

Severe Traumatic Brain Injury (TBI)

OVERVIEW

Traumatic Brain Injury (TBI) is any injury that results from a blow or jolt to the head from blunt or penetrating trauma. TBI can be the result of any blunt head injury, but common causes include falls, sports injuries, vehicle accidents and assault. There are different degrees of head injury ranging from a mild concussion, which requires symptom monitoring and rest, to a severe TBI, which could require hospitalization and/or surgery.

What is a traumatic brain injury?

TBI is an injury to the head resulting from blunt or penetrating trauma. The initial injury is known as the primary injury. Primary injuries can affect the entire brain (diffuse injuries) or a specific section (focal injuries).

Types of diffuse injuries:

- **Concussions** are mild head injuries that can cause brief loss of consciousness without brain tissue injury.
- **Diffuse axonal injury (DAI)** is commonly referred to as shear injury. This is an injury that occurs when the brain quickly moves back and forth inside the skull damaging the cells that carry information throughout the brain. This disrupts how the brain normally communicates information and can result in changes in a patient's consciousness.
- **Traumatic subarachnoid hemorrhage** is caused from bleeding on the surface of the brain.

Types of focal injuries:

- A **cerebral contusion** is a bruise on the brain tissue.
- A **subdural hematoma (SDH)** is bleeding that occurs under the dura, or layer of tissue that surrounds the brain. Tearing of veins or vessels that deliver the blood back to the heart is often the cause this type of bleeding.
- An **epidural hematoma (EDH)** is a blood clot that forms on top of the dura, below the skull. Arteries that supply blood from the heart most commonly cause this type of bleed. Because the blood within the arteries travels at a

high pressure this bleed can grow quickly, resulting in a rapid decrease in a patient's consciousness.

- **Intracranial hematoma (ICH)** is bleeding within the brain tissue.

Although we describe these as individual injuries, it is rare for a patient to suffer only one type of injury. It is more common for a patient to have a combination of injuries, all of which may have different levels of severity. This makes questions like, "what part of the brain is hurt?" extremely difficult to answer, as it is usually not just one area.

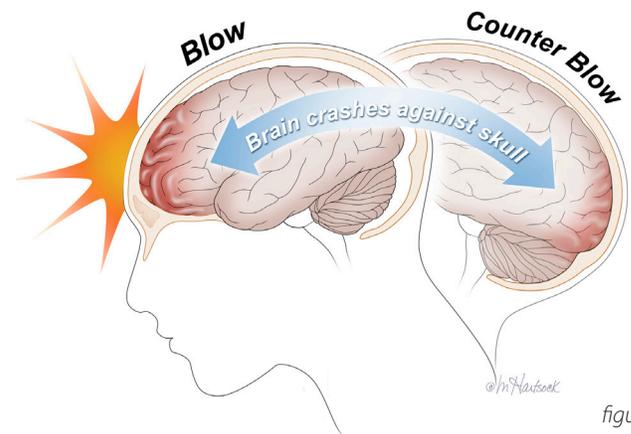


figure 1

Secondary injury is an injury that occurs as a result of the body's response to the primary injury. The inflammatory response of a brain injury causes extra fluid to collect in the brain in an attempt to heal the injury. In other areas of the body swelling (edema) is a good response; however it can be dangerous in the brain, where space is limited by the skull. The swelling causes injury to parts of the brain that were not initially injured, resulting in "secondary brain injury."

This swelling happens gradually and can occur up to 5 days after the primary injury. Nurses and doctors in the Neuroscience Intensive Care Unit (NSICU) will monitor patients closely for signs of cerebral edema, or swelling of the brain tissue, by analyzing their responsiveness and exam results. One type of technology that is used to show swelling of the brain is an intracranial pressure (ICP) monitor. The monitor is placed inside the brain to measure pressure inside the head, and gives the NSICU team the ability to intervene if the pressure level rises above normal.

