Lessons from functional brain mapping in pre- and intra- operation for low-grade glioma: insights into associations between tumour and brain plasticity

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Objective: To explore brain language function reorganization in response to progressive growth of low-grade gliomas (LGGs) using preoperative functional MRI (BOLD-fMRI and diffusion tensor imaging (DTI)) and intraoperative functional brain mapping (direct electrical stimulation).

Methods: BOLD-fMRI of picture naming task and DTI were performed using a Siemens Trio MR scanner in six right-handed healthy volunteers and six right-handed adult patients with LGGs involving left hemispheric cortical language regions[1]. Activated pixels were identified and a lateralization index (LI) was calculated for a cortical region by SPM2. Bilateral arcuate fasciculi were visualized with the fiber-tracking technique. They were divided into foreside, the middle part and the end, whose FA values were measured separately. They were operated under local anesthesia using intraoperative functional brain mapping with the method of direct electrical stimulations using the picture naming task, through which the exact language sites were identified[2].

Results: During picture naming, the left lateral premotor inferior frontal and superior temporal were activated within the six healthy volunteers, foreside and middle parts FA of the left arcuate fasciculus of whose were higher than those of the right ones. In six LGGs patients, these structures were also activated on the right ride. LIs indicated that language hemispheric dominance of two of six patients was right side, in whom intraoperative functional brain map didn't figure out the definite language sites in the left hemisphere, foreside and middle parts FA of the right arcuate fasciculus of whose were higher than those of the left ones (Figure 1). The rest four was left side, in whom intraoperative functional brain map detected exact language sits in the left, left FA values of whose were higher than those of the right ones (Figure 2).

Conclusion: For patients with LGGs affecting the left language regions, two ways were recruited into language processing networks during progressive growth. One is intra-hemisphere, and the other is inter-hemisphere[3]. Our data provide evidence of effective plasticity in the progressive growth of the LGGs, which should assist presurgical planning, define surgical indications, predict the risk of postoperative deficit and aspects of operative surgical neuro-ocology.

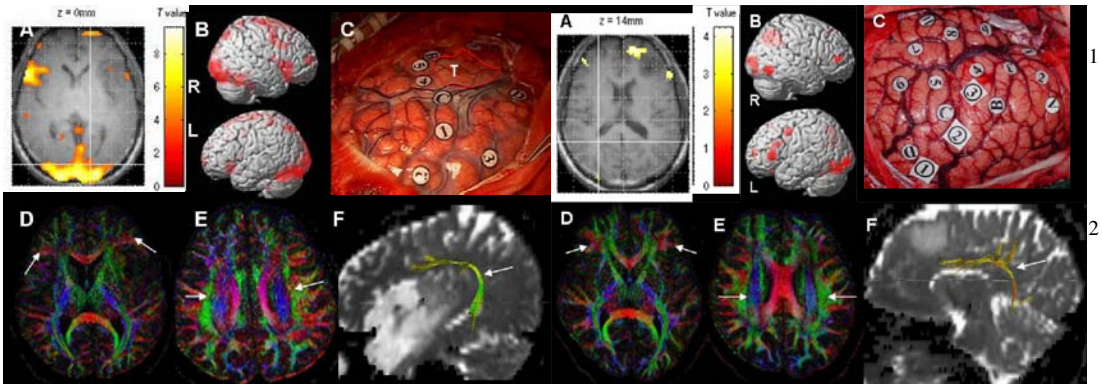

Figure 1: inter-hemisphere right language lateralization. (A, B) LIs showed the dominance is right side. (C) Intra-operative functional mapping didn't find the definite language sites.(A,B,C,D represented the border of tumor . 1,2,3,4,5 represented hand and face motion sites. T: tumour). (D,E,F) DTI showed the right arcuate fasciculus (↖) was higher than left one

Figure 2: intra-hemisphere left language lateralization. (A, B) LIs showed the dominance is left side. (C) Intra-operative functional mapping found the definite left language sites.(A,B,C,D represented the border of tumor . 1,2,3,4 represented Broca's area, and 6,7,8,9,10 represented Wernicke's area). (D,E,F) DTI showed the left arcuate fasciculus (↖) was higher than right one

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