Acute Brain Injury

A Guide for Family and Friends

New Jersey Edition, 2012

1999 CREDITS FOR IOWA EDITION

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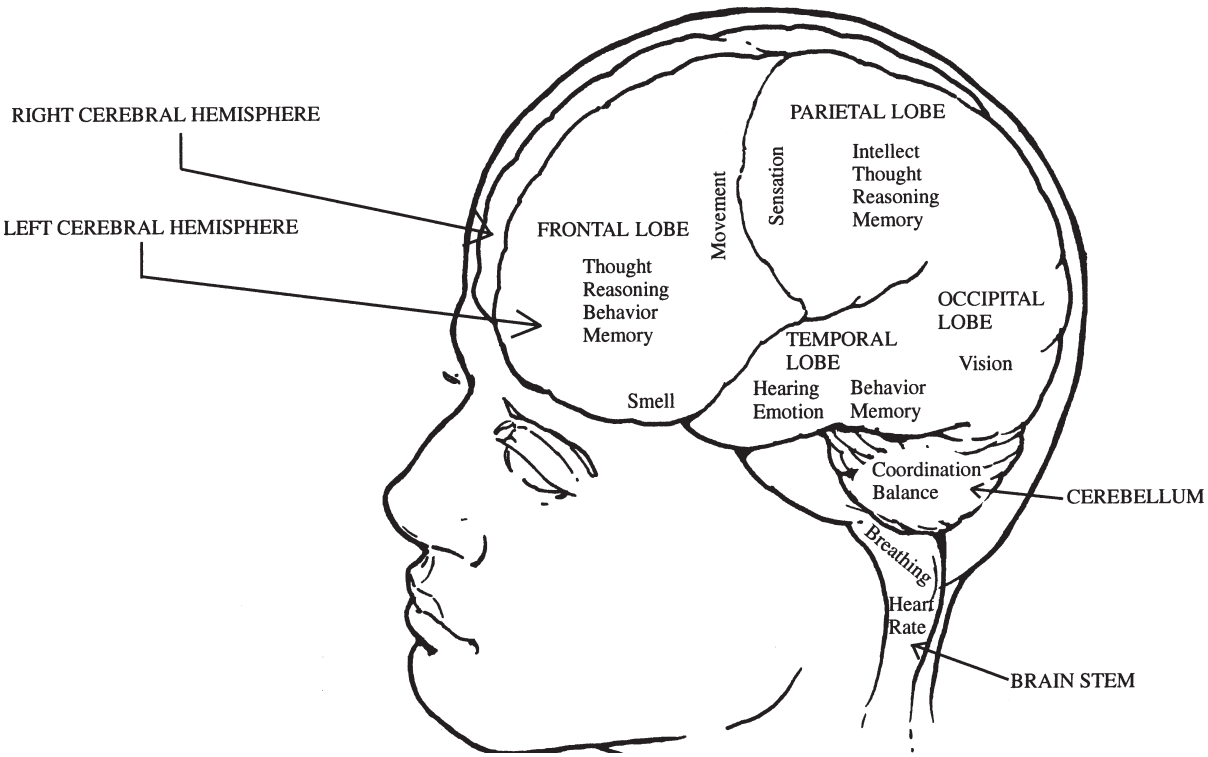
A Guide for Family and Friends

How Does the Brain Work?

The brain controls the actions of the body and allows us to think, learn, and remember. The brain has three main sections: the **cerebral hemispheres**, **cerebellum**, and **brain stem**. There are **left** and **right cerebral hemispheres**. The cerebral hemispheres are divided into sections called **lobes**. Each section of the brain has special jobs to do and sections of the brain also work together. The left cerebral hemisphere controls the right side of the body and is usually responsible for speech. The right cerebral hemisphere controls the left side of the body and is usually responsible for creative thinking.



