

PHTLS

Prehospital Trauma Life Support
NINTH EDITION

LESSON 7A

Disability: Traumatic Brain Injury

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Lesson Objectives

- Identify the signs and symptoms of traumatic brain injury.
- Explain the pathophysiology of traumatic brain injury (TBI).
- Discuss the biomechanics of injuries that cause TBI.
- Distinguish primary and secondary brain injuries.
- Demonstrate proper medical management of traumatic brain injuries.

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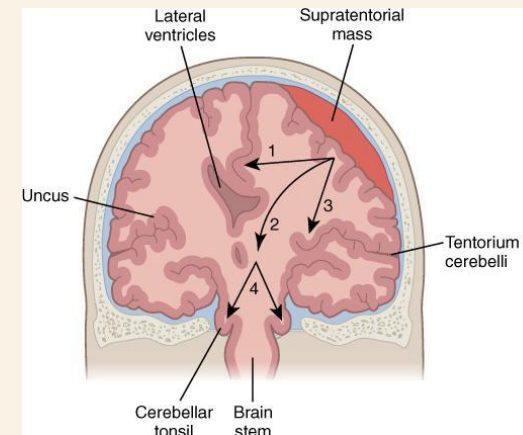
Traumatic Brain Injury

- Traumatic brain injury (TBI) affects over 10 million people annually throughout the world.
- In the United States, approximately 2.8 million TBI-related events occur yearly.
 - This total equates to one person sustaining a TBI every 21 seconds.
 - TBI is the most frequent cause of death and disability among children in the United States.

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Common Causes of TBI

- What are most common causes of head injury?



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Presentation/Dispatch

- You are dispatched to a report of a male who was riding at a skatepark, fell, and hit his head.

- Scene is safe.
- One 22-year-old patient
- His friend tells you they were trying to see who could ride the longest down the rail when the patient fell.
- Patient struck his hand first, then his head on the concrete.
- Patient was not wearing a helmet.



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Discussion

- What are the concerning physics of trauma for this patient?
- What injuries may the patient have incurred?

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Scene Size-Up and General Impression

- Scene size-up
 - Scene is safe.
- General impression
 - Patient lying prone
 - Hematoma and abrasions to right side of head

Primary Survey

- X—Oozing of dark blood from the right side of the head; open fracture of the distal right radius/ulna. No active exsanguination
- A—Patent, no airway obstruction; your partner is performing manual in-line stabilization.
- B—Breathing increased, 20 breaths/min; lungs clear bilaterally
- C—Skin is pale, warm, and dry; pulse 100 beats/min, SpO₂ 92%, ETCO₂ 32
- D—Patient is conscious, confused, GCS 13 (E3, V4, M6), pupils 3 mm and equal bilaterally with sluggish response to light
- E—Outside temp 78°F (25°C). Patient's skin temp is normal. Right forearm is deformed with a bleeding open fracture.

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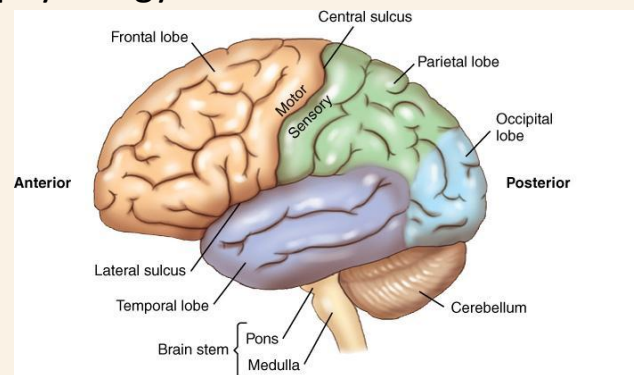
Discussion

- Is there a need for hemorrhage control?
- Is airway management indicated?
- Is spinal motion restriction indicated?
- Could this patient have a traumatic brain injury?

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Traumatic Pathophysiology

- Why is the brain unique in terms of traumatic pathophysiology?



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Cerebral Blood Flow

- The brain needs a constant flow of blood in order to provide oxygen and glucose to the brain's neurons.
- If the patient's blood pressure (BP) decreases, the cerebral perfusion pressure will decrease.
 - This causes blood vessels in the brain to dilate.
 - This allows more blood into the confined space of the skull.
 - This leads to an increase in intracranial pressure.

