

# Aurora Health Care EMS Continuing Education 3<sup>rd</sup> Quarter 2011 Packet

## **HEAD TRAUMA**

### **Head Injury Overview**

Traumatic head injuries are a major cause of death, and disability but it might be best to refer to the damage done as traumatic brain injury.

The purpose of the head, including the skull and face, is to protect the brain against injury. In addition to the bony protection, the brain is covered in tough fibrous layers called meninges and bathed in fluid that may provide a little shock absorption.

When an injury occurs, loss of brain function can occur even without visible damage to the head. Force applied to the head may cause the brain to be directly injured or shaken, bouncing against the inner wall of the skull. The trauma can potentially cause bleeding in the spaces surrounding the brain, bruise the brain tissue, or damage the nerve connections within the brain.

Caring for the victim with a head injury begins with making certain that the ABCs of resuscitation are addressed (airway, breathing, circulation). Many individuals with head injuries are multiple trauma victims and the care of their brain may take place at the same time other injuries are stabilized and treated.

### **Skull Fracture**

The skull is made up of many bones that form a solid container for the brain. The face is the front part of the head and also helps protect the brain from injury. Depending upon the location of the fracture, there may or may not be a relationship between a fractured skull and underlying brain injury. Of note, a fracture, break, and crack all mean the same thing, that the integrity of the bone has been compromised. One term does not presume a more severe injury than the others. Fractures of the skull are described based on their location, the appearance of the fracture, and whether the bone has been pushed in.

Location is important because some skull bones are thinner and more fragile than others. For example, the temporal bone above the ear is relatively thin and can be more easily broken than the occipital bone at the back of the skull. The

middle meningeal artery is located in a groove within the temporal bone. It is susceptible to damage and bleeding if the fracture crosses that groove.

**Basilar skull fractures** occur because of blunt trauma and describe a break in the bones at the base of the skull. These are often associated with bleeding around the eyes (raccoon eyes) or behind the ears (Battle's sign). The fracture line may extend into the sinuses of the face and allow bacteria from the nose and mouth to come into contact with the brain, causing a potential infection.

In infants and young children, whose skull bones have not yet fused together, a skull fracture may cause a **diastasis fracture**, in which the bone junctions (called suture lines) widen.

**Fractures can be linear** (literally a line in the bone) or stellate (a starburst like pattern) and the pattern of the break is associated with the type of force applied to the skull.

**Penetrating skull fractures** describe injuries caused by an object entering the brain. This includes gunshot and stab wounds, and impaled objects to the head.

A **depressed skull fracture** occurs when a piece of skull is pushed toward the inside of the skull (think of pressing in on a ping pong ball). Depending upon circumstances, surgery may be required to elevate the depressed fragment.

It is important to know whether the fracture is open or closed (this describes the condition of the skin overlying the broken bone). An **open fracture** occurs when the skin is torn or lacerated over the fracture site. This increases the risk of infection, especially with a depressed skull fracture in which brain tissue is exposed. In a **closed fracture**, the skin is not damaged and continues to protect the underlying fracture from contamination from the outside world.

### **Intracranial Bleeding**

Intracranial (intra=within + cranium=skull) describes any bleeding within the skull. Intracerebral bleeding describes bleeding within the brain itself. More specific descriptions are used based upon where the blood is located.

Bleeding in the skull may or may not be associated with a skull fracture. An intact skull is no guarantee that there is not underlying bleeding, or hemorrhage, in the brain or its surrounding spaces. For that reason, plain X-rays of the skull are not routinely performed.

Epidural, subdural, and subarachnoid bleeding are terms that describe bleeding in the spaces between the meninges, the fibrous layered coverings of the brain. Sometimes, the terms hemorrhage (bleeding) and hematoma (blood clot) are interchanged. Because the skull is a solid box, any blood that accumulates within

the skull can increase the pressure within it and compress the brain. Moreover, blood is irritating and can cause edema or swelling as excess fluid leaks from the surrounding blood vessels. This is no different than the swelling that can occur surrounding a bruise on an arm or leg. The only difference is that there is no room within the skull to accommodate that swelling.

### **Subdural Hematoma**

When force is applied to the head, bridging veins that cross through the subdural space (sub=beneath +dura= one of the meninges that line the brain) can tear and bleed. The resultant blood clot increases pressure on the brain tissue. Subdural hematomas can occur at the site of trauma, or may occur on the opposite side of the injury (contra coup: contra=opposite + coup=hit) when the brain accelerates toward the opposite side of the skull and crushes or bounces against the opposite side.

