Traumatic Brain Injury (TBI)

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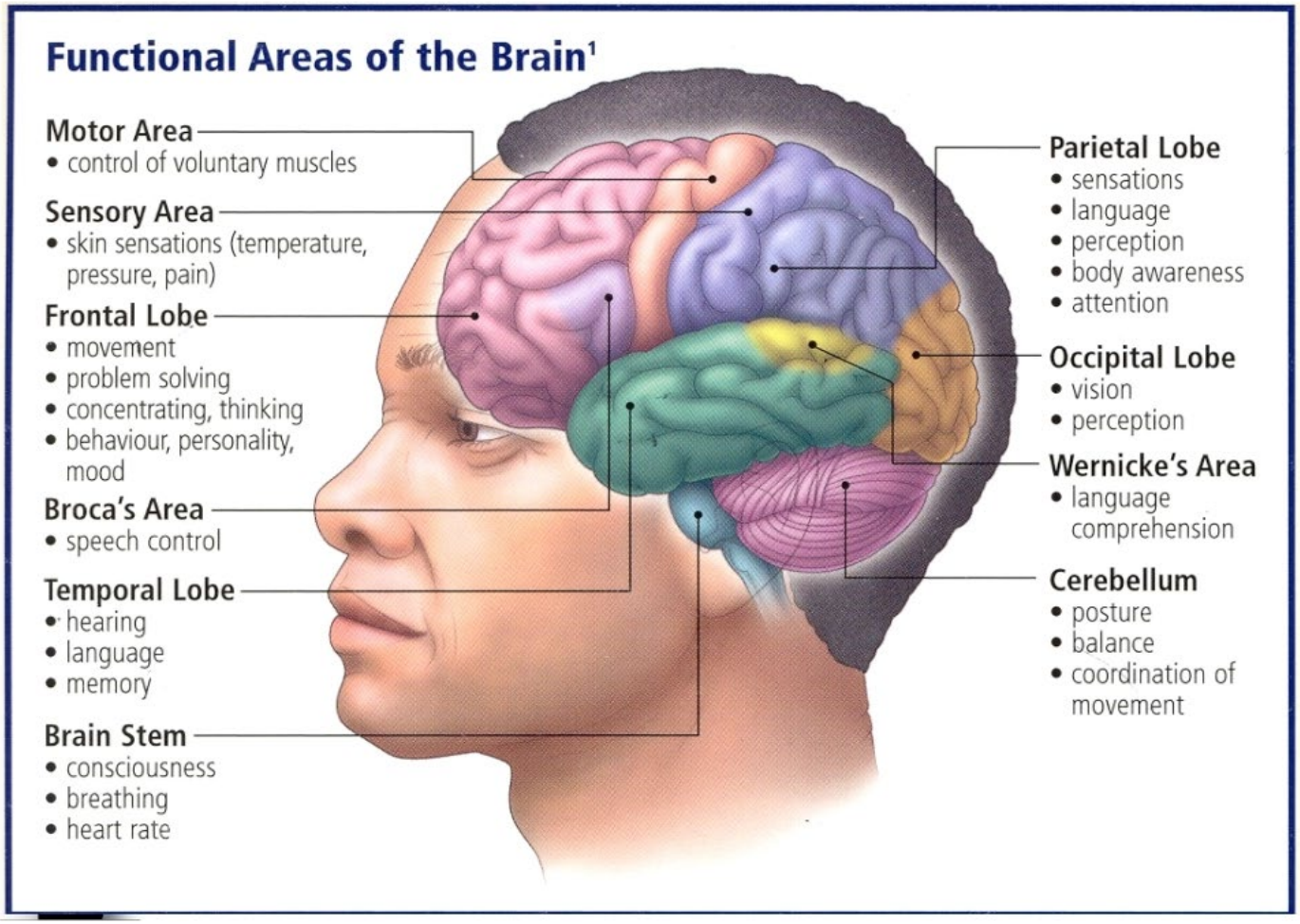
NeuroRestorative.Com


