



# **Polytrauma Rehabilitation Family Education Manual**

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## INTRODUCTION:

Welcome to the Polytrauma Rehabilitation Center (PRC) at the Richmond McGuire VA Medical Center. This manual is provided to you to help educate you about brain injury, brain injury rehabilitation and other related topics that may come up during your family member's stay at the PRC. The information included in this manual has been written and compiled from several sources and is intended only as a general guide for families and friends of patients with brain injuries. Please read the manual at your own pace. NOTE: To simplify the reading of this material the pronoun "he" has been used throughout the text to represent individuals with brain injury, although we certainly recognize that brain injury is *not* gender-specific.

For your convenience and to help make this information understandable, we have included a "Glossary of Terms" at the end of the manual. Terms included in the Glossary can be found throughout the pages in *italics*, also often followed by a definition. Additional information about the Polytrauma Rehabilitation Unit, the McGuire VAMC facility and patient and family rights and responsibilities can be found in the ***Polytrauma Rehabilitation Center Orientation Handbook for Patients and Families***, which you received on or before admission.

As you learn more about the brain and its functions, you are likely to have many questions. Members of our rehabilitation team are here to answer your questions and to provide you with information about brain injury and recovery. Please use them as a resource. You may also find additional information related to brain injury by visiting these websites:

- The Brain Injury Association of America: [www.biausa.org](http://www.biausa.org)
- Defense and Veteran's Brain Injury Center: [www.dvbic.org](http://www.dvbic.org)
- National Institute of Neurological Disorders and Stroke: <http://www.ninds.nih.gov/disorders/tbi/tbi.htm>
- Centre for Neuro Skills: TBI Resource Guide: [www.neuroskills.com](http://www.neuroskills.com)
- National Resource Center for TBI: <http://www.nrc.pmr.vcu.edu>

For more information about outcomes data on the brain injury program at the Richmond Polytrauma Rehabilitation Center go to: <http://www1.va.gov/netsix-braininjury/>

For information about military resources and service-specific benefits go to:

- Military OneSource: <http://www.militaryonesource.com> (800-342-9647)
- Army Wounded Warrior Program (AW2): <https://www.aw2.army.mil> (800-833-6622)
- Marine For Life (M4L): <https://www.m4l.usmc.mil> (866-645-8762)

- Safe Harbor (Navy): <http://www.npc.navy.mil/CommandSupport/SafeHarbor/>  
(877-746-8563)
- Palace Hart (Air Force) (888-774-1361)

## **PART I: EQUIPPING YOURSELF WITH KNOWLEDGE**

Traumatic brain injury (TBI) affects not only the individual but the family as a whole. One minute the person is fine, the next minute he is involved in an overwhelming medical emergency, perhaps a fight for life. As a family member, you are also involved in this complex process. Even as the initial crisis passes, you are suddenly involved in making sense of all the new and complicated situations in which you find yourselves. In order to gain the confidence to make decisions about your family member's care, it is important to learn as much as possible about brain injury, and how it can affect a person's cognition (thinking) and behavior (acting).

In addition to providing basic information about brain injury, this guide also offers some information about how treatment at our rehabilitation facility promotes the recovery process and how we approach this treatment as an interdisciplinary team. Finally, we have included information about some of the ways you can and should take care of yourself during this difficult and challenging time.

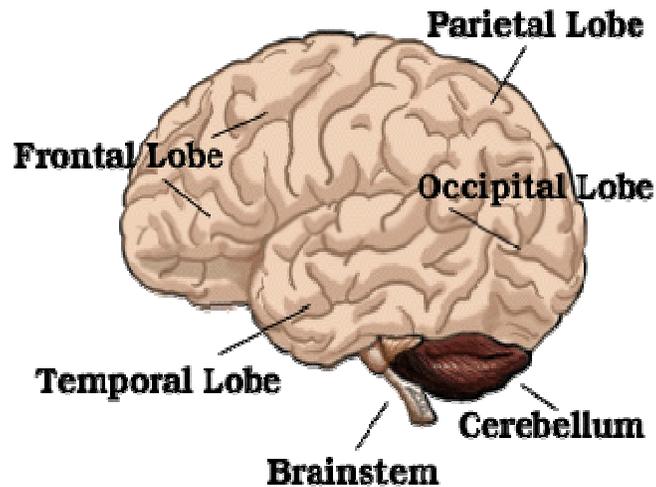
Please note that some of the information in this manual may not directly apply to your family member - or to your experience thus far. No two people have the same brain injury, and so the recovery process and the long-term effects of an injury will vary for each patient. This is important to remember when coming to know other patients and families on our unit. Your family member's recovery will be individualized and may proceed more rapidly or slowly than other patients. Please try to avoid comparisons whenever possible.

### **WHAT ARE THE FUNCTIONS OF THE BRAIN?**

Though it weighs barely three pounds, the brain has an enormous job. It regulates all of our physical movement and sensation as well as our ability to think, act, feel and communicate. Because the brain is such a complex organ, it is probably best to begin with a basic explanation of its functions. This may help you to understand some of the changes that you may observe in your family member over time.

The brain is divided into several parts, each with very specific functions. Normally, the brain manages to perform routine actions regularly and quickly through constant communication between one part of the brain and the next. When the brain is injured, communication between the different areas of the brain can become disrupted and interrupt the simplest of tasks. Certain types of problems are commonly seen with injury to specific parts of the brain. In fact, in some cases the areas of the brain that have been damaged can be identified by changes in the individual's behavior following injury. The best way to understand the deficits associated with brain injury is to

understand the function of each area of the brain and its related systems and structures (refer to picture below).



### **Skull**

The bones that come together to cover and protect the brain.

### **Brain Stem**

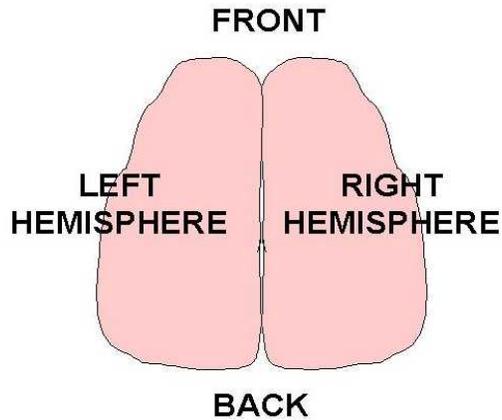
The brain stem, located at the base of the skull, is a very small area that is responsible for life-sustaining functions such as regulation of blood pressure, heart rate, breathing, and body temperature. The system that is responsible for arousal and alertness is also in the brain stem and is known as the Reticular Activating System (RAS). The RAS functions like a dimmer in a light switch, increasing and decreasing the responsiveness to the environment. If the RAS is damaged, an altered state of consciousness such as coma or a vegetative state may result.

### **Cerebellum**

The cerebellum, located behind the brain stem, is responsible for muscle coordination and balance.

### **Cerebral Cortex**

The cerebral cortex (cerebrum) is what is most commonly thought of as "the brain". It is divided into left and right hemispheres. Generally, each hemisphere directs the opposite side of the body (i.e., the left hemisphere directs the right side of the body and vice versa).



