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Contact Hours: **3**

Pediatric Abusive Head Trauma

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COURSE OBJECTIVE: The purpose of this course is to enable healthcare professionals to recognize and prevent pediatric abusive head trauma (AHT).

LEARNING OBJECTIVES

Upon completion of this course, you will be able to:

- Define pediatric abusive head trauma (AHT).
- Identify the mechanism of injury for abusive head trauma and risk factors for head injuries resulting from abuse.
- Describe clinical presentation, physical assessment, and diagnosis for pediatric AHT.
- Distinguish between accidental and abusive head trauma in the pediatric population.
- Discuss the common outcomes of pediatric AHT.
- Explain prevention strategies related to pediatric AHT.

INTRODUCTION

Child abuse and neglect continues to be a serious threat to children. The United States has at least 3 million reports made every year (Childhelp, 2015). In 2012, there were 1,598 and in 2013, 1,484 fatalities attributed to child maltreatment. That is four to five children per day. Of these children, 70% were ages two or younger, and in 80% at least one parent was the perpetrator (U.S. DHHS, 2013).

Pediatric abusive head trauma (AHT) is one of the most serious categories of child abuse and in infants is the leading cause of death from injury. With reported rates of AHT of approximately 15 to 30 per 100,000 in the first year of life, this translates to about 1,200 cases annually among children under 1 year of age in the United States (Shanahan et al., 2013). Nearly one fourth of

cases of AHT in children under 2 years result in death. The costs to the child, family, health system, and society are enormous.

According to the American Academy of Pediatrics (2015), AHT is a well-recognized constellation of brain injuries caused by the directed application of force to an infant or young child, resulting in physical injury to the head and/or its contents. It is the leading cause of traumatic death in children under 2 years of age; it has a characteristic clinical presentation and injury pattern; and it involves a variety of different injury mechanisms (Colbourne, 2015).

It is also important to consider the long-term implications of child maltreatment. Research from the ACE (Adverse Childhood Experiences) study demonstrates that survivors of child abuse and neglect have life-long health and behavioral issues. These include 67% of people in substance abuse treatment and between 14% and 36% of people in prison who report being abused as a child (Childhelp 2015).

Besides physical trauma, exposure to abuse and neglect as a young child has also been shown to “cause important regions of the brain to fail to form or grow properly, resulting in impaired development. These alterations in brain maturation have long-term consequences for cognitive, language, and academic abilities and are connected with mental health disorders” (CWIG, 2013).

Infants frequently present with nonspecific clinical features without a “history” of trauma. In a landmark study on diagnosis of AHT, nearly 30% of patients admitted with abusive injury had been misdiagnosed in the outpatient setting (Jenny & Hymel, 1996). Abusive head injuries are also one of the most common causes of serious acquired disability in children.

Healthcare providers also need to be aware of other “red flags” for inflicted injury. Ward and colleagues (2013) report that 38% of cases of pediatric AHT presented previously in a healthcare setting at least once before recognition of the child’s AHT, and 39% of cases exhibited bruising at the time of presentation for medical care. Bruises are very uncommon in nonmobile infants (<1%), and any unexplained bruise in a child who does not yet crawl or walk should lead healthcare providers to consider inflicted injury and/or a coagulation disorder.

The good news is that much more is now known about recognizing and preventing AHT. Predicting Abusive Head Trauma (PredAHT) is a new clinical prediction tool used to estimate the probability of AHT in young children presenting with intracranial injuries and specific combinations of six historical and clinical features (Cowley et al., 2015). (See “Distinguishing between Accidental Head Trauma and Abusive Head Trauma” later in this course.)

It has also been found that when provided with support services and appropriate supervision, the vast majority of potentially abusive and neglectful parents can learn to safely care for their children (Every Child Matters Education Fund, 2012). It is also important for child welfare systems to increase their implementation of “trauma-informed” practices (CWIG, 2015).



TERMINOLOGY

Abusive Head Trauma (AHT)

An injury to the skull or intracranial contents of an infant or young child (<5 years of age) due to inflicted blunt impact and/or violent shaking. The Centers for Disease Control and Prevention and the American Academy of Pediatrics (2015) recommend use of the term *abusive head trauma* for injuries from these conditions, including shaking, blunt impact, suffocation, strangulation, and others. (In the past, other terms have also been used, including those listed below.)

Shaken Baby Syndrome (SBS)

One form of abusive head trauma with a characteristic pattern of injuries that may include retinal hemorrhages, certain fractures (in particular, ribs and the ends of long bones), and recognizable patterns of brain injury.

Pediatric Acquired/Traumatic Brain Injury (PA/TBI)

Includes traumatic causes such as those sustained as a result of motor vehicle accidents, sports-related injuries, blast injuries from war, assaults/child abuse, gunshot wounds, and falls.

Triad of SBS

This term refers to a supposedly diagnostic “triad” of encephalopathy (hypoxic-ischemic injury) with subdural hematoma and retinal hemorrhage. In fact, the diagnosis of pediatric AHT can only be made following “detailed medical examinations and testing and is not made automatically on the basis of the presence of these three findings, nor can it be excluded if one or more of these elements is missing” (AAP, 2015). (See also below under “Mechanism of Injury.”)

Other less common terminology includes:

- Nonaccidental head injury (NAHI)
- Shaken impact syndrome (SIS)
- Whiplash shaken infant syndrome
- Inflicted neurotrauma
- Inflicted traumatic brain injury (iTBI)
- Nonaccidental head trauma (NAHT)

“ABUSIVE HEAD TRAUMA” OR “SHAKEN BABY SYNDROME”?

The American Academy of Pediatrics provides clarity for this issue and recommends the term *abusive head trauma* rather than a term that implies a single injury mechanism (such as *shaken baby syndrome*) in their diagnosis and medical communications. AAP (2015) also reinforces the fact that shaking is an important contributor to abusive head injuries and that “shaken baby syndrome” is a subset of AHT.



Additionally, since the release of their AHT statement, peer-reviewed medical literature, including case reports in which adults have admitted shaking an infant or child, have been published and further underscore the significance of shaking as an important contributing mechanism of injury. An anonymous phone survey in North Carolina reported that 1% of parents with a child under 2 years of age reported shaking their child as a form of discipline, and pediatric AHT is reported in all types of families (Keenan, 2010).

The message to “NEVER SHAKE A BABY” needs to be addressed in the media and in the prevention strategies shared below.

INCIDENCE AND PREVALENCE

Understanding the true magnitude of AHT, including the exact numbers of children affected, is difficult for many reasons, including issues with classification and determining subpopulations of children not included in data collection.

While accidental trauma is the most common cause of death in childhood, abusive head trauma is the most common cause of traumatic death during infancy. The incidence of abusive head trauma in the United States is estimated to be 15 per 1,000 children each year, though this may be an underestimate. Nearly 25% of children under 2 years of age who are hospitalized for head trauma have been abused. Among U.S. children of all ages, AHT is the third-leading cause of all head injuries after falls and motor vehicle accidents (Parks et al., 2012).

Younger children are more vulnerable to death as the result of child abuse and neglect. According to the U.S. Department of Health and Human Services (2010), 79.4% of all child fatalities due to abuse were younger than 4 years old. Examining this percentage by single-year-age reveals that 47.7% of child fatalities due to abuse were those younger than 1 year of age.

For children in the first year of life, the majority of serious head injuries result from abuse, and this peak incidence and rapid decrease with age are thought to be related to episodes of prolonged, inconsolable, and unpredictable crying that are developmentally normal for infants (Parks et al., 2012). Thus, it is important to aim prevention strategies toward supporting parents and caregivers in dealing with crying.

According to the CDC National Center for Injury Prevention and Control (Parks et al., 2012), the case fatality rate for abusive head trauma has been estimated to exceed 20%, with significant disability for nearly two thirds of the survivors. Deaths due to abusive head trauma also peak at 1 to 2 months of age, most likely due to higher physiologic vulnerability.

Infants who have abuse-related head injuries at 3 to 4 months of age or older may be more resilient and more likely to survive their injuries. However, these children often have long-term consequences of their injuries. Neurologic, behavioral, and cognitive sequelae have been observed in victims of abusive head trauma, including severe developmental delays. Serious



brain injury in children has been estimated to consume billions of dollars in healthcare costs each year.

It is important to note that there are continued challenges related to tracking incidence and prevalence and in tracking the effectiveness of programs to reduce, and ultimately eliminate, abusive head trauma. These include limitations in available national data sets, inconsistency in definitions of abusive head trauma, and variation in how these definitions are applied. Clearly, a standardized method for defining abusive head trauma is needed if data are to be comparable across geographic areas and over time (Parks et al., 2012).

UNDERSTANDING INCIDENCE VS. PREVALENCE	
Incidence	Prevalence
# of newly diagnosed cases among those at risk	# of cases of disease existing in a population
# of cases per # in population at risk over a specific time period	# of cases per # in population at a specific point in time
Indicates the rapidity with which a new disease is occurring in the population	Indicates the overall number of cases surviving in the population
Sources: NYS DOH, 1999; UNC, 1999.	

ETIOLOGY AND RISK FACTORS

Mechanism of Injury

Abusive head trauma encompasses many mechanisms of injury. Children who present with AHT may have been injured in a number of ways, including shaking, blunt impact, suffocation, strangulation, and others.

