Medical and Physical Complications

Section 3

THE ESSENTIAL BRAIN INJURY GUIDE

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**Medical Complications**

Gain an understanding of medical complications frequently seen in persons with brain injury
Be able to articulate the common issues related to elimination in the TBI population
Be able to describe dysphagia and the importance of tube feeding in persons with brain injury
Be able to discuss prevention and treatment of pressure sores
Be able to distinguish between epileptic seizures and post-traumatic seizures
Know the symptom clusters of different types of headaches frequently observed in the TBI population and appropriate treatments for each

**Brain Injury and Body Systems**

Cardiopulmonary & Vascular
Sleep
Musculoskeletal
Elimination
Gastrointestinal
Reproductive
Metabolic & Endocrine

Complications involving the heart (cardiac) and breathing (respiratory)
Can occur immediately, chronically, or emerge as late complications
Associated with increased mortality and morbidity
Chronic Cardiopulmonary Issues

- Orthostatic hypotension
- Aspiration pneumonia
- Deep vein thrombosis

Dysautonomia

Sometimes called “autonomic storming”

MUSCULOSKELETAL COMPLICATIONS

Identification and Management of Chronic and Late Emerging Complications

Urinary Incontinence Management

Essential TIP!

- Frequent/painful urination
- Fever
- Possibly increased agitation
- Possibly decreased level of alertness
Bowel and Fecal Incontinence Management

Early Issues: Nutrition and Feeding

Swallowing Process

National Dysphagia Diet Levels: Food

<table>
<thead>
<tr>
<th>Level</th>
<th>Dysphagia Severity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Dysphagia Pursed</td>
<td>Moderate to Consists of pureed, homogenous and cohesive foods, and pudding consistency. Foods requiring bolus formation, and chewing are not allowed.</td>
</tr>
<tr>
<td>Level 2</td>
<td>Dysphagia Mechanically Altered</td>
<td>Mild to Moderate pharyngeal</td>
</tr>
<tr>
<td>Level 3</td>
<td>Dysphagia Advanced</td>
<td>Mild</td>
</tr>
<tr>
<td>Level 4</td>
<td>Regular Diet</td>
<td>N/A</td>
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</tbody>
</table>

National Dysphagia Diet Levels: Liquids

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin</td>
<td>No alteration</td>
</tr>
<tr>
<td>Nectar-like</td>
<td>Slightly thicker than water, the consistency of un-</td>
</tr>
<tr>
<td>Honey-like</td>
<td>A liquid with the consistency of honey</td>
</tr>
<tr>
<td>Spoon-thick</td>
<td>A liquid with the consistency of pudding</td>
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</tbody>
</table>
METABOLIC/ENDOCRINE

Diabetes Insipidus/ Metabolic and Endocrine Disorders

Individuals may present with
- Metabolic syndrome
- Hypothalamic-pituitary changes
- Growth hormone dysfunction
- Hypopituitarism
- Gonadotropin deficiency

Essential TIP!
These problems tend to be diagnosed a year or more post-injury and occur in up to 30% of individuals with moderate-severe injuries who are greater than one year post injury.

REPRODUCTIVE SYSTEM

Reproductive Health Challenges

INTEGUMENTARY

Common Skin Problems
- Acne
- Sweating
- Rashes
- Fungal and Bacterial Infections
- Wounds
- Abrasions
- Incisions
- Pressure sores

Pressure Sores

Pressure sores can be prevented by:
- Keeping skin clean and dry
- Changing position every two hours
- Using pressure-relieving devices both preventatively as well as after the development of a pressure ulcer, including:
  - Specialty mattresses
  - Specialty cushions
  - Pressure-relieving tilt-in-space wheelchairs

Essential TIP!
Stages of Pressure Sores

**Normal Skin**

**STAGE I**
- Intact skin with non-blanchable redness of a localized area usually over a bony prominence.
- Darkly pigmented skin may not have visible blanching. Its color may differ from the surrounding area. May indicate "at risk" persons.

