Guidelines for the acute treatment of cerebral edema in neurocritical care patients.

Guideline ID: 1867 Published: 2020 Jun

Neurocritical Care Society (NCS)

Cook AM, Jones GM, Hawryluk GWJ, et al. Guidelines for the acute treatment of cerebral edema in neurocritical care patients. Neurocrit Care. 2020 Jun;32(3):647-666. [186 references] PubMed

View Original Guideline

Overview

Guideline Objective

To evaluate the role of hyperosmolar agents (mannitol, hypertonic sodium soluation [HTS]), corticosteroids, and selected non-pharmacologic therapies in the acute treatment of cerebral edema

Patient Population

Patients with cerebral edema

Recommendations

Recommendation Statements

Treatment of Cerebral Edema in Patients with Subarachnoid Hemorrhage (SAH)

In patients with SAH, does sodium target-based dosing with hypertonic sodium solutions (HTSs; sodium chloride, lactate, or bicarbonate) improve intracranial pressure (ICP)/cerebral edema compared to intermittent, symptom-based bolus doses of HTSs?

In patients with SAH, does sodium target-based dosing with HTSs (sodium chloride, lactate, or bicarbonate) improve neurological outcomes at discharge compared to intermittent, symptom-based bolus doses of HTSs?

1. We suggest using symptom-based bolus dosing of HTSs rather than sodium target-based dosing for the management of ICP or cerebral edema in patients with SAH. (**Conditional recommendation; Very low quality evidence**)

   Rationale: In making this recommendation, the panel felt that while the quality of evidence was very low, the consistency of the literature justified symptom-based bolus dosing of HTS as an effective means of reducing ICP and cerebral edema in patients with SAH. The data on sodium target-based HTS dosing regimens for ICP control were extremely limited and provided only indirect evidence and thus could not be recommended.

2. Due to insufficient evidence, we cannot recommend a specific dosing strategy for HTS to improve neurological outcomes in patients with SAH.

Treatment of Cerebral Edema in Patients with Traumatic Brain Injury (TBI)

In patients with TBI, does the use of HTSs improve cerebral edema compared to mannitol?

In patients with TBI, does the use of HTSs for cerebral edema improve neurological outcomes compared to mannitol?

1. We suggest using HTSs over mannitol for the initial management of elevated ICP or cerebral edema in patients with TBI (**Conditional recommendation; Low quality evidence**). We suggest that neither HTS nor mannitol be used with the expectation for improving neurological outcomes in patients with TBI. (**Conditional recommendation; Low quality evidence**)

   Rationale: In making this recommendation, the panel felt that while the quality of evidence was low, the consistency of the literature suggested HTS was at least as safe and effective as mannitol. In addition, the panel agreed that the putative advantages of HTS over mannitol for fluid resuscitation and cerebral perfusion justified the suggestion to use HTS over mannitol. Although treatment effect of these agents on elevated ICP or cerebral edema may be expected based on the literature, neither agent has been demonstrated to improve neurological outcomes.

2. We suggest that the use of mannitol is an effective alternative in patients with TBI unable to receive HTSs. (**Conditional recommendation; Low quality evidence**)

   Rationale: Although HTS was recommended over mannitol, the quality of evidence was low and the literature consistently suggests that mannitol is also a safe and effective option for the initial management of elevated ICP or cerebral edema in patients with TBI, particularly those with concomitant severe hypernatremia or volume overload.

3. We recommend against the use of HTSs in the pre-hospital setting to specifically improve neurological outcomes for patients with TBI. (**Strong recommendation; Moderate quality evidence**)

   Rationale: Acute treatment of cerebral edema and herniation syndromes is often necessary in the pre-hospital setting. However, well-designed clinical trials did not suggest any benefit from the use of HTS in the pre-hospital setting on long-term outcomes in patients with TBI.

4. We suggest against the use of mannitol in the prehospital setting to improve neurological outcomes for patients with TBI. (**Conditional recommendation; Very low quality evidence**)

   Rationale: In making this recommendation, the panel felt that the quality of evidence

was very low and did not suggest any potential benefit in the pre-hospital setting on long-term outcomes in patients with TBI.