In order to reduce missed cases of pediatric abusive head trauma, tools have been developed to show high prediction for AHT. Hymel and colleagues (2014) conducted a prospective, multicenter, observational, cross-sectional study and were able to derive a four-variable clinical prediction rule for predicting AHT. Their four “readily available” variables include:

1. Acute respiratory compromise before admission
2. Bruising of the torso, ears, or neck
3. Bilateral or interhemispheric subdural hemorrhages or collections
4. Any skull fractures other than an isolated, unilateral, nondiastatic, linear, parietal fracture

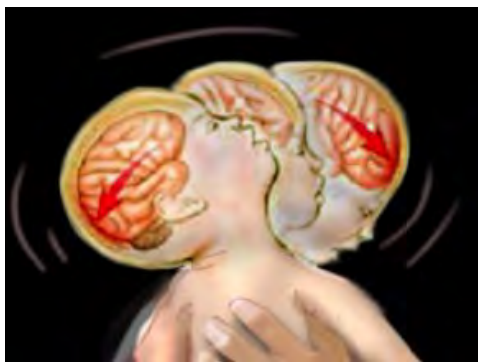
In a systematic review, Maguire et al. (2009) showed that the presentations of apnea and retinal hemorrhage continue to have a high ratio for association with inflicted head trauma.

(See also below under “Distinguishing between Accidental and Abusive Head Trauma.”)



The presence of uncontrolled early seizures—prevalent during the initial 24 to 72 hours after both AHT and hypoxic-ischemic encephalopathy (HIE) but generally rare following accidental trauma—strongly supports an ischemic pathophysiological basis for AHT. It is unclear whether the cerebral ischemia is primary and due to the apnea commonly reported in these cases or due to secondary metabolic cascades (Dias, 2010).

Dias (2010) reported that it is increasingly clear from both neuro-imaging studies and postmortem analyses of fatal cases of AHT that the widespread cerebral and axonal damage are in fact ischemic rather than directly traumatic in nature. There is also mounting evidence that the primary damage involves an upper cervical spinal cord or brain stem injury that was not previously emphasized. The study recognized that this type of injury was especially common in fatal cases.



When a baby is shaken, the neck snaps back and forth, causing the brain to hit the front and back of the skull. (Source: Radiologyassistant.nl.)

Risk Due to Infant Anatomy/Physiology

The head of a young child is proportionately much larger and heavier than later in life because the brain grows very rapidly and attains 75% of its full weight by the age of 2 years (although it is far from mature in development). The newborn child's head is about 10% to 15% of its body weight compared to 2% to 3% for the adult head (NCSBS, n.d.). The combination of a disproportionately larger head, soft and rapidly growing brain, thin skull wall, and lack of mobility and control of the head and neck makes infants extremely vulnerable to injury from shaking actions.

Additionally, the infant's brain has higher water content and less myelination than an adult brain, is more gelatinous, and is easily compressed and distorted within the skull during a shaking episode. The infant's blood vessels around the brain are more susceptible to shearing, and tearing can lead to the characteristic subdural and/or subarachnoid hemorrhages. Because of their minimally developed anatomy, infants are also at increased risk for death and permanent disability (Altimier, 2008).



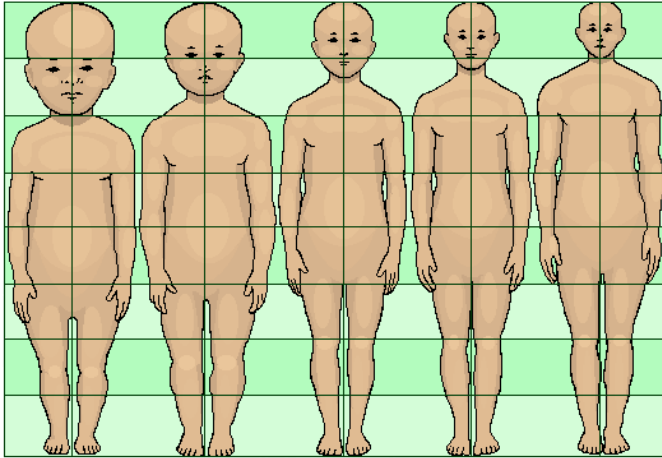


Diagram showing the proportionally larger head of an infant relative to an adult.
(Source: Journal of Heredity, 1921.)

Household Risk Factors and Perpetrator Characteristics

According to Barr (2012), perpetrators of pediatric AHT are most likely to be related males, followed by boyfriends or stepfathers, mothers, temporary caregivers, and others. Inflicted deaths are increased in households with unrelated adults rather than two biological parents but not in single-parent households without other adults.

An additional, unexplained finding is that victims are more likely to be male than female. Two hypotheses to account for this discrepancy are that there are male/female differences in some property of crying for which there is no evidence or that caregivers (particularly fathers) are more frustrated by male than female infant crying, perhaps by extrapolation from the adult belief that “men do not cry, but women do,” although this has not been investigated.

A critical risk factor is the occurrence of shaking used either to calm infants and children or as a means of discipline. Less consistent risk factors include socioeconomic status, societal and family stress, prematurity, multiple births, developmental delay, prior military service, and childhood history of abuse in the perpetrator.

In other studies, male caregivers were more frequently identified as the perpetrators of abusive head trauma in children, although up to 5% of mothers also report shaking as a means of discipline or in response to crying (Esernio et al., 2011). Children who have younger or single parents or parents with a history of mental illness or substance abuse and children living with an unrelated adult in the home are at increased risk, and perpetrators are most likely to be fathers, followed by mothers' boyfriends, female babysitters, and mothers (Pierce et al. 2012).

According to the CDC (2012a), factors that increase the caregiver's risk for undertaking an action that can harm a baby include:

- Having unrealistic expectations about child development and child-rearing
- Having been abused or neglected as a child
- Being a victim or witness to domestic violence
- Being a single parent

Child Risk Factors

Children with special needs—including those born prematurely and/or having developmental delays and/or disabilities—are at higher risk for AHT. A lack of understanding of premature infant development may lead to additional frustration, stress, decreased tolerance, and resentment among caregivers. Since premature infants have a higher rate of disabilities than full-term infants, their risk is even greater.

Infants experiencing neonatal abstinence syndrome (NAS) are at particular risk for child abuse, including abusive head trauma, due to the irritability and excessive crying that result from withdrawal from substance addiction. This can last for weeks and months, making such babies difficult to care for (Kentucky Department of Public Health, 2013).

Additionally, the CDC (2012a) reports that the following characteristics also increase an infant's risk for being shaken, particularly when combined with a parent or caregiver who is not prepared to cope with caring for a baby:

- A history of previous child abuse
- Being one of a multiple birth
- Being less than 6 months of age
- Being perceived as inconsolable and/or crying frequently

Barr and colleagues (2006) have shown that the curve of incidence for AHT is parallel to the curve of age-related crying in infants.

MAJOR RISK FACTORS FOR AHT

- Younger children, especially under the age of 5 years
- Parents or caregivers who are under the age of 30
- Low income, single-parent families experiencing major stresses
- Children left with male caregivers who lack emotional attachment to the child
- Children with emotional and health problems
- Lack of suitable childcare



- Substance abuse among caregivers
- Babies in withdrawal (NAS)
- Parents and caregivers with unrealistic expectations of child development and behavior

Source: National MCH Center for Child Death Review, n.d.

CASE

Jasper is 3-1/2 months old and was born prematurely at a gestational age of 34 weeks. He was admitted to the ED after his father called 911 because Jasper turned blue while being bottle-fed. Emergency personnel had started CPR because Jasper was not breathing and they were unable to get a pulse. Jasper had been seen by his primary care physician three times since his discharge from the NICU and has been diagnosed with colic, feeding difficulties, and possible gastro-esophageal reflux.

Jasper was initially resuscitated, and once he was stable he had a CT of the head that revealed both subdural and subarachnoid bleeds, diffuse axonal injury, and severe cerebral edema. Jasper's physical exam showed a torn labial frenum and bilateral discoloration to the chest. Jasper was transferred to a regional PICU (pediatric intensive care unit) and was removed from life support three days later because he had irreversible brain stem dysfunction.

Jasper's father later reported that Jasper's mother had just returned to work after six weeks of parental leave. He had agreed to look after the infant, but he felt incompetent in his own ability to meet Jasper's needs. He lost his temper and shook Jasper because he kept on crying and refusing the bottle.

ASSESSMENT AND DIAGNOSIS OF PEDIATRIC ABUSIVE HEAD TRAUMA

Clinical Presentations

Healthcare professionals may first encounter young children with AHT in a range of clinical settings including primary care, urgent care, and emergency departments. Since there are significant variations in the clinical presentation of children with AHT, it is important that professionals are trained to identify potentially life-threatening situations.

Less severely injured infants and young children may present with symptoms that are quite nonspecific and without a history of trauma provided by a caregiver. These symptoms may be transient and improve if the trauma is not repeated. They include irritability, vomiting, and apnea.

These and other symptoms of AHT are related to other minor medical conditions and can easily lead to a mistaken diagnosis of those conditions instead. Healthcare providers may have



difficulty recognizing that such symptoms are the result of abuse, and the infant may return to an abusive environment (see also “Differential Diagnoses” below).

Jenny et al. (1999) reported that 31% of infants who ultimately were found to have AHT had symptoms that in retrospect were “missed” upon initial presentation. These infants were often diagnosed with viral syndromes, colic, and gastro-esophageal reflux. The more clearly the symptoms were neurological in nature (seizures and alterations in consciousness), the more likely that cranial imaging would be requested and a diagnosis of intracranial bleed made.

