

S16 MEDICAL IMAGING OF PEDIATRIC ABUSIVE HEAD TRAUMA

OBJECTIVES

- Define abusive head traumas and the outcomes in the pediatric population
- Describe the tools for diagnosis associated with pediatric abusive head traumas

THESIS STATEMENT

- Identify abusive head traumas and what imaging modalities are used to help diagnose AHT

DEFINE ABUSIVE HEAD TRAUMAS

- The US Centers for Disease Control and Prevention defines abusive head traumas as “an injury to the skull or intracranial contents of an infant or child younger than 5 years caused by inflicted blunt impact, violent shaking, or both.” (Biwas et al., 2023)
- AHT (abusive head trauma) is one of the most common causes of brain injuries in pediatrics and is a leading cause of death (Dekun et al., 2023)
- AHT is diagnosed at a rate of 14-40 per 100,000 children under the age of 1 (Cartocci et al., 2021)
- Fatality rates are more than 20% (Wright, 2019)

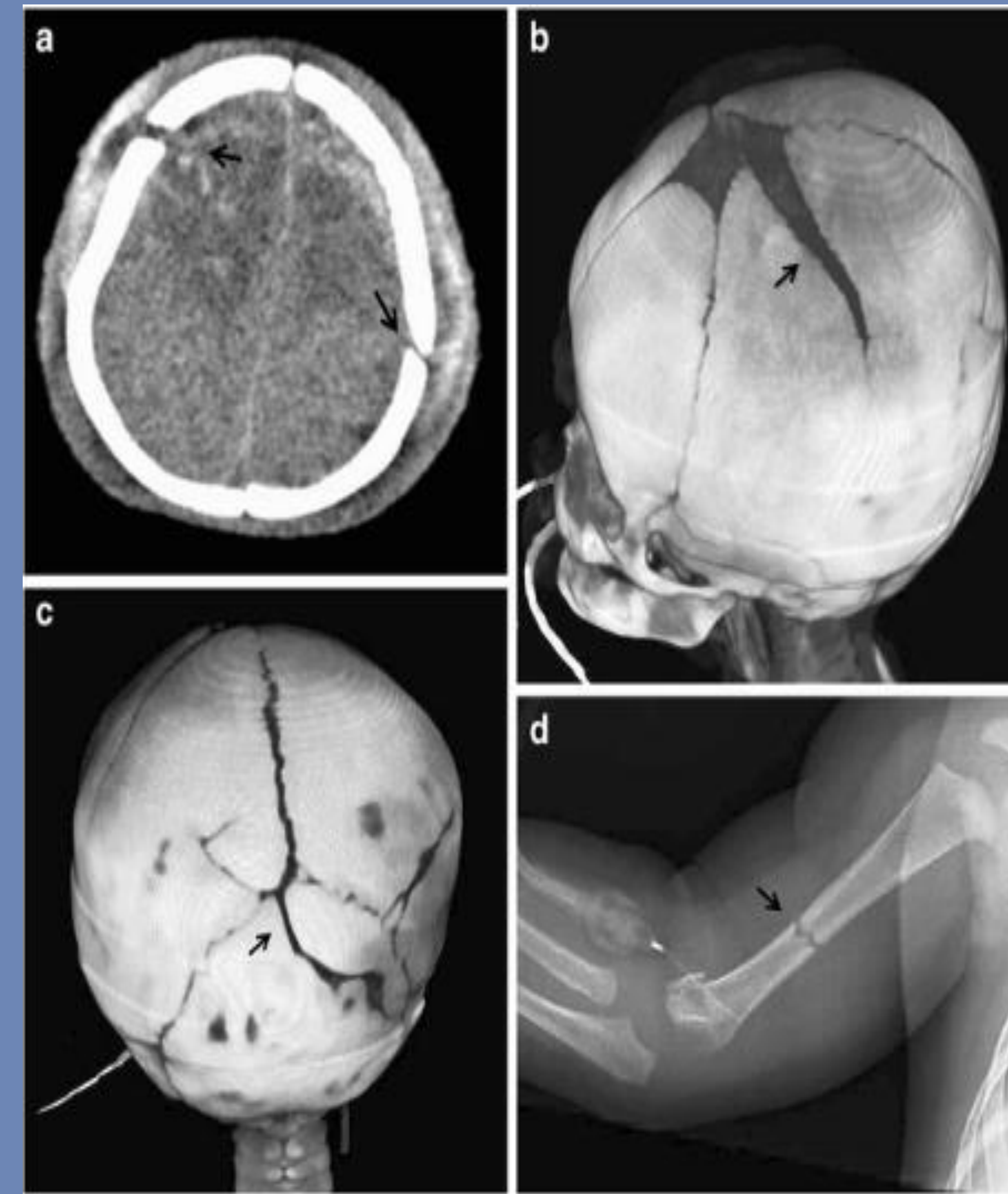
COMMON INJURIES & SYMPTOMS

COMMON INJURIES

- Parenchymal injury is the leading cause of death (Cartocci et al., 2021)
- Hemorrhages (Cartocci et al., 2021)
- Subdural hematomas (Dekun et al., 2023)
- Subarachnoid hematomas (Dekun et al., 2023)
- Ischemic damage (Cartocci et al., 2021)
- Skull fractures (Cartocci et al., 2021)
- Ligamentous injuries (Karmazyn et al., 2022)

COMMON SYMPTOMS

- Developmental delays
 - Respiratory compromise and apnea
 - Altered mental status
 - Seizures
 - Unexplained bruising and fractures
 - Inconsolable crying
 - Vomiting and/or poor feeding
 - Falls
- (Choudhary et al., 2018)



Vazquez, E. (2021). Fig. 5 [Photograph]. Springer Nature Link.
