



Abusive Head Trauma

Contact Hours: 1
First Published: 11/12/2016
Last Updated: 4/1/2019
Course Expires: 4/30/2021

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Purpose

The purpose of this course is to provide healthcare professionals with information about Abusive Head Trauma.

Learning Objectives

After successful completion of this course, you will be able to:

1. Define abusive head trauma.
2. Delineate the most common injuries associated with abusive head trauma.
3. Describe predisposing factors and causes of abusive head trauma.
4. Compare diagnostic tests used to confirm a diagnosis of abusive head trauma.
5. Describe ways to prevent abusive head trauma

Introduction

Serious injuries in infants, particularly those that result in death, are rarely accidental unless there is another clear explanation, such as trauma from a motor vehicle crash.

Abusive head trauma (AHT), which includes shaken baby syndrome is a preventable and severe form of child abuse that results in an injury to the brain of a child caused by shaking, blunt impact, suffocation, or strangulation (Centers for Disease Control and Prevention (CDC), 2019).

AHT Facts:

- Leading cause of physical child abuse deaths in children under 5 years of age
- Accounts for 1/3 of all maltreatment deaths
- Babies less than one year of age are at greatest risk
- Most common trigger of AHT is inconsolable crying (CDC, 2019)
- The US government estimates that about 30 children younger than one year of age per 100,000 are injured from AHT
 - Resulting in at least 1200 seriously injured infants
 - At least 80 deaths each year (American Academy of Pediatrics (AAP), 2019)

Therefore, it is imperative that all clinicians learn the signs and symptoms of abusive head injury.

What is AHT?

AHT is a well-recognized constellation of brain injuries caused by the direct application of force to an infant or young child, resulting in physical injury to the head and/or brain (CDC, 2019).

Injuries that are commonly seen in infants and children with AHT include:

- Bleeding over the surface of the brain (subdural hemorrhages).
- Other brain injuries, including brain swelling and injuries to the white matter of the brain.
- Bleeding on the back surface of the eyes (retinal hemorrhages).
- Some victims have evidence of blunt impact to the head; others do not.
- Some victims have other evidence of physical abuse, including bruises, abdominal injuries, and recent or healing broken bones; other do not. (AAP, 2019)

Hallmark Injuries for AHT:

- Subdural hematomas with concomitant brain injury **AND**
- Retinal hemorrhages

Infants and children presenting with these hallmark injuries must be assessed with a high level of suspicion of AHT, as these injuries are not always tantamount to abuse. The injuries when individually present are NOT specific for the AHT diagnosis.

Did You Know?

AHT is a serious, preventable and clearly definable form of child abuse.

Test Your Knowledge

Which of the following statements about Abusive Head Trauma (AHT) are true?

- A. The hallmark of AHT is subdural hematomas and retinal hemorrhages**
- B. AHT can result from shaking and/or a blunt force injury**
- C. AHT is most common in children between the ages of 5 - 10 years
- D. AHT is seldom misdiagnosed

Rationale: Abusive head trauma (AHT), formerly known as shaken baby syndrome, is a violent injury to the head caused by shaking, blunt impact, suffocation, or strangulation.

Hallmark Injuries for AHT: Subdural hematomas with concomitant brain injury **AND** retinal hemorrhages

Risk Factors

Small children are particularly vulnerable to such AHT because of the large disparity in size between them and an adult-sized perpetrator.

Risk factors for child maltreatment have been categorized as intrinsic to the:

1. Child
 2. Perpetrator
 3. Family structure and society
- (CDC, 2019b)

Child:

The following factors increase the risk for infants and small children

- Physical helplessness and dependency
 - Large heavy head
 - Weak neck muscles
 - A more pliable skull
 - Large fontanel and open sutures
 - High water content of the brain
 - Large subarachnoid space
 - Vessels bridging the space between the meninges and the skull are less tightly bound
- (CDC, 2019b)

Other risk factors:

- Gender – no consensus, although boys tend to be injured more
- Race – no consensus, although black children have a higher risk of mortality
- Prematurity – higher risk for abuse
- Special needs – disabilities, mental health issues, and chronic illness (CDC, 2019b)

Perpetrator:

The following factors increase the risk that abuse may occur.