Each hemisphere is then divided into four lobes that have specific functions:

### Frontal Lobes

Particularly vulnerable to trauma and necessary to higher level thinking, often called “executive” functions. These functions include the ability to focus attention, organize and plan, problem-solve, make good decisions, and show appropriate judgment. Executive functions also play a role in controlling behavior and emotions.

### Occipital Lobes

Responsible for aspects of visual function.

### Temporal Lobes

Regulate memory function, language information, aspects of emotional processing, and behavior.

### Parietal Lobes

Important in sensation (touch, pressure, temperature, pain), perception, attention and complex aspects of brain processing.

### Sensory & Motor Strips

Primarily responsible for organization of higher level motor behavior, such as the coordination of movement in walking.

### Limbic System (located inside the temporal lobe)

In addition to the different lobes of the brain, there are systems within it that connect these lobes. The *limbic system* is an area of vital importance to mood and emotional regulation, motivation, attention, and memory. Injury to this system may result in behaviors ranging from a). flat affect (no expression) to aggressiveness b). mild distractibility to the inability to pay attention and, c). slight memory problems to the inability to recall what happened 30 minutes ago.

## WHAT IS BRAIN INJURY AND WHAT HAPPENS TO THE BRAIN WHEN IT IS INJURED?

Injury to the brain can occur when the head is injured by an external force (called *traumatic brain injury* or *TBI*) or by a non-traumatic event such as a tumor, stroke, aneurysm, or infection. Any brain injury can cause a wide range of functional changes that may affect thinking, sensation, language, memory and/or emotions.

### Initial Events

Three initial events can occur following a brain injury. First, immediate damage can occur if the brain hits or rubs against the bony structures of the skull, especially in the area of the forehead (*frontal area*) and upper cheek and ear (*temporal area*). This impact can cause tearing, bleeding, and bruising of brain tissue. Second, the brain is fixed to the spinal cord and as it turns and twists during injury tearing and stretching of the nerve fibers (*axons*) can occur all over the brain and in the brain stem. Third, the brain can suffer *diffuse* (all over) swelling which, in 75 percent of cases, will result in an increase in *intracranial pressure*, due to the inability of the skull to expand. General swelling and increased pressure reduces the blood flow necessary for undamaged brain tissue to function properly. Unconsciousness or coma may result, depending on the severity of these injuries.

The type of injuries described thus far generally occur in the minutes, hours and initial days after the injury. Once brain swelling is reduced and blood flow returns to normal, the extent to which the brain tissue has been damaged becomes clearer. Some brain tissue may return to normal functioning. Other tissue may be permanently damaged.

### Categories of Brain Injury

Brain injuries range from "mild" to "severe" and are categorized as *penetrating* (open) or *non-penetrating* (closed). A brain injury is classified as a *traumatic brain injury* or TBI when the injury to the brain is caused by an external force. TBIs can be caused by penetrating or non-penetrating injuries. A penetrating TBI means the skull has been punctured or opened in some way as in the case of injury caused by shrapnel or gunshot wound. In a non-penetrating TBI, the head is shaken or hit by an external force which causes the brain to impact against the bony structure of the skull (e.g., exposure to a blast, fall or motor vehicle accident).

The brain can also sustain injury from non-traumatic events such as *anoxia* (insufficient oxygen to the brain), *aneurysm* (burst blood vessel) or stroke. Brain injury from any cause can result in one or more of the following:

contusion: a bruise to a part of the brain

laceration: a ragged tear in the tissue of the brain

hemorrhage: bleeding following damage to the blood vessels

A *hemorrhage* may eventually develop into a *hematoma* (a blood clot) and can occur in any part of the brain. Clots fill the space between the skull and the brain and put pressure on the brain. The most common forms of hemorrhage are:

epidural hemorrhage: forms between the dura (tissue which covers and protects the brain) and the skull

subdural hemorrhage: forms between the brain and the dura

subarachnoid hemorrhage: forms in between the layers of membranes covering the brain

intraventricular hemorrhage: blood that enters the open spaces (*ventricles*) of the brain

Damage to the brain from either an open or closed injury may be *focal*, meaning a specific area of the brain is affected, or *diffuse*, meaning brain cells in many areas of the brain are affected. A patient with a brain injury may suffer from both diffuse and focal injuries.

### Anoxia

Because brain cells need a constant supply of blood to provide them with oxygen and nutrients, any interruption in this supply can cause damage. Insufficient oxygen to the brain is called *anoxia*. An anoxic injury can follow several events including, heart attack, complications of anesthesia or respiratory failure.

*Diffuse Axonal Injury* (DAI) is widespread damage to the *axons* or communication pathways that connect the different areas of the brain. This occurs when there is twisting and turning of the brain tissue at the time of injury. Consequently, brain messages are slowed down or lost and there is a reduction in the number of cognitive operations that the brain can engage in at any given time.

### **Rancho Los Amigos Scale**

The Rancho Los Amigos Scale is an instrument used to track recovery from brain injury. It is most helpful in assessing the patient in the first weeks or months following the injury, because it does not require the cooperation of the patient. The Rancho Levels are based upon observations of the patient's responses to the world around him. They provide insight into the expected progression during recovery and rehabilitation.

An understanding of the characteristics of each of the eight Rancho Levels (see scale below) is helpful when families must cope with the behaviors demonstrated by their family member following head injury.

- **Level I - No response.** Patient does not respond to external stimuli and appears asleep.
- **Level II - Generalized response.** Patient reacts to external stimuli in nonspecific and inconsistent manner with stereotypic (repeated, purposeless movements) and limited responses
- **Level III - Localized response.** Patient responds specifically and inconsistently with delays to stimuli, but may follow simple commands for motor action.
- **Level IV - Confused, agitated response.** Patient exhibits bizarre, non-purposeful, incoherent or inappropriate behaviors, no short-term recall; attention is short and nonselective.
- **Level V - Confused, inappropriate, non-agitated response.** Patient gives random, fragmented and non-purposeful responses to complex or unstructured stimuli. Simple commands are followed consistently, memory and selective attention are impaired and new information is not retained.
- **Level VI - Confused, appropriate response.** Patient gives context- appropriate, goal-directed responses, dependent upon external input for direction. There is carry-over for relearned, but not for new tasks, and recent memory problems persist.
- **Level VII - Automatic, appropriate response.** Patient behaves appropriately in familiar settings, performs daily routines automatically, and shows carry-over for new learning at lower than normal rates. Patient initiates social interactions, but judgment remains impaired.
- **Level VIII - Purposeful, appropriate response.** Patient is oriented and responds to the environment but abstract reasoning abilities are decreased compared to pre-morbid (before the injury) levels.

## **MEDICAL AND RELATED PHYSICAL EFFECTS OF BRAIN INJURY**

Many potential deficits are discussed in the following four sections. Remember as you read these descriptions that only some may apply to your family member. As noted earlier, each person's injury and path to recovery is unique.

### Problems with nutrition, swallowing and eating

Physical and cognitive changes such as diminished attention, poor hand coordination, and difficulty in swallowing, can disrupt normal eating habits. Proper nutrition is essential to

healing so evaluations are performed to determine the best means for your family member to maintain adequate nutrition. Retraining efforts by nursing, occupational therapy, and speech therapy can help a person recover eating abilities.

