

Research Article

Functional MRI Examination of Visual Pathways in Patients with Unilateral Optic Neuritis

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The relations between brain areas involved in vision were explored in 8 patients with unilateral acute optic neuritis using functional magnetic resonance imaging (fMRI) and diffusion tensor imaging (DTI). In all patients monocular stimulation of affected and unaffected eye elicited significantly different activation foci in the primary visual cortex (V1), whereas the foci evoked in the middle temporal visual area (area V5) were similar in size and in delay of blood-oxygen-level-dependent response. DTI analysis documented lower white matter anisotropy values and reduced fibre reconstruction in the affected compared with the unaffected optic nerves. The preserved activation of area V5 observed in all our patients is an interesting finding that suggests the notion of a different sensitivity of the optic pathways to inflammatory changes.

1. Introduction

Optic neuritis (ON) is an inflammatory disease of the optic nerves characterized by retrobulbar pain, unilateral vision impairment or loss, visual field defects, and impaired contrast and colour sensitivity [1, 2]. Evolution usually involves spontaneous recovery of vision after resolution of the inflammation and remyelination, by virtue of cortical and subcortical visual pathway neuronal plasticity, but progression to monocular blindness may take place in a significant number of cases [1, 3–5]. Several studies of functional recovery after brain injury have suggested that changes in local connectivity [6, 7], recruitment of existing pathways, or creation of new pathways [8] may account for recovery of vision in these patients. For instance, the evidence of preserved visual function despite a damaged primary visual cortex (V1) in primates has generated the hypothesis of alternative visual pathways involving the lateral geniculate nucleus (LGN) and the middle temporal area

(V5) [9–12]. In this study the responses of the visual cortex to monocular visual stimuli were investigated by functional magnetic resonance imaging (fMRI) to elucidate the connections among the brain areas involved in vision during unilateral vision loss in patients with a damaged optic nerve but a healthy visual cortex.

2. Materials and Methods

2.1. Subjects. fMRI and diffusion tensor imaging (DTI) data were collected in 8 patients with acute ON (mean age 46 years, 5 women; Table 1). In 4 patients ON was the first manifestation of multiple sclerosis and 2 further patients had, respectively, optic nerve damage connected to maxillofacial injury and ischemic optic neuropathy; the remaining two cases were classified as idiopathic, because of negative MRI findings and the absence of any clear cause.

Exhaustive ophthalmological examination and perimetry testing demonstrated unilateral vision loss or impairment