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# *Traumatic Brain Injury: A Nursing Guide for Rehabilitation Part 1*


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## Objectives

- Discuss the prevalence, causes, and demographics of traumatic brain injuries (TBIs).
- Be able to classify and define TBIs.
- Identify assessment tools that will assist in caring for a TBI patient.
- Identify common structural functions of the brain and how injury affects those structures.

## Incidence of Traumatic Brain Injury

- Approximately 2.87 million TBI-related to emergency department visits and deaths annually
  - over 837,000 of those were children
  - approximately 56,800 of those with TBI died, including 2,529 children

## Incidence of Traumatic Brain Injury

- Approximately 288,000 were hospitalized including over 23,000 children (these were TBIs with/without other injuries)
- 5.3 million living with disability as a result of a TBI

## Causes of Traumatic Brain Injury

- Falls 48%
  - 49% of children between 0-17 years of age
  - 81% of adults over 65; leading cause of death for this age group
- Struck by or against something

## Causes of Traumatic Brain Injury

- Motor vehicle accidents (MVA): leading cause of death for persons 15-35
- Intentional self-harm (leading cause of death for persons 45-64) assaults/homicide

## Demographics

- Average age of TBIs
  - 0-4 years
  - 15-19 years
  - >75 Years
- Males comprise approximately 59% of TBIs
- Military personnel
- Incarcerated persons
- 30-60% of injured patients are alcohol/intoxication-related

## Definition of Traumatic Brain Injury

- A disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head or a penetrating head injury (Marr and Coronado, 2004)

## Definition of Traumatic Brain Injury

- Observing one of the following clinical signs constitutes an alteration in brain function (Menon, Schwab, Wright, and Maas, 2010):
  - any period of loss of or decreased consciousness
  - any loss of memory for events immediately before (retrograde amnesia) or after the injury (post-traumatic amnesia)

## Definition of Traumatic Brain Injury

- Observing one of the following clinical signs constitutes an alteration in brain function (Menon, Schwab, Wright, and Maas, 2010):
  - neurologic deficits such as muscle weakness, loss of balance and coordination, disruption of vision, change in speech and language, or sensory loss
  - any alteration in mental state at the time of the injury such as confusion, disorientation, slowed thinking, or difficulty with concentration

## Types of Traumatic Brain Injury: Nature of Injury

- Diffuse axonal injury
- Concussion
- Contusion
- Coup-contrecoup injury
- Penetration injury
- Second impact syndrome
- Non-traumatic brain injuries or acquired brain injuries

## Types of Brain Injuries: Primary and Secondary

- Primary injury - the initial injury that results from the trauma
- Secondary injury - second injury that results from complications from the trauma

## Types of Brain Injuries: Primary and Secondary

Examples:

- swelling of the brain tissue
- edema causing increased intercranial pressures
- drop in blood pressure causing decreased blood flow to the brain

## Types of Brain Injury: Focal or Diffuse

- Focal (localized)
  - only one area of the brain is injured
  - example: penetrating injuries

## Types of Brain Injury: Focal or Diffuse

- Diffuse (widespread)
  - several areas of the brain are injured
  - most severe
  - usually result of injury that “shakes up” the brain
  - tearing of multiple nerve tissues that lead to secondary brain injuries
  - most common causes: coup-contrecoup injuries, motor vehicle accidents, shaken baby syndrome

## Assessment of a Brain Injury: Glasgow Coma Scale

Printer-friendly graphics are available online in the course support materials

| ADULT | | INFANT |
|---|---|---|
| **Eye opening** | **E** | **Eye opening** |
| Spontaneous | 4 | Spontaneous |
| To speech | 3 | To speech |
| To pain | 2 | To pain |
| No response | 1 | No response |
| **Best motor response** | **M** | **Best motor response** |
| Obeys verbal command | 6 | Normal movements |
| Localizes pain | 5 | Localizes pain |
| Flexion - withdraws from pain | 4 | Withdraws from pain |
| Flexion - abnormal | 3 | Flexion - abnormal |
| Extension | 2 | Extension |
| No response | 1 | No response |
| **Best verbal response** | **V** | **Best verbal response** |
| Oriented and converses | 5 | Coos, babbles |
| Disoriented and converses | 4 | Cries but consolable |
| Inappropriate words | 3 | Persistently irritable |
| Incomprehensible sounds | 2 | Grunts to pain/restless |
| No response | 1 | No response |

