If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

This handout is for reference only. It may not include content identical to the powerpoint. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.
Aquatic Therapy for Those With Spinal Cord Injuries

Created by Rachel Mertins, PT, DPT

www.kennedykrieger.org

Objectives

Part 1: Overview

- Define spinal cord injury (SCI) and list typical effects and complications associated with the diagnosis

- Describe the properties and benefits of aquatic therapy and how they can be applied to those with SCI

- Identify indications, contraindications, and precautions for aquatics with those suffering from SCI
Objectives
Part 2: Treatment Options

- Explain various treatment options for those with SCI in an aquatic environment including:
  - Tone Management
  - Stretching
  - Strengthening
  - Balance training
  - Swimming
  - Functional mobility training
  - Gait training
  - Aquatic locomotor training

Objectives
Part 3: Research

- Review current evidence based practice for SCI and aquatics in the neurological population

- Discuss the gaps in recent literature regarding aquatics and SCI

- Brainstorm ways in which one can add to the literature
Aquatic Therapy for SCI
Part 1: Overview

Spinal Cord Injury Defined

- A spinal cord injury is defined as damage to one’s spinal cord from either traumatic or non-traumatic origin\(^1\)
  - Traumatic: fall, diving, motor vehicle accident, violence
  - Non-traumatic: pathology such as Transverse Myelitis (TM), Neuromyelitis Optica (NMO), Guillan-Barre Syndrome (GBS) etc.

- In the United States, there are \(~12,000\) SCI’s every year with \(270,000\) individuals said to have been living with the diagnosis in 2012.\(^2\)
Common SCI Effects

• Typical effects associated with SCI are:
  – Decreased strength
  – Spasticity (upper motor neuron) or flaccidity (lower motor neuron)
  – Impaired sensation
  – Respiratory changes
  – Loss of bowel and bladder control
  – Disrupted genital function
  – Decreased cardiovascular control
  – Thermoregulation disruption

Common SCI Complications

• Complications linked to SCI are:
  – Pressure ulcers
  – Respiratory complications
  – Decreased range
  – Heterotopic ossification
  – Osteoporosis and fractures
Common SCI Complications Continued

- Complications linked to SCI are:
  - Pain
  - Gastrointestinal (GI) and urinary tract complications
  - Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE)
  - Autonomic Dysreflexia (AD)
  - Cardiovascular Disease

The Most Common SCI Goal

- The main goal among those with SCI is TO WALK
- The effects and complications mentioned can result in:
  - Many compensatory strategies & movement deficiencies
  - Limiting their ability to functionally ambulate
- The properties of the water can enhance a PT(A)s’ ability to address patient impairments in a safe, body weight supported, environment.
- When a patient is a more active vs. passive participant in therapy, larger performance improvements result.
Properties of Aquatic Therapy

- **Buoyancy**
  - Creates a medium for partial body weight support
  - Can assist, resist, or support movement

- **Hydrostatic Pressure**
  - Increases venous return and circulation

- **Resistance**
  - Velocity of movement used for strength and balance training in addition to postural awareness
  - Viscosity allows for a longer response time

- **Temperature**
  - Therapeutic water between 91-95 degrees

Therapeutic Benefits of Aquatic Therapy

- **Promotes muscular relaxation**
- **Assists in edema control**
- **Reduces pain sensitivity**
- **Decreases muscle spasm**
- **Increases ease of joint movement**
- **Increases muscle strength and endurance**
- **Reduces gravitational forces**
- **Increases peripheral circulation**
Therapeutic Benefits of Aquatic Therapy

Continued\(^{10,11,12}\)

- Improves respiratory muscles
- Improves body awareness and balance
- Improves proximal trunk stability
- Improves patient morale and confidence
- Enhances cardiovascular function
- Increases motor output via sensory stimulation of nerve receptors in skin
- Potentially encourages plasticity via motor and sensory stimuli

Added Benefits of the Underwater Treadmill\(^{11}\)

- The absence of a harness:
  - Promotes more natural gait patterns
  - Better challenges one’s balance
  - Decreases the chance of skin breakdown

- Off-weighting is provided for all body parts submerged
  - Land-based harness systems off-weight only the body
Common INDICATIONS for Aquatics with SCI

- Weakness
- Gait abnormalities
- Tightness
- Postural abnormalities
- Pain
- Edema
- Compromised balance
- Impaired function and mobility

CONTRAINDICATIONS for Aquatics with SCI

- Communicable disease risk to others
- Active diarrhea
- Stage IV wounds
- Central lines
- Accessed ports
- Ventilators*
- Diaphragmatic pacers
PRECAUTIONS for Aquatics with SCI