**STAGE II**
- Partial thickness loss of dermis presenting as a shallow open ulcer with a red pink wound bed, without slough. May also present as an intact or open/ruptured serum-filled or sero-sanguinous filled blister.*Bruising indicates deep tissue injury.

**STAGE III**
- Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle are not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunneling.

**STAGE IV**
- Full thickness tissue loss with exposed bone, tendon or muscle. Slough or eschar may be present. Often includes undermining and tunneling.

**UNSTAGEABLE**
- Full thickness tissue loss in which actual depth of ulcer is completely obscured by slough (yellow, tan, gray, green or brown) and/or eschar (tan, brown or black) in the wound bed.

**DEEP TISSUE INJURY**
- Purple or maroon localized area of discolored intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or cooler as compared to adjacent tissue.

**COMMON INFECTIONS**

- Individuals with brain injuries are susceptible to infection when they have open wounds, use indwelling devices, or are immuno-suppressed.

**Neurologic Complications**

- **Seizure**
- **Pain**
- **Headache**

**Status Epilepticus**

- The Epilepsy Foundation has revised the definition of Status Epilepticus to include seizures that last too long (any seizure lasting longer than 5 minutes), as well as those so close together that the person does not recover from one before another begins.

- Status epilepticus carries a high mortality risk.
Seizure First Aid

- Do not force any object into the person’s mouth or try to hold the tongue
- Clear the environment of harmful objects
- Ease the individual to the floor to prevent injury from falling
- Turn the person to the side to keep the airway clear and allow saliva to drain from mouth
- Put something soft under the head and along bedrails, if in bed
- Loosen tight clothing around the neck

Non-Headache Pain

The most common pain pathways in persons with TBI are nociceptive and neuropathic, requiring different pharmacologic approaches

Nociceptive Pain
- Pain related to the peripheral nerve fibers
- Pharmacologic treatments include:
  - NSAIDS - aspirin, ibuprofen, naproxen
  - Acetaminophen
  - Topical agents
  - Antispasmodics
  - Opioids

Neuropathic Pain
- Pain associated with primary lesion of dysfunction of the nervous system
- Medications to treat neuropathic pain in persons with TBI include:
  - Topical agents, opioids, tricyclics, Lyrica, anticonvulsants and antidepressants
  - Tricyclics (a category of antidepressants)
  - Interventional techniques including trigger point injections, nerve blocks and epidural steroids may also prove to be effective

Post-traumatic Headache

Two important designations in this classification system are whether the headaches are primary or secondary, and whether they are acute or chronic headache

Primary or Secondary
- A primary headache has no specific cause
- A secondary headache may have an identifiable cause that can be determined

Acute or Chronic
- A chronic headache is one that occurs at least 15 days per month for at least 3 months
- A chronic headache cannot be linked to overuse or withdrawal of medication

Tension Type Headache

- Headache is bilateral head pain of pressing quality, much like that of a tight hand or vice clamping across the head
- Occurs from either a neck or head muscle strain or injury

- Does not get worse with physical activity and patients do not present with other symptoms like sensitivity towards light, sound and taste
Craniomandibular Headache

- Defined as a subtype of tension type headaches associated with the temporal mandibular joint
- Can be very debilitating causing patient to have difficulty with eating and talking, which require movement of the jaw and mouth

Cervicogenic Headache

- Defined as a head pain generated from the cervical spine
- A clinical diagnosis can be made clinically (provoking the headache by manipulation), or by nerve block
- Nerve block is preferable as it the best diagnostic method and can eliminate other types of headaches which can mimic this type of headache

Migraine Phases

- Tend to occur as episodes of headaches that may have different phases
- Wolff’s Headache and Other Pain 8th ed., states that there are four phases of migraine:
  - Prodrome
  - Aura
  - Headache
  - Postdrome

Migraine Abortive Medicines
Preventative Treatments

Character - sensation and intensity (throbbing, etc.)
Origin - pattern to timing (morning, triggers)
Location - where does it start? - does it radiate?
Duration and frequency
Exacerbation - what intensifies the headache
Relief - what reduces the headache
Brain Injury Specialists and Medications