## Assessment of a Brain Injury: Glasgow Coma Scale

- 3 scores are given in the area of
  - eye response 1-4
  - verbal response 1-5
  - motor response 1-6

## Assessment of a Brain Injury: Glasgow Coma Scale

- Overall score will be 3-15
  - mild TBI = 13-15
  - moderate TBI = 9-13
  - severe TBI <8
- It is best reported as an overall score with the components broken out (i.e., E3V3M5=GCS 11)

## Mild TBI:  GCS 13-15

- Concussions
- Brief loss of consciousness (seconds to minutes)
- Testing and scans appear normal

## Mild TBI: GCS 13-15

- Diagnosed by symptoms:
  - headache
  - fatigue
  - sleep disturbances
  - irritable/emotional/anxiety/depression
  - light and/or noise sensitive

## Mild TBI: GCS 13-15

- Diagnosed by symptoms:
  - balance problems
  - decreased concentration and/or attention span
  - decreased speed of thinking
  - memory problems
  - nausea

## Moderate TBI: GCS 9-12

- Loss of consciousness lasting from a few minutes to hours
- Confusion for days to weeks
- Physical, cognitive, and/or behavioral impairments last for months or may be permanent
- Can usually make a good recovery with appropriate rehabilitation education on how to compensate for their deficits

## Severe TBI: GCS 8 or Less

- Prolonged unconscious state that lasts days, weeks, or months

## Severe TBI: GCS 8 or Less

- Severe TBI is further categorized into subgroups with separate features:
  - coma - unconscious, cannot be awakened, no sleep/wake cycle, no meaningful response to stimuli, no voluntary activity, no awareness of environment

## Severe TBI: GCS 8 or Less

- Severe TBI is further categorized into subgroups with separate features:
  - vegetative state - can be aroused, but not able to interact with environment, eye opening spontaneous or in response to stimuli, generalized response to pain (heart rate, respirations), sleep-wake cycles, respiratory function, and digestive function return

## Severe TBI: GCS 8 or Less

- Severe TBI is further categorized into subgroups with separate features:
  - minimally responsive state - distinct behavioral signs of consciousness such as following basic commands, intelligible verbalizations, yes/no responses or gestures, non-reflexive emotional or motor behavior in response to environmental stimuli

## Severe TBI: GCS 8 or Less

- Severe TBI is further categorized into subgroups with separate features:
  - locked-in syndrome - eye movement present and may be the only form of communication, basic cognitive functioning evident on exam, clinically quadriplegic, often the result of damage in the pons area of the brain

## Assessment of TBI: Rancho Los Amigos Level of Cognitive Functioning

Level 1: no response, person appears to be in deep sleep

Level 2: generalized response, person reacts inconsistently, not directly in response to stimuli

Level 3: Localized response, reacts inconsistently, directly to stimuli

## Assessment of TBI: Rancho Los Amigos Level of Cognitive Functioning

Level 4: confused/agitated, person is extremely confused and agitated

Level 5: confused-inappropriate/non-agitated, person is confused, and responds inaccurately to commands

Level 6: confused-appropriate, person is confused, responds accurately to commands

Level 7: automatic-appropriate, person goes through daily routine with minimal confusion

## Assessment of TBI: Rancho Los Amigos Level of Cognitive Functioning

- Level 8: purposeful-appropriate, person has functioning memory responsive to environment, may display depression
- Level 9: purposeful-appropriate, goes through daily routine aware of need for stand-by assistance, depression may continue
- Level 10: purposeful-appropriate, goes through daily routine but may require more time or compensatory strategies, periodic depression may occur

