Department of Rehabilitation Medicine

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General Summary

The main research projects in our department have been focused on neurorehabilitation, stroke, brain injury, cognitive science, and dysphagia.

Research Activities

Facilitated beam-walking recovery during the acute phase by kynurenic acid treatment in a rat model of photochemically induced thrombosis causing focal cerebral ischemia
We previously demonstrated the presence of activated areas in the uninjured contralateral sensorimotor cortex in addition to the ipsilateral sensorimotor cortex of the area surrounding a brain infarction, using a rat model of focal photochemically induced thrombosis (PIT) and functional magnetic resonance imaging. Using this model, we next applied gene expression profiling to screen key molecules upregulated in the activated area. RNA was extracted from the sensorimotor cortices ipsilateral and contralateral to the focal brain infarction and from the sham-controlled cortex and hybridized to gene-expression profiling arrays containing 1322 neurology-related genes. We found that glycine receptors were upregulated in the cortices both ipsilateral and contralateral to the focal ischemic lesion. To prove the preclinical significance of upregulated glycine receptors, kynurenic acid, an endogenous antagonist of glycine receptors on neuronal cells, was administered intrathecally. The kynurenic acid significantly improved behavioral recovery within 10 days from paralysis induced by the focal PIT ($p < 0.0001$), as evaluated with beam walking. These results suggest that intrathecal administration of a glycine receptor antagonist may facilitate behavioral recovery during the acute phase after brain infarction.

Laterality of swallowing in healthy subjects by AP projection using videofluoroscopy
Although anteroposterior projections in videofluoroscopic examination of swallowing provide clinically important information, the laterality of swallowing in healthy subjects has not been fully examined fully. A total of 167 healthy volunteers were prospectively studied. The subjects were asked to swallow 5 ml of a barium solution 3 times while X-ray images were obtained showing the pathway of the solution from the pharynx to the esophagus to assess the laterality of swallowing. We classified patterns of swallowing into 3 types according to the passage of the barium solution in the pharyngoesophageal segment as indicated by width: right-side-dominant flow, left-side-dominant flow, and no laterality in flow. The swallowing pattern was classified as no laterality in 58%, left-side dominant in 35%, and right-side dominant in 7%. The ratio of the 3 swallowing patterns in women was 7 : 2 : 1. There were no significant differences in swallowing patterns according to age. Although swallowing patterns in young men

(aged 20–30 years) tended to be the same as in women regardless of age, the prevalence of the left-side-dominant pattern tended to increase with age: 71% of older adults (aged 51–75 years) showed this pattern. These results demonstrate laterality in normal swallowing and will be helpful in determining treatment strategies for the patients with dysphagia.

Is the ipsilateral cortex surrounding the lesion or the uninjured contralateral cortex important for motor recovery in rats with photochemically induced cortical lesions?
Primary Objective: To determine whether the ipsilateral cortex surrounding the lesion or the uninjured contralateral cortex is more important for motor recovery after brain damage in the PIT model.
Research Design: We induced PIT in the sensorimotor cortex of rats and examined the recovery of motor function using the beam-walking test.
Methods and Procedures: In 24 rats, the right sensorimotor cortex was lesioned after 2 days of training for the beam-walking test (group 1). After 10 days, PIT was induced in the left sensorimotor cortex. Eight additional rats (group 2) received 2 days of training in beam walking and then underwent the beam-walking test to evaluate function. After 10 days of testing, the left sensorimotor cortex was lesioned, and recovery was monitored with the beam-walking test for 8 days.
Main outcomes and results: In group 1, left hindlimb function impaired by a right sensorimotor cortex lesion recovered within 10 days after the operation. Right hindlimb function impaired by the left-sided lesion recovered within 6 days. In group 2, right hindlimb function impaired by the left-sided lesion after a total of 12 days of beam-walking training and testing recovered within 6 days, as with the double-PIT model. The training effect may be relevant to reorganization and neuromodulation. Motor recovery patterns did not indicate whether motor recovery was dependent on the ipsilateral cortex surrounding the lesion or on the contralateral cortex.
Conclusion: The results emphasize the need to select appropriate programs tailored to the area of cortical damage to enhance motor functional recovery in this model.

Publications

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