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Case Presentation

Case Report: Aquatic Therapy and End-Stage Dementia

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Abstract

A 54-year-old woman, retired due to progressive cognitive decline, was diagnosed with early-onset Alzheimer dementia. Conventional medication therapy for dementia had proven futile. Initial evaluation revealed a nonverbal female seated in a wheelchair, dependent on 2-person assist for all transfers and activities of daily living. She had been either nonresponsive or actively resistive for both activities of daily living and transfers in the 6 months before assessment. After a total of 17 1-hour therapy sessions over 19 weeks in a warm water therapy pool, she achieved the ability to tread water for 15 minutes, transfers improved to moderate-to-maximum assist from seated, and ambulation improved to 1000 feet with minimum-to-moderate assist of 2 persons. Communication increased to appropriate "yes," "no," and "okay" appropriate responses, and an occasional "thank you" and "very nice." The authors propose that her clinical progress may be related to her aquatic therapy intervention.

Level of Evidence: IV

Introduction

The role of exercise in the preservation and improvement of cognitive function is becoming well-established science [1,2]. Even in the case of dementia, exercise science has established a body of research in both humans and animals demonstrating a strong role for aerobic activity [3-5]. There are as yet no medications that can consistently maintain cognitive ability, much less reverse the course of diseases such as Alzheimer disease.

Simple aquatic immersion produces increases in cardiac output and cerebral blood flow that may parallel some of the general physiologic effects of exercise, but whether aquatic immersion alone is therapeutically useful in dementia remains an important unanswered question [6]. There is an emerging body of literature demonstrating clinical benefits from participation in an aquatic exercise program in patients with mild-to-moderate Alzheimer disease [7-10]. Studies are as yet small, but results are promising, and the clinical implications for the therapeutic management of this troublesome disease merit more research, although the question of immersion benefits versus aquatic exercise benefits remains.

To our knowledge, we present the first case report of the use of aquatic therapy for an individual diagnosed with end-stage Alzheimer disease and severe behavioral issues who showed significant functional and behavioral gains, as well as speech and language gains, over a period of 4 months of aquatic activity, initiating with passive therapies and progressing to aquatic exercise. The potential physiologic rationale for these clinical improvements will hopefully spur further research.

Case Presentation

A female former physical therapist was diagnosed at age 53 years with early-onset Alzheimer disease after a neurologic assessment that included a positron emission tomography scan. She underwent unsuccessful trials of memantine and donepezil as well as a clinical trial of rivastigmine transdermal patches. The patient had lived independently until her parents found her unable to safely continue in that environment and moved her to live with them until the living environment in their home had become impractical. Over the year after diagnosis, she continued to deteriorate and was placed in a memory care residential facility. She was referred

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for physical therapy assessment at age 54 years. Because the patient had been an avid swimmer before her illness, a trial of aquatic therapy was encouraged by her family and initiated on physician referral. At the time of her physical therapy assessment, the patient was alert but with very limited communication and scant ability to follow even single-stage commands. Her medications consisted of calcium 650 mg twice daily, acetaminophen 325 mg twice daily, carbidopa/levodopa 10/100 mg once daily, and when necessary bisacodyl, APAP/hydrocodone 325/5 mg, and alprazolam 0.5 mg. Her physician authorized a therapeutic trial of aquatic therapy, initiating the assessment by a physical therapist working with an experienced physical therapist assistant with extensive aquatic experience in cognitively impaired patients.

At the time of her initial physical therapy evaluation, the patient physically required total assistance of 2 staff members for all transfers and activities of daily living as the result of her being either nonresponsive or having episodes of very active resistance. The patient showed no signs of ability to perform, or even initiate, weight bearing, even with total assistance. Her muscle strength was unable to be tested because of her inability to follow commands. The patient's family stated the patient could, on occasion, propel herself using her legs in her wheelchair but would not follow any directions. The patient had not taken steps, stood, or assisted with transfers in more than 6 months.

Cognitively, the patient was given the Mini-Mental Status Evaluation before evaluation but gave no direct response, nor did she respond with direct eye contact or recognition that questions were being directed to her, with a consequent score of 0. She did not respond to direct questions and would slap her thighs, looking away to the left and repeatedly reaching to touch the couch in a dissociative manner. The patient's family and facility caregivers stated that she would occasionally say the words "yes," "no," and "okay," but they were rarely appropriate and out of context. She would mostly grunt or make unintelligible syllables but would occasionally give short bursts of gibberish. The family stated this had been her cognitive state for more than 6 months.