Functional Areas of the Brain[1]
Motor Area
• control of voluntary muscles
Sensory Area
• skin sensations (temperature, pressure, pain)
Frontal Lobe
• movement
• problem solving
• concentrating, thinking
• behaviour, personality, mood
Broca's Area
• speech control
Temporal Lobe
• hearing
• language
• memory
Brain Stem
• consciousness
• breathing
• heart rate
Parietal Lobe
• sensations
• language
• perception
• body awareness
• attention
Occipital Lobe
• vision
• perception
Wernicke's Area
• language comprehension
Cerebellum
• posture
• balance
• coordination of movement

Hemispheric Specialization

LEFT

- Motor/sensory control of right side of body
- Typically, dominant for language (reading/writing/ understanding/speaking/ verbal memory)
- Analytical
- Linear processing
- Detail oriented
- "Can't see the forest for the trees"

RIGHT

- Motor/sensory control of left side of body
- More diffusely organized
- Primarily non-verbal/visuospatial
- Visual memory
- Subtle aspects of language
- Can cope with novelty
- Conceptual
- Sees the whole/big picture oriented

TBI

- Damage to brain tissue from external mechanical forces
- Severity of the injury is dependent on location and trauma itself
  - Diffuse Axonal Injuries-90% never regain consciousness. Damage widespread to axons.
  - Injury to the Brain Stem
    - Regulates CNS, respiratory, and cardiac functions

Incidence and Epidemiology

- 2.8 million TBIs per year
- Over 1 million treated and released from ED
- 223,135 required hospitalization
- 80-90,000 long term or permanent disability
- 5.3 million Americans have TBI
- 64,362 deaths annually

https://www.cdc.gov/traumaticbraininjury/data/index.html

https://www.biausa.org/public-affairs/public-awareness/brain-injury-awareness

Incidence and Epidemiology

- Major cause of disability in individuals under age 40
- Males 1.5 more likely than females
- >75yo highest rate TBI hospitalizations & deaths
- 0 – 4yo, 15 – 19yo highest rates of ED visits
- Boys, 0 – 4yo highest rate of TBI related deaths, hospitalization, & ED visits followed by girls 0 – 4yo, 15 – 19yo, >65yo

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Etiologies Of TBI

- MVA: 13.2%
- Falls: 47.9%
- Assault and violence: 8.3%
- Sporting injuries (being struck by or against something): 17.1%
- Other/Unknown 13.2%

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Types/ Mechanisms of Injuries

- Forces of acceleration – the sudden linear movement of the skull
- Forces of deceleration – sudden reduction in velocity of linear movement
- Rotation – sudden rotary movements of the skull
- Missile penetration

Primary Damage
Occurs at the moment of impact

- Acceleration – deceleration (Coup- Contracoup)
- Rotation with shearing of white matter axons (diffuse axonal injury)
- Combination of the above
- Focal damage – consolidated areas of tissue destruction, hemorrhage, and/or edema

Secondary Damage
Can compound primary damage

- Cerebral edema
- Increased ICP
- Hypoxemia & ischemia
- Hypotension
- Infection, inflammatory response
- Hypocapnia, electrolyte imbalance
- Hyperthermia
- Vasospasm

Types of Injuries

- Closed head injury
  - Identifiable brain lesions
- Open head injury
- Concussion
- Contusion
- Penetration
- Hemorrhagic
- Subdural hematoma
- Epidural hematoma
- Intracerebral hemorrhage
- Subarachnoid hemorrhage

Concussion

- An immediate, temporary loss of consciousness resulting from a mechanical force to the brain
- May or may not report LOC
- Momentary loss of reflexes or memory
- Headache, confusion, dizziness
- Irritability
- Visual and gait disturbances

Subdural Hematoma

- Bleeding between the dura and arachnoid interface
- Acute, subacute, or chronic
  - Immediate, 4-21 days, 21 days +
- Occurs 5-22% of patients with intracranial injuries
- More common in older adults
- Changes in LOC, elevated ICP
- Seizures
- Paresis