Diffuse injuries, like concussion or DAI will typically cause an overall decreased level of consciousness. Focal injuries, like ICH or cerebral contusion, will trigger symptoms based on the area of the brain that is affected. Every patient is unique and some injuries involve more than one area of the brain, making it difficult to predict which specific symptoms a patient will experience.

What are the symptoms of traumatic brain injury?

Depending on the type and location of the injury, a patient's symptoms may include:

- Loss of consciousness
- Confusion and disorientation
- Memory loss/amnesia
- Fatigue
- Headaches
- Visual problems
- Poor attention/concentration
- Sleep disturbances
- Dizziness/loss of balance
- Irritability/emotional disturbances
- Feelings of depression
- Seizures
- Vomiting

How is a diagnosis made?

When a patient is brought to the emergency room with a head injury, doctors will learn as much as possible about his or her symptoms and how the injury occurred. The person's condition is assessed quickly to determine the extent of injury.

A **Glasgow Coma Score (GCS)** is a coma score that is used to assess a patient's level of consciousness. The GCS has three categories that are scored based on a patient's responsiveness. The categories consist of the patient's ability to:

- Open his or her eyes
- Respond appropriately to orientation questions like, "what is your name?" and "what is the date today?"
- Follow commands like holding up two fingers or responding to painful stimulation

A number is assigned to each category based on a patient's performance and the scores are added together to get the total GCS score. The scores range from 3 to 15 and help determine if a patient has a mild, moderate or severe brain injury. A mild TBI scores anywhere from 13-15, a moderate TBI scores from 9-12 and a severe TBI scores anything below 9.

Other tests may also be used to assess a patient's injury:

- A Computed Tomography (CT) Scan uses X-rays and a computer to create images of the brain at the time of injury to quickly diagnose the type, location and extent of injury. CT scans are used throughout recovery to evaluate the injury and help guide the decision-making in a patient's care.

- A Magnetic Resonance Imaging (MRI) uses a magnet, radio waves and a computer to create images of the brain and is used to further define the extent of injury. The MRI can detect more subtle changes in the brain that cannot be seen on the CT scan. These tests are not used in emergency situations because they can take anywhere from 30-90 minutes to complete.

What treatments are available?

Mild TBI usually requires rest and medication to relieve symptoms, while moderate to severe TBI require intensive care in a hospital bed. Bleeding and swelling in the brain can become an emergency that requires surgery. However, there are times when a patient does not require surgery and can be safely monitored in the NSICU.

The goals of treatment are to stabilize a critically ill patient, minimize secondary brain injury and complications, and facilitate the patient's transition to a recovery environment. The care of critically ill patients with a TBI is overseen by a neurosurgical team and a neurointensivist, a specialty-trained physician who coordinates the patient's neurological and medical care.

Seeing a patient who has suffered a severe TBI can be shocking. It is possible that your loved one's appearance will be altered because of facial injury and equipment that is used for monitoring. Numerous tubes, lines and equipment are used to closely monitor his or her heart rate, blood pressure and other critical body functions.

