Safety of Simultaneous Intracranial EEG-fMRI in Humans: Histopathological Observations

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Introduction: Simultaneous intracranial EEG and functional MRI (icEEG-fMRI) recordings in humans, whereby EEG is recorded from electrodes implanted inside the cranium during fMRI scanning, were made possible following safety studies on test phantoms and our specification of a rigorous data acquisition protocol [1-3]. The purpose of this report is to further explore the safety of icEEG-fMRI by presenting some retrospective histopathological observations in surgical tissue samples from three patients who underwent simultaneous icEEG-fMRI following our scanning protocol [2].

Methods: We performed histopathology analyses on surgical tissue samples from five patients who had been implanted with icEEG electrodes [4]. Three of these underwent icEEG-fMRI at similar time points following icEEG implantation and the other two did not undergo MRI.

Results: The histopathological findings from patients who underwent icEEG-fMRI were similar to those who did not, in that they showed no evidence of additional damage in the vicinity of the electrodes (figure 1).

Conclusion: This work provides additional evidence that functional MRI in the presence of implanted EEG electrodes as performed in our centre under our strict patient selection and scanning protocol [2] is unlikely to result in significant additional brain damage.

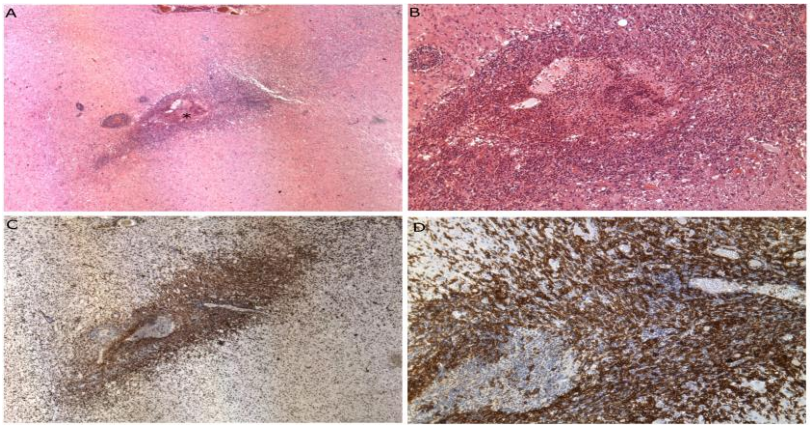

Figure 1: Hematoxylin and eosin staining revealed a lesion with a necrotic core and a small cavity (*) that infiltrated with small inflammatory mediators. Increased numbers of cells and hemorrhagic blood vessels were also noted in the periphery of the lesion. (C,D) The lesion core and immediate vicinity were strongly immunopositive for iba1. Iba1-immunopositive cells were densely populated around the lesion core, and individual iba1immunopositive cells were only visible further away from the lesion.

References: 1) Carmichael DW, et al. *Neuroimage* 49. (2010) 379-90. 2) Carmichael DW, et al. *Neuroimage* 63 (2012) 301–309 3) Hawsawi HB, et al. *Frontiers in Physics* 5 (2017) 1-42. 4) Goc J, et al. *European Journal of Neuroscience* 39 (2014) 2151-62.