Chronic subdural hematoma may occur in patients who have had atrophy (shrinkage) of their brain tissue. These include the elderly and chronic alcoholics. The subdural space increases and the bridging veins get stretched as they cross a much wider distance. Minor or unnoticed injuries can lead to some bleeding, but because there is enough space in the skull to accommodate the blood, there may be minimal initial symptoms. Asymptomatic (producing no symptoms) chronic subdural hematomas may be left to resolve on their own; however, it may require attention if the individual's mental status changes or further bleeding occurs.

Depending upon the neurologic status of the affected individual, surgery may be required.

### **Epidural Hematoma**

The dura is one of the meninges or lining membranes that covers the brain. It attaches at the suture lines where the bones come together. If the head trauma is epidural (epi=outside +dura) the blood is trapped in a small area and cause a hematoma or blood clot to form. Pressure can increase quickly within the epidural space, pushing the clot up against the brain and causing significant damage.

While individuals who sustain small epidural hematomas may be observed, most require surgery. Patients have improved survival and brain function recovery if the operation to remove the hematoma and relieve pressure on the brain occurs before they have lost consciousness and become comatose.

An epidural hematoma may often occur with trauma to the temporal bone located on the side of the head above the ear. Aside from the fact that the temporal bone is thinner than the other skull bones (frontal, parietal, occipital), it is also the

location of the middle meningeal artery that runs just beneath the bone. Fracture of the temporal bone is associated with tearing of this artery and may lead to an epidural hematoma.

### **Subarachnoid Hemorrhage**

In a subarachnoid hemorrhage, blood accumulates in the space beneath the inner arachnoid layer of the meninges. The injury is often associated with an intracerebral bleed (see below). This is also the space where cerebral spinal fluid (CSF) flows and affected individuals can develop severe headache, nausea, vomiting, and a stiff neck because the blood causes significant irritation to this meningeal layer. It is the same response that can be seen in patients who have a leaking cerebral aneurysm or meningitis. Treatment is often observation and controlling the symptoms.

### **Intraparenchymal Hemorrhage, Intracerebral Hemorrhage and Cerebral Contusion**

These terms describe bleeding within the brain tissue itself and can be considered a bruise to the brain tissue.

Aside from the direct damage to the brain tissue that was injured, swelling or edema is the major complication of an intracerebral bleed.

Surgery is not often considered except in situations in which the pressure within the skull increases to the point at which part of the bone is temporarily removed to allow the brain to expand. When and if the brain swelling resolves, another operation replaces the piece of skull that was removed.