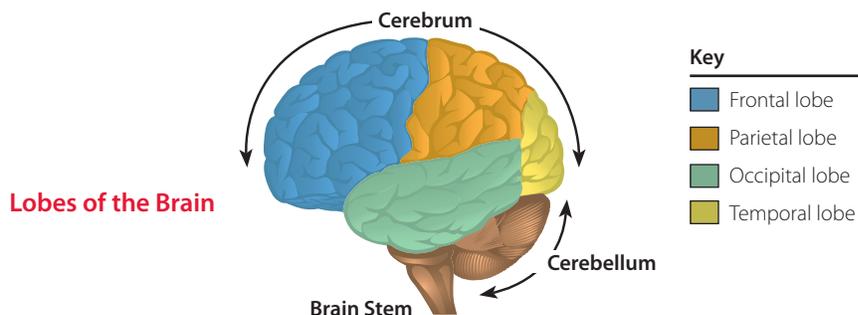
Medication

- **Sedation and pain** – After a head injury it may be necessary to keep a patient sedated with medications. The dosage of medications can be altered quickly in order to awaken a patient. Because patients usually have additional injuries, pain medication is given to keep them comfortable.
- **Controlling intracranial pressure** – Some medications are used to control pressure within the brain. They work by drawing the extra water out of the brain cells and into the blood vessels, allowing the kidneys to filter it out of the blood.
- **Preventing seizures** – Patients who have had a moderate to severe TBI are at higher risk of having seizures during the first week after their injury. Patients are given an anti-seizure medication to prevent seizures from occurring during their hospital stay.
- **Preventing infection** – Although every attempt is made to prevent infection while your loved one is in the hospital, the risk is always present. Any device placed within the patient has the potential to introduce a microbe that can cause an infection. If an infection is suspected, a test will be sent to a laboratory for analysis. If an infection is present, it will be treated with appropriate antibiotics.

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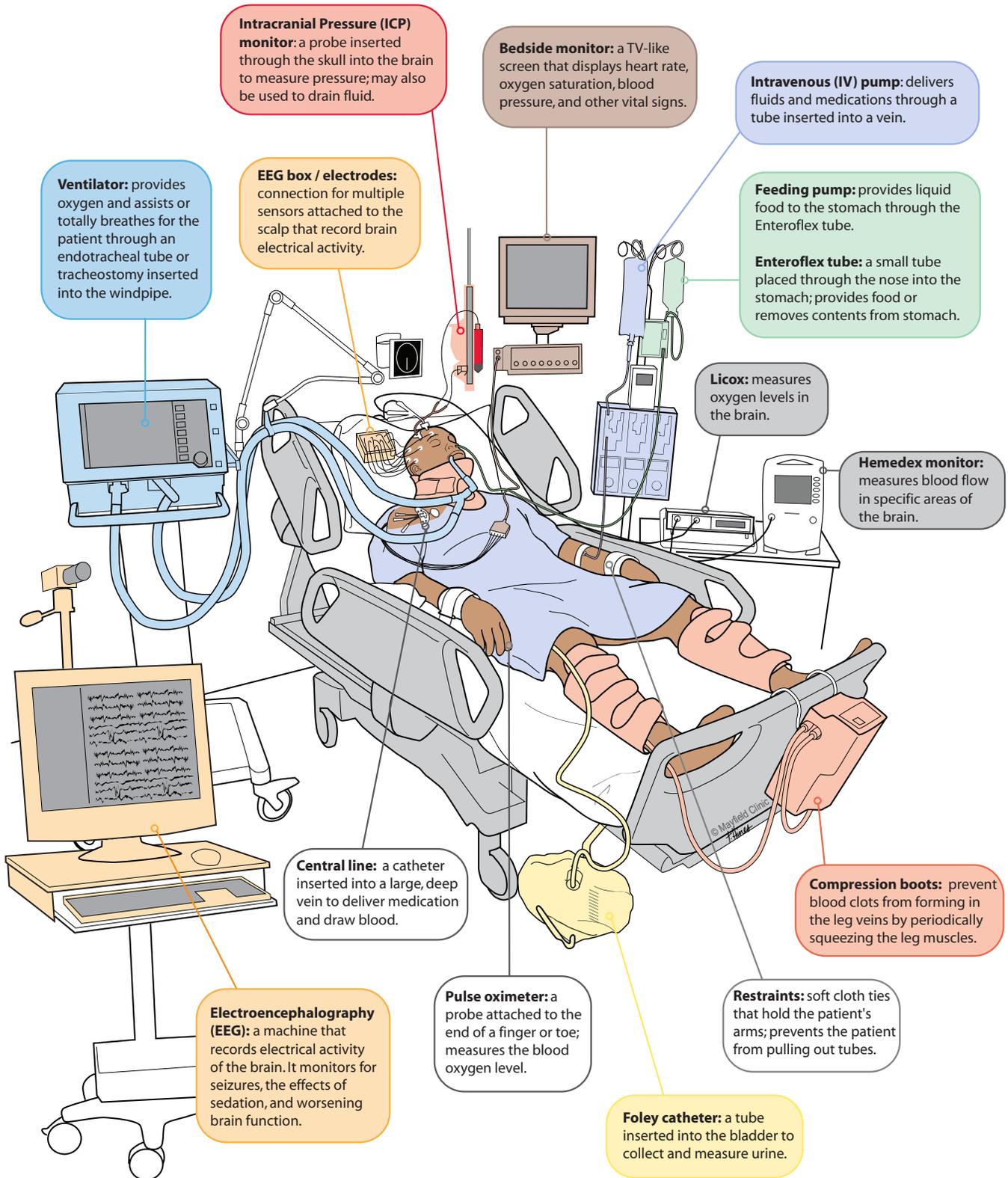
IMPACT OF A BRAIN INJURY



