

FMRI RESTING STATE IS A VALID SUBSTITUTE OF TRADITIONAL TASK-RELATED FMRI IN PRE-SURGICAL MAPPING?

Marta Maieron¹, Barbara Tomasino², Serena D'Agostini³, Miran Skrap⁴, and Ferdinando Calzolari⁵

¹SOC Medical Physics, AOU - S. Maria della Misericordia di Udine, Udine, UDINE, Italy, ²IRCCS Medea: Nostra Famiglia, Piasan di Prato, Udine, Italy, ³SOC of Neuroradiology, AOU S. Maria della Misericordia di Udine, Udine, Italy, ⁴SOC of Neurosurgery, AOU S. Maria della Misericordia di Udine, Udine, Italy, ⁵SOC of Neuroradiology, AOU S. Maria della Misericordia di Udine, Udine, Italy

Aim: Functional magnetic resonance imaging (fMRI) has been widely used to map brain functions and in the recent years there has been a rapid increased in the application of fMRI in routine clinical practice as a pre-surgical functional mapping of eloquent cortex (1). Conventional fMRI requires the patients to perform different tasks each of them is designed to target one function (motor/language/auditory/visual/memory). The tasks are usually delivered in a stimulus-driven paradigm and using the relative changes from baseline in the Blood-oxygen-level dependent (BOLD) signal in response to a stimulus it is possible to infer the localization of activated areas. The fMRI images obtained are used prior to surgery to identify the closeness of the lesion to regions of functional activity. There are, however, some limitations for this technique; the task are relatively demanding and some patients can have difficulty in performing those, especially those who have neurological deficits such as weakness of limbs for performing motor function, aphasia or cognitive impairments. Functional mapping based on spontaneous intrinsic activity of brain, resting state fMRI (rs-fMRI), could offer an alternative approach to presurgical mapping. Several studies have shown the application of this technique in identification of various resting state networks and functionally-related regions demonstrating synchronous BOLD fluctuations at rest (2,3,4). The aim of this study was to establish the interchangeability of the rs-fMRI and task-related fMRI as a clinical tool for mapping functional areas in patients with brain tumors.

Materials and methods: Data were acquired on a 3T Achieva Philips system from 10 healthy subjects (HS), 10 patients with tumor in motor cortex and 10 patients with tumor located in language areas. The BOLD sequences were: 1) a rs_fMRI run while the subjects were lying with open eyes; 2) a motor run (hand clenching task) and a language run (nouns task). Motor and nouns runs were delivered in a block design paradigm (15s active- 15s rest). T1 anatomical image were acquired. The fMRI parameters were: TR/TE = 2500/32 ms, 28 axial slices, 3mm thickness, matrix 128X128, FOV = 24 cm, number of repetitions: rs-fMRI =200, motor = 102, nouns = 54. The fMRI data were analysed using FSL software. Tasks runs were linearly modelled with the experimental paradigm, using a general linear model approach with local autocorrelation correction, as implemented in FEAT tool; rs_fMRI was analyzed using an ICA approach as implemented in MELODIC tool. The activation maps from different acquisitions were compared and analysed.

Results: Results of rs-fMRI map the sensorimotor system both in all HS and in all motor patients (fig. 1), language network was identified for all HS but not for all patients (6/10). The spatial overlapping between task-fMRI and rs-fMRI maps show a good agreement (90% HC, 71% patients for motor maps and 84% HC, 64% patients for language maps). For patients, in some cases (4/10 motor, 4/10 language) the rs-fMRI maps do not find the neuronal activation close to lesion, as the task-related maps do.

Discussion and conclusions: Our results demonstrate that rs-fMRI is a promising tool to overcome the challenge of active participation of patients in clinical fMRI practise but before it becomes a really useful tool some problems need to be resolved. We found that rs-fMRI activation maps not always replicate the “real” cortical activity revealed by standard fMRI tasks analysis and this could result in a underestimation of the still active neuronal areas in patients.

References

- 1) Voyvodic JT et al. *J Magn Reson Imaging*. 2009 Apr;29(4):751-9.
- 2) Fox MD and Greicius M. *Front Syst Neurosci*. 2010 Jun 17;4:19.
- 3) Lee MH et al. *AJNR Am J Neuroradiol* 2012 Aug 30.
- 4) Zhang D et al. *Neurosurgery* 2009;65:226-36.

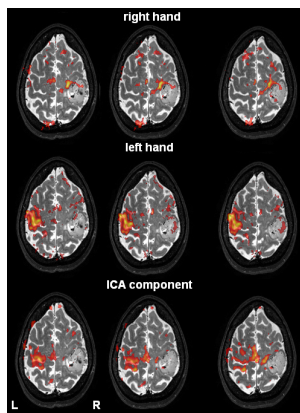


Fig.1 In the figure are displayed for a single patient the activation maps related to the movement of right hand (upper row), to the movement of left hand (middle row) and the motor network resulting from analysis of rs-fMRI run (lower row).