Brain Injury as Disease

Section 1 outlined how brain injury is:

- **Disease - causative**
  - Brings about diseases that the individual would not have been at risk for without having a brain injury

- **Disease - challenging**
  - Brings about increased complexity of medical management when additional co-morbidities, whether pre-existing or post-injury, combine with a brain injury

- **Disease - accelerative** has also been a term used to describe this concept:
  - Increases mortality
  - Increases morbidity

Essential TIP!

For the remainder of this chapter when applicable, these issues will be highlighted.

Brain Injury and Body Systems

- **Cardiopulmonary & Vascular**
- **Neurological**
- **Sleep**
- **Infection**
- **Elimination**
- **Musculoskeletal**
- **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
**Early Cardiopulmonary Issues**

- May be caused by direct trauma or result from damage to the parts of the brain that control heart and lung function.
- Some individuals require immediate life support (ventilator) and subsequent tracheostomy for breathing.
- Some need medication to maintain adequate blood pressure to insure cerebral blood flow.

**Chronic Cardiopulmonary Issues**

- Orthostatic hypotension
- Aspiration pneumonia
- Deep vein thrombosis

**Clustering of Blood Cells**

**Dysautonomia**

- Sometimes called "autonomic storming."
- Autonomic functions such as heart and respiratory rates, blood pressure, temperature, and penisaeration are disrupted.
- May also present with muscle over-activity, posturing, dystonia, rigidity, and spasticity.
- Usually resolves in early recovery.

**Cardiovascular and Pulmonary Monitoring**

- Monitor heart rate: 60-90 beats per minute.
- Monitor blood pressure: 100/65-137/84.
- Monitor respirations: 12-20 breaths per minute.
- Observe for light headedness and dizziness.
- Listen for cough, congestion, difficulty breathing, fever.
- Look for leg swelling (DVT) usually only on one extremity.

**Musculoskeletal Complications**

- Fractures, dislocations, and spinal and peripheral nerve injuries are often due to initial trauma.
- Neurologically-based changes in reflexes, sensory integration, range of motion, muscle tone, strength, endurance, spasticity, postural control and alignment, tone and soft tissue integrity.
Musculoskeletal Complications

**Hypertonia**
- Involuntary exaggerated deep tendon reflexes

**Contractures**
- Abnormal, usually permanent condition of joints characterized by decreased range of motion, often in a flexed position, and fixation due to wasting away and shortening of muscle fibers and loss of skin elasticity

Specific Musculoskeletal Complications

- Spasticity
  - Involuntary increase in muscle tone
- Heterotopic Ossification (HO)
  - Abnormal growth of bone in soft tissues adjacent to the joints

Chronic and Late Emerging Issues

- Impact of normal aging and degeneration
- Physical trauma that occurred at the time of the accident have long-term consequences and may re-emerge as problems over time
- Musculoskeletal problems impact one another and create new problems, including postural control, balance, and pain
- May require physical therapy and medication
- Osteoporosis

Management of Musculoskeletal Complications

- Treatment options for spasticity and contracture include exercise, casting and orthotic techniques, ultrasound and functional electrical stimulation to improve flexibility and normalize tone
- Oral anti-spasticity medications are also used
- For some, nerve blocks, botulinum toxin (Botox), orthopedic management, and surgically implanted baclofen pumps might also be prescribed

Elimination

- The brain is the control center for bowel and bladder function, and when injured, the regulatory systems in elimination may be disturbed resulting in incontinence or accidents
- Elimination
  - Urinary
  - Fecal
Urinary tract infections are common and can be chronic; early detection is important. Interventions include maintaining adequate hydration (minimize caffeine, which acts as a bladder irritant), timed voiding, and use of absorbent briefs or condom catheters. Catheters—may be used early on to manage incontinence (caution: infection risk).

Urinary Incontinence Management

- Begin bladder training: timed void every two hours
- Avoid indwelling catheters
- Look for signs and symptoms of urinary tract infection (UTI)

Essential TIP!
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- Avoid indwelling catheters
- Look for signs and symptoms of urinary tract infection (UTI)

Urinary Incontinence

- Frequent/painful urination
- Fever
- Possibly increased agitation
- Possibly decreased level of alertness

Elimination - Fecal Incontinence

- Medications including stool softeners, cathartics, bulk laxatives, and/or suppositories or low volume enemas help to restore and maintain bowel emptying
- Individuals with BI are often poor reporters of bowel emptying and managing this issue can be very challenging for family and care providers
- Also comes with social consequences and medical consequences such as skin breakdown, pressure ulcers, and skin infection

Bowel Management

- Monitor dietary and fluid intake
- Establish regular toileting schedule—at least every 2-3 days
- Stool softeners, bulk laxatives and regularly scheduled suppository may be required

Gastrointestinal

- Involves regulation from the hypothalamus, parasympathetic and sympathetic nervous systems as well as cortical functions
- Achieving adequate nutrition after brain injury is often complicated by arousal, dysphagia, safety awareness, and medical issues including reflux and medication-related matters
Early Issues: Nutrition

Metabolism increases significantly following a moderate to severe brain injury

- A person will require at least 40% more calories than was needed pre-injury
- The more severe the head injury, the more calories required for healing
- This can persist indefinitely

Early Issues: Feeding

- Initially nourished by parenteral (IV supported) nutrition and/or feedings by gastric or small bowel tube feedings (tubes surgically implanted into the stomach or small bowel)
- Dysphagia may necessitate feeding support
- Tube feeding: gastropasty or jejunostomy

Chronic Issues: Swallowing

- Monitor swallowing programs prescribed by therapist (types of food and/liquid permitted, level of supervision)
- Monitor for coughing while eating or drinking
- Monitor weight loss and dehydration
- May need to offer fluids

Swallowing Process

Swallowing is a complicated process, and dysfunction can lead to aspiration

Essential TIP!