*Dysphagia* is a term used to describe swallowing disorders. After a brain injury, a patient may *aspirate* (inhale) food or liquids into the lungs. Sometimes a patient can aspirate without choking or coughing (silent aspiration). Aspiration can cause pneumonia to develop, which can be a life threatening condition. Speech/language pathologists conduct evaluations to determine a person's level of safety in swallowing. Some patients may require a feeding tube to help maintain proper nutrition until they are able to swallow properly again. Several feeding tubes are common:

nasogastric (NG) tube: does not require a surgical procedure for use and is passed through the patient's nose and into the stomach

jejunostomy (J) tube: surgically inserted directly into the small intestine

gastrostomy (G) tube: inserted directly into the stomach.

**NOTE:** It is very important that you DO NOT feed or offer liquid to your family member until given clearance by the medical team.

### Fever

If fever occurs, blood and urine tests and x-rays may be needed to help discover the cause of the fever. Fevers are most often caused by infections (e.g., urinary tract) or pneumonia and, typically, can be easily treated with antibiotics. Fevers are also occasionally due to actual damage or dysfunction of the brain area that controls temperature.

### Fractures

Many individuals who suffer a brain injury also sustain other trauma such as fractured bones. Orthopedic care can continue in the rehabilitation setting and rehabilitation specialists (physical therapists, kinesiotherapists) can assist in recovery from the effects of these injuries. Often, activities will be restricted for a period to allow for proper healing. **NOTE:** After brain injury, a patient may not understand activity restrictions or the need for them. For their safety, it is up to the treatment team AND family to monitor the patient's activity level and to continually reinforce any restrictions.

### Heterotopic Ossification

Many patients with severe brain injury develop extra bone in the soft tissue around their joints — usually shoulders, elbows, knees, and hips. This formation, called *heterotopic ossification*, can cause pain and diminish the range of motion (ROM) in the affected joints. Range of motion therapy can help to lessen the problem and may be used along with medication. In more severe cases, future surgery may be necessary.

## Hydrocephalus

*Cerebrospinal fluid (CSF)* is like a "shock absorber" for the brain. CSF fluid circulates around the brain and spinal cord and acts as a protective cushion against physical impact. The amount of CSF in the skull must be maintained at a certain volume for the brain to function normally. *Hydrocephalus* is a condition in which there is too much CSF in the skull. This condition causes the enlargement of the four cerebral *ventricles* (connected hollow spaces in the brain) that help to produce, filter, and distribute the CSF. Hydrocephalus can be caused by an abnormal production of CSF or by an obstruction that does not allow the fluid to circulate properly. In some cases, a small catheter or *shunt* may be required to drain excess fluid from the brain.

## Bladder and Bowel Incontinence

It is common for brain injury survivors to temporarily lose control of bowel and bladder functions, particularly early in recovery when their overall awareness is diminished. In addition, pain medications often cause problems with constipation. Functional problems with bowel and bladder may persist even after the patient regains awareness, if there is damage to the areas of the brain that control those muscles. Bowel and bladder programs can be implemented during rehab to improve function. Management techniques include laxatives and/or suppositories, use of *catheters* or external collecting devices and scheduled times and reminders for voiding. Bowel and bladder functions also may be improved by changes in diet.

## Problems of Inactivity

The long period of inactivity that often accompanies recovery from a brain injury can also lead to certain physical problems. *General deconditioning* is a condition where an individual's strength and energy gradually decreases due to extended bed rest. Individual exercise programs can help restore lost muscle strength and physical endurance. Skin problems such as *pressure ulcers* can develop after lying in one position for a long time. The best prevention of pressure sores is frequent inspection of the skin, shifting and repositioning, and good nutritional status. Blood clots, called *deep vein thrombosis* (DVT) may develop, especially in the legs, when patients have limited ability to move. Although the clots are not always apparent, they may be accompanied by pain, warmth, and swelling. Occasionally, a piece of clot can break off and damage the lungs (*pulmonary embolism or PE*). To prevent further problems, clot-preventing medications (anti-coagulants) are usually prescribed. In some patients who may not tolerate anti-coagulants, a filter (*Greenfield filter*) is sometimes placed in a large vein to prevent clots from traveling to the lungs.

## Seizures

*Seizures* are a common complication of brain injury and are caused by an abnormal electrical discharge by brain cells. The symptoms of a seizure can range from

generalized shaking and loss of consciousness, to a short episode of altered attention, emotion, sensation, or movement. The risk of seizures is greater with penetrating injuries, *depressed skull fracture*, or *intracranial hemorrhage*. Depending on different factors, seizures are usually treated with an anti-convulsant medication for a period of time.

### Sensorimotor Effects

This term refers to the relationship between movement and sensory perceptions. The brain interprets information sent by the senses, and directs physical movement of the body. Any of several movement disorders can result if a brain injury interrupts the smooth operation of this process. Different types and levels of paralysis can affect different parts of the body and last for unpredictable periods of time. *Hemiparesis* is weakness on one side of the body; when this weakness is more severe, it is called *hemiplegia*. Motor control in general can decrease because the injury has affected the way the brain directs the muscles to move. This can result in complete or partial interruption of certain movements, uncontrollable spasms, and/or a general inability to control movements. Another common problem with motor control is *apraxia*, or the inability to carry out purposeful movements. For example, a person may have the ability to lift his arm, but may not be able to do it voluntarily because the instructions cannot be communicated from the brain. A person's balance and coordination may also be affected by brain injury. Because balance depends upon vision, hearing, and sense of position, any interruption in these connections can disrupt balance. Poor coordination (*ataxia*) can be caused by injury to the cerebellum or portions of the inner ear and their connections to the brain. This condition can interfere with the performance of even the most basic movements and tasks.

### Problems With Muscle Tone and Range of Motion

Muscle tone is frequently abnormal after a brain injury. Sometimes muscle tenseness may increase with movement. This is called *spasticity*. This change in muscle tone can be painful and can lead to decreased range of movement and abnormal posture. For example, the arms may be held tightly across the chest and the legs may be held in a straight, rigid position. Treatment for abnormal muscle tone includes exercises to reduce muscle tension, gain posture control, and improve flexibility. Most importantly, at least once a day every major joint (shoulders, hips etc.) need to be moved through its full range (called range-of-motion exercises). This is something family members are trained to do and should do on a regular basis. Other strategies include slow rocking, balance training, and serial casting (the application of casts to prevent deformity and gradually increase range of motion). Anti-spasticity medication, selected nerve block injections, and selected muscle injections may also be used. Orthopedic or neurosurgical procedures may be required in severe or chronic situations.

## Dysarthria

*Dysarthria* refers to slurred speech and an abnormal voice quality. This term describes a variety of speech difficulties caused by muscle weakness or paralysis. The problem can be located anywhere in the process of speech production: the muscles of the mouth, the passageway between nose and mouth, the voice box (*larynx*), or the respiratory system.