### **Diffuse Axonal Injury or Shear Injury**

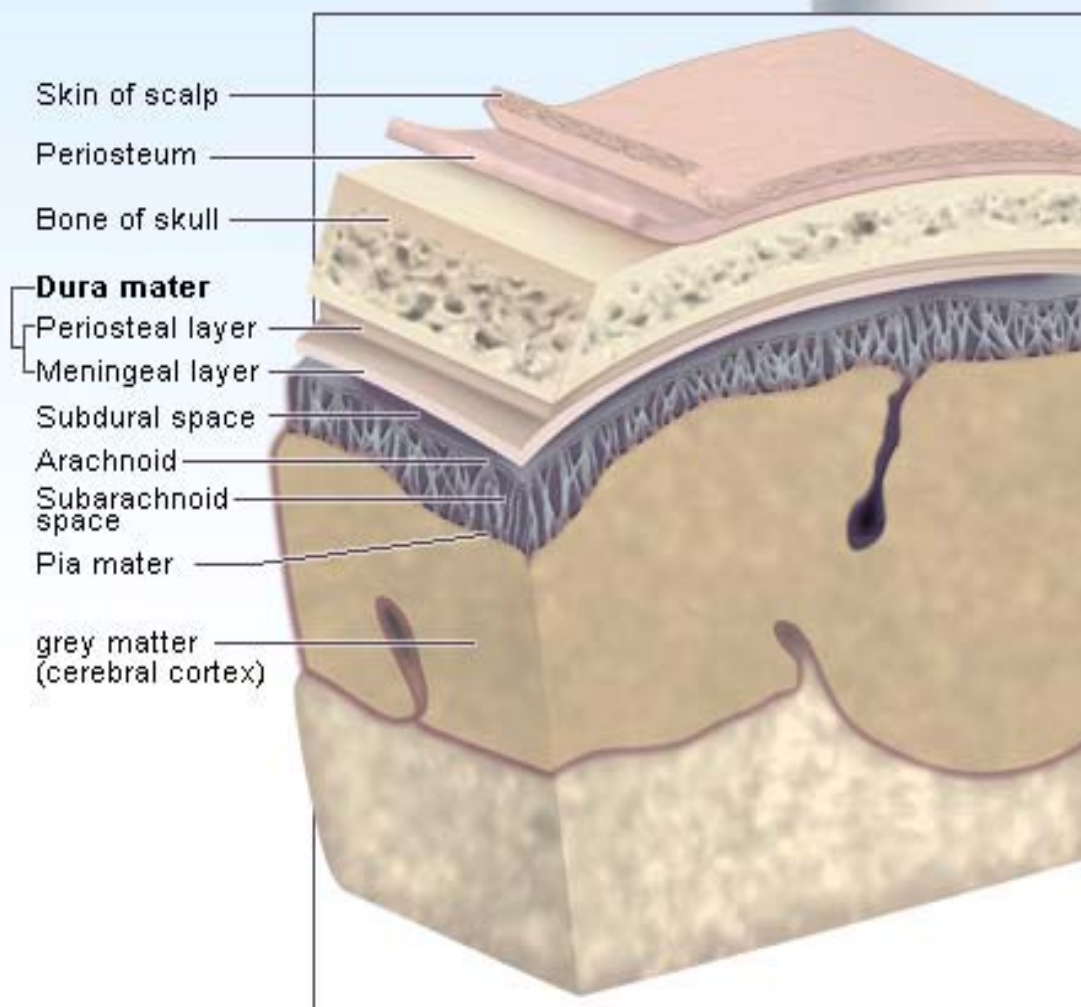
A potentially devastating brain injury occurs when the brain injury occurs to the axons, the part of the neurons or brain cell that allows those cells to send messages to each other. Because of the damage of electrical flow between cells, the affected individual often appears comatose with no evidence of bleeding within the brain. The mechanism of injury is usually acceleration-deceleration, and the nerve endings that connect the brain cells rip apart.

Treatment is supportive, meaning that there is no surgery or other treatment presently available. The patient's basic needs are met hoping that the brain will recover on its own. Most don't.

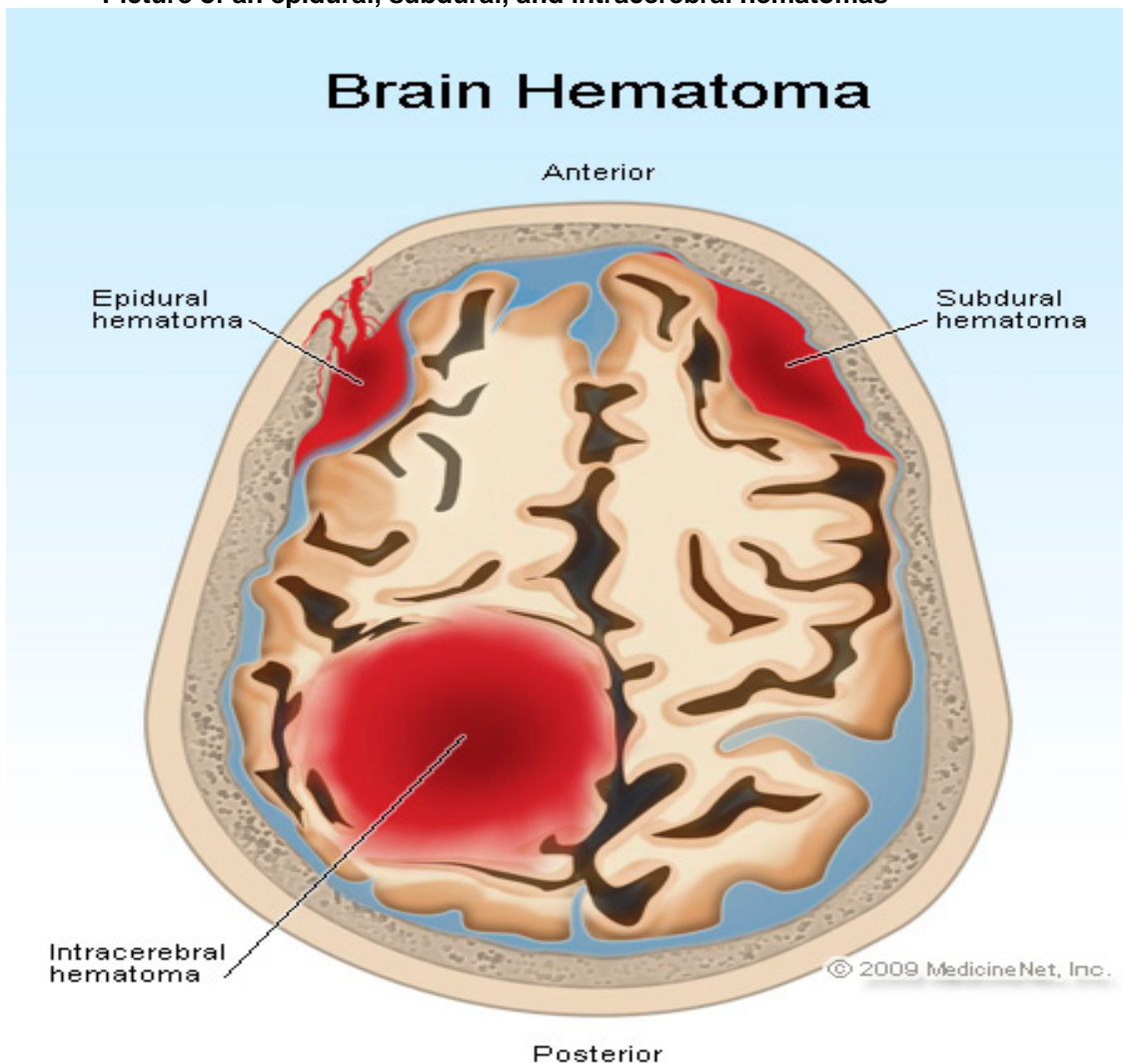
Concussions may be potentially considered a milder form of this type of injury.

