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A Clinical Analysis of Alzheimer's Research in Neuromuscular Physical Medicine and Rehabilitation

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Purpose and Hypothesis

The purpose of this commentary is to discuss the role of clinical research as an effective method for studying the comparative effects of selected therapeutic interventions, upon the rehabilitation outcome of persons with Alzheimer's disease. Furthermore it is an analysis which will endeavor to suggest that within reason, physical therapy and orthopedic practitioners can expect patients with neurological and cognitive losses, to demonstrate functional improvement [1]. Implementing reliable experimental, clinical research and quasi-experimental design methodologies will contribute to the establishment of scientifically based standard-of-care treatment protocols [2]. The construct of innovation in neuromuscular research, is an evident trend in the rehabilitation literature [3-5]. Consistent with this trend, it is hypothesized that by integrating physical therapy treatment with cognitive therapy treatment, patients with progressive neuromuscular decline will achieve better functional outcomes.

When conducting research on human subjects with the diagnosis of Alzheimer's disease, post-hoc statistical analyses of pre-to-posttest outcome measures, using established treatment modalities, would be one possible strategy for making clinical inferences from the data collected [6]. A functional research approach to the treatment of the disease is needed [7]. By utilizing basic research design methodologies and sound statistical analyses, practitioners in their daily clinical routines, can provide important answers to questions, or discover pieces of the puzzle, that might prove to be important in the treatment and cure of Alzheimer's disease [8].

Background

Decreased cognitive focus, weakness, poor appetite, changing sleep patterns, weight loss, psychosocial withdrawal, chronic fatigue, inability to plan, confusion, difficulty processing and understanding verbal conversations, and loss of memory, are just some of the early onset to mid-stage symptoms that are experienced by Alzheimer's patients [9,10]. To affect any meaningful degree of recovery for patients with the disease, it is thought that rehabilitation treatment strategies should attempt to maximize the possibility for nerve cell regeneration, oxygenation, and possible increased brainwave activity and relearning [11-14].

Based upon the literature, therapeutic exercises, both physical/aerobic and cognitive, may be important treatment interventions for neurological patients with Alzheimer's disease [15,16]. With certain forms of exercise, alternate neuromuscular pathways might be developed, and cortical nerve impulse propagation might be facilitated, thereby improving a patient's ability to translate conscious thoughts into action through "willed behavior," and thus functional rehabilitation outcomes among Alzheimer's patients, would be improved [17].

For example hydraulic biometric rehabilitation machines have been shown to be safe, simple, challenging and easy to use in the physical therapy clinic. They are especially effective for neuromuscular patients. Hydraulic exercise provides a motivational component because the resistance of the machine is directly related to the force being exerted by the patient. Also, the stationary bicycle ergometer is similarly safe and with individualized variable resistances, which allow for patient comfort, progressive cardiovascular training and self-directed exercise programming [18].

The individualized "effort dependent" nature of hydraulic resistance is effective in facilitating coordination, proprioception, motivation, and self-directed behaviors among rehabilitation patients [19]. Cardiovascular "aerobic brain" exercise routines such bicycle ergometers, have demonstrated both physical and psychological advantages, by developing the individual's pulmonary endurance, functional stamina, and general well-being [20]. Furthermore, "cognitive exercise" activities are important for individuals of all ages, and in particular, the multifaceted benefits derived through self-directed life-long learning include intellectual, self-esteem, and socially adaptive personality variables [21-23].

Recent experimental research findings in regenerative biology and functional kinesiology have challenged the once accepted scientific notion that neurons cannot regenerate. In fact pluripotent embryonic cells and the regeneration of nerve cells may hold hope for the future of neurological rehabilitation [24]. Physical therapy findings have suggested improved functional outcomes among neurological patients, thereby reinforcing the validity of this concept [25].

On the other hand, the nerve cell is extremely vulnerable to oxygen deprivation, and thus oxygenation and aerobic exercise appear to be essential components of neurological rehabilitation programming [26,27]. However based upon this review, ongoing Alzheimer's clinical research is warranted.

Although different physical and cognitive therapies have been employed in a variety of neurological rehabilitation settings [28], there were no articles found in the literature that studied the relative influence of adjunctive aerobic versus cognitive exercises upon the functional outcome measures of individuals with progressive cognitive loss. It would be interesting to know which such physical and/or cognitive brain exercises would be most helpful.

Future Directions

Therapeutic exercise is an important and widely used physical therapy procedure [29] and thus is routinely prescribed for patients with neuromuscular dysfunction syndromes of all types. Those with certain neurological diseases, involving both physical and cognitive

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impairments [30], often go through different adjunctive treatments in an effort to achieve the optimal functional outcomes [31,32]. With Alzheimer's, there is an evolving body of knowledge concerned with the question "What would be the most clinically beneficial modality and medically accepted approach to treatment?"

The advantages of "physical exercise" have been well documented, including the development of muscle strength, endurance, neuromuscular proprioception, and motor control [33]. Alzheimer's patients pose unique clinical challenges. It is never known the extent to which their cognitive loss is stable, deteriorating, or if there remains a good prognosis for improvement. In addition it is not clear whether cognitive status is related to, or affected by their variable day-to-day physical function.

"Aerobic cardiovascular" and/or standard cognitive "cerebral" brain exercises, or just placebo "social interaction activities" might all be beneficial as possible adjunctive exercise treatments. It has not been determined however, which of the different "brain exercise" therapy components might be the most effective [34-36], or whether any of these adjunctive interventions would be beneficial. The goal of each and every treatment intervention would be to facilitate maximal functional independence among patients diagnosed with Alzheimer's disease.

Establishing medically accepted rehabilitation strategies for Alzheimer's patients is consistent with a fundamental principle of the new medical model, in which all individuals are given access to treatment, regardless of their diagnosis [37]. The myriad of problems associated with Alzheimer's disease are formidable. In this era of healthcare reform, and increased fiscal accountability for care, it is important that the services rendered, are clinically effective, normalizing, and promote the human dignity of the patient. It is theorized that the null would be rejected in favor of the alternative hypothesis, and that physical exercise together with certain adjunctive aerobic and cognitive brain exercise therapies would result in improved physiological and functional outcomes among Alzheimer's physical therapy patients.

Initially, when investigating the benefits or lack thereof, derived from certain interventions, a retrospective versus a priori approach would be recommended when studying the comparative treatment effects of different modalities, in patients with Alzheimer's disease [38]. To illustrate this point, the clinician might administer similar but different prescribed adjunctive exercises and the measured "within and between group differences" on selected functional outcome variables, could subsequently be analyzed. The a posteriori results and conclusions could then be inferred to the population.

Was one of the adjunctive treatment regimens more effective than the others? With Alzheimer's disease, conducting retrospective research, looking back at the data collected during the usual course of medically necessary treatment, would be one suggested approach.

Since an Institutional Review Board (IRB) has the liability of protecting the safety and human rights of subjects, they are charged with the task of determining whether subject's "informed consent," has been satisfactorily achieved. Medical ethics issues abound in studying individuals with progressive neurological cognitive impairments, and Human Subjects Review Committees cannot compromise their standards [39].

Based upon the literature, conducting innovative neuromuscular research is essential. Alzheimer's is a complex disease, often with functionally interrelated physical and cognitive symptoms, and thus to achieve maximal clinical outcomes, it is hypothesized that physical therapy sessions should perhaps address both components simultaneously.

As practitioners, if we hope to establish scientifically-based rehabilitation options and standard-of- care treatment protocols for patients with Alzheimer's disease, we must continue to work together and collaborate inter-professionally to find a cure.

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