Swallowing is a complicated process, and dysfunction can lead to aspiration

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 Diaphagia</td>
<td>Moderate</td>
<td>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 Diaphagia</td>
<td>Mild to Moderate pharyngeal</td>
<td>All foods from level one, plus foods that are moist, soft form a bolus. Food pieces no larger than ¼ inch. Some Level 3 Diaphagia</td>
</tr>
<tr>
<td>Level 3 Diaphagia</td>
<td>Mild</td>
<td>This level includes most textures except hard, sticky or level includes soft foods that require chewing ability.</td>
</tr>
<tr>
<td>Level 4 Regular Diet</td>
<td>N/A</td>
<td>All foods as tolerated</td>
</tr>
</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>
</tr>
</tbody>
</table>
**Chronic Issues: GERD and Weight Management**

- Gastroesophageal reflux (GERD): chemical irritation of the lungs as gastric contents reflux into upper airways and irritate the trachea/pharynx. Medications: Prilosec, Protonix, Zantac, Pepcid, and Reglan
  - Weight management is critical to maintaining health; weights should be routinely screened
  - Adequate nutritional intake and maintaining targeted weight helps to maintain functional independence, mobility, cardiovascular and endocrine health

**Diabetes Insipidus/ Metabolic/ Endocrine**

- BI impacts metabolism and hormone production
- Individuals may present with:
  - Metabolic syndrome
  - Hypothalamic-pituitary changes
  - Growth hormone dysfunction
  - Hypopituitarism
  - Gonadotropin deficiency

**Diabetes Insipidus & SIADH**

- Diabetes Insipidus (DI)
  - Occurs when too little Vasopressin is produced
  - Individual produces too much urine and has excessive thirst
  - The individual can become severely dehydrated and confused

- Syndrome of Inappropriate Anti-diuretic Hormone (SIADH)
  - Can occur after BI, both early on and later
  - It can be caused by changes to the hypothalamus or by certain medications

**Metabolic Syndrome**

- Increases risk for cardiovascular disease, diabetes and death
- Marked by central obesity, insulin resistance, high blood pressure, and dyslipidemia
- Risk factors include history of hypertension or diabetes mellitus, smoking, physical inactivity, obesity, stress, and prolonged use of anti-psychotic medications
- Treatment: diet, weight loss, and medication

**Reproductive System**

- BI can result in changes in libido, arousal, and sexual performance
- These changes can be compounded by medications prescribed and hormonal changes
- Judgment, awareness, social skills and functional abilities also play a role in dating, relationships and intimacy
Reproductive Health Challenges

- The following are special concerns for women with brain injury
  - Urinary tract infections
  - Depression
  - Osteoporosis
  - Endocrine disorders
  - Dysmenorrhea
  - Polycystic ovarian symptoms

- Reproductive health can be impacted by disability
  - Potential limited use of oral/estrogen therapy for contraceptives/hormone replacement due to DVT/embolus history post injury
  - Increased risk for cardiovascular disease and cancer overtime

Skin Care

- Inspect areas where moisture accumulates: between skin folds, in perineal region, rectal area, between buttocks, under breasts, toes, and any area where contractures or spasticity may be present
- Look for signs of infection, rashes, slow healing wounds and other changes
- Antibiotics may need to be prescribed by physician
- Keeping skin clean and dry
- Turning schedule
- Adequate fluid intake
- Good hygiene
- Routine inspection
- Proper fitting equipment

Pressure Sores

- Concern for individuals with decreased mobility and their occurrence is correlated with dependence on others for ADLs
- Form at areas of bony prominence
- Develop when a person lies in bed or sits in a wheelchair for long periods of time without repositioning

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

Stages of Pressure Sores

Normal Skin

Pressure Ulcer Staging

INTEGUMENTARY

Common Skin Problems

Wounds

Abrasions

Lacerations

Pressure sores

Acne

Sweating

Rashes

Fungal and Bacterial Infections
### Stages of Pressure Ulcers

**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 the ulcer is completely obscured by slough (yellow, tan, gray, green or brown) and/or eschar (tan, brown or black) in the wound bed.