Picture of the areas of the brain subject to injury

## Cross-Section of Head and Brain



Picture of an epidural, subdural, and intracerebral hematomas



### Head Injury Causes

Traumatic head injury affects more than 1.7million people in the United States each year including almost a half million children; 52,000 people die.

Adults suffer head injuries most frequently due to falls, motor vehicle crashes, colliding or being struck by an object, and assaults. Falls and being struck are the most common causes of head injury in children.

### Head Injury Symptoms

It is important to remember that a head injury can have different symptoms and signs, ranging from a patient experiencing no initial symptoms to coma.

A high index of suspicion that a head injury may exist is important, depending upon the mechanism of injury and the initial symptoms displayed by the patient. Being unconscious, even for a short period of time is not normal. Prolonged confusion, seizures, and multiple episodes of vomiting should be signs that prompt medical attention is needed.

In some situations, concussion-type symptoms can be missed. Patients may experience difficulty concentrating, increased mood swings, lethargy or aggression, and altered sleep habits among other symptoms. Medical evaluation is always wise even well after the injury has occurred

### **Head Injury in Infants and Young Children**

Infants often visit health care practitioner because of a head injury. Toddlers tend to fall as they learn to walk, and falls remain the number one cause of head injury in children. While guidelines exist regarding the evaluation of head injury victims, they tend to be applied to those older than 2 years of age.

A minor head injury in an infant is described by the American Academy of Pediatrics as the following: a history or physical signs of blunt trauma to the scalp, skull, or brain in an infant or child who is alert or awakens to voice or light touch.

Infants are usually unable to complain about headache or other symptoms. Therefore, basic guidelines as to when to seek medical care can include the following:

- Altered mental status. The child is not acting or behaving normally for that child.
- Vomiting
- Scalp abnormalities including lacerations and swelling that may be associated with skull fracture Forehead contusions tend to be less worrisome than occipital (back of the head) contusions
- Seizure

Often a careful physical examination is all that is needed to assess the infant's risk for intracranial hemorrhage, but some testing may be considered.

CT scan may be indicated based upon the health care practitioner's assessment of the child. Plain skull X-rays may be considered to look for a fracture, as a screening tool to decide about the need for a CT scan.

Usually, if the health care practitioner finds no evidence for concern, the infant can be discharged home for observation. While parents may choose to, there is no need to keep the infant awake or waken them should they fall asleep.

## **Head Injury Guidelines and Assessment: Glasgow Coma Scale**

The Glasgow Coma Scale was developed to provide a simple way for health care practitioners of different skill levels and training to quickly assess a patient's mental status and depth of coma based upon observations of eye opening, speech, and movement. Patients in the deepest level of coma:

- do not respond with any body movement to pain,
- do not have any speech, and
- do not open their eyes.