Children in Jenny’s study who were likely to be missed were from white families, with both parents involved, and who had health insurance. Nearly 28% were reinjured after the missed diagnosis, and 40% experienced medical complications related to the missed diagnosis. Four of five deaths in the group with unrecognized AHT might have been prevented by earlier recognition of abuse. Because of these findings it is important to consider inflicted head trauma in infants and young children presenting with nonspecific clinical signs.

More seriously injured children have symptoms that should lead to rapid diagnosis of intracranial trauma. The caregiver may report some type of acute collapse, such as unconsciousness, apnea, or seizures. An episode of minor trauma may be given as an explanation for the injury. Examples include falls off beds, being dropped by caregivers, or other minor contact injuries to the head. However, a history of trauma is rarely provided in the initial stages. An initial examination may not reveal any external injuries such as bruises, leading to concerns about medical rather than traumatic causes (Fraiser, 2009).

Besides the presentations described above, Hymel & Deye (2011) give examples of clinical presentations that should create a reasonable suspicion of AHT, including clinical presentations involving soft tissue trauma to the face, scalp, or ears (especially in a nonmobile infant); intraoral trauma or bleeding (e.g., torn frenum or gingival laceration); and/or skull fractures that are multiple, complex, or attributed to a short-distance fall (usually less than six feet).

Presenting History

Any reported history or statements made by the caregiver regarding the injury should be documented accurately and completely. Information should be gathered in a nonaccusatory but detailed manner. There are two general portions of the presenting history that are important to document. The first is the history of the injury event and the second is how the child responded or behaved after the injury.

Questions asked when taking a presenting history should include:

- What happened?
- Who was there when it happened?
- Where did it happen?
- When did it happen?



- What happened afterwards?
- When was the child noticed to be ill or injured? How did the child respond? When did symptoms start? How did you respond?
- What made you bring your child to the doctor? Hospital?
- When was the last time your child was totally normal or well?

Medical, Developmental, and Social History

Information that may be useful in the medical assessment of suspected physical abuse include:

- Past medical history (trauma, hospitalizations, congenital conditions, chronic illnesses)
- Family history (especially of bleeding, bone disorders, and metabolic or genetic disorders)
- Pregnancy history (wanted/unwanted, planned/unplanned, prenatal care, postnatal complications, postpartum depression, delivery in nonhospital settings)
- Familial patterns of discipline
- Child temperament (easy to care for or fussy child)
- History of past abuse to child, siblings, or parents
- Developmental history of child (language, gross motor, fine motor, psychosocial milestones)
- Substance abuse by any caregivers or people living in the home
- Social and financial stressors and resources
- Violent interactions among other family members
(Christian, 2015)

Other important health history information includes:

- Nutrition history
- Seizure history
- Medications and immunizations
(Jackson & Jackson, 2011)

The social history is a critical component of the evaluation. Asking parents about the household composition, other caregivers, siblings, substance abuse, mental illness, and social stressors can provide valuable information. It is preferable to interview caregivers separately; thorough and accurate documentation, including the use of quotes, is critical.



Information that may be useful in the assessment of suspected physical abuse includes:

- History of past abuse to child, siblings, or parents, including history of Child Protective Services or police involvement
- Substance abuse by any caregivers or people living in the home
- Social and financial stressors and resources (unemployment, divorce/separation, etc.) (Pierce & Fingarson, 2012; Christian, 2015)

Explanations that are of concern for AHT include:

- Any infant or young child whose history is not plausible or consistent with the presenting signs and symptoms (i.e., explanation that is inconsistent with the pattern, age, or severity of the injury or injuries or is inconsistent with the child's physical and/or developmental capabilities)
- The presence of a new adult partner in the home
- A history of delay in seeking medical attention
- A previous history or suspicion of abuse
- The absence of a primary caregiver at the onset of injury or illness
- Physical evidence of multiple injuries at varying stages of healing
- Unexplained changes in neurologic status, unexplained shock, and/or cardiovascular collapse (CDC, 2012b)

Physical Assessment

There are various signs and symptoms of AHT that can be recognized in a physical assessment of the child. Depending on the severity of the clinical presentation, initial assessment is often focused on identifying and treating life-threatening issues. This initial assessment focuses on the airway, breathing, circulation, and neurologic status.

As noted above, the consequences of less severe cases may not be brought to the attention of healthcare professionals and may never be diagnosed. In most severe cases, which usually result in death or severe neurological consequences, the child usually becomes immediately unconscious and suffers rapidly escalating, life-threatening central nervous system dysfunction.

Common presenting **signs and symptoms of AHT** are:

- Lethargy/decreased muscle tone
- Extreme irritability



- Decreased appetite, poor feeding, or vomiting for no apparent reason
- Grab-type bruises on arms or chest (rare)
- No smiling or vocalization
- Poor sucking or swallowing
- Rigidity or posturing
- Difficulty breathing
- Seizures
- Head or forehead appears larger than usual or soft-spot on head appears to be bulging
- Inability to lift head
- Inability of eyes to focus or track movement or unequal size of pupils
(NCSBS, n.d.)

Complete **physical exam** for any young child with suspected AHT should include:

- Inspection of all body parts, scalp, ears, and hair
- Inspection of the mouth (lip, tongue, buccal) to look for frenula tears or dental injuries
- Palpation of legs, arms, hands, feet, and ribs to feel for crepitus or deformities

Nursing neurologic assessment of the child with head trauma should include evaluation of:

- Eye opening
- Arousability level or irritability/consolability
- Symmetry of facial expressions
- Movement of upper and lower extremities
- Increased weakness or pitch in cry/vocalizations
- Fontanel
- Each pupil separately for size, shape, equality of reaction to light
- Ability to track objects
- Muscle tone for rigid extension or flexion of extremities, flaccidity, and/or unusual posturing
(Stanford School of Medicine, n.d.)

Several specific types of injuries are commonly associated with AHT. These include the “triad” of retinal hemorrhage, subdural hematoma, and hypoxic-ischemic injury/encephalopathy as well as others described below.



RETINAL HEMORRHAGE (RH)

Retinal hemorrhage is bleeding in the back wall of the eye. Retinal hemorrhages are a common but not universal finding in AHT. Clinical and pathological studies have shown strong associations of severe RH and AHT, especially in infants. It is important to understand, however, that RHs can result from other causes including medical disease (coagulopathy or leukemia) or trauma, including accidental or birth trauma (AAP, 2015).

RHs can vary in size, number, and location within the retina itself. An examination by using indirect ophthalmoscopy is required in the evaluation of AHT, preferably by an ophthalmologist with pediatric or retinal experience. Location, depth, and extent of retinal hemorrhages may distinguish between abusive and nonabusive causes of head trauma. Hemorrhages that extend to the ora serrata and involve multiple layers of the retina are strongly associated with AHT.

Recent studies suggest that fundoscopic examination may not be necessary if examination and neuroimaging show no evidence of intracranial injury, since the likelihood of encountering retinal hemorrhages in those children is very low (Christian, 2015).

SUBDURAL HEMATOMA

Subdural hematoma (SDH) is bleeding inside the skull but outside the brain. SDH is found in the majority of victims of pediatric AHT, and the majority of neurologically symptomatic SDHs identified in infants and toddlers are the result of child abuse. The extent, location, and size of SDHs are variable, and SDHs can result from accidental or abusive trauma and secondary to medical disease. Although SDHs are not exclusive to abusive trauma, a number of studies have demonstrated a significant and strong association of SDH with abuse compared with accidental injury (AAP, 2015).

HYPOXIC-ISCHEMIC ENCEPHALOPATHY INJURY

Hypoxic ischemic encephalopathy injury (HIE) to the brain is caused by lack of oxygen and/or blood flow to the brain. HIE is a common feature of AHT and the biggest contributor to the poor developmental outcomes in survivors of AHT. The pathophysiology for HIE in victims of AHT is multifactorial and includes traumatic axonal injury to the brainstem and spinal cord, apnea (inadequate breathing) attributable to injury, seizures, alterations in blood flow to the brain after trauma, unmet metabolic demands of the injured brain, secondary cerebral edema (brain swelling), and others. Other potential causes of HIE in infants and children include birth asphyxia, accidental or intentional trauma or suffocation, infection, metabolic disease, congenital anomalies, drowning, and choking (AAP, 2015).

FRACTURES

The possibility of concurrent fractures is important to consider in children presenting with possible AHT. Fractures are the second most common injury in physical abuse and are detected in 30% to 55% of abused children (Baz & Wang, 2012). Studies have estimated that up to 1 in 5

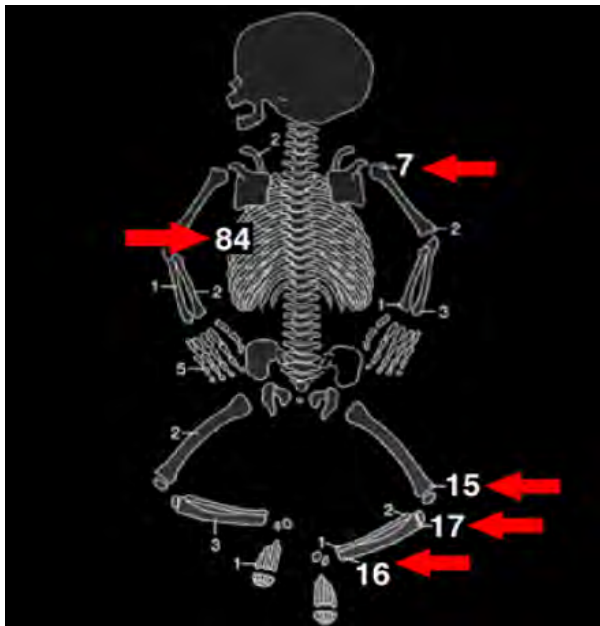


children with abuse-related fractures are missed during the initial medical visit. As will be discussed below, understanding the unique physiology of children's skeletal injuries is crucial for correctly differentiating between injuries incurred from normal childhood trauma and those from abusive trauma.

