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TRAUMATIC HEAD INJURY DUE TO CHILD MALTREATMENT

Introduction:

Hi everyone! This podcast will review an approach to traumatic head injury due to child maltreatment also known as Abusive Head Trauma, a diagnosis that often goes missed and is underreported in clinical research. The approach includes understanding the biomechanics, pathophysiology, features on history, physical examination findings, investigations, and approach to management. This podcast was created by Ojas Srivastava, a medical student at the University of Alberta, in collaboration with pediatrician Dr. Mel Lewis and retinal specialist Dr. Matthew Tennant also from the University of Alberta.

Objectives

1. Identify common clinical presentations suspicious for AHT
2. List the investigations for consideration in a child presenting with possible Abusive Head Trauma
3. Discuss the common diagnostic imaging findings in AHT and their relationship to the biomechanics involved in the acceleration deceleration forces involved in AHT
4. Develop an approach to the management of AHT including obligations for reporting
5. Review the prognosis and sequelae of a child following Abusive Head Trauma

Case

Let us start our discussion off with a case that we will reference throughout our podcast.
You are a medical student on your pediatric emergency rotation, and you are asked to assess a 3 month old named Oscar with a chief complaint of lethargy, irritability, and vomiting. His uncle is with him and is concerned because he is not feeding and continues to vomit.

Identification and definition

Before we continue our story with Oscar, the topic of our podcast today is Abusive Head Trauma or AHT. Abusive head trauma is a leading cause of childhood traumatic morbidity and mortality in the United States and Canada, and children under the ages of 3 are at the greatest risk of death. Approximately 80% of these fatalities are due to child maltreatment (1). Previously, this was known as Shaken Baby Syndrome, however the Public Health Agency of Canada in partnership with the Canadian Pediatric Society has updated this condition to Traumatic Head Injury due to Child Maltreatment. This condition is a form of abusive head trauma leading to traumatic brain injury with characteristic injuries that may not be present in every patient which include: intracranial hemorrhage, retinal or vitreous hemorrhage, brain injury, and bone fractures (2). This constellation of findings in AHT can often be non-specific and occult in nature therefore it is crucial to consider child maltreatment in all children with altered levels of consciousness not

due to obvious causes or witnessed accidental trauma. If child maltreatment is not considered in the physician's differential diagnosis, it can very easily be missed.

Pathophysiology

The underlying physiology behind AHT is not clearly understood as events are often unwitnessed and the perpetrator often obscures or omits the actions that led to injury. However, all cases are caused by inflicted trauma often involving vigorous shaking of the infant with or without impact. These rapid and repetitive acceleration-deceleration forces with or without contact to nearby surfaces, cause the tearing of bridging veins leading to acute subdural hematoma, diffuse axonal injury, hypoxia, raised intracranial pressure, and potentially cerebral edema. Specific to the eyes, the increased intracranial pressure and disruption of the vascular system can lead to a lack of peripheral perfusion, manifesting as retinal ischemia, vitreous hemorrhage, and retinal detachment. A common finding in acute abusive head traumas are retinal hemorrhages. Although the pathogenesis of these hemorrhages is multifactorial, there is growing evidence to suggest that vitreoretinal traction during repetitive acceleration-deceleration shearing forces results in retinal hemorrhage and macular retinoschisis (Christian and Levin).

Clinical Presentation

Let's bring it back to our case with Oscar. What types of questions should we ask on history? Are there any overt symptoms that we should raise our suspicion for child maltreatment? It is important to remember that external signs of trauma may not be physically visible on the presenting infant. If physicians are presented with an unclear or unverifiable history that is inconsistent with the constellation of symptoms present, it is important to investigate the child for abusive head trauma. When asking questions to the child's provider, it is important to ask open-ended questions to prevent any unintentional bias.

Common presentations of abusive head trauma will be outlined in two sections:

<u>Neurological</u>

The most common neurological signs as a result of abusive head trauma include: altered state of consciousness, seizures, vomiting, and in the long term, developmental delay as a result of brain injury. These can manifest as symptoms of irritability, poor feeding, and decreased energy (3).

These signs are a result of both primary and secondary neurological damage. Primary neurological injuries commonly seen in abusive head trauma include subdural hemorrhage, subarachnoid hemorrhage, cerebral edema, diffuse axonal injury, and skull fractures (a sign confirming impact). The most common form of intracranial bleed associated with abusive head trauma is subdural hemorrhage. Subdural hemorrhage can occur from repetitive acceleration-deceleration forces to the brain within the cranium which cause tears in the intracranial bridging veins. The same mechanism of injury can lead to diffuse axonal injury which shears the long connecting fibers in the brain. Subarachnoid and intraventricular hemorrhage result from damage to the subarachnoid or pial (peal) vessels and subependymal (SUBEPEN DAMEL) vessels, respectively, however this is more common in neonates with AHT. Skull fractures occur as a result of direct contact trauma which can lead to a CSF leak.

