Understanding Brain Injury

acute hospitalization

a guide for family & friends

edited by: David Kushner, M.D.

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UNDERSTANDING
BRAIN INJURY

ACUTE HOSPITALIZATION

SECOND EDITION

EDITED BY:
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A GUIDE
FOR FAMILIES
AND FRIENDS
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A sudden traumatic brain injury of a family member or close friend can be overwhelming and frightening. The uncertainty associated with the brain injury prognosis and eventual outcome, adds to this stress. It is difficult for a physician or health care professional to predict the outcome during the first days, weeks, and even months. Along with family members, physicians must “wait and see” how the patient progresses. There is no certain correlation between brain injury severity and the final functional outcome. It is not unusual for families and friends to feel alone and confused while struggling to understand and cope with this complex condition.

Although each family member or friend may deal with the crisis in his or her own way, all can benefit from certain basic knowledge regarding brain injury and normal brain function. This booklet provides information on a wide variety of helpful topics. The first section describes the structure and function of the brain and continues to explain the effects of injury. Patient care in the intensive care unit and in other hospital settings is also addressed. The second section of the booklet discusses post-traumatic reactions of family members and close friends and answers some common questions. A glossary of hospital terms is also included in the back of the booklet.

Although family and friends may be anxious to learn more about head injury, reading a booklet may be difficult initially following their loved one’s hospitalization. It may be hard to concentrate and remember explanations. However each individual is different. Some want to learn everything they can as quickly as possible. Others prefer absorbing information a little bit at a time.

This booklet should be read at one’s own pace, perhaps a section at a time. Some individuals begin by reading the question and answer section. Many find it useful to jot down their own questions as they go along. Some may wish to use the blank note pages in the back of this booklet for this purpose. In addition, keeping a journal or diary of events, feelings, concerns and questions may also be helpful.

Plan to use this booklet as a guide. As one collects information about brain injury one may wish to discuss further concerns with family, friends, and caregivers. This booklet should provide a solid foundation of information regarding traumatic brain injury including its possible effects on an individual’s physical, cognitive and behavioral function; the acute medical treatment; and information regarding related adjustment issues.
Structures and Functions

The brain is the control center for the entire body and directs all its functions such as circulation, breathing, digestion, elimination, and motion. Signals from the five senses – sight, smell, taste, touch, and hearing, are processed through the brain. In addition, the brain is responsible for higher human functions and attributes including thought, comprehension, memory, speech, emotion, and personality. Understanding the normal structure and function of the brain is the first step in learning about the effects of injury.

This section will cover the structures and functions of the following areas:

- The Skull
- The Cortex (Cerebrum)
- The Cerebellum
- The Brain Stem

The Skull

The skull serves as the bony encasement for the delicate tissues that make up the brain. The skull protects the brain from the bumps and bruises of everyday life. Supporting and protecting the brain within the skull are three layers of membranes. These membranes help to separate and protect the lobes or sections of the brain. The outermost membrane is called the dura mater, or dura for short. The middle layer is called the arachnoid membrane, and the membrane in direct contact with the brain’s surface is called the pia mater.
Clear cerebrospinal fluid surrounds and cushions the brain and its membranes. Manufactured within small passageways or ventricles inside the brain, this fluid transports certain nutrients between blood vessels and the brain. The ventricles consist of two lateral ventricles and a third and fourth ventricle.

The brain consists of three main sections, namely the cortex (also called the cerebrum or cerebral cortex), the cerebellum, and the brain stem. Although the brain operates in a highly interconnected manner, each section has distinct functions and characteristics. For example, one area controls balance while another regulates emotions. Because the skull is a rigid structure, the space within it remains fixed. Nearly 20 percent of this space is occupied by the membranes and cerebrospinal fluid. The remaining 80 percent consists of the cortex, cerebellum, and brain stem.

The Cortex (Cerebrum)

The largest section of the brain, the cortex, is divided into two connected hemispheres or sides that control important functions, such as speech, perception, and memory. Specific areas within the cerebral cortex regulate separate functions. For example, the speech center governs the ability to form sounds into meaningful words, phrases, and sentences. The left side of the brain controls movement and receives sensory messages from the right side of the body. The right side of the brain controls movement and receives sensory messages from the left side of the body.

Each person has a dominant and a non-dominant cerebral hemisphere. The dominant hemisphere, usually on the left, mediates cognitive functions including speech, comprehension, the ability to perform reading, writing, and arithmetic calculations. The non-dominant hemisphere's functions include creativity such as artistic and musical skills and spatial perception.
Each cerebral hemisphere is subdivided into four distinct lobes: frontal, parietal, temporal, and occipital. Located in the front of the cerebrum behind the forehead bone, the frontal lobes contribute to a person’s judgement, reasoning, personality, motivation, inhibition and concentration.

The parietal lobes sit just behind the frontal lobes. The parietal lobes receive and process sensations of touch, including pain, heat, cold, pressure, size, shape, and texture. Combined analysis of information from the various senses also occurs in the parietal lobes.

Alongside the frontal and parietal lobes and above the ear sits the temporal lobes. The temporal lobes contain the centers for hearing. In the left hemisphere, the temporal lobe receives and interprets sounds such as words. Both the right and left temporal lobes serve an important role in memory and emotion.

The occipital lobes are located in the back of the cortex behind the parietal and temporal lobes. The occipital lobes contain the centers for sight and are responsible for visual recognition.

The Cerebellum

The cerebellum is a much smaller section of the brain, which lies beneath the cerebral cortex in the back of the skull. It transmits and coordinates signals from the cortex that control the movement of voluntary muscles, such as those in the arms and legs. It also plays an important role in regulating balance and posture.
The Brain Stem

The brain stem is located in front of the cerebellum beneath the cerebral cortex. It connects the spinal cord to the cortex and serves as a sort of relay station, passing messages back and forth between various parts of the body and the cerebral cortex. For example, when a person accidentally touches a hot surface, the messages travel from the nerves of the fingertips through the brain stem to the appropriate area of the cerebral cortex. The cortex translates the message, “This surface is hot.” In response, it sends a message through the brain stem to the muscles of the arm, “Take your hand away or you’ll be burned.” When the brain is functioning properly, all this happens instantaneously as a reflex.

Originating in the brain stem are twelve cranial nerves that mediate smell, hearing, balance, vision, eye movement, facial sensations, taste, swallowing, and movement of the face, neck, shoulder, and tongue muscles. Also located in the brainstem are vital control centers regulating respiration, pulse (heart rate), and blood pressure. In addition, a brainstem structure plays a role in mediating the circadian rhythm including the regulation of an individual’s ability to maintain a wakeful conscious state.
This section will discuss:
- Skull Fractures
- Concussions
- Contusions
- Hematomas
- Increased Intracranial Pressure
- Seizures
- Coma
- Anoxia
- Arterial Dissections
- Hydrocephalus

The term traumatic brain injury is often used interchangeably with head injury. However, brain injury is a more specific term. Most traumatic brain injuries occur in association with accidents or physical assaults that result in a forceful blow to the head, yet injury to the brain can occur in other ways. A near drowning victim revived through cardiopulmonary resuscitation suffers damage to brain cells because of lack of oxygen. A stroke occurs when a brain blood vessel ruptures or becomes clogged, and the blood supply (carrying oxygen and nutrients) is interrupted, resulting in injury to the brain tissue. Likewise, bleeding from a ruptured artery underneath the skull or within the brain can compress brain tissue and lead to permanent damage and or temporary loss of brain function. Infections, such as meningitis, brain tumors, an overdose of medications, and certain diseases can also result in injury to the brain. This booklet will focus on brain injury that results from head trauma.