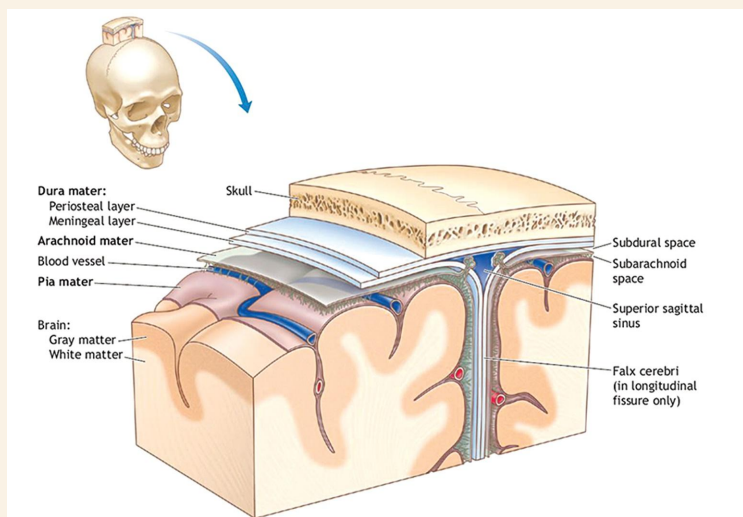
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Discussion

- Why is airway management important in a patient with TBI?
- Does oxygen saturation or ETCO_2 tell us more about the ventilatory status of a patient with TBI?
- Is airway management necessary for our patient?
- What does the patient's ETCO_2 tell you about him?

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Cerebral Perfusion Pressure



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Discussion

- How would you manage this patient's initial oxygen needs?
- Is spinal motion restriction indicated?

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Primary Brain Injury (1 of 3)

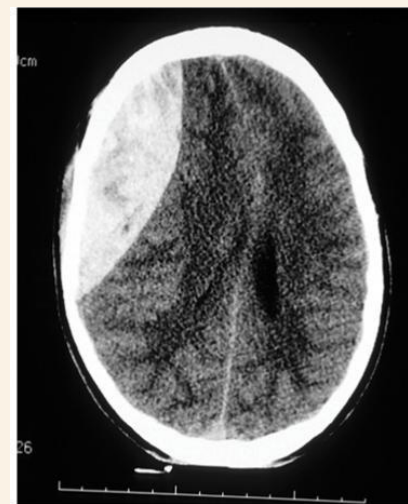
- Primary brain injuries include:
 - Concussion
 - Brain contusion
 - Intracranial hemorrhage
 - Epidural
 - Subdural
 - Subarachnoid
 - Intracerebral
 - Cerebral laceration
 - Diffuse axonal injury



Courtesy of Peter T. Pons, MD, FACEP.

Primary Brain Injury (2 of 3)

- Skull fracture
 - Injury to the brain's protective case
 - Indicates significant force
 - Suggests injuries to the brain and spine
 - Increases the suspicion for intracranial hematoma and TBI



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Primary Brain Injury (3 of 3)

- Are there any other brain injuries we have not yet discussed?
 - Cerebral concussion
 - Posttraumatic amnesia
 - Brain impact apnea with a brain stem contusion

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What Are the Symptoms of a Concussion?

- Vacant stare
- Delayed verbal and motor responses
- Confusion and inability to focus attention
- Disorientation
- Slurred or incoherent speech
- Lack of coordination
- Emotions inappropriate to the circumstances
- Memory deficits
- Inability to memorize and recall

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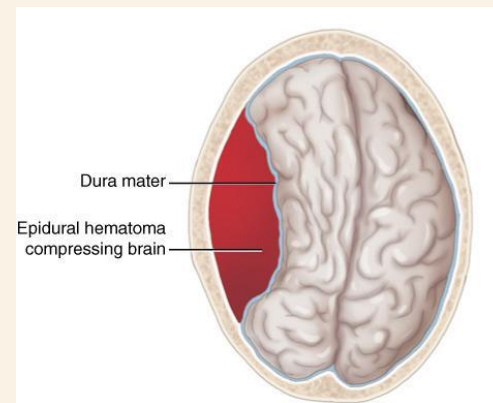
Intracranial Hematomas

- Types
 - Epidural
 - Subdural
 - Intracerebral

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Epidural Hematoma

- What are some signs and symptoms of epidural hematomas?

