A Physician Talks About Severe Brain Injury: The Basics

Brain Injury Association of America

This brochure was developed for persons with brain injury, family members, caregivers, and friends to suggest ways to deal with the problems one may face when living with brain injury.

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Nathan D. Zasler, MD

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Introduction

A severe brain injury is one that typically causes an unconscious state or coma, generally lasting no more than a few weeks. When they do not result in death such injuries are catastrophically disabling, and family members often have many questions: about terminology, determining a prognosis, health consequences, and what types of care are available. This booklet aims to help families understand what is happening to their loved ones in the days, weeks, and months following a severe brain injury. A list of additional sources of information is included for the unanswered questions that remain.

First Days: Names for Unconscious States

All severe brain injuries result in unconsciousness. But not all unconscious states are the same. Doctors distinguish among three states of low neurological activity:

Coma: The individual is unresponsive and unaware, typically with eyes closed. Generally, coma does not last longer than three to four weeks.

Vegetative state: The person is unaware of his or her environment, either external or internal. But he or she typically displays so-called "vegetative functions," including normal digestive and sleep/wake cycles. The person's eyes are usually open.

The term **permanent vegetative state** is applied when doctors believe it very unlikely that an individual will ever come out of the vegetative state. A person is generally considered permanently vegetative one year after a traumatic brain injury (TBI) or three to six months after a hypoxic-ischemic brain injury (one that occurs when blood flow is blocked, starving the brain of oxygen). In some rare cases, however, individuals with TBI have emerged from a vegetative state after more than a year, and individuals with hypoxic-ischemic brain injury have done the same after more than three months.

Minimally conscious state: The person shows minimal but definite behavioral evidence of being aware of himself or herself or the environment. This evidence may include responding to simple commands, making yes/no gestures, or speaking intelligible words, albeit often incompletely or inconsistently.

Sometimes individuals in minimally conscious states may be inappropriately diagnosed as vegetative. That is because, even in a vegetative state, individuals can at times respond to stimuli; to declare a person minimally conscious a doctor must find evidence that he or she has at least some level of awareness.

Looking Ahead: How Doctors Develop a Person's Prognosis

A variety of outcomes are possible following a severe brain injury, everything from death to extremely good function (though the latter is rare). In the early stages following the injury, doctors may use the following to determine which are more likely:

- The person's score on the Glasgow Coma Scale. A lower score indicates a worse prognosis.

The Glasgow Coma Scale

Best eye response (E)
4. Spontaneous
3. To speech
2. To pain
1. No eye opening

Best verbal response (V)
5. Oriented
4. Confused
3. Inappropriate words
2. Incomprehensible sounds
1. No verbal response

Best motor response (M)
6. Obeys commands
5. Responds purposefully to pain
4. Withdraws from pain
3. Flexes in response to pain
2. Extends in response to pain
1. No motor response

Doctors add the scores from all three parts of the test. A patient with a total score of less than 8 is considered to be in a coma.

- CT or MRI images of the brain, which can show the extent and type of primary brain damage (localized versus stretch/shear-type injury) and reveal the presence or absence of secondary injuries caused by a lack of blood flow. Such secondary injuries indicate a worse prognosis.
- Measurements of pressure inside the skull. Elevated pressure is typically associated with a worse prognosis, especially when sustained.
- Measurements of the electrical activity of the brain, such as electroencephalograms (EEGs) or multimodal evoked potentials, which may reveal the degree of damage.

Another important measurement is time: the longer a person stays in a coma or vegetative state, the worse the likely extent of the damage and, therefore, the worse the overall neurological and functional prognosis.

The Days that Follow: Potential Effects and Care

Increased Intracranial Pressure: Early after a severe injury, changes in the brain can lead to elevated pressure within the skull, which can cause further damage if not aggressively controlled. A doctor may intervene in a number of ways:

- By using a ventilator or a bag valve mask to make the person hyperventilate. This reduces the amount of carbon dioxide in the blood which, in turn, makes blood vessels in the brain constrict, reducing pressure.
- By implanting a catheter to drain excess fluid.
- With medications that decrease pressure, such as Mannitol.
- In extreme cases, by removing part of the skull (craniotomy), which allows the brain to expand beyond its normal space.

Nutrition: An unconscious person must be fed through a feeding tube. At first this will generally be a nasogastric (NG) tube: one that goes down the nose and all the way to the stomach. For a variety of reasons, however, NG tubes should only be used for a short time. If a person is unable to eat normally for a longer time, typically a feeding tube is placed directly into the stomach.

Early after an injury, a person is often in a hypercatabolic state, meaning he or she is burning many more calories than normal. Once this acute phase has passed, people who are physically disabled usually require

fewer calories to maintain body weight than they did before the injury. It is important that nutrition be enough to maintain a person's weight but not so much as to cause obesity.

Seizures: Seizures are caused by abnormal signals in the brain. They may appear in the form of shaking limbs, but not always: they may instead cause abnormal thinking or behavior, headache, hallucinations, or a variety of other effects. In a person who has suffered a severe brain injury and is highly impaired, it may be impossible to recognize seizures without an EEG. (These types of seizures, which cannot be observed in an external physical exam, are known as clinically silent.)

Yet seizures may significantly interfere with recovery if they are not aggressively treated. They may even make someone in a low level state appear more neurologically impaired than in fact they are. If a doctor suspects a person is having seizures, an EEG or similar diagnostic test should probably be used.

