Disorders of Consciousness: A Comprehensive Treatment Approach

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Disclosure / COI Statement

We have the following relevant relationships in the products or services described, reviewed, evaluated or compared in this presentation.

Relevant Financial Relationship(s)

- TIRR Innovations Grant
  - Use of the Body Weight Support Treadmill in the Minimally Conscious Patient: Effects on Arousal, the Cardiopulmonary System, and Response to Multi-Sensory Stimulation
  - Principal Investigators: Kelly Betts, PT, DPT and Patrice Perrin, PT, DPT

- TIRR Memorial Hermann Employees
  - Kelly Betts, PT, DPT, NCS
  - Kristen M. Ferguson, M.A. CCC-SLP

Relevant non-financial relationship(s)

- No relevant non-financial relationships to disclose
Course Objectives

1. Overview of Disorders of Consciousness (DOC)
   - Describe the Coma Recovery Scale – Revised (CRS-R) and its limitations
   - Explain the use of Individualized Quantitative Behavior Assessments (IQBAs)

2. Discuss importance of assessment in this population
   - Describe the Coma Recovery Scale – Revised (CRS-R) and its limitations
   - Explain the use of Individualized Quantitative Behavior Assessments (IQBAs)

3. Interdisciplinary Goal Planning
4. Interdisciplinary Interventions
5. Discharge Planning

Conscious behavior is often subtle and inconsistent in the aftermath of a severe brain injury.

It must be systematically differentiated from reflexive or random behaviors.
The Trans-disciplinary Team Approach

- Input from many disciplines regarding patient’s abilities, well-being, and overall care.
- Important to bridge all of the various medical and paramedical disciplines.
- Critical to include the family as part of the team.
- Need multiple observers at different times of day.

<table>
<thead>
<tr>
<th>PM&amp;R Physician</th>
<th>Clinical Neuropsychologist</th>
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<tr>
<td>Speech-Language Pathologist</td>
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<td>Occupational Therapist</td>
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<td>Social Worker</td>
<td>Chaplain</td>
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<td>Family</td>
<td>Patient</td>
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Diagnostic Accuracy

- The literature suggests that approximately 40% of patients are erroneously assigned a diagnosis of VS.
- Standardized behavioral assessment is a much more sensitive means of establishing a diagnosis than clinical consensus.

Schnakers et al. BMC Neurology 2009

Standardized Assessment

Neurology 2009
Behavioral Assessment

• Behavioral observation constitutes the major tool for detecting signs of consciousness.

• Distinction between arousal vs. consciousness:
  – Arousal is necessary, but insufficient, for consciousness.
  – The repertoire of behaviors available for assessment of conscious awareness may be dramatically diminished.

Neurobehavioral Assessment of Disorders of Consciousness

Scales with acceptable standardized administration and scoring procedures:

- Coma Recovery Scale-Revised (CRS-R)
- Sensory Stimulation Assessment Measure (SSAM)
- Wessex Head Injury Matrix (WHIM)
- Western Neuro Sensory Stimulation Profile (WNSSP)
- Sensory Modality Assessment Technique (SMART)
- Disorders of Consciousness Scale (DOCS)
- Coma/Near-Coma Scale (CNC)

Coma Recovery Scale – Revised

• The CRS-R was developed in 1991 and revised in 2004.
• The CRS-R assists with:
  – Differential diagnosis.
  – Prognostic assessment.
  – Treatment planning.
• Contains 23 Items that comprise 6 subscales.
• Standardized scoring is based on the presence or absence of operationally defined behavioral responses to specific sensory stimuli.
Who is Appropriate?

- Patients who range from Rancho Level II to V:
  - Level II: Generalized Response:
    - Begin to respond to stimuli but slow, inconsistent, or delayed.
    - Responses tend to be similar irrespective of stimulation.
  - Level III: Localized Response:
    - Increased movements and reacts more specifically to stimuli (e.g., turns toward sound, withdraws from pain).
    - May begin to respond inconsistently to commands and yes/no questions.
  - Level IV: Confused and Agitated
  - Level V: Confused and Inappropriate

Coma Recovery Scale-Revised Subscales

Baseline Observation

- Purpose:
  - Determine level of arousal.
  - Facilitate selection of appropriate commands.
  - Help differentiate volitional from random/coincidental movements.
- Observe for one minute and record observations:
  - Resting posture of extremities, eye opening status, presence/absence of spontaneous visual fixation or tracking, type/frequency of spontaneous movement.
  - If no eye opening, perform the arousal protocol.
Visual Function
- 5: Object Recognition *
- 4: Object Localization – Reaching *
- 3: Visual Pursuit *
- 2: Fixation
- 1: Visual Startle
- 0: None