### Pressure Sores Risk Factors
- Incontinence
- Poor nutritional status
- Contractures
- Spasticity
- Use of casts and/or splints
- Sensory impairment

### COMMON INFECTIONS
- Meningitis
- Respiratory infections
- Urinary tract infections
- Surgical site infections
- Cellulitis
- Urosepsis (UTIs)

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

### NEUROLOGIC COMPLICATIONS
- Seizures
- Headache

### EARLY POST-TRAUMATIC SEIZURES (EPTS)
**RISK FACTORS**
- Severe brain injury
- Depressed skull fracture
- Penetrating head injury
- Hematomas
- Cortical contusion
- Post traumatic amnesia > 24 hours
- Chronic alcohol use
- Children and adolescents

**Detection and treatment of EPTS are necessary in order to minimize the potential for secondary brain damage.**

**The occurrence of EPTS is a strong risk factor for the development of late post-traumatic seizures (LPTS).**

### OCCURRENCE RANGES FROM 4-53%
Late Post-Traumatic Seizures (LPTS)

**RISK FACTORS:**
- Similar to those for EPTS, although LPTS are less frequently seen in children and more frequently seen in people > 65 years of age
- The strongest risk factors for LPTS are missile wounds, bilateral or multiple contusions and multiple craniotomies
- Occur later than one week after initial head trauma
- Strong predictor of recurrent seizures

Status Epilepticus

- Defined as more than 30 minutes of continuous seizure activity, or two or more sequential seizures without full recovery of consciousness between seizures

RISK FACTORS:
- 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
- Loosen tight clothing around the neck
- Do not attempt to restrain the person
- Do not give liquids during or just after the seizure
- Continue to observe the person until fully alert, checking vital signs such as pulse and respiration periodically
- Give artificial respiration if person does not resume breathing after seizure
- For Status Epilepticus call 911 within 3-5 minutes or based on physician recommendations
- For seizures that are prolonged or different from a person’s normal baseline seizure, call 911

Seizure Treatment

- **Prophylaxis** - For adult patients with severe TBI, prophylaxis with phenytoin for 7 days is effective in decreasing the risk of early post-traumatic seizures.
- Continuing antiepileptic prophylaxis (phenytoin, carbamazepine or valproate) beyond one week has not been shown to be effective in decreasing the risk of late post-traumatic seizures
- Levetiracetam is also used prophylactically

**Status Epilepticus**
- Benzodiazepines are first line treatment for this condition, as they provide rapid seizure control.

Practical Implications of Seizures

- Increased mortality
- Increased morbidity
- Risk of injury
- Can lead to disability
- Impacts employment
- Impacts driving
General

- Pain can be in the form of orthopedic injury/musculoskeletal, headache, pain due to spasticity and contracture, heterotopic ossification, myofascial pain, neuropathic pain or pain related to other medical conditions.
- Pain can disrupt the rehabilitation process with restlessness, agitation, non-compliance and sleep disturbances.
- After the event, multiple fractures, internal injuries, and shoulder injuries often produce acute pain symptoms.
- Over time, neuropathic pain secondary to nerve injuries, subluxation, tendinitis, and pain due to spasticity may emerge.
- Pain experiences can be subjective and can be acute or chronic.

Non-Headache Pain

Non-Headache Pain includes pain related to the peripheral nerve fibers. Pharmacological treatments include:

- NSAIDs: aspirin, ibuprofen, naproxen
- Acetaminophen
- Topical agents
- Anti-spasticity medications
- Opioids

Nociceptive Pain is pain related to the peripheral nerve fibers. Pharmacological treatments include:

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- Topical agents
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- Opioids

Neuropathic Pain is pain associated with primary lesion of dysfunction of the nervous system. Medications to treat neuropathic pain in persons with TBI include:

- Topical agents, opioids, tramadol, 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 (PTH)

Post-traumatic Headache is defined by the International Headache Society as a headache that commences within 14 days of consciousness. It may resolve over the next six months or symptoms may persist and become chronic.

- More prevalent in mild TBI with 95% of individuals reporting pain while only 22% of those with moderate to severe TBI reporting pain.

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.

Pain Management

Pain Management is best addressed by an interdisciplinary team with the goal of pain reduction and self-management. A comprehensive treatment plan is then developed to support the stabilization of pain generators including the design of a medication regime.

- Looking at the individual’s daily activities to ensure a balance of rest, activity, and sleep can also be important.

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.

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Types of Post Traumatic Headache

- Tension Type Headache (TTH)
- Cervicogenic
- Cranio-mandibular
- Migraine

Tension Type Headache

- Headache is bilateral head pain of pressing quality, much like that of a tight hand or vice clamping across the head
- Occur from either a neck or head muscle strain or injury
- Do not get worse with physical activity and patients do not present with other symptoms like sensitivity towards light, sound and taste

Treatment for TTH

- Episodic tension type headaches are often easily treated with NSAIDs (e.g., aspirin) or acetaminophen
- Key is to prevent a tension type headache from becoming chronic
- Therapies like low load cranio cervical mobilization and resistive exercise systems were found to be effective and recommended for long term management of both episodic and chronic tension type headaches
- Other pharmacological alternatives for headache prevention include antidepressants, anticonvulsants and botulinum toxin injections

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
- Nerve injections and freeing the nerves have been effective in treating cervicogenic headaches for a short period
- Another type of technique in which nerves are severed by burning them has been found to be effective for longer periods

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

Migraine

- Noise
- Smell
- Light
- Touch
**Migraine Presentation**

- Usually located on one side of the head
- Patients tend to complain that the headache is throbbing or stabbing/sharp, worsened with heat, bright light, excessive physical activity, and have associated nausea or vomiting
- The headache tends to have a peak of severity with resolution within 24 hours of onset, however may range anywhere from 4-72 hours

**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 Phases**

<table>
<thead>
<tr>
<th>Prodrome</th>
<th>Aura</th>
<th>Headache</th>
<th>Postdrome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Symptoms</td>
<td>Symptoms that follow headache</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Migraine abortive medications**