- Relationship to child
- Perpetrator was abused or abandoned as a child
- Young parents
- Female, although males are more likely to cause death by abuse
- Decreased self-esteem
- Depression
- Stress
- Unplanned or unwanted pregnancy
- Criminal activity (CDC, 2019b)

Family Structure and Society:

- Lack of community support
- Relationship issues
- Alcohol or drug abuse
- Economic recession -rates and severity of abuse increase (CDC, 2019b)

Most instances of AHT occur because a parent or caregiver is frustrated or angry with a child, frequently when the child is crying. When a parent or caregiver shakes a crying baby, the baby may cease to cry because of the injury inflicted by the shaking. The caretaker may then associate such cessation with a gratifying response in that the infant ceases crying, causing the abuser to repeat the behavior.

Test Your Knowledge

Which child/infant is at greatest risk for AHT?

- Less than one year of age**
- Less than five years of age
- Older than five years of age
- Any age child

Rationale: AHT Facts:

- Leading cause of physical child abuse deaths in children under 5 years of age
- Accounts for 1/3 of all maltreatment deaths
- Babies less than one year of age are at greatest risk
- Most common trigger of AHT is inconsolable crying (CDC, 2019)
- The US government estimates that about 30 children younger than one year of age per 100,000 are injured from AHT

Pathophysiology of AHT

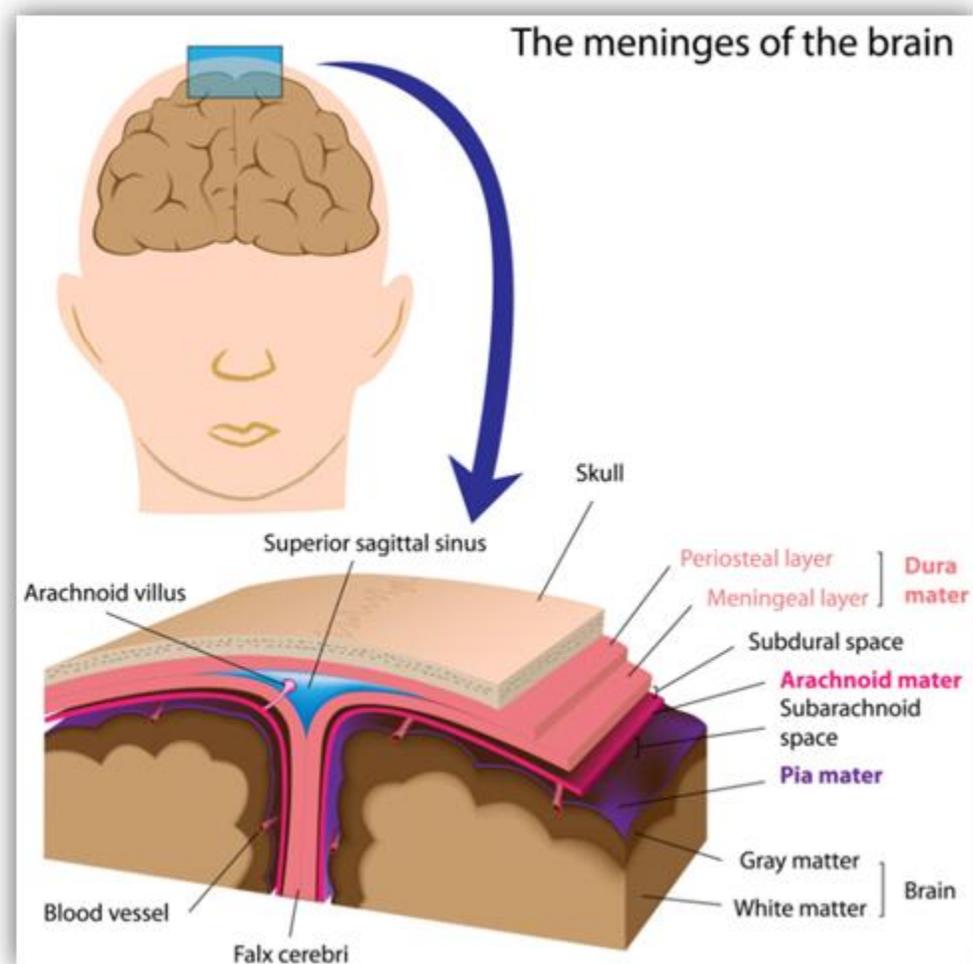
AHT, whether it has been caused by an impact or by a shaking mechanism, has the same pathological findings within the cranial cavity.

