Differential Pediatric Diagnoses and Benefits of Aquatic-Based Interventions

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Combined Sections
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Pediatric Physical Therapist since 1995

Developed aquatic therapy programs for
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Pediatric Aquaticist℠ Instructor for Aquatic Therapy University (ATU)

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Aquatic Therapy Benefits for Many Pediatric Diagnoses

- Often least restrictive environment to address impairments and work toward achieving goals
Aquatic Therapy Benefits for Many Pediatric Diagnoses

- Patient preference
- Children are motivated in the water...play is a child’s work!!
Potential Benefits of Aquatic Therapy

- Increased sensory stimulation
- Fun and social interaction
- Improved relaxation
- Increased ease of movement
- Assistance of movement, balance and postural control
- Acquisition of group skills
- Turn taking
- Increased independence in the water
Physiological Benefits

- physical fitness
- psychomotor development
- motor performance
Physiological Benefits

- Perceptual-motor factors include:
  - balance
  - kinesthetic awareness
  - laterality
  - directionality
  - spatial relationships
  - visual and auditory discrimination
  - hand-eye and foot-eye coordination.
Psychological Benefits

- The benefits for an individual with a disability is the same as for the individual without a disability
  - Opportunity to do something well
  - Feeling of success
  - Building of a positive self-image
  - Chance to play and have fun
Social Benefits

- Peer group interaction, even with one to one therapy
- Self-help skills
  Ideal place to teach activities of daily living
  - Dressing
  - Showering
Potential Benefits of AT

- “As the child develops an ability to move and enjoy the water, he seems to improve his self-awareness and his inner self-esteem. The achievements of simple skills or moving on his own allows for a beginning sense of independence and accomplishment” (Martin).

- Moving around in the water inspires strong feelings of freedom in those that cannot move around without assistance on land.
Pediatric Aquatic Research

• Over the past decade there has been a substantial increase in the number of articles published on pediatric aquatic interventions.

• 3 recurring issues within the pediatric aquatics literature: (1) limited descriptions of the aquatic environment; (2) heterogeneity of studies; and (3) variety of outcome measures. It is hoped that future research will adopt the ICF as a conceptual framework to develop and guide the reporting of aquatic interventions.

• World Health Organization's 2001 International Classification of Functioning, Disability and Health (ICF) as a framework
Pediatric Aquatic Research

Source: Exploring the Aquatic Environment for Disabled Children: How We Can Conceptualize and Advance Interventions With the ICF

Andrea Cross, Peter Rosenbaum, Jan Willem Gorter

Critical Reviews™ in Physical and Rehabilitation Medicine, Volume 25, 2013, Issue 1-2
Aquatic Therapy Benefits for Individuals that are... Medically Fragile & Terminally ILL
Medically Fragile

- Often more severely involved
- Less active functional movement
- Often very little head control or active movement
- Benefit the most from aquatic therapy
Medically Fragile

- Frequently more challenging individuals to work with
- Hesitant to bring these kids/adults into the pool
Medically Fragile

- Once skills obtained to handle individuals appropriately and safely
- Clinicians quickly learn it is often the most appropriate environment
What type of therapy one is providing varies depending on clients' health status and functional abilities.
Parents often report direct benefits from aquatic sessions including:

- able to take longer nap
- more restful and deeper sleep at night for a few nights after an aquatic session
- less crying if the child tends to be fussy or in chronic pain
- parents reported: child was able to tolerate more painful medical procedures, including blood draws
Terminally ILL

- Goal of therapy - same as with all clients to improve function
- Function may be improving quality of life
- Maintenance is a truly functional goal
- Extremely severe providing palliative care providing end of life care
Terminally ILL

- In the US there has been an increased focus on improving palliative and end of life care for the elderly
- Few clinics, hospitals and therapist’s focus on providing care for children and their families with life threatening illnesses
- **Case example** - Those who are born without an expectation of survival but live a long time.
Terminally ILL

- Pediatric palliative care helps a child and family live as typically as possible
- Critical realization: palliative care is not just for the dying - it's about living well for as long as you can

- Benefits of palliative care include fewer trips to hospital, improved function and enjoyment of life and longer life for the terminally ill
Terminally ILL