The changes that occur after a brain injury depend on the severity, type and location of the damage. For example physical, emotional, mental, and behavioral changes can be temporary or long-lasting. Since no part of the brain operates independently, an injury in one area often affects the functions of many areas of the brain simultaneously. Interactions between different parts of the brain are essential for almost all body functions. Fortunately, in some cases, when one part of the brain fails to operate properly, other parts may gradually compensate for the loss. Recovery following a brain injury can take a great deal of time and may be partial or complete.

To assist the reader to better understand the effects of traumatic brain injury in more detail the causes and types are outlined on the following pages.
Skull Fractures

All skull fractures are associated with a risk of underlying brain injury which may include brain bruising or bleeding. Most people realize that a strong blow to the head can cause the skull bones to break. Sometimes the injury results in a crack without displacement of the bone. Physicians may compare this “nondisplaced” fracture to the crack of an eggshell in which the shape of the shell remains unchanged. These fractures usually heal on their own. A more serious fracture results when pieces of skull bone are displaced and press in against brain tissue. This type of skull fracture usually requires corrective surgery.

Concussions

A concussion is a common term used to describe a mild traumatic brain injury. Signs of a concussion that may briefly follow trauma may include: confusion, amnesia, slurred speech, headache, dizziness, nausea, vomiting, as well as loss of balance or loss of consciousness. A major misconception is that a concussion only occurs when an individual is “knocked out”. The majority of concussions do not involve loss of consciousness. Usually the more intense the blow, the more severe the concussion and the resulting symptoms. Symptoms that may follow a concussion may include difficulties with headaches, dizziness, vision, hearing, tasting, smelling, balance, coordination, sleep regulation, fatigue, sensation, cognition and emotional regulation.

Contusions

A contusion involves the bruising of brain tissue. This can occur beneath a skull fracture or in response to an impact in which the brain shifts and rebounds against the skull. The tissue damage and bleeding associated with a contusion can be serious. Multiple contusions may result in life threatening brain swelling. Symptoms will vary with the location of contusions on the brain and these may include problems with weakness, numbness, incoordination, imbalance, vision, cognition and emotional regulation.
Hematomas

A strong blow to the head may damage or rupture one of the blood vessels surrounding the brain, or within the brain leading to heavy bleeding (hemorrhage) or to the slow leakage of blood from the torn vessel. Other traumatic causes of bleeding are brain lacerations (tearing of brain tissue) and penetrating wounds from bullets, knives, or other sharp instruments. The accumulation of blood from these injuries is called a hematoma.

In an epidural hematoma, bleeding occurs between the skull and the dura mater, the outermost membrane covering the brain. Epidural hematomas occur most frequently in conjunction with a skull fracture on the side of the head over the temporal lobe. Although the underlying brain may not have been damaged initially, the brain impinging pressure from the bleeding hematoma can lead to further brain injury.

When bleeding occurs between the dura mater and the underlying membranes covering the brain itself, the term subdural hematoma is used. Subdural hematomas often occur in association with direct damage to the brain. They may produce symptoms immediately or gradually as blood seeps out of torn vessels.

Bleeding that occurs directly within the brain tissue may lead to a build-up of a blood clot within the brain itself, called an intracerebral hematoma. These hematomas usually result from penetrating wounds or blood vessels that rupture.

Frequently, the neurosurgeon can remove subdural and epidural hematomas and stop the bleeding. However, a blood clot deep within the brain tissue itself may not be treatable with surgery.
Increased Intracranial Pressure

Patients' symptoms following a brain injury are often a direct result of a build-up of pressure within the skull. The brain, its membranes, and the cerebrospinal fluid are encased within rigid skull bones; there is no leeway to accommodate the swelling or accumulation of blood (hematomas) caused by injury. Increased intracranial pressure compresses delicate brain tissue and leads to further brain injury.

To help reduce this increased intracranial pressure, surgeons remove hematomas in the operating room or use other methods of control. They carefully monitor for signs and symptoms of increasing pressure in the brain, including: decreased alertness, drowsiness, coma, severe headache, forceful vomiting, development of weakness or paralysis of arms and/or legs, irregular breathing patterns, and changes in the pupils' reaction to light. In addition, surgeons often insert a special device beneath the skull to monitor pressure so they can detect abnormally elevated pressures early on and respond quickly.

Physicians may use other methods besides surgery to manage increased intracranial pressure. These include certain medications and controlled hyperventilation using a respirator to increase the breathing rate, thus reducing carbon dioxide in the blood.

Seizures

Five to 10 percent of all patients with traumatic brain injury will have seizures or convulsions soon after a brain injury or even years later. Seizures indicate irritation or injury to certain areas of the brain which interferes with the normal pattern of communication and transmission of information between brain cells (neurons). During the seizures, patients often lose consciousness and their bodies shake and writhe. Since prolonged uncontrolled seizures can cause further damage to the brain, medications are often used to prevent or control them.

Coma

Brain injury can also result in coma. This condition is defined as a state of unconsciousness in which the patient is unresponsive to, and unaware of surroundings. The length of a coma varies with each traumatic brain injury and can last from a few days to several months and in rare cases years. Family members should not expect a patient to suddenly wake up from a coma as they do after a night's sleep. Emergence from a coma is usually a very gradual process of increasing responsiveness and awareness.
Physicians and nurses usually cannot predict how an individual will progress and often must be patient along with the family.

Family members and friends often wonder if comatose patients can hear. Sometimes patients seem to show signs that they may understand by possibly following a simple request, like squeezing a hand. Occasionally, they seem to be calmed by a familiar voice or music. Since patients rarely remember these events later, it is impossible to know what they actually experience. Nevertheless, health care professionals recommend that people should approach comatose patients as if they could possibly hear and understand.

Anoxia

The decreased availability of oxygen to the brain is called anoxia and quickly leads to brain injury. Since the blood carries oxygen throughout the body, any interference in circulation means a decrease in the oxygen supply to vital organs. Thus, when the heart stops pumping during a cardiac arrest, the oxygen supply to the brain also stops. Drownings or various accidents that cause severe blood loss can result in anoxia. Strokes and serious infections can also cause this condition.

Arterial Dissections

Blunt or penetrating trauma to the head or neck may cause the arteries in the neck to tear. These tears are also referred to as “dissections” and are a common cause of stroke after head injury. The carotid or vertebral arteries may be involved. Treatment may involve the use of blood thinners, placement of a metallic stent to keep the blood vessel patent or bypass surgery.

Hydrocephalus

Hydrocephalus may develop in individuals following a traumatic brain injury. Hydrocephalus occurs when there is obstruction of the normal flow of cerebrospinal fluid between the fluid-filled spaces of the brain. Blockage of the flow of cerebrospinal fluid will result in dilation of the brain's ventricles (fluid-filled spaces) which can be seen on CT or MRI scans. Symptoms of hydrocephalus may include the deterioration of a patient's physical, cognitive, and emotional condition, as well as the failure of a patient to improve despite aggressive therapies and treatments. Treatment includes the neurosurgical placement of a “shunt”. A “shunt” is a surgically placed tube connected to a brain ventricle for the purpose of diverting excessive fluid to the abdominal cavity, heart, or a large vein in the neck.
This section will discuss:
- Early Assessment
- Diagnostic Tests
- Glasgow Coma Scale
- Vital Signs and Reflexes
- Early Treatment

Early Assessment

Quick and efficient assessment and treatment of patients with brain injuries are the keys to preventing further damage and related complications. Advances in emergency medicine, more sensitive diagnostic tests, surgical procedures, and life support systems have helped increase the survival rate over the past 10 to 15 years. Paramedics and emergency medical technicians are specially trained to respond at-the-scene to brain injuries and cardiac arrests. The paramedics often begin to stabilize patients before transferring them to an emergency department or trauma center. Ambulances are equipped with two-way radios, enabling paramedics to communicate with physicians and alert the hospital of the patient's condition.