<https://link.springer.com/article/10.1007/s00247-014-3216-5>

The images in Figure 5 were performed on a three-month-old boy that was suspected of suffering from abusive head trauma. The images demonstrate parenchymal injury and skull fractures. An axial CT demonstrates contusions in both cerebral hemispheres, soft-tissue injuries, and skull fractures. 3-D CT images demonstrate skull fractures. A skeletal survey was also performed and demonstrated a right humerus fracture.

HOW IS MRI USED TO DIAGNOSE AHT?

ADVANTAGES:

- MRI is radiation free to ensure ALARA (Cartocci et al., 2021)
- MRI is better than CT for detecting parenchyma, hemorrhages, brainstem and cerebellar injuries (Cartocci et al., 2021)
- Whole-spine MRI is used for ligament injury (Orman et al., 2022)
 - A study showed that 53.4% of patients who underwent whole-spine MRI were more likely to be diagnosed with AHT (Karmazyn et al., 2022)
 - Unsuspected spinal injury is found in 75% of children with AHT (Wright, 2019)

DISADVANTAGES:

- More difficult to obtain imaging due to length of exam with possible sedation/general anesthesia (Vazquez et al., 2021)
- Only for stable patients (Vazquez et al., 2021)

HOW IS CT USED TO DIAGNOSE AHT?

ADVANTAGES:

- CT is needed to diagnose complex fractures along with ischemic injury, cerebral edema, and appearance of blood (Cartocci et al., 2021)
 - The likelihood of a skull fracture in children diagnosed with AHT is 30% (Vazquez et al., 2021)
- CT can be performed quickly on ill children without having to go under general anesthesia/sedation (Vazquez et al., 2021)
- Intracranial injury is commonly found when receiving an initial CT (Wright, 2019)

DISADVANTAGES:

