Changes of Regional Cerebral Blood Flow During Language Stimulation

IV. 9. Changes of Regional Cerebral Blood Flow During Language Stimulation

Kawashima R., Itoh M., Hatazawa J.*, Miyazawa H., Yamada K., Matsuzawa T. and Fukuda H.*

Department of Radiology and Nuclear Medicine, The Research Institute for Tuberculosis and Cancer
*Department of Nuclear Medicine, Cyclotron Radioisotope Center**

Introduction

It is commonly accepted that native language is processed mainly in the left hemisphere of normal right-handed human. On the other hand, unfamiliar language is supposed to be recognized better by the right hemisphere than by the left hemisphere[1]. To confirm these hypothesis, we measured the regional cerebral blood flow (rCBF) of normal volunteers during various language stimulation.

Materials and Methods

Eight young normal male volunteers were studied. Their ages ranged from 18 to 23 years, and all subjects were right-handed according to the H.N.Handedness Inventory[2]. Behavioral control and task procedure; The paradigm including one control condition (white noise) and two native language conditions and two unfamiliar language conditions (Italian). White noise, Japanese story and Italian story were recorded on magnetic tape and presented binaurally through a pair of headphones from tape recorder. When Japanese story were presented, subjects were asked to summarize the gist of a story or to visualize a story. When Italian story were presented, subjects were asked to summarize the gist of a story or to evaluate the emotional tones in the story. Positron emission tomographic measurements; The subject was placed supine and comfortably on the table of positron emission tomography (PET) scanner. He was instructed not to move, not to say anything and not to change respiratory rhythms. His eyes were closed and covered with cotton wool pads, and the room was darkened and kept noiseless for the duration of study. The PET system (Model 931/04, CTI Inc.) was employed for all measurement and obtained 7 planes parallel to the OM line. Subject was inhaled $C^{15}O_2$, that was delivered with air to give concentration of 10 mCi/100ml/min, continuously through the facial mask for 7 min to reach an equilibrium

state, then control scan for 3 min was obtained. After that, one of the auditory stimulation was presented for 3 min, then 3 min stimulation scan was btained. Three or four different condition scans were obtained for one series of measurement. Auditory stimulations were presented all through inhalation continued. PET analysis; We eliminated the arterial blood sampling, so that we could not calculate the regional cerebral blood flow (rCBF) quantitatively. Thus, because global CBF (gCBF) can vary independence of the relative rCBF distribution[2], rCBF were calculated after scalar normalization neglecting intersubject variation of gCBF[3,4]. Stereotaxic measurements; Prior to the PET scan, each subject received an magnetic resonance imaging (MRI) of his brain. And matching brain slices were performed between the MRI and the PET images[5].

Results and Discussion

The mean rCBF of ten cortical fields and two subcortical structures during control state and language stimuli states were calculated. The control state and each stimulate state were compared using the paired t test for each ROI. The cortical regions that showed statistically significant increase of rCBF by language stimuli were summarized in Fig.1. When asked to summarize the gist of a story presented in the native language, the rCBF increased bilaterally in the superior temporal gyri, the right Broca's area and the right frontal pole. While the unfamiliar language increased rCBF in the left superior temporal gyrus, the left Broca's area and the right frontal pole. When asked to evaluate the emotional tones used in the unfamiliar language, rCBF increased in the right superior temporal gyrus and left angular gyrus. When asked to visualize the story presented by the native language, rCBF increased in the bilaterally superior temporal gyri, the left striate cortex, the right angular gyrus and the left cingulate gyrus. These results suggest that native language may be recognized in bilateral language cortex and unfamiliar language may be recognized in dominant hemisphere of the language cortex. And the rCBF may change regionally in association with internal processing of language stimulation.