- Multi-drug resistant organisms
  - May attend as long as no signs/symptoms present

- Open wounds
  - Must be covered with waterproof bandage

- Seizures
  - >5 minutes should be seizure free for >/= 1 month and require physician clearance

- Incontinence
  - Diaper and rubber pants required

PRECAUTIONS for Aquatics with SCI
Continued

- Ostomy
  - Must be fully healed, empty and clean
  - Secured seal, picture frame taped with waterproof dressing

- Tracheostomy
  - Must tolerate capping or Passe-Muir valve usage for >/= 4 hours
  - Stoma must be free of scabbing/infection/drainage
  - Splashing/turbulence should be minimized
  - Water no deeper than T4
  - Respiratory therapist present pool side, attending physician on call
  - Patients arrive with suction, extra trachs, and ambu bag
Aquatic Therapy for SCI
Part 2: Treatment Options

Percentage of Body Weight Supported\(^8, 13\)

- **NECK LINE:**
  - 90% Buoyant, 10% weight bearing (WB)

- **NIPPLE LINE:**
  - 75% Buoyant, 25% WB

- **WAIST LINE (ASIS):**
  - 50% Buoyant, 50% WB

***NOTE***
with activity/when moving, body weight support should be considered one level up from the listed values (e.g. in order for a moving patient to be 50% WB, the water level should be at his/her chest)
Equipment: HydroWorx Pools

- Elevating floors
- Underwater treadmill
- Video monitoring
- Jets
- Removable parallel bars
  - 1 horizontally placed
  - 1-2 vertically placed

Equipment
Tone Management

- Warm water decreases muscle tone\textsuperscript{14}

- Influencing tone and pain through vestibular system activation\textsuperscript{15}
  - Rotational trunk movements
  - Gentle, whole body, rocking

- **Watsu**
  - Rhythmical rocking
  - Passive stretching
  - Breath
  - Use water, little-no equipment
  - Intimate, gentle touch

- **Ai Chi**
  - Movement patterns
    - Symmetric$\rightarrow$ asymmetric$\rightarrow$ weight shifting
  - Diaphragmatic breathing

VIDEO 1: Scapular Walking & Tone Reduction

www.kennedykrieger.org
Stretching

STRETCHING

- Beneficial with therapeutic pool temperatures

- Easier and/or more tolerable to get patients into stretching positions

- Pool equipment can be used to do the stretch

Standing hip flexor stretch

Stretch for Shoulder Adductors, Internal Rotators & Lateral Trunk Flexors
VIDEO 2: Prone Prop With Hip Flexor Stretch

Strengthening

• Modified planks
  – Over bench
• Tall kneeling
• Tall kneel walking
• Half kneeling
• Quadruped

*Protect knees/feet from skin irritation

• Proprioceptive neuromuscular facilitation (PNF)
  – Bad Ragaz
  • 3-D, diagonal movements
  • Horizontal positioning, supported by rings or floats
  • PT(A) stabilizes, patient moves through the water
  • Muscular strength, endurance, core stabilization
VIDEO 3: Scapular Retraction and Depression

VIDEO 4: Half Kneel for Core Strength
Balance Training

**Sitting balance:**
- Over bench, saddle board, V board
- While propelling through water

**Standing balance:**
- Bilateral, tandem, single limb stance
- Over noodle

Aquatic therapy allows for increased response time & assists balance control

**Sitting and standing balance:**
- Against jets
- With overhead activities
  - Ball toss, reaching

---

VIDEO 5: Sitting balance & Core Strengthening

CONTINUED™
Modified Swimming

• Modified strokes post SCI:
  – Inexperienced swimmer:
    • Elementary backstroke
    • Prone doggie paddle
      – With/without snorkel
    • Adjusted backstroke and/or breaststroke
  – Experienced swimmer:
    • Freestyle
    • Backstroke
    • Breaststroke
    • Butterfly

• Halliwick Method[12]
  – Emphasis:
    • Mental adjustment
    • Balance control
    • Movement
  – 10 point system
    • Mental adjustment through breath control
    • Rotational control and balance
    • Progression to basic swimming

VIDEO 6: Elementary Backstroke
Safety Techniques

- Floating
  - Prone float
  - Supine float

- Rolling and transitions
  - Prone to supine
  - Supine to sit and/or stand as applicable
  - "Halliwick method"

- Swimming and/or walking
  - To edge of pool

VIDEO 7: Safety
Functional Mobility Training

- Transfer training
  - Floor & sit to/from stand
  - Wheelchair to/from mat/bed/car
    - Even & uneven

- Bed mobility training
  - Rolling, scooting
  - Sit to/from sidelying to/from supine
  - Supine to/from

- Activities of daily living (ADL)
  - Bathing, dressing, feeding, grooming, hygiene
  - Instrumental ADLs
    - Food prep, child rearing, shopping, etc.

