Posthemorrhagic hydrocephalus

- Establishment and evaluation of a novel rat model of the fourth ventricle hemorrhage
- Evaluation of the Endoscopic Third Ventriculostomy Success Score for pediatric hydrocephalus: experience from a Singapore children's hospital
- Neuroinflammation in an optimized model of lysophosphatidic acid (LPA)-induced post-hemorrhagic hydrocephalus
- Cerebrospinal fluid analysis and changes over time in patients with subarachnoid hemorrhage: a prospective observational study
- Spinal Ultrasound Assessment of Correlation Between Intraventricular Hemorrhage Severity and Cerebrospinal Fluid Volume in Preterm Infants
- Delayed-Interval Delivery in Multifetal In Vitro Fertilization (IVF) Pregnancies: Two Case Reports
- Preterm Hemorrhagic Brain Injury: Recent Advances on Evaluation and Management
- Inhibition of histone deacetylase 6 activity mitigates neurological impairment and post-hemorrhagic hydrocephalus after intraventricular hemorrhage by modulating pyroptosis and autophagy pathways

Risk factors

Posthemorrhagic hydrocephalus (PHH) often develops following hemorrhagic events such as intraventricular hemorrhage (IVH) and subarachnoid hemorrhage (SAH).

Cerebrospinal fluid total protein (CSF-TP) × time ≥ 9,600 and GCS score <8 were independent risk factors for PHH. CSF-TP was higher in the PHH group than in the NPHH group [1)]

Classification

Hydrocephalus after subarachnoid hemorrhage.

Hydrocephalus after intraventricular hemorrhage.

Posthemorrhagic hydrocephalus of prematurity.

Pathogenesis

Lolansen et al. aimed to elucidate the molecular coupling between a hemorrhagic event and the subsequent PHH development, and reveal the inflammatory profile of the PHH pathogenesis.

CSF obtained from patients with SAH was analyzed for inflammatory markers using the proximity extension assay (PEA) technique. We employed an in vivo rat model of IVH to determine ventricular size, brain water content, intracranial pressure, and CSF secretion rate, as well as for transcriptomic analysis. Ex vivo radio-isotope assays of choroid plexus transport were employed to determine the

direct effect of choroidal exposure to blood and inflammatory markers, both with acutely isolated choroid plexus and after prolonged exposure obtained with viable choroid plexus kept in tissue culture conditions.

The rat model of IVH demonstrated posthemorrhagic hydrocephalus and associated CSF hypersecretion. The Na+/K+-ATPase activity was enhanced in choroid plexus isolated from IVH rats, but not directly stimulated by blood components. Inflammatory markers that were elevated in SAH patient CSF acted on immune receptors upregulated in IVH rat choroid plexus and caused Na+/K+/2Cl- cotransporter 1 (NKCC1) hyperactivity in ex vivo experimental conditions.

Cerebrospinal fluid hypersecretion may contribute to PHH development, likely due to hyperactivity of choroid plexus transporters. The hemorrhage-induced inflammation detected in CSF and in the choroid plexus tissue may represent the underlying pathology. Therapeutic targeting of such pathways may be employed in future treatment strategies towards PHH patients [2)].

Treatment

Posthemorrhagic hydrocephalus treatment.

Complications

Complications associated with posthemorrhagic hydrocephalus can vary and may include:

Hydrocephalus-related complications: The primary complication of PHH is the accumulation of cerebrospinal fluid (CSF) in the brain, leading to increased intracranial pressure. This can result in a variety of issues, including:

Cognitive and developmental delays: Increased pressure on the brain can affect normal brain development, leading to delays in motor skills, cognitive function, and other developmental milestones. Seizures: Some infants with PHH may experience seizures as a result of increased intracranial pressure.

Vision problems: Pressure on the optic nerve can lead to vision impairments.

Shunt-related complications: In many cases, the treatment for posthemorrhagic hydrocephalus involves the placement of a ventriculoperitoneal (VP) shunt to drain excess CSF from the brain. Complications associated with shunting may include:

Infection: Shunt infections can occur, requiring prompt medical attention.

Malfunction: Shunts can become blocked or malfunction, leading to a recurrence of hydrocephalus symptoms.

Overdrainage or underdrainage: Improper drainage of CSF can result in complications, such as low-pressure headaches or persistent hydrocephalus.

Neurological issues: The bleeding and increased intracranial pressure associated with PHH can cause additional neurological problems, including:

Brain damage: The initial bleeding and pressure on the brain tissue may lead to permanent damage.

Motor impairments: Depending on the extent and location of brain damage, motor skills may be affected, leading to issues with coordination and movement.

1)
Wang Z, Chen Y, Zhou X, Wang C, Chen X, Min F, Liu R, Xiang H. Risk Factor of Posthemorrhagic Hydrocephalus: Cerebrospinal Fluid Total Protein. Front Surg. 2022 Feb 17;9:692383. doi: 10.3389/fsurg.2022.692383. PMID: 35252319; PMCID: PMC8891476.
2)
Lolansen SD, Rostgaard N, Barbuskaite D, Capion T, Olsen MH, Norager NH, Vilhardt F, Andreassen SN, Toft-Bertelsen TL, Ye F, Juhler M, Keep RF, MacAulay N. Posthemorrhagic hydrocephalus associates with elevated inflammation and CSF hypersecretion via activation of choroidal transporters. Fluids Barriers CNS. 2022 Aug 10;19(1):62. doi: 10.1186/s12987-022-00360-w. PMID: 35948938.