References

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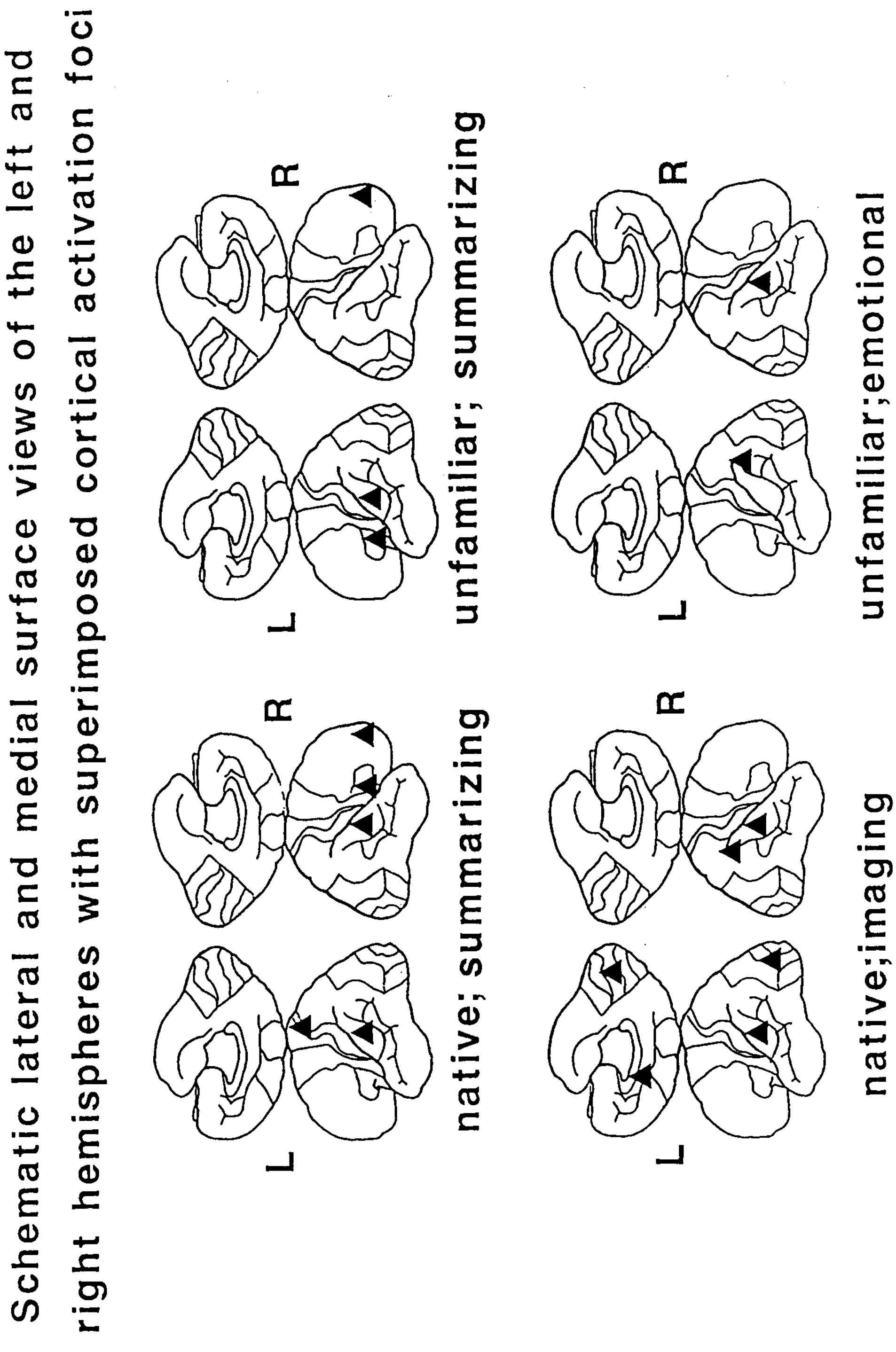

Fig. 1. Schematic lateral and medial surface views of the left and right hemispheres with superimposed cortical activation foci