Fractures in children due to inflicted injury can be divided into the following three categories:

- **Highly specific** injuries include metaphyseal fractures (sometimes termed classic metaphyseal lesions [CMLs]), rib fractures, scapular fractures, spinous process fractures, and sternal fractures.
- **Moderate-specificity** fractures include multiple fractures (especially if bilateral), fractures of different ages, epiphyseal separations, vertebral body fractures, digital fractures, and complex skull fractures.
- **Common but low-specificity** fractures include clavicle fractures, long-bone shaft fractures, and linear skull fractures. Moderate- and low-specificity fractures become highly specific when a credible history of accidental trauma is absent, particularly in infants.

(Baz & Wang, 2012; Kleinman et al., 1986)



Common fracture locations in a shaken infant. This image shows the distribution of fractures observed in 31 AHT fatalities: ribs (84) due to compression when being tightly held; arms and legs (7, 15, 16, 17) due to whiplash movement when being shaken (Kleinman, 1995). (Source: Radiologyassistant.nl.)

ORAL INJURIES

The mouth should be fully examined and any missing or abnormal teeth recorded. It is also very important to be aware of normal dentition in a child and to be alert to subtle changes (e.g., the



most common oral injuries described are bruising or lacerations to the lips). Other possible oral injuries include unexplained bruising to the cheeks, ears, neck, or trunk in association with a torn frenum. A torn frenum may occur with force-feeding an infant (Baz & Wang, 2012).

ABDOMINAL INJURIES

Liver lacerations and other abdominal organ injuries are often seen in AHT cases but are commonly missed because the internal injuries are not visible to the naked eye. Blood tests (liver transaminase levels, pancreatic amylase and lipase) can immediately alert clinicians to the possibility of an occult abdominal injury (Lindberg et al., 2015; Kempe, 2015).

Diagnostic Procedures

All infants and children with suspected AHT require cranial CT, MRI, or both.

CT SCAN

A CT scan is usually the first modality of choice diagnostically in symptomatic children due to its availability, rapidity, and ability to look at brain parenchyma, vascular structures, bone, and extracranial swelling. The CT in AHT may demonstrate intracranial bleeding, specifically subdural hematomas. A CT of the head will identify abnormalities that require immediate surgical intervention and is preferred over MRI for identifying acute hemorrhage and skull fractures and scalp swelling from blunt injury.

MRI

MRI is the optimal modality for assessing intracranial injury, including cerebral hypoxia and ischemia, and is used for all children with abnormal CT scans, asymptomatic infants with noncranial abusive injuries, and for follow-up of identified trauma (Christian, 2015).

SKELETAL SURVEY

Skeletal surveys are recommended in suspected physical abuse and in serious head trauma in children younger than 2 years of age because the diagnosis of abuse may be made or supported if unsuspected or occult traumatic injuries are found in other parts of the body. Such accompanying skeletal fractures are seen in roughly half of the cases of abusive head injury (Christian & Block, 2009; Christian 2015).

While bony injuries are rarely life threatening, they can provide important evidence for the diagnosis of physical abuse. Skeletal surveys can help to identify characteristic injury patterns such as the classic metaphyseal lesion in long bones, previously referred to as “bucket-handle” and “corner” fractures or posterior rib fractures, both of which are rarely accidental and thus strongly suggestive of abuse even when clinical information is lacking (Jain, 2015).



Per the American College of Radiology Guidelines (2014), skeletal surveys should include the following films:

- Thorax: Routine anteroposterior (AP) and lateral to include ribs, thoracic and upper lumbar spine, and an oblique views of the ribs
- Long bones of arms and legs: Routine AP views (humeri, forearms, femurs, and lower legs); additional views if needed—coned views of joints to look for metaphyseal injuries in greater detail
- Hands and feet: Posteroanterior (PA) hands, AP or PA feet
- Abdomen/lumbosacral spine, pelvis: AP to include mid-lumbar spine, lumbosacral spine lateral, and pelvis
- Cervical spine: AP and lateral
- Skull: Additional views if needed: oblique recommended if occipital injury is suspected

LAB TESTING

Laboratory testing, including a CBC (complete blood count) and a coagulation panel, are also important in assessing AHT (Fingarson & Pierce, 2012).

NEUROLOGIC ASSESSMENT TOOLS

Pediatric neurologic assessment tools include a variety of scales healthcare professionals can use to assess and monitor level of consciousness in young children. The Glasgow Coma Scale continues to be one of the most widely used to evaluate injury severity of young children presenting with altered level of consciousness. Any combined score of less than 8 suggests severe brain injury and represents a significant risk of mortality (see table below).

PEDIATRIC GLASGOW COMA SCALE		
Behavior	Response	Score
Eye opening	Does not open eyes	1
	Opens eyes in response to painful stimuli	2
	Opens eyes in response to speech	3
	Opens eyes spontaneously	4
Verbal response	No verbal response	1
	Inconsolable, agitated	2
	Inconsistently inconsolable, moaning	3
	Cries but consolable, inappropriate interactions	4
	Smiles, orients to sounds, follow objects, interacts	5



Motor response	No motor response	1
	Extension to pain (decerebrate response)	2
	Abnormal flexion to pain for an infant (decorticate response)	3
	Infant withdraws from pain	4
	Infant withdraws from touch	5
	Infant moves spontaneously or purposefully	6
Total score:		_____
	Best response	15
	Comatose client	8 or less
	Totally unresponsive	3
Source: Brainline.org, n.d.		

Other tools used to assess neurologic status in the pediatric population include the Starship Infant Neurological Assessment Tool, CHOP Infant Coma Scale, Adelaide Pediatric Coma Scale, and the FOUR Score Coma Scale. The FOUR Score Coma Scale assesses eye response (whether eyelids are opened or closed and tracking), motor response, brainstem reflexes (pupil and corneal reflexes), and respiration (respiratory patterns) (Cohen, 2009).

Distinguishing between Accidental and Abusive Head Trauma

Clinical prediction tools are available to help healthcare providers differentiate accidental head trauma versus AHT. One is called **Predicting Abusive Head Trauma (PredAHT)**. This tool estimates the probability of AHT in young children presenting with intracranial injuries and specific combinations of six features:

- Head or neck bruising
 - Seizures
 - Apnea
 - Rib fracture
 - Long-bone fracture
 - Retinal hemorrhage
- (Cowley et al., 2015)

In a prospective, multicenter, observational, cross-sectional study, researchers were able to derive a **four-variable clinical prediction rule (CPR)** with a high sensitivity for predicting AHT. Their four “readily available” variables include:

- Acute respiratory compromise before admission
- Bruising of the torso, ears, or neck
- Bilateral or interhemispheric subdural hemorrhages or collections



- Any skull fractures other than an isolated, unilateral, nondiastatic, linear, parietal fracture (Hymel et al., 2014)

Other research comparing children with noninflicted head trauma to those with inflicted head trauma found several clinical and radiological features that are helpful in distinguishing accidental from abusive head trauma. It was determined that the children with AHT had:

- More frequently experienced noncontact injury mechanisms
- Sustained greater injury depth
- More frequently manifested acute cardio-respiratory compromise
- Had lower initial Glasgow Coma Scale scores
- Experienced more frequent and prolonged impairments of consciousness
- More frequently demonstrated bilateral, hypoxic-ischemic brain injury
- Had lower mental developmental index scores six months post-injury
- Had lower gross motor quotient scores six months post-injury (Hymel et al., 2007)

There are several challenges to differentiating between accidental (nonabuse/noninflicted) trauma or age-appropriate injuries and child abuse in infants and young children. This is especially true in children who are not yet verbal enough to explain what happened to them (i.e., infants, toddlers, and children with developmental delay and/or altered levels of consciousness).

Because of this, knowledge of typical developmental patterns of injury is helpful (see below). That is, how does the presenting pattern(s) of injury and the child's age and developmental level match up with the reported mechanism of injury?

DEVELOPMENTAL PATTERNS OF INJURY

Developmental patterns of injury seen in the 0- to 3-year-old range (the age range most frequently seen with AHT) include trauma from falls from furniture or down stairs and being dropped by another person. Nonabusive trauma can also come from traumatic delivery (e.g., forceps, vacuum extraction, and/or breech) and/or motor vehicle accidents. Head injury is frequently involved with these traumas because of several factors, including the larger head-to-body ratio and the inability to shield oneself during a fall.

Developmentally, this age range is at risk for accidental injury because the child's developmental milestones include increasing motor skills and curiosity, allowing them a greater range and access to potential hazards (Flavin et al., 2006). The advancing physical abilities of young children often precede their ability to understand the consequences of their actions. Thus, parent/caregiver knowledge of growth and developmental milestones may reduce the likelihood that they will misjudge the ability of the child and utilize an inappropriate supervision strategy. The mechanisms seen in accidental (noninflicted) injuries are generally different in these types of injuries as compared to AHT, as discussed below.



RED FLAGS FOR INFLICTED INJURY IN A CHILD WITH BRUISING

Healthcare providers can differentiate between accidental trauma and inflicted injury by watching for these “red flags” in children with bruising.

