

Non-Accidental Head Injury (NAHI): A Neurosurgical Perspective

Diagnosis and Management in Children Under 2 Years

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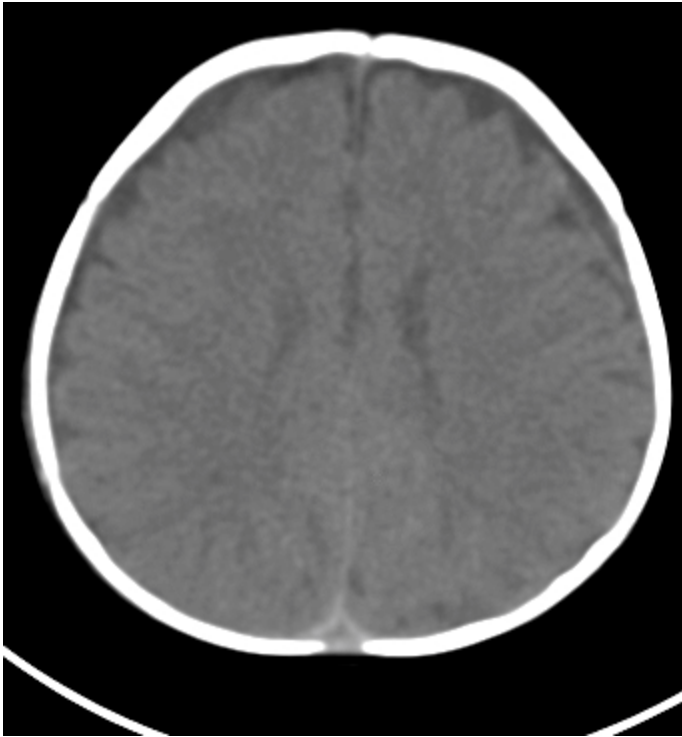
Definition & Epidemiology

- **Definition:** NAHI refers to intracranial injuries caused by abuse or inflicted trauma, including Shaken Baby Syndrome (SBS) and direct impact.
- **High-Risk Age:** Under 2 years (especially <6 months)
- **Incidence:**
 - USA: A CDC study (2000–2009) reported AHT incidence of **39.8/100,000** in infants <1 year and **6.8/100,000** in 1-year-olds.¹
 - Taiwan (Jan–Jun 2024): **257** reported abuse cases in children aged 0–2 (138 boys, 119 girls); **16** fatal cases, including **7** from severe abuse.²