Epidural Hematoma

- Rapid arterial or venous bleed often associated with skull fracture
- Most common cause lacerated meningeal artery
- 2% of traumatic intracranial insults
- More common in older adults
- Changes in LOC, elevated ICP
- Seizures
- Paresis

Intracerebral Hemorrhage

- Bleeding into cerebral tissue
- Associated with contusions
- May act as a space-occupying lesion compressing brain tissue; poor prognosis
- Headache, deteriorating consciousness, coma
- Contralateral paresis
- Ipsilateral dilated pupil
- Signs of herniation

Subarachnoid Hemorrhage

- Bleeding into the subarachnoid space
- Severe head injury and aneurysmal ruptures
- Symptoms related to elevated ICP and meningeal irritation

Penetrating Injuries

Missile injuries (high velocity trauma)

- Gunshots, nail guns, other missiles
- Severity depends on location, pathway, depth
- Associated with infection caused by bone, skin, hair entering the brain

Stab wounds

- Piercing of the scalp, skull, or brain by foreign object
- May cause severe neurological impairment depending on location

Complications Following TBI

- Acute

  - HTN

  - Cardiopulmonary

- Posttraumatic hydrocephalus-See in many LTC BI clients.
- Posttraumatic epilepsy
- Hypothalamic and endocrine dysfunction

  SIADH-Syndrome of Inappropriate Diuretic Hormone released by pituitary gland. Pituitary size of a pea.

Prognosis for Recovery Following TBI

- Duration of coma
- Longer in coma, poorer prognosis

- Age-60 y/o and under 4
- Injury location

Classification of TBI

- Mild TBI or post-concussive syndrome
- Moderate TBI
  - A moderate TBI is a term used when a person experiences changes in brain function for longer than a few minutes following trauma. Symptoms may similar to a mild TBI, but the symptoms do not go away or may even get worse.
- Severe TBI-May require LTC or supports

Mild TBI

- Accounts for 75-90% of all brain injuries
- Loss of consciousness < 30 minutes
- Glasgow Coma Scale 13 – 15
- Negative neuroimaging
- Alteration in mental status
- Loss of memory

"Complicated" mild TBI has Glascow Coma Scale 13 – 15 but with positive CT findings

Loss of Memory

- Posttraumatic amnesia (PTA)
  - Retrograde
  - Anterograde
    - PTA < 1 hour; mild severity
    - PTA 1-24 hours; moderate severity
    - PTA 1 day – 1 week; severe
    - PTA > 7 days; very severe

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC155413/

Mild TBI – Physical Symptoms

- Nausea
- Headache
- Dizziness
- Insomnia, fatigue
- Decreased memory
- Irritability
- Confusion/Decreased concentration
- Vision changes
- Tinnitus

Moderate TBI

- Glasgow Coma Scale 9 – 12
- Abnormal CT findings
- Physical, cognitive, & behavioral symptoms last several months or are permanent
- May have good recovery or learn to compensate

Severe TBI

- LOC hours - years
- Glasgow Coma Scale 8 or lower
- Injuries focal & diffuse

  - Focal: hemorrhage or hematoma

  - Diffuse: result from secondary complications
- Usually left with permanent residual neurological deficits

Poor, Complicated Outcomes

- Coma
- Vegetative state
- Minimally conscious state
- Locked in syndrome
- Akinetic mutism-cannot move nor speak
- Persistent vegetative state (PVS)

Coma

Complete absence of arousal or responsiveness

- Eyes do not open
- Absent sleep-wake cycle
- No purposeful motor activity
- No ability to follow commands or intelligible verbalization
- No conscious awareness of self or environment

Vegetative State

No distinct evidence of conscious awareness

- Sleep-wake cycle is present
- Eyes open spontaneously
- No signs of intentional, purposeful, or reproducible behavioral responses to stimuli
- No signs of language perception or communication
- Corneal, pupillary, oculocephalic reflexes are present