- Triptans
- Non-steroidal anti-inflammatory drugs (e.g., aspirin)
- Ergot derivatives
- Atypical antipsychotics
- Narcotics

It is important to note however that the initial medication for aborting the migraine is a combination of aspirin, acetaminophen, and caffeine (AAC)

**Treatment of Migraines**

- For preventative treatments, there are several medications that have been used with varying levels of efficacy
  - Tricyclic antidepressants (which have an effect inhibiting reuptake of serotonin, thus increase its availability)
  - Topiramate (inhibiting the firing of neurons of the trigeminal nerve complex)
  - Beta-blocker
  - Calcium channel blockers

- Treatments should also include controlling nausea
  - Dark room
  - Quiet environment

**Headache Symptoms**

- Character - sensation and intensity (throbbing, etc.)
- Onset - 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

**Pharmacological Treatment of Brain Injury**
**Pharmacological Treatment of Brain Injury**
- Medications work by either facilitating or inhibiting neurochemical transmitter activity
- Medications are often used in brain injury rehabilitation to enhance arousal
- Promote behavioral control and/or mood regulation after brain injury
- Treat related physical problems

**CBISs and Medications**
- **Should be prepared to:**
  - Evaluate the efficacy of medications
  - Observe for signs of side effect or allergic reaction
  - Facilitate proper administration of prescribed medications when trained

- **Should ask if medications are:**
  - Producing the desired effect?
  - ...being taken as prescribed?
  - ...still needed?
  - ...causing adverse effects (e.g., sedation, memory problems, decreased arousal, etc.) that may impede recovery?

**General First Aid**
- All staff in a facility should be trained to handle medical emergencies, and includes the following:
  - Contacting medical personnel, poison control, and the emergency services
  - Identifying emergencies
  - Administering basic first aid (e.g., minor cuts, burns, bleeding, etc.)
  - Performing the Heimlich maneuver
  - Performing cardiopulmonary resuscitation (CPR)

**Standard Precautions**
- An approach to infection control that helps prevent transmission of blood-borne pathogens
- Intended to reduce the presence of microbiological agents in a health care facility
- Reduce the spreading of contagions and risk of infection

**Medical Procedures and Related Monitoring**
- Might include:
  - Vital signs
  - Blood glucose checking with diabetics, monitor or wound care
  - Input and output monitoring
  - Toileting schedules
  - Assist individuals with CPAP equipment
Physical Complications

Chapter 9

Learning Objectives

- Be familiar with motor learning principles
- Be able to discuss the specific needs of a person with concomitant TBI and SCI
- Be able to articulate the types of coordination disorders common to persons with TBI
- Be able to distinguish between the standard of care for lower extremities as opposed to upper extremities in patients with severe spasticity
- Gain an understanding of various presentations of hydrocephalus, appropriate treatments and the risks involved in the treatment

Learning Objectives

Prevalence

- A study in 2007 of Veterans with a severe brain injury found that over 30% had ongoing physical or neuromotor abnormalities at 2 year follow up

Rehabilitation of Physical Complications

- Requires a common language (motor learning terminology)
- Requires strategic approach (motor learning principles)
- Requires understanding of various disease processes and common impairments following brain injury, including concomitant injuries (e.g., spinal cord injury)

Motor Learning Principles

Stages of Motor Learning

- Cognitive (What to do)
  - Learner acquires knowledge to perform task
- Associative (How to do)
  - Learner begins to apply and self-monitor performance of task
- Autonomous (How to succeed)
  - Learner consistently self-regulates and makes corrections to successfully perform task

Motor Learning: Considerations for Treatment Design

Performance

- Repetition of a task

Generality

- Applying a learned motor skill to a similar task to determine if it can be replicated.

Resistance to contextual change

- Motor skills should be performed in multiple and new environments

Guidance

- Care provider physically assisting with task to achieve desired movement

Feedback

- Intrinsic – (i.e., sensorimotor system like visual, vestibular, etc.)
- Extrinsic – external sensory cues (augmented feedback) – how much feedback should be given, when should it be given.
Motor Learning: Considerations for Treatment Design

- **Practice type**: different sequences of presenting information
  - Part vs. whole
  - Practice order
  - Massed vs. variable (how much rest between task practice sessions)

- **Environmental influences on motor learning**
  - Open environment - variable and changing
  - Closed: familiar with minimal or controlled distractions

Types of Hydrocephalus

**Obstructive/non-communicating**
- Occurs when there is obstruction of CSF fluid
- May occur after brain injury
- hydrocephalus ex vacuo
  - After brain injury, the injured brain tissue will cause neuronal loss and brain tissue shrinkage
  - This causes ventricles to look enlarged
  - Normal pressure hydrocephalus (NPH) may result

**Treatments and Risks**
  - Surgical placement of shunt from ventricles in the brain to abdominal cavity
  - Promotes flow of CSF
  - Over-drainage of CSF will cause headache or possible brain bleed; under shunting will cause re-emergence of hydrocephalus symptoms
  - Other risks include fever, neck stiffness, or change in level of alertness; this requires immediate medical attention

Spasticity

- An increase in tonic stretch with exaggerated tendon reflexes
- Sudden firing or extending of a limb which is not voluntary
- Can occur with minimal triggers like movement of the limb, stretching
- Characterized by increased muscle tone, exaggerated tendon reflexes and clonus
- Occurs after damage to the upper motor neurons