## Visual Deficits

Vision is often affected by trauma to the brain. Vision can be impaired in one eye, in both eyes, or on one side of the visual field (*hemianopsia*). *Diplopia*, or double vision, is also common after brain injury and is usually due to nerve damage. An eye patch often relieves initial discomfort and improvement usually occurs over several months. If symptoms persist, special glasses or eye surgery may be considered. Often, people have visual-spatial difficulty that is not due to nerve damage and is caused when the brain has difficulty interpreting what is seen. These problems include:

visual neglect: a person is less attentive to objects on one side of the body

decreased depth perception: difficulty in perceiving how far away something is

visual agnosia: problems recognizing common objects

## Other Perceptual Deficits

Because sensory information is processed in the brain, any of the other senses (hearing, taste, smell, and touch) may also be affected by a brain injury. The ability to taste and smell as well as hearing, or the quality of what is heard (*auditory acuity*), may be diminished. Certain sensitivities may be heightened, including sensitivity to touch and to movement.

## Fatigue

Fatigue is common in the early stages after brain injury when the activating centers of the brain, which help to keep a person alert and awake, become impaired. Patients should have scheduled rest breaks in their daily rehabilitation schedules to compensate for fatigue. Decreased alertness and mental fatigue gradually lessen as recovery progresses.

## **BEHAVIORAL EFFECTS OF BRAIN INJURY**

Behavioral symptoms are common following brain injury including, anxiety, agitation, frustration, impulsiveness, repetitiveness, depression, regression (childishness) and *disinhibition* (inability to control impulsive behavior and emotions). Pre-existing personality traits will often also be magnified (e.g., the tendency to be moody or anxious). Each person's symptoms are different and depend on the nature and extent of the brain injury.

### Excessive agitation

Excessive agitation and restlessness is common in certain stages of the brain injury recovery process. Trauma to parts of the frontal or temporal lobes of the brain results in behavior that gradually resolves as an individual recovers. When dealing with an agitated relative, family members must behave calmly, and should try to create a quiet, consistent, loving environment. Often, it is recommended that families seek counseling from the team psychologist to reduce their stress and to learn healthy coping strategies.

### Extreme Changes in Emotion

Extreme or rapid changes in emotion (mood swings) may occur in patients with certain frontal and/or temporal lobe injuries. For example, contentment and satisfaction can quickly turn to tears or anger. Other related symptoms include depression, angry outbursts, excessive laughing or crying, and swearing. Lack of ambition, lack of interest in the world, and changes in personality may also occur.

### Disinhibition & Impulsiveness

The frontal and temporal lobes of the brain contain areas that act as a mental "brake" to help individuals to monitor their behavior and act in socially acceptable ways. After a brain injury, this "brake" may no longer function properly. This may cause your family member to act impulsively and out of character (e.g., making silly or inappropriate comments). Disinhibited, impulsive behavior can be very frustrating and sometimes embarrassing to family or friends. Remember, that this behavior is not typically willful and is a result of the injury to your family member's brain. Regardless, a great deal of patience may be required to manage these behaviors. Give gentle feedback to your family member on how to control this behavior (e.g., "Let's try to use another word when you are angry") and praise your loved one when they remember to do so.

### Self-Centeredness

After brain injury, individuals often seem self-centered and demanding. They become intensely aware of their own feelings and needs, but they may be insensitive to the feelings of others. Again, offer support understanding and gentle feedback about unrealistic demands and try not to withdraw or take this behavior personally.

## **COGNITIVE EFFECTS OF BRAIN INJURY**

### Arousal, Attention and Concentration

In early recovery, patients can often remain completely alert for only brief periods of time. Later, it may be difficult for them to focus their attention or to finish a project or conversation without becoming overstimulated. Patients can be easily distracted by their own emotions, thoughts, or by any element in their environment, such as noise, music, or sudden changes in the room. NOTE: It is important to be aware of the

environment in your family member's room and to make adjustments (e.g., limit visitors, decrease noise and light) if you see evidence of overstimulation (i.e., agitation, fatigue, irritability, distractibility).

### Communication

A brain injury can affect a person's ability to understand language and communicate thoughts. *Aphasia* is a type of communication problem in which a person loses the ability to speak or understand speech. People who have difficulty understanding speech have *receptive aphasia* (Wernicke's aphasia); those with difficulty saying or producing speech have *expressive aphasia* (Broca's aphasia). A person may have either receptive or expressive aphasia or a combination of both.

### Memory

Memory impairment, or *amnesia*, is common after TBI. Here are descriptions of three different types of amnesia:

retrograde amnesia: the inability to remember events that

occurred for period of time immediately before the injury

anterograde amnesia: the ongoing inability to make new memories following injury

post-traumatic amnesia (PTA): the inability to remember day-to-day events during a period of time after the injury

Precise assessment of how much actual memory loss has occurred is difficult. Patients in a confused state will often not remember things because of their severely impaired attention, but may show good memory function once their attention improves. The length of PTA is often an indicator of injury severity.

There are different types of memory. *Short-term memory* is the ability to recall things occurring within a few seconds to a day. *Long-term memory* is the ability to recall things occurring within a longer period of weeks and months, and *remote memory* is the ability to recall events that occurred many years ago. Often, remote memory begins to return before short-term or long-term memory. The good news is that the memories of childhood and upbringing are often spared after an injury to the brain. However, difficulty forming new memories can be devastating for patients when it comes to day-to-day functioning. Many patients with severe memory difficulties can recall events from years ago, but cannot remember what they had for breakfast that day. Also, patients who are confused can misunderstand situations and may offer responses that appear made up. This behavior is called *confabulation* in which the person resorts to using unrelated memories to fill in missing memory gaps.

Various aspects of memory can be affected differently after brain injury. For example, memory of things seen (*visual or "nonverbal" memory*) differs from memory of things heard (*auditory or "verbal" memory*), and strength in one area can be used in therapy to help improve other memory deficits.

## Judgment

Many people with brain injury exhibit lack of *insight* (awareness) into their medical condition and resulting deficits. Problems can range from complete unawareness of severe physical impairments (that are obvious to everyone else), to minimizing the extent of *cognitive* (thinking) deficits. Consequently, brain injury patients can have difficulty judging their limitations when planning or problem-solving. Family members as well as rehabilitation staff need to have a realistic appraisal of the patient's strengths and weaknesses so they can provide guidance for planning and problem solving.

## **PROGNOSIS**

The first question typically asked is "Will my family member get better?" Often the most honest answer to the question about *prognosis* (eventual outcome) is that there is no definite answer. Why? Because the long-term effects of brain injury can be difficult to predict. Evidence from years of treatment, however, does offer some useful information to consider as your family member progresses through recovery.

The most rapid improvement usually occurs in the first few months after the injury and the majority of improvement is seen within the first 12 months. No one, however, can reliably say when recovery stops. Many people with brain injury continue to show gradual progress, or windows of progress, for several years. The rate of progress can vary greatly, depending upon the individual and the time since injury. At times, progress can seem frustratingly slow. The best predictors for outcome are made after considering the specifics of each patient's case in addition to his level of functioning before the injury. Some of the different factors that can affect recovery include individual personality traits, physical health, intellectual level, and the availability of family and social support systems.