The location of intracranial bleeding is an important indicator of the mechanism of injury. Abusive head injuries can be categorized according to their location. There are four types of abusive head injuries:

- Subdural hemorrhage
- Subarachnoid hemorrhage
- Retinal hemorrhage
- Diffuse axonal injury

Normal Anatomy

It is important to recognize the normal structure of the cranial vault and the layers of meninges covering the brain to understand the mechanism and type of injuries that result from AHT.



Canstock Photo Inc. / Alila 2013

Cranial Blood Vessels

It is important to note that the blood vessels supplying the surface of the brain are vulnerable to tearing when subjected to sudden head motion that overextends the vessels.

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Dura Mater Hemorrhages and Hematomas

Injuries involving the dura mater are categorized by the space above or below the dura mater (adhering to the skull). Hemorrhage and hematomas may appear in the epidural and subdural space.

Epidural hemorrhages/hematomas are caused by an arterial bleed and are located above the dura mater. This type of injury requires direct physical impact. Hemorrhages in the epidural space does not cross suture lines. These hemorrhages may be asymptomatic until brain structures are compromised; however, they progress rapidly and can compress the brainstem leading to unconsciousness and possibly death if not treated.

Subdural hemorrhages/hematomas are associated with traumatic brain injury

Subdural hemorrhages/hematomas are caused by a venous bleed and are located below the dura mater and above the arachnoid (covering the brain). This type of injury does not require direct physical impact, but may result from abrupt deceleration (violent shaking of the head) results in tears of bridging veins which cross the subdural space. The resultant bleeding may cause an increase in intracranial pressure (ICP), which can cause compression of and damage to brain tissue. Subdural hematomas can be life-threatening.

Although subdural hematomas are classically crescent-shaped on a CT scan, they can appear convex in the early stage of bleeding. This may cause difficulty in distinguishing between subdural and epidural hemorrhages. A more reliable indicator of subdural hemorrhage is its involvement of a larger portion of the cerebral hemisphere since the bleeding can cross suture lines.

On a CT scan, subdural hematomas are classically crescent-shaped, with a concave surface away from the skull. Note: Blood is white on CT scans.

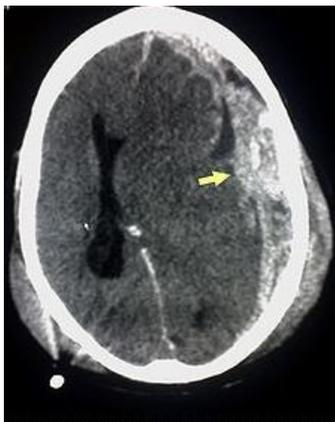


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Subarachnoid Hemorrhage

Subarachnoid hemorrhages/hematomas are caused by arterial or venous bleeding and are located below arachnoid and above the pia mater. Subarachnoid hemorrhage tends to be sparse and occurs in patches especially over the parasagittal cerebral convexities.

CT scan showing subarachnoid hemorrhage as a white area in the center of the brain.



Image provided courtesy of the GNU Free Documentation License.

Intraventricular Hemorrhage/Hematomas

Intraventricular hemorrhage/hematomas are caused by subependymal veins are torn and the resultant blood fills the lateral ventricles.

