brain was clearly visualized with MEMRI. Signal enhancement was found in the healthy rat brains in following ipsilateral regions: the sensorimotor cortex, the striatum, the thalamus and the substantia nigra. We also detected transhemispheric connections. The pattern of manganese-induced contrast enhancement in ischemic rat brain was largely similar to that in controls. However, signal enhancement in the ipsilateral substantia nigra was significantly reduced as compared to control rat brain. The loss of connection from intact brain to remote areas may play a significant role in loss of specific functions after stroke. MEMRI provides a unique tool for the *in vivo* assessment of functional connectivity in injured brain.

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