**Spasticity: Treatment Options**
  - Remove irritating factors (noxious stimuli) that may cause increased spasticity
  - Oral antispasmodics
    - Baclofen
    - Dantrium
    - Diazepam
    - Tizanidine
  - Monitor for sedating effects
    - Drowsiness, fatigue
  - Intrathecal Baclofen (ITB) pump
    - Implanted reservoir that delivers baclofen at the spinal level
    - Considered the standard of care for severe spasticity
    - Typically is not considered until at least 1 year post injury
    - Greater effect on lower extremities
  - Neurotoxins
    - Botox® injections
    - Phenol injections
Spasticity Management

Treatment of spasticity should include different therapeutic interventions. In addition to medications, occupational and physical therapists address secondary complications of spasticity:

- This includes prevention of contractures and skin breakdown along with provide interventions addressing positioning.
- Treatment of spasticity should be multimodal.
- Consider a combination of options in order to 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.

**Identification**
- Surface around affected joint may become red or swollen with possible increased pain, decreased range of motion and/or spasticity.
- Lab studies and x-rays will detect HO.

**Intervention**
- Medications used might include Etidronate disodium or NSAIDS.
- Surgery may be required once the abnormal bone has matured and maximal recovery has occurred.

Vascular Thrombosis

Deep vein thrombosis (DVT) occurs when a blood clot (thrombus) forms in one or more of the deep veins in your body, usually in the leg. Deep vein thrombosis can cause leg pain or swelling, redness, or fever but may occur without any symptoms.

- Occurs often after immobility.
- Prophylaxis includes anti-coagulants like Heparin, Lovenox or Coumadin.
- Without prophylaxis, a pulmonary embolus (PE) or clot to the lungs can occur; this may interfere with breathing and can lead to death.

Cranial Nerve Dysfunction

The cranial nerves are a vital part of the nervous system and are responsible for controlling various functions in the body. Dysfunction of these nerves can lead to a variety of symptoms. The cranial nerves are:

- 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 (XII)
- Hypoglossal nerve (XIII)

**MAY CAUSE:**
- Visual disturbance (acuity, diplopia, CN VI palsy).
- Facial drooping.
- Postural instability.
- Dysphagia.
- Autonomic dysregulation.

Somatosensory Issues

The somatosensory system pertains to touch and can be impacted by TBI. This system sends nerve impulses regarding:

- Proprioception.
- Tactile sensation.
- Thermal sensation.
- Pressure sensation.
- Pain.

Essential TIP!

Pulmonary embolism is the 3rd leading cause of death in those who survive the first day.
**Functional Movement Dysfunction**

- Overall mobility
  - Bed mobility
  - Transfers - moving from one surface to another
  - Gait - walking, including community mobility (wheelchair or walking)
  - Balance - required for basic and complex mobility functions

- Object manipulation
  - Reaching
  - Grab/release
  - Object with one or both hands (bimanual)

**Coordination Disorders**

- **Interlimb Coordination**
  - When the corpus callosum damaged, motor impairments that affect upper extremities as well as bimanual coordination can occur
  - These motor impairments can affect timing, sequencing and force production

- **Ataxia**
  - When injury to the cerebellum occurs, motor impairments are characterized by lack of muscle coordination during voluntary movements
  - May include trunk-affecting posture; facial muscles affecting swallowing

**Coordination Disorders**

- **Athetoid**: slow, involuntary, convoluted, writhing movements of the fingers, hands, toes, and feet and in some cases, arms, legs, neck and tongue
- **Ballisms**: quick flailing movements
- **Choreiform**: continuous rapid and unpredictable movements
- **Tremors**: unintentional trembling or shaking movements in one or more parts of the body

**Terms of Visual Function**

<table>
<thead>
<tr>
<th>Visual Function</th>
<th>Description</th>
</tr>
</thead>
<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, 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>Vestibuloocular reflex (VOR) to maintain gaze during head turning</td>
</tr>
</tbody>
</table>

**Visual Perception or Interpretation Deficits**

- **Visual Acuity**
- **Spatial Relation**
- **Body Schema**
- **Agnosia**

**Perception or Interpretation Disorders**

- **Sensation and Perception are commonly confused**
  - **Sensation** is appreciation of stimuli through senses, and peripheral cutaneous and internal receptors
  - **Perception** incorporates sensation and interprets information
Vision Issues

- The visual system is one of the most complex and redundant systems of the brain.
- Visual impairments include:
  - Visual field loss
  - Decreased visual acuity
  - Decreased contrast sensitivity

Types of Perceptual Deficits

Body Schema / Body Image Disorders

- Unilateral neglect: not integrating stimuli from one side of body or environment
- Anosognosia: lack of awareness or denial of paralysis or of a limb itself
- Right/left discrimination: cannot identify one's own left and right or distinguish these with verbal commands
- Somatognosia: lack of awareness of body structure and body part relationship

Spatial Relation Disorders

- Form discrimination: Challenges with objects if in different orientation or close in shape (pen and toothbrush)
- Spatial relations disorder: inability to perceive relationships between objects or between one self and object (i.e., difficulty crossing midline)
- Vertical disorientation: noted in posture for balance, difficulty maintaining upright position
- Depth and distance perception: inaccurately judging depth, distance and direction

Figure-ground discrimination: cannot determine a figure from its background

Types of Perceptual Deficits

Agnosia

- Visual Object Agnosia: inability to recognize objects visually
- Auditory Agnosia: inability to distinguish between different sounds unrelated to speech; for example the difference between a doorbell and alarm
- Tactile Agnosia: inability to recognize an object through touch and manipulation

Types of Perceptual Deficits

Apraxia

- Ideomotor Apraxia: inability to perform a task on command or imitate gestures
- Ideational Apraxia: inability to perform tasks automatically and on command
- Buccofacial apraxia: limitations in performing purposeful movements of the lips, cheeks, tongue, larynx and pharynx

Types of Perceptual Deficits

- CONCOMITANT TBI AND SPINAL CORD INJURY (SCI)
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).