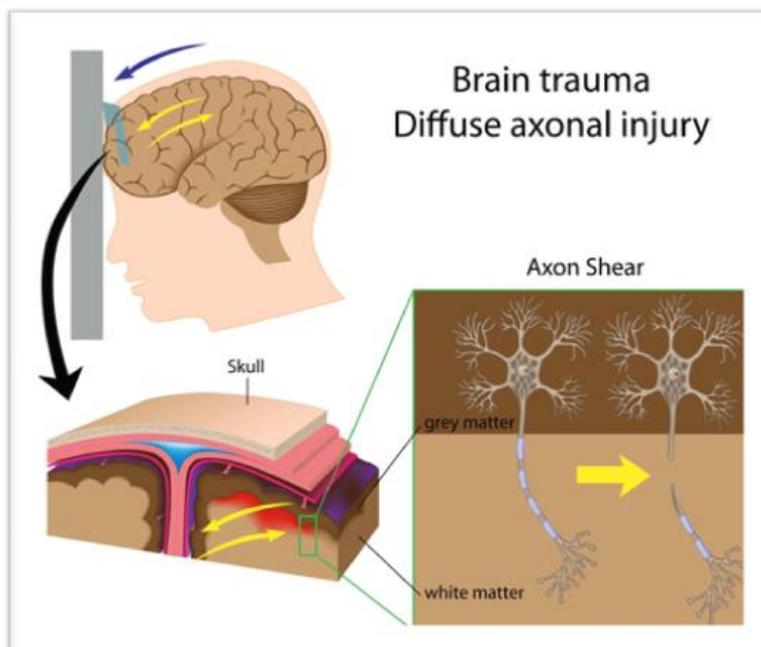
Traumatic Diffuse Axonal Injury

Traumatic diffuse axonal injury results from sudden acceleration and deceleration of the brain tissue within the cranial vault. The abrupt movement of the brain when combined with a rotational force results in tears of axonal processes and small blood vessels in the brain.

When significant degrees of diffuse axonal injury occur, unconsciousness occurs. Traumatic diffuse axonal injury implies widespread injury as opposed to a focal brain injury.

On CT scan, traumatic diffuse axonal injury appears as extensive lesions in white matter tracts.

Image of traumatic diffuse axonal injury in head trauma.



Retinal Hemorrhages

Retinal hemorrhages are very distinctive injuries and are seen in 60 - 85% of AHT cases. These injuries are often unilateral or bilateral, multilayered, subretinal, intraretinal, and preretinal, and would rarely be seen in any other ocular or systemic disease. Therefore, the presence of severe retinal hemorrhages is diagnostic of AHT (AAP, 2019).

To confirm retinal hemorrhage, an ophthalmology consultation should be obtained in all cases in which AHT is suspected. Except in cases where a child's pupils may be fixed and dilated, the pupils should be dilated with ocular medication so that the entire retina can be examined. The ophthalmologist can also perform retinal photography for documentation purposes.

Test Your Knowledge

Which cranial hemorrhage is considered a medical emergency?

- A. Epidural
- B. Retinal
- C. **Subdural**
- D. Subarachnoid

Rationale: Resultant bleeding from a subdural hemorrhage may cause an increase in intracranial pressure (ICP), which can cause compression of and damage to brain tissue. Subdural hematomas can be life-threatening.

Diagnosing AHT

When AHT is suspected, the following list of assessments, tests and imaging are recommended:

- Focused neurological exam
 - CT scan
 - Obtained on admission and serially to identify and follow the evolution of hemorrhage and increased intracranial pressure and swelling.
 - Confirm AHT by demonstrating damage to the brain tissue
 - MRI/MRA
 - Considered to be complementary to CT scans since they are not as sensitive to identifying fractures and subarachnoid blood
 - Some areas of the brain may be better visualized with MRI than CT
 - Skeletal survey
 - Obtained on admission and serially to identify fractures
 - May support AHT, especially when old or unhealed fractures are present
- (Joyce & Hueker, 2019)

Signs and Symptoms

There is a wide spectrum of clinical presentations of abusive head trauma and may vary from mild and non-specific to severe and may include the following.