Minimally Conscious State

Distinct behavioral signs of conscious awareness

- Basic command following
- Intelligible verbalization
- Yes – no responses, verbal or gesture
- Nonreflexive emotional or motor behavior that occurs in response to environmental stimuli

Locked-in Syndrome

- Eye opening is present
- Basic cognitive function evident on exam
- Clinical evidence of complete tetraplegia
- Occurs as a result of brain damage to specific portions of the lower brain and brainstem
- Limited treatment

Akinetic Mutism

Condition characterized by diminished neurological drive or inattention; movement and speech are extremely deficient

- Eye opening and spontaneous visual tracking
- Can be considered a subcategory of minimally conscious state because purposeful responses often are inconsistent but can be elicited with stimulation

Residual Deficits

- Sensory function
- Cranial nerve (VIII) injury
- Dysphagia
- Communication disturbances

Residual Deficits: Memory Dysfunction

- Retrograde memory-preinjury
- Posttraumatic amnesia (PTA)-post injury
- Selective memory deficits-relationships, special talents, traumatic events.

Residual Deficits: Motor Skills

- Hemiplegia
- Spasticity
- Ataxia-loss of full body movements
- Apraxia-inability to plan motor movements.

Residual Deficits: Visual-perceptual Disturbances

- Agnosias- is the inability to process sensory information. May not recognize objects.
- Dysfunction of senses
- Somatosensory agnosias-May not recognize by touch.
- Visual and/or spatial deficits
- Spatial relations
- Depth perception
- Relationship of figure to ground

Residual Deficits: Behavioral Changes

- Social behavior
- Withdrawal
- Decreased cooperation
- Insatiable appetite
- Loss of inhibition
- Impulsivity
- Excessive talking
- Irritation
- Agitation

Residual Deficits: Attention and/or Concentration

- Arousal
- Orientation
- Selective attention

Residual Deficits: Emotional Responses Blunted or increased

- Flat affect: Inability to smile
- Crying
- Inappropriate smiling
- Anger
- Emotional control
- Depression
- Initiation

Residual Deficits: Intellectual Functions

- Problem solving
- Judgment
- Abstract reasoning
- Planning and reasoning
- New learning
- Increased response time

Residual Deficits: Denial/Egocentricity

- Lack of awareness of physical or mental limitations (Anosognosia)
- Unrealistic expectations of present or future abilities
  - Pt and families
- Focus on self
- Attention-seeking behavior
- Difficulty in sharing with others

Assessment - Neuro

- Cranial nerves-There are 12 nerves, physical examination.
- PT, OT, SLP evaluation results
- MRI, CAT Scan, Glasgow Coma Scale, Rancho Scale, Neurosurgery reports

Behavior –Causes

- Impaired cognition
- Focal cortical injury
- Patient's psychodynamic ability to deal with changing functional status

Communication Strategies

- Try to help patient calm down before they escalate
- Use simple directions – tell them what you want them to do
- Keep your voice calm and supportive
- Repeat commands, cues, and explanations often
- Decrease noise/ activity around the patient

Communication Strategies

- Look for antecedents and patterns for what upset the patient
- Communicate the above to other staff
- Assess comfort – cold, hot, hungry, tired, or pain can make patient act out
- Anticipate their needs and plan to meet them
- Orient the patient with each task

Communication Strategies

- Approach the patient slowly from the side
- Let the patient know you are going to touch him/her before doing so
- Pay attention to your body language and that of the patient
- Respect the patient's personal space as much as possible

Assessment
Ranchos Los Amigos Scale

Measure of behavior

- Levels 1 – 3, levels of coma
- Levels 4 – 6, typical acute rehab TBI client
- Levels 7 – 10, functioning in the community

Management/ Interventions Behavior for Rancho Levels I, II, III

- Sensory stimulation
- Periods of activity interspersed with periods of low stimulation