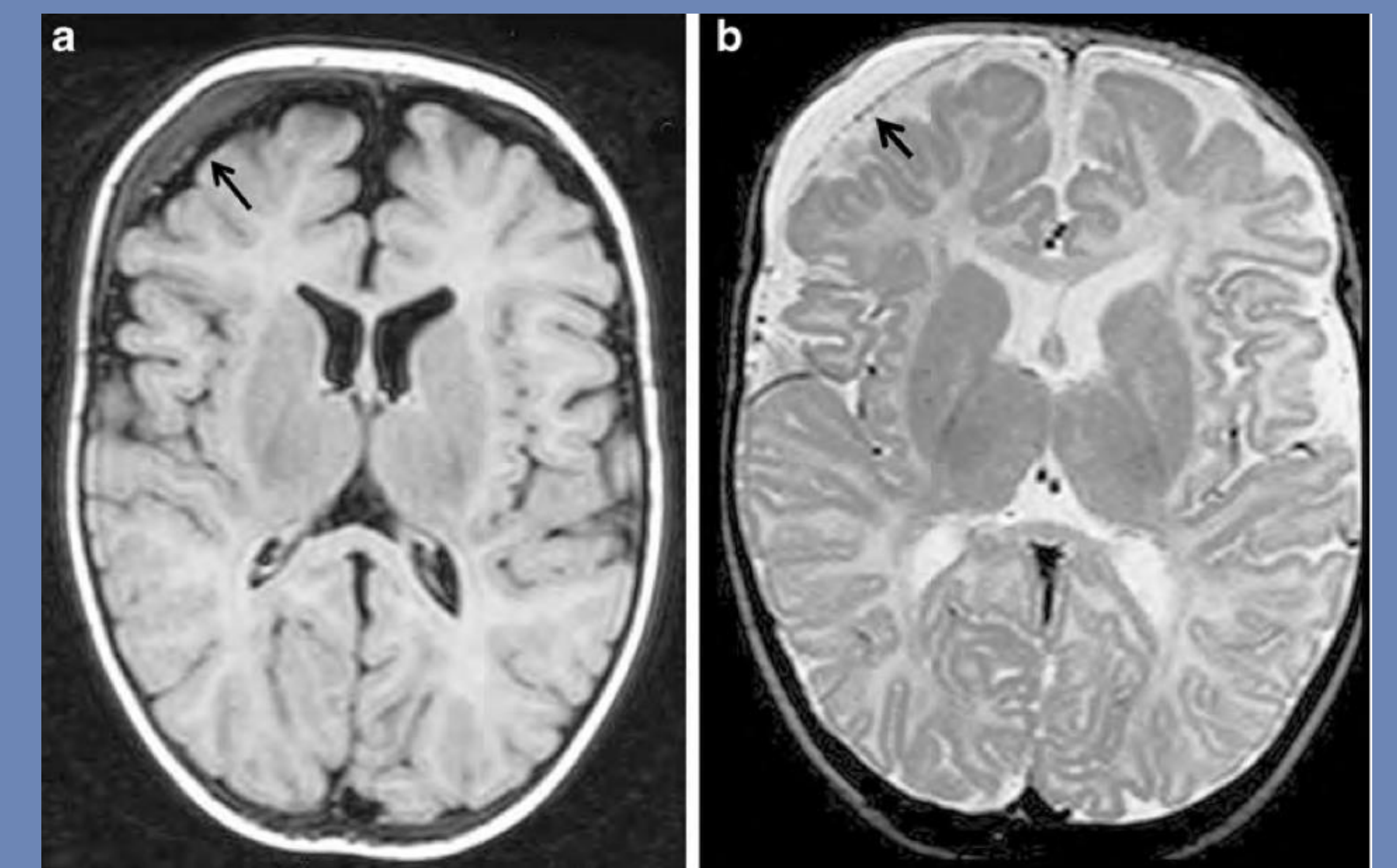
- Radiation exposure
- Lack of definition on imaging, which limits ability to diagnose hemorrhages and ischemic damage
 - MRI is needed for further diagnosis (Vazquez et al., 2021)

IMPORTANCE OF USING CT & MRI FOR THE DIAGNOSIS OF AHT

- Head CT with brain/spine MRI imaging is necessary to investigate CNS involvement in infants (Cartocci et al., 2021)
 - 95% of CNS injuries in children 1 year or younger are due to AHT (Vazquez et al., 2021)
- CT and MRI should be used together to collect the age of an injury (Vazquez et al., 2021)
- When MRI is accompanied with CT imaging, new diagnoses are found in 25% of cases (Vazquez et al., 2021)