Spasticity: Damage to areas of the brain that control movement may result in uncontrollable muscle spasms. These changes can interfere with a person's ability to walk and take care of himself or herself. Treatments include:

- Oral medication or medication administered through the feeding tube.
- Intrathecal medication (medicine administered directly into the spinal fluid through an implanted pump).
- Injection into the affected muscle of

chemical blockers such as phenol or botulinim toxin.
- Surgery.

Contractures: When a person is immobile for a long time, soft tissues, vessels, and nerves can shorten, leading to permanent limb deformities. This can happen to limbs whose muscles are locked in spasm or to those with flaccid muscles. To minimize this problem, doctors may apply splints or casts to keep limbs extended, and will start the person moving as early as is medically appropriate, through range-of-motion exercises and, when the person is ready, by getting him or her out of bed.

Heterotopic Ossification (HO): Sometimes, injury to the brain releases chemicals that cause bone to form around major joints, limiting their movement. There is no definitive treatment of HO, but research has shown that some medications may inhibit the process to a degree. Ultimately, if the problem becomes serious, surgery may be required to remove the excess bone. To prepare for such surgeries, some doctors will use radiation on the affected area, which inhibits regrowth following the operation.

Neuroendocrine Disorders: A severe injury may damage deep parts of the brain responsible for such primitive functions as temperature regulation, hormone balance, and appetite. When a doctor suspects this may have happened, laboratory studies should be conducted to determine whether the condition is treatable.

This is more likely to be the case if the

damage is not to the brain itself but to the hormone-secreting glands inside it. For example, the pituitary gland, located at the base of the brain, releases hormones that control the rest of the endocrine system. Panhypopituitarism occurs when the pituitary or its outflow tract are damaged, impairing the production or release of these "master" hormones. It may be treated with hormone therapy.

Near the pituitary is the hypothalamus, responsible for a range of normal functions. Injury to the hypothalamus can result in central dysautonomia (also called hypothalamic storming), involving problems with high body temperatures, fast heart rate and breathing, sweating, and increased muscle rigidity. The condition is usually resistant to hormone treatments, but it is also typically short-lived, resolving on its own. Some clinicians may opt to treat it with medications including neuroleptics, dopamine agonists, dantrolene sodium, and morphine.

Pressure Sores: When a person is immobile for a long time, blood flow to the skin can be diminished, especially to areas that have weight resting on them. Eventually, the skin can begin to break down, leading to pressure sores (also called decubitus ulcers). To diminish this risk, clinicians or family members must turn the person frequently and get him or her out of bed if appropriate. Other interventions may include special pressure-reducing mattresses and skin ointments and creams. If sores do develop, surgery may be needed to repair them.

Hygiene: An immobile person or one with limited mobility cannot clean himself or herself as usual. He or she should be provided with good general hygiene, including dental care.

General Health: A person with a severe brain injury still has the same range of medical risks as everyone else. Some risks are actually increased. Therefore, it is important that good general and preventive medical care continue including, for women, regular visits with an OB/GYN.

Conclusion

The care of people who have suffered severe brain injuries requires both specialized knowledge and staff. Ideally, an individual with such injuries should be cared for in a center that has both. The family should make sure that the treatment staff (including doctors, nurses, psychologists, and therapists) has experience with individuals with similar injuries and is up to date on current standards of care.

Resources

Brain Injury Association of America
National Brain Injury Information Center:
1-800-444-6443
www.biausa.org

Brain Injury Association of America, *Living with Brain Injury*: A Guide for and About Adults with Moderate to Severe Brain Injury, 2007. Available in print at or as a free download at www.biausa.org.

Brain Injury Association of America, *Living with Brain Injury*: A Guide for the Family of a Child with a Traumatic Brain Injury, 2007. Available in print or as a free download at www.biausa.org.

N.D. Zasler. "Ask the Doctor," *Brain Injury Source*. An article on coma stimulation available free at www.biausa.org/publications/comastimulation.htm.

National Institute for Neurological Disorders and Stroke, "Coma and Persistent Vegetative State Information Page," www.ninds.nih.gov/disorders/coma/coma.htm.

M.E. Yonker, "What Is a Coma?" The Nemours Foundation's Center for Children's Health Media, www.kidshealth.org/kid/talk/qa/coma.html.

About the Author

Nathan D. Zasler, MD, FAAPM&R, FAADEP, DAAPM, is an internationally respected physician specialist in brain injury rehabilitation. He is Medical Director of both the outpatient Concussion Care Centre of Virginia and Tree of Life, a long-term living assistance and transitional rehabilitation program. Dr. Zasler is a Professor of Physical Medicine and Rehabilitation at two Virginia universities, the Chairperson of the International Brain Injury Association, and chief editor of several international publications including Brain Injury, NeuroRehabilitation, and The Neurotrauma Letter. He has lectured and published extensively in the field of brain injury rehabilitation both nationally and internationally, and recently co-edited Brain Injury Medicine: Principles and Practice.

Notes

Notes

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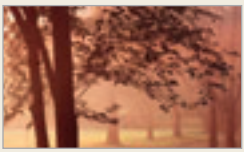
A Physician Talks About Severe Brain Injury: The Basics is one in a series of brochures on "Living with Brain Injury."

Preparing for Life after High School

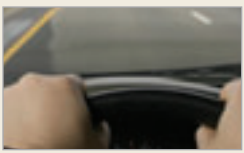
A Basic Legal Glossary

Substance Abuse



Depression

Falls and Traumatic Brain Injury



Driving after Brain Injury

To order any of these booklets, please contact the Brain Injury Association of America at

1.800.444.6443 or
www.biausa.org