- Bruises in babies who are not yet cruising
- Bruises on the ears, neck, feet, buttocks, or torso (torso includes chest, back, abdomen, genitalia)
- Bruises not on the front of the body and/or overlying bone
- Bruises that are unusually large or numerous
- Bruises that are clustered or patterned (patterns may include handprints, loop or belt marks, bite marks)
- Bruises that do not fit with the causal mechanism described

Source: Ward et al., 2013.

ASSESSMENT QUESTIONS

The following are questions to help separate the unintentional from the inflicted injury:

- What is the **age of the child**? What are the normal behaviors of a child at that age? Is this particular child “hyperactive” either in the eyes of his or her caretakers or in actual fact? Developmental stages of childhood determine what kinds of injuries are likely to be seen. The motor skills of the child determine what the child could have done to incur injury. Based on the child’s age, is the presenting injury plausible?
- Is the **history plausible**? Could this injury have been sustained in the manner described? Does the history change with changing information supplied to the caretaker? Adjustments in the account of the injury may be made by caretakers to fit the evolving information, indicating the tailoring of the history to fit the new information. Does the history change when related in subsequent accounts by other family members?
- Was the injury **witnessed**? The lack of information as to how a serious injury has occurred should raise the index of suspicion for an abusive origin.
- Is the **social situation** in which the injury occurred a high-risk environment? The presence of community or intrafamilial violence, substance abuse, chaotic living arrangements, poverty, social isolation, transient lifestyles, mental health issues, or conflict among family members are red flags.
- Can the **described mechanism of injury** account for the observed injury? What else could produce the clinical picture?



Explanations that are concerning for intentional trauma include:

- No explanation or vague explanation for a significant injury
- An important detail of the explanation changes dramatically
- An explanation that is inconsistent with the pattern, age, or severity of the injury or injuries
- An explanation that is inconsistent with the child's physical and/or developmental capabilities
- Different witnesses provide markedly different explanations for the injury or injuries (Christian, 2015)

WHAT TO DO WHEN CONSIDERING A DIAGNOSIS OF AHT

- **Call social services.** They can assist with interview of family and discussion with CPS.
- **Call Child Protective Services.** They will take a report and decide whether they will pursue an investigation. Often, CPS is involved in assisting with the disposition of the child if not admitted (they will make a safety plan) or when child goes home from the hospital. CPS may also contact law enforcement.
- **Call a child abuse consultant.** These professionals are key in suggesting studies for workup as well as discussing appropriate disposition. Regional child abuse centers often have a consultant on call if there is not one available in one's own system.
- **General rule for disposition.** If there is any question of the child's safety at home (e.g., unexplained injury, uncertain perpetrator) and/or further workup is required (e.g., skeletal survey), the child should be admitted to the hospital for observation and protection until the workup can be completed and safe disposition decided between admitting provider, child abuse consultant, social services, and CPS.

Source: Baz & Wang, 2012.

CASE

Anthony is an 11-month-old admitted to the ED with a history of altered level of consciousness and multiple facial, skull, and body soft tissue injuries after a reported "fall down the stairs while in a baby walker." This occurred while he was at a family childcare home. He regained consciousness but was very irritable.

On arrival to the ED, the triage nurse assessed his airway, breathing, circulation, and level of consciousness. He received a prompt evaluation by the ED physician for head trauma because of the history. In this case, the details of the event and injury patterns seemed to match up. Anthony had a CT of the head and ophthalmologic evaluation, and both were found to be negative.



Anthony was discharged home from the ED after observation. The family childcare home was cited for a health and safety violation.

Differential Diagnoses

It is also important to rule out underlying conditions that may look like abuse or AHT. These include inquiring about the presence of any of the following conditions or practices:

- Congenital, metabolic, or neoplastic conditions (e.g., aneurysm, arteriovenous malformation, brain tumor, leukemia)
 - Connective tissue disease or osteogenesis imperfecta, which may lead to fragile bones that fracture with less force than would be expected
 - Acquired causes (e.g., meningitis, obstructive hydrocephalus)
 - Undetected bleeding disorders that can lead to abnormal bleeding patterns (e.g., hemophilia, Von Willebrand's disease, liver disease)
 - Traditional or alternative healing practices, which may lead to unusual bruising and scarring patterns (e.g., coin rubbing, cupping, burning herbs on the skin over acupuncture points)
- (Hymel & Deyes, 2011)

To protect children who are possible victims of physical abuse, it is also important to be alert for injuries that raise suspicion of abuse, including:

- **Any** injury to a nonmobile infant, including bruises, oral injuries, or fractures
 - Injuries in unusual locations, such as over the torso, ears, or neck
 - Patterned injuries
 - Injuries to multiple organ systems
 - Multiple injuries in different stages of healing
 - Significant injuries that are unexplained
- (Christian, 2015)

Additionally, consider the possibility of AHT in young infants who present with nonspecific symptoms of possible head trauma, including unexplained vomiting, lethargy, irritability, apnea, or seizures, and consider head imaging in their evaluation.

INTERVENTION FOR PEDIATRIC AHT PATIENTS

Intervention focuses on detection of primary injury (as discussed above), treatment of that injury, and prevention or treatment of secondary brain injury. Resuscitation (attention to airway,



breathing, and circulation) and stabilization efforts for patients with traumatic brain injury take priority because of the life-threatening presentation of the child with AHT.

Acute Management of Traumatic Brain Injury

In 2012, the Society of Critical Care Medicine updated their guidelines for the acute management of severe traumatic brain injury for the pediatric population (Kochanek et al., 2012). This edition includes topics not covered previously, such as the use of therapeutic hypothermia in children, the implementation of monitoring for brain-tissue oxygen pressure, a randomized controlled trial of immune-enhanced nutrition, and many reports regarding fundamental aspects of pediatric TBI care. Several topics were added (advanced neuro-monitoring, neuroimaging, cerebrospinal fluid drainage, antiseizure prophylaxis) and others were eliminated (trauma systems, prehospital airway management, resuscitation of blood pressure and oxygenation, intracranial pressure monitoring technology, and the critical pathway). The result is that the guidelines are now considerably more focused on therapies for improvements in outcomes (Bell & Kochanek, 2012).

Management of traumatic brain injury is divided into first-, second-, and third-tier therapy. As described by Gier and colleagues (2013), the goal of all therapies is to maintain a low and stable intracranial pressure (ICP) and adequate blood pressure (BP).

FIRST-TIER THERAPIES

The initial management (first-tier therapies) of a child with a traumatic brain injury begins with strict attention to the maintenance of the patient's airway, breathing, and circulation (blood pressure). Children with normal blood pressure and no alterations of consciousness may be managed with supportive care. Hypotension should be treated with fluid boluses. Those with decreased consciousness (GCS <9), marked respiratory distress, or hemodynamic instability require advanced airway management to enhance oxygenation and ventilation and prevent aspiration of gastric contents. Cervical spine immobilization, when needed, must be maintained during advanced airway procedures.

As discussed about concepts in the treatment of traumatic brain injuries, consider both the immediate or primary brain injury results from the initial forces generated following trauma and also equally important the two forms of secondary brain injury that can occur. The first form of secondary brain injury includes hypoxemia, hypotension, intracranial hypertension, hypercarbia, hyper- or hypoglycemia, electrolyte abnormalities, enlarging hematomas, coagulopathy, seizures, and hyperthermia.

The primary goal in the acute management of the severely head-injured pediatric patient is to prevent or ameliorate these factors that promote secondary brain injury. The other form of secondary brain injury involves an endogenous cascade of cellular and biochemical events in the brain that occurs within minutes and continues for months after the primary brain injury that lead to ongoing or "secondary" traumatic axonal injury (TAI) and neuronal cell damage (delayed brain injury) and ultimately, neuronal cell death.



The following treatable conditions can exacerbate secondary brain injury:

- Hypoxemia
- Hypotension
- Elevated intracranial pressure leading to intracranial hypertension
- Hypercarbia or hypocarbia
- Hyperglycemia or hypoglycemia
- Electrolyte abnormalities
- Enlarging hematomas
- Coagulopathy
- Seizures
- Hyperthermia

(Su, 2015)

Oxygenation is best monitored using pulse oximetry, with supplemental oxygen administered when necessary to ensure adequate oxygenation. For initial monitoring of ventilation of children with traumatic brain injury, capnography is recommended to monitor end-tidal CO₂ in order to avoid excessive hyperventilation and resultant hypocapnia, thereby leading to vasoconstriction and decreased cerebral perfusion. In order to prevent secondary brain injury, intracranial pressure management is crucial. Raising the head of patients to 30° optimizes cerebral perfusion pressure and leads to a decrease of intracranial pressure by improving venous drainage without affecting cerebral blood flow.

SECOND-TIER THERAPIES

Some children with severe TBI may develop intracranial hypertension that is resistant to first-tier medical management. These patients may require second-tier treatments, including increased levels of sedation, possibly with barbiturates. High-dose barbiturate therapy lowers ICP by decreasing cerebral metabolism, thus decreasing cerebral blood flow (Kochanek et al., 2012).

Other second-tier treatments include moderate hypothermia; therapeutic hypothermia may reduce cerebral metabolic demands, inflammation, lipid peroxidation, excitotoxicity, cell death, and acute seizures. Hypothermia is defined as temperatures less than 35 °C. If hypothermia is used, it may be necessary to use a neuromuscular blockade to prevent shivering (Kochanek et al., 2012).