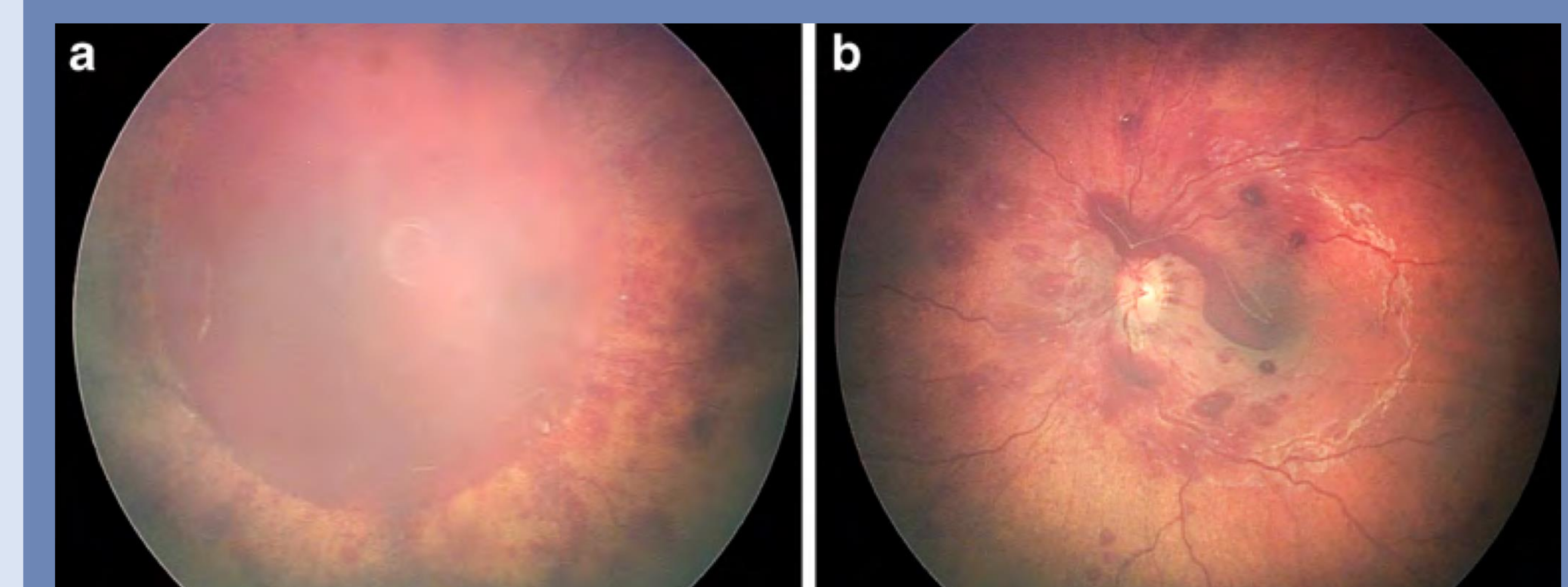
CONCLUSION

- Utilizing different modalities is optimal for diagnosing abusive head traumas
- MRI and CT scans complement each other by highlighting different body components. As a result, radiologists can accurately diagnose patients by viewing the complete picture