Because the patient had not responded to all previous attempts of land-based therapy and her family emphasis of her previous love of swimming and water, the trial of aquatic therapy was initiated. The patient's plan of care began for a period of 4.5 months. During this time period, she received 17 total aquatic therapy sessions on a weekly basis, with several missed weeks. The transport process to and from her care center to the aquatic facility required her transfer to her family's sport utility vehicle, as she became extremely agitated in a handicap transport van trial, and even in the sport utility vehicle she needed to be seated in the back seat for safety. The commute was exhausting to family, remained so for a period of months, and required the care facility to administer alprazolam to the patient 30 minutes before transport on a number of visits over the 19-week period.

The initial sessions in the 89-90°F heated pool were significant for a dramatic reduction in agitation and facial expressions of anger with increased verbalization, including her calling out, "Hi Mom," to her mother, who was present in the pool during the therapy session, which she had not done in more than a year. During the pool sessions, she tolerated swaddling with a blanket and modified Watsu techniques supine in the water. (Watsu is a passive aquatic technique derived from classic Shiatsu massage that has been adapted into aquatic therapy practice. It is intended to create relaxation through gentle, slow movements through a warm water environment while being held or supported by the aquatic therapist. It has been found successful in working with patients with stroke, cerebral palsy, and autism) [11]. She did not initially tolerate the upright posture in water until 45 minutes of supine activity and swaddling had been done. Modifications of Water-Specific Therapy, based on the 10 points of the Halliwick Concept, were incorporated during the treatment sessions with the use of metacentric effects to influence the patient's active participation. (The Halliwick Concept was developed in the United Kingdom in the 1950s as a method of teaching swim readiness to disabled children using the properties of water in a highly structured progression, beginning with balance in water and progressing into movements incorporating rotation, static, and increasingly dynamic activities. The method developed into a progressive 10-Point-Program used to promote posture and balance control, and exercises from this 10-Point-Program became the basis for an aquatic therapy approach called Water-Specific Therapy with the focus on objectives related to levels of function, structure, and activity) [12]. Over subsequent sessions with the patient, this preliminary supine activity required less time and functional patterns became more instinctive.

On her second pool visit, she was able to exit the pool via a ramp, walking 20 feet with minimum to moderate assist. Walking on level ground improved dramatically also, to 75 feet on visit 6 with contact-guard-minimum assist, increasing to 1000 feet with minimum to moderate assist of 2 on visit 14. Also, by the sixth visit, the patient began to show ability to tread water, initially for a few seconds but later for minutes, achieving ultimately 15 minutes per session. She gained the ability to stand upright from a water-treading position, and then to walk, but preferred to swim and tread water. On later visits, she was able to ascend the entire ramp length of greater than 50 feet with standby to moderate assist with rests and redirection. Her aquatic trial was formally terminated after the 15th

Table 1
Clinical progress of the patient

Visit	Behavior	Transfers (Assist Needed)	Ambulation/Activity	Communication	Eye Contact
Initial evaluation	Agitated to unresponsive	Max 2 persons	None	No words, no commands followed	None
1	Agitated, calmed @45 min	Max 2 persons	None	Yes/no accurate, "Hi Mom," did follow some instruction	5 s
3	More initial agitation	Max 2 persons	Limited but CGA-SBA, exited via 40-foot ramp CGA-Min	Garbled language only	
5	Less anxious, less initial agitation	Max 1-2 person	CGA to deep, began sculling, dancing to music, exit ramp CGA to Min	"Okay," followed most commands	Consistent
7	Mod anxious, Agitation soon dropped	Mod-max 1	30 s to 3 min treading CGA, self-correcting balance, exit ramp CGA-SBA	"Thank you," appropriate	Consistent
9	Initial mod agitation, decreased during rx	Max-mod 1	Treading 8 min nonstop × 1, 5 min × 1, 60 feet land CGA of 1, 150 feet land CGA of 2	Appropriate yes/no, "scared," "thank you" ×3, "nice, very nice"	Consistent
11	Less anxious, Agitation dropped fast	Min-mod	Mod to ramp bottom, min-mod up, land 150 feet CGA of 2, then 400 feet CGA of 2	"Thank you," appropriate, "Oh, my God," "tired," "please"	Consistent
13	Much less anxious,	W/c max,	Ramp down mod-max, treading much, exit ramp CGA ×2, land 600 feet CGA-mod ×2 with rests	"Oh, my gosh," "sure," appropriate, more vocal throughout	Consistent
15	More agitation	Sit-stand mod, w/c mod	Entry amb unable, treading × multiple times,	"I want to say something," laughing but no further responses	Consistent
17	Agitation much less	Mod-min car to w/c,	Ramp down mod-max, much treading, ramp exit min-max, land 750 feet with CGA ×2	Identified staff by gender correctly, more words	Much more

CGA = contact guard assist; SBA = standby assist; Min = minimum assist); Mod = moderate assist; rx = treatment; w/c = wheelchair; amb = ambulation.

visit, although she has continued sporadic aquatic therapy 2-4 times per month. During her therapy visits, no adverse events occurred. Her clinical progress is summarized in Table 1, with only odd numbered visits shown in the interest of brevity.

