Aquatic Therapy for Patients Post Stroke

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**What Is A Stroke?**

A stroke occurs when a clot blocks an artery (ischemic stroke) or a blood vessel breaks (hemorrhagic stroke) and disrupts blood flow to an area of the brain8. The lack of blood flow causes an area in the brain to die.  At a young age, men are more likely to have a stroke than women but later in life women are more likely to have more strokes than men.

Common stroke symptoms include:

* Sudden numbness or weakness on one side of the body
* Facial droop, sudden confusion, difficulty speaking or understanding speech
* Sudden trouble seeing in one or both eyes
* Sudden trouble with walking, loss of balance, dizziness, or coordination
* Sudden severe headache with no known cause

It is important to recognize and respond to stroke symptoms.  Use the acronym F.A.S.T to respond8:

F = face (facial droop),  
A = arms (arm drift)  
S = speech (slurred speech)  
T = time (call 911).

**General Treatment**

Rehabilitation can help to improve function to increase the strokes survivors’ independence. Physical therapists, occupational therapists, and speech therapists may be involved in treating the patient.  Options for rehabilitation includes: rehabilitation unit in the hospital, subacute care unit, rehabilitation hospital, home therapy, home with outpatient therapy, or a long-term care facility that provides therapy and skilled nursing care8.

Helpful Websites:

* [www.stroke.org](http://www.stroke.org/)
* <http://www.stroke.org/site/DocServer/STROKE_101_Fact_Sheet.pdf?docID=4541>
* <http://www.stroke.org/site/DocServer/ExplainingStroke_web.pdf?docID=3321>

**What is Aquatic Therapy?**

Aquatic therapy is a skilled therapeutic practice led by a physical therapist or physical therapist assistant in an aquatic environment. Aquatic therapy includes but is not limited to treatment, rehabilitation, prevention, and health and wellness of a patient or patient population.  These patients may be treated with assistive devices, orthotics, or adaptive equipment1.

The goals for aquatic therapy can include and are not limited to improving or maintaining the following: function, strength, flexibility, endurance, balance, coordination, gait, and relaxation1.

**Therapeutic Exercises:**

Strength and flexibility exercises can be administered with the use of adaptive aquatics equipment such as water weights, floatation devices, noodles, etc.  By placing floatation devices in strategic locations under the patient’s limbs, the therapist can create an extensive stretch on the desired limb (for example, a flotation device around or under the ankle with the leg extended and hip flexed in front will create a hamstring stretch when the pt. is in standing).  Likewise, strengthening exercises can be performed by asking the pt. to push down against a floatation device towards the bottom of the pool (with the hamstring example, having the pt. push down on the floatation device towards the bottom of the pool will create a concentric contraction of the hamstrings.)  These techniques can be performed in various ways across all muscles/joints of the body either in standing (can stabilize pt. by having him or her hold onto an assistive bar), in supine, or in side lying with appropriative floatation devices.

**Gait Training:**

Gait training can be achieved in the aquatic therapy setting with a post-stroke patient by many different methods including:

1. Ambulating in the water with use of flotation devices or manual assistance (if necessary.)  Ambulation can be performed in varying water depths to increase (shallow water) or decrease (deep water) the patient’s weight bearing status.
2. Ambulation in deep water without weight bearing with use of excessive floatation devices around the trunk.
3. Ambulation with use of an underwater treadmill.

The advantages to gait training in the water include: the above mentioned decreased fear of falling seen in some patients, the buoyancy created by the water which allows for a controlled amount of weight bearing, increased time available for error correction, and increased sensory feedback for error recognition.

See this video for an example of gait training via an underwater treadmill: <https://www.youtube.com/watch?v=S31sK54qynM>   
See this video for an example of gait training activities for a high-level mobility patient: <https://www.youtube.com/watch?v=ZgxniVfKT4I>

**Balance and Posture Training:**

As previously described, the aquatic setting allows for increased time for error correction and increased sensory feedback for error recognition in the post-stroke patient.  Methods for improving balance and posture in post-stroke patients include simple dynamic standing and sitting exercises in which the water can be used to manipulate the pt. into a desired postural stance (with methods similar to PNF) or to challenge the pt. to maintain posture by causing perturbations either manually or with water resistance.  With more advanced patients, balance and posture can be practiced by having the patient perform sitting or standing on an adaptive aquatics matt.  These matt’s create an unstable service for the patient which forces the patient to coordinate deep stabilizing muscles in order to maintain balance and stability.

The water is also unique because it offers an environment in which a patient can be laying supine (with adaptive floats) so that the therapist has access to the pt. from all directions in order to address matters of posture and stability.

