Dehydration on Prognosis in Aneurysmal Subarachnoid Hemorrhage

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Dehydration is a negative prognostic factor in aSAH. It increases the risk of vasospasm and ischemic complications, leading to worse outcomes. Management strategies should focus on maintaining **strict euvolemia**, monitoring fluid and electrolyte status carefully.

1. **Risk of Cerebral Vasospasm**

    1. Dehydration can lead to **hypovolemia**, reducing cerebral perfusion.
    1. It’s associated with **delayed cerebral ischemia (DCI)**, a major complication post-aSAH.
    1. Studies show that **low intravascular volume** correlates with higher risk of vasospasm and poorer neurological outcomes.

2. **Electrolyte Imbalances**

    1. Dehydration contributes to **hyponatremia** (often via SIADH or cerebral salt wasting), exacerbating neurological deficits.

3. **Hemoconcentration**

    1. Leads to **increased blood viscosity**, which may impair microcirculatory flow.

Management Guidelines

1. **Avoid both Hypovolemia and Hypervolemia**

    1. Modern guidelines emphasize maintaining **euvolemia**.
    1. Former strategies like “triple H therapy” (hypervolemia, hypertension, hemodilution) are no longer standard due to evidence of harm.

2. **Use of Advanced Monitoring**

    1. Devices like PiCCO or CVP catheters are sometimes used to guide fluid therapy.

    1. **Daily weights, fluid balance, serum sodium** are key indicators.

3. **Isotonic fluids (e.g., Normal saline)** are generally preferred.

    1. **Avoid hypotonic solutions**, which may worsen cerebral edema.

Prospective observational cohort studies

Zhang et al. investigated the association between the Urea/Creatinine Ratio trajectory and delayed cerebral ischemia (DCI) as well as functional aneurysmal subarachnoid hemorrhage prognosis. Additionally, they explored the role of DCI as a mediator and its interaction with dehydration.

Consecutive aSAH patients were reviewed. A latent class growth mixture model (LCGMM) was applied to classify the dehydration trajectory over 7 days. Multivariate logistic regression was conducted to examine associations between dehydration trajectories, DCI, and poor outcome. Furthermore, causal mediation analysis combined with a four-way decomposition approach was employed to quantify the extent to which DCI mediates or interacts with dehydration in influencing poor outcomes.

A total of 519 aSAH patients were included. By applying the LCGMM method, we categorized participants into three dehydration trajectory groups: low group (n=353), decreasing group (n=97), and high group (n=69). Multivariate analysis demonstrated that dehydration trajectory was independently associated with both DCI and poor outcome. The effect of dehydration trajectory on poor outcome was partially mediated by DCI, involving both pure mediation and mediated interaction. Specifically, the excess relative risk of DCI was decomposed into four components: controlled direct effect (66.42%), mediation only (16.35%), interaction only (6.09%), and mediated interaction (11.16%).

Among aSAH patients, dehydration trajectory was significantly associated with poor functional outcome, with DCI serving as a partial mediator through both direct and interaction effects [1)]

Zhang et al. provide compelling evidence that dehydration trajectory over time is a key determinant of outcomes in aSAH, with delayed cerebral ischemia playing a partial mediating role. Their application of advanced statistical techniques adds credibility and depth to the findings. However, limitations related to the surrogate marker for hydration, retrospective design, and need for external validation should temper overinterpretation. Nonetheless, this work lays a strong foundation for further prospective, mechanistic, and interventional research.

Hyponatremia and dehydration due to natriuresis after subarachnoid hemorrhage are related to symptomatic vasospasm. Therefore, most institutions are currently targeting euvolemia and eunatremia in subarachnoid hemorrhage patients to avoid complications [2)].

1)

Zhang P, Tu Q, Tong M, Shi K, Yang T, Wang J, Zhang W, Pang Q, Li Z, Xu Z. Association between dehydration trajectory, delayed cerebral ischemia, and functional outcome in patients with aneurysmal subarachnoid hemorrhage: assessment of interaction and mediation. J Neurointerv Surg. 2025 Mar 20:jnis-2024-022953. doi: 10.1136/jnis-2024-022953. Epub ahead of print. PMID: 40113247.
2)

Uozumi Y, Mizobe T, Miyamoto H, Ashida N, Katsube T, Tatsumi S, Nakamura M, Kohmura E. Decreased serum sodium levels predict symptomatic vasospasm in patients with subarachnoid hemorrhage. J Clin Neurosci. 2017 Dec;46:118-123. doi: 10.1016/j.jocn.2017.08.037. Epub 2017 Sep 5. PubMed PMID: 28887070.