Treatment of Cerebral Edema in Patients with Acute Ischemic Stroke (AIS)

In patients with ischemic stroke, does the use of HTSs improve cerebral edema compared to mannitol?

In patients with ischemic stroke, does the use of HTSs for cerebral edema improve neurological outcomes compared to mannitol?

1. We suggest using either HTSs or mannitol for the initial management of ICP or cerebral edema in patients with AIS (**Conditional recommendation; Low quality evidence**). There is insufficient evidence to recommend either hypertonic saline or mannitol for improving neurological outcomes in patients with AIS.

   Rationale: In making this recommendation, the panel felt that the quality of evidence was low and the literature in patients with AIS was not compelling to recommend one agent over the other for initial management of elevated ICP or cerebral edema. Patient-specific factors may be employed to aid clinicians in selecting the appropriate initial agent in patients with either measured elevated ICP or symptoms of cerebral edema.

2. We suggest that clinicians consider administration of HTSs for management of ICP or cerebral edema in patients with AIS who do not have an adequate response to mannitol. (**Conditional recommendation; Low quality evidence**)

   Rationale: In making this recommendation, the panel felt that the quality of evidence was low, but the literature in patients with AIS suggested that patients who do not have an adequate treatment response to mannitol may still respond to HTS.

3. We suggest against the use of prophylactic scheduled mannitol in AIS due to the potential for harm. (**Conditional recommendation; Low quality evidence**)

   Rationale: In making this recommendation, the panel felt that while the quality of

evidence was low, the lack of benefit and the potential association with worse neurological outcomes justified avoiding prophylactic mannitol in patients with AIS.

Treatment of Cerebral Edema in Patients with Intracerebral Hemorrhage (ICH)

In patients with ICH, does the use of HTSs improve cerebral edema compared to mannitol?

1. We suggest using HTSs over mannitol for the management of ICP or cerebral edema in patients with ICH. (**Conditional recommendation; Very low quality evidence**)

   Rationale: In making this recommendation, the panel felt that while the quality of evidence was very low, the consistency of the literature suggested HTS was at least as safe and effective as mannitol. In addition, the panel agreed that the putative advantages of HTS over mannitol for fluid resuscitation and cerebral perfusion justified the suggestion to use HTS over mannitol.

2. We suggest that either symptom-based bolus dosing or using a targeted sodium concentration is appropriate HTS administration strategy for the management of elevated ICP or cerebral edema in patients with ICH. (**Conditional recommendation; Very low quality evidence**)

   Rationale: In making this recommendation, the panel felt that the quality of evidence was very low and the literature in patients with ICH was not compelling to recommend one method of administration of HTS over the other for initial management of elevated ICP or cerebral edema. Patient-specific factors may be employed to aid clinicians in selecting the appropriate initial agent.

In patients with ICH, does the use of corticosteroid therapy improve neurological outcomes compared to placebo/control?

1. We recommend against the use of corticosteroids to improve neurological outcome in patients with ICH due to the potential for increased mortality and infectious complications. (**Strong recommendation; Moderate quality evidence**)

Treatment of Cerebral Edema in Patients with Bacterial Meningitis

In patients with bacterial meningitis, does the use of HTSs for cerebral edema improve cerebral edema compared to mannitol?

In patients with bacterial meningitis, does the use of corticosteroid therapy improve neurological outcomes compared to placebo/control?

1. We recommend dexamethasone 10 mg intravenous every 6 h for 4 days to reduce neurological sequelae (primarily hearing loss) in patients with community-acquired bacterial meningitis. (**Strong recommendation; Moderate quality evidence**)

2. We suggest dexamethasone 0.15 mg/kg intravenous every 6 h for 4 days as an alternative dose for patients with low body weight or high risk of corticosteroid adverse effects. (**Good practice statement**)

3. We recommend administering dexamethasone before or with the first dose of antibiotic in patients with bacterial meningitis. (**Strong recommendation; Moderate quality evidence**)

4. We recommend use of corticosteroids to reduce mortality in patients with tuberculosis meningitis (**Strong recommendation; Moderate quality of evidence**). We cannot make a recommendation for one specific corticosteroid or dose in patients with TB meningitis due to the inconsistency of agents and doses evaluated in the literature.