The primary goal of emergency personnel is to maintain a proper oxygen supply to the brain and other vital organs by sustaining adequate blood pressure. Thus, they assess and treat other injuries that cause loss of blood, which may lead to shock and cardiac arrest.

At the scene of an injury and in the emergency department, trauma personnel try to obtain information about the accident or sudden illness from observers and family members. Proper assessment of the cause of an injury frequently helps physicians diagnose the extent and type of damage and decide on treatment.

The first minutes and hours after an acute injury are very difficult for families and close friends, but physicians and nurses must stabilize and assess the patient and begin treatment before they can offer information and answer questions.
Diagnostic Tests

After the patient is stabilized in the hospital emergency unit, physicians often request a number of tests to determine the extent and nature of the injury. The tests used for the assessment of patients with brain injuries may include:

- Skull X-ray
- CT or CAT (Computed Axial Tomography) Scans
- MRI (Magnetic Resonance Imaging)
- EEG (Electroencephalogram)
- Angiography

Skull and Neck X-ray
Skull X-rays can identify the presence and extent of a fracture. Since some patients with head injuries also suffer neck fractures, neck X-rays also are obtained.

Brain CT or CAT Scan
Patients with skull fractures, those who show changes in their level of alertness or function, and those who may have suffered a brain injury, usually undergo CT scans, a special type of X-ray that works in association with a computer. Thin sections of the brain can be examined showing areas of hemorrhage, fluid collection, contusions, stroke, and special types of skull fractures. The scan, a painless procedure, also helps determine the amount of brain swelling. CT scans are an excellent way for physicians to determine if there is brain injury that may require emergency neurosurgical intervention.

Brain MRI
MRI, a painless test similar to a CT scan, uses magnetic fields instead of x-rays to produce a picture of the brain tissue. MRIs can pick up slight changes not seen on a regular x-ray or CT scan, making this test especially important in the evaluation of symptomatic individuals having mild traumatic brain injuries (concussions). MRIs may be used in evaluation of patients demonstrating chronic cognitive or behavioral symptoms despite negative CT scans.

Cerebral Angiography
Angiography is an x-ray test that enables the blood vessels of the brain to be seen on film after the vessels have been injected with contrast medium (a substance opaque to x-rays). Angiography is used to detect diseases that alter the appearance of the blood vessel channel. Angiography is a useful way for physicians to diagnose dissections (tears) of the carotid or vertebral arteries.
EEG
An EEG (electroencephalogram) is a recording of the electrical activity of the brain. This painless procedure is similar to an electrocardiogram that records the electrical activity of the heart. Specially trained technicians paste electrodes, which look like small flat sponges with wires attached, onto the scalp and connect the wires to a machine that measures brain activity. Patients with seizures often require EEGs to locate the area of abnormal electrical activity in the brain. EEG's are also used to confirm the diagnosis of epilepsy, a seizure disorder. Epilepsy can result from brain trauma.

Other Tests
Tests that examine specific responses of the senses and the potential for further recovery are also used in some cases. For example, specialized EEG's, known as a visual evoked potential study and a brainstem auditory evoked potential study, may be performed if there is uncertainty regarding an individual's ability to see or hear following a brain injury. In addition, patients undergo frequent blood and urine tests to check the concentration of body chemicals, gases, and cells. If the patient shows signs of infection, nurses send samples of blood, urine, mucus, wound drainage, and other body fluids to the laboratory to be examined for the presence of bacteria (germs).

Glasgow Coma Scale

Once the patient is partially stabilized in the emergency department, he or she is usually transferred to an intensive care unit where assessment and treatment continue. Physicians commonly use a clinical test, the Glasgow Coma Scale, to evaluate brain injuries. It rates three categories of patient responses: eye opening, best verbal response, and best motor response. Levels of responses indicate the degree of functional brain impairment.

**Eye opening** tests indicate the function of the brain's activating centers. The patient's eyes may open spontaneously, only on verbal request, or only with painful stimulation. **Best verbal response** indicates the condition of the central nervous system within the cerebral cortex. The patient may be able to speak normally and be oriented to time and place, or he or she may be disoriented and use inappropriate words. At the other end of the scale, the patient may only make incomprehensible sounds or no sound at all. **Best motor response** tests examine a patient's ability to move arms and legs. Responses may vary from the ability to move about on command to the ability to move reflexively only in response to pain or not at all.
Each category of the Glasgow Coma Scale is rated using “1” as the lowest possible score. The worst possible Glasgow Coma Scale score is “3”, while the best possible score is “15”. Physicians classify brain injuries as mild, moderate, or severe, using these scores. Other determinants of brain injury severity include the duration of the loss of consciousness or coma, and the length of time a patient experiences confusion or amnesia.

**Vital Signs and Reflexes**

Constant and frequent assessment is the hallmark of intensive care, as changes in vital signs, responsiveness, and reflexes often indicate problems that need immediate attention or close observation. These can include fever, increasing intracranial pressure, and bleeding. Nurses carefully monitor vital signs, such as temperature, pulse rate, breathing rate, and blood pressure. They also assess the status of the nervous system by checking the pupils' response to light, a patient's response to commands, the strength of a hand grip, and the movement and strength of arms and legs. Physicians check the function of the 12 cranial nerves and other reflexes to determine the extent and nature of the injury.

**Early Treatment**

Treatment of brain injury varies according to the severity and type of injury. In the first hours and days after an injury, treatment plans may change rapidly in response to the patient's condition. Family members and friends may find it difficult to follow the constant changes. Writing down explanations, preparing written questions ahead of time, and asking doctors and nurses to repeat or thoroughly explain information can help in understanding early treatments.

Basic treatment goals include: preventing or controlling increased intracranial pressure with surgery and other methods, controlling bleeding, maintaining adequate blood pressure, maintaining an adequate supply of oxygen to the brain and other vital organs, preventing or controlling seizures, maintaining fluid balance, preventing infection, and supporting all the systems of the body in the best way possible.

In addition to the acute treatment of medical problems, preventative rehabilitation care also begins the moment the head trauma patient arrives in the intensive care unit. Thus, such issues as good nutrition, proper positioning of arms and legs, and proper skin care are also part of the treatment that comatose and immobilized patients receive in the intensive care unit.
Most people have never been inside an intensive care unit, where the sights and sounds can be somewhat overwhelming.

This section presents a brief explanation of the common equipment used in the care of patients with brain injuries.

- Intravenous Line
- Arterial Line
- Cardiovascular Monitor
- Foley Catheter
- Chest Drainage System
- Nasogastric Tube
- Cooling (Hypothermia) Blanket
- Endotracheal and Tracheal Tubes
- Ventilator (Respirator)
- Suction Catheter
- Ventriculostomy

Intensive care treatment may last from several hours to several weeks, depending on the extent of the individual’s injury.