Medical issues involved in estimating recovery from brain injury include the type of injury the person has sustained, the cause, location and severity of the injury, the amount of time spent in coma or post-traumatic amnesia (PTA), the care the person has received, age, and time since injury. Medical personnel in both acute care and rehabilitation hospitals use several diagnostic tools to assess the level of brain injury. These tools include measurement scales that gauge a person's response and function, and diagnostic tests that determine the location and, to some degree, severity of the injury (i.e., Rancho Los Amigos scale, neuropsychological tests, MRI, CT scan, EEG, see *Glossary*). Please talk with your medical team about the specifics of the prognosis for your family member.

## **RECOVERY FROM BRAIN INJURY**

It is difficult to predict a person's ultimate level of recovery. Although you may be anxious to know if your family member will fully recover, the treatment team may not be

able to provide you with a definitive answer. However, we do know that after a brain injury, the body often begins a remarkable repair process. Unlike the skin, the brain does not heal by forming new cells. Instead, existing cells will change to make up for the lost cells. In most cases, brain swelling subsides within a few weeks and the pressure inside the skull stabilizes. This is the time when recovery is most rapid. The brain's chemical balance returns to normal within several months. And while the damaged connections between nerve cells will not *regenerate* (grow back), research has shown that some new connections may develop between these cells over an extended period of time. Existing connections may also be used in new ways to help offset the effects of the injury.

As people recover from brain injury, they often move through progressive stages previously described by the Rancho Levels — though, as noted earlier, each individual will move through the levels uniquely. The Rancho Levels offer a gauge to understand what point your family member has reached, based on the behaviors he is displaying. Below is a series of four stages in recovery extracted from the Rancho Levels. They represent general behaviors people exhibit as they progress and offer some guidelines for how you can react to and interact with your family member during these recovery stages.

#### Emergence from Coma (Rancho Levels II and III)

Unlike the dramatic reawakening you may have seen on television, the emergence from coma may be very gradual in people with severe brain injuries. Although the term "coma" suggests closed eyes, in fact your family member's eyes may open before any signs of consciousness are apparent. Consciousness is judged by a person's ability to interact and is usually tested by his or her ability to follow commands and respond to stimulation from the environment.

In the course of emerging from PTA or coma, people typically progress from inconsistent responses with only certain people to responses that are more consistent. The patient's sleep/wake cycle normalizes and they begin to follow objects with their eyes (*tracking*). Other indications of emergence from coma, such as assisting in therapy, or having facial expressions signifying emotions may be evident before a patient begins giving consistent responses to commands.

During this time, the rehabilitation team looks for purposeful responses and tries to facilitate these responses by using multi-sensory stimulation (e.g., range of motion exercises, taste, smell, sound and movement stimulation, changing the patient's position, and using visual images and verbal reassurance). Family members can assist in this process by engaging in direct, uncomplicated activities for short periods of time and describing them simply and in a calm speaking voice ("I am holding your hand now"). You can try to have the person look at you and others in the room when his eyes are open. It

is very important not to overstimulate a person at this level as this may lead to confusion and to a temporary inability to respond ("shutdown"). Presenting one simple, familiar command or action at a time and allowing additional response time are techniques to avoid overstimulation. As the responses to commands become more consistent, you can continue to ask your family member to follow these commands and ask basic "yes" or "no" questions. This period of growing awareness is also a time to begin orienting your family member to where he is and what has happened. If you are concerned about overstimulating your family member, please ask a member of the rehabilitation team how much stimulation is optimal.

#### Agitated State (Rancho Level IV)

A phase of restless, agitated, or aggressive behavior often accompanied by confusion can occur in patients as they progress. These behaviors are part of the recovery process and your family member will not necessarily exhibit them over the long-term. During this time, the rehabilitation team will reduce distracting stimuli (i.e., television, radio, noise level), try to establish normal sleep/wake patterns, and create as protected an environment as possible. Protection may include the use of mats or a specially designed bed with the least amount of restraint necessary to allow your family member to move freely without harm. Behavior modification strategies and medications are also helpful for some patients. It is important to remember that this agitated stage is a step in the recovery process. Though these behaviors may be difficult to watch and respond to, they are often signs of improvement. You can also help by being aware of and reducing the stimulation that could promote agitation. You can continue to seek responses to commands and questions, but speak in gentle, low tones and move about quietly and slowly. You can set limits to very inappropriate behavior, but do not expect to control or rationalize the patient into "normal" behavior. This is a stage requires a great deal of tolerance by all.

#### Confused State (Rancho Levels V and VI)

Most patients pass through a period of confusion in which they have difficulty maintaining a coherent line of thought. In this stage, patients do not recall new information and may not be oriented to time or place. It is possible that your family member will go through a period of confusion, especially if he or she has had a long period of unresponsiveness. Improving attention is usually gradual at this point, but learning can take place during this stage. As patients become less confused, their ability to focus on a task and recall daily events often improves. To assist your family member through the period of confusion, ask simple questions that will encourage memory and offer generous words of encouragement and praise for the answers. Create steady routines to develop greater organization. Do not treat the person as a child because his thinking is muddy, but continue to be as honest and direct as possible. As your family member progresses in this stage, help him get organized to do simple daily tasks and begin building greater independence by offering only occasional support to complete

these tasks. The patient's tolerance levels for activities may still be low, so show great patience and maintain realistic expectations.

#### High Functional Level (Rancho Level VIII)

Although patients who reach this stage may be medically stable, they may continue to have physical and/or cognitive deficits. Treatment is aimed at helping the patient to recognize these deficits, develop independence, solve problems, and display appropriate social behavior. Anticipatory anxiety about the imminent return to family, community, and school or work may appear as ambivalence and/or disinterest in the future.

Psychological counseling can help you and your family member to better understand how his levels of functioning have changed and to develop appropriate coping skills. In this stage, you will need to encourage, and should expect, full participation in daily activities. Your family member should begin taking responsibility for his personal care and should begin to employ those strategies that will help make up for cognitive and/or physical deficits.

## Part II. THE REHABILITATION PROCESS

Rehabilitation is a method of treatment that uses up-to-date care to help individuals recover from brain injury. This comprehensive and integrated approach requires individualized and creative treatment that focuses on the exact needs of patients. The goal of rehabilitation is to help an individual return to a life that is as independent and productive as possible while preventing secondary complications or further decline. At the Richmond Polytrauma Rehabilitation Center, our clinical specialists work together as an interdisciplinary team (IDT) to address the specific cognitive, behavioral, physical, and emotional difficulties that a person faces after brain injury. We consider the patient's family and support system to be an integral part of our team and encourage you to fully participate in your loved one's rehabilitation treatment plan.

Our core interdisciplinary team includes specialists in physical medicine/rehabilitation (physiatrist), rehabilitation nursing, neuropsychology, rehabilitation psychology, physical therapy, occupational therapy, speech/language pathology, kinesiotherapy, and social work and recreation therapies. All clinical team members contribute to an integrated team approach while providing treatment within their own specialty areas. The team also consults with specialists from other disciplines in the hospital as necessary (i.e., neurosurgery, orthopedics, nutrition, chaplain services). In addition, there is a full time military liaison on the PRC unit who is available to assist you with questions about benefits and other military-related issues.

In the first few days at our facility, you will meet every member of the team who will be working with your family member. To help you better understand the specialty work of our clinicians, we have included a description of their team role, including specific diagnostic and treatment methods and special equipment they may use.

