Relation between neuropsychological and neuroimaging findings in patients with late whiplash syndrome

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Abstract

Objectives—The interpretation of long term cognitive impairment after whiplash injury is still a problem for many physicians. On the grounds of nuclear medicine findings previous research speculated that brain damage is responsible for cognitive problems of patients with whiplash. To test this hypothesis the relation between neuroligaging and neuropsychological findings was analysed.

Methods—Twenty-one patients (11 women, 10 men, mean age 42.2 (SD 8.6) years) with the late whiplash syndrome (average interval of trauma 26.1 (SD 20.7) months) referred for diagnostic action to the Department of Neurology were investigated. Assessment included computer-assisted assessment of working memory and divided attention, neuroligaging (by the means of [18F]-FDG-PET, [15O]-H2O-PET and [11C]-HMPAO-SPECT, [18F]-FDG-PET), testing of emotional functioning (depression and anxiety ratings), and pain intensity at the time of testing.

Results—On average, scoring on tests of cognitive functioning was very low. However, no significant correlations were found between regional perfusion or metabolism in any brain area and the scores of divided attention or working memory. By contrast, significant relations were found between indices of impaired emotional functioning (state anxiety) and divided attention. In addition, low scoring in divided attention was significantly correlated with pain intensity at the time of testing.

Conclusions—The present data do not provide evidence of a significant relation between detectable morphological or functional brain damage and impaired cognitive performance in the late whiplash syndrome. Results indicate triggering of emotional and cognitive symptoms on the basis of initial injury of the cervical spine.

Keywords: brain damage, neuroimaging, neuropsychological testing, whiplash injury, working memory.

The so-called whiplash injury of the cervical spine is a benign condition with a reasonable rate of recovery1 and a lack of identifiable physical or neurological damage.1 However, various studies have reported impairment in cognitive performance in patients who had whiplash injury.2 Cognitive impairment of these patients is mainly concerned with attentional functioning of which divided attention is the most impaired aspect.3 Furthermore, considerable impairment was found in tasks requiring working memory.4 Working memory itself is a temporary information store, which provides the possibility for holding several types of information at the same time.6 Accordingly, unhindered functioning of working memory is a necessary requirement for different aspects of attentional functioning including divided attention.4 Recent studies using functional MRI or PET in humans showed that the dorsolateral frontal cortex is the structure of the brain critically involved in tasks requiring working memory.7 8 10

Both PET and SPECT have been shown to be useful in the assessment of mild brain injuries (concussion) in which MRI or CT and clinical neurology failed to provide findings of detectable damage.8 9 11 In these patients with mild traumatic brain injury perfusion deficits were found in the rostral brain areas11 12 which corresponded to neuropathological findings in the brain obtained by experimentally induced acceleration-deceleration trauma.12 Notably, in patients with mild brain injury perfusion deficits were significantly correlated with neurophysiological performance.12 13 Moreover, follow up studies of mild traumatic brain injury showed regression of rostral perfusion deficits accompanied by improvement in neurophysiological performance.13

Based on findings of impaired cognitive functioning of patients with whiplash, recent research suggested brain damage in those who had this injury.1 Using SPECT13 or PET14 the specific damage has been suspected in the parieto-occipital brain. However, by contrast with frontal brain damage, damage to parieto-occipital areas is an uncommon finding in both experimentally induced acceleration-deceleration trauma15 and in patients who had mild brain injury.15 16 In addition, it has recently been shown that both normal controls and patients with whiplash displayed parieto-occipital perfusion or metabolism deficits on visual analysis.16 However, when analysed using statistical parametric mapping, discrete deficits in the frontal pole or putamen were found in patients with whiplash but not in controls.18