Modification of Brain Activation of Neuropathic Pain During Lidocaine Infusion: an fMRI study

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Introduction The aim of this study was to assess the effect of lidocaine for the management of neuropathic pain using functional MRI. Neuropathic pain and skin hypersensitivity can be caused by injury of peripheral nerves. One of the proposed mechanisms of neuropathic pain is the development of abnormal excitory activity and subsequent input of aberrant signal to the spinal cord and brain from damaged nerves. This activity seems to be partly in the form of ectopic discharges mediated via the activation of sodium channels expressed by the sensory nerves [1]. Lidocaine is a sodium channel blocker, and may attenuate neuropathic pain and skin hypersensitivity in some patients [2]. Brain activity on tactile sensory stimulation was therefore assessed before and during the infusion of lidocaine using functional MRI.

Methods Only patients that had developed hypersensitivity in the form of allodynia (pain evoked by a normally non-noxious stimulus) and responded significantly to lidocaine were included in the fMRI study. A standardised monofilament brush was used to stimulate patients. Patients were then scored to check their suitability for the study dependent on their response before and following the infusion of lidocaine. Six patients were scanned on a 1.5T Siemens Vision MRI system. The fMRI scans were performed with an EPI pulse sequence, TR 6 s, TE 54 ms, FOV 240 mm, matrix 128 x 128, slice thickness 5 mm, scan time 6.5 mins. 65 volumes were collected in total, each volume containing 20 slices, covering the whole brain.

FMRI data were acquired during saline (placebo) and lidocaine infusion. Tactile stimulation was performed in random order on the affected, adjacent and contralateral areas. The fMRI data sets were then analyzed using SPM99 and areas of activations during saline infusion were compared to those during lidocaine infusion.

Results In patients with complex proximal brachial plexus injury the activity appeared changed in both hemispheres. In a more distal focal nerve injury there was increased area of activation in sensory area in the contralateral hemisphere. Five out of the six patients showed significant reduction in activation upon stimulation of the affected allodynic area following lidocaine infusion. Figure 1 shows the results obtained for the patient with distal injury. This shows difference between activation on stimulation of the painful area minus stimulation of the non-painful area during saline and lidocaine infusion respectively. Reduced activation during lidocaine infusion is evident.

Discussion Although there was consistent activation of areas known to be involved in pain perception [3], further studies with subsets of patients (e.g. distal limb nerve injury) are necessary prior to statistical analysis, as patients with complex proximal injuries may have shift in brain maps as well as altered activation. This fMRI protocol can be used to assess patients with allodynia, and to select patients for the evaluation of new agents.

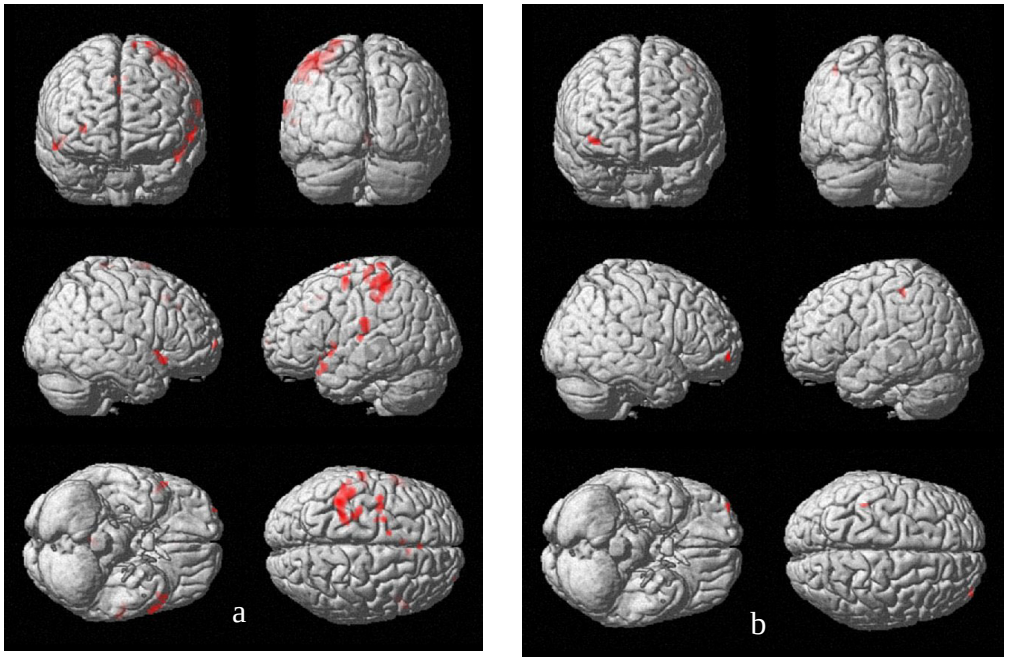

Figure 1. Affected area stimulated a) under saline infusion and b) under lidocaine infusion

References

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