- Stair training
Gait Training

- Toe/heel walking
- Backwards
- Sidestepping
- Karaoke
- High knee stepping
- Heel kicks
- Turns
- With resistance shoes
- Walking lunges
- Against turbulence
  - Jets vs. manual
- While talking
- While catching and/or throwing a ball
- Over obstacles

VIDEO 11: Sidestepping
VIDEO 12: High Knee Stepping

VIDEO 13: Walking With Resistance Shoes
Aquatic Locomotor Training (ALT)

- ALT utilizes the principles of locomotor training from the Neurorecovery Network and applies them to the aquatic setting.
- May require up to 3 people
- Therapists are highly trained, using their legs and feet to provide properly timed underwater cues through the gait cycle
- Lifeguards present poolside & video monitoring available

Overground LT

- Encompasses a variety of interventions
  - Improves postural control, balance, standing, walking, health and quality of life for those with neurological impairments
  - Not enough evidence that one particular LT strategy enhances walking recovery over any other
- Can require many staff members to perform
- Is potentially associated with wounds, pain, injuries, and excessive fatigue
LT Principles Applied to Aquatics

- Maximize weight bearing on the legs
  - Minimize upper extremity (UE) support
  - Inversely related to the level of water

- Optimize sensory cues
  - Use proper feet placement to facilitate
  - Underwater treadmill speed tends to be slower than over land

- Optimize kinematics for each motor task
  - Optimize posture and alignment
  - Utilize visual feedback via video monitoring

- Maximize recovery; minimize compensation
  - Continuously monitor the need for UE support and the water level

Hand Placement for Hips

- Hip technique for:
  - Stabilizing pelvis
  - Cueing weight shift and pelvic rotation
Feet Placement for SWING Phase

- LE technique for swing phase of gait:
  - Cueing anterior tibialis tendon and
  - Medial hamstring tendon

Additional Feet Placement for SWING Phase

www.kennedykrieger.org
Feet Placement for STANCE Phase

• LE technique for stance phase of gait:
  – Cueing patellar tendon and
  – Back of heel

Additional Feet Placement for STANCE Phase
Aquatic Therapy for SCI  
*Part 3: Research*

- Demonstrates the positive effects of underwater treadmill training, for improved leg strength, balance, and walking function in adults with incomplete SCI.\(^{20}\)

- Results suggest the effects of aquatic exercise on pulmonary function in patients with SCI were significantly higher in the aquatic group vs. the land based group.\(^{21}\)
Current Research for Aquatic Therapy for the Neurological Population

- Mobility improvements for those with neurological disease:
  - Fair evidence that aquatic therapy is effective in improving dynamic balance and gait performance
  - Lack of strong evidence that aquatic therapy is more beneficial than land therapy

- Significant effects found on the gross motor function of children with cerebral palsy following aquatics.
  - Improvements in water skills also noted

Current Research for Aquatic Therapy for the Neurological Population Continued

- Aquatic lower extremity proprioceptive neuromuscular facilitation (PNF) enhances balance and activities of daily living in patients with stroke.

- Halliwick method can be a useful tool for balance gains in the stroke population, but may not have significant influences on quality of life.
Gaps in Recent Literature

- Lack of evidence for aquatic therapy, particularly for those with SCI

- “Aquatic intervention is one of the most popular supplementary treatments for children with neuro-motor impairments…but there is a lack of evidence-based studies documenting the effects.”\(^{22}\)

How Can PT(A)s ADD to the Literature?

- Case reports
  - Must justify the use of a single case
  - Do not test hypotheses
  - Do not establish case/effect relationships
  - Retrospective vs. prospective
How Can PT(A)s ADD to the Literature?  
*Continued*

- **Case reports**
  - Retrospective example:
    - *Journal of Aquatic Physical Therapy*
      - Application of Aquatic Therapy to a Land Therapy Program Emphasizing Gait and Balance Training in an Adult with Neuromyelitis Optica: A Case Report
  - Prospective example:
    - Evaluate the efficacy of ALT compared to overground LT for gait and quality of life with SCI

- **7 focus-based case report formats per Physical Therapy Journal**
  - Diagnosis/prognosis
  - Clinical measurement procedures
  - Intervention
  - Application of theory to practice
  - Risk management
  - Administrative/educational process
  - “Full” traditional case report
THANK YOU!

QUESTIONS?
REFERENCES


REFERENCES