Auditory Function
- 4: Consistent Movement to Command *
- 3: Reproducible Movement to Command *
- 2: Localization to Sound
- 1: Auditory Startle
- 0: None

Oromotor/Verbal Function
- 3: Intelligible Verbalization
- 2: Vocalization/Oral Movement
- 1: Oral Reflexive Movement
- 0: None

Motor Function
- 6: Functional Object Use *
- 5: Automatic Motor Response *
- 4: Object Manipulation *
- 3: Localization to Noxious Stimulation *
- 2: Flexion Withdrawal
- 1: Abnormal Posturing
- 0: None/Flaccid

Arousal Scale
- 3: Attention
- 2: Eye Opening without Stimulation
- 1: Eye Opening with Stimulation
- 0: Unarousable

Communication Scale
- 2: Functional – Accurate *
- 1: Non-Functional – Intentional *
- 0: None
Limitations and Medical Complications

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<tr>
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<tbody>
<tr>
<td>Post-traumatic Epilepsy</td>
<td>Dysautonomic Storming, tachycardia, blood pressure changes, fever</td>
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<tr>
<td>Spasticity and Posturing</td>
<td>Arousal Deficits</td>
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<tr>
<td>Hydrocephalus</td>
<td>Attention Deficits</td>
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<td>Tracheostomy and secretion management</td>
<td>Apraxia</td>
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<td>Bruxism</td>
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Individualized Quantitative Behavioral Assessment (IQBA)

- Due to the variability of this patient population, individualized assessments are needed to more formally assess a patient’s response.
- Complements standard neurobehavior assessments, such as the CRS-R
- Advantage is that this address the particular questions and behaviors of concern to family members and clinicians
- Differences in the frequency of the target behavior can be assessed statistically to determine if the rate of occurrence is significantly greater in one condition relative to others.

IQBA

Command Following Protocol
- Establishes a method for consistently and accurately assessing a patient’s ability to follow commands.
- General data recording is not sensitive enough to show if patient is becoming more consistent over time.
- Ambiguity regarding command-following responses in DOC patients:
  - Voluntary, involuntary, and reflexive responses.
  - Reliability issues (false positive data recording).
- Important for treatment: a starting point for communication.

Vision Protocol
- Visual functioning is one of many areas used to assess a patient’s level of consciousness.
- Clinical questions regarding the status of the visual system may arise.
- Vision is a critical channel for acquiring information, especially in the DoC population because exploring and manipulating the environment can be limited.
Command Following Protocol

- Determine the command
- Setup of IQBA with team collaboration
- Collection of data
- Review of results
- Integrate into treatment plan

VP Methods

- Similar to Command Following Protocol, set-up and assessment are individualized to the particular patient.
- Stimuli:
  - Glossy, color, meaningful photo.
  - Plain white card the same size as the photo
- Procedure:
  - Patient shown unilateral stimulus or bilateral stimuli.
  - **Yes Response**: first lateralized eye movement after presentation.
  - **No Response**: No eye movement within 5 seconds.

Data Pattern for VP

<table>
<thead>
<tr>
<th>Stimulus (left/right)</th>
<th>Looks Left</th>
<th>Looks Right</th>
<th>No Response</th>
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<tbody>
<tr>
<td>1. Photo/___</td>
<td>9</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>2. ___/Photo</td>
<td>1</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>3. Card/___</td>
<td>12</td>
<td>4</td>
<td>16</td>
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<tr>
<td>4. ___/Card</td>
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<tr>
<td>5. Photo/Card</td>
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<tr>
<td>6. Card/Photo</td>
<td>4</td>
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<td>9</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>28</strong></td>
<td><strong>89</strong></td>
<td><strong>75</strong></td>
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IQBA Conclusions

- Command Following Protocol and Vision Protocols are examples of IQBAs.
- Command-following and vision protocols are aspects used in assessing level of consciousness.
- Command-following is central to ensuring the modality of treatment intervention matches patient’s abilities:
  - It can also help to facilitate family members’ understanding of observed behaviors (e.g. volitional versus involuntary/spontaneous).
- Vision protocols assist in helping determine if a patient has gaze preference, field cut, neglect, etc.
- Quantitative data can identify and validate subtle patterns we do not pick up on as clinicians.

Pain Assessment

- Biofeedback (vitals)
- NCS-R (Chatel et al.)