See this video for an example of standing balance exercises in the pool: <https://www.youtube.com/watch?v=mVvzsFk6rPo>   
Or this video for an example of dynamic balance exercises: <https://www.youtube.com/watch?v=Ek0EyulZrsc>

**Manual Therapy and Joint Manipulation:**

As previously described, the aquatic therapy setting allows the therapist to have access to the patient from all dimensions while the pt. is maintaining a relaxed position in supine.  This method is extremely conducive for both manual therapy and aquatic therapy techniques.

Bad Ragaz describes is a specific technique used by therapist specializing in aquatic therapy to promote increased ROM, decreased spasticity, and increased strength. There are many highly detailed exercises associated with the practice of Bad Ragaz, but one in particular which is utilized commonly in the post stroke patient is that of Bad Ragaz Ring Therapy for trunk elongation. During this exercise, the patient is situated in supine and told to relax as much as possible. By having the pt. patient positioned supine in the water, the therapist is able to use his or her body to stabilize the pt. patient from a flotation device across the ASIS and propel the pt. patient through a semicircle pattern so that the therapist remains in the center of the circle. This movement, when performed towards the more effected side, promotes elongation and extension of the more effected side of the trunk. This exercise can also be performed in a concentric matter to increase dynamic core strength.

Halliwick therapy is another specific technique used in a therapeutic pool to encourage improved postural stability and controlled mobility17. It involves a 10-step process that slowly progresses the patient towards safe, independent balance capabilities in the water. 17In a study done by Tripp and Krakow, 30 patients in the post-acute phase of stroke rehabilitation were studied to determine the effects of Halliwick techniques on postural stability via the Berg Balance Scale. The 14 patients in the experimental group demonstrated significantly improved outcomes on the Berg Balance Scale as compared to the control group.17

See this video for a visual demonstration of Bad Ragaz: <https://www.youtube.com/watch?v=YO_ynkKj8kg>  
See this video for an example of spinal mobilizations in the pool (around 0:40): <https://www.youtube.com/watch?v=r_hgGasnix8>

**Proprioceptive Training:**

The water is a remarkable tool for proprioceptive training due to the increased amount of sensory feedback received in the water as compared to when on land.  The increased density of the water allows for a heightened sense of where the body is located in space.  Simple exercises such as floating in supine with eyes open or closed, and ears above or below the water, allows for varying proprioceptive practice in the post stroke patient.   Another exercise includes having the pt. lie supine on the therapeutic aquatic matt in order to receive alternating proprioceptive feedback.  The pt. can then perform UE and LE movements/exercises as the pt. advances.

**PT Training and Certification2**

1. The ATRI Aquatic Therapeutic Exercise Certification is available for licensed professionals who have completed at least 15 hours of Aquatic Therapy, Rehab, and/or Aquatic Therapeutic Exercise education and who have passed the certification exam.
2. Ai Chi, ATRI Rheumatology, and Risk Awareness and Safety Training (RAST) Certifications are also available through the Aquatic Therapy Rehabilitation Institute.

**History of Aquatic Therapy**

Throughout history, many different cultures have used water as a source of healing. Water therapy at this time was bathing in hot springs or spas which had relaxation and healing effects on the bather. Many different cultures had bathing houses or spas set up there for social or healing effects. In Switzerland, the Benedictine Abbey of Pfäfers served as a spiritual and cultural center of Switzerland. By the nineteenth century, Bad Ragaz (Switzerland) had become a major health resort spa where today the Bad Ragaz ring method is taught and practiced for aquatic rehabilitation3.

In America, after World War I, there were spa doctors who did research on the benefits of water, baths, and pools3. These doctors did not put a lot of emphasis on water exercise. Dr. Charles LeRoy Lowman started using therapeutic tubs to treat patients with cerebral palsy and spastic conditions as early as 1911.3 Lowman founded the Orthopaedic Hospital in Los Angeles in 1913; today this hospital is known as Rancho Los Amigos.3 President Roosevelt was known to use therapeutic water exercises; this encouraged the medical acceptance of aquatic rehabilitation. 3 In the 1950s, polio affected nearly 58,000 Americans annually. With the polio epidemic, therapists like Sister Kenny used water activity therapy to treat polio patients.3

Today, aquatic therapy is used to treat many different diseases and illnesses including but not limited to: osteoarthritis, spinal cord injury, stroke patients, MS patients, and cerebral palsy. With the push for evidence based practice, we have research to support the use of aquatic therapy.

