

## Department of Rehabilitation Medicine

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### General Summary

The main research topics of our department are rehabilitation programs that facilitate driving resumption, the predictive validity of a new scale, a new computerized assessment software program, a new therapeutic strategy for aphasia, and the effect of changes in regional cerebral blood flow (rCBF).

### Research Activities

#### *Programs that facilitate driving resumption*

Being able to drive a car is an important element of a patient's sense of participation in society after a stroke. However, driving a car is a complex task that requires a combination of motor, perceptual, visual, sensory, and cognitive skills. Therefore, after a stroke, some patients have difficulties resuming driving because of various physical and neuropsychological impairments.

To investigate the rate of driving resumption and the severity of physical impairment of patients after a stroke, we performed a questionnaire survey. Data were collected on 525 patients (359 male and 166 female) who had been admitted after a stroke to Tokyo Metropolitan Rehabilitation Hospital from April 2006 through February 2008. Driving habits before and after the stroke were surveyed. Also, the Brunnstrom stage, indicating hemiparetic severity, and functional independence measure (FIM) scores, indicating the activity of daily life, were evaluated from available medical records. Appropriate responses were obtained from 216 patients (41.1%). Among the 118 patients (107 male and 11 female) who had been driving a car before their stroke, 42 (38 male and 4 female) resumed driving afterwards. For patients who resumed driving, the mean Brunnstrom stages were  $5.4 \pm 1.0$  for the upper extremity,  $5.5 \pm 1.1$  for the hand, and  $5.5 \pm 0.8$  for the lower extremity; the FIM motor score was  $83.5 \pm 8.1$ , and the FIM cognitive score was  $32.8 \pm 3.3$ . These values were significantly higher than those of patients who did not resume driving. Furthermore, patients who resumed driving were significantly younger than those who did not. Rehabilitation programs that facilitate driving resumption are necessary for younger patients with mild hemiparesis and disabilities of activities of daily living after a stroke. In addition, multidisciplinary assessments should be considered to determine whether patients can drive safely after a stroke. Comprehensive assessments with physical and neuropsychological findings will be needed for making this decision. A system that supports the resumption of driving and includes evaluations of motor function and cognitive dysfunction might be useful for helping patients resume driving a car after a stroke.

*Predictive validity of a new scale*

The objective of this study was to examine the predictive validity of a new scale, the Revised Version of the Ability for Basic Movement Scale (ABMS II). The subjects of this prospective study were 71 patients who had had a stroke. In addition to the ABMS II score, other predictor variables were age, limb paresis as indicated with the Brunnstrom stage, and functional ability as indicated with the Barthel Index. Pearson's correlation coefficient analysis showed that the state of functional ability according to the 4-week Barthel Index was positively correlated with the total scores of the ABMS II and Brunnstrom stage at all data collection time-points. The results of linear stepwise regression analysis indicated that the "turn over from supine position" at the start of rehabilitation and "remain sitting" items of ABMS II at 2 weeks after onset of stroke, in addition to the 2-week Barthel Index and the 2-week Brunnstrom stage, were significant predictors (88.9%) of functional ability 4 weeks after onset of stroke. This study provides evidence for the predictive value of the ABMS II with regard to functional ability in patients after stroke.

*A new software program for assessing cognitive function*

**Background:** The screening of healthy elderly persons is a worthwhile strategy for detecting cognitive impairment at the earliest possible stage. Simple, reliable tests are needed to evaluate cognitive function. We aimed to measure cognitive function with a new software program, the Higher Brain Functional Balancer (HBFB), in healthy elderly subjects. The objective of this study was to examine the effectiveness of the HBFB.

**Methods:** Forty-eight healthy elderly subjects participated in this prospective study. In addition to the HBFB quotient, variables examined were age, length of education, and total scores of the Mini-Mental State Examination (MMSE).

**Results:** Pearson's correlation coefficient analysis showed that the state of cognitive function, according to the total scores of the MMSE, were significantly correlated with scores of "Orientation," the "modified Trail Making Test," "Route 99," and "Just Fit" of the HBFB. The results of linear stepwise regression analysis indicated that "Orientation" and the "modified Trail Making Test" of the HBFB were significant predictors of the total scores of the MMSE.