Clinical Presentation & Imaging

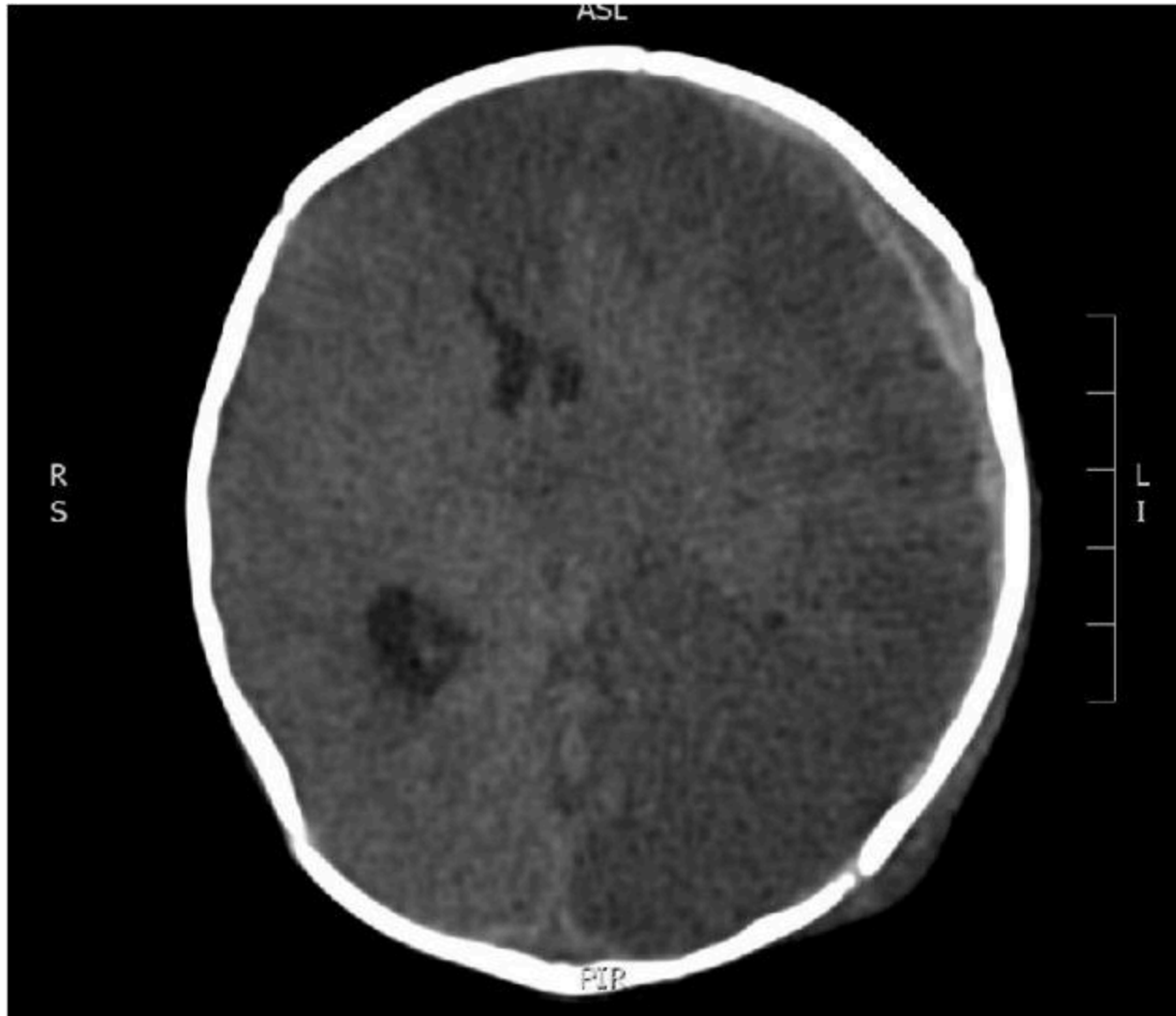
- **Nonspecific Symptoms:** Lethargy, seizures, irritability, respiratory instability
- **Imaging Modalities:**
 - **CT:** First-line for acute phase to assess bleeding and mass effect
 - **MRI:** Recommended in suspected abuse (e.g., old injuries, axonal injury), even with normal CT, especially in infants <1 year old ³
- **Common Imaging Findings:**
 - SDH (Subdural Hematoma)
 - SAH, cerebral edema, retinal hemorrhage (often co-evaluated by ophthalmology)

Imaging Example – SDH (CT)



Bilateral SDH in an infant – [Radiopaedia](#)

Imaging Example – Cerebral Edema (CT)



Diffuse cerebral edema – [Radiopaedia](#)

Summary of International Guidelines

- 2019 – Brain Trauma Foundation:⁴
 - Recommends ICP monitoring in pediatric TBI with GCS ≤ 8 (Level III evidence)
 - Maintain ICP ≤ 20 mmHg. Sustained ICP > 40 mmHg linked to poor prognosis
- 2020 – AAP:⁵
 - Advocates for multidisciplinary evaluation in suspected abuse cases
- 2023 – NICE NG232:
 - MRI recommended for infants < 1 year with any safeguarding concerns, **even if CT is normal**

Multidisciplinary Team: Neurosurgery, Pediatrics, Ophthalmology, Social Work, Forensic Medicine

Surgical Indications & Management Principles

- **Surgical Indications:**
 - SDH with mass effect / midline shift >5mm
 - ICP >20 mmHg unresponsive to medical therapy
 - Neurological deterioration / declining GCS
- **Common Procedures:**
 - Fontanelle tapping / Burr hole drainage (common in infants)
 - Mini-craniotomy / Decompressive craniectomy
- **Additional Measures:** ICP monitoring, osmotic therapy (mannitol, 3% saline), head elevation

