

# Newborn Critical Care Center (NCCC) Clinical Guidelines

## Post-Hemorrhagic Hydrocephalus Guidelines for Management

### BACKGROUND

Post-hemorrhagic hydrocephalus (PHH) resulting in increased intracranial pressure (ICP) can be a complication of any grade intraventricular hemorrhage but is more common with grade III and/or IV intraventricular hemorrhage. The signs and symptoms of increased ICP are bulleted below. Follow head circumferences and palpate the anterior fontanelle daily after a  $\geq$  Grade II hemorrhage is identified on head ultrasound to aid in detecting worsening hydrocephalus. Weekly head ultrasounds initially may be beneficial in detecting changes within the ventricles that have not yet manifested as rapidly increasing head circumference. If there are no changes or stable hydrocephalus, obtaining head ultrasounds every 2 weeks or perhaps monthly may be indicated.

It is important to note that the subarachnoid space communicates with the ventricular system.

Another cause of PHH can be hemorrhage into the subarachnoid space by ruptured aneurysms, arteriovenous malformations, trauma, or systemic bleeding disorders.

Ventricular access devices (VADs) and subgaleal shunts (SGS) are used as temporary neurosurgical interventions whereas ventriculoperitoneal shunts (VP) are performed for infants with progressive hydrocephalus.

Some of the benefits of SGS over VADs are the decrease in need of daily taping, maintenance of a closed system in which no fluids and electrolytes are lost, and a potential earlier discharge. Complications are CSF leakage from the incision site, meningitis, malfunction, migration of the catheter from the ventricle or slippage into the ventricle, and intraparenchymal hemorrhage.

VP shunts should be performed late on premature infants as clearance of ventricle from blood products takes at least 5 weeks. Higher rates of infection and obstruction rates with earlier placements. It is not used as a first intervention for several reasons: the risk of skin ulceration in VLBW infants, the high incidence of shunt obstruction, malfunction, and frequent need of revision.

There are no standardized criteria to define when to convert to a permanent shunt.

***Consult Neurosurgery for all patients with PHH and evidence of increased ICP (pager 123-2642)***

### SIGNS AND SYMPTOMS OF INCREASED ICP

- Rapidly enlarging head circumference ( $> 1.5$  cm in  $< 7$  days)
- Increased splaying of the cranial sutures
- Progressively full and/or tense fontanelle
- Worsening of apnea and/or bradycardia episodes
- Lethargy
- Feeding intolerance
- Progressive ventricular dilatation or thinning of cortical mantle on serial HUS

## CSF DRAINAGE FROM VENTRICULAR TAP OR VENTRICULAR RESEVOIR

- ***Intermittent withdrawal of CSF from ventricular taps or ventricular reservoirs should be performed by Pediatric Neurosurgery or by direction of Pediatric Neurosurgery.***
- Recommended drainage volume is 10-15 mLs/kg.
  - Guided by discretion of the neurosurgeon and clinical status of the infant.
  - If > 10 mLs/kg is removed, consider IV replacement fluid (typically normal saline 1:1, determined by primary team) and monitoring serum sodium concentrations.
  - Monitor post-withdrawal of CSF for hypotension, hypovolemia, and tolerance of procedure.
- Notify Neurosurgery if symptoms of increased ICP do not improve after CSF withdrawal
- Use symptoms of increased ICP, opening pressure, closing pressure, changes in head ultrasounds and Pediatric Neurosurgery consult to determine frequency of CSF withdrawal until PHH stabilizes and/or the need for a permanent shunt is determined

### References:

1. De Vries, L., Annemieke, B., & Groenendaal, F. (2012). Posthaemorrhagic ventricular dilatation when should we intervene? *Archive of disease in childhood fetal neonatal edition*. doi:10.1136/archdischild-2012-303158.
2. Kormanik, K., Praca, J., Garton, HJL., & Sarkar, S. Repeated tapping of ventricular reservoir in preterm infants with post-hemorrhagic ventricular dilatation does not increase risk the risk of reservoir infection. *Journal of Perinatology*, 2010, 30: 218-221.
3. Robinson, S. Neonatal post hemorrhagic hydrocephalus from prematurity: pathophysiology and currently treatment concepts. *Journal of Neurosurgery Pediatrics*, 2012, 9: 242-258.
4. Shooman, D., Pertess, H., & Sparrow O. (2009). A review of the current treatment methods for posthaemorrhagic hydrocephalus of infants. *Cerebrospinal Fluid Research*. doi: 10.1186/1743-8454-6-1.
5. Kadri H, Mawla AA, Kazah J. The incidence, timing, and predisposing factors of germinal matrix and intraventricular hemorrhage (GMH/IVH) in preterm neonates. *Childs Nerv Syst*. 2006;22:1086–1090. doi: 10.1007/s00381-006-0050-6.
6. Köksal V, Öktem S. Ventriculosubgaleal shunt procedure and its long-term outcomes in premature infants with post-hemorrhagic hydrocephalus. *Childs Nerv Syst*. 2010 Nov;26(11):1505-15. doi: 10.1007/s00381-010-1118-x. Epub 2010 Mar 19. PMID: 20300758; PMCID: PMC2974185.
7. Intraventricular hemorrhage and posthemorrhagic hydrocephalus in preterm infants: diagnosis, classification, and treatment options Paola Valdez Sandoval<sup>1</sup> & Paola Hernández Rosales<sup>1</sup> & Deyanira Gabriela Quiñones Hernández<sup>1</sup> & Eva Alejandra Chavana Naranjo<sup>2</sup> & Víctor García Navarro<sup>1,3</sup>