- Evaluate medication efficacy
- Observe side effects
- Facilitate proper administration
- ... and ask questions

Learning Objectives

- Be familiar with motor learning principles
- Be able to discuss the specific needs of a patient with concomitant TBI and SCI
- Be able to articulate the 5 types of coordination disorders common to persons with TBI
- Be able to describe typical treatments for heterotopic ossification and deep vein thrombosis
- Be able to distinguish between the standard of care for lower extremities as opposed to upper extremities in patients with severe spasticity
Motor Learning Principles

Stages of Motor Learning
- Cognitive (What to do)
- Associative (How to do)
- Autonomous (How to succeed)

Motor Learning: Considerations for Treatment Design

<table>
<thead>
<tr>
<th>Performance</th>
<th>Feedback</th>
</tr>
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<tbody>
<tr>
<td>Generalizability</td>
<td>Practice type</td>
</tr>
<tr>
<td>Resistance to contextual change</td>
<td>Environmental influences on motor learning</td>
</tr>
</tbody>
</table>

Types of Hydrocephalus

- Obstructive/non-communicating
- Hydrocephalus ex-vacuo

Surgical placement of a shunt to promote flow of CSF; careful monitoring is required.

Spasticity Management

- Multimodal approach to treatment
  - Medications
  - Occupational and physical therapists
- Goal: optimize recovery and reduce disability
Heterotrophic Ossification (HO)

HO is the formation of new bone around joints as a consequence of trauma and/or immobility.

Vascular Thrombosis

Essential Tip:
Incidence for Deep Vein Thrombosis (DVT) is as high as 54% in patients with TBI.

Pulmonary Embolism (PE) is the 3rd leading cause of death in those who survive the first day.

Cranial Nerve Dysfunction

Somatosensory Issues

Functional Movement Dysfunction

COMPLICATIONS WITH SENSORY SYSTEMS OR MOVEMENT

Cranial Nerve Dysfunction

The Cranial Nerves

- Olfactory nerve (I)
- Optic nerve (II)
- Oculomotor nerve (III)
- Trochlear nerve (IV)
- Trigeminal nerve (V)
- Abducens nerve (VI)
- Facial nerve (VII)
- Vestibulocochlear nerve (VIII)
- Glossopharyngeal nerve (IX)
- Vagus nerve (X)
- Accessory nerve (XI)
- Hypoglossal nerve (XII)

Functional Movement Dysfunction

Functional movement dysfunction creates problems with:
- Overall mobility
- Object manipulation
Coordination Disorders

- Interlimb Coordination
- Ataxia
- Athetoid
- Ballisms
- Choreiform
- Tremors

Visual Perception or Interpretation Deficits

- Visual Acuity
- Spatial Relation
- Body Schema
- Agnosia

Terms of Visual Function

<table>
<thead>
<tr>
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<th>Description</th>
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<tbody>
<tr>
<td>Visual acuity</td>
<td>Clarity of vision (Snellen chart for testing)</td>
</tr>
<tr>
<td>Eye movements</td>
<td>Tracking, saccades, smooth pursuit, fixation</td>
</tr>
<tr>
<td>Visual fields</td>
<td>Zone of vision, central vs peripheral and quadrants</td>
</tr>
<tr>
<td>Binocular vision</td>
<td>Left and right eye move together (conjugate)</td>
</tr>
<tr>
<td>Vergence</td>
<td>Eyes symmetrically turn inward/outward for adjustment to varying object distances</td>
</tr>
<tr>
<td>Vestibular interactions</td>
<td>Vestibulo-ocular reflex (VOR) to maintain gaze during head turning</td>
</tr>
</tbody>
</table>

