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Letters

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## Diagnosis and Treatment of Traumatic Brain Injury

**To the Editor:** The National Institutes of Health (NIH) Consensus Development Panel on Rehabilitation of Persons With Traumatic Brain Injury,<sup>1</sup> as forward thinking as it was, failed to address the increasing role of advances in neuroimaging and neuromodulation in the diagnosis and treatment of traumatic brain injury (TBI).

In the past several years, there has been a revolution in cognitive neuroscience that may soon transform the diagnosis, treatment, and rehabilitation of persons with TBI. For instance, diagnostic functional positron emission tomography has demonstrated a heterogeneity of brain states that can lead to impaired consciousness such as coma and the persistent vegetative state.<sup>2-3</sup> Kennedy and Bakay<sup>4</sup> have reported restoring communication for a patient with locked-in syndrome using an implantable electrode grafted to the motor cortex. Rinaldi et al<sup>5</sup> demonstrated that stimulation of the left medial thalamus can modulate working memory and verbal fluency in patients with chronic pain. This observation suggests that impaired cognitive abilities can be augmented. Bejjani et al<sup>6</sup> found that deep-brain stimulation, intended to treat the motor function of a patient with Parkinson disease, unexpectedly caused a transient depression. This serendipitous finding has the potential for developing new treatments for affective disorders and providing insight into their basic mechanisms.

Although neuromodulation has gained increased acceptance as therapy for movement disorders like Parkinson disease, the validation of these interventions in TBI will be complicated. The ethical challenge of conducting research on a vulnerable population that often lacks decision-making capacity, coupled with the novelty of these therapies, requires careful deliberation. To make prudent judgments about research in this rapidly evolving area, practitioners, researchers, and bioethicists must become familiar with the neurobiology underlying these innovative techniques.

Neuroscientists and bioethicists can also be patient advocates by promoting future NIH consensus statements on TBI that better articulate a responsible research agenda. The staggering public health need posed by TBI, coupled with society's marginalization of persons with brain injuries, makes this dialogue an ethical imperative in providing the benefits of science to these historically underserved individuals.

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**In Reply:** We did not find the available data sufficiently reliable to recommend the use of neuroimaging to assess impairment and disability, or to make predictions regarding outcomes. However, one of the main recommendations made by the Consensus Development Panel was that the neurobiology of TBI in humans should be studied with modern imaging techniques (eg, positron emission tomography and functional magnetic resonance imaging) and correlated with neuropsychological findings. It is certainly our hope that this rapidly developing technology may be useful in the diagnosis and treatment of persons with TBI.

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