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Treatment Innovation in Rehabilitation of Cognitive and Motor Deficits after Stroke and Brain Injury:

Physiological Adjunctive Treatments

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Stroke and traumatic brain injury (TBI) are leading causes of adult disability in the United States today. Of the 5.5 million people in the United States surviving stroke,¹ half live on with motor and/or cognitive impairments that affect their ability to effectively function and diminish their quality of life. In about 25% of stroke survivors, motor problems may give rise to a need for physical assistance by others. However, cognitive symptoms also affect independence, and their consequences may equal or even exceed those caused by physical limitations.^{2,3} The number of people with TBI is comparable with that of stroke, with 1.4 million U.S. citizens sustaining TBI annually, and at least 5.3 million living with its disabling effects.^{4,5} The most frequent unmet needs for services after TBI hospitalization are cognitive (memory and problem solving), emotional, and vocational in nature.⁶

Those of us who study motor and cognitive deficits in survivors of brain injury from stroke or trauma find these statistics disturbing, with our experiences leading us to suspect that even these formidable numbers underrepresent the magnitude of the problem. The reasons for this underrecognition may relate to a number of issues. One such issue is that systematic motor assessment of survivors of brain injury, like other physical diagnostic “how” skills, may take a back seat in current medical and psychiatric training to learning procedures, specifics of new treatments, and other “what” treatment commodities.^{7,8} We suspect that many stroke and TBI sufferers, especially in the long-term phase of recovery, may not be assessed for spasticity or even weakness. Thus, they are not identified as appropriate candidates for care to augment motor function. Similarly, many brain injury survivors may receive no evaluation or only a brief screening for cognitive dysfunction.⁹ Evaluation may only assess a cognitive index, with limited sensitivity. This betrays limited appreciation for the fact that *cognition* is a term that applies collectively to many differentiated functional systems, from attention to mathematical skill, and a composite score such as a cognitive index is like obtaining a “sensory score” after only testing vision, which is implied to index the integrity of all senses.

In addition to underrecognition of the long-term consequences of brain pathology, referral and attempts at treating these symptoms have historically been met with limited enthusiasm. Additionally, there has been a longheld assumption that therapy techniques, medications, or other interventions are no longer effective after some arbitrary interval—typically, 6 mos to a year after the brain injury—all of which fuels medical nihilism. A negative expectation keeps some therapy candidates from reaching the practitioners and allied health professionals who have tools to augment their recovery.

Cognitive and motor rehabilitation researchers are quite concerned about systemwide biases that may impair development of innovative rehabilitation techniques. Skilled nursing facilities or other supervised, long-term care settings may not be surveyed for stroke or TBI databases. Cognitive disorders may exclude stroke sufferers from research recruitment, and brain injury sufferers with abnormal arousal and motivation, aphasia, or difficulty organizing and planning activities and complying with instructions may also exclude themselves from research participation by failing to respond to requests for volunteers or recruitment contacts.

In the neuroscience of basic discovery, researchers routinely suggest that elucidating mechanisms of brain injury–related cognitive and motor deficits may inspire new treatments. However, basic research may choose outcome measures that assess impairment but not function. How can we move from this kind of paradigm toward large-scale, systematic, clinical studies, and then beyond—to the applicability of a treatment to an individual patient? We feel that observational, case study, and case series designs bring such questions forward; they can bridge the gap to randomized group studies and then to clinical practice. Using the Phase III research methodology is neither appropriate nor desirable when a question to be tested is at an early part of an experimental therapy evolution from innovation to refinement and when its feasibility and optimal setting is being explored.

The value of case series and group studies are often underestimated, and, in turn, these studies are not attempted often enough.¹⁵ This is extremely unfortunate, because averaged results from patients with diverse presentations of a clinical disorder in such a clinical trial may not represent the spectrum of treatment response. If patients with some theoretically defined subtypes of a clinical disorder benefit and others experience adverse effects, without appropriate secondary analyses, this may go undetected in a large-scale trial reporting lack of benefit.^{10,11} We must thus look to case series and group studies to remind us of theoretically defined subgroups by which we may reexamine “gold standard” results, especially as paradigm shifts in the field of neurological rehabilitation help us to basic definitions of brain-behavior disorders. Smaller sample trials in selected patient groups not included in a large-scale trial, who still may be an important treatment population (e.g., people who have sustained more than one TBI or stroke) complete the translation of knowledge to practice and make knowledge usable in individual patient care.

In this issue and the following three issues of *The American Journal of Physical Medicine & Rehabilitation* (June through September 2007), a special section of studies investigating neurorehabilitation will be published. In this issue, a uniquely translational treatment article relevant to the care of stroke-related cognitive impairment is presented. Hillis¹² reviews work suggesting that focusing attention on intervention to improve cerebral blood flow, including *increasing* blood pressure, mechanically restoring circulation, and pharmacological interventions, may improve symptoms of acute poststroke aphasia. In the next three issues of this journal, the special sections will focus on innovative approaches to spatial neglect (July 2007), pharmaceuticals as neurorehabilitation adjuncts (August 2007), and refining existing treatment delivery (September 2007).

In the past, both the medical community and the lay public believed that recovery after brain injury was very limited. We are now entering an exciting period in rehabilitative care, in which the time span over which continued improvement may occur, and the improvement to be expected, are increasing. In two recent publications, we have commented on the “new era of optimism” for cognitive recovery and poststroke cognitive rehabilitation.^{13,14} We feel that a scientific attitude of hope and expectation itself benefits people with brain injury and their families. These current papers provide examples of how scientific questions can be applied across the translational continuum—not only to develop new theoretically based treatments, but to assist with developing appropriate treatment combinations, and ensuring that even treatments widely considered helpful receive continued examination that will lead toward increased efficacy, efficiency, and economy.

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