**Diagram 8**

**Intravenous Line**

To insert an intravenous (IV) line, a small plastic tube called an intravenous catheter, is threaded into the vein (blood vessel) using a needle. Once the catheter is in place, the needle is removed. The intravenous catheter is connected to a longer piece of tubing that is attached to a bag or syringe of fluid. IVs are used to deliver fluid, nutrients, and medication to the body. They can be inserted into veins in almost any part of the body, including the arms, legs, neck, and chest.
Arterial Line

Similar to an IV, an arterial or A-line is a catheter placed in one of the arteries (blood vessels), usually in the wrist. Arteries carry oxygen and nutrient-rich blood from the heart to the tissues and organs throughout the body. Veins carry blood that is higher in content of carbon dioxide back to the heart and lungs. Physicians and nurses draw small amounts of blood from the arterial line at regular intervals to measure the oxygen and carbon dioxide content of the blood and many of the body's chemicals (electrolytes). Therefore, each time a blood sample is required, the patient need not receive a needle stick.

Cardiovascular Monitor

The cardiovascular monitor looks like a small television screen and can usually be found at the head of the patient's bed. Wires and small sponge-like pads, called electrodes, attached to the patient's body are connected to the monitor to measure heart rate and rhythm. The arterial line discussed earlier is also connected to the monitor and provides constant blood pressure readings. If the heart rate or blood pressure goes above or below a certain point, an alarm sounds to alert the nurse. However, alarm signals do not necessarily mean that anything is wrong. Often, the alarm sounds when the patient moves around in bed or when an electrode becomes loose.

Interpreting the information displayed on the monitor requires considerable medical training and experience.
Foley Catheter

The Foley catheter is a small tube inserted into the bladder to drain urine. It is connected to a urine drainage bag that hangs on the side of the bed. Measuring and testing the body’s output of urine helps to monitor the patient’s fluid status and kidney function.

Chest Drainage System

Patients with brain trauma often experience other types of injuries. Those with chest trauma may need a tube inserted into their chest wall to drain air, fluid, and blood into an airtight plastic container attached to a suction catheter. This treatment promotes the re-expansion of a collapsed or partially collapsed lung. Patients with chest tubes who are alert and awake may require pain medication.

Nasogastric Tube

A nasogastric (NG) tube is usually inserted when a patient is in the hospital unit. It is a clear plastic tube about the size of a small straw that is inserted through the nose down the back of the throat through the esophagus (the tube-like passage between the throat and the stomach) and into the stomach. Initially, this tube is used to remove air and digestive juices from the stomach. When the patient becomes more stable, it may also be used as a feeding tube.
Cooling (Hypothermia) Blanket

Because of injury or pressure on the temperature control center of the brain, a head trauma patient may run a very high fever. Cooled liquid pumped though the coils of a hypothermia blanket help to keep the patient's temperature as close to a normal range as possible.

Endotracheal and Tracheal Tubes

Patients with severe brain injury may not breathe deeply and regularly and may experience problems clearing their air passages. This condition may be caused by injury or swelling in the area of the brain that controls breathing. Such patients usually require a breathing (endotracheal) tube to keep their airways open. The tube passes through the nose or mouth and into the windpipe or trachea. Oxygen is delivered to the lungs through the endotracheal tube. Mechanical ventilation (artificial respiration) may be required which can control breathing rate and depth.
If breathing must be controlled for longer than a few days, the surgeon may create an opening directly into the windpipe through the neck. This is called a tracheostomy. This artificial airway is easier to manage and prevents irritation to the nose and throat caused by an endotracheal tube.

Ventilator (Respirator)

A ventilator aids the patient’s breathing. This machine moves air and oxygen in and out of the lungs through the endotracheal or tracheostomy tube, which is connected to the ventilator by large plastic tubes. Ventilator controls allow for a variety of settings. Sometimes the patient activates the ventilator by taking a breath. At other times the ventilator automatically delivers air at a given rate and volume. As mentioned in the section on intracranial pressure, some patients require rapid breathing rates (hyperventilation) to help control rising intracranial pressure. To prevent reflexes from competing with the ventilator, some patients may receive medication that temporarily deactivates (paralyzes) the muscles that assist in breathing.

Suction Catheter

Small, pliable tubes or catheters about the size of a narrow straw are used to clear the nose, mouth, endotracheal tube, or tracheostomy tube of mucus (phlegm or secretions). These catheters connect to tubing that attaches to a wall suction unit. The nurse uses them to suction the patient regularly, depending on the accumulation of secretions. Patients who can respond may consider suctioning uncomfortable.

ICP Monitor

The ICP monitor (Intracranial pressure monitor) is a small tube placed into or just on top of the brain through a small hole in the skull. This is a device with which to measure the intracranial pressure inside the skull and brain. Neurosurgeons monitor an individual’s intracranial pressure closely in the ICU (intensive care unit) following a traumatic brain injury. Abnormal elevations of intracranial pressure resulting from brain swelling, inflammation or bleeding are treated aggressively by neurosurgeons to prevent further injury to the individual’s brain.
Ventriculostomy

The optimal device with which to measure intracranial pressure is a ventriculostomy catheter, a small tube placed within the cerebrospinal fluid (CSF) chamber (ventricle) of the brain. When the brain swells, small amounts of CSF can be drained through the tube to help relieve increasing intracranial pressure.
This section will discuss the acute rehabilitation phase of care, including:

- Rancho Los Amigos Scale of Cognitive Functioning
- Physical Care
- Airway Management
- Maintaining Nutrition and Fluid Balance
- Promoting Normal Elimination Patterns
- Preventing Eye Irritations
- Skin Care
- Positioning and Exercise

Physicians discharge brain trauma patients from intensive care units (ICUs) once their vital signs are stable for a period of time and they are no longer at risk of acute medical and surgical problems, such as bleeding or rapidly increasing intracranial pressure. Following their discharge from the ICU, these patients are then transitioned to a "step down unit" where there is less intensive nursing and medical care, but still close observation. Next, these patients are transferred to specialized acute brain injury rehabilitation programs or units.

Some hospitals have special units for patients with specific types of neurological problems. For example, most hospitals having emergency care trauma centers will also offer acute brain injury rehabilitation units. These programs are designed to assess the physical, cognitive, and behavioral status of patients, to establish specific treatment, and to prevent complications. Rehabilitation staff members evaluate each patient carefully and devise individual plans of care.

Family members and friends may know that discharge from the ICU is a step forward. They may be relieved that the patient's condition has stabilized to the point where he or she no longer needs intense observation. Still, they may feel anxious about leaving the security of the ICU. They may have come to know and trust the ICU staff and now must get acquainted with a whole new group of caregivers. Often times, the staff is aware of these feelings and is available to help patients and families become accustomed to a new unit.

Many patients are in a semi-comatose or confused and restless state when they are discharged from the ICU. These patients' physical problems may be less difficult to identify than their cognitive and behavioral deficits. Usually a neuropsychologist assists the medical team in describing and treating specific areas of a patient's neuropsychological dysfunction (behavioral and cognitive problems). The Rancho Los Amigos Scale of Cognitive Functioning, named for the center where it was developed, is used in rehabilitation settings throughout the country, to assist the neuropsychologist and rehabilitation team in following a patient's cognitive and behavioral recovery.
Rancho Los Amigos Scale of Cognitive Functioning

The following is a brief explanation of the Rancho Los Amigos Scale of Cognitive Functioning:

**Level 1** – No response. The patient appears to be in a very deep sleep or coma and does not respond to voices, sounds, lights or touch.

**Level 2** – Generalized response. The patient may move, but movement does not seem to have a purpose or consistency. Patients may open their eyes but do not seem to focus on anything in particular. There are inconsistent non-purposeful, non-specific reactions to stimuli. Patients respond to pain, but the response may be delayed.