Protection and Oxygen for the Brain

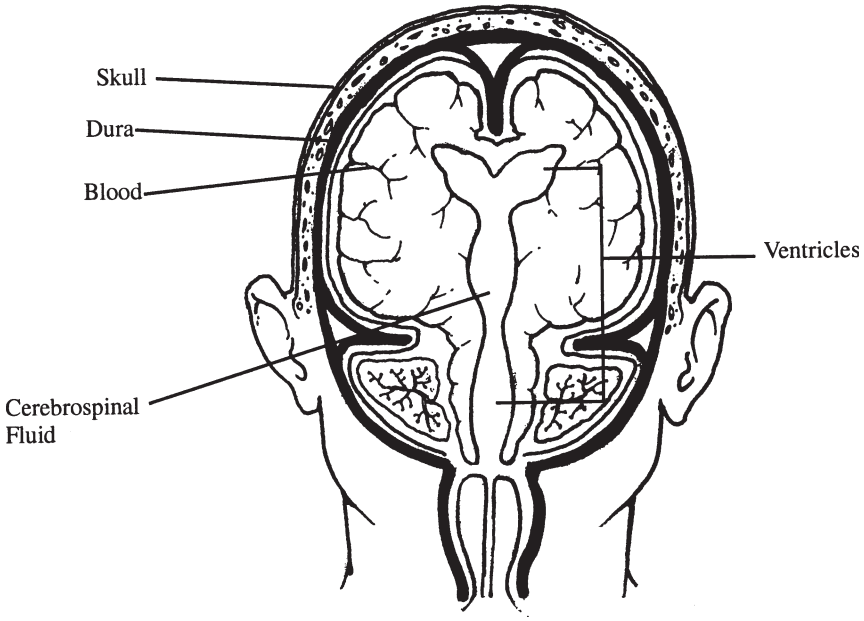
The brain controls many important functions. It needs good protection and oxygen. The brain is protected and receives oxygen in the following ways:

Skull: A hard bone that surrounds the brain tissue

Dura: A tough covering around the brain tissue and the spinal cord

Cerebrospinal Fluid (CSF) or Spinal Fluid: Fluid that flows through the ventricles and around the brain and spinal cord. The **ventricles** are spaces inside the brain. The cerebrospinal fluid acts like a "shock absorber" for the brain.

Blood: Provides oxygen and food for the brain



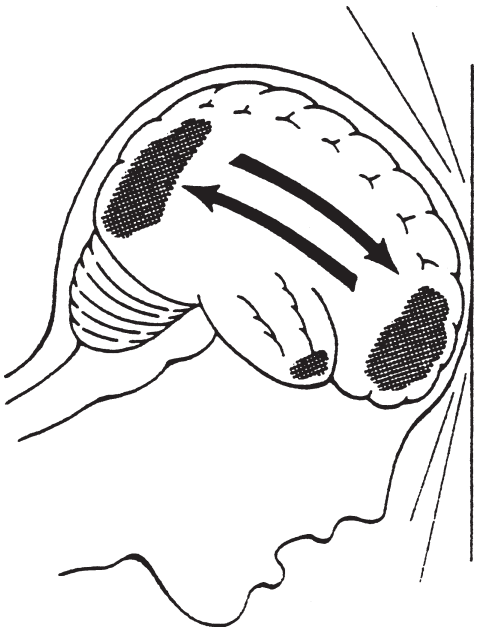
What Types of Brain Injuries May Occur?

Even though the brain is well protected, it may be injured. Every injury is different. Most injuries are a result of bruising, bleeding, twisting, or tearing of brain tissue. Damage to the brain may occur at the time of injury. It may also develop after the injury due to swelling or further bleeding. Patients may have more than one type of brain injury.

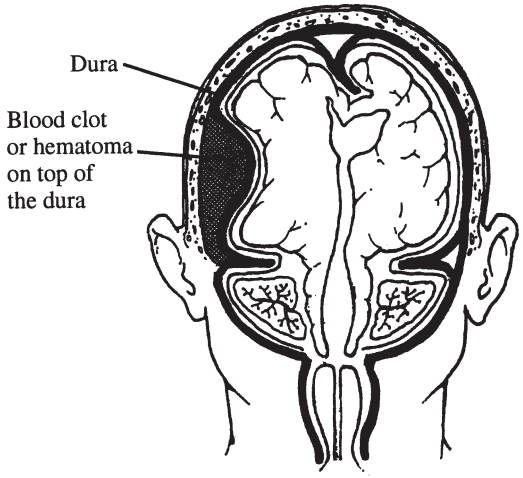
Skull Fracture: A break in the bone that surrounds the brain. These fractures often heal on their own. Surgery may be needed if there has been damage to the brain tissue below the fracture.