- Palliative care can be provided concurrently with life-prolonging treatments. (Institute of Medicine, 2003)
- The aquatic environment is a very appropriate medium to address
  - pain management
  - assistance and improvement with breathing
  - bowel functioning
  - generalized muscle relaxation to aide in improving sleep and daily functioning
Terminally ILL

- Quote by Azevedo:
  “Providing palliative care in the aquatic environment is...medically beneficial, morally justified, community building enterprise.”
Aquatic Therapy Benefits for Individuals that have... Muscular Dystrophy
Muscular Dystrophy

- Aquatic medium offers distinct benefits to treat impairments:
  - Limited ROM
  - Limited active movement
  - Major predispositions to develop contractures and deformities (including of the rib cage)
  - Limited functional mobility,
  - Poor respiratory function
  - Discomfort or pain in joints
Muscular Dystrophy

- One major life threatening area for individuals with muscular dystrophy has to deal with respiratory compromise due to scoliosis and weakness of intercostal musculature
When body is submerged up to thorax in water...

- Vital capacity decreases by 6-9%
- Expiratory reserve volume (ERV) is reduced 11% of vital capacity
- Results in an increased amount of work necessary for breathing (mostly during inspiration) and one gets a conditioning effect from being in the water.

Becker (see references)
Muscular Dystrophy

- Pool is an excellent and very motivating environment to work on increasing respiratory function:
  - blowing bubbles
  - holding breath under water
  - swim strokes
  - immersion to chest level
Muscular Dystrophy

- The aquatic environment allows the individual to work on respiratory capacity and is, “the only environment in which they retain any sort of control as the disease progresses” - Fritsky
Muscular Dystrophy

- Due to the muscle weakness of muscular dystrophy, floating and swimming on the back tend to be the easiest and safest but the child also has to learn a recovery method. (Martin)
Muscular Dystrophy

- Sub maximal exercise is recommended to maintain function
- Caution is required to avoid the client reaching significant fatigue levels
- Rest periods should be incorporated
Muscular Dystrophy

- Pool is an excellent environment to provide active and passive range of motion as the warmth of the pool relaxes the muscles.
- Often more tolerant of stretching in the water due to the ability to have fun and also to relax while floating during active stretching.
Muscular Dystrophy - Research

• Several aquatic case-studies and non-experimental investigations published which found aquatic therapy helpful for individuals with MD but conclusions limited.
• Not a lot of high quality research even for land-based therapies
• Primarily investigating effects of exercise/therapy
The Relationship Between Aquatic Independence and Gross Motor Function in Children with Neuro-Motor Impairments

Purpose: Investigate the relationship between motor performance in the aquatic setting as measured by the Aquatic Independence Measure (AIM) to motor performance on land as measured by the GMFM and PEDI.
Getz et al
The Relationship Between Aquatic Independence and Gross Motor Function in Children with Neuro-Motor Impairments

• AIM is designed to measure performance rather than quality of movement. 22 items that are essential for achieving aquatic safety and independence.
• GMFM and PEDI: Considered the most reliable and valid instruments detecting functional change over time.
The Relationship Between Aquatic Independence and Gross Motor Function in Children with Neuro-Motor Impairments

- Aquatic Program 2x’s per week by adaptive aquatics instructor.
- Halliwick method – targeting functional independence in the water
- 20 minutes – practiced individually according to goals
Getz et al
The Relationship Between Aquatic Independence and Gross Motor Function in Children with Neuro-Motor Impairments

• Sample of 49 children with a range of functional abilities and aquatic function.
• Significant relationship with the total GMFM and the PEDI scores (p<.01 to p<.05)
• Significant relationship between GMFM/PEDI and water adjustment (AIM sub-scale)
Aquatic Therapy Benefits for Individuals that have... Cerebral Palsy
Cerebral Palsy

- Children and adults with CP often have limited range of motion, limited active movement, predispositions to develop contractures, high, low and fluctuating tone, limited functional mobility, and often discomfort or pain in joints.
- Therapy intervention focuses on addressing all these impairments and the aquatic medium offers distinct benefits.
Cerebral Palsy

- Neurodevelopmental techniques (NDT) focuses on increasing pelvic mobility, leg dissociation and trunk rotation and the pool is a great medium to address these areas.
Cerebral Palsy