THIRD-TIER THERAPIES

Third-tier therapies include decompressive craniectomy for patients showing early signs of neurologic deterioration or herniation or for those not responding to first- or second-tier therapy. This surgical treatment involves removing part of the skull, which allows for swelling to occur more freely while limiting secondary injury (Kochanek et al., 2012).



Nursing Care Planning

Nursing care planning for children with AHT and their families may be very complex and includes addressing the following issues:

- Risk for altered parenting (defined as inability of the primary caregiver to create, maintain, or regain an environment that promotes the optimum growth and development of the child)
- Risk for violence related to history of family violence
- Risk for injury related to physical or psychological conditions in the environment
- Hopelessness related to long-term family stress
- Post-trauma response related to physical or psychosocial abuse

The treatment of child abuse is complex and often involves long-term psychotherapy for the parents or other perpetrators as well as the child. Most states require some kind of counseling for the parents (see also below under “Prevention Strategies”).

Children who have suffered severe or long-term abuse often need early intervention and/or special education programs as well as physical, occupational, and/or speech therapy or home-healthcare secondary to their injuries.

Nursing care will generally involve significant discharge planning and referral to appropriate healthcare and social services.

MORBIDITY AND MORTALITY

Young children diagnosed with AHT have a range of outcomes, including death, significant developmental outcomes, and life-long disability (see list below). Approximately 25% of children die, 25% appear neurologically normal at the time of discharge, and up to 50% may have some form of neurodevelopmental impairment.

Many children have persisting deficits in attention/arousal, emotional regulation, and motor coordination (Fraiser, 2009). Shein and colleagues (2012) looked at the mortality rates in a large cohort of children who were identified as sustaining AHT and found that low initial GCS score, retinal hemorrhage, intraparenchymal hemorrhage, and cerebral edema are independently associated with mortality in abusive head trauma.

The morbidity rates of children with AHT are also variable. Greiner and colleagues (2012) found that clinical factors at the time of injury, such as early posttraumatic seizures and intubation requirement, were associated with poorer developmental outcome. Their study also suggested the importance of close developmental follow-up for all children with AHT, regardless of whether or not the child was admitted to the PICU.



Outcomes were evaluated one year after severe traumatic brain injury among young children and compared between children with inflicted versus noninflicted injuries. Children with inflicted TBI had worse outcomes than those with other TBIs one year after injury. The majority of children who had suffered inflicted head trauma also demonstrated a broad spectrum of neurological and developmental disabilities after a follow-up of up to five years. Many researchers suggest that many years of careful developmental follow-up may be required to recognize the true long-term outcomes of AHT (Fraiser, 2009).

HEALTH AND DEVELOPMENT CONDITIONS RELATED TO AHT

- Learning disabilities
- Physical disabilities
- Visual disabilities or blindness
- Hearing impairment
- Speech disabilities
- Cerebral palsy
- Seizures
- Behavior disorders
- Cognitive impairment
- Death

Source: NCSBS, n.d.

Rehabilitation and Recovery

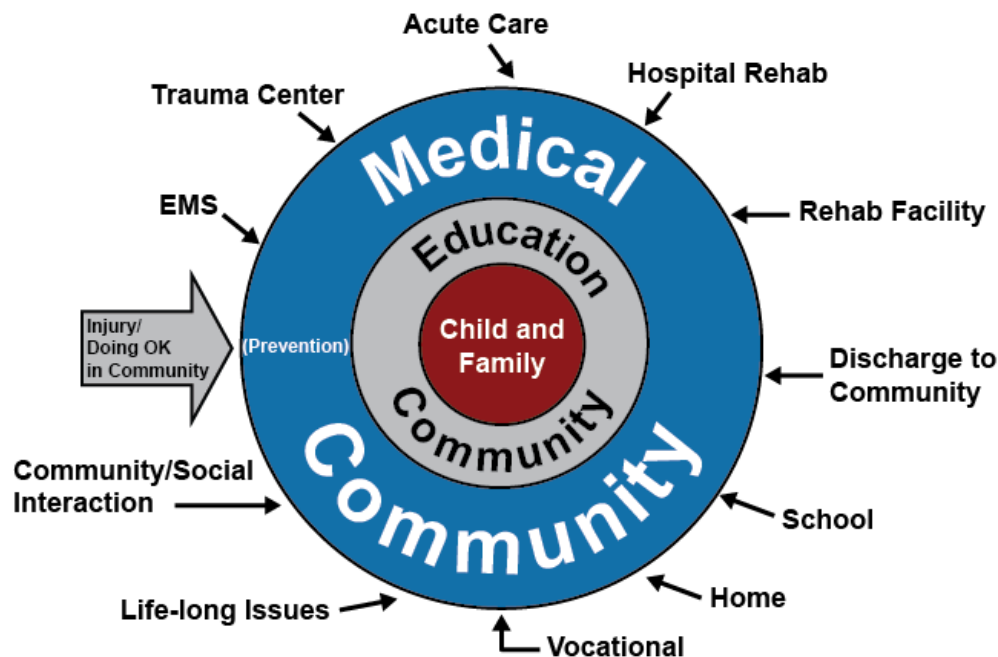
Savage (2012) provides a “call to action” in describing the complexities of the ongoing care (recovery, rehabilitation, and habilitation) of a child who has sustained an “acquired” traumatic brain injury such as AHT. Because the brains of infants and young children are still developing, AHT can result in widespread impairment and dysfunction not only in cognition and motor function but also in behavior and social function.

AHT can also impact the developmental trajectory in all developmental domains. This process is influenced by the child’s pre-injury status, the acute care, and the responses of the patient’s family, school, and community. Because the effects are so complex, successful treatment requires the integration of medical, educational, judicial, and social service systems.

Rehabilitation represents periods of active intervention that might include but are not limited to: pharmacologic, physical, occupational, vision, speech-language, psychological, behavioral, and/or educational therapies. Rehabilitation should continue as long as it results in improvements in function.

When interventions no longer yield improvements in function, the child transitions into a period of “habilitation.” Professionals must now understand that recovery may be a lifelong process for the child’s entire circle of family, friends, and healthcare providers.





The circle of care. (Source: Roberta DePompei, PhD. Published with permission.)

CASE

Nina is now a 6-year-old female who suffered a traumatic brain injury due to AHT. Per court records, her mother came home from her second day back at work and found Nina, then a 3-month-old, with her arms twitching. Nina was being cared for by her father, the mother's boyfriend. Her mother took Nina to the emergency department of the local hospital, however by the time they arrived, the twitching had stopped. After several hours of observation, they were sent home.

That evening Nina ate poorly and vomited. The next morning Nina's mom found her unresponsive, with abnormal posturing. Her mother called 911. Nina was stabilized in the ED and transferred to a tertiary care pediatric medical center. She was in the intensive care unit for two weeks and the pediatric rehabilitative unit for three weeks. Nina was discharged to a foster home.

The father reported that he had accidentally dropped Nina the day before, but the history and clinical presentation did not match up, and the father was arrested for child abuse. He was later convicted for child abuse because of the physical findings associated with Nina's case.

Nina's mother was able to regain custody of her after three months and a lengthy police and child welfare investigation. To regain custody of Nina, her mother was required to take parenting classes and was referred to Public Health Nursing, Early Head Start, and early intervention services. The Maternal-Child Health, Public Health Nurse and Early Intervention Service Coordinator helped Nina's mother learn ways to organize Nina's daily medical care



and walked her through how to access and advocate for the variety of services and supports that the family was going to need to support Nina's special needs.

Nina was diagnosed with cerebral palsy, neurologic (cortical) vision impairment, seizure disorder, and global developmental delay. She is technologically dependent on a gastrostomy tube for her nutrition needs. Nina continues to have severe developmental disabilities and delays (she is both nonambulatory and nonverbal) and receives intensive special education and therapy services. The Special Education School Nurse, county health department Public Health Nurse and IFSP (Individualized Family Service Plan), and/or IEP (Individualized Education Plan) team members work regularly with Nina's family to ensure that her educational, therapeutic, and medical needs are met. Nina also has a home care nurse who provides respite care. Nina will need care for all of her activities of daily living for the rest of her life.

PREVENTION STRATEGIES

Research has shown that certain protective factors are linked to a lower incidence of child abuse and neglect. They are attributes that serve as buffers, helping parents who might otherwise be at risk of abusing their children to find resources, supports, or coping strategies that allow them to parent effectively, even under stress. These protective factors include:

- Nurturing and attachment
- Knowledge of parenting and child development
- Parental resilience
- Social connections
- Concrete supports for parents
- Social and emotional competence of children

(U.S. DHHS, 2010)

These protective factors apply to AHT prevention in several ways, specifically in the understanding of typical infant development in regards to infant crying, which has been identified as a primary trigger for abuse. Many states have thus enacted programs aimed at preventing child abuse by developing programs to increase parental understanding of infant development, in particular infant crying and coping strategies to address it. The evidence behind these practices is still in the early stages.

Stoll and Anderson (2013) reviewed the literature on prevention of AHT and the opportunities for nurses and other healthcare providers to intervene. They proposed a model that incorporates many of the strategies described below. This model consists of a) completion of personal inventory, b) involvement in multi-modal parental education, c) commitment to a prevention program, d) participation of the family and community, and e) connection to a spiritual element. Through these components, it is hoped there is enhancement of the quality of life for parents and infants and a discouragement of situations that increase the risk of infant injury.