## Assessment of TBI: Rancho Los Amigos Level of Cognitive Functioning

- Pediatric scale- for children and adolescents
  - Level V:
    - no response to stimuli
    - complete absence of observable change in behavior to visual, auditory, or painful stimuli

## Assessment of TBI: Rancho Los Amigos Level of Cognitive Functioning

- Pediatric scale- for children and adolescents
  - Level IV:
    - gives generalized response to sensory stimuli
    - gives generalized startle to loud sound
    - responds to repeated auditory stimulation with increased or decreased activity
    - gives generalized reflex response to painful stimuli

## Assessment of TBI: Rancho Los Amigos Level of Cognitive Functioning

- Pediatric scale- for children and adolescents
  - Level III:
    - gives localized response to sensory stimuli
    - blinks when strong light crosses field of vision
    - follows moving object passed within visual field; turns toward or away from loud sound
    - gives localized response to painful stimuli

## Assessment of TBI: Rancho Los Amigos Level of Cognitive Functioning

- Pediatric scale- for children and adolescents
  - Level II:
    - demonstrates awareness of environment
    - follows simple commands
    - refuses to follow simple commands by shaking head or saying “no”; imitates examiner’s gestures or facial expressions

## Assessment of TBI: Rancho Los Amigos Level of Cognitive Functioning

- Pediatric scale- for children and adolescents
  - Level II:
    - responds to name
    - recognizes mother or other family members
    - enjoys imitative vocal play

## Assessment of TBI: Rancho Los Amigos Level of Cognitive Functioning

- Pediatric scale- for children and adolescents
  - Level I:
    - oriented to self and surroundings
    - provides accurate information about self; is aware of being away from home
    - knows where toys, clothes and other objects are kept
    - actively participates in treatment program
    - recognizes own room, knows way to bathroom, nursing station, etc., is potty-trained

## Assessment of TBI: Rancho Los Amigos Level of Cognitive Functioning

- Pediatric scale- for children and adolescents
  - Level I:
    - shows active interest in toys; will examine or manipulate before mouthing or discarding
    - watches other children at play; may move toward them purposefully to watch or snatch a toy
    - initiates social contact with adult; enjoys socializing

## Parts of the Brain: Forebrain, Midbrain, Hindbrain

- All parts of the brain are interconnected and work together
- Some parts of the brain contribute to the same functions
- Injuries to different parts of the brain have different presentations in traumatic head injury
- It is important to know functions of different parts so that you can anticipate the needs and interventions for the patient with the corresponding injury

## Hindbrain

- Located at the base of the brain
- Includes the cerebellum, the medulla, and the pons
- These structures control or influence some motor functions and vital autonomic responses such as breathing, heartrate, and sleep

## Hindbrain: Medulla

- This is the topmost portion of the spinal cord (connects the spinal cord to the brain)
- Controls vital voluntary bodily functions like swallowing, coughing, and heart rate
- Some parts of the medulla also are involved with sensations like touch and pressure

## Hindbrain: Reticular Formation

- Above the medulla
- Functions:
  - assists with smooth muscle activity
  - postural reactions and tone
  - wakefulness
  - alertness and reactivity (fight or flight)

## Hindbrain: Cerebellum

- About the size of a tennis ball
- Contains approximately 80% of the brain's neurons while only being about 10% of the brain's mass
- Functions
  - coordinates fine muscle movements
  - regulates posture and balance

## Hindbrain: Cerebellum

- Although the commands for the movements occur in other higher parts of the brain, the cerebellum organizes and adjusts muscle activities to help make those movements smooth and precise
- It tells which muscles to move and just how much to move

## Hindbrain: Cerebellum

- The cerebellum is involved in activities that require rapid skilled sequences of movements (like speaking, typing, riding a bike) as well as normal everyday activities like picking up a cup and bringing it to your mouth to drink
- The cerebellum is involved with learning and memory that is associated with movement