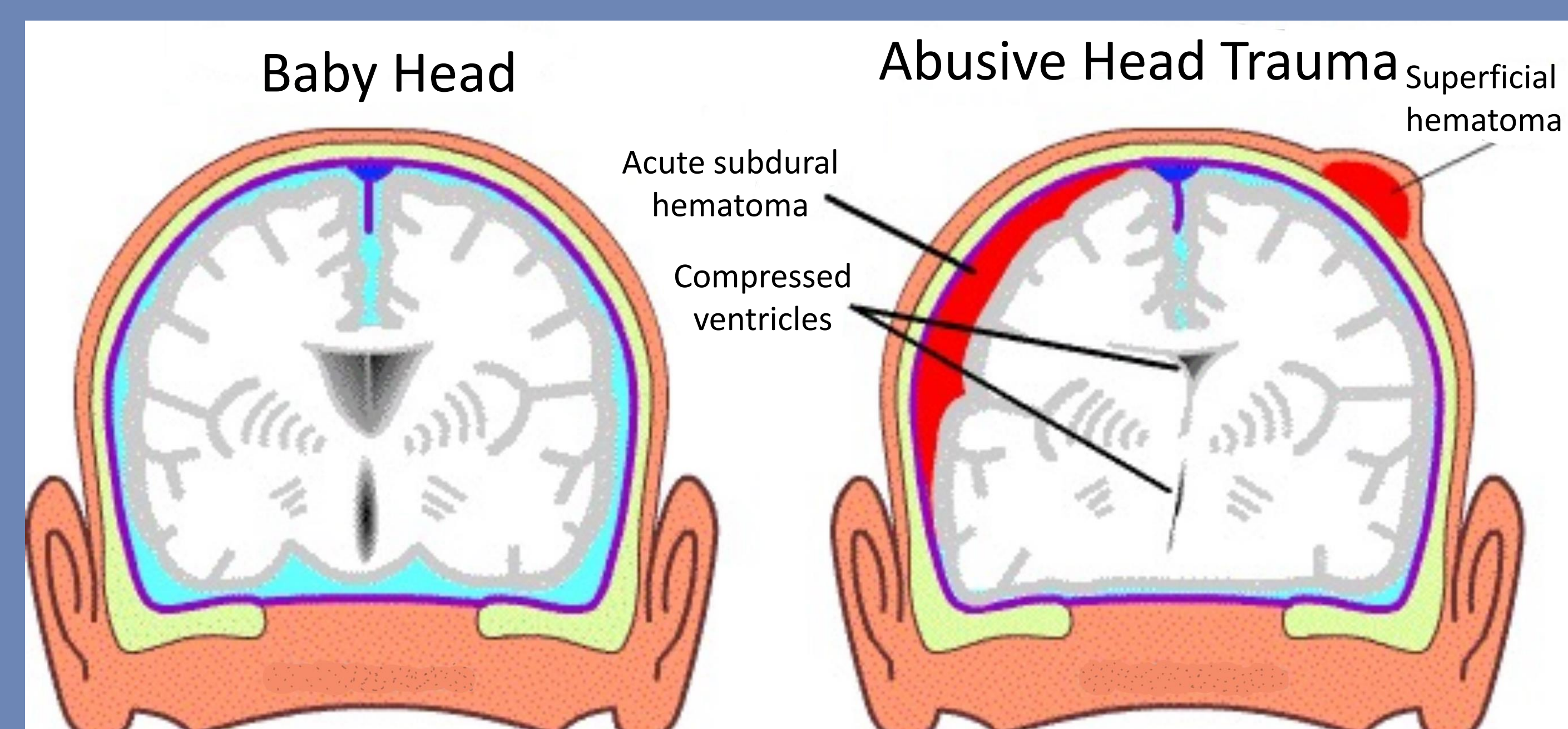
Vazquez, E. (2021). Fig. 8 [Photograph]. Springer Nature Link.
<https://link.springer.com/article/10.1007/s00247-014-3216-5>

Figure 8 demonstrates BESS, also known as benign enlargement of the subarachnoid space. These images were obtained through an MRI through Axial FLAIR and T2-W to show the subarachnoid space and a small subdural component shown by the arrow. (Vazquez et al., 2021)



Vazquez, E. (2021). Fig. 3 [Photograph]. Springer Nature Link.
<https://link.springer.com/article/10.1007/s00247-014-3216-5>

Retinal hemorrhages are common in children with abusive head trauma, (present at ophthalmoscopy in approximately 80–92% of cases) retinal hemorrhages can also be seen on MR scans, and can be a major indicator of non-accidental traumas. Although these hemorrhages can occur in children with non-abusive TBI's, they are seen in less than 10% of cases. (Vazquez et al., 2021)



Ornstein, A. (2024). [photograph]. Ann & Robert H. Lurie Children's Hospital of Chicago.

https://www.luriechildrens.org/contentassets/55e11b6030114beebfea2e537f2f0811/lurie_2024_ornstein_for_posting.pdf

The image above demonstrates what happens when a child experiences an abusive head trauma. Commonly due to blunt force trauma or being shaken.