- Individuals with CP have less voluntary movement control on land
- Viscosity allows more time for the body to receive feedback
- Time to make an appropriate motor response
Cerebral Palsy

- In water, tone is decreased and allows active strengthening to take place which frequently can’t occur on land.
Cerebral Palsy

- Greatest tool to normalize tone is weight bearing
- More involved clients often have difficulty weight bearing on land
  - UE
  - LE
- Buoyancy allows for weight bearing
Cerebral Palsy

- Concerns about safety and challenges with therapist’s ability to support the child appropriately on land
Cerebral Palsy

In water, the child with high spasticity/rigidity no longer weighs dramatically more than his typical counterpart and there is an “ease of handling” in the pool compared to land due to buoyancy.
Cerebral Palsy
S/P Ortho. Surgeries

- Prohibited from weight-bearing on land - at risk for muscle atrophy and deconditioning
- Often orthopedist’s do not think about this option - post operatively
- Allow partial weight bearing in a safe environment
- Exercises more comfortable then land based exercises
- Principle of **hydrostatic pressure** increases muscle pumping and decreases edema (need to be chest deep)
- Discuss with surgeon...
Cerebral Palsy

- Viscosity of the water allows individual to automatically make balance adjustments
- More opportunities to experience near falls and the ability to learn balance reactions and improve their motor planning
- Easier environment for repetition which promotes increased exercise intensity
Researchers have begun to examine the efficacy of exercise in water in individuals with CP. Few studies have quantified the energy requirements of physical activity in the water in individuals with CP. Prior to the Ondrak-Thorpe case study no previous studies have compared the physiological response of activities on land vs. water in the Cerebral Palsy population.
Ondrak-Thorpe case study

- Results suggested that water walking elicited a higher VO₂, oxygen cost, and caloric cost compared to walking on land.
- Not statistically significant due to small number in the study.
Ondrak-Thorpe case study

- Please note a higher VO2 max is not necessarily a bad thing
- Allows the client with CP to work harder aerobically in a controlled and often safer environment
- Results: Activities in the water should be performed at:
  - lower intensity
  - shorter duration
- Achieve the same response as on land
Thorpe, Reilley and Case

- Examined effects of an aquatic resistive exercise program on ambulatory children with CP.
- Results of 10 week study...
Aquatic resistive exercises did correlate with a gain in GMFM scores.

Positive trend between strengthening specific muscles and improving function.
Cerebral Palsy

- Speakers Case Report
- Individual with CP that walks with a crouched gait and requires a reverse walker
- Water to chest level able to walk independently
- “You walk with your legs not your arms!”
- Carry over to land...
Cerebral Palsy

- Individuals with CP, especially as teenagers and adults have major problems with joint integrity secondary to overuse syndromes related to contractures, postural alignment and generalized weakness
- Therapy and exercise in general in the water provides these individuals with more joint protection
- The aquatic environment can easily provide the individual with CP with a life long fitness practice
Pediatric Aquatic Therapy on Motor Function and Enjoyment in Children Diagnosed with Cerebral Palsy of Various Motor Severities

- Children with spastic CP
- Aquatic group or control group (total 24 participants)
- Single-blind, quasi –experimental study
- 12 weeks (One hour – 2 times per week)
- AT group improved GMFM (4.7 points) and generated greater enjoyment of therapy than conventional therapy, even for those with more severe CP (level IV)
- Did not translate into improvements in ADL’s and health related quality of life.
Aquatic Therapy Benefits for Individuals that have... Osteogenesis Imperfecta
Osteogenisis Imperfecta

- OI is a congenital disease that causes extremely fragile bones.
- Extremely weak bones puts them at risk for fractures and they tend to have multiple fractures.
- Additional characteristics:
  - Short stature
  - Chest deformities /scoliosis
  - Contributes to decreased vital lung capacity
Osteogenisis Imperfecta

“One disability area for which aquatics are especially beneficial – and in some cases essential...children with osteogenesis imperfecta ”

-Priest
Osteogenesis Imperfecta

- Logical place since it is contraindicated for the therapist to perform passive or even active assisted range of motion
Osteogenisis Imperfecta