Contusion/Concussion: A mild injury or bruise to the brain which may cause a short loss of consciousness. It may cause headaches, nausea, vomiting, dizziness, and problems with memory and concentration. This injury will not need surgery.

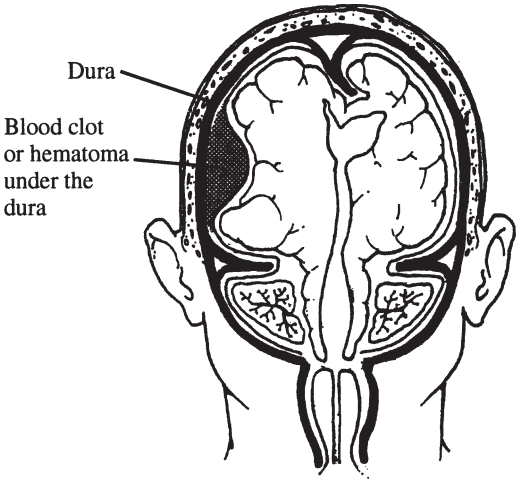
Coup/Contre-Coup: A French word that describes contusions that occur at two sites in the brain. When the head is hit, the impact causes the brain to bump the opposite side of the skull. Damage occurs at the site of impact and on the opposite side of the brain.



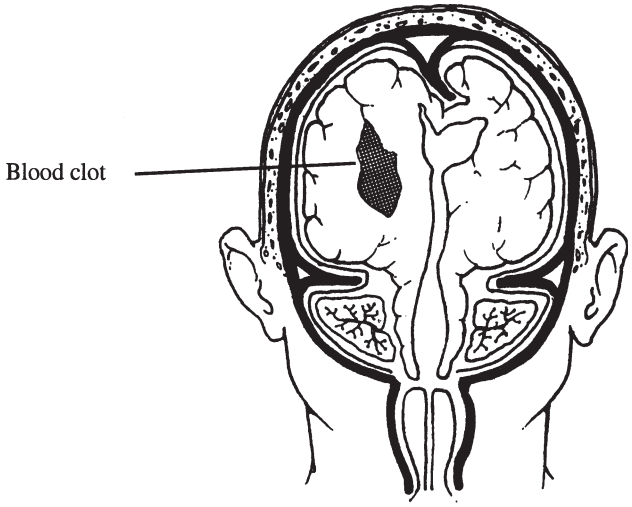
Epidural Hematoma: A blood clot that forms between the skull and the top lining of the brain (dura). This blood clot can cause fast changes in the pressure inside the brain. Emergency surgery may be needed. The size of the clot will determine if surgery is needed.



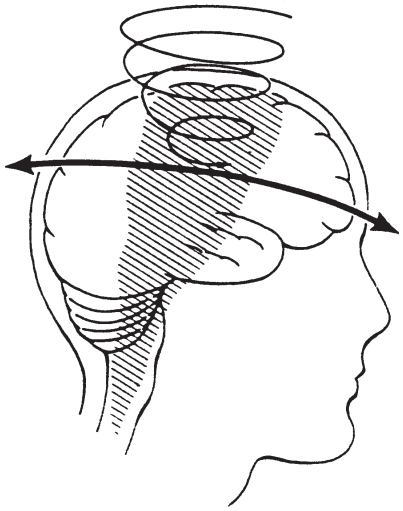
Subdural Hematoma: A blood clot that forms between the dura and the brain tissue. If this bleeding occurs quickly it is called an **acute subdural hematoma**. If it occurs slowly over several weeks, it is called a **chronic subdural hematoma**. The clot may cause increased pressure and may need to be removed surgically.



Intracerebral Hemorrhage: A blood clot deep in the middle of the brain that is hard to remove. Pressure from this clot may cause damage to the brain. Surgery may be needed to relieve the pressure.