Affective Responding
Affective Responding

- Often forgotten during assessment but also very powerful.
- Frequently reported by family.
- Environmentally contingent affective responses are a sign of conscious awareness:
  - May require an IQBA to assess.
  - Standardized neurobehavioral assessments do not quantify this area.

Therapy Goals

PT/OT Goals

- Assess level of consciousness
- Positioning in wheelchair and bed
- Spasticity Management
- Standing Programs
- Equipment trials
- Establishing a home program
- Initiate intensive mobility program
- Family/Caregiver Training
- Manage medical issues with medical team
OT/PT Goal Examples

**Positioning Goals:**
- Pt will tolerate bed positioning to inhibit abnormal tone, maintain alignment, and prevent skin breakdown
- Pt will tolerate wheelchair positioning to inhibit abnormal tone, maintain alignment, and prevent skin breakdown

**Neuromuscular Goals:**
- Pt will have increased ROM in ankle via serial casting to improve alignment in preparation for weight bearing with functional tasks.
- Patient participates in activities to facilitate increased postural and motor control throughout UEs/LEs/trunk/head in preparation for participation in functional mobility and ADLs
- Pt will participate in a standing program for...

OT/PT Goal Examples

**Discharge Planning Goals:**
- Patient/family will be trained in all aspects of patient's care,
- Patient/family has necessary equipment and supplies and/or generated prescriptions prior to time of discharge.
- Patient will have written and/or verbal home program prior to discharge.

PT/OT Treatment Options

- Pain assessment and management
- Spasticity assessment and management
- Head/trunk control
- Identifying movement for command protocols
- Surface EMG
- Vestibular assessment and treatment
- Positioning programs: bed and w/c
- Splinting and casting for ROM and/or positioning
- Standing program
- Trying various positions/activities to promote increased arousal and consciousness
- Prone, tall kneeling, quadruped, standing, walking
- Responses to multisensory stimulation
- Co-treats with MT and TR to improve responsiveness
- Equipment trials
- Caregiver/Family training
- Establishing an extensive home programs and modifying
Spasticity Management

• Conservative management
  – Casting
  – Splinting
  – w/c and bed positioning
  – Stretching
  – Inhibitive techniques
• Medical management
  – When the above techniques aren’t adequate or are no longer working
  – Oral medications
  – Injections/Neurolytics
  – Intrathecal Baclofen (ITB) pump

Casting

• Indications for casting:
  – Decreased ROM
  – To maintain proper alignment
  – Reduce motion at joints to counteract effect of spasticity
  – Improve:
    • Function
    • Hygiene
    • Cosmesis
  – Skin integrity

Positioning: In Bed

• Goals:
  – To maintain neutral alignment
  – Minimize the effects of spasticity
  – Decrease risk of skin breakdown
• Props: foam, casts/bivalves, splints
• Consider:
  – Position: side-lying is considered the most neutral position for spasticity
  – How they can be used in more than one position
    • They need to roll every 2 hrs
  – User friendliness
    • Can nursing and/or family implement your program?
Positioning: In Bed (cont.)

- Specific examples:
  - Adductor wedges
  - Foam blocks to inhibit extensors spasms of LEs.
  - Pillows between arms and trunk
    - If too strong consider foam here as well
  - Bivalves vs. PRAFOs vs. custom orthotics
    - When to consider ordering custom orthotics
  - UE bivalves and splints

Bed Positioning

Bed Positioning
Positioning

Positioning: In W/C

• **Goal:** Attempt to achieve neutral midline alignment while maintaining function
  – May not be 100% ideal but what is a good compromise to allow them to be functional and prevent skin breakdown/contracture/compensation.
• **Props:** lap tray, angle adjustable foot plates, foam build ups, inserts for trunk or pelvis, straps

W/C Positioning
Short term vs. long term

• Short term:
  – Foam, straps, bi-valves

• Long term
  – Custom orthotics, custom wheelchair
    • NOTE: Is their positioning going to change with spasticity management?
    • The patient may not be appropriate for a custom orthotic if they are receiving Botox or an ITB pump

OT/PT Treatment Options: Proprioceptive Feedback

Developmental positions
• Weight bearing
• Quadruped
• Tall kneeling
• Prone
• Standing

(Co-treats are important)

OT/PT Treatment Options: Electrical Stimulation

• Various uses:
  – To prevent atrophy in an acute care setting
  • Hirose et al:
    – 700-4000mA, 30 min daily, BLES (flexors and extensors)
    – Acute care setting; starting 7 days after admission
    – Performed weekly for 6 weeks
    – Result: effective in preventing disuse atrophy in pt's with DOC
  – To improve arousal
  • Right Median Nerve stimulation:
    – Shown to cause earlier arousal from coma
    – Inconsistently shown to improve functional and cognitive outcomes
    – Coas 2014

• FES
  – Decreases spasticity
  – Prevent muscle atrophy
  – Provides sensory input
OT/PT Treatment Options: Standing Program

• Elliott L, Coleman M, Shiel A, et al. demonstrated Improvement in behavioral responses in those in vegetative and minimally conscious states.

