Using Sentence Comprehension Task to Detect Awareness in Disorders of
Consciousness: Evidence from Event-related fMRI

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Abstract

Introduction

Neurologists routinely use visual, auditory, tactile, or noxious stimuli to examine the extent of purposeful motor responses indicating awareness in patients with disorders of consciousness (DOC), however with a high rate of misdiagnosis. Previous studies have shown that functional neuroimaging can be used to detect conscious awareness in this patient group because some patients fulfilling the criteria for a diagnosis of being in a vegetative state retained some level of awareness during imagery tasks and covert naming tasks through their cerebral activity, rather than through conventional motor responses. In light of these studies we used this improved tool to explore hemodynamic responses elicited by a sentence comprehension task in patients with DOC.

Methods

27 patients with DOC completed this study, including 12 in a persistent vegetative state (PVS) and 15 in a minimally conscious state (MCS). Neural differences in the processing of true and
false sentences were acquired at two separate imaging centres (Tuebingen, Siemens 3T MR, n=6; Vogtareuth, Siemens 1.5T MR, n=21). Data analysis was performed with SPM8 to identify task-specific activation at the single subject level.

**Results**

The whole-brain analysis showed that the brain activities of 4 patients reach statistical significance (p<0.001 uncorrected) in some regions belonging to the network activated in healthy subjects when they listened passively to the same sentence stimuli. Lowering the threshold to p<0.005 yielded additional activation in two more patients. These 6 patients showing a pattern of activity similar to those of healthy volunteers had a range of clinical diagnoses: 3 were classified as PVS and 3 were in MCS.

**Conclusions**

The comparison of the brain circuits observed in our patients with those of healthy subjects demonstrates some evidence for preserved language processing of true and false statements in some of the noncommunicative patients. This result suggests that sentence comprehension task using fMRI could be a useful paradigm for patient assessment in addition to the conventional bedside examination. Further work may be needed for the classification addressing the possibility to distinguish between PVS and MCS.