Secondary neurological injuries include raised intracranial pressure, herniation, ischemia, infection, and CSF leak.

Ocular

Now let us move onto the ocular manifestations of abusive head trauma. The number of ocular manifestations of child abuse are numerous, including periorbital hematoma, lid edema, orbital fractures, subconjunctival hemorrhage, hyphema, iris prolapse, corneal lacerations, cataract, retinal or vitreous hemorrhage, retinal detachment, papilledema, and cranial nerve palsies. The most common objective finding in all abusive head trauma patients are retinal hemorrhages, which are seen in 85% of cases (4). Physicians should always suspect non-accidental trauma when finding retinal hemorrhage accompanied by head trauma and an unverified history

Other common findings that can be seen in in conjunction with traumatic head injury due to child maltreatment include rib, skull, or metaphyseal fractures, lethargy, decreased feeding, irritability, vomiting, dyspnea, and apnea (2)

Given the non-specific presentation of head trauma, physicians must always maintain an index of suspicion when seeing pediatric patients with head injuries or acute neurological and ocular signs and symptoms.

Physical Exam and Investigations

Following every good history is a robust general and focused physical exam. While conducting a physical exam for a non-specific diagnosis can be difficult, there are certainly a few signs to be aware of. As with all physical exams, the examination begins with assessing the patient's general appearance and vital signs. When assessing general appearance, look for lack of a social smile, reduced interactions, and inconsolability. Depending on the severity of the injury, vital signs may be unstable. Next, conduct a neurological exam to assess for any signs of acute trauma. This includes completing a pediatric Glasgow Coma Scale (CGS) assessment to evaluate level of consciousness. Subsequently, conduct a cranial nerve assessment, upper and lower limb tone, power, sensation, and reflexes. It is important to involve a pediatric neurosurgeon and/or neurologist if there are any suspicions of neurologic involvement. Complete a full physical exam with special attention to the skin and oral mucous membranes looking for any injuries indicative of abuse or neglect such as burns, bruises, and any injury to the genital area.

It is critical to involve an ophthalmologist for an eye exam in cases suspicious of abusive head trauma. A full view of the retina and observation of any hemorrhages require urgent consultation by an ophthalmologist who is trained to use the indirect ophthalmoscope. An eye exam begins with checking the vital signs of the eye which include visual acuity, pupillary response, and eye pressure. When assessing pupillary response, the ophthalmologist will conduct a swinging light test to look for a relative afferent pupillary defect, which can indicate damage to the optic nerve. Additionally, extraocular movements, confrontational visual fields, and colour vision will all be assessed. However, often not all of these tests are possible in infants, toddlers, or children with decreased LOC. Any restriction or paralysis of extraocular movements can indicate neurological issues or orbital fractures.

Next comes the anterior segment examination, with portable slit lamp when available, with direct or indirect ophthalmoscope otherwise. This begins with application of local anesthesia and

fluorescein drops to assess for corneal abrasions with cobalt blue light which can sometimes be difficult to do in children. Start with completing an external examination of the surrounding structures of the eye. Assess the orbital rim for any tenderness, bruising, or signs of fracture. Examine the lid margins and evert the lids to look for any abnormalities. Next, assess the conjunctiva, sclera, and cornea for any signs of trauma, irritation, or foreign bodies. Subsequently, look at the anterior chamber for signs of intraocular bleeding or damage to the iris and/or lens with cataract formation.

You will then begin the posterior segment exam which is done with an indirect ophthalmoscope to look at the retina and surrounding structures. Ophthalmologists will look for signs of disease that are in the differential diagnosis for retinal hemorrhages which include papilledema, vasculitis, infection, or leukemic infiltrates (5).

Additional investigations after the ophthalmic exam will include CBCd, prothrombin time, partial thromboplastin time, factor VII, factor IX, D-dimer, and fibrinogen to assess for bleeding disorders (1). Next, if child maltreatment is suspected, and the child is under 2 years of age or unable to communicate pain, a skeletal survey is completed to look for occult fractures. If your history and physical exam reveals any neurological deficits, abnormal mental status, or signs of impact (subgaleal swelling) suspicious of head trauma order an urgent head CT or MRI. Imaging will assess for intracranial hemorrhage, cerebral edema, herniation, ischemia, and/or skull fractures.

Now let's talk about Oscar again. As the medical student, you go in first to get the history from Oscar's uncle and discover that Oscar was sitting on a couch in the basement and experienced an unwitnessed fall. You notice that Oscar is lethargic and not interacting with you during your examination.. When you go back into the room with your attending physician, Oscar's uncle forgets that Oscar was in the basement, and says that he was on a couch in the living room. After conducting a physical exam which does not reveal any external signs of trauma, you note that Oscar is very lethargic and refusing to feed. Your differential is quite large at this point including infection and trauma (inflicted vs accidental). You order laboratory tests including CBCD, blood cultures, and urine cultures and arrange an urgent CT. The CT reveals acute subdural hematomas in the locations of the falx cerebri and tentorium cerebelli. You immediately consult the child abuse specialist, neurosurgeon and ophthalmologist for a dilated indirect ophthalmoscope exam. As you are on the phone with the physicians, your nurse tells you that Oscar has started vomiting again.