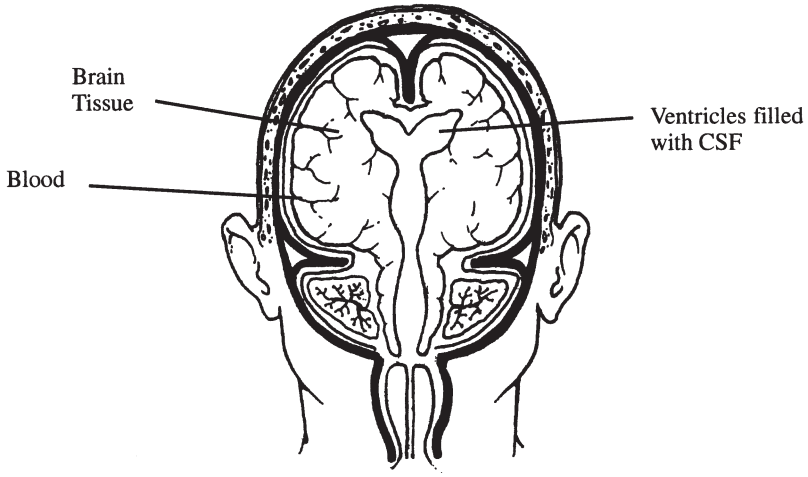
Diffuse Axonal Injury (DAI): Damage to the pathways (**axons**) that connect the different areas of the brain. This occurs when there is twisting and turning of the brain tissue at the time of injury. The brain messages are slowed or lost. Treatment is aimed at managing swelling in the brain because torn axons can not be repaired.



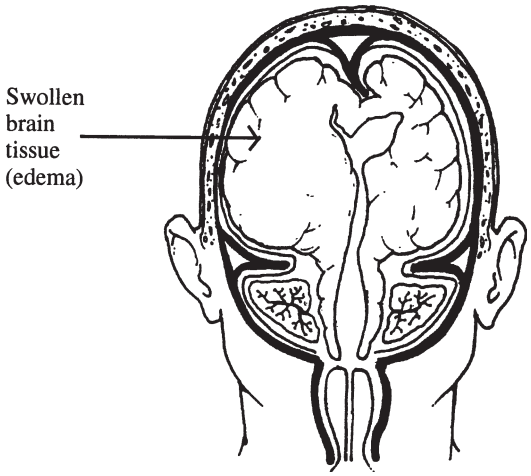
Anoxic Brain Injury: An injury that results from a lack of oxygen to the brain. This is most often from a lack of blood flow due to injury or bleeding.

What Happens When the Brain Is Injured?

Damage to the brain may occur immediately, as a result of the injury, or it may develop as a result of swelling or bleeding that follows the injury. The skull is usually filled like this:



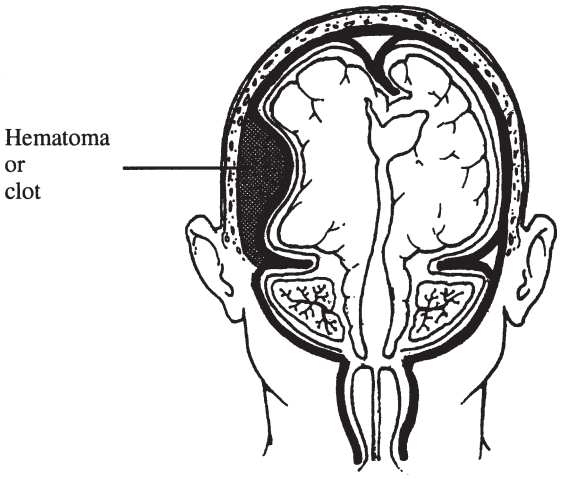
Normal Brain



Brain with Edema

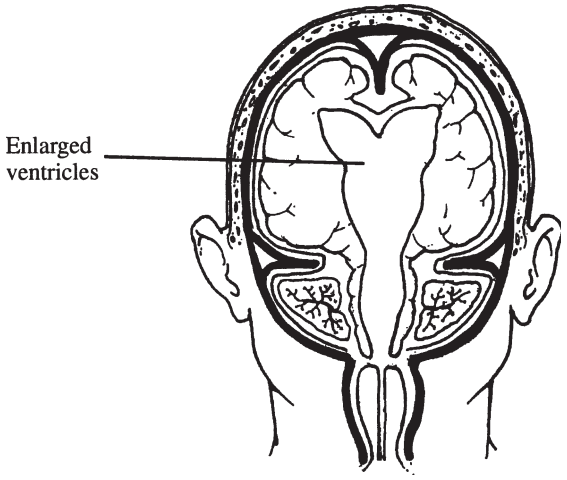
Changes can occur as a result of brain injury. The brain tissue may swell causing it to take up more room in the skull. This is called **edema**. When this occurs, the swollen brain tissue will push the other contents of the skull to the side.