- Aquatic medium promotes active movement from the infant/child in a safe environment.
- Water allows the child to explore movement and learn functional positions and developmental movements patterns.
- Carry over to their daily environments once they have strengthened their muscles, increased their balance and set up motor plans.
Osteogenesis Imperfecta

- Able to learn to roll and develop abdominal activation and trunk mobility at a much earlier age
- Often these children have fractures and weight bearing restrictions, so often water is the only appropriate choice!
Aquatic Therapy Benefits for Individuals that have... Spinal Muscular Atrophy
Spinal Muscular Atrophy

- SMA is a neuromuscular disease that attacks the motor neurons with resultant muscle atrophy and weakness.
- Four types of SMA with life expectancy ranging from young infant to typical adult life expectancy.
Spinal Muscular Atrophy

- Excellent medium - provides water assisted movement and the patient is able to move with a significant decrease in effort
- Valuable for clients at all levels of the SMA continuum
Spinal Muscular Atrophy

- Aquatic environment is extremely beneficial for individuals that have SMA Type I and II due to the fact that they have less physical mobility on land.
- Water provides an opportunity for more independent movement.
- Impacts the child’s respiratory system which is critical with this population.
Spinal Muscular Atrophy

- Children with type I and II have a lowered vital capacity. Working on breathing activities is very important in their therapy routine.
- Submerging the child up to their neck, the child has to breath against resistance of the water, which works the respiratory musculature.
- Critical that the treating therapist be aware and monitor the child closely to determine if they are able to handle this respiratory challenge.
- Modify by submerging the client less into the water or laying them in supine instead of in vertical.
Spinal Muscular Atrophy

- The pool is also a great environment to provide vestibular stimulation in a safe environment.
- For a more involved child this can be provided just by hold the child and walking him in a variety of directions, facing forward and backward and with gently bouncing while holding the child.
- Child with type I and often type II does not get an opportunity to experience these movements in the daily life
Spinal Muscular Atrophy

- A great environment to work on transitional movement patterns as often very challenging on land
Case study by Figures of a child with type I SMA

- Received aquatic therapy
- Did not show significant increases in active movement (of upper or lower extremity muscles)
- Continued to gain weight without decreasing active strength or movement out of the water which is generally seen with children with type I SMA
- Maintained the function he had prior to the aquatic therapy
- Parents reported increased ease of handling and carry over of active lower extremity movements during baths at home
Aquatic Therapy Benefits for Individuals that have... Rett Syndrome
Rett Syndrome

- Rett syndrome is a complex neurological disorder caused by genetic abnormality. Rett’s is a progressive disorder found mostly in girls.
Rett Syndrome

- Many benefits to AT at any stage of the child or adult with Rett’s life cycle.
- Most beneficial is to introduce the young child to the water and establish comfort and enjoyment of the water.
- As the individual experiences loss of mobility due to increased tone, weakness and decreased range of motion they will most likely continue to feel comfortable in the water.
Rett Syndrome

- Individual’s with Rett syndrome often have difficulty adjusting to new and different situations
- Critical to be patient and allow the child to become comfortable at their pace in order to promote a life long joy of the water!
Rett Syndrome

- Individual’s with Rett syndrome especially later in their life cycle have poor respiratory and cardiovascular functioning
- Just being immersed in the water is highly beneficial due to the hydrostatic pressure
- Able to achieve a higher level of relaxation and work on skills that have been lost on land
- Case examples
Rett Syndrome

- Exercising in the water in vertical with water up to or near chest level creates an open kinematic chain which does not exert pressure on the joints and allows for more joint protection.
- Often beneficial and at times critical as individuals with Rett’s usually have scoliosis and limited mobility in their low backs due to lack of functional mobility.
- Standing or walking in water may help slow down the progression of scoliosis due to the ability to assume and maintain a more upright posture while in the water.
Rett Syndrome

- Viscosity of the water allows the individual with Rett’s more time to adjust to balance challenges and gives them more time to self-correct and avoid loss of balance during transfers and gait.
Lotan et. al. “Aquatic physical therapy for Rett Syndrome: a practice report”

- Thorough description aquatic intervention goals during stage III and IV
  - Improved relaxation of mood swings
  - Improved respiration
  - Improved hand function
  - Improved social skills
  - Sensory retraining
  - Improved transitional movements
  - Preventing/Reducing musculoskeletal abnormalities
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