• Study states that patient experienced increased arousal at 85 degrees on a tilt table vs. supine in bed
  – Great reason to co-treat with SLP

OT/PT Treatment Options: Ambulation

• Progression from standing
• Automatic motor activity, thus may see:
  – Increased arousal
  – Increased muscle activation
  – Improved responsiveness to stimuli
• No literature present on use of ambulation in those with DOC, though it seems a natural progression from a standing program
• Con: difficult and labor intensive; maintaining safety while optimizing movement patterns

OT/PT Treatment Options: Body Weight Supported Treadmill Training (BWSTT)

• Benefits:
  – Increased repetition of a task-specific activity (motor planning principles)
  – Earlier opportunities for weight bearing
  – Improve strength
  – Reduce spasticity
  – Decreased burden on therapist; allowing for focus to be on facilitating various components of gait
    • Improve safety when working with those with significant functional impairment
• Allows for improve safety and mechanics when ambulating with the DOC population
OT/PT Treatment Options: BWSTT (cont)

• VERY limited evidence when studied in the TBI population with inconsistent reports in its efficacy
  • Lapitskaya, Nielsen, Fuglsang-Frederiksen (2011)
    – No changes in EEG following robotic gait training in pts with severe TBI
    – Might be an indicator of the severity of the brain injury/dysfunction
  • In case studies with TBI, it has shown:
    – Improve cardiorespiratory capacity
    – Improve efficiency of gait
    – Increase gait speed
    – Decrease use of assistive devices
• Supported in the literature in those with SCI and CVA (Tefertiller et al 2011)

OT/PT Treatment Options: BWSTT (cont.)

• Research has demonstrated that it is not superior to standard gait/over-ground training
  – However, it is shown to be an effective treatment modality
• This suggests it should be used in a progression:
  – Transitioning from BWS/robotic gait training to traditional over-ground training as is safe and effective
  – Use those clinical reasoning skills: to optimize gait mechanics, weight bearing, repetitions
  – Progress from a more restrictive environment to a less restrictive environment when appropriate
Caregiver Training

• Importance
  – Almost all caregivers of a study stressed the importance of being informed about their relatives’ health condition, being able to take care of them, being involved in decisions that affect their relatives and easily communicating with operators of the treating team (Leonardi, 2012)

Caregiver Considerations

• Interventions should be aimed at minimizing caregiver burden and developing individualized disability management programs.

  • Therapists working with this patient population should consider the needs of the individual patient in the context of their family/care environment and recognize ease of care-giver burden as a meaningful outcome.

  (Wheatley-Smith, 2013)

Caregiver Considerations

• As care-giving is a long-term commitment process, support to the caregiver should be guaranteed throughout the duration of the relative’s disease

  • Early involvement of caregivers in a comprehensive process of care should be guaranteed by healthcare supporting programs

  (Giovannetti, 2012)
Equipment

- Things to consider ordering:
  - Hospital Bed and Mattress (Group 1 and 2)
  - Tilt in space w/c and cushion
  - Hoyer lift with slings
  - Ramps
  - Tilt in space shower chair
  - Inflatable tub
  - Orthotics (solid vs articulated)
  - Standers

SLP Goals

- Assess level of consciousness
- Auditory Comprehension
- Verbal Expression and Voice
- Swallowing & Secretion Management
- Attention/Arousal
- Family/Caregiver training and home program
- Manage medical issues

SLP Goals - Inpatient

- Goals for first 2 weeks (geared more toward the inpatient setting)
  - Oral Care Training
  - Passive oral motor exercises/swallowing via TTS using lemon swabs
  - Trach Management PMV/Trach cap toleration
  - Voicing
  - Attend to environmental stimuli
  - Understand patient’s visual perceptual ability
  - Identify best communication modality for yes/no response
  - Possible MBSS if indicated or FEES to assess how patient is managing secretions and possible PO trial tolerance.
SLP Goals - Inpatient/Outpatient

- Auditory Comprehension
  - Patient will follow 1-step simple commands with 30-50% accuracy with max cues.
  - Patient will establish consistent yes/no communication system
- Verbal Expression
  - Patient will voice to command 1-3 times in a 60-minute session with max cues.
- General Health
  - Complete instrumental swallow assessment as appropriate (FEES/MBSS)
  - PMV/Trach occlusion trials
- Attention
  - Patient will maintain eye opening for a 60-minute session over 3 consecutive sessions.

SLP Example Goals

- Comprehension/CRS-R Auditory Function
  - Long Term Goal:
  - Patient will demonstrate consistent movement to commands.
  - Short Term Goals:
  - Patient will demonstrate localized response to auditory stimulation with ____% accuracy given max cues.
  - Patient will follow 1-step commands with ____% accuracy per session with max cues.

- Comprehension/CRS-R Motor Function
  - Long Term Goal:
  - Patient will demonstrate functional object use.*
  - Short Term Goals:
  - Patient will respond to/follow 1-step commands with ____% accuracy per session with max cues.
  - Long Term Goal:
  - Patient will demonstrate functional communication.*
  - Short Term Goals:
  - Patient will establish yes/no communication modality with given max cues and modeling.
  - Patient will answer egocentric yes/no questions using establish yes/no communication modality with ____% accuracy with max cues.
SLP Example Goals

• Comprehension/CRS-R Communication
  - Long Term Goal:
    • Patient will demonstrate functional communication.* (via verbalizations, UE and LE movements, eye gaze, etc.)
  - Short Term Goals:
    • Patient will answer yes/no egocentric questions with ___% accuracy with max cues.

SLP Example Goals

• Expression/CRS-R: Oromotor/Verbal Function
  - Long Term Goal:
    • Patient will produce intelligible verbalizations for communication.
  - Short Term Goals:
    • Patient will demonstrate non-meaningful vocalization with ____% accuracy in response to pain/discomfort.

SLP Example Goals

• General Health & Dysphagia/CRS-R: Oromotor
  - Long Term Goal:
    • Patient will demonstrate reflexive and/or volitional swallow.
    • Patient will tolerate PO trials and/or PO diet without s/s of aspiration.
  - Short Term Goals:
    • Patient will tolerate oral care via suction swab/suction toothbrush/standard toothbrush with (min/mod/max) cues for mouth opening.
    • Patient will elicit 10 swallows per 30-minute session using thermal tactile stimulation and PO trials of ice chips.
    • Patient will participate in objective swallow assessment (FEES and/or MBSS) to determine appropriate consistency for PO trials.
SLP Example Goals

**Attention/CRS-R: Visual Function**
- **Long Term Goal:**
  - Patient will demonstrate object recognition.
- **Short Term Goals:**
  - Patient will follow stimuli visually through left and right visual fields with ___% accuracy given max cues in a given session.

**Attention/CRS-R: Arousal**
- **Long Term Goal:**
  - Eye opening without stimulation and attention
- **Short Term Goals:**
  - Patient will maintain eye opening for ___ minutes in a given session with max cues.
  - Patient will track visual stimuli in 3 out of 4 trials with max cues.

**Education and Discharge Planning Goals:**
- **Long Term Goal:**
  - Educate family regarding SLP plan of care
  - Patient and/or family will be trained in all aspects of patient’s care.
  - Patient will have written and/or verbal home program prior to discharge.
- **Short Term Goals:**
  - Utilize quantitative data from visual and command following IQBA protocols to educate family regarding incidental vs. intentional behaviors.
**SLP Treatment Options**

- Assess level of consciousness via CRS-R bi-weekly with therapy team (PT/SLP and NP/OT)
- Sensory Stimulation Program
  - Auditory stimulation
  - Visual Stimulation
  - Olfactory Stimulation
  - Tactile Stimulation
- Gustatory Stimulation
- Auditory Stimulation
- Olfactory Stimulation
- Visual Stimulation

**Discharge Planning**

- Skilled Nursing Facility vs. Home Health vs. Outpatient
- Appropriate time to discharge
  - Medically stable
  - Can move on to next level of care
- Often meet with resistance (see as giving up)
  - Setting clear expectations from the beginning
  - Giving family clear expectations from OP
  - Giving family goals to work on at home if pt meets/progressed then they can set up a time to be re-evaluated again for either IP or OP
- Working with Social Worker and Case Manager to help with realistic length of stay goals

**References**