Those in lighter comas may offer some response, to the point they may even seem awake, yet meet the criteria of coma because they do not respond to their environment.

### **Medical Care**

Any person who has suffered a significant head injury should be evaluated for that injury. This includes all persons with loss of consciousness who do not immediately waken and return to normal as well as those who show signs of weakness or numbness on one side of their body, complain of difficulty speaking, or have vision loss. These are the same symptoms as a person having a stroke.

Mechanism of injury is also an important consideration. Persons in a motor vehicle collision or who have fallen from a height should be kept still with their neck protected, in case there is an associated spinal cord injury.

Other symptoms that should prompt seeking medical care include confusion, loss of short-term memory, and repeated vomiting.

A less specific symptom but one that can also be used with children is to decide whether the person is acting like his or herself. This is a subtle and non specific way of evaluating an injured person, but if there is concern that they are not acting "normal", medical care should be accessed.

Persons with head injuries who are impaired because of alcohol or drugs should be brought for medical attention and evaluation.

Those who are taking prescription blood thinning medications such as warfarin (Coumadin), dabigatran etexilate (Pradaxa), enoxaparin (Lovenox), and heparin should seek medical care for all head injuries, even if it is very minor.

### **Head Injury Diagnosis**

The physical examination and the history of the exact details of the injury are the first steps in caring for a patient with head injury. The patient's past medical

history and medication usage will also be important factors in deciding the next steps. Plain skull X-rays are rarely done for the evaluation of head injury. It is more important to assess brain function than to look at the bones that surround the brain. Plain X-ray films may be considered in infants to look for a fracture, depending upon the clinical situation.

Computerized tomography (CT) scan of the head allows the brain to be imaged and examined for bleeding and swelling in the brain. It can also evaluate bony injuries to the skull and look for bleeding in the sinuses of the face associated with basilar skull fractures. CT does not assess brain function, and patients suffering axonal shear injury may be comatose with a normal CT scan of the head.

Numerous guidelines exist to give direction as to when a CT should be completed in patients who present awake after sustaining a minor head injury.

**The Ottawa CT head rules apply to patient's age 2 to 65.**

### **High Risk**

- Glasgow Coma Scale less than 15, two hours after injury
- Suspect open or depressed skull fracture
- Sign of basilar skull fracture
- Vomiting more than once
- Older than 65 years of age

### **Medium Risk**

- Amnesia before impact greater than 30 minutes
- Dangerous mechanism of injury

### **Head Injury Treatment**

#### **Head Injury Self-Care at Home**

Many people who hit their heads choose not to seek medical attention. People often hit their heads on a cupboard or trip and fall on a soft surface, get up and dust themselves off and are otherwise well.

Occasionally, a bump can occur underneath the skin of the scalp or forehead. This 'goose egg' is a hematoma on the outside of the skull and is not necessarily related to any potential bleeding that can affect the brain. Treatment is the same as any other bruise or contusion and includes ice, and over-the-counter pain medication.

## **Head Injury Medical Treatment**

Treatment for head injury will be individualized for each patient depending upon the underlying injury and the patient's situation.

As with any other injury, the ABCs of resuscitation take priority to restore or support breathing and circulation in the body. Care for the head injury often occurs at the same time other injuries are attended to in the multiply traumatized patient.

Any time there is a head injury, EMT's must consider the possibility of an underlying C-spine injury and take appropriate C-spine precautions.

## **Head Injury Prevention**

Falls are the number one cause of head injuries. Some, like toddlers falling when learning to walk, are unavoidable. Others may be preventable, especially in the elderly. Opportunities exist to minimize the risk of falling at home with the use of proper floor coverings, the use of assist devices such as canes and walkers, and by evaluating homes for high risk areas like bathrooms and stairs. A primary care health care practitioner such as an EMT or a home health nurse may be able to help with home assessment.

Routine use of helmets may decrease head injury while riding a bicycle or motorcycle. Their use is also encouraged for sporting activities like skateboarding, skiing, and snowboarding.

Head injuries are a major consequence of motor vehicle crashes. Lives can be saved by wearing seatbelts, driving cars with air bags, and by avoiding risky driving behavior (drinking and driving, texting while driving).

## **Head Injury Prognosis: Outlook and Recovery**

The recovery from head injury depends upon the amount of damage inflicted upon the brain. Not surprisingly, the brain cannot recover from severe injury, but the goal of treatment is to return as much function as possible.

Concussion, once thought to be relatively minor, may have more long-term effects than initially appreciated and should not be ignored.