Overview of ICP Monitoring

- **Guideline-Based Recommendations:**
 - ICP monitor in children with $GCS \leq 8$ and abnormal imaging (Level III) ⁴
- **Common Techniques:**
 - **EVD:** Allows CSF drainage and monitoring; effective but technically demanding
 - **Parenchymal probe (e.g., Codman):** Easier to place, lower infection risk
 - **Subdural drainage:** Common in infants
- **Placement Considerations:**
 - Site determined by pathology; typically via frontal burr hole
 - **Infant Considerations:** Thin skull and small ventricles make EVD/parenchymal probes challenging. **Subdural drains** often serve as practical ICP monitors.

ICP Management – First-Tier Therapies⁶

- **ICP Threshold:** Maintain ICP <20 mmHg. Treat if >20 mmHg for **over 5 minutes**.
- **Tier-1 Management:**
 - ABC stabilization
 - Head elevation to 30° with midline position
 - Adequate sedation and analgesia
 - CSF drainage via EVD
 - Hyperosmolar therapy: 3% saline or *mannitol* (based on labs/hemodynamics)
- **Monitoring:**
 - ICP, CPP, serum sodium/osmolarity, MAP, renal function
 - Consider multimodal monitoring (PbrO₂, EEG, PRx)

ICP Management – Second-Tier Therapies⁶

- **Indication:** ICP remains >20 mmHg despite tier-1 treatment
- **Tier-2 Options:**
 - **Neuromuscular blockade:** To eliminate posturing or ventilator dyssynchrony
 - **Mild hyperventilation:** Target PaCO₂ 30–35 mmHg temporarily
 - **Barbiturate coma:** Consider pentobarbital infusion if refractory ICP; monitor for hypotension
 - **Decompressive craniectomy:** Consider in select cases with refractory ICP, impending herniation
- **Goals:** Reduce ICP, maintain CPP, avoid secondary injury

Case Discussion – Young child with SDH & IICP

- **Case Summary:** No trauma history. Presented with cardiac arrest. Brain CT: bilateral SDH with diffuse brain swelling.
- **Management Plan:**
 - *Emergency burr hole*
 - ICP monitoring and continuous evaluation
 - ICP goal: <20 mmHg, repeat imaging
- **Team Activation:** Social work, ophthalmology, pediatric evaluation

Summary & Recommendations

- NAHI diagnosis requires high clinical suspicion and multidisciplinary collaboration
- **Role of Neurosurgeons:**
 - Imaging interpretation and ICP management
 - Determining surgical indication and monitoring
- Promote interhospital collaborative mechanisms to improve detection and timely intervention

Thanks for Listening!

References:

1. Niederkrotenthaler, Thomas et al. "Descriptive factors of abusive head trauma in young children--United States, 2000-2009." *Child abuse & neglect* vol. 37,7 (2013): 446-55. [doi:10.1016/j.chiabu.2013.02.002](https://doi.org/10.1016/j.chiabu.2013.02.002)
2. [Taiwan Ministry of Health and Welfare – 2024 Statistics](#)
3. [NICE Guideline NG232 \(2023\) – Head Injury: Assessment and Early Management](#)
4. Kochanek, Patrick M et al. "Guidelines for the Management of Pediatric Severe Traumatic Brain Injury, Third Edition: Update of the Brain Trauma Foundation Guidelines." *Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies* vol. 20,3S Suppl 1 (2019): S1-S82. [doi:10.1097/PCC.0000000000001735](https://doi.org/10.1097/PCC.0000000000001735)
5. Narang, Sandeep K et al. "Abusive Head Trauma in Infants and Children." *Pediatrics* vol. 145,4 (2020): e20200203. [doi:10.1542/peds.2020-0203](https://doi.org/10.1542/peds.2020-0203)
6. Kochanek PM et al. *Pediatric Critical Care Medicine* 2019;20(3):269–279