**Level 3** – Localized response. Patients begin to move their eyes and look at specific people and objects. They turn their heads in the direction of loud voices or noise. Patients at Level 3 may follow a simple command, such as “Squeeze my hand”, but response to commands and stimuli are inconsistent.

**Level 4** – Confused and agitated. The patient is very confused and agitated about where he or she is and what is happening in the surroundings. These patients are disoriented and unaware of present events and demonstrate frequent bizarre and inappropriate behavior.

**Level 5** – Confused, inappropriate but not agitated. The patient is confused but alert and able to follow simple directions. There are nonpurposeful random or fragmented responses to instructions when task complexity exceeds abilities. Stressful situations may provoke some upset, but agitation is no longer a major problem. Patients may experience some frustration as elements of memory return.

**Level 6** – Confused but appropriate. The patient’s speech makes sense, and he or she is able to do simple things such as dressing, eating, and teeth brushing. Behavior is goal-directed. Conversation is appropriate to the situation but with incorrect responses due to memory difficulties.

**Level 7** – Automatic, appropriate. Patients can perform all self-care activities. They may have difficulty remembering recent events and discussions. Rational judgement, calculations, and solving multi-step problems present difficulties, yet patients may not seem to realize this. Insight is poor but overall these patients are oriented to the place or the setting.
Level 8 – Purposeful and appropriate. At this level patients are independent and can process new information. They remember distant and recent events and can solve complex and simple problems. However, difficulties with abstract reasoning may remain. Tolerance to stressful situations may be poor.

As patients improve after a brain injury, they may move from one Rancho's cognitive level to the next, but often demonstrate characteristics of more than one level at a time. Depending on the extent and type of injury, they may remain at any one level for an extended period.

Using information from this scale, the health care team can begin treatment that will help develop skills and promote appropriate behavior. Health care professionals often suggest the following simple measures to family and friends while the patient is still in a coma:

- Always talk as if the patient hears when you are nearby.
- Speak directly to the patient about simple things and reassure him or her frequently.
- Explain events and noises in the surrounding area. Tell the patient what has happened and where he or she is.
- Touch and stroke the patient gently. Tell the patient who you are each time you approach the bedside. Hold his or her hand.
- Play the patient's favorite music or tape a soothing message that can be played when you are away from the bedside.
- For parents of young children, tape yourself singing or reading your child's favorite stories.

Physical Care

Physical care may be less complex once patients leave the ICU, but it is still the basis of good rehabilitation. In this phase, family members and friends can participate more extensively in the patient's care under guidance of the health care team.

Airway Management

Oftentimes, physicians are unable to remove endotracheal tubes before a patient leaves the ICU. These patients receive humidified air through a clear plastic mask-like device that fits over the tracheostomy. Moist air keeps secretions loose, and thus easy to cough up.
Respiratory therapists often work with patients to promote good air exchange. The respiratory therapist may place the patient in positions that facilitate chest drainage and clap and vibrate the patient's chest and back to loosen lung secretions and stimulate coughing (chest physical therapy). Prevention of pneumonia is an important part of the treatment plan.

**Maintaining Nutrition and Fluid Balance**

It may take several weeks or longer before patients can eat or drink. Because of injury to certain areas of the brain, they may be unable to coordinate taking food into the mouth and then swallowing. Sometimes the gag reflex, which prevents choking, is inadequate. Staff members begin retraining patients to eat and drink as soon as possible, but in the interim, many patients may require tube feedings. Tube feedings often begin in the ICU via a nasogastric (NG) tube. For patients who require tube feedings for any length of time, physicians may place a gastrostomy tube (G-tube) directly into the stomach. The G-tube eliminates irritation to the nose and throat that may occur with prolonged use of an NG tube.

To create the gastrostomy opening, the surgeon makes a small incision through the skin and into the stomach and stitches the gastrostomy tube in place while the patient is under anesthesia. The skin around the tube usually heals in a few days, leaving a very small painless opening. Ready-to-use tube feeding products, slowly infused through the tube and into the stomach, contain all the essential nutrients required by the body to grow, heal, and maintain its functions.
Promoting Normal Elimination Patterns

Another goal of rehabilitation is to help patients regain bladder and bowel regularity and the control of elimination. By scheduling regular, well-tolerated feedings and administering stool softeners and certain medications, nurses and doctors help the patient regain regular bowel habits. External drainage systems that do not require insertion of a catheter into the bladder can help keep the patient dry and protect sensitive skin from the irritation of urine.

Preventing Eye Irritations

Brain injuries may interfere with the blinking reflex, which protects the eyes from injury and helps keep eye membranes moist. Nurses keep the eyes of comatose patients closed and instill lubricating eye drops every few hours. As patients emerge from a coma, they may continue to need lubricating drops depending on the nature of their injury.

Skin Care

Another essential aspect of care that begins in the ICU and continues through all phases of treatment is skin care. Patients who are confined to bed or sit in one position for a long time can develop bedsores (decubiti). To prevent this, nurses change the patient's position frequently, massage the bony areas over the joints where the skin is more likely to break down and use moisturizing lotion on all areas of the skin. Special types of mattresses that redistribute weight and protective devices for elbows and heels also help prevent skin irritation. Family members and friends can assist with this aspect of patient care.
Positioning and Exercise

To prevent future dysfunction and loss of mobility, nurses place the patient's joints in positions that promote maximum use. When patients are unable to move about, nurses change their positions in the bed or chair frequently. Sometimes, physical therapists design splints for arms, legs, feet, hands, and the neck to help maintain proper positioning.

Physical therapy begins as soon as possible to help restore or maintain muscle tone, strength, and joint range of motion. While patients are unable to move about themselves, nurses and physical therapists stimulate their joints through passive exercises. Family members are often instructed on how they may be able to help with passive range of motion exercises.
Brain injury results in three main types of impairments. This section will discuss:

- Physical Problems
- Cognitive (Thinking and Comprehending) Impairments
- Behavioral Disorders

Physical Problems

Physical problems may be simpler for family to understand because these may be easier to see or identify than emotional or cognitive impairments. The physical problems may include painful headaches, sudden seizures, decreases in muscular strength and coordination, loss of sensation to a part of the body, loss of vision, hearing, taste or smell, and complaints of pain. Because of damage to specific areas of the brain and lack of activity, patients' muscles may contract and joints may become stiff. For example, some patients involuntarily maintain their feet in a rigid position with the toes pointed downward (foot drop). These patients require special splints and exercises to keep their ankles bent and their feet in the position normally used in walking. Many show weakness or are unable to move one side of their body. Difficulties with vision, speech, hearing, smell and taste are among other physical problems.

Cognitive Impairments

Less apparent than physical problems, cognitive impairments or disturbances in thought processes may be more difficult for family to understand. Examples include: problems or deficits in reasoning, short-term and long-term memory; slowness in thinking; poor attention span; difficulties in reading, writing, and speaking; inability to comprehend or process information; and problems with planning, organizing, insight, and judgment.