5. We suggest that treatment with corticosteroids should be continued for two or more weeks in patients with tuberculosis meningitis. (**Conditional recommendation; Low quality of evidence**)

   Rationale: In making this recommendation, the panel felt that the quality of evidence was low and considerable variability exists within and across studies regarding the duration of corticosteroid treatment. Clinicians should use patient-specific response and clinical factors to optimize the duration of corticosteroid treatment in this setting.

6. There is insufficient evidence to determine whether HTSs or mannitol is more effective to reduce ICP or cerebral edema in patients with community-acquired

bacterial meningitis.

Treatment of Cerebral Edema in Patients with Hepatic Encephalopathy

In patients with hepatic encephalopathy, does the use of HTSs improve cerebral edema compared to mannitol?

In patients with hepatic encephalopathy, does the use of hyperosmolar therapy improve neurological outcomes at discharge compared to ammonia-lowering agents?

1. We suggest using either HTSs or mannitol for the management of ICP or cerebral edema in patients with hepatic encephalopathy. (**Conditional recommendation; Very low quality evidence**)

   Rationale: In making this recommendation, the panel felt that the quality of evidence was very low and the literature in patients with hepatic encephalopathy was not compelling to recommend one form hyperosmolar therapy over the other. Thus, either agent could be used and patient-specific factors may be employed to aid clinicians in selecting the appropriate initial agent.

2. There is insufficient evidence to determine whether either hyperosmolar therapy or ammonia-lowering therapy improves neurological outcomes in patients with hepatic encephalopathy.

Hyperosmolar Therapy Safety and Infusion Considerations

In patients receiving mannitol, does osmolarity or osmolar gap best predict the likelihood for acute kidney injury (AKI)?

1. We suggest using osmolar gap over serum osmolarity thresholds during treatment with mannitol to monitor for the risk of AKI. (**Conditional recommendation; Very low quality evidence**)

   Rationale: In making this recommendation, the panel felt that the quality of evidence

was very low. While osmolar gap has not been definitively shown to predict AKI during mannitol treatment, the osmolar gap appears to correlate best with mannitol concentration and elevated mannitol concentration is best associated with toxicity. Thus, the physiological rationale for the use of osmolar gap is stronger than using an empiric osmolarity threshold.

2. There is insufficient evidence to recommend a cutoff value for osmolar gap when evaluating for the risk of AKI.

   Rationale: In making this recommendation, the panel felt that the quality of evidence was too low to make a definitive recommendation. While the panel recognizes that an osmolar gap of 20 mOsm/kg has been used in clinical practice, we were unable to identify evidence to support this threshold. Research suggests that serum mannitol concentrations are the most effective method to assess AKI risk, but this laboratory measurement is not commonly available. We did identify one study that demonstrated an osmolar gap of 55 mOsm/kg or higher being most correlated with serum mannitol concentration.

3. Renal function measures should be monitored closely in patients receiving mannitol due to the risk of AKI with hyperosmolar therapy. (**Good practice statement**)

In patients receiving HTSs, does the serum sodium concentration best predict toxicity [AKI, unwanted acidosis] compared to the serum chloride concentration?

1. We suggest that severe hypernatremia and hyperchloremia during treatment with HTSs should be avoided due to the association with AKI (**Conditional recommendation; Low quality evidence**). An upper serum sodium range of 155–160 mEq/L and a serum chloride range of 110–115 mEq/L may be reasonable to decrease the risk of AKI. (**Conditional recommendation; Very low quality evidence**)

   Rationale: In making this recommendation, the panel rated the quality of evidence as very low. The precise serum values associated with AKI varies across the literature. Clinicians should evaluate the appropriate sodium and chloride concentrations in individual patients based on renal function, acid–base balance, and the need for acute treatment for elevated ICP or cerebral edema.