Management/ Interventions Behavior for Rancho Levels IV, V

- Decreased general stimuli
- Structured environment
- Safe environment
- Discourage inappropriate response patterning

Management/ Interventions Ranch Levels VII - X

- Decreased structure
- Increase responsibility

Management/ Interventions General Environment

- Calm
- Consistent
- Low stimulation
- Low density
- Visitor restriction

Management/ Interventions Individual Environment

- Consistent schedule by team
- One-to-one supervision
- Limit television
- Limit telephone
- Limit visitors
- Frequent rest periods
- Restrict travel/ confine to unit

Family Restructuring

- Modify system to allow client's return home
- Options for destination and activity patterns
- Target outcome goals; develop structured post discharge activities
- Home eval
- Empower the family to assume responsibility

Client, Family, & Community Education

- Prevention of further injury
- Safety devices for motor vehicles
- Psychosocial components of prevention
- Safety measures for the home
- Proper use of assistive devices
- Home modifications

Client, Family, & Community Education

- Client's psychosocial adaptions to own needs-Adjustment
- Low level of anxiety or depression
- Control over self and behavior
- Intact self-concept
- Socializing
- Verbalizes feelings
- Achieves developmental tasks

Special Needs of Spouses or SO's

- Counseling
- Support groups

- **REMEMBER!!!** TBI affects the family and friends as well. There is often guilt on the family's part associated with the survival of the individual, who now may be very different from prior to injury.

Conclusions

- Working with TBI can be very challenging.
- Proactive planning is often the key to success and avoiding situations of conflict.
- Education of family and friends is key to successful rehab of individuals with brain injury.

Question

Which of the following types of brain injury causes widespread shearing and rotational injuries?

A. Cerebral contusion
B. Concussion
C. Diffuse axonal injury (DAI)
D. Contracoup injury

Answer

The correct answer is: C

A DAI produces damage throughout the brain. DAI is associated with a poorer prognosis than a focal lesion or ischemia.

Cerebral contusions are a diffuse form of injury but do not cause the damage extent that DAI does.

Concussion is a mild BI w/ microscopic bruising

Contracoup injury occurs dt an impact w/ the skull on the side opposite the initial force.

Question

The behavior of a patient with a Ranchos Los Amigos of Cognitive Function Scale Level V is:

A. Confused and agitated
B. Confused and appropriate
C. Confused and non-agitated
D. Automatic and appropriate

Answer

The correct answer is: C

A patient with a Level V demonstrates confusion without the agitation expressed at Level IV. The patient at Level V can pay gross attention to the environment but is highly distractible and requires continuous redirection.

Question

Which of the following is an example of an “executive” function?

A. Setting the table
B. Heating an item in the microwave
C. Doing dishes
D. Grocery shopping

Answer

The correct answer is: D

Executive functions require anticipation, goal selection, planning, self-monitoring, and incorporating feedback.

Grocery shopping requires all of these. All the other activities are less complex tasks.

Question

Damage to what part of the brain results in impaired voluntary movement, altered social functioning, problems w/ short term memory, and inhibition of impulses and emotions?

A. Frontal lobe
B. Temporal lobe
C. Occipital lobe
D. Brainstem

Answer

The correct answer is: A

Damage to the brain's temporal lobe produces impaired hearing and long-term memory deficits.

Damage to the occipital lobe produces visual perception problems.

Damage to the brainstem produces impaired wakefulness, life-sustaining regulation symptoms, and cranial nerve deficits.

Question

Deficits with socialization, motivation, and sexual behaviors seen after brain injury are due to damage to:

A. Reticular activating system
B. Right hemisphere
C. Left hemisphere
D. Limbic lobe of both hemispheres

Answer

The correct answer is: D

The reticular activating system is responsible for arousal and alertness.

The right hemisphere controls recognition of faces and forms or artistic intelligence.

The left hemisphere controls memory for language, math, and analytical skills.

Questions ??