There may be bruising called **contusions** or a collection of blood called a **hematoma** or **clot**. This may also push the other contents to one side.



Brain with a Hematoma

The flow of CSF may also become blocked. This will cause the open spaces (**ventricles**) to become enlarged. This is called **hydrocephalus**.

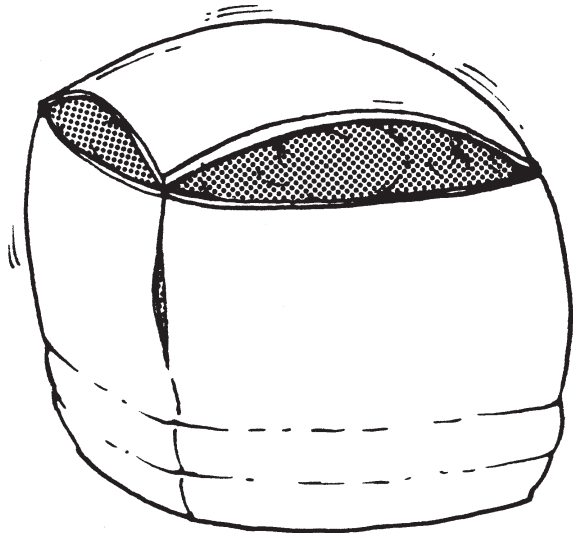


Brain with Hydrocephalus

Any of these changes can cause **increased intracranial pressure**.

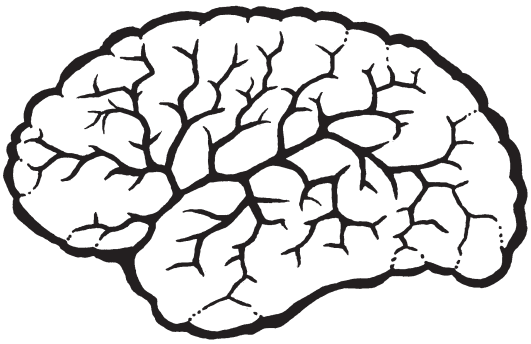
What is Intracranial Pressure?

To understand intracranial pressure, think of the skull as a rigid box. After brain injury, the skull may become overfilled with swollen brain tissue, blood, or CSF. The skull will not stretch like skin to deal with these changes. The skull may become too full and increase the pressure on the brain tissue. This is called **increased intracranial pressure**.

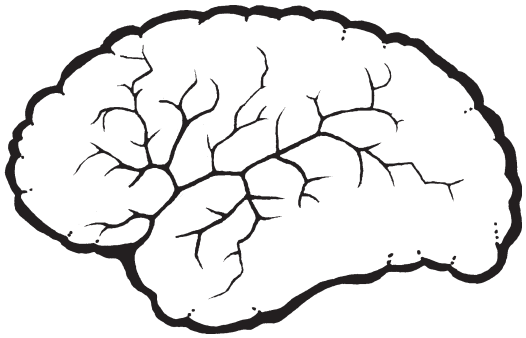


What is Cerebral Perfusion Pressure?

Blood flow to the brain is called cerebral perfusion pressure. Blood pressure and intracranial pressure affect the cerebral perfusion pressure. If the blood pressure is low and/or the intracranial pressure is high, the blood flow to the brain may be limited. This causes **decreased cerebral perfusion pressure.**



Normal blood flow



Limited blood flow

How will the Patient Respond to a Brain Injury?

The patient's responses may vary depending on the type of injury or pressure changes in the brain. Possible responses include: agitation, confusion, decreased responses and **coma.**

> **Coma:** A state of unresponsiveness when patients do not speak or follow commands, and are unaware of their surroundings. The length of time a patient remains in a coma varies.

Patients may also have problems with speech, vision, or muscle weakness in their arms or legs.

How Are Brain Injuries Evaluated?

Patients with brain injury require frequent assessments and diagnostic tests. These include:

- **Neurological Exam:** A series of questions and simple commands to see if the patient can open their eyes, move, speak, and understand what is going on around them. For example: What is your name? Where are you? What day is it? Wiggle your toes. Hold up two fingers. A standard way to describe patient responses may be used. Most hospitals use the **Glasgow Coma Scale** or **Rancho Levels of Cognitive Functioning.** You can read about these scales and what the scores mean on p. 31.