Physical Medicine & Rehabilitation Specialist (also known as a physiatrist). The physiatrist is a medical doctor and the team leader who directs and coordinates the patient's care. Physiatrists treat problems that touch upon all the major systems in the body with a focus on restoration of impaired function.

### Rehabilitation Nursing

Rehab nurses combine traditional patient care skills with expertise in rehabilitation nursing. Nurses help to ensure a safe, supportive environment 24 hours a day. They educate the patient and family members about brain injury and safety issues such as fall prevention and maintaining skin integrity. Nurses reinforce the skills that the patient and family are learning in the different therapies and help them carry out the treatment plan generated by the team.

### Occupational Therapist (OT)

Occupational therapists help patients with brain injury regain their ability to manage every day tasks or "activities of daily living" (ADLs) (i.e., eating, grooming, dressing, bathing and toileting). OTs also help patients re-learn work, school and home management skills (i.e., shopping, cooking, money management). OTs may provide adaptive equipment (i.e. custom-fabricated splints) and make recommendations for changes in the home environment that will enable your family member to function more effectively in the world after discharge (i.e., ramps, handicapped accessible bathrooms). The goal of occupational therapy is to help a person regain independence, prevent further disability and re-learn skills needed for daily life and work.

### Social Work Case Manager

Upon referral to the Richmond PRC, your family member will be assigned to a social work/case manager who will be available 24/7 to answer your questions and to locate needed services. When possible, the social work/case manager will speak with you before your arrival to assist with transition issues (i.e., arranging for appropriate lodging, transportation, and help with financial concerns). Shortly after your arrival at the PRC, the social worker will take you on a tour of the facility and conduct an interview with you and/or your family member to obtain background information and to complete a psychosocial history. This assessment includes information about financial resources, education level, work history, living situation and level of social support. Information from the psychosocial assessment will help to inform treatment and discharge planning. NOTE: Discharge planning, which often begins before your arrival to the unit, is the responsibility of the social work/case manager and is a normal, integral part of the rehabilitation process. Ongoing involvement with your social work/case manager will help you to make informed decisions about your family member's discharge. Throughout your stay, your social work/case manager will present and discuss different discharge options, provide resource information and will assist you in making a decision about referral to an appropriate follow-up facility or agency. An outpatient social work/case manager will also provide follow-up for a period of one year after discharge from the PRC.

### Speech/Language Pathologist (Speech Therapist)

Language deficits are among the most common problems for persons with a brain injury. However, helping to improve speech is only one area in which speech therapists provide intervention. SLPs also specialize in evaluating and treating cognitive deficits, including problems with attention, memory, reading comprehension, writing, planning and sequencing. Another function of the speech pathologist is to evaluate and treat swallowing disorders. After a diagnostic assessment, diets can be adjusted or modified and specialized swallowing strategies can be implemented.

### Physical Therapist (PT)/Kinesiotherapist (KT)

Physical therapists and KTs provide services that help restore function, improve mobility, relieve pain, and prevent or limit permanent physical disability from injury or disease. PTs and KTs test and measure a patient's strength, range of motion, balance and coordination, posture, muscle performance, respiration, and motor function. They also determine the patient's level of independence and ability to re-enter the community or workplace after injury. Treatment often includes patient and family training in transfers, ambulation and wheelchair mobility with the goal of improving a person's functional ability at home and/or work. Therapists also teach patients and family members to use assistive and adaptive devices, such as crutches, prosthetics, and wheelchairs. PTs and KTs are very involved in elements of discharge planning, including assessments for specialized equipment and recommendations for home modification.

### Recreational Therapist (RT)

Recreational therapists help patients become independent in leisure activities, which are an important, enjoyable part of life. They assist patients in re-entering the community by applying practical skills to real-life situations. The goal of recreational therapy is to make sure that patients function safely in community environments where there are various barriers (i.e., curbs, stairs, uneven surfaces and ramps). When appropriate, therapy takes place in a community setting.

### Rehabilitation Psychologist

The rehabilitation psychologist is a licensed clinical psychologist who has been specially trained to assess and treat the many issues facing brain-injured patients and their families. Rehab psychologists have a doctoral degree in psychology and provide clinical and counseling services for coping and adjustment problems related to chronic or traumatic injury or illness. Rehabilitation psychologists work with the patient and family to identify and address specific factors (i.e., mood/emotions, self-esteem, body image, role changes, quality of life issues) that may prevent the patient and family from achieving the highest level of functioning after injury.

### Neuropsychologist

The neuropsychologist is also a licensed clinical psychologist with a doctoral degree in psychology. The neuropsychologist has additional training in understanding brain-behavior relationships including specialized training in brain anatomy, brain function, and brain injury or disease. Neuropsychologists are specially trained to administer and interpret certain types of cognitive and emotional tests. The results of these tests are used to identify deficits and remaining strengths after injury and to clarify individual cognitive, vocational, and relationship goals.

## DoD Military Liaison

The PRC has a full-time, active duty military liaison that is present on the unit to provide assistance and support to service members and their families as they transition from Military health care to the VA health care system. The liaison has subject matter expertise in processing travel vouchers and claims (e.g., TSGLI) and facilitates communication between the injured serviceman and his chain of command. The liaison also serves as a consultant to the interdisciplinary team on military matters.

## **What Happens Here at the Richmond PRC?**

Following their initial assessments, the members of the interdisciplinary team will have an admission conference, typically within 48-72 hours of admission, to discuss their findings and to formulate a rehabilitation treatment plan, including an estimated length of stay. You and your family member will be informed about the team's findings and recommendations following the conference and encourage you to provide input about your goals and expectations for rehab as well. The team also meets in weekly rounds to evaluate your family member's progress and to adjust or redefine the treatment goals accordingly.

We encourage you to ask questions and strongly recommend that you keep a notebook (or use the note pages at the back of this manual) to write down questions, concerns or other information that you would like to discuss with the doctor or other team members. You will find that it is much easier to refer to a written list than to try to remember all of your questions on the spot.

It is important to provide a structured environment for brain-injured patients and to establish new routines to help them re-learn old skills and develop new strategies. Each patient's daily therapy schedule is listed on the large dry erase board around the corner from the nurses' station. We would like you to be involved as much as possible with nursing and the different therapies so that you can learn new critical care giving skills (i.e., positioning, transfers, feeding, bathing, toileting and medication management). Throughout this process, the team will be here to help and support you and your family member.

You should anticipate that your family member will be participating in at least 3 hours of therapy per day to include, at minimum, PT, OT and speech therapy. NOTE: There may be times when a therapist feels that a one-on-one session with your family member will be more productive. Likewise, nursing may need to conduct an assessment or complete an element of nursing care without interruption. This is not an effort to exclude you, but is rather an opportunity for the staff to work more efficiently toward meeting your family member's rehabilitation goals.

## Family Education

Our team is committed to providing you with up-to-date information about brain injury and recovery so that you will be able to make informed decisions about treatment and follow-up care. First and foremost, we are happy to answer any questions that you might have. There is also a family resource room where there is written material (i.e., books, pamphlets, resource guide) about topics related to brain injury and computers with internet access. Keep in mind your social work/case manager and military liaison are the point persons for discharge planning and for helping to identify available resources during your stay at the PRC and beyond. The PRC also has a collaborative relationship with the Brain Injury Association of Virginia (804.355.6381) which has a wealth of regional and national information about services for which you or your family member may be eligible after discharge.