There are several types of prevention education programs and supports currently being utilized and evaluated. These include:

- Hospital-based (inpatient parent training) education programs
- Home visiting programs
- General parenting education classes
- Parent support groups
- Family resource centers
- Crisis intervention services such as hotlines and crisis nurseries

Primary prevention efforts address a broad segment of the population, such as all new parents. Secondary prevention efforts target a specific subset of the population considered to be at higher risk for child maltreatment. Tertiary prevention efforts target perpetrators of child maltreatment and seek primarily to prevent recidivism.

Primary Efforts: General Public and Parent Education

Primary prevention activities are directed at the general population and attempt to stop maltreatment before it occurs. All members of the community have access to and may benefit from these services. Primary prevention activities with a universal focus seek to raise the awareness of the general public, service providers, and decision makers about the scope and problems associated with child maltreatment. Universal approaches to primary prevention might include:

- Public service announcements that encourage positive parenting
- Parent education programs and support groups that focus on child development, age-appropriate expectations, and the roles and responsibilities of parenting
- Family support and family strengthening programs that enhance the ability of families to access existing services and resources to support positive interactions among family members
- Public awareness campaigns that provide information on how and where to report suspected child abuse and neglect

Parent education and support programs typically focus on educating parents on child development and parenting strategies and also have the goal of decreasing parenting practices and behaviors associated with child abuse and neglect. Although parent education programs may serve the general community, many are also directed at populations determined to be at risk for child maltreatment.

Parent education and support programs can address:

- Developing and practicing positive discipline techniques



- Learning age-appropriate child development skills and milestones
- Promoting positive play and interaction between parents and children
- Locating and accessing community services and supports

Healthcare professionals can provide the following messages to parents and caregivers during their everyday encounters:

- Remind parents and caregivers that crying is normal for babies.
- Explain to parents that excessive crying is a normal phase of infant development.
- Ask parents how they are coping with parenthood and their feelings of stress.
- Assure parents that it is normal to feel frustrated at long bouts of crying and a sudden decrease in sleep, but that things will get better.
- Give parents the number to a local helpline or other resource for help.
- Talk with parents about the steps they can take when feeling frustrated with a crying baby, such as putting the baby safely in a crib on his or her back, checking on the baby’s safety every 5 to 10 minutes, and calling for help or a friend.
- Let parents know what to check for when their baby is crying: signs of illness, fever, or other behavior that is unusual; discomfort like a dirty diaper, diaper rash, teething, or tight clothing; or whether the baby is hungry or needs to be burped.

(CDC, 2012b)

The **Period of PURPLE Crying** is an example of a primary-level program specifically geared to the prevention of AHT. The target population is all parents of new infants and society in general with the goal of increasing their understanding of early infant crying and shaken baby syndrome. Barr et al. (2009) demonstrated that the use of the PURPLE education materials seem to lead to higher scores in knowledge about early infant crying and the dangers of shaking, and in sharing of information behaviors considered to be important for the prevention of shaking.

PERIOD OF PURPLE CRYING		
P	Peak of crying	Your baby may cry more each week, the most at 2 months, then less at 3 to 5 months.
U	Unexpected	Crying can come and go and you don’t know why.
R	Resists soothing	Your baby may not stop crying no matter what you try.
P	Pain-like face	Your crying baby may look to be in pain even when he or she is not.
L	Long lasting	Crying can last as much as 5 hours a day or more.
E	Evening	Your baby may cry more in the late afternoon or evening.
Source: NCSBS, 2012.		



The PURPLE program also contains a public media component aimed at changing cultural attitudes about crying, especially inconsolable crying. The approach includes educating parents and the community about normal infant development, specifically crying in normal infants, rather than being limited to warnings of the negative consequences of shaking.

The PURPLE programs uses a DVD and 11-page booklet translated into nine languages to take home to review and share with others. It includes three 5- to 10-minute “doses”:

- In the maternity ward, given separately from other materials
- Either pre- or post-birth as a second “dose” (e.g., in prenatal classes and in the first pediatric office visit)
- Via media campaign

Through the three contacts, the duration of the program is at least a week and can last much longer since a key element of the program is that each parent receives a copy of the DVD and booklet to take home with them. This way they can refer to the DVD again when the infant is crying and show it to other temporary caregivers.

(See also “Resources” at the end of this course for links to other prevention efforts.)

Secondary Efforts: Home Visitation Programs

Secondary prevention efforts, such as home visitation programs, target a specific subset of the population considered to be at higher risk for child maltreatment. Researchers have identified five common co-occurring parental risk factors—substance abuse, mental illness, domestic violence, child conduct problems, and poverty—that lead to child maltreatment (Barth, 2009). Secondary prevention programs have had the greatest demonstrated success in reducing child maltreatment but often require considerable resources and funding.

Approaches to prevention programs that focus on high-risk populations might include:

- Parent education programs located in high schools focusing on teen parents or within substance abuse treatment programs for mothers and families with young children
- Parent support groups that help parents deal with their everyday stresses and meet the challenges and responsibilities of parenting
- Respite care for families who have children with special needs
- Family resource centers that offer information and referral services to families living in low-income neighborhoods
- Home visiting programs that provide support and assistance to expecting and new mothers in their homes



Home visiting is a mechanism to provide direct support and coordination of services for families, beginning prenatally or at birth. Visits are conducted by a nurse, social worker, or trained paraprofessional. Programs vary, but components may include:

- Education in effective parenting and childcare techniques
- Education on child development, health, safety, and nutrition
- Assistance in gaining access to social support networks
- Assistance in obtaining education, employment, and access to community services

Two examples of such programs are listed below:

Kentucky has a home-visiting program targeted to first-time parents called **Health Access Nurturing Development Services (HANDS)**, which is one of the largest early childhood home-visitation programs in the nation. Frequent pre- and post-natal home visits by trained professionals are provided to first-time parents. These appointments assist new parents by sharing important information, problem solving, and helping them to meet basic needs such as housing, food, healthcare, and other required services. (See “Resources” at the end of this course.)

Although there is currently no data to support the HANDS program’s effectiveness as it relates to AHT prevention, there is supporting data that demonstrates this program has resulted in less preterm births, fewer children with developmental delay, fewer emergency department visits, increased family self-sufficiency, and lower infant mortality rates (PEW, 2012).

The **Nurse-Family Partnership (NFP)** program provides home visits by registered nurses to first-time, low-income mothers, beginning during pregnancy and continuing through the child’s second birthday. It operates nationwide. The program has three primary goals: 1) to improve pregnancy outcomes by promoting health-related behaviors; 2) to improve child health, development, and safety by promoting competent caregiving; and 3) to enhance parent life-course development by promoting pregnancy planning, educational achievement, and employment. The program also has two secondary goals: to enhance families’ material support by providing links with needed health and social services and to promote supportive relationships among family and friends. The NFP is most often cited as the most effective intervention to prevent child abuse and neglect, which contributes to childhood injury.

CASE

Martha is a 19-year-old who is currently 6 months pregnant and who wants to keep her new baby. Her history is significant in that she was removed from her biological mother at 12 years of age because her mother was addicted to methamphetamine and Martha had been physically and sexually abused by her mother’s boyfriend. Martha has lived with two foster families and dropped out of high school at age 16. The father of her unborn baby is not involved, and Martha is currently living with her new 26-year-old boyfriend, who has a history of substance abuse but is now “clean and sober.”



Martha is receiving prenatal care at Planned Parenthood, is signed up for WIC (Women, Infants, and Children), and is getting ready to take her GED exam so she can work once the baby can be safely cared for. Because of her risk factors, the nurse at Planned Parenthood gave Martha written information and a DVD on the Period of PURPLE Crying program and a referral to the Nurse-Family Partnership (NFP) program, where a public health nurse was assigned to her case.

OTHER CHILD ABUSE PREVENTION PROGRAMS

The Child Welfare Information Gateway and the California Evidence-Based Clearinghouse for Child Welfare (CEBC) both provide databases on other evidence-based practices. Several child-abuse prevention and home-visiting programs have been reviewed by and rated by the CEBC. To be rated in this area, a program needs to either have goals or objectives directly related to the prevention of child abuse and/or neglect or have published peer-reviewed research measuring outcomes directly related to the prevention of child abuse and/or neglect, such as data on reports of abuse or neglect behaviors through a standardized measure.

The following programs have been reviewed by the CEBC and have received their top scientific rating of 1 (Well Supported by Research):

- Nurse-Family Partnership
- SEEK (Safe Environment for Every Kid)
- Incredible Years

These programs have a rating of 2 (Supported by Research):

- SafeCare
- Triple P Positive Parenting

These programs have received a rating of 3 (Promising Research):

- ACT Raising Safe Kids
- Circle of Security Home Visiting
- Exchange Parent Aide
- Parents as Teachers
- Period of PURPLE Crying
- Upstate New York Shaken Baby Syndrome Education Program

These programs may serve as useful resources and models for professionals.



EFFICACY

The efficacy of home visiting programs continues to be challenging to evaluate, especially as they relate to child abuse prevention. Multiple studies have concluded that the strategy, when well implemented, does produce significant and meaningful reduction in child-abuse risk and improves child and family functioning. Others are more limited in their conclusions (CWIG, 2011).

Howard & Brooks-Gunn (2009) examined home visiting as a strategy for preventing child abuse and neglect. They found little evidence that home-visiting programs directly prevented child abuse and neglect. However, they did report that home visits can impart positive benefits to families by way of influencing maternal parenting practices, the quality of the child's home environment, and children's development. They also reported improved parenting skills, which would likely be associated with improved child well-being and corresponding decreases in maltreatment over time.