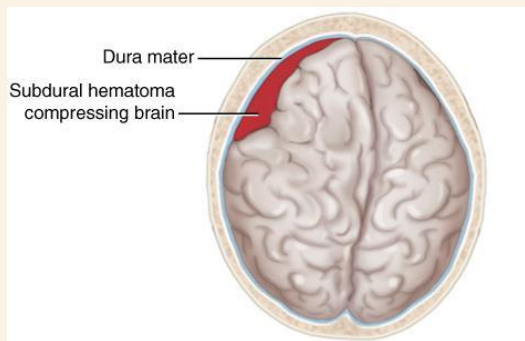


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Subdural Hematoma

- What is different about subdural hematoma?
- What are the common signs and symptoms?



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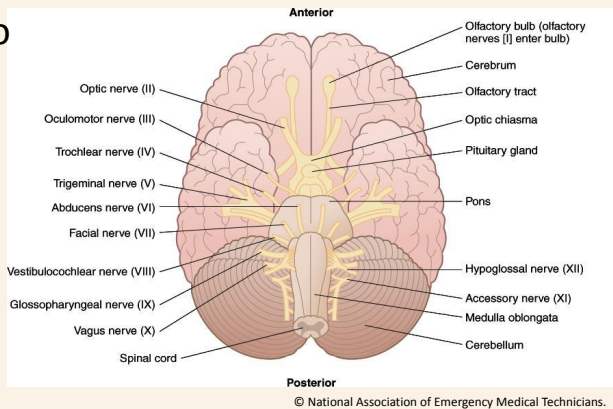
Intracerebral Hematoma

- What are the common signs and symptoms of intracerebral hematoma?

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Diffuse Axonal Injury

- Widespread damage to the nerve axons
 - Represents a shearing injury to the nerve cells
- Symptoms
 - Loss of consciousness
 - Increased ICP



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Case Progression (1 of 2)

- What is the condition of the patient?
- What kind of brain injury might the patient have?



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Case Progression (2 of 2)

- Spinal motion restriction is applied and the patient is moved to the ambulance.
- Supplemental oxygen is provided and you are preparing for IV access.
 - What is the appropriate IV access this patient should receive?
- As you start your secondary survey, you note the patient is no longer talking to you.
 - How would you reassess this patient?

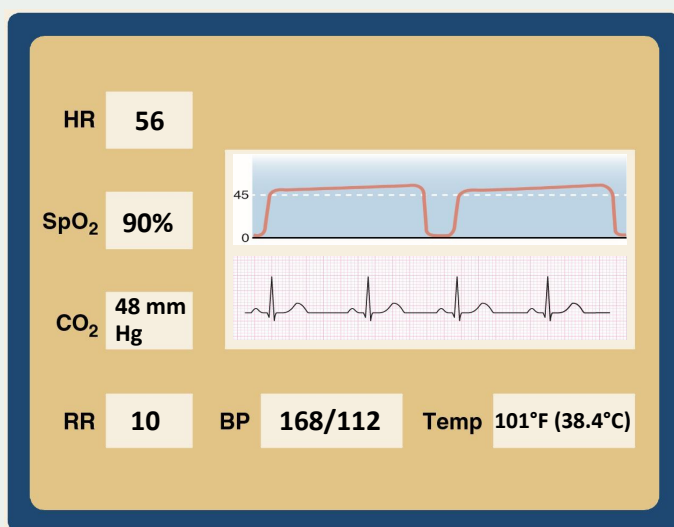
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Secondary Survey (1 of 2)

- HEENT—Patient has a laceration in the right temporal region with a depression of the skull. Pupils left 3 mm, right 5 mm, and nonreactive
- Neck—No step off or pain was noted when cervical collar applied.
- Chest—Lungs clear bilaterally, no noted injury
- Abdomen—Soft, nontender, no masses
- Pelvis—Intact
- Extremities/neurologic—Patient has an open fracture of the distal right radius/ulna.