**Conclusions:** This study provides evidence for the predictive value of the HBFB with regards to cognitive function in elderly persons.

*New therapeutic repetitive transcranial magnetic stimulation strategy for patients with aphasia*

Four patients with motor-dominant aphasia after a stroke underwent 10 treatment sessions with low-frequency repetitive transcranial magnetic stimulation (rTMS). Each treatment session consisted of 1200 pulses of stimulation to an area homologous to the most activated site on functional magnetic resonance imaging (fMRI) performed before rTMS. Consequently, rTMS was applied to the right frontal lobes of 2 patients and to the left frontal lobes of 2 patients. Treatment improved language function in all 4 patients. Our therapeutic rTMS strategy seems to be a practical approach for neurorehabilitation for patients with aphasia after a stroke.

**Purpose:** To examine the safety and efficacy of long-term application of rTMS and speech therapy for patients with aphasia after a stroke.

**Subjects and Methods:** The subjects were 2 patients with motor-dominant aphasia after a stroke. Before rTMS treatment, fMRI was performed with a word repetition task. The site selected for rTMS application was the area homologous to the most activated area on fMRI. Twenty-minute low-frequency rTMS of 1 Hz was applied once per week in the outpatient clinic for 6 months after a 6-day in-hospital application, combined with speech therapy. Language function was evaluated at the beginning and end of the inpatient and outpatient treatment courses.

**Results:** rTMS was applied to the right inferior frontal gyrus, because the left inferior frontal gyrus was most activated area in both patients. Both patients successfully completed the therapeutic rTMS protocol without any adverse effects. The inpatient and outpatient treatments improved language functions, such as naming and writing, in both patients.

**Conclusion:** Our protocol of weekly long-term rTMS treatment is a practical therapeutic approach for patients.

#### *Effect of rCBF changes*

**Objective:** The objective of this study was to clarify the effect of changes in rCBF in language-relevant areas of the dominant hemisphere on the rCBF in each region in the nondominant hemisphere in patients with aphasia after stroke.

**Methods:** The subjects were 27 patients with aphasia who had had their first symptomatic stroke in the left hemisphere. In each subject, we measured rCBF by means of <sup>99m</sup>Tc-ethylcysteinate dimer single-photon emission computed tomography (SPECT). The SPECT images were analyzed with the statistical imaging analysis program “easy Z-score Imaging System” and with voxel-based stereotactic extraction estimation. Segmented into Brodmann area (BA) levels, regions of interest (ROIs) were set in language-relevant areas bilaterally, and changes in the relative rCBF as mean negative and positive Z-values were computed automatically. To assess the relationship between the rCBF changes of each ROI in the left and right hemispheres, the Spearman ranked correlation analysis and stepwise multiple regression analysis were applied.

**Results:** Globally, a negative and asymmetric effect of rCBF changes in the language-relevant areas of the dominant hemisphere was found on the right hemisphere. The rCBF decrease in the left BA22 significantly affected the rCBF increase in the right BA39, BA40, BA44, and BA45.

**Conclusions:** The results suggest that the chronic increases in rCBF in the right language-relevant areas are due, at least in part, to reduction in the transcallosal inhibitory activity of the language-dominant left hemisphere caused by the stroke lesion itself and that these relationships are not always symmetric.

#### **Publications**

**Hashimoto K, Goto H, Abo M.** Computerized assessment tool for healthy elderly persons as a

predictor of cognitive function. *Jikeikai Med J* 2010; **57**: 1-4.

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**Abo M, Kasahara K, Kakuda W, Senoo A.** Functional MRI activation in repetition task using block and event-related design. *J Appl Res*

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**Uruma G, Kakuda W, Abo M.** Changes in regional cerebral blood flow in the right cortex homologous to left language areas are directly affected by left hemispheric damage in aphasic stroke patients: Evaluation by Tc-ECD SPECT and novel analytic software. *Eur J Neurol* 2010; **17**: 461-9.