Behavioral Disorders

Changes in behavior and personality may be the most difficult problems for family members and friends to face. As individuals emerge from a coma, normally quiet, well-mannered persons may become agitated and aggressive. Later, mood swings
may be sharp and occur without warning. Preexisting personality traits often become magnified following a traumatic brain injury. Individuals may become impulsive and disinhibited, resulting in socially inappropriate behaviors. Depression, anxiety, irritability, and restlessness are other common problems. These complex behaviors may result directly from the brain injury as well as indirectly result from the patient's emotional response to frustration and confusion caused by the trauma. Physical and cognitive problems often intensify the frustration associated with behavioral disorders. A brain trauma patient's abnormal behavioral symptoms often resolve gradually over time with the help of intensive neuropsychological rehabilitation interventions including the use of structured therapy settings and the aggressive redirection of inappropriate behaviors. In some cases the attending rehabilitation physician may need to temporarily prescribe special medications to calm a patient's extreme restlessness and agitation. The team neuropsychologist is often able to assist the Family with the many adjustment issues related to a brain injury patients change in both emotional and cognitive functions.
This section presents some common feelings families and friends may experience after a loved one has suffered a head injury.

When a brain injury occurs, the family suffers along with the patient. Clinical psychologists report that many family members and friends find their reactions quite similar to the grieving that occurs after a death. In fact, some claim that a severe brain injury can be more difficult to deal with than death. Family members may spend day after day at the hospital and see very little improvement, or they may see coma change to aggression, agitation and confusion. The person they loved and may have depended on is alive, yet different.

In the first days and weeks after the injury, family members and friends often experience disorientation and anger as they try to come to terms with this overwhelming crisis. Strong feelings that are difficult to accept or express seem to inundate them. Although these experiences are quite normal, loved ones may feel guilty and confused. This section describes many of the feelings sustained during the intensive care and acute rehabilitation phases of the recovery process.

Feelings of Panic

Generally, the first reaction family experience after sudden brain injury is panic and fear. While physicians and nurses are busy assessing the patient and providing emergency care, family members can only sit and wait. When details become available, their fears intensify since the news often presents life-threatening injury. Until the patient becomes medically stable and the imminent danger of death has passed, physical and emotional feelings of panic may continue to resurface. Often during this difficult period of time family members may feel dizzy and short of breath. They may breathe rapidly, be unable to eat or sleep, or have an upset or nervous stomach and experience the sensation of a constant lump in their throat. Some may cry frequently, and some feel numb inside, as if everything around them is unreal. They may find it difficult to concentrate and may be unable to remember answers to questions they
asked just an hour or two ago. Health care personnel realize that family members are under great strain and often encourage that they start a journal to help remember conversations with staff members and the answers to questions. In most hospitals, social workers and clinical psychologists are available to help families at this time and through the various stages of adjustment and reaction after a brain injury. Many families benefit from counseling with the clinical psychologist.

**Anxiety and Hope**

As a patient becomes more stable, anxiety about survival is coupled with hope. The thought, “If only he lives...that’s all that matters,” gives way to “Maybe he’ll open his eyes, look at me, smile and talk to me again.” Hope and anxiety are constant companions in the early days and weeks after an injury. Each small change and improvement often fuel a hope that the patient will recover completely. However, the slow pace of changes, setbacks, and complications may cause more worry.

**Denial**

In some situations denial is a healthy defense response to an overwhelming crisis or loss. For example, some family members may find that they are unable to completely comprehend and accept that the injury has actually occurred. They may say to themselves, “No, this isn’t really happening. There’s some mistake. It can’t be as serious as the doctor says it is.” One parent of a teenager with a brain injury compared denial to a raincoat, a necessary protection against stormy weather. Denial may help some individuals by protecting them from constant, intense emotional pain and gives them time to gather their strength and face the crisis.

Later, denial can become a problem for family members and friends if they begin to set unrealistic goals for recovery without paying attention to information provided by the health care team. In the acute rehabilitation stage a family member may be in denial and set unreachable goals for the patient. When the patient cannot meet them, both the family member and the patient feel depressed and guilty.
Anger

Feelings of anger are very common for family members and friends after a brain injury. As they let go of denial, they may be flooded with feelings of rage at the person or situation they blame for the injury. Anger may be directed towards the patient and other individuals (family, hospital staff, clergy) for having “allowed” the injury to happen. Also, frustration often goes hand in hand with anxiety and anger. The brain injury of a loved one can be extremely frustrating. Since each brain injury is different, the hospital course does not always follow a predictable pattern, and the answer to so many questions is an indefinite “wait and see.” Often talking about these feelings of anger and frustration to other family members, friends or a hospital psychologist, may help individuals to cope with these issues.

Fatigue

Even when family members begin to sleep regularly again, they may feel constantly exhausted. The stress of the initial sleepless nights following their loved one’s injury takes its toll, and the constant pressure of uncertainty and anxiety drains energy. Family members may find themselves becoming irritable and short-tempered with those whose support and love they need the most. Sometimes, in an effort to regain some control, they begin to concentrate on small details and lose sight of the overall situation. Talking over feelings and issues with close friends, relatives, and professional counselors can help. Often, people need to take a second look at the amount of time they are spending at the hospital and must begin to re-establish some routines that allow time away from the hospital setting.

Social workers can help family members and friends discuss sharing responsibilities. In the acute rehabilitation phase, this becomes even more important. When the patient begins to emerge from a coma, health care staff members may wish to involve the family in the rehabilitation program. The stress of dealing with a confused, aggressive, or agitated patient can be very demanding.
Guilt

Most individuals feel a certain amount of guilt after a family member or friend sustains a serious brain injury. No matter how unreasonable it seems, they feel that they should have somehow been able to prevent the injury. This is especially true when the patient is a child or adolescent, since parents feel responsible for protecting their children from physical harm.

Later, guilt may be connected to feelings of inadequacy and helplessness. No matter what family members and friends do and say, and despite how much they pray, the patient's condition may stay the same or change gradually. People usually think there has to be something more they can do to speed up the recovery process.
Immediately after the injury, family members may be surrounded by concerned friends and relatives offering support and assistance. As the patient’s condition stabilizes and the days turn into weeks, friends return to the demands of their own lives. Additionally, family members may find themselves unable to communicate as easily with friends. They may find it difficult to explain the complexities of brain injury to those not directly involved in the day-to-day experience. Close friends may remain in touch, but after such a dramatic event people often change and find they have less in common with those they were close to in the past.

Friends of those with brain injuries may find it uncomfortable to visit the hospital when the patient is confused or agitated. Honest explanations from family members may help them continue to offer the attention and support that can be so helpful to patients. Sharing this booklet is another way to help them understand.

Social workers can help families form new relationships when they feel ready, possibly with others who have gone through a similar traumatic experience. Often there are local support and informational groups in addition to national support groups located throughout the country.
Patients and family members learn to expect both good and bad days. Several days of progress may be followed by days of agitation, confusion or medical complications such as pneumonia or urinary tract infections. In fact, what health team members label as improvement may be followed by days of agitation and confusion. The hostility and agitation patients demonstrate as they emerge from coma can be terribly upsetting. Patients may look more and more like themselves as swelling from injury subsides, tubes are removed, and they sit up in a chair. Yet, family members often find that the person they knew and loved has disappeared. It remains unclear for some time how much of the “old personality” will return and what changes will last.
Since each patient's care and rehabilitation plan is different, the family's involvement in the early stages of rehabilitation varies. Health team members often instruct people in specific ways they can become involved in the treatment plan. The following guidelines will help during the acute rehabilitation phase:

**Avoid overstimulation.** This is especially important in the early stages. A patient who is tired or physically weakened fatigues quickly. Later, overstimulation may only increase agitation and confusion.

**Use the familiar.** A patient with a short attention span is more likely to focus on something familiar and comfortable than something new and strange. Familiar voices, music, and objects may help a patient's memory and reduce confusion.