HEALTHY BRAIN	INJURED BRAIN
Frontal lobe	
Personality and emotions	Changes in social behavior and personality
	Mood swings, irritability, impulsiveness
Intelligence	Repetition of a single thought
Attention and concentration	Unable to focus on a task
Judgment	Impaired judgment
Body movement (motor strip)	Loss of movement (paralysis)
Problem solving	Difficulty with problem solving
Speech (speaking & writing)	Difficulty with language; can't get the words out (aphasia)
Sense of smell	Loss of smell
	Loss of appetite
Parietal lobe	
Sense of touch, pain and temperature (sensory strip)	Lack of awareness or neglect of certain body parts
Distinguishing size, shape and color	Difficulty distinguishing left from right
Spatial perception	Difficulties with hand-eye coordination
Visual perception	Problems with reading, writing, drawing and naming
	Difficulty with mathematics
Occipital lobe	
Vision	Defects in vision or blind spots
	Blurred vision
	Visual illusions/hallucinations
	Difficulty reading and writing
Temporal lobe	
Speech (understanding language)	Difficulty understanding language and speaking (aphasia)
Memory	Difficulty recognizing faces
Hearing	Difficulty identifying/naming objects
Sequencing	Problems with short-term and long-term memory
Organization	Changes in sexual behavior
	Increase in aggressive behavior
Cerebellum	
Balance	Difficulty walking
Coordination	Difficulty coordinating fine movements
	Tremors
	Dizziness (vertigo)
	Slurred speech
Brainstem	
Breathing	Changes in breathing
Heart rate	Difficulty swallowing food and water (dysphagia)
Alertness and consciousness	Problems with balance and movement
	Dizziness and nausea (vertigo)

EQUIPMENT IN YOUR ROOM

The picture below shows the equipment that might be in our patient rooms. Please ask your nurse if you have questions about any of the technology in your room.



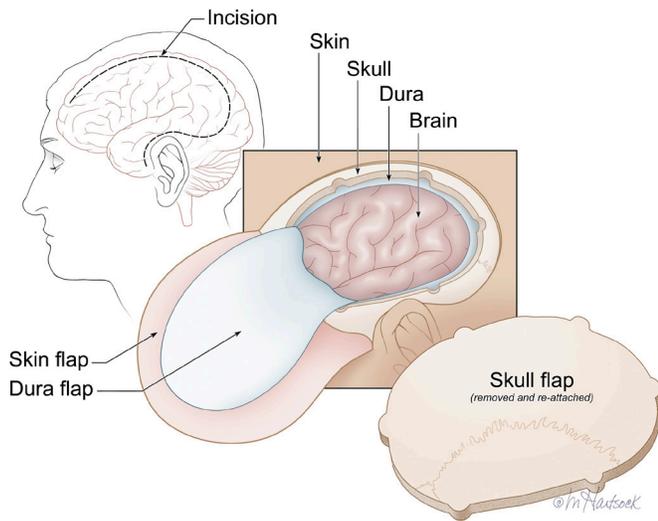


figure 2

Surgery

Surgery is sometimes necessary to repair skull fractures, repair bleeding vessels or remove large blood clots. It is also performed to relieve extremely high intracranial pressure.

