Combining EEG and fMRI data from a Wistar rat: a new tool for comparative neuroimaging

A. Sumiyoshi¹, T. Ogawa¹, R. Kawashima¹, and J. J. Riera¹

¹The Institute of Development, Aging and Cancer (IDAC), Tohoku University, Sendai, Japan

INTRODUCTION

EEG and fMRI data fusion in humans has been useful in the past since these two modalities provide complementary information in time and space. However, EEG and fMRI concurrent recording in rodents has been limited in terms of the number and the characteristics of the utilized electrodes (Mirsattari et al., 2007). In this work, we introduce a methodology to obtain high-resolution scalp EEG data concurrently with high-field fMRI-BOLD signals.

MATERIALS & METHODS

Animal preparation: A male Wistar rat weighting 215g was used. The hair on its head was carefully removed and the skin was degreased by applying 70% ethanol. A tracheotomy was performed for mechanical ventilation. The muscle relaxant pancuronium (2mg/kg/hr) and the anesthetic α-chloralose (20mg/kg/hr) were administrated via tail-vein injection. Two small needle electrodes were inserted in the right forepaw for electrical stimulation.

Electrophysiology: We prepared a MRI-compatible EEG mini-cap composed of 32 quasi perpendicularly movable electrodes which have been made from platinum wires (Fig. 1). The EEG and ECG signals were recorded with a commercially available MRI-compatible 32-channels BrainAmp system.

Magnetic resonance imaging: The MRI data was acquired by a 7T PharmaScan with a 38mm volume coil. The fMRI-BOLD signals were obtained using single-shot gradient echo-planar images with the following parameters: TR=2sec, TE=15msec, effective spectral width=250kHz, FOV=2.5x1.5cm², in-plane resolution=200x200μm², 7 coronal slices, 1.5mm thickness.

RESULTS & DISCUSSION

The EEG mini-cap did not produce any distortion on the T₂ mapping and EPI images although SNR for EPI images slight decreased (Fig. 2). Fig. 3A shows event-related EEG response with the three classical components and their scalp topographies. The SPM t-test mapping (p<0.05) for the used stimulation paradigm reveals a clear activation in the primary somatosensory region (Fig. 3B). By means of the proposed methodology, one can combine brain electrical source reconstruction and their coupled hemodynamic responses at the level of single voxels with pharmacological/genetic strategies.

REFERENCE