2. Clinicians should routinely monitor both sodium and chloride serum concentrations to assess risk of AKI related to elevated concentrations. (**Good practice statement**)

3. Renal function should be monitored closely in patients receiving HTSs due to the risk of AKI with hyperosmolar therapy. (**Good practice statement**)

   Rationale: In making these good practice statements on monitoring renal function, serum sodium, and serum chloride, the panel felt that the practice of routine monitoring for AKI was prudent given the potential risks of both HTS in this setting. Clinicians should use patient-specific factors to determine the frequency of monitoring with ranging from twice daily to every 2 h based on rapidity of change to interventions.

Recommendations for the Optimal Administration Method of HTS

In patients with cerebral edema, how does continuous infusion of HTSs compare to bolus infusion of HTSs in improving neurological outcomes?

1. There is insufficient evidence to support use of a continuous infusion of HTS targeting a serum sodium goal for the purpose of improving neurological outcomes.
2. Due to insufficient evidence, we cannot recommend a specific dosing strategy for HTS to improve neurological outcomes in patients with cerebral edema.
3. Clinicians should avoid hyponatremia in patients with severe neurological injury due to the risk of exacerbating cerebral edema. (**Good practice statement**)

Non-pharmacologic Treatment of Cerebral Edema and Elevated ICP

In patients with cerebral edema, how do non-pharmacological interventions compare to pharmacological interventions for reduction of cerebral edema?

1. We suggest that elevating the head of the bed to 30 degrees (but no greater than 45 degrees) be used as a beneficial adjunct to reduce ICP. (**Conditional recommendation; Very low quality evidence**)

   Rationale: In making this recommendation, the panel rated the quality of available evidence as very low. However, this intervention has been used extensively in the

clinical setting and the risk of elevating the head of the bed is generally very low and may be beneficial.

2. We recommend that brief episodes of hyperventilation can be used for patients with acute elevations in ICP. (**Strong recommendation; Very low quality evidence**)

   Rationale: In making this recommendation, the panel rated the quality of available evidence as very low. However, a strong recommendation was felt to be appropriate given the extensive amount of practical experience with this therapeutic strategy. Clinicians should be mindful of the limitations of acute hyperventilation related to cerebral blood flow and the extent of $PaCO_2$ reduction. Clinicians should also maintain careful awareness of the duration of therapy to avoid deleterious changes in cerebral perfusion.

3. We suggest that the use of cerebrospinal fluid (CSF) diversion be considered as a beneficial adjunct to reduce ICP. (**Conditional recommendation; Very low quality evidence**)

   Rationale: In making this recommendation, the panel felt that the quality of evidence was very low. Clinicians should assess the risks and benefits of CSF diversion using patient-specific factors.

4. While non-pharmacological interventions may be effective for acute elevations in ICP, there is insufficient evidence that non-pharmacological interventions are effective for the treatment of any specific physiological changes that produce brain swelling related to cerebral edema.

Evidence Rating Scheme

The panel used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology to evaluate the quality of evidence as high, moderate, low, or very low.

Recommendation Rating Scheme

The panel classified recommendations as **strong** ("We recommend") when they are the preferred treatment for most patients and should be adopted as policy in the majority of situations. **Conditional** recommendations ("We suggest," "Clinicians should consider") should be further considered based upon the clinical scenario and carefully evaluated by stakeholders before being implemented as policy. Areas where there is insufficient

evidence to support recommendations are identified, and, in some instances, "**good practice statements**" are provided. These statements are meant to state guidance where there may be a lack of published evidence, but the practice is commonly accepted as beneficial.

Related Content

Supporting Documents

- Summary of Findings Table.
- Risk of Bias Tables.

Implementation Tools

No implementation tools available.

Patient Education

No patient education materials available.

Disclaimer

If you desire to use content from the original clinical practice guideline cited herein, you must contact the guideline developer directly to obtain permission rights.

ECRI's Guideline Profiles are designed to provide information and assist decision-making. Variations in practice will inevitably, and appropriately, occur when clinicians take into account the needs and preferences of individual patients, available resources, and limