Brain Injury On-The-Go Part 1 & 2

We are hearing more about sports related traumatic brain (BI) injuries from the media and with good reason. Brain injuries, both traumatic and non-traumatic, can have long term devastating outcomes to the patient and their support system, causing lifelong functional, cognitive and psychological deficits.

**Brain Injury On-The-Go is comprised of two parts:**

**Brain Injury On-The-Go Part 1:**

Part 1 reviews the differences between a traumatic and non-traumatic brain injury, signs and symptoms of a BI, the different outcomes of an acute traumatic brain injury, examples of severity assessment tools and prognosis.

Additionally, Part 1 also provides clinicians an interdisciplinary approach to the evaluation and treatment guidelines as well as the extensive patient/caregiver education and training needed by the patient and their support system in order to enhance rehabilitation outcomes.

**Brain Injury Severity Assessments On-The Go Part 2**

Part 2 outlines in detail examples of five severity assessment tools as well as the associated scoring. These include Length of Loss of Consciousness, Westmead Post-Traumatic Amnesia Scale, Rancho Los Amigos Scale, Full Outline of Unresponsiveness and Cranial Nerve Assessment.

We hope that this series will be useful as a refresher for a seasoned clinician and provide a recent graduate with the knowledge and skills to provide effective treatment programs. Additionally, these can be utilized as an aid in deeming therapists, assistants and nurses competent in this area.

Brain Injury On-The-Go Part 1 and Brain Injury Severity Assessments On-The-Go Part 2 will be housed on Knect: Kindred Rehab Services (KRS)>Clinical>Hospital (KHRS)>IRF Clinical Services>CARF>Specialty Competencies>Brain Injury>Brain Injury On-The-Go Part 1 and Brain Injury On-The-Go Part 2 and also will be available laminated on the Rehab 451 site soon.
Types and Causes of Brain Injury (BI)

Traumatic Brain Injury (TBI) is a blow or jolt to the head, which can disrupt the normal function of the brain, including closed head injury (skull intact), open head injury (brain exposed or penetrated), concussion, confusion and hemorrhagic injury.

- Causes may include:
  - motor vehicle accidents; bomb blast
  - falls
  - assault; gunshot wound
  - sports related brain injuries

Non-Traumatic Brain Injury involves no external force or action.

- Causes may include:
  - near drowning, strangulation
  - brain tumors
  - infectious diseases (encephalitis, meningitis)
  - metabolic disorders
  - toxins, poisons, alcohol and illicit drug abuse
  - endocrine disorders, degenerative disease
  - diseases and conditions affecting the blood supply to the brain (stroke)

Neuroanatomy

Refer to Neuro On-the-Go on Knect for detailed information on the brain structures and their functions.

Signs and Symptoms of a BI:

- fatigue; changes in sleep patterns
- trouble problem solving
- difficulty making decisions
- inability to concentrate
- trouble organizing thoughts
- memory problems
- difficulty finding words
- personality changes; irritability
- easily confused
- difficulty reading or watching television
- changes in sexual function
- headaches
- vision problems

Outcomes of an Acute TBI

A TBI can cause problems with arousal, consciousness, awareness, alertness and responsiveness. There are seven abnormal states of consciousness that can result from a TBI:

- Stupor:
  - Unresponsive but can be aroused briefly by a strong stimulus such as sharp pain

- Coma:
  - Generally short duration lasting a few days to a few weeks; after this time some patients gradually come out of the coma, some progress to a vegetative state and others die

- Vegetative State:
  - Patient may appear responsive but show no awareness of self and environment, have a sleep wake cycle and can have periods of alertness, involuntary functions continue to work, no high level of function but may move, groan, or show reflex responses, may be able to breathe without assist and may live for decades in this state

- Persistent Vegetative State:
  - Patient does not recover from a vegetative state within 30 days

- Minimal Consciousness:
  - Patient is aware of sights and sounds, may respond to words, may attempt to communicate or reach for objects and can regain full consciousness

- Akinetic Mutism:
  - Patient lacks the ability to move or speak; however, his/her eyes may follow the observer or respond to an auditory stimulus

- Locked-in Syndrome:
  - Patient is awake but cannot move or communicate due to complete paralysis of body

- Brain Death:
  - An irreversible cessation of all functions of the brain including the brainstem

Common Disorders and Impairments

Tissue damage, swelling and bleeding will occur following a brain injury. Depending on the severity and location in the brain, the following impairments may be exhibited in varying degrees of severity:

- Motor Impairments:
  - Paralysis/paresis, coordination, balance, walking, hand function, speech, weakness, spasticity, flaccidity

- Cognitive Disorders:
  - Impairment of attention and performance on tests of logic, reasoning, memory, language, organization, learning, orientation, perception, impaired safety awareness, problems with math skills, denial of disability (anosognosia)

- Changes in Psychological or Social Functioning:
  - Personality changes, impulsivity, agitation, aggression, hypersexual, diminished interest in sexual activity, social withdrawal, difficulty regulating one's emotional responses and psychiatric disorders (anxiety, depression, post-traumatic stress disorder, psychosis)

- Sensory Loss:
  - Loss of touch, hearing, sense of smell and or taste as well as blindness or other visual impairments

- Medical Complications:
  - Spasticity, DVT, pulmonary embolism, aspiration pneumonia, UTI, post-traumatic epilepsy, hydrocephalus, heterotopic ossification, electrolyte imbalance, skin breakdown, seizures, chronic pain, sleep and headache disorders, swallowing disorders, decreased or increased appetite, bowel and bladder issues and substance abuse

Examples of Assessment Tools to Measure Severity

Refer to Brain Injury Severity Assessments On-the-Go Part II for complete descriptions and score values for these assessment tools.

- Duration of Loss Consciousness (LOC)
- Glasgow Coma Scale score (GCS)
- Westmead Post-Traumatic Amnesia Scale (WPTAS)
- Rancho Los Amigos Scale
- Full Outline of UnResponsiveness (FOUR)
- Cranial Nerve Assessment

Prognosis

The outcome of TBI ranges from good recovery to death and depends on:

- cause, location and the severity of the injury
- extent of neurological damage
- duration of coma and age
- premorbid cognitive deficits

Evaluation

- Chart Review:
  - Cause, onset/mechanism of injury
  - Areas of brain damage
  - Co-morbidities/PMH, secondary complications
  - Surgical procedures
  - Current medications
  - Pertinent laboratory and diagnostic tests

Continued >>
• Social History:
  - Prior functional level including home environment and any architectural barriers
  - Family/caregiver support system
  - Sexual assessment
  - History of substance abuse, smoking
  - Education level achieved, vocational and spiritual history

• Physical Examination:
  - Vital signs
  - Respiratory status and cardiovascular status
  - Responsiveness to stimulation
  - Skin integrity, edema
  - Nutrition
  - Pain
  - Sensation including proprioception, protective responses and stereognosis
  - Range of motion (ROM) (UE & LE)
  - Strength (UE, LE, Trunk)
  - Tone including changes in position
  - Bed mobility, transfers
  - Positioning and w/c mobility/management
  - Static and dynamic balance in sitting/standing; rhomberg
  - Endurance
  - Ambulation including gait analysis, assistive device, gait on even and uneven surfaces
  - Vision including visual acuity, visual field, oculomotor skills, depth perception, contrast sensitivity
  - Perception including identifying body parts, right/left discrimination, spatial relations, figure ground
  - Grooming, dressing UB/LB and bathing UB/LB
  - Eating/swallowing/self feeding
  - Toileting including transfer, clothing management, hygiene
  - Homemaking including cleaning, bed making, clothing care and meal preparation
  - Sleep-wake cycles
  - Bowel and bladder

• Cognitive - Mental Status
  - Determine Rancho Cognitive Level
  - Orientation, attention, memory, language, visual and auditory perception
  - Ability to follow commands and problem solve
  - Reasoning, abstract thinking and organization
  - Sequence and complete tasks
  - Safety

• Psychological Considerations:
  - Premorbid psychological diagnosis and or hospitalization
  - Coping mechanisms and adjustment to new diagnosis
  - Depression, anxiety
  - Agitation, aggression, behavior
  - Personality change
  - Psychosis
  - Patient and family/caregiver support

Treatment Guidelines and Education
• Rancho Los Amigos Scale
• Pain Management
• Positioning
  - In and out of bed
• ROM (UE) (LE)
• Strengthening
  - UE/LE for transfers and ambulation with/without an assistive device, ADL, IADL
  - Trunk stabilization exercises to assist in positioning, ambulation, transfers, ADL

• Balance: Sitting and Standing
  - Static
  - Dynamic

• Functional Mobility
  - Bed mobility
  - Transfers including sliding board, shower, toilet, car
  - Gait training with/without an assistive device on even and uneven surfaces, including stairs, ramp
  - Progression of distance and speed of gait
  - Manual or motor wheelchair mobility and management
  - Training in maneuvering w/c around obstacles

• ADL and IADL
  - Transfers, hygiene, grooming, bathing, dressing, toileting
  - Home and money management

• Dysphagia Management
• Communication
• Memory
• Vision
• Bowel and Bladder Training
• Tone

• Equipment/Adaptive Equipment/Splinting
  - Assistive device; UE/LE splint/s
  - Adaptive equipment for dressing, eating
  - Bathroom/bathing equipment

• Psychosocial/Neuropsychiatric Services
  - Allow and encourage patient to express grief, anger, fear and concerns
  - Identify and address each patient’s psychological problems such as denial, depression, anxiety, aggression, behavior, substance abuse, personality change
  - Assess the impact of psychological problems on the family/caregiver about the rehabilitative process including discharge
  - Identify and emphasize with the patient’s strengths and skills
  - Encourage the patient and family/caregivers to express feelings about having a brain injury

• Medication Management
  - Medication self-administration
  - Recognition and troubleshooting complications

• Nutrition Management
  - Nutrition assessment, counseling on balanced diet, maintaining fluid intake

• Additional Patient/Family/Caregiver Training and Education
  - Suspected abuse and neglect
  - Pressure relief, skin care
  - Care/support for the caregiver/family including spouse, parents, children and or sibling/s, respite care
  - Sexual counseling including fertility
  - Boundary setting
  - Signs of an infection including UTI, diarrhea, dehydration
  - Discharge planning
  - Home exercise program
  - Home safety instructions including accessing emergency care
  - Home modification/accessibility
  - Fall prevention and management
  - Substance abuse groups
  - Peer and group support options
  - Information about resources including financial (locally, regionally and nationally)
  - Driving
  - Returning to work
  - Travel including hotels, airline and car
  - Technology

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**Brain Injury Severity Assessments**

**Severity Assessments for Traumatic Brain Injury:**
Severity of the injury refers to the amount of brain tissue damage and can be measured by the following tests:

**Length of Loss of Consciousness (LOC):**
Measures duration of loss of consciousness as mild, moderate or severe
- Mild
  - LOC 0-20 minutes
- Moderate
  - LOC 20 minutes to 6 hours
- Severe
  - LOC more than 6 hours

**Glasgow Coma Scale (GCS):**
- 15-point test based on best eye, verbal and motor responses
  - Score of 13-15: Mild TBI
  - Score of 9-12: Moderate TBI
  - Score < 8: Severe TBI

**Eye Opening**
- Open eyes on own – score 4
- Open eyes when asked to in a loud voice – score 3
- Open eyes when pinched – score 2
- Does not open eyes – score 1

**Motor Response**
- Follows simple commands – score 6
- Pulls examiner’s hand away when pinched – score 5
- Pulls part of body away when examiner pinches patient – score 4
- Flexes body inappropriately to pain – decorticate posturing – score 3
- Body becomes rigid in an extended position when examiner pinches victim – decerebrate posturing – score 2
- Has no motor response to pinch – score 1

**Verbal Response**
- Carries on a conversation correctly and tells examiner where he is, who he is, and the month and year – score 5
- Seems confused or disoriented – score 4
- Talks so examiner can understand victim but makes no sense – score 4
- Makes sound that examiner can understand victim but makes no sense – score 2
- Makes no sound – score 1

**Westmead Post-Traumatic Amnesia Scale (WPTAS)**
This scale is used as an index of severity for prognosis for a patient regaining consciousness. The Westward PTA consists of seven orientation in time and place and five memory questions. Each answer will receive a 0 or 1 allowing for a maximum score of 12. The test is completed daily until a perfect score is achieved for three consecutive days.

- How old are you?
- What is your date of birth?
- What month are we in?
- What time of day is it (morning, afternoon or night)?
- What day of the week is it?
- What year are we in?
- What is the name of this place?
- The examiner asks the patient to remember his/her face and name.
- The patient is shown three colored common objects and asked to name them.

**Westmead Post-Traumatic Amnesia Scale (WPTAS)***

**On-The-Go Part 2**

**Rancho Los Amigos Scale (Levels of Cognitive Functioning)**
This scale provides a longer term indicator of functioning, which can be used for tracking recovery, considering prognosis, planning and placement decisions and measuring treatment effects and outcomes.

- **Stage I:** No Response – person does not respond to external stimuli and appears to be in a deep sleep
- **Stage II:** Generalized Response – person responds inconsistently to stimuli and response is non-purposeful
- **Stage III:** Localized Response – responds inconsistently, but response is specific to the stimulus
- **Stage IV:** Confused, Agitated Response – person is extremely confused with a heightened activity of any stimuli
- **Stage V:** Confused, Inappropriate and Agitated – patient looks awake, memory impaired, and needs lots of structure
- **Stage VI:** Confused, Appropriate Response – knows things going on around them, but answers are inconsistent with question
- **Stage VII:** Automatic, Appropriate Response – person is engaged in a structured life
- **Stage VIII:** Purposeful, Appropriate Response – able to remember more, responses are consistently appropriate and fitting of the question

**Full Outline of Unresponsiveness (FOUR)**
The FOUR assesses impaired level of consciousness and consists of four categories, which are individually scored 0-4 and collectively 0-16. The lower the score the worsening level of consciousness.

**Advantages found with the FOUR Score:**
- Test can be fully administered even if intubated
- Brain stem reflexes are tested
- More precise measurements and higher agreement between evaluators
- Recognition of locked-in syndrome
- Attention to stages of brain herniation and breathing as indicators of coma depth
- Scores have a better correlation with outcomes

**Eye Response**
- Score best possible response of three trials
  - 4 = eyelids open or opened, tracking or blinking on command
  - 3 = eyelids open but not tracking
  - 2 = eyelids closed but open to loud noise
  - 1 = eyelids closed but open to pain
  - 0 = eyelids remain closed with pain

**Motor Response**
- Score best possible response of the arms
  - 4 = demonstrates thumbs-up, fist or peace sign
  - Demonstrates at least one of the three hand positions
  - 3 = Localizing pain
  - Patient touches examiner’s hand after a painful stimulus compressing the temporomandibular joint or supraorbital nerve
  - 2 = Extension response to pain
  - Any upper extremity flexion movement
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Brain Injury Severity Assessments

- Brainstem Reflexes – Grade best possible response
  - 4 = pupil and corneal reflexes present
  - 3 = One pupil wide and fixed
  - 2 = Pupil or corneal reflexes absent
  - 1 = Pupil and corneal reflexes absent
  - 0 = Absent pupil, corneal and cough reflex
- Respiration
  - 4 = Not intubated, regular breathing patterns
  - 3 = Not intubated, Cheyne-Stokes breathing patterns
  - 2 = Not intubated, irregular breathing
  - 1 = Breaths above ventilator rate
  - 0 = Absent pupil, corneal and cough reflex

Cranial Nerve Assessment

A neurologic examination that assesses the 12 paired cranial nerves, classified as motor nerves, sensory nerves or both motor and sensory nerves.

I. Olfactory (sensory)
- Smell
  - Assessment I – Have the patient close his/her eyes. Occlude one nostril with your finger and ask him/her to identify nonirritating odors such as coffee, tea, cloves, soap, chewing gum, and/or peppermint. Repeat the test on the other nostril.

II. Optic (sensory)
- Vision
  - Assessment II – Assess visual activity with a Snellen chart or newspaper and ask the patient to count how many fingers you are holding up. Check visual fields by confrontation. Have the patient sit directly in front of you and stare at your nose. Slowly move your finger from the periphery toward the center until the patient says that he/she can see it. Check color vision by asking the patient to name the color of several nearby objects.

III. Oculomotor (motor)
- Downward and inward eye movement
- Papillary constriction

IV. Trochlear (motor)
- Upper eyelid elevation
- Most eye movement

V. Abducens (motor)
- Lateral eye movement
  - Assessment III, IV, V – The motor functions of these nerves overlap so test them together. First, inspect the eyelids for ptosis. Then assess ocular movements by moving your finger to each quadrant of the visual field with the patient’s eyes fixed on your finger. Note any eye deviation. Test accommodation and direct and consensual light reflexes.

VI. Trigeminal (both)
- Sensation to the corneas, nasal and oral mucosa, and facial skin
- Mastication
  - Assessment VI – To test motor function, ask the patient to close his jaws tightly, and then try to separate his clenched jaw. Also, test the corneal reflex by lightly touching the patient’s cornea with a cotton wisp. To check this nerve’s sensory function, ask the patient to close his/her eyes, and then lightly touch his/her forehead, cheeks, and chin. Can he/she feel the touch equally on both sides?

VII. Facial (both)
- Facial muscles
- Taste perception (on the tongue’s anterior two-thirds)
  - Assessment VII – Have the patient show his/her teeth, attempt to close his/her eyes against resistance and puff out his/her cheeks. Then dab sugar, salt, or vinegar on the front of his/her tongue. Have the patient identify these substances by their taste.

VIII. Vestibular-Cochlear (sensory)
- Hearing (cochlear)
- Equilibrium (vestibular)
  - Assessment VIII – Rub a few strands of hair between your fingers next to the patient’s ear and then have him/her identify which ear you selected. Also, check his/her ability to hear a watch ticking or a whisper. Observe the patient’s balance. Does the patient sway in standing?

IX. Glossopharyngeal (both)
- Swallowing and phonation
- Sensation to the pharyngeal, soft palate, and tonsillar mucosa
- Taste perception (on the tongue’s posterior third)
- Salivation
- X. Vagus (both)
- Swallowing and phonation
- Sensation to the exterior ear’s posterior wall and behind the ear
- Sensation to the thoracic and abdominal viscera
  - Assessment IX, X – First, have the patient identify tastes at the back of his/her tongue. Then, inspect the soft palate. Observe for symmetrical elevation when the patient says aah. Touch the soft palate’s mucous membrane with a swab to elicit the palatal reflex. Touch the posterior pharyngeal wall with a tongue depressor to elicit the gag reflex.

XI. Spinal Accessory (motor)
- Uvula and soft palate movement
- Sternocleidomastoid muscle
- Upper portion of trapezius muscle (governs shoulder movement and neck rotation)
  - Assessment XI – Palpate and inspect the sternocleidomastoid muscle as the patient pushes his/her chin against your hand. Palpate and inspect the trapezius muscle as the patient shrugs his/her shoulders against your resistance. Also, have the patient stretch out his hands toward you.

XII. Hypoglossal (motor)
- Tongue movements involved in swallowing and speech
  - Assessment XII – Observe the tongue for asymmetry, atrophy, deviation to one side, and fasciculations. Ask the patient to push his/her tongue against a tongue depressor. Then, have him/her move his/her tongue rapidly in and out and from side to side.