Finally, the Richmond Polytrauma Center sponsors an hour long weekly Family Education Series. Each week, a member of the team provides a 20 to 30 minute presentation on a topic related to their specialty followed by a question and answer session. We strongly encourage you to attend these sessions, as they will give you an opportunity to learn, offer your support to other families and ask questions that are important to you. Session information (time, place, speaker, topic) can be found on flyers posted in your family member's room and throughout the unit. Weekly information updates are located on a message board in the family resource room.

**REMINDER:** Additional information about the Polytrauma Rehabilitation Unit, the McGuire VAMC facility and patient and family rights and responsibilities can be found in your copy of the *Polytrauma Rehabilitation Center Orientation Handbook for Patients and Families*.

## Part III: TAKING CARE OF YOURSELF

At the PRC we also recognize the importance of helping to maintain the health and well being of our families, whose involvement and support are crucial components to the successful rehabilitation and recovery of their injured family member.

Without question, you are acutely aware of the changes that have taken place in your life since your loved one was injured. Typically, when a family member sustains a serious injury, the family suffers along with the patient. Family members and friends frequently experience emotional reactions that are quite similar to the grief that occurs after a death. When someone close to you sustains a brain injury, a sense of loss often occurs because the person you knew is somehow changed or different.

Although the emotions you experience are part of a normal adjustment process, you may still feel guilty and confused by how you feel. Some days you may feel denial, anger, and grief all co-mingled together. Other days you may find yourself making bargains with a higher power (or yourself) to change the situation or outcome. At times, you may feel ready to accept the life changes and challenges facing you only to find yourself feeling frustrated again the next day. Mental health professionals agree that it is normal for families to experience complex emotions and a significant period of adjustment following brain injury to a loved one.

So, how do you begin to cope with your complicated feelings? First, it is important to remember that people (and family systems) react differently in similar situations. Therefore, there is no right or wrong way to handle this family crisis. Some family members respond by involving themselves completely in the rehab and recovery process because they feel more in control if they can do something constructive. Other family members may feel a bit overwhelmed by what is required of them after a relative is injured (i.e., new responsibilities, role changes, decision-making). Ultimately, every individual has to find his or her own way, hopefully with help from many sources of support including, family, friends, healthcare professionals and other people who are in your same situation.

### **Learning to Deal With Your Own Reactions**

#### Anxiety

You have probably become well acquainted with this emotion over the past few months. Initially, your worry probably stemmed from a concern about whether or not your family member would survive. Later, other worries began to arise: to what extent will my family member's life (or mine) be changed? Will I be able to meet my care-giving responsibilities? What does the future hold?

*Suggestions:*

- If you are a natural worrier, allow yourself 15 or 20 minutes during the day when you do nothing but worry about whatever concerns you. If you come up with a solution, great, if not, move on...more worry is unhealthy and non-productive. When your time period is up, refocus yourself on the tasks at hand or allow yourself a break.
- Keep a journal. Writing down your thoughts, feelings and concerns often helps you process through difficult emotions.
- Participate in the Family Education Series sessions. You will have an opportunity to address your questions to members of the team and gain invaluable support from other families.
- If you begin to feel overwhelmed, seek help from the PRC rehab psychologist. It can be very helpful to discuss your worries and concerns with an objective professional who will help you to build coping skills and talk about your feelings in a confidential setting.

### Unrealistic Expectations

It is sometimes difficult to be realistic about your expectations for recovery but know that some degree of change following a brain injury is inevitable. Setting realistic goals requires an understanding of the nature of the injury and your ability to adapt to changes. It is best to approach recovery with a "one day at a time" attitude and adjust your expectations as the process evolves.

#### *Suggestions*

- Realize that recovery from brain injury is not a predictable process and progress can sometimes occur very slowly
- Celebrate the good days; learn from and re-group after the tough ones
- Try to be aware of the positive progress that has occurred since the day of injury. Remember, progress is often measured in small steps, not giant leaps
- Make "one day at a time" your motto

### Frustration

Frustration is an emotional reaction that you will most likely experience from time to time throughout the rehab process and beyond. There may be many sources of frustration including, dealing with paperwork, recovery setbacks, identifying resources, planning for discharge and even at times, communication with the health care team. How you manage your frustration can make a difference in how you feel emotionally.

#### *Suggestions:*

- Do not try to resolve important issues when you are frustrated; give yourself time to calm down before talking to someone
- It is *okay* to take a break for a couple of hours or even a day. Ask another family member or friend to take over for you. Allowing time for yourself is *healthy* and *necessary* to maintain your strength and stamina

- Let a team member know when you are feeling frustrated. Ask them to advocate for you if you feel overwhelmed or unheard
- Remember that your injured family member may sense your emotional distress and react to it

### Stress

Stress is a physical or emotional response to feeling overwhelmed and/or unable to cope with current demands. It is normal to experience some degree of stress following injury to a loved one, particularly when the course of recovery is unclear. Here are some effective ways to cope with stress that you can use every day.

#### *Suggestions:*

- First, remember that you are important too. To be an effective caregiver, you must try to remain healthy, both physically and emotionally.
- Take short rest periods during the day so that you are refreshed and ready to cope with caregiving and training responsibilities. We strongly recommend that you leave the unit by 8 pm if possible so that you have time to unwind and get a good night's rest.
- Learn to pace yourself. Try to delegate and divide responsibilities among family members.
- Try to eat properly whenever possible (Pepsi and donuts are *not* breakfast!)
- Weather permitting, sit outside for a short time during the day or take a short walk. Visit the store or cafeteria. Bring a book to read. If you have a CD player, listen to music or ask the psychologist if you can borrow a relaxation CD.
- Avoid excessive use of alcohol or over the counter (OTC) medications to help you sleep or stay awake (e.g., NoDoz, Tylenol PM). Instead of eliminating problems and relieving stress, overuse of these substances can create more problems

### Depression

There will probably be periods during this process when you will feel down or depressed. Learn to recognize the symptoms of depression and ask for professional help if you feel overwhelmed or unable to cope. Some signs of depression include: overwhelming feelings of sadness or guilt, loss of pleasure and/or interest, crying spells, fatigue, irritability, sleep and appetite disturbances and suicidal thoughts. Given what you are going through, having these feelings occasionally is normal but they should pass with time. However, if you begin to experience several of these symptoms and they persist beyond a few weeks, it is time to take action.

#### *Suggestions:*

- Oftentimes, talking the situation over with a trained professional will help you process your thoughts and feelings and put them into perspective
- Maintain close family relationships. Consider the idea that this life event may present an opportunity for you to learn and grow as a family. Use each other as a support system. Use each other to remain strong.
- Remember, the rehab team is here to help you in any way we can

**"Quick Tip" Summary:**

- Try to eat properly
- Get enough rest
- Express your feelings (journal, talk to others who are going through the same experience)
- Know the signs of depression and seek professional help if necessary
- Avoid excessive use of alcohol or OTC medications
- Ask questions, get answers
- Make "one day at a time" your motto
- Maintain close family relationships
- Use the rehab team as a resource

## Glossary of Terms

### A

**Anoxia** Lack of oxygen. When oxygen levels in the blood are low, brain cells are damaged.

**Amnesia** Memory impairment.

**Aneurysm** Weakness or injury to the wall of a blood vessel (artery or vein) causing a "ballooning". Weak area can burst resulting in a hemorrhage or stroke.