<table>
<thead>
<tr>
<th>SCI &amp; TBI</th>
<th>SCI Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>60%</td>
<td>40%</td>
</tr>
</tbody>
</table>

SCI Considerations

- Skin care needs below level of injury
  - Skin is vulnerable to pressure sores due to lack of sensation and pressure over bony prominences.
  - Requires skin inspection by patient or caregiver particularly over bony prominences twice per day.
  - May need reminders due to cognition and caregiver help due to diminished mobility.

Bowel care needs

- Bowel function controlled by the sacral spinal nerves.
  - When SCI occurs, bowel control may lead to incontinence without intervention.

SCI above T12
- Sensation may be lacking, but the anal sphincter remains tight.
- This is called an upper motor neuron or reflex bowel.
- Continent evacuation can be stimulated through a bowel routine procedure.

SCI below T12
- The defecation reflex and anal sphincter muscle may be affected.
- Management of this type of bowel problem may require the implementation of a bowel program with greater frequency.

Bladder care needs

- Bowel function is also dependent on the level of SCI.
  - The information cannot travel between the spinal cord and brain when there is an SCI.
  - Depending on the level of injury, the individual either experiences:
    - A reflex or spastic bladder (upper motor neuron injury).
    - A flaccid bladder (or lower motor neuron injury).
  - Goals of bladder management include urinary tract infection prevention, maintaining low residuals in bladder and continence.

Bladder Management after SCI

- The type of bladder will dictate type of management.
- Types include Foley or suprapubic catheterization (tube in bladder).
- External catheterization; condom catheters - a collection device.
- Intermittent catheterization - catheterizing several times per day.
- Spontaneous voiding - may require external collecting device.
- Stimulated voiding - voiding is mechanically stimulated through anal stretching or tapping.
- Surgical procedures.

Disorders of Consciousness

Chapter 5
Learning Objectives

- Be able to describe the appropriate use of goal-setting for the person with DOC
- Be able to provide examples of the modalities of sensory stimulation
- Distinguish between diagnostic criteria for coma, vegetative state, and minimally conscious state
- Be able to articulate the methods of physical management for the person with DOC
- Be able to identify the methods of medical management for the person with DOC
- Be able to provide examples of the modalities of sensory stimulation
- Gain an understanding of disorders of consciousness (DOC)

Disorders of Consciousness

Classification System

- 3 Generally accepted levels
- Injury
- Coma
- Vegetative
- Minimally Conscious

Incidence and Prevalence

- Vegetative State
  - 4,200/year in the U.S.
  - Estimated 315,000 persons living with a DOC in U.S.

Past and Present Perspectives

Past Assumption of Poor Prognosis

- Brain was a physiologically static structure
- Neurons, once damaged do not repair or recover

Emerging Assumption

- Individuals with DOC have potential for long term recovery
- Neuroplasticity, coined in 1969
- Cases of recovery for DOC
- Neuroimaging has lead to better understanding of DOC

Disorders of Consciousness

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

Arousal

- Primitive and involuntary response to both internal and external stimuli
- Maintained by the reticular activation system (RAS), a collection of primitive structures and nerve pathways within the brain

Rainbow Rehabilitation Centers
Awareness

- Ability to receive and process sensory information
- Use sensory information to relate to the outside world
- Required for voluntary response
- Regulated by higher cortical areas in cerebrum

Disorders of Consciousness

- Recovery occurs over weeks, months, or longer
- Fluctuations in arousal and awareness affected by changes in medical status
- Recovery is evaluated through behavioral signs

Disorders of Consciousness

### DOC Subcategory

<table>
<thead>
<tr>
<th>Subcategory</th>
<th>Arousal</th>
<th>Awareness</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coma</td>
<td>No</td>
<td>No</td>
<td>Weeks</td>
</tr>
<tr>
<td>Vegetative State</td>
<td>Yes</td>
<td>No</td>
<td>Months to years</td>
</tr>
<tr>
<td>Minimally Conscious State</td>
<td>Yes</td>
<td>Fluctuates</td>
<td>Months to years</td>
</tr>
</tbody>
</table>

**Diagnostic Criteria: Coma**

- No arousal/eye-opening
- No behavioral signs of awareness
- Impaired spontaneous breathing
- Impaired brainstem reflexes
- No vocalization > 1 hour

**Coma usually resolves in 2-4 weeks with the individual passing away or resolving into VS or MCS**

**Diagnostic Criteria: Vegetative State**

- Arousal/spontaneous or stimulus induced eye opening
- No behavior signs of awareness
- Preserved spontaneous breathing
- No purposeful behaviors
- No language production or comprehension