Perception or Interpretation Disorders

- Body Schema/Body Image Disorders
  - Unilateral neglect
  - Anognosia
  - Right/left discrimination
  - Somatognosia
- Agnosia
  - Visual Object Agnosia
  - Auditory Agnosia
  - Tactile Agnosia
- Apraxia
  - Ideomotor Apraxia
  - Ideational Apraxia
  - Buccofacial apraxia

More Perceptual Deficits

- Spatial Relation Disorders
  - Form discrimination
  - Spatial relations disorder
  - Vertical disorientation
  - Depth and distance perception

Figure ground discrimination: cannot determine a figure from its background

Vision Issues

- Photophobia
- Double Vision (Diplopia)
Concomitant TBI and SCI

**Incidence**
- SCI annual incidence is approximately 12,000 new cases annually, or 3.1/100,000
- TBI present in 60% of individuals with SCI

**SCI Injury Description**
- Complete injury = almost all or all feeling (sensory) and all ability to control movement (motor function) are lost below the spinal cord injury
- Incomplete injury = feeling (sensory) and or ability to control movement (motor function) is partially preserved
- Paralysis of the body below the level of the spinal cord injury:
  - Paraplegia means trunk, legs and pelvic organs are affected (paralyzed)
  - Tetraplegia means arms, hands, trunk, legs and pelvic organs are all affected (paralyzed)

SCI: Considerations

- Skin Care needs
  - Monitoring and repositioning
- Bowel Care needs
  - Bowel program
- Bladder Care needs
  - Bladder management for UTI prevention, maintaining low residuals in bladder, and continence.

Disorders of Consciousness

**Classification System:** 3 generally accepted levels
- Coma
- Vegetative State
- Minimally Conscious

Learning Objectives

- Be able to provide examples of the modalities of sensory stimulation
- Gain an understanding of disorders of consciousness (DOC)
- Be able to articulate the methods of medical management for the person with DOC
- Be able to describe the appropriate use of goal-setting for the person with DOC
- Be able to identify the methods of physical management for the person with DOC

Disorders of Consciousness

- Estimated 315,000 persons living with DOC in U.S.
- 280,000 Minimally Conscious
- 35,000 Vegetative State (VS)
Disorders of Consciousness

- Occurs with injury to:
  - Reticular Activating System (Arousal)
  - Higher cortical areas in the cerebrum (Awareness)

DOC: Medical Management Goals

- Full participation in therapeutic activity and daily routine
- Prevent medical complications
- Stimulate (environmental, pharmacologic)

DOC: Medical Management

Also called
- Dysautonomia
- Sympathetic Storming
- Autonomic Dysreflexia
- Paroxysmal Autonomic Instability with Dystonia

Glasgow Coma Scale (GCS)

The GCS is a neurobehavioral scale which provides an objective assessment of coma or impaired consciousness.

- A score of 13 to 15 correlates to mTBI
- A score between 9 and 12 correlates to a moderate TBI
- A score below 8 correlates to severe TBI
### Goal Setting: Considerations

<table>
<thead>
<tr>
<th>Goal Type</th>
<th>Considerations/Examples</th>
</tr>
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<tbody>
<tr>
<td>Response Based</td>
<td>Base the goal on the response types exhibited by the person (no response/ generalized response / localized response)</td>
</tr>
<tr>
<td>Response Type</td>
<td>If the person currently responds to auditory stimuli in a generalized way, the logical goal progression would be to the localized response level.</td>
</tr>
<tr>
<td>Tolerance for Stimuli or Intervention</td>
<td>Base the goal on the level of tolerance exhibited by the person for a given intervention.</td>
</tr>
<tr>
<td>Risk Management</td>
<td>There are a number of interventions designed to reduce risk for physical complications (see physical management section of this chapter).</td>
</tr>
<tr>
<td>Caregiver Development</td>
<td>Goals related to the education and training of caregivers within the person's support system are integral in ensuring person-centered care.</td>
</tr>
</tbody>
</table>