**Be consistent.** Staff, family, and friends should use a routine approach with the patient. The staff can assist family members in developing helpful approaches and responses, as it can be difficult to approach a confused, agitated, and aggressive patient. In addition, a consistent approach can help improve memory, reduce confusion, foster language skills, and promote emotional control. Following a daily routine in the acute rehabilitation phase can help the patient become oriented and feel more secure.

**Stay calm.** Family and staff should serve as role models for the patient. Observing a loved one's calmness can help to decrease the patient's confusion and agitation.

**Give step-by-step directions.** When the patient begins to follow simple commands, give directions one step at a time. This approach lessens fatigue and confusion, improves memory, and gives the patient a sense of success in completing a task.

**Do not remind the patient of past abilities.** As patients gradually become aware of their deficits, reminding them of abilities they no longer have may upset or embarrass them.
**Do not talk down to the patient.** Talk with patients at a level appropriate to their age and current level of understanding.

**Avoid arguments and stressful situations.** Remember that patients are particularly sensitive to stress after a brain injury.

**Allow response time.** As patients' abilities to speak and comprehend return, they usually take longer to respond to a question or join in conversation.

**Maintain a sense of humor.** A sense of humor has a healing influence. Once a patient's condition stabilizes and improves, family members find their ability to laugh returns. Moreover, they find that laughter helps them as well as the patient.

**Remember to praise.** When family members tell patients how proud they are of their progress, they promote further improvement. This simple advice may be easy to remember when dealing with children, but it applies to adults as well.
This section offers simple tips on dealing with stress.

Learning to manage stress is important for those closest to the person with a brain injury. Many individuals become so involved with the crisis that they neglect their own health, their jobs, and other family responsibilities. Time away from the bedside and the hospital is essential for the health and emotional welfare of all family members.

Following a brain injury, the strain of worry and the upheaval of family life quickly takes its toll. Of course, avoiding stress is unrealistic, but there are ways to manage it. Those who do not pay attention to their own needs may become unable to help the patient because of exhaustion and irritability.

Some warning signs of stress include inability to sleep, poor self-care, constant self-blaming, frequent feelings of loneliness, nightmares, excessive use of alcohol and/or medications, a sense of worthlessness, and not knowing where to turn for help.

Some tips for managing and preventing stress are listed below:

*Eat properly.* Skipping meals, eating on the run, or filling up on junk food will diminish energy reserves. A regular diet rich in nutrition will help the body to better manage the effects of stress.

*Ttry to get enough rest.* Immediately following the injury and during the first days of uncertainty, one’s body will run on “nervous energy,” but that soon ends. Plan to take turns at the hospital with family members and friends, and use some time away from the hospital to rest. One may find that giving constant progress reports to concerned friends and relatives can be very draining. Give information to one person and have that person contact others.
Avoid excessive use of alcohol and sedative medications. Instead of relieving stress, overuse of these substances may only create more problems.

Express feelings. Discuss positive and negative feelings with trusted friends, family members, or staff. As mentioned in the introduction to this booklet, some people find it helpful to keep a diary or journal of their feelings and experiences. Use the blank pages in this booklet. List problems and worries and then ask three things: What things can I change and how can I change them? What further information do I need and where can I get that information? What things are beyond my control to change? This exercise may help to clear the mind, redirect nervous energy, and allow one to take action when necessary.

Seek out professional help. Physicians, nurses, social workers, psychologists, psychiatrists and clergy are easily accessible in most hospitals. They can offer assistance and suggest other sources of help.

Be kind to yourself. Take time for exercise or a meal with a friend. By taking care of your own needs, you will be better able to respond to the patient’s needs.

Let others help. When someone offers to help, accept the offer. Be specific about how the person can help, either at home or in the hospital. Ask hospital staff about support groups within the hospital or the surrounding community.

Ask questions. Write questions down and ask hospital staff members for answers. Although many questions may have no clear-cut answers, a more thorough understanding of a situation or problem can help one to manage or cope better with them.
Because brain injury is a complex problem, many members of the hospital team plan and deliver care. It can be confusing to meet the numerous people who provide such a variety of services. The following list includes many treatment team members and briefly describes their responsibilities.

Anesthesiologist: A physician who administers anesthesia for surgery and special procedures. Anesthesiologists usually meet with patients and family members before surgery.

Attending Physician: The physician who is primarily responsible for the care of the patient. This is often a neurosurgeon immediately following the trauma.

Clinical Psychologist: An expert in the management of cognitive, emotional and behavioral problems. Psychologists also work closely with the rehabilitation team.

Consulting Physician: A physician who is a specialist in a medical field other than that of the attending physician. Consulting physicians may be called in by the attending physician to provide opinions on various aspects of care.

Intern: A physician who has finished medical school and is usually in the first year of specialty training. Interns work under the supervision of attending physicians and residents.

Internist: A physician who specializes in internal medicine. Internists are often consulted after a brain injury to assist in the management of problems of the heart, digestive tract, or other internal organs.


Neuropsychologist: A psychologist who specializes in working with patients who have experienced brain injuries. Neuropsychologists often administer special psychometric tests of brain function and work very closely with the rehabilitation team.

Neurosurgeon: Neurosurgeons operate on the brain and spinal cord and are often attending physicians for patients with brain injuries during the acute hospitalization.

Neurorehabilitationist: A neurologist who is specialized and board certified in the comprehensive rehabilitation care of patients having neurological disorders such as stroke or traumatic brain injury.
**Nurse:** A person with special training in the care of patients with various medical problems. As part of the brain-injury team, nurses also have special training and experience in caring for patients with diseases and injuries of the brain and spinal cord.

**Nutritionist:** An expert in the nutritional requirements of patients. Nutritionists are also adept at nutritional augmentation through various alternative methods of feeding for those patients unable to take in food and fluid by mouth.

**Occupational Therapist (OT):** A specialist involved in the retraining of patients with brain injuries to resume the self-care activities important to daily living. OTs work to improve function in the patient’s hands and upper body and become involved during the acute rehabilitation phase.

**Physical Therapist (PT):** An expert in maintaining and improving the movement and function of joints and limbs. Physical therapists may begin to work with patients while they are still in the intensive care unit.

**Speech Pathologist (ST):** A therapist responsible for the evaluation and treatment of problems with speech and language including: auditory, cognitive comprehension, attention, writing, reading, and expression skills.

**Psychiatrist:** A physician who specializes in the management of emotional and behavioral problems.

**Physiatrist:** A physician responsible for coordinating the rehabilitative needs of a patient.

**Resident:** A physician who has completed medical school and an internship who is taking additional training in a specialty, such as neurology, neurosurgery or psychiatry. Residents work under the supervision of attending physicians.

**Social Worker:** A trained specialist in the social, emotional and financial needs of families and patients. Social workers often help families and patients obtain the services they have been prescribed.

**Unit Secretary/Clerk:** A person who coordinates messages and manages the clerical work on the nurses’ station under the direction of the nurses.
HOW LONG DOES IT TAKE FOR PATIENTS TO COME OUT OF A COMA?

It is very difficult to predict when an individual with a brain injury will regain consciousness. The time varies from minutes to months, or even longer. Usually, the more severe the injury, the longer the period of unconsciousness or coma. Unconsciousness of one-half hour or less is classified as a mild head injury, while unconsciousness lasting more than 24 hours is considered a severe head injury.

HOW DO PATIENTS ACT AS THEY COME OUT OF A COMA?