**Diagnostic Criteria: Minimally Conscious State**

- Arousal/spontaneous eye-opening
- Fluctuating but reproducible behavioral signs of awareness
- Response to verbal directive
- Environmentally-contingent smiling or crying
- Object localization and manipulation
- Sustained visual fixation and pursuit
- Verbalizations
- Intentional but unreliable communication
- Emergence from MCS: functional communication, functional object use

**Presentation (partial or complete) of hypothalamic and brain stem autonomic functions**

- May grimace to pain, localize to sounds inconsistently
- Atypical visual fixation, response to threat, inappropriate single words

**Preservation (partial or complete) of hypothalamic and brain stem autonomic functions**

- May grimace to pain, localize to sounds inconsistently
- Atypical visual fixation, response to threat, inappropriate single words
**Emergence from DOC**

At least one behavior present to meet criteria to be classified as out of DOC:
- Communication (verbal or gestural – yes/no)
- Use of two or more objects

**DOC: Medical Management Goals**

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

**DOC: Medical Management**

- **KEEP LUNGS AND AIRWAY CLEAR**
  - Tach tube to clear secretions
  - Sleep apnea – obstructive
  - Central
  - Aspiration

- **KEEP BLADDER AND BOWEL HEALTHY**
  - Incontinence
  - Constipation
  - Infection
  - Skin breakdown

**DOC: Medical Management**

- Autonomic Dysfunction Syndrome (ADS)

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

**ADS: Behavioral Signs**

- Dystonia (posturing) episode
- Agitation
- Tachycardia (rapid heartbeat)
- Diaphoresis (sweating)
- Hyperthermia (high temp)
- Hypertension (high blood pressure)
- Tachypnea (rapid breathing)

**ADS: Treatment**

- Environmental Control
  - Light? Sound? Aggravating movements?
- Pharmacological Intervention
  - Propranolol
  - Gabapentin
  - Clonidine
  - Bromocriptine
  - Dantrolene
  - Morphine
DOC: Pharmacologic Neuromodulation

- Medications to affect arousal and awareness
  - Antidepressants
  - Dopaminergic agents
  - Drugs to treat ADHD

Neurobehavioral Assessment

- ACCURATE DIAGNOSIS
- CAREGIVER EDUCATION
- TREATMENT PLANNING
- PROGNOSIS

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

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Spontaneously</td>
</tr>
<tr>
<td>3</td>
<td>To speech</td>
</tr>
<tr>
<td>2</td>
<td>To pain</td>
</tr>
<tr>
<td>1</td>
<td>No response</td>
</tr>
<tr>
<td>5</td>
<td>Oriented to time, person &amp; place</td>
</tr>
<tr>
<td>4</td>
<td>Confused</td>
</tr>
<tr>
<td>3</td>
<td>Inappropriate words</td>
</tr>
<tr>
<td>2</td>
<td>Incomprehensible sounds</td>
</tr>
<tr>
<td>1</td>
<td>No response</td>
</tr>
<tr>
<td>6</td>
<td>Obey commands</td>
</tr>
<tr>
<td>5</td>
<td>Move to localized pain</td>
</tr>
<tr>
<td>4</td>
<td>Flex to withdraw from pain</td>
</tr>
<tr>
<td>3</td>
<td>Abnormal fixation</td>
</tr>
<tr>
<td>2</td>
<td>Abnormal extension</td>
</tr>
<tr>
<td>1</td>
<td>No response</td>
</tr>
</tbody>
</table>

Standardized Assessment Tools

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

Neurobehavioral Assessment

- Why Rate DOC?
  - Objective measure of function
  - Care giver education
  - Outcome prediction
  - Allow professionals to identify most effective targets for treatment

- Challenges to Rating
  - Medications
  - Medical Complications (ADS, seizures)
  - Sensorimotor involvement (apraxia, hearing)
  - Communication/cognitive deficits

DOC: Rehabilitative Goal Setting

- Traditional Rehab Candidate
  - Based on a functional skill
  - Created in collaboration with the individual
  - Individual is an active participant
  - Individual has some level of volitional control

- Individual with DOC
  - Based on responses to stimuli
  - Individual is not able to participate
  - Individual is a passive participant
  - Individual does not have volitional control
### Goal Setting: Considerations

<table>
<thead>
<tr>
<th>Goal Type</th>
<th>Considerations/Examples</th>
</tr>
</thead>
</table>
| **Response Based**            |  Bear the goal on the response types exhibited by the person (no response / generalized response / localized response)  
  If the person currently responds to auditory stimuli in a generalized way, the logical goal progression would be to the localized response level. |
| **Tolerance for Stimuli or Intervention** |  Bear the goal on the level of tolerance exhibited by the person for a given intervention (see signs of distress in the ADS section of this chapter)  
  If the person begins to exhibit signs of distress after a given intervention has been administered for 5 minutes, a logical goal might be to progress tolerance to 10 minutes. |
| **Risk Management**           |  There are a number of interventions designed to reduce risk for physical complications (see physical management section of this chapter)  
  Goals based on these interventions are very appropriate for persons with DOC |
| **Caregiver Development**     |  Goals related to the education and training of caregivers within the person’s support system are integral in ensuring person-centered care  
  Some examples might include training in the appropriate administration of sensory stimulation, monitoring for signs of distress, and follow-through with physical management interventions such as range of motion. |