- **X-ray:** A picture that looks at bones to see if they are broken (**fractured**). It can also be used to take a picture of the chest to look at the lungs. This test may be done at the bedside or in the X-ray department and takes between 5-30 minutes to complete.

- **CT Scan (CAT Scan):** An X-ray that takes pictures of the brain or other parts of the body. The scan is painless but the patient must lie very still. The test takes 15-30 minutes to complete.

- **MRI (Magnetic Resonance Imaging) Scan:** A large magnet and radio waves are used, instead of X-rays, to take pictures of the body's tissues. It is painless but noisy. The machine is shaped like a long tube. The patient must lie still on a flat table in the middle of the machine. The test takes about 60 minutes to complete.

- **Angiogram:** A test to look at the blood vessels in the brain. Using a catheter, or small flexible tube, dye is put into an artery (usually in the groin) that supplies blood to the brain. This test can tell if the blood vessels have been damaged or are spasming. The test takes 1-3 hours.

- **ICP Monitor:** A small tube placed into or just on top of the brain through a small hole in the skull. This will measure the pressure inside the brain (**intracranial pressure**).

- **EEG (Electroencephalograph):** A test to measure electrical activity in the brain. Special patches called electrodes are applied to the head to measure the activity. The test is painless and can be done at the bedside or in the EEG department. The length of the test varies.

How are Brain Injuries Treated?

The goals of brain injury treatment are to:

- Stop any bleeding
- Prevent an increase in pressure within the skull
- Control the amount of pressure, when it does increase
- Maintain adequate blood flow to the brain
- Remove any large blood clots

Treatments will vary with the type of injury. The doctor will decide which ones are used. Some common treatments are:

Positioning: Usually the head of the bed will be elevated slightly and the neck kept straight. This position may decrease the intracranial pressure by allowing blood and CSF to drain from the brain. Please do not change the position of the bed without asking the nurse.

Fluid Restriction: It may be necessary to limit the fluids that a patient receives. The brain is like a sponge. It swells with extra fluid. Limiting fluids can help control the swelling. Please do not give fluids without asking the nurse.

Medications: There are several types of medications used to treat brain injury. Some of these include:

- **Diuretics** are used to decrease the amount of water in the patient's body. This makes less water available to the brain for swelling.

- **Anticonvulsants** are used to prevent seizures. **Seizures** occur as a result of extra electrical activity in the brain. There are several types of seizures. The most common type causes the patient to have jerking movements of the arms and legs followed by sleep. Other types may cause slight tremors of the face, or staring spells. Please notify the nurse or doctor if you see any of these signs. Some patients have a seizure at the time of injury while others may develop seizures after the injury.

- **Barbiturates** are given if the patient's intracranial pressure is very high and hard to control. This medicine puts the patient into a deep "sleep" called a barbiturate coma. This may help prevent more swelling and damage.

Ventricular Drain (Ventriculostomy): A small tube is placed in the **ventricle.** It measures and controls pressure inside the skull. It can be used to drain some **CSF** (**cerebrospinal fluid**) from the brain.

Ventilator: A machine used to support the patient in their own breathing, or give the patient breaths. When the ventilator gives extra breaths, the blood vessels in the brain become smaller. This may help control the intracranial pressure.

Surgery: There are three types of surgery used with brain injury:

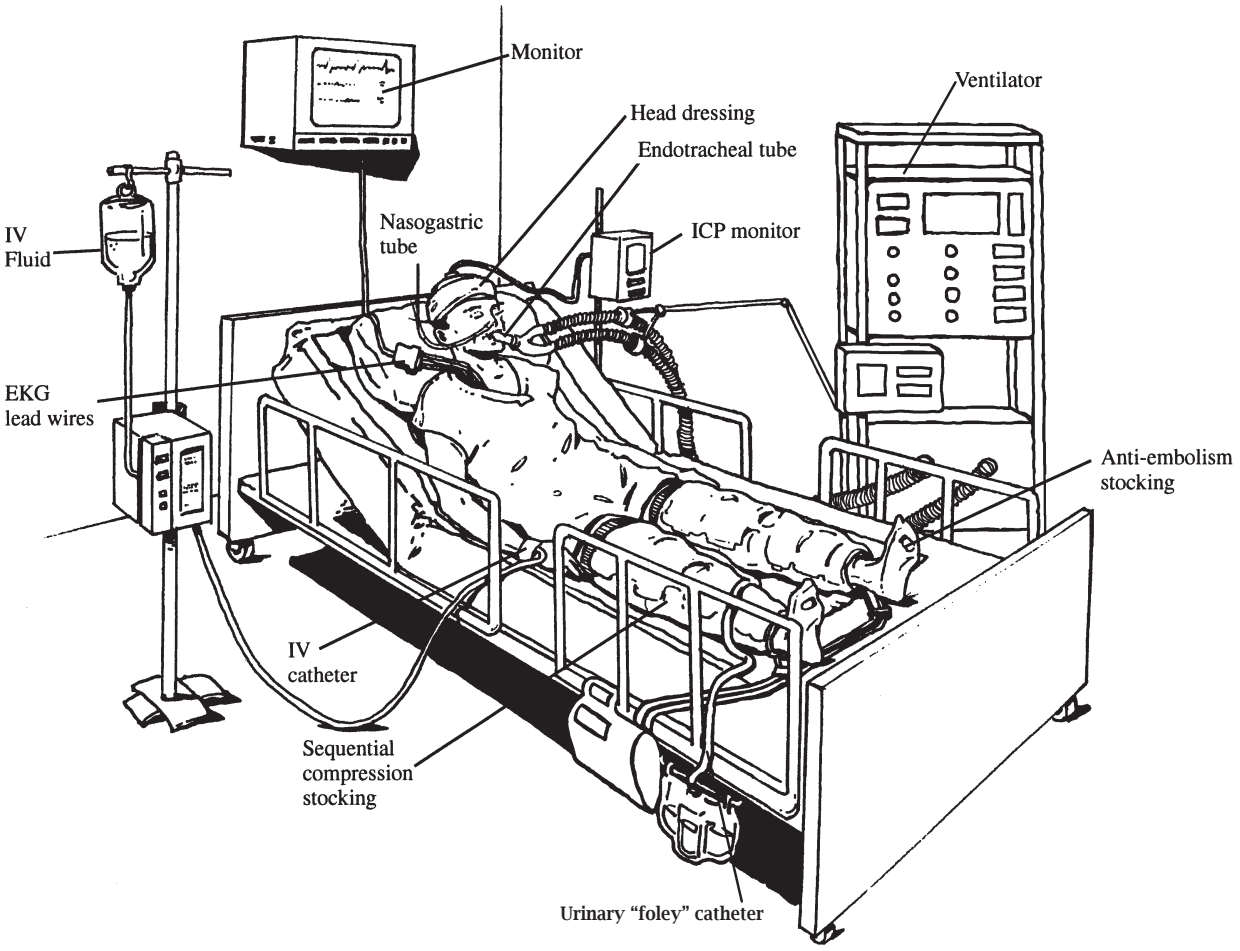
- **Craniotomy** - The skull is opened to relieve the causes of increased pressure inside the skull. Causes may be fractured bones, blood clots, or swollen brain tissue.

- **Burr holes** - A small opening is made into the skull to remove blood clots.

- **Bone flap removal** - A piece of bone is removed from the skull to relieve pressure caused by swollen brain tissue.

What Equipment Will You See When You Visit?

Depending on the type of brain injury, different kinds of equipment will be used. Some common equipment is shown in the picture below. Ask a member of the health care team if you have any questions about equipment.



Monitor: A machine that shows heart rate, breathing, blood pressure, intracranial pressure, and cerebral perfusion pressure.

Head Dressing: A bandage around the head used to keep the wound or incision clean and dry.

ICP Monitor: A small tube placed into or just on top of the brain through a small hole in the skull. This will measure the amount of pressure inside the brain (intracranial pressure).

Nasogastric Tube (NG): A tube placed through the nose into the stomach that can be used to suction the stomach or provide liquid formula directly into the stomach.

Endotracheal Tube: A tube inserted through the patient's nose or mouth into the trachea (windpipe) to help with breathing and suctioning.

EKG Lead Wires: Wires connected to the chest with small patches that measure the heart rate and rhythm.