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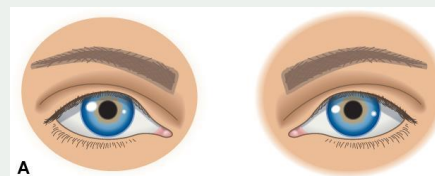
Secondary Survey (2 of 2)



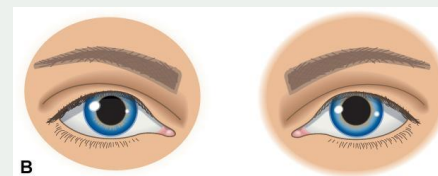
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Discussion (1 of 2)

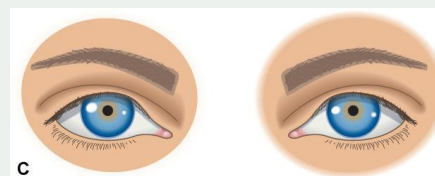
- What do the unequal pupils indicate in this patient?



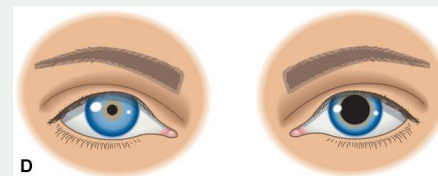
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Discussion (2 of 2)

- What is most likely happening in the brain cavity?
- What type of injury could be causing the patient to be unconscious?

Mass Effect

- How does mass effect present in a brain-injured patient?

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Signs and Symptoms of Brain Herniation

- Clinical signs
 - Cushing's phenomenon (triad)
 - Bradycardia
 - Hypertension
 - Alterations in ventilatory patterns (e.g., Cheyne-Stokes)



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Airway Management of Brain Herniation (1 of 2)

- Hyperventilation indicated for:
 - Asymmetric pupils
 - Dilated and nonreactive pupils
 - Extensor posturing or no response on motor examination
 - Neurologic deterioration
 - Decrease in GCS of two or more points in patient with initial GCS < 8

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Airway Management of Brain Herniation (2 of 2)

- Mild hyperventilation target
 - ETCO_2 30–35 mm Hg
- Ventilatory rate
 - Adult: 20 breaths/min
 - Child: 25 breaths/min
 - Infant (<1 yr): 30 breaths/min

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Secondary Brain Injury

- Secondary brain injuries
 - Hypotension
 - Hypoxia
 - Cerebral edema
 - Increased ICP
 - Intracranial infection
 - Seizure
- Can further exacerbate the primary brain injury

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Discussion

- How does the EMS practitioner prevent secondary brain injury for the patient in this case study?
- What injuries does the patient in this case study have that may precipitate secondary brain injury?

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Case Progression

- X—Bleeding is controlled.
- A—Airway is maintained with a nasal airway and bag-mask device.
- B—Breathing is maintained by mildly hyperventilating the patient and keeping the ventilatory rate at 20 breaths/min, watching the capnography, and keeping it between 30 to 35 mm Hg. Lungs remain clear.
- C—Blood pressure is maintained at 168/90 mm Hg, patient's color improves. Pulse 56 beats/min, strong and regular
- D—Serial neurologic exams are completed. Patient has decerebrate posturing; GCS 5 (E1, V1, M3).
- E—No change

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Case Summary

- While en route to the hospital, you complete the secondary survey.
- You transport the patient to the closest level I trauma center.
- A stat CT scan was completed, and the OR was mobilized for evacuation of a large epidural hematoma.
- After surgery, the patient was admitted to the trauma ICU with continuing care.

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Critical Actions

- Disability assessment to identify potential life threats
- Determination of the best management for this patient
- Reassessment of interventions

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Wrap-Up

- It is important for EMS practitioners to recognize the signs and symptoms of TBI and make sound decisions on how to treat the patient appropriately.
- EMS treatment of traumatic brain injury is focused on maintaining the patient's oxygenation and perfusion to prevent secondary brain injury.
- It is important to recognize injuries requiring specialized urgent transport to a trauma center.

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