Example: When we learn to walk or ride a bike, those detailed control activities are stored within the cerebellum

## Hindbrain: Pons

- Small bundle of neural tissue at the top of the medulla
- Functions:
  - involved in sleeping and dreaming
  - helps control breathing and other muscle movements
  - connects parts of the brain to one another by relaying messages between the cerebral cortex and the cerebellum and between the medulla and the midbrain

## Midbrain

- The central part of the brain
- Is only about 2.5cm long
- Connects upper and lower brain areas

## Midbrain

- Functions
  - involved with movement
  - sleep and arousal
  - visual
  - auditory
  - tactile sensory information

## Midbrain

- Receives information from the eyes and ears and helps produce orientation through movements

Example:

## Forebrain

- Largest and most important part of the brain
- Is connected to the midbrain and hindbrain to coordinate brain activity
- Includes the hypothalamus, thalamus, and cerebrum

## Forebrain

- Together with other structures, the forebrain regulates complex cognitive processes such as:
  - memory
  - learning
  - perception
  - personality
  - emotion

## Forebrain: Hypothalamus

- Vital in maintaining the body's internal homeostasis
- Is part of the limbic system
- Takes part in many aspects of our behavior
- Functions:
  - regulates the release of hormones from various glands
  - influences behaviors associated with basic biological needs such as hunger, thirst, and sleep
  - involved in emotions such as anger, fear

## Forebrain: Thalamus

- Filters information from almost all the sense receptors and passes it on to the relevant areas of the brain for further processing
- Basically all sensory organs (eyes, skin, ears) send information to the thalamus which sends that information on to the correct part of the brain to be interpreted
- Constantly filters large amounts of information coming from sensory receptors and then chooses which information is most important to be interpreted by the brain

## Forebrain: The Cerebrum

- This is the largest portion of the brain that we refer to as the lobes of the brain
- Is responsible for almost everything we think, feel, and do
- Divided into 2 halves called cerebral hemispheres
- The two hemispheres are connected by the corpus callosum, which allows for exchange of information between the two hemispheres

## Forebrain: Cerebellum: Lobes of the brain

- Frontal lobe
  - largest lobe - one of the most commonly injured due to location and size

## Forebrain: Cerebellum: Lobes of the brain

- Frontal lobe
  - responsible for:
    - emotional responses
    - behavior and judgement
    - attention
    - Broca's area- responsible for the motor activities required to speak
    - also assists with limb strength and coordination of movements

## Forebrain:  Cerebellum:  Lobes of the brain

- Parietal lobe
  - integrates the motor, sensory, and attention
  - disengagement of attention in order to re-engage
  - Short-term memory
  - logical features of memory

## Forebrain:  Cerebellum:  Lobes of the brain

- Temporal lobe
  - information processing
  - auditory memory
  - complex perceptual organization
  - memory
  - language
  - emotional processing- anxiety, depression, and delusions
  - Wernicke's area-comprehension of speech

## Forebrain:  Cerebellum:  Lobes of the brain

- Occipital lobe
  - primary visual pathways
  - spatial analysis and  orientation
  - visual perceptions of shapes and patterns

## Brain Injury Rehabilitation:  A Team Effort

## Recovery from TBI

- Nature of the injury
- Physical condition
- Extent of injury
- Location of injury
- Psychosocial background
- Sex of the patient
- Family support and perception
- Age of the patient
- Duration of the lesion

## Conclusion

- We have discussed the prevalence, causes, and demographics of TBI
- Reviewed the ways to classify and define TBIs
- We have identified common structural functions of the brain and how injury affects those structures

In Part 2 we will:

- Identify techniques to utilize with a TBI during rehabilitation
- Identify common obstacles met during brain injury rehabilitation
- Understanding the physical, cognitive, and behavioral aspects of brain injury rehabilitation
- Identify the need for a team approach for brain injury rehabilitation

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