**Introduction to Aquatic Therapy for the Patient who is Post-Stroke:**

While the side effects of stroke are vast and dependent upon variables such as the type of stroke, the location of the stroke, and the age of the patient, it is evident that for many patients aquatic therapy is not only a viable option, but in many situations, a preferable option.

Studies have shown that many stroke patients maintain a fear of falling post stroke. While this fear can inhibit the patient’s participation in therapy sessions on land, often these patients feel much more comfortable with their level of stability in the water. Due to the increased density and buoyancy of water compared to air, the patient is given more time for error correction (due to decreased effects of gravity, etc.) when in the water as opposed to when on land. By decreasing the pt.’s fear of falling and increasing the pt.’s level of confidence, more progressive rehabilitation will be possible and earlier return to functional daily living may occur.

Many post stroke patients also prefer aquatic therapy over treatment on land due to the warm-therapeutic water temperatures associated with aquatic therapy and heated pools. This thermal effect works to relax the patient while also encouraging spastic and/or contracted muscles to relax at the same time.

There are many different aquatic therapy techniques that are utilized by therapist for patients post-stroke. Dependent upon the needs of the patient, aquatic therapy for post-stroke patients can include but is not limited to: therapeutic exercises for improvement of strength and flexibility, gait training, balance and posture training, manual therapy/joint manipulation, and proprioceptive training.

**Benefits:**

The unique properties of an aquatic environment provide buoyancy, support, and resistance for the patient to work with or against during treatment1. Aquatic physical therapy can be used for patients at any age with musculoskeletal, neuromuscular, cardiovascular/pulmonary, and CNS disorders.

The buoyancy of water has the opposite effect of gravity, creating an upward force on an object that is submerged. This property can act as an aid or a resistance tool to challenge one’s core musculature, strengthen, and improve stability.11 Buoyancy reduces weight bearing, allowing patients with weakness to focus on the sequence and coordination of gait and exercises rather than their fear of falling10,11.

The hydrostatic pressure of water decreases pain and edema, increasing range of motion. It also assists the heart by increasing venous return.11

The viscosity of water requires one’s muscles to work harder than they originally would on land in order to move through the resistance of the water. This includes the heart muscle, which increases cardiovascular fitness. This water resistance requires both sides of the body to work equally in order to maintain balance in the water, improving muscle balance. The resistance of water allows for objects to naturally move slower, therefore providing an ideal environment for neuromuscular reeducation, prolonging the time for motor correction after loss of balance or response to perterbations11.

Studies show that aquatic therapy is psychologically beneficial in decreasing stress and anxiety, increasing concentration, and improving feelings of well-being and confidence.10,11 It allows the patient to practice functional activities such as walking with minimal support and without an assistive device.

**Barriers:**

Many of the advantages to aquatic therapy can also cause safety risks for more involved patients. The buoyancy of water can reduce stability for both the patient and the therapist, making it difficult to provide assistance or hands-on correction.11 This can be especially dangerous for a patient with a stroke affecting the frontal lobe since they may have difficulties with cognition, attention, comprehension, and problem-solving. Furthermore, most patients after a stroke have a startle reflex. Each time they are perturbed, they are startled and lose their balance. When in an aquatic environment, they may experience this response often due to the constant current and turbulence of the moving water. Severe spasticity may be a hindrance to one’s ability to balance in the water. Spastic, flexed limbs tend to sink while flaccid, weak muscles often float.10 This may cause the patient to roll over in the water. Flotation devices are a helpful remedy to keep spastic extremities floating for improved balance during aquatic activities.11 Also, warming the water to about 93 degrees is helpful in diminishing involuntary spastic movements.11 Clinical judgment should be used to determine the suitability of aquatic therapy for the patient at hand.

One of the most common barriers to rehabilitation after stroke is post-stroke depression. 18-68% of patients experience depression following a stroke13. This high incidence begs the attention of therapist and should encourage the therapist to perform an assessment for depression, make referrals as necessary, and incorporate appropriate methods of positive motivation throughout the treatment session. Another common barrier is post-stroke fatigue. Statistics show that this fatigue occurs in 39% of patients after a stroke14. If a patient is experiencing post-stroke fatigue, aquatic exercises may be too demanding because of the extra resistance the water adds to exercises. However, passive movements such as Bad Ragaz and low intensity exercises may be beneficial for these patients due to the decreased weight bearing. In a study performed by Macko et al, patients with hemiparetic gait were treated with low-intensity aerobic exercise for six months. Results showed an improvement in cardiac function and a reduction in energy demands throughout the day. These authors predicted that these results would lead to prevention of deconditioning in patients with post-stroke fatigue.12