"Waking up" from a coma is not like waking up after sleep. It is a much more gradual process. At first, patients are confused and agitated. They may not know where they are or what has happened, and may not recognize family members. This period of confusion and agitation can last from a few days to several weeks. It will also take several weeks or longer before doctors can evaluate the long-lasting effects of the injury.

WHAT DOES IT MEAN WHEN THE PATIENT MOVES WHILE HE IS IN A COMA?

Those in deep coma may only move in an involuntary response to something uncomfortable or painful. As coma lightens, and consciousness is regained, patients may respond to a simple request, such as "squeeze my hand" or "open your eyes."

IS THERE ANYTHING I CAN DO TO BRING THE PATIENT OUT OF A COMA?

Once a person's brain has been injured, it takes time to heal. There seems to be very little anyone can do to speed up emergence from a coma. Yet, it remains unknown the extent to which the presence of caring people and the sound of familiar voices may be beneficial to a patient in a coma. Take time to touch, hold, and talk to the patient and express feelings of love and caring.
WHAT CAN I TELL MY CHILDREN ABOUT A COMA AND BRAIN INJURY?

Adults often find it difficult to understand and explain brain injury and coma to themselves as well as their children. Talk simply and honestly with children and use judgment as to what each one can comprehend. Often, hospital social workers or counselors can help in finding the right words. Like any other family member, children may feel shock, sadness, anger, guilt, and worry at different times, and may not want to believe what has really happened. There will be times when talking together will be very important, times when they may wish to be alone and times when they wish to be with others without talking about the patient.
ANOSMIA - Loss of the sense of smell.

ANOXIA - A lack of oxygen. Brain cells need oxygen to exist. When blood flow to the brain is reduced or when oxygen in the blood is low, brain cells are damaged.

BRAIN CT SCAN - An imaging technique of the brain that reveal tumors, blood clots, hemorrhages, or other abnormal anatomy. A series of computerized X rays of the brain at various levels to reveal its structure.

CATHETER - A flexible plastic tube of varying sizes utilized for withdrawing fluids from or introducing fluids into a cavity of the body. This tubing is also used in specialized medical procedures.

CEREBROSPINAL FLUID - The liquid that fills the ventricles of the brain and surrounds the brain and spinal cord.

CLOSED HEAD INJURY - Trauma to the head that does not penetrate the skull but that results in injury to the brain.

COGNITION - The conscious process of the mind by which one becomes aware of thoughts and perceptions, including all aspects of perceiving, thinking, and remembering.

COMA - A state of unconsciousness from which the patient cannot be aroused, even by powerful stimulation. Coma involves the loss of awareness of self and the surrounding environment.

COMPUTERIZED TOMOGRAPHY (CT) SCAN or COMPUTERIZED AXIAL TOMOGRAPHY (CAT) SCAN - A series of computerized X rays which may be taken at various levels of the body's anatomy to reveal structure or abnormalities.

DECUBITUS ULCER - A bed sore or discolored, open area of skin damaged by pressure. Common areas for breakdown of skin are the buttocks, hip, shoulder areas, ankles, heels and elbows.

DEFICIT - A lacking or deficiency in the amount or quality of functioning.

DIPLOPIA - Double vision; the perception of two images of a single object.

ELECTROENCEPHALOGRAM - The recording of electrical activity of the brain by positioning electrodes on the scalp.

ELECTROCARDIOGRAM - A method for evaluating heart rate and rhythm by positioning electrode pads on the patient's chest, which are connected to a monitor.

EYE TAPE - Tape used to close the eyes of a patient who is unable to blink. Blinking is important to keep the eyes moist.

HALO - A metal ring used for patients with upper spinal cord injuries that surrounds or encircles the patient's head, allowing for proper alignment of the neck and spinal column.

JEJUNOSTOMY TUBE - A type of feeding tube surgically inserted into the small intestine.

MAGNETIC RESONANCE IMAGING (MRI) - A diagnostic procedure that uses magnetic fields to create pictures of specific areas of anatomy. MRI can provide a more detailed picture than the CT scan in some situations.
ORTHOSIS - Splint or brace used to support, align and improve function of movable parts of the body.

PERSISTENT VEGETATIVE STATE - A condition in which the patient is unable to speak or follow simple commands and does not respond in any psychologically meaningful way. The transition from coma to a vegetative condition reflects changes from a period of no response to the internal or external environment (other than reflexively) to a state of wakefulness but with no indication of awareness.

PLATEAU - A temporary or more permanent leveling off in the recovery or rehabilitation process.

RESPIRATOR - (see ventilator)

SCANNING - An active, usually visual search of the environment for information. Used in reading, driving, and other daily activities.

SEIZURE - An uncontrolled discharge of nerve cells that may spread to other cells throughout the brain. The sudden attack may be accompanied by loss of bowel and bladder control, involuntary movements, and a change in mentation.

SENSORY INTEGRATION - Interaction of two or more sensory processes in a way that enhances the adaptiveness of the brain.

SENSORY STIMULATION - Arousal of the brain through any of the senses.

SEQUENCING (motor) - Contracting muscles in an orderly and meaningful manner.

SHUNTING/SHUNT - A method of removing excessive fluid from the ventricles of the brain in hydrocephalus. A surgically placed tube connected to a ventricle deposits fluid into the abdominal cavity, heart or large vein in the neck.

VENTILATOR - Equipment that mechanically does the breathing for the unresponsive patient. The machinery serves to deliver air with the appropriate percentage of oxygen and at the appropriate rate.

Medications

ANTIBIOTICS - Used to treat a variety of infections, which may occur in hospitalized patients such as pneumonia and urinary tract infections. Patients may also be placed on antibiotics to help prevent possible infections.

ANTICOAGULANTS - Medications, such as heparin or coumadin, utilized to slow down normal blood clotting and prevent clots from forming.

ANTICONVULSANTS - Anti-seizure medications. These medications help to prevent seizures.

ANTIDEPRESSANTS - These medications help the patient control the symptoms and signs of depression.

ANTIPSYCHOTICS - These medications add a calming influence and help prevent sudden mood swings.
BETA RECEPTOR BLOCKERS - A group of medications used to reduce agitation, rapid heart beat, elevated blood pressure, and tremors.

ETIDRONATE DISODIUM (DIDRONEL) - Given to patients who demonstrate a tendency to form calcium deposits and abnormal bone formation around joints and in injured soft tissues.

FUROSEMIDE (LASIX) - This medication helps the body to eliminate water by increasing the excretion of sodium through the body's urinary system.

LAXATIVES - These medications are usually used along with a carefully supervised dietary program to promote bowel regularity. Constipation often occurs because of nervous system damage and long periods of inactivity in bed.

MANNITOL - This drug helps remove water from the brain, and helps decrease intracranial pressure and brain swelling.

MORPHINE SULFATE (MS) - Narcotic that acts to relieve pain.

MUSCLE RELAXANTS - These drugs relax the muscles for greater comfort, to ease therapy, and to reduce spasticity.

PENTOBARBITOL (NEMBUTAL) - A barbiturate used in extreme cases to help control the pressure inside the head. This drug can be effective in cases in which other measures fail to reduce abnormally elevated intracranial pressure or to stop seizures.

PANCURONIUM BROMIDE (PAVULON) - Relaxes skeletal muscles to keep the patient from working against the respirator.

DIAZEPAM (VALIUM) - A barbiturate that can be used to stop repetitive seizures. Also may be used as a muscle relaxant.


### Reference Tools


HDI Publishers, _HDI Coping Series on Head Injury_, 10131 Alfred Lane, Houston, TX 77041.