- Craniotomy is a procedure that involves removing a section of skull bone in order to access the brain. After the intended procedure is completed the bone is replaced and secured in place. (figure 2)
- Craniectomy is the removal of a portion of the skull bone to allow room for the brain to swell. This procedure is typically done when a patient has a large amount of damage to an area of the brain and the swelling becomes life-threatening. When the pressure returns to a normal level the bone can be replaced with a procedure called a cranioplasty.

Some procedures may be necessary to aid in a patient's recovery. These procedures help patients transition their care from the NSICU to an area where less monitoring is appropriate. These procedures are not always needed, however when they are needed they are not always permanent. As a patient recovers, and if it's medically appropriate, the devices can be removed.

- **Tracheotomy** is a procedure that involves making a small incision in the patient's neck to place a breathing tube into the windpipe. A ventilator, or breathing machine, will then be connected to assist the patient with normal breathing.
- **Percutaneous Endoscopic Gastrostomy (PEG) Tube** is a feeding tube that is inserted directly into the stomach through the abdominal wall. A small camera is placed down the patient's throat into the stomach to aid with the procedure and to ensure correct placement of the PEG tube.

Recovery & Prevention

The recovery process varies by patient depending on the severity of the injury, but typically progresses through 3 stages: coma, confusion/amnesia and recovery.

The Family's Role

Family members often express feelings of helplessness when their loved one is in the NSICU. You are not alone. Please take care of yourself and use your energy wisely.

Visiting hours are limited in the NSICU. Patients with neurological problems often need quiet surroundings, and may become too excited by touching, music, talking or loud noises. Our staff asks for no more than 2 visitors in a patient room at a time. Too much excitement may cause harmful changes in your loved one's vital signs. The bedside nurse will guide you on the appropriate amount of stimulation a patient can tolerate, and may ask that visitors leave the room at times.

Rehabilitation

Patients are discharged from the hospital when their condition has stabilized and they no longer require intensive care. After discharge a patient is likely to go to one of the following facilities:

A **long-term acute care (LTAC) facility** is a place for patients who have stabilized from their initial head injury, but still require a ventilator or frequent nursing care. Many patients are discharged to an LTAC after their injury to continue being weaned from the ventilator. Once off the ventilator, they can be moved to a rehabilitation or skilled nursing facility where they will continue their recovery.

A **rehabilitation facility** is a place for patients who do not require a ventilator, but still require help with basic daily activities. Physical and occupational therapists work with patients to help them achieve their maximum potential for recovery. Rehab facilities are either Acute Inpatient Rehab that requires patients to participate in 3 hours or more of rehab a day or a Skilled Nursing Facility (SNF) that will provide 1-3 hours of rehab a day depending on what the patient can tolerate.

Prevention

Tips to reduce the risk for a head injury:

- Always wear your helmet when riding a bicycle, motorcycle, skateboard or all-terrain vehicle.
- Never drive under the influence of alcohol or drugs.
- Always wear your seatbelt and ensure that children are secured in the appropriate child safety seats.

(continued)

- Avoid falls in the home by keeping unsecured items off the floor, installing safety features such as non-slip mats in the bathtub, handrails on stairways and keeping items off the stairs.
- Avoid falls by participating in an exercise program to increase strength, balance and coordination.
- Store firearms in a locked cabinet with bullets in a separate location.
- Wear protective headgear while playing sports.

Resources:

- The Brain Injury Association of Ohio
www.biaoh.org
www.traumaticbraininjury.com
www.tbiguide.com

Sources:

1. Brain Trauma Foundation: Guidelines for the Management of Severe Traumatic Brain Injury. J Neurotrauma 24 Suppl 1:S1-106, 2007
2. Johnson G. Traumatic Brain Injury Survival Guide, 2004. www.tbiguide.com

Updated: 09.2013**Reviewed by: Erin Silva, CNP; Norberto Andaluz, MD**

This information is not intended as a substitute for professional medical care. Always follow your healthcare professional's instructions