### Common Goals: Sensory Stimulation and Regulation Programs

- Increase level of alertness and arousal through stimulation of the RAS
- Facilitate increased response frequency and consistency through structurally planned sensory input
- Prevent sensory deprivation associated with prolonged immobility and dependence
- Facilitate the ability to follow commands and to communicate meaningfully

### Sensory Stimulation Modalities

<table>
<thead>
<tr>
<th>Sensory Modality</th>
<th>Intervention Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual (seeing)</td>
<td>Direct family 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 shampoo, cologne or perfumes, spices, and environmental scents</td>
</tr>
<tr>
<td>Gustatory (tasting)</td>
<td>Lemon swabs, 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 risk</td>
</tr>
<tr>
<td>Proprioceptive / Vestibular (moving)</td>
<td>Movement of the body in space as well as the awareness of the position and movement of body parts, and inclinations of motion, hand-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., corduroy, sandpaper, silk)</td>
</tr>
</tbody>
</table>

### Sensory Stimulation Protocols

- Low distraction environment
- Present stimuli one at a time
- Allow time for response
- Vary stimuli
- Do not overstimulate

### 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 stimulus)
- 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
Persons with DOC offer professionals the unique opportunity to witness some of the most fascinating and inspirational recoveries in medicine.

Fatigue and Sleep Disturbance

Chapter 7

Learning Objectives

- Distinguish between excessive daytime sleepiness (EDS) and fatigue
- Be familiar with the types of instruments to measure fatigue
- Describe physiological changes which contribute to sleep disturbances after TBI
- 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 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.

Impact of Fatigue

- Persists for years after a moderate to severe injury
- May be associated with muscle weakness or other changes in the peripheral nervous system
- Impacts everyday life-work, school, social interactions, and leisure
- Causes decreased energy
- Leads to isolation, depression
- Many people (32-73%) report experiencing fatigue and sleep disturbances after a brain injury
- Fatigue is a phenomenon which is not well understood
- No well-established treatments

FATIGUE
Types of Fatigue

- **Physiological Fatigue**
  - May be due to a possible depletion of energy, hormones, neurotransmitters, or reduction in the number of neural connections.
  - Is a direct result of brain injury or brain dysfunction.

- **Psychological Fatigue**
  - Is a state of weariness related to reduced motivation, prolonged mental activity or boredom that occurs with chronic stress, anxiety or depression.
  - This is relevant as a high proportion of people with brain injuries experience depression and anxiety.

Primary Fatigue

- Fatigue resulting directly from injury or disease.
  - Direct result from a diffuse injury affecting brain centers which control arousal, attention, and response speed.
  - Includes injuries to:
    - Ascending reticular activating system (ARAS)
    - Limbic system
    - Anterior cingulate
    - Middle frontal area
    - Basal ganglia area

Secondary Fatigue

- Occurs from factors that exacerbate fatigue such as:
  - Sleep disturbances
  - Pain
  - Stress
  - Anxiety
  - Depression
- Fatigue after brain injury is often a combination of these influences.

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.
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.

Sleep Disturbances

PAIN
NAP
MELATONIN
REM SLEEP

Causes of Sleep Disturbances

- Daytime napping
- Pain, depression and anxiety
- Possible disruption of the circadian rhythm and melatonin synthesis
- Changes in REM (Rapid Eye Movement) sleep

COMMON SLEEP DISORDERS

Narcolepsy
- Characterized by repeated episodes of naps or laps into sleep of short duration usually less than one hour

Sleep Apnea Syndromes
- Characterized by repetitive episodes of upper airway obstruction that occur during sleep (Obstructive) or characterized by the decreasing or stopping of breaths during sleep (Central)

Post-Traumatic Hypersomnia
- Excessive sleepiness that occurs as a result of a traumatic event involving the central nervous system

Periodic Limb Movement Disorder
- Characterized by periodic episodes of repetitive and highly stereotyped limb (usually leg) movements that occur during sleep

Insomnia
- Characterized by difficulty falling asleep, frequent awakenings with difficulty then falling back to sleep (>30 minutes) and a feeling of daytime fatigue and/or difficulty getting through the day

Diagnosis

Sleep disorders are diagnosed through sleep history to include specific complaints, sleep wake patterns (pre and post injury), sleep symptoms and daytime consequences related to poor sleep.

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

Treating Sleep Disturbances

- Lifestyle modifications: Exercise, regular sleep schedule, avoiding naps, limiting fluid before bed and decreasing caffeine
- Relaxation training, guided imagery, cognitive behavioral therapy to clarify the individual’s beliefs about sleep, sleep hygiene education
- Both prescription and OTC medication
- Devices for apnea: CPAP, oral appliances
### Practical Implications

Sleep disturbance can impact:
- Attention
- Processing speed
- Medications
- Pain
- Mood
- Sleep changes

### Strategies to Improve Energy

#### PHYSICAL
- 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 Hygiene

- Techniques to improve quality of sleep
- Adherence to a regular sleep time
- Avoidance of naps
- Avoidance of time in bed, when awake

### Other Interventions

#### Sleep study
- Identifies presence and causes of sleep disturbances
  - For short term use
  - May cause side effects (daytime sedation)
  - Wake promoting (e.g., Modafinil)

#### Bright light therapy
- Has potential to reduce sleepiness, promote arousal, increase vigilance, performance and improve mood

---

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