Intravenous Catheter (IV) and Intravenous Fluid: A flexible catheter which allows fluid, nutrients, and medicine to be given directly into a vein.

Ventilator: A machine used in the Intensive Care Unit to support the patient in their own breathing or give the patient breaths.

Anti-Embolism Stockings (Frequently call TEDS): Long white stockings used to help prevent the pooling of blood in the legs.

Sequential Compression Stockings (Frequently called Kendalls): Plastic leg wraps that help prevent blood clots by inflating and deflating around the legs.

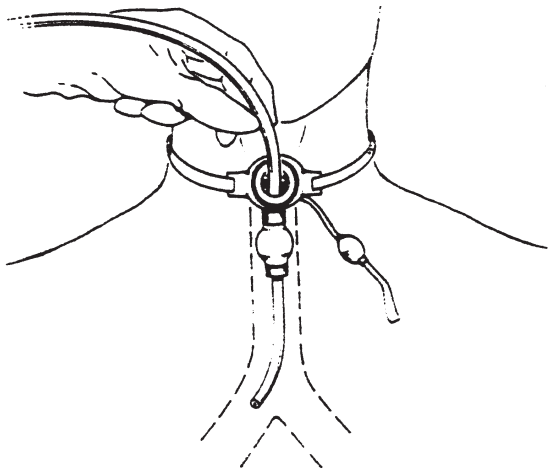
Urinary "Foley" Catheter: A tube inserted into the bladder to drain and allow for accurate measurement of urine.

What Other Treatments May Be Used?

Antibiotics: Antibiotics are used to prevent and treat **infections** that occur. It is not unusual for people with brain injuries to get infections. They may get pneumonia, bladder infections, blood infections, or infections in the brain or cerebrospinal fluid called **meningitis**.

Chest PT and Suctioning: To prevent or treat **pneumonia,** staff may use a vibrating machine or may clap on the patient's chest. This loosens the phlegm in the lungs. Then the patient will be asked to cough. If the patient is not able to cough up the phlegm they must be suctioned. When a patient is suctioned a catheter is placed in the back of the throat or into the lungs.

Tracheostomy (Trach): If the patient has a lot of lung secretions or is on a ventilator for a long time they may need a trach. A trach is a tube placed in the trachea (windpipe). It will make it easier for the patient to cough up phlegm. It also allows the nurse to suction the lungs.



Initially the patient will be unable to talk while the trach is in place. As the patient improves, a talking trach may be used. A trach is usually not permanent.

Suctioning of the Stomach:
Sometimes after brain injury, the stomach will stop working for a short time. This is called an **ileus**. Even though the stomach may not be working it continues to make acid. The acid may damage the stomach lining and cause stomach ulcers if they are not removed. A **nasogastric tube** (**NG**) will be placed through the nose into the stomach. This tube will be used to help remove stomach secretions. Medications may also be given to help prevent stomach ulcers.

Nutrition: Meeting nutrition and fluid needs is important after brain injury. Patients may be less active, yet have very high nutritional needs. At first, nutrition may be supplied by an IV. When the stomach starts working, an evaluation of chewing and swallowing safety will be completed. If the patient is too sleepy to eat, or unable to swallow, a small **nasogastric feeding tube** may be used for nutrition. The tube is placed through the nose into the stomach. Liquid formula will be given through the feeding tube. Feedings may be given continuously or several times a day. The dietician will assist with food and fluid selection. Milkshakes and liquid formulas may also be used to provide extra calories and high protein nutrition. A feeding tube may be used if the patient continues to be too sleepy to eat or unable to swallow. A **gastrostomy tube** is a feeding tube that goes in the stomach. A **jejunostomy tube** is a feeding tube that goes in the intestine.

Bowel and Bladder Care: Patients may not have control of their bowel or bladder. Catheters or diapers will be used until bowel and bladder control returns.

Skin Care: Some things that help prevent bedsores include turning the patient, padding equipment, keeping skin clean and dry, using special mattresses, and making sure the patient gets enough calories.

Range of Motion (ROM) and Splints: Patients with brain injury may not be able to move their joints as much as needed. This can cause tight muscles and joints called **contractures**. Range of motion (ROM) exercises and special splints for hands and feet help prevent contractures.

Pain Control: Comfort measures and medication will be used for pain control. However, medications may be limited to types that do not cause drowsiness.