Carryover of mobility skills to her care center was short-lived, unfortunately. She remained wheelchair dependent. Over the months of her treatment and even after that period, her mother reported that her improved communication skills persisted. She demonstrated consistent yes/no response accuracy and social comments such as appropriate "thank you" and "very nice" comments recurring as well as other appropriate verbalization. She continued episodic aquatic visits.

Discussion

The pathophysiology of the various forms of dementia remain incompletely understood. Medication management often is minimally helpful, as in this case. Individuals with dementia pose a difficult management group both for residential facilities as well as for those striving to care for family members at home. Exercise has been shown to have a modulating effect on dementia in recent studies [13,14]. Several publications have noted cognitive as well as functional gains after courses of aquatic exercise in older adults, both community-dwelling and in residential facilities [8,9,15,16]. In these publications improvements in measures of executive function, attention, and memory were noted even in quite brief exercise intervention periods.

Several physiologic alterations occurring during aquatic immersion may be participatory in the cognitive and functional changes noted in the aforementioned publications. Aquatic immersion produces significant alterations in the cardiovascular system, resulting in an increase in cardiac output and a decrease in peripheral vascular resistance [6]. It has been speculated that this cardiac output increase is primarily distributed to the brain, muscles, and kidneys. Two newer reports add support to this speculation by demonstrating alterations in cerebral blood flow during clavicle-depth immersion. Increases in both middle and posterior cerebral arterial flow velocities were noted both during sedentary immersion and during aquatic exercise [17,18]. The relationship between dementia and cerebral blood flow may play a part of the aforementioned cognitive and behavioral effects.

There is also a neurophysiologic autonomic alteration in sympathovagal balance produced during warm water immersion, as described in articles in which authors assess cardiac vagal control [19,20]. Warm water immersion produces a dramatic decrease in sympathetic cardiac influence with an increase in cardiac vagal control. The role of the autonomic nervous system in Alzheimer disease has been well described [21], with cognitive function positively associated with increased cardiovagal influence and negatively associated with increased sympathetic autonomic output. These effects may play an important role in this case report as well as in the blood flow papers cited previously.

Some of the activities that our case study patient did in water included actual exercise, such as treading water, whereas others were simply passive, or low-level ambulation. Heart rates were not monitored. Further trials should incorporate this simple metric to ascertain cardiac aerobic levels. Our patient received therapy only once per week, and increased treatment frequency may have achieved greater gains, so this should be addressed in future studies. Clinical gains also may relate to aerobic levels achieved, over and above simple immersion results. Trials of aquatic therapy in a broader range of patients with dementia are needed, and because immersion trials cannot be blinded, other research methods may be used, assessing effect magnitude and durations specifically including cognitive status, communication/language skills and functional motor performance.

The role of aquatic therapy in the management of individuals with dementia has received little emphasis. Logistic difficulties often are present, concerns over incontinence are real (although often excessively emphasized), and staffing to treat these individuals is often problematic. Such individuals require close hands-on in-water supervision for safety at the least, and ideally responsible on-deck support with lifesaving certification. Although a number of residential facilities for elderly individuals have aquatic facilities, in both authors' experience only rarely are these facilities extensively used. Yet, there are very few therapeutic successes seen with currently available medications. Our patient was an avid swimmer previously, but positive results have been seen in patients with Alzheimer disease who are not as comfortable with the aquatic environment [8,9]. No previous papers have addressed the issue of participant comfort in the aquatic environment, although all referenced studies included individuals who were either regular swimmers or had a history of or interest in swimming. We suspect that hydrophobic individuals would not do as well. A warm-water aquatic environment produces a calming and relaxing effect on humans across the age span, from infancy through adulthood. This effect is therapeutic, increasing cardiac efficiency, lowering blood pressure, improving sleep patterns, and having positive effects on the endocrine system as well as the cognitive effects described [6]. The implications for its use in individuals with dementia are potentially quite profound, as the graying of our nation increases the population potentially at risk.

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Disclosure

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