Tertiary Efforts: Recidivism Prevention

Tertiary prevention activities focus on families where maltreatment has already occurred and seek to reduce the negative consequences of the maltreatment and to prevent its recurrence. These prevention programs may include services such as:

- Intensive family preservation services with trained mental health counselors that are available to families 24 hours per day for a short period of time (e.g., 6 to 8 weeks)
- Parent mentor programs with stable, nonabusive families acting as role models and providing support to families in crisis
- Parent support groups that help parents transform negative practices and beliefs into positive parenting behaviors and attitudes
- Mental health services for children and families affected by maltreatment to improve family communication and functioning
(CWIG, 2012c)

SafeCare is an evidence-based training curriculum for parents who are at-risk or have been reported for child maltreatment. Parents receive weekly home visits to improve skills in several areas, including home safety, healthcare, and parent-child interaction (CWIG, 2012).

Education for Healthcare Professionals

Many states have enacted legislation to reduce the incidence of AHT, including legislation that mandates education designed to prevent AHT. Many educational initiatives, including the nationally recognized Period of PURPLE Crying Program (see above under "Prevention Strategies"), are offered throughout the United States. Some states have also adopted their own



programs, including the All Babies Cry program in Massachusetts and the Calm a Crying Baby program in Colorado. All of these programs are designed to target new parents.

Many states also require that, prior to discharge, each woman who gives birth in a hospital or a free-standing birthing clinic must receive information or watch a presentation describing the nature of, dangers of, and methods for the prevention of AHT. Several states require childcare personnel to be trained in recognizing and preventing AHT and understanding early childhood brain development. Several states, including Kentucky, have established a statewide shaken baby syndrome prevention program that involves a multiyear, collaborative approach.

Federal and additional state mandates may be forthcoming, and there continues to be research to insure that these efforts are evidence-based.

REPORTING CHILD ABUSE AND NEGLECT

All fifty states have statutes that mandate reporting of suspected child abuse and neglect; the healthcare provider is not required to prove abuse before reporting. Familiarity with state laws will ensure that providers report to the appropriate agency within the required time frame; some states have provided the option of making such a report through the Internet. Information on specific state laws is provided by the Children's Bureau of the Administration for Children and Families, U.S. Department of Health and Human Services (CWIG, 2012b).

CONCLUSION

Child abuse and neglect is a serious problem, and pediatric abusive head trauma is the leading cause of death from injury in infants. It is important for healthcare professionals to be aware of the risk factors and signs and symptoms of AHT in the patients they care for. Many states mandate that healthcare professionals immediately report suspected abuse or neglect.

Various resources are also available to help prevent the behaviors that lead to AHT, including Kentucky's statewide HANDS program. Prevention education by healthcare professionals serves the important goal of reducing child abuse and neglect, including abusive head trauma.



RESOURCES

Brain injury in children (Brain Injury Association of America)
<http://www.biausa.org/brain-injury-children.htm>

CEBC (California Evidence-Based Clearinghouse for Child Welfare)
<http://www.cebc4cw.org>

Child abuse evaluation and treatment for medical providers
<http://childabusemd.com>

Childhelp
<https://www.childhelp.org>

Child Welfare Information Gateway
<http://www.childwelfare.gov>

FRIENDS National Resource Center for Community-Based Child Abuse Prevention
<http://www.friendsnrc.org>

Kentucky's HANDS
<http://www.kyhands.com/about>

National Center on Shaken Baby Syndrome
<http://www.dontshake.org>

Prevent Child Abuse America
<http://www.preventchildabuse.org>

Shaken Baby Alliance
<http://www.shakenbaby.org>

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1. “Red flags” for pediatric abusive head trauma in infants include previous visits to a healthcare facility for nonspecific clinical symptoms and:
 - a. Fever.
 - b. Bruising.
 - c. Drooling.
 - d. Failure to thrive.

2. Pediatric abusive head trauma is defined by the Centers for Disease Control and Prevention as an injury to the:
 - a. Skull of an infant or young child (<3 years of age) due to neglect or violence, including gunshot wounds, stab wounds, or penetrating trauma.
 - b. Skull or intracranial contents of an infant or young child (<5 years of age) due to inflicted blunt impact and/or violent shaking.
 - c. Scalp of an infant or young child (<2 years of age) due to an open or closed head fracture.
 - d. White brain matter of an infant or young child (<4 years of age) due to causes of unknown etiology.

3. What percentage of U.S. children who are admitted to the hospital for pediatric head trauma have suffered abuse?
 - a. 5%
 - b. 15%
 - c. 25%
 - d. 35%

4. Infants are more susceptible to pediatric abusive head trauma because their:
 - a. Brains have a higher water content and less myelination and are easily compressed within the skull during a shaking episode.
 - b. Skulls are thick and rigid, with open fontanels that swell and bleed with excessive shaking.
 - c. Heads are smaller in relation to their body size, and their blood vessels are stiff and dilate when shaking occurs.
 - d. Brains have less water content and contain more brain cells than an adult brain.



- 5.** A clinician who assesses families for risk of pediatric abusive head trauma identifies which situation to have the highest risk?
- A mother states she is going back to work, leaving her 3-month-old infant with a neighbor who provides in-home care for her own 6-month-old infant.
 - A single mother states that her live-in boyfriend, who is currently unemployed, will be caring for her 4-month-old infant while she attends a job-training program.
 - A new mother's appearance, affect, responses, and unprompted statements all strongly suggest that she is experiencing postpartum depression.
 - A husband brings his 1-month-old infant to the family's appointment, stating that his wife is being treated for postpartum anemia.
- 6.** A 6-pound male infant is born at 38 weeks' gestation to a mother who is opioid addicted and married to the baby's father. The infant is most at risk for pediatric abusive head trauma because of his:
- Size.
 - Risk for neonatal abstinence syndrome.
 - Risk for preterm birth complications.
 - Parental marital status.
- 7.** Which information is vital to obtain from the parents when taking the presenting history of a child with a head injury?
- The child's pattern of development and weight
 - The marital status of the parents
 - The date that the child was last examined by the pediatrician
 - The history of the injury and how the child behaved after the injury
- 8.** A 6-week-old infant is admitted to the emergency department with an altered level of consciousness secondary to "rolling off the bed." Initial diagnostic studies for ruling out pediatric abusive head trauma will most likely include a head computed tomography scan (CT), a complete blood count, and:
- A lumbar puncture.
 - An electrolyte panel.
 - A skeletal survey.
 - A lipoprotein panel.



- 9.** A 6-month-old male infant is admitted to the emergency department with a Glasgow Coma Scale of 5 and a history of turning blue while being fed. He is intubated; a computed tomography scan of the head shows subdural bleeding and an ophthalmic examination reveals retinal bleeding. Once the infant is stabilized, which additional diagnostic studies are ordered?
- A lumbar puncture, skull X-ray, and chest X-ray
 - A cerebral spine film and calcium level
 - A skeletal series, magnetic resonance imaging scan of the head, CBC and coagulation panel
 - A vision/hearing exam and electroencephalogram
- 10.** Developmental patterns of accidental injury in the 0- to 3-year-old age range include:
- Fractured long bones and ribs.
 - Head injury from falls down stairs or being dropped.
 - Retinal hemorrhage and bilateral, hypoxic-ischemic brain injury.
 - Bruises that are clustered or patterned.
- 11.** Which nonspecific patient symptoms may indicate possible head trauma in young infants?
- Fever, diarrhea, and poor sleeping
 - Vomiting, lethargy, and apnea
 - Patterned bruising
 - Multiple fractures in different stages of healing
- 12.** To differentiate between underlying conditions and abusive injuries, researchers Hymel and Deyes recommend inquiring about traditional or alternative health practices because:
- Some of these practices may leave marks suggestive of abuse.
 - Families using culturally based health practices may also use more physical discipline.
 - Use of alternative practices is associated with laissez-faire parenting.
 - Caregivers may be hesitant to disclose non-mainstream health practices.
- 13.** Children with traumatic brain injury who show symptoms of decreasing consciousness, respiratory distress, or hemodynamic instability will usually require management with which first-tier medical therapy?
- Defibrillation
 - Decompressive craniectomy
 - Advanced airway management
 - Increased sedation



- 14.** Which is a persisting neurological deficit often seen in children with abusive head trauma?
- Obstructive sleep apnea
 - Vomiting syndrome
 - Conditions of low attention/arousal
 - Blood disorders
- 15.** Which intervention by a healthcare professional is the best example of a **primary** child abuse prevention strategy?
- Offering a parenting course to teen mothers at risk for child abuse
 - Referring parents with “mental health” issues to a community mental health agency
 - Providing all new parents with information on normal newborn crying and steps to take if they become frustrated
 - Referring parents convicted of child abuse to a home-visiting program that teaches parenting skills
- 16.** The Period of PURPLE Crying program’s target population is:
- All families at risk of child abuse and neglect.
 - Parents identified as child abuse perpetrators.
 - All parents of new infants and society in general.
 - Parents with co-occurring risk factors for child maltreatment.
- 17.** Which **secondary** prevention services for pediatric abusive head trauma are most likely to be provided by a home-visiting program?
- Advice on car seat safety
 - Information on where to report child abuse
 - Referral to a local childcare provider
 - Education on child health and development
- 18.** Which action must a healthcare provider take when suspecting a patient is a victim of child abuse or neglect?
- Reporting the case to the appropriate state agency
 - Reporting the case to the local police department
 - Referring the parent to the state mental health agency
 - Educating the parent about normal child health and development