**Indications, Contraindications and Precautions of aquatic therapy:**

**Indications**

* Pain
* Gait deviations
* Immobility
* Weakness
* Dyscoordination
* Touch down weight bearing
* PT managed

**Contraindications**3

* Cardiac failure
* Urinary infections
* Open wounds
* Contagious skin rash
* Infectious dieses
* Uncontrolled bowel or bladder incontinence
* Vomiting
* Scabies or lice
* Severe burns
* Menstruation without internal protection
* Premature rupture of membranes in pregnancy
* Suprapubic catheter
* Nontunnel catheters: High risk for serious infection
* History of uncontrolled seizures
* Colostomy
* Unplugged G-tube

**Precautions**3

* Hypersensitivity to any sanitizing agents or chemicals used in pools
* Thermoregulatory problems
* Excessive fear of water
* Severely weakened or reconditioned state
* Compromised respiratory function and vital capacities
* Multiple sclerosis: water temperature above 88 degrees F may cause fatigue and stress
* Perforated eardrum
* Ostomy
* Intravenous lines: Cover with a transport dressing and plastic bag.
* Peripheral vascular disease
* Incipient cardiac failure
* Dysphagia
* Epilepsy
* Unstable high or low blood pressure
* Fever
* Inability to enter the pool on one’s own can also create a hazard.
* Dehydration

**Equipment/Resources Needed for Aquatic Therapy1,2**

1.    Facility – access to a therapy or community pool in a physical therapy office, at the YMCA, health club, etc.  
2.    The following equipment is suggested and may be beneficial, but is not necessary2:

* Swimsuit and additional items such as water shoes, neoprene vest, swim cap, earplugs, etc.
* Flotation belt
* Bar Bells – fillable
* Buoyant hand bars
* Ankle cuffs/weights
* Short-tipped fins/flippers
* Resistant bands/tubing/paddles
* Kickboards
* Mask
* Gloves
* Noodles
* Cervical collars
* Platforms

**Costs Associated with Treatment**

Costs of aquatic therapy will vary based on the program and facility, and may or may not be covered by insurance.  Aetna, for example, will cover aquatic therapy if it is administered by a licensed physical therapist, and is deemed medically necessary if progress is documented.  Maintenance programs are not covered.5 Medicare generally will cover aquatic physical therapy under the same guidelines, but each state and carrier is slightly different so it would be best to check with the specific Medicare Carrier (can be found through the APTA) to determine reimbursement guidelines prior to treatment.1

The CPT code for aquatic therapy is 97113. This is the only CPT code that explains the *environment* of therapy as opposed to the *type* of therapy. This code does not explain the intervention taking place in the water; therefore, many insurers have problems with this code as it is difficult to prove medical necessity for an extended period of time with a code that lacks explanation of treatment. Be aware that payers tend to pay special attention to this code.15

**Evidence Supporting Use of Aquatic Therapy for Patients Following Stroke**

1. A randomized controlled trial was conducted to evaluate the effect of an aquatic therapy program designed to increase balance and lower extremity strength in patients following stroke.  25 ambulatory stroke patients participated in the study, 13 people participated in an aquatic therapy group participating in a program consisting of Ai Chi and Halliwick methods, and 12 people participated in a conventional therapy group involving in traditional gym exercises.  Outcome measures used were the Berg Balance Scale, Weight-Bearing Ability, and secondary measures of muscle strength.  The aquatic therapy group attained significant improvements in Berg Balance Scale scores, weight-bearing abilities (forward and backward), and knee flexor strength as compared to the conventional therapy group.  There were other significant differences in the other measures of strength between the groups.9

2. A randomized controlled trial was conducted to evaluate the ability of an 8-week, water-based program and an upper-extremity function program to increase cardiovascular fitness for people post-stroke.  12 participants who were post-stroke and experiencing mild to moderate motor deficits participated in the study.  All subjects participated in 1-hour group exercise programs 3x/week for 8 weeks.  The experimental group exercised in chest-deep water maintaining a targeted heart rate.  The control group performed arm and hand exercise in sitting.  VO2max (cardiovascular fitness), maximal workload, muscle strength, gait speed, and Berg Balance Scores were the outcome measures for this study.  The experimental group gained significant improvements over the control group in VO2max, maximal workload, gait speed, and lower extremity muscle strength.  There was an average of 22% improvement in cardiovascular fitness in a small group of the participants who had relatively high function.4

3. A control case match study was conducted to compare the effects of hydrotherapy on spasticity and FIM scores of patients with spinal cord injury.  20 patients recovering from spinal cord injury participated in the study and were divided into 2 groups.  The control group received passive range of motion exercise 2x/day and oral baclofen for 10 weeks.  The experimental group received the same interventions, but with the addition of 20 minutes of aquatic exercise 3x/week.  Outcome measures used were spasm severity, FIM scores, oral baclofen intake, and Ashworth scales.  The experimental group demonstrated a larger increase in FIM scores, a decrease in oral baclofen intake and a larger decrease in spasm severity than the control group.7 Although this is a study of aquatic therapy for patients with spinal cord injury, spasticity is a common impairment for patients post-stroke as well, and aquatic therapy could be just as beneficial for these patients. Further research is necessary to determine effectiveness of aquatic therapy and reducing spasticity post-stroke.