### Sensory Stimulation Modalities

<table>
<thead>
<tr>
<th>Sensory Modality</th>
<th>Intervention/Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual (Seeing)</td>
<td>Mirror, familiar photographs, bubbles, scenery and setting changes</td>
</tr>
<tr>
<td>Auditory (hearing)</td>
<td>Pre-recorded voices of family members and friends, favorite music, as well as environmental noises</td>
</tr>
<tr>
<td>Olfactory (smelling)</td>
<td>Fragrances such as shampoos, cologne or perfumes, spices, and environmental scents</td>
</tr>
<tr>
<td>Gustatory (tasting)</td>
<td>Lemon wafers, cotton-tipped applicator dipped in any variety of flavors preferred by the person, gustatory stimulation should be directed by speech pathology due to the inherent aspiration risks</td>
</tr>
<tr>
<td>Proprioceptive / Vestibular (moving)</td>
<td>This modality involves the movement of the body in space as well as the awareness of the position and movement of body parts, and includes range of motion, head-over-hand assistance for motor tasks, position changes, and movement of the wheelchair</td>
</tr>
<tr>
<td>Tactile (touching)</td>
<td>Preferred textures (e.g., favorite stuffed animal, clothing items, etc.), alternating smooth and rough textures (e.g., cotton, sandpaper, silk)</td>
</tr>
</tbody>
</table>

### Sensory Stimulation Response Monitoring

- **No Response (NR)**
  - No discernable reflexive or volitional response
- **Generalized Response (GR)**
  - Non-purposeful and non-specific reflexive response
- **Localized Response (LR)**
  - Localized response that is not reflexive (e.g., turn head toward auditory stimuli)

### Caregiver Education

- Train family members on how they can contribute and participate in the stimulation/ regulation protocols

### Complex Physical Management to Include in Treatment

- Range of motion
- Orthotic use
- Upright positioning
- Bed positioning

### Learning Objectives

- Distinguish between excessive daytime sleepiness (EDS) and fatigue
- Be familiar with the types of instruments to measure fatigue
- Gain an understanding of the Coping Hypothesis
- Explain the role of pain, depression and anxiety on sleep
- Understand pharmacological and non-pharmacological approaches to sleep disturbance

### Fatigue and Sleep Disturbance

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8/18/2017
Fatigue is the awareness of a decreased capacity for physical and/or mental activity due to an imbalance in the availability, utilization and/or restoration of resources needed to perform activity.

**Types of Fatigue**
- Physiological
- Psychological

**Primary and Secondary Fatigue**
- Sleep Disturbance
- Pain
- Anxiety
- Stress

**The Coping Hypothesis**
- This hypothesis suggests that fatigue may come from the compensatory effort necessary to meet the demands of everyday life due to cognitive deficits including impaired attention and speed of processing.
- Cognitive demand, overtime, may require a greater level of effort to maintain performance, creating stress and fatigue.

**Measures of Fatigue**
- The Visual Analogue Scale for Fatigue (VAS-F)
  - Assesses fatigue and energy at a single point in time
- The Fatigue Severity Scale (FSS)
  - Assesses the impact of fatigue on daily function using a 7-point scale
- The Barrow Neurological Institute Fatigue Scale (BNI Fatigue Scale)
  - Assesses the difficulty level of energy and alertness
- The Global Fatigue Index (GFI)
  - Assesses four domains of fatigue-severity, distress, impact on activity and timing of fatigue
- The Causes of Fatigue Questionnaire (COF)
  - Assesses the extent to which physical and mental activities may cause fatigue.
Strategies to Improve Energy

- Reducing work hours
- Taking frequent breaks
- Participating in physical conditioning activities
- Addressing pain, anxiety and/or depression

COGNITIVE

- Modifying the pace or demands of the task
- Reducing distractions
- Managing information overload

Sleep Disturbances

There are still unanswered questions about fatigue and sleep disturbances, and further study of interventions is needed.

Diagnosis and Treatment

DIAGNOSTIC TOOLS

- Epworth Sleepiness Scale
- Pittsburgh Sleep Quality Index
- Polysomnography
- Multiple Sleep Latency Test