Management

Let's move onto the management of cases such as this. The initial management of these patients is first to maintain the airway, breathing, and circulation, followed by stabilizing the vitals to ensure there is no secondary injury from hypotension, ischemia, or elevated intracranial pressures. It is imperative to involve consultants early in the workup of a patient with possible traumatic head injury due to child maltreatment. Important consultants to reach out to include a child abuse pediatrician, ophthalmologist, neurosurgeon, neurologist, and child protective services. The specifics of medical management will not be elaborated on in this podcast as it is significantly varied based on the severity of the case. The most important points of management are to ensure the patient is stable and involve a child abuse specialist, ophthalmologist, neurosurgeon and neurologist as soon as possible and recall your obligation to report cases of child maltreatment to the appropriate authority.

Developed by Ojas Srivastava for PedsCases.com.
September 10, 2022.

Prognosis

The prognosis of traumatic brain injury due to child maltreatment is bleak and correlates with the injuries seen on neuroimaging. Studies have shown that infants less than 2.5 years of age who experience traumatic brain injury from maltreatment experience increased cardiorespiratory diseases, more substantial neurological deficits, and worsening cerebral hypoxia and ischemia in comparison to children with accidental head injuries. Children with these injuries due to child maltreatment can experience multiple long-term sequelae, some of which include blindness, developmental delay, seizures, and generalized weakness. Approximately half of children less than four years old who are diagnosed with traumatic brain injury due to child maltreatment will die before the age of 21 (6).

Conclusion

As a quick recap, based on Oscar's presenting complaints, unreliable and unspecific history, and your consultants' assessments, it is deemed that Oscar is suffering from a traumatic head injury due to child maltreatment also known as abusive head trauma. On further examination, retinal hemorrhages were identified by the ophthalmologist in the subretinal, intraretinal, and preretinal layers, and a head CT showed a small subdural hematoma. Additionally, a skeletal survey revealed multiple posterior rib fractures and metaphyseal lesions to the wrists bilaterally. Fortunately, you involved the right teams in Oscar's care as soon as possible and they immediately admitted Oscar. He will be receiving close monitoring in the PICU, followed by admission to the General Pediatrics unit and will be followed by the neurology team, ophthalmology team, rehabilitative specialists, social work, and the child abuse service.

As we can see from this case, consulting your friendly neighborhood ophthalmologist, neurosurgeon and neurologist is a vital component of the diagnostic evaluation of a previously well children under the age of 5 with intracranial injury, unexplained decreased LOC, seizures, vomiting, or systemic disorders with ocular manifestations (5).

Key Points

Let's review the key points from today's episode:

1. Child maltreatment is often a non-specific clinical presentation and therefore it is crucial to consider it on your differential for all children with altered levels of consciousness not due to an obvious etiology
2. There are multiple neurological and ocular manifestations of child maltreatment, however when retinal hemorrhage is present in conjunction with an unexplained or inadequately explained acute head injury, the diagnosis of traumatic head injury due to child maltreatment should be strongly considered.
3. Following a robust neurological and eye examination, brain imaging should be prioritized along with laboratory investigations including CBCd, PT, PTT and coagulopathy/bleeding workup. A skeletal survey and bone scan should be considered to rule out occult fractures.
4. The care of a child with abusive head trauma requires an interprofessional approach including members from the emergency department, social work, ophthalmology, neurosurgery, neurology, PICU, pediatricians, physiatrists and radiologists
5. The outcomes of traumatic head injury due to child maltreatment are severe and can often result in death or long-term disability in survivors.

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September 10, 2022.

References

1. Paul AR, Adamo MA. Non-accidental trauma in pediatric patients: a review of epidemiology, pathophysiology, diagnosis and treatment. Translational Pediatrics. 2014 Jul;3(3):195.

1. Canadian Pediatric Society. Multidisciplinary guidelines on the identification, investigation and management of suspected abusive head trauma.

1. Sieswerda-Hoogendoorn T, Boos S, Spivack B, Bilo RA, van Rijn RR. Educational paper. European journal of pediatrics. 2012 Mar;171(3):415-23.

1. Sturm V, Landau K, Menke MN. Retinal morphologic features in shaken baby syndrome evaluated by optical coherence tomography. American journal of ophthalmology. 2009 Jun 1;147(6):1102.

2. Levin AV, Christian CW, Committee on Child Abuse and Neglect. The eye examination in the evaluation of child abuse. Pediatrics. 2010 Aug 1;126(2):376-80.

1. Joyce T, Huecker MR. Pediatric Abusive Head Trauma.

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