- Irritability
- Altered or decreased level of consciousness and lethargy
- Unequal pupils

- Inability to track with the eyes or focus attentively
- Inability to swallow or suck
- Poor feeding and/or vomiting
- Rigid or limp extremities (posturing)
- Bulging fontanelle or head that appears larger than normal
- Hypothermia
- Seizures
- Hypotension (late sign)
- Difficulty breathing*
- Bradycardia*
- Hypotension*

*Cushing's triad indicating intracranial hypertension
(Joyce & Hueker, 2019)

In cases that frequently result in severe injury or death, the child or infant will often become unconscious immediately and will have life threatening central nervous system impairment (Joyce & Hueker, 2019).

Test Your Knowledge

Signs and symptoms of AHT include (choose all that apply):

- A. Irritability and poor feeding**
- B. Seizures**
- C. Bradycardia, hypertension, difficulty breathing**
- D. Lethargy**

Rationale: There is a wide spectrum of clinical presentations of abusive head trauma and may vary from mild and non-specific to severe

Post Injury Care

As with many pediatric illnesses or injury, AHT care is dependent on the severity of the injury.

- Minimal injury: Care in the emergency department and at home may be appropriate
- Moderate injury: Admission to an acute care hospital unit may be appropriate
- Severe injury: Admission to a pediatric intensive care unit is warranted
(Joyce & Hueker, 2019)

In minimal and moderate injury cases, AHT management is supportive.

In severe injury cases, those with a Glasgow Coma Scale score of less than 9, advanced life support is necessary.

- Maintain airway, breathing
 - Intubation and mechanical ventilation
 - Oxygenation
- Maintain circulation
 - Fluid boluses
 - Vasopressors
- Manage intracranial pressure
 - Surgical intervention for subdural hematomas
 - Intracranial pressure monitoring

(Joyce & Hueker, 2019)

Reporting suspected and confirmed abuse is imperative. In most states, nurses and other professionals are mandated reporters. By law they must report any suspicion of child abuse to child protective services or the appropriate designated authority as soon as possible.

Did You Know?

It is your responsibility to know the child abuse mandated reporting statutes of the state you are working in and how the facility you are working for enforces compliance to those statutes.

Outcomes/Prognosis

Neurodevelopmental outcomes differ between abusive head trauma and accidental head injuries.

- Infants younger than 36 months old with abusive head trauma experience:
 - More frequent non-contact injury mechanisms resulting in cardiorespiratory compromise, deeper brain injuries, diffuse cerebral hypoxia-ischemia, and worse outcomes than those with an accidental head injury
 - Children diagnosed with abusive head trauma are more likely to die than children with accidental head trauma

Abusive head trauma, mild, moderate, or severe commonly causes several long-term sequelae.

- More than 50% of children will have partial or complete blindness
 - Another 5% need eye surgery
 - More than 20% will require a feeding tube after the injuries
 - More than 50% of children aged 4 years or younger with AHT will die before they reach adulthood
 - The quality of life for children with AHT is reduced by 55%
 - Attention deficit syndrome
 - Developmental delays
 - Hearing impairment
 - Motor dysfunction
 - Failure to thrive
 - Hemiplegia, quadriplegia
 - Hydrocephaly
 - Microcephaly
- (Joyce & Hueker, 2019)

Did You know?

Mild cases of AHT will have less severe injuries that could result in learning disabilities, behavior or personality problems, developmental delays or seizure disorders.

Preventing AHT

Abusive head trauma is a preventable problem and a major societal challenge. Prevention should focus on reducing child abuse, maltreatment, and increasing education (Joyce & Hueker, 2019).

There are numerous health initiatives supported by American Academy of Pediatrics, the National Center on Shaken Baby Syndrome, and Prevent Child Abuse America.

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One such initiative is the Period of PURPLE Crying Program. This program focuses on caregiver education regarding normal newborn behaviors, such as crying.

THE LETTERS IN PURPLE STAND FOR

P	U	R	P	L	E
PEAK OF CRYING	UNEXPECTED	RESISTS SOOTHING	PAIN-LIKE FACE	LONG LASTING	EVENING
Your baby may cry more each week, the most in month 2, then less in months 3-5	Crying can come and go and you don't know why.	Your baby may not stop crying no matter what you try.	A crying baby may look like they are in pain, even when they are not.	Crying can last as much as 5 hours a day, or more.	Your baby may cry more in the late afternoon and evening.

