SYNAPSE
AUSTRALIA'S BRAIN INJURY ORGANISATION

Traumatic Brain Injury

Traumatic brain injury (TBI) has been defined as 'an injury to the brain resulting from an externally applied mechanical force that affects the brain and leads to loss of consciousness or coma' (Kay and Lezak, 1990).

In this article

An introduction to traumatic brain injury (TBI)

TBI is caused by either a blow to the head or by the head being forced to move rapidly forwards or backwards. Brain tissue may be torn, stretched, penetrated, bruised or become swollen. Oxygen may not be able to get through to the brain cells, and there may be bleeding.

Common causes include motor vehicle accidents, assault, falls, sporting accidents and domestic domestic violence. The effects can be temporary or permanent, and range from mild injuries, such as being momentarily stunned, to a very severe injury that may cause prolonged loss of consciousness.

As well as injury to the brain caused by the initial trauma, there are secondary effects that can arise from bleeding, bruising, lack of oxygen and increased pressure within the skull.

Types of TBI

Closed & open head injuries

A TBI can be described as being a closed or open brain injury.

An **open head injury** results from the head hitting an object, or an object piercing the skull and brain tissue (open or penetrating head injury).

A **closed head injury** occurs without the skull being broken or penetrated, so the brain has not been exposed. An example of a closed head injury is when the rapid movement of the head backward and forward causes the brain to slam against the inside of the skull.

Focal & diffuse brain injury

A TBI can be focal or diffuse, meaning damage may be isolated to one specific area of the brain, or widespread. Both types of injury can occur together.

Focal damage involves damage to specific areas of brain tissue. Focal injuries include:

- Contusions (bruised brain tissue), which often occur under the sight of impact.
- Lacerations (torn brain tissue)
- Hematoma (a collection of blood inside or around the brain), which can be the result of hemorrhaging and can lead to increased pressure on the brain.

Diffuse damage involves damage to axons, the brain's microscopic communication pathways which extend from brain cells. Damage occurs when the axons are stretched or severed.

Secondary injury

A TBI often results in secondary injuries, which arise due to the brain's reaction to the first injury. These include brain swelling and hemorrhaging. Swelling puts pressure on brain tissue, which can restrict oxygen supply to other parts of the brain leading to cell death. Treatment is focused on controlling the secondary effects of a brain injury to prevent further damage.

Possible effects of TBI

The effects of a TBI and the degree of recovery that can be expected will depend on the location and severity of the injury. The success of the rehabilitation process will also determine the extent of the long-term effects.

Cognitive effects can include:

- memory problems
- fatigue and slowed responses
- poor concentration and attention
- irritability, anger and susceptibility to stress
- inappropriate behaviour and poor social skills
- self-centredness, dependency and lack of insight
- poor problem-solving, initiative and motivation
- depression and lack of emotional control
- impulsivity.

Physical effects can include:

- Loss of taste and smell
- diziness and balance problems
- epilepsy and seizures
- fatigue
- headaches and chronic pain
- visual problems
- paralysis or movement disorders.

Diagnosing and Assessing TBI

Initial diagnosis and treatment usually occur at the hospital emergency department. Once the person is assessed as not being in immediate medical danger, a neurological evaluation is performed.
This evaluation is to rule out conditions requiring neurosurgery, such as: hematomas, skull fractures, and high intracranial pressure.

Different imaging tests may be used in diagnosis, including:

- **Computed tomography (CT) scans** which provide a three-dimensional view of the brain to detect abnormalities.

- **Magnetic resonance imaging (MRI)** which uses electromagnetic radio waves to produce either 3-D or 2-D images of the brain.

- **X-radiation (composed of X-rays)** is a form of radiation used as a diagnostic tool that reveals damage to structures of the brain.

- **Inter-cranial pressure (ICP) monitors** implanted inside the skull to track changes in intracranial pressure.

Assessing the severity of a TBI

The severity can range from a mild brain injury (often called concussion) to severe or catastrophic brain injury. Two reliable indicators of severity include how long the person is in a coma and the length of time in post-traumatic amnesia.
Another widely used indicator is the Glasgow Coma Scale (GCS). This scale measures a person's level of consciousness on a scale of 3-15, with 3 being the lowest level of consciousness.
Scoring is based on verbal, motor and eye-opening reactions to stimuli. A score of 13 or above on the GCS is considered a mild brain injury or concussion, 9-12 as moderate and 8 or below severe.

References and Further Information

- Australian Institute of Health and Welfare (2008). Hospital separations due to traumatic brain injury, Australia 2004-05. Retrieved on 11 October 2009, from http://www.aihw.gov.au/publications/index.cfm/title/10505

- Neurology Channel: http://www.neurologychannel.com/diagnostictests/CTscan.shtml