**Anterograde amnesia** The inability to make new memories.

**Aphasia** Loss of ability to verbally express oneself and/or to understand language. This is usually a result of injury to parts of the speech and hearing centers in the brain.

**Apraxia** Loss of ability to perform purposeful, voluntary movements.

**Ataxia** Uncoordinated movement caused by damage to the cerebellum.

**Auditory acuity** The quality of what is heard.

**Auditory memory** Memory of things heard.

**Axon** The part of the nerve cell that carries outgoing messages from one area of the brain to another.

### B

**Bilateral** Referring to both sides (e.g., of the brain).

### C

**Catheter** A flexible tube used to drain fluid from the body or urine from the bladder.

**Cerebrospinal fluid** Liquid that fills the ventricles of the brain and surrounds the brain and spinal cord.

**Closed head injury (non-penetrating)** Trauma to the head that does not fracture or penetrate the skull but severely shakes the brain.

**Confabulation** Using imaginary or unrelated details to fill in gaps in memory.

**Cognitive** Thinking abilities.

**Cognitive deficit** Difficulty in reasoning, judgment, intuition, memory. Also, lack of awareness.

**Coma** A state of unconsciousness and unresponsiveness that results from disturbance or damage to areas of the brain.

**Contusion** Any injury (usually caused by a blow) in which the skin is not broken (a bruise).

**Craniectomy** Surgery involving the removal of a piece of the skull bone to gain access to the brain (to remove a blood clot or drain an abscess or blood clot).

**CT scan/CAT scan** - A series of computerized X-rays that take pictures of the brain or other parts of the body at various levels.

### D

**Deconditioning** Condition where an individual's strength and energy gradually decreases due to lengthy bed rest.

**Deep vein thrombosis (DVT)** Blood clots that develop (especially in the legs) due to limited ability to move.

**Depressed skull fracture** Skull fracture where one or more parts of the skull break and come into contact with the brain.

**Diffuse** Widespread, all over.

**Diffuse Axonal Injury (DAI)** Widespread injury to and disruption of the axons, the wires of communication that exist between brain cells. A result of the forces of trauma.

**Diplopia** Double vision.

**Disinhibition** Inability to control impulsive behavior and emotions.

**Dysarthria** Slurred speech and an abnormal voice quality caused by muscle weakness or paralysis.

**Dysphagia** Inability or difficulty swallowing.

## E

**Electroencephalogram (EEG)** Recording of electrical activity of the brain using electrodes (fine wires that carry electrical activity).

**Encephalitis** Inflammation of the brain.

**Epidural hemorrhage** Bleeding that occurs between the dura (tissue which covers and protects the brain) and the skull.

**Epidural hematoma** A collection of blood between the skull and dura.

**Expressive aphasia** Difficulty saying or producing speech.

## F

**Focal** Limited to a specific area (e.g., damage to a specific area of the brain).

**Frontal lobe** Front part of the brain involved in planning, organizing, problem solving, attention and personality.

## G

**Gastrostomy tube (G tube)** A type of feeding tube inserted directly into the stomach.

## H

**Hematoma** A collection of blood, usually clotted, caused by bleeding from a burst blood vessel.

**Hemianopsia (visual field cut)** Blindness for half the field of vision in one or both eyes.

**Hemiparesis** Weakness in one side of the body.

**Hemiplegia** Paralysis of one side of the body.

**Hemispatial neglect** Inattention or lack of response to objects on one side of the body or space.

**Hemorrhage** Bleeding following damage to the blood vessels.

**Heterotopic ossification** Formation of extra bone in the soft tissue around joints.

**Hydrocephalus** An excessive amount of cerebrospinal fluid in the brain.

## I

**Insight** Awareness, a feeling of understanding.

**Intracranial pressure** A build-up of pressure within the skull.

**Intracranial hemorrhage** Bleeding within the skull.

**Intraventricular hemorrhage** Blood that enters the open spaces (ventricles) of the brain.

## J

**Jejunostomy tube (J tube)** A type of feeding tube surgically inserted into the small intestine.

## L

**Laceration** A ragged tear in the tissue of the brain.

**Limbic system** Area of the brain that regulates mood, emotion, motivation, attention, and memory.

**Long-term memory** The ability to recall events that occurred many years ago.

## M

**Magnetic Resonance Imaging (MRI)** A diagnostic technique that uses magnetic fields to produce images of the brain and other organs within the body without X-ray or other forms of radiation.

## N

**Nasogastric tube (NG tube)** A thin, plastic tube passed through the nose into the stomach.

## O

**Occipital lobe** Located in the back of the brain; the center for sight.

## P

**Parietal lobe** Area of the brain behind the frontal lobe. It receives and processes sensations of touch including pain, heat, cold, pressure, size, shape, and texture.

**Penetrating head injury** Injury or trauma to the head that penetrates or fractures the skull.

**Post-traumatic amnesia** The inability to remember day-to-day events during a period of time following injury.

**Pressure ulcer** Bedsore caused by prolonged pressure or rubbing on vulnerable areas of the body (lower back, hips, ankles, heels, elbows and ear).

**Prognosis** Eventual outcome, a prediction of how things will turn out.

**Pulmonary embolism (PE)** Blood clot from another part of the body that travels to the lungs.

## R

**Rancho Los Amigos Scale of Cognitive Functioning** Eight level scale used to track recovery from brain injury.

**Receptive aphasia** Difficulty understanding speech.

**Regenerate** The ability to grow back.

**Remote memory** The ability to recall events that occurred many years ago.

**Retrograde amnesia** The inability to remember events that occurred for a time period immediately before a brain injury.

## S

**Short-term memory** The ability to recall things occurring within a few seconds to a day.

**Shunt** A surgically placed tube which removes excess fluid from the brain.

**Spasticity** Increased tension or contractions of the muscles causing stiff and awkward movements.

**Subarachnoid hemorrhage** Bleeding which occurs between the layers of membranes coating the brain.

**Subdural hemorrhage** Bleeding which occurs between the brain and the dura (tissue which covers and protects the brain).

**Subdural hematoma** A blood clot that forms between the brain and the dura.

## T

**Temporal lobe** The middle part of the brain on both sides, located behind the ear. This area controls our ability to process and understand the meaning of the verbal message and our memory functions.

**Tracking** The ability to follow objects with the eyes.

**Traumatic brain injury** Injury to the brain caused by an external force, resulting from a blast or a blow to the head.

## V

**Ventricles** Connected hollow spaces in the brain that help to produce, filter, and distribute cerebrospinal fluid.

**Visual agnosia** Problems recognizing common objects.

**Visual memory** Memory of things seen.

**Visual perceptual deficit** Visual-spatial problems caused when the brain has difficulty understanding what is seen.

## Notes

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