THE WORD PERIOD MEANS THAT THE CRYING HAS A BEGINNING AND AN END

National Center on Shaken Baby Syndrome

For more information on this initiative go to: <http://purplecrying.info/what-is-the-period-of-purple-crying.php>

Education of parents, family, healthcare providers, and community members is essential in the prevention AHT. This education should include:

- Parenting techniques
- Child development
- Nurturing
- Social support
- Social and emotional competence of children
- Mandatory reporting statutes
- Parental resilience strategies

(Childwelfare.gov, 2016)

Case Scenario:

Jonathon, a 9 month-old male is brought to the ED by his aunt, who cares for him during the week, when his mother is at work.

On admission the following findings are evident:

- HR: 185
- RR: 60
- Capillary Refill Time: More than 3 seconds
- Weak pulses
- Extremities cool
- Anterior fontanel firm and bulging
- Retractions & nasal flaring

- Pale mucus membranes in the mouth

Normal assessment findings for a baby (birth - 1 year)

- Respiratory Rate: 24-40 breaths/min
- Heart Rate: 90-130 beats/min
- Capillary Refill Time: 2-3 seconds

Test Your Knowledge

What do you know from your assessment?

Did you consider:

- Respiratory distress: elevated RR, increased work of breathing
- Diminished cardiac output: elevated HR, poor perfusion
- Firm and bulging fontanel: quiet or crying

If you thought of these major points, congratulations.

Test Your Knowledge

In response to your assessment, what would be the first thing that you would do?

- Interview the aunt for past and current history
- Intervene to support airway, breathing, and circulation**
- Send to radiology for diagnostic imaging
- Call the mother for past and current history

Did you decide to support his airway, breathing, and circulation? You are correct. This patient is in distress and at risk for further deterioration. Stabilizing him is your first concern.

You notify the physician who orders oxygen. Because of the bulging fontanel in the now lethargic and flaccid patient, he gives a small amount of fluid resuscitation to support the marginal blood pressure. During his evaluation, he notes retinal hemorrhages.

Test Your Knowledge

What orders do you anticipate receiving?

- CT scan**
- MRI/MRA
- Full skeletal series**
- Laboratory studies**
- Consults: Neurosurgery, Ophthalmology**

If you selected all but the MRI/MRA you are correct. MRI/MRA are not a diagnostic test but are considered a complimentary test to the CT scan.

The neuroradiologist determines the following:

- Subarachnoid hemorrhage
- Intraventricular hemorrhage
- Intracranial swelling
- No skull fractures
- Old rib fractures

The ophthalmologist confirms that there are bilateral retinal hemorrhages.

Based on these facts, a diagnosis of AHT is made. Because the child deteriorated during the diagnostic testing, he was intubated and placed on mechanical ventilatory support. He was transported to the PICU for further management.

Following your institution's policy and procedure on reporting child abuse, a report is made. Child Protective Services will follow and evaluate the case.

Conclusion

Abusive head trauma is PREVENTABLE! As healthcare workers we are in a good place to help prevent AHT. Educating every parent about child abuse prevention can be the first step in prevention. Even mild injuries may cause life-long issues. Do all you can to educate the public. Prevention is the key.

Resources

National Center on Shaken Baby Syndrome

2955 Harrison Blvd, #102
Ogden, UT 84403
(888) 273-0071
www.dontshake.com

Parents Anonymous®, Inc.

675 West Foothill Blvd., Suite 220
Claremont, CA 91711-3475
(909) 621-6184
www.parentsanonymous.org

Shaken Baby Alliance

4516 Boat Club Rd., Suite 114
Ft. Worth, TX 76135
(877) 6-END-SBS
www.shakenbaby.org

Shaken Baby Syndrome Prevention Plus

649 Main St., Suite B
Groveport, OH 43125
(800) 858-5222

Shaken Baby Syndrome

American Humane is a nonprofit organization dedicated to protecting children and animals from abuse, neglect and exploitation.

For more information or to lend your support, please visit www.americanhumane.org or call (800) 227-4645.

State Central Register of Child Abuse & Maltreatment: 1-800-635-1522

References

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