4. 22 volunteers with chronic hemiparesis caused by stroke participated in a comparative gait analysis to investigate how the application of additional weight to the affected leg influences gait patterns during aquatic treadmill walking. Spatiotemporal and kinematic gait parameters were measured.  The use of the applied ankle weight on the affected limb reduced unwanted limb flotation on the paretic side during aquatic treadmill training.  It was also seen to increase the stance phase by approximately 3%, and therefore increasing stance stability. 6

5. In a study done to determine the effects of aquatic gait training on a variety of patients, significant improvements were found when an aquatic gait program was established three times per week for eight weeks. Patients after stroke improved their aerobic capacity, gait speed, strength of paretic limbs, and balance.16

**Translation to Practice:**

Determining the true effectiveness of aquatic therapy for patients after a stroke requires one to look into how well the literature and facts translate into practice. Based on the current literature, it is clear that aquatic therapy has been shown to be beneficial for patients during stroke rehabilitation. However, recreating these studies in the clinic is a difficult task. Few facilities have access to a therapeutic pool on site and those that do often don’t have the funds to provide all of the aquatic equipment that is used in these studies such as an underwater treadmill, aquatic assistive devices, or a lift for safe entrance and exit to and from the pool.

There are also a host of considerations one should note before recommending aquatic therapy for a patient. The water can be a very scary environment for some individuals, especially those who have decreased motor control. The patient’s fears and hesitations should be heard and respected when deciding whether or not aquatic therapy is a good treatment approach. The patient should be clear of all contraindications and the therapist should strongly consider any existing precautions. For example, a patient with high levels of spasticity may benefit from the warm water or may struggle in the pool due to a spasticity-created imbalance. Also, patients with severe cognitive effects from the stroke may put both themselves and the therapist at risk in an aquatic environment. The patient will need to have a swimsuit or have a family member that is willing to bring one from home. The therapist should consider that choosing to participate in an aquatic treatment session will reduce the total treatment time for that patient due to extra time needed for changing clothes, instruction to the patient, and transfer into and out of the pool. The therapist should also be sure that the payer source will cover the services. As mentioned above, many insurance companies require an explanation of medical necessity prior to reimbursement. Each of these items should be considered before choosing aquatic therapy as a treatment technique for a patient post-stroke.

Although some studies have concluded that aquatic therapy is beneficial in improving postural stability, cardiovascular fitness, gait speed, and strength of the hemiparetic limb in patients after stroke, not all studies demonstrated such positive findings. In a Cochrane review of the results of aquatic therapy during stroke rehabilitation, the authors were unable to conclude that aquatic therapy was effective for reducing disability; however, it was also unable to conclude that aquatic therapy was ineffective or harmful.18 The studies used had small sample sizes, findings of bias, and a lack of follow-up after the study.18 Therefore, it is impossible to say that a patient in the clinic will have the same results as a patient in one of these studies. One should consider the patient’s desires and clinical presentation when determining whether or not to use aquatic therapy as a treatment approach. After choosing this approach, continue to reevaluate the patient to ensure continuous functional improvements both for best practice as well as reimbursement concerns.

**In Conclusion:**

The aquatic therapy setting for a patient post stroke can be incredibly beneficial for improving functional impairments and limitations in the post-stroke patient.  That being said, it is important to keep in mind that a crucial part of aquatic therapy, especially when used with post-stroke patients, is the transfer of these practices to land.  This aspect of the therapy is often what is most challenging for the patients.  It is up to the therapist to utilize motor learning theories of practice transfer, feedback, etc. in order to create a program in which the pt. is able to transfer the information learned in the aquatic therapy setting to functional use on land.

Helpful Websites:

1. The APTA Aquatic Therapy Section: <http://www.aquaticpt.org/>
2. Keifer Aquatic Therapy Equipment: <http://www.kiefer.com/>
3. Demonstration of concentric strengthening of trunk using bad ragaz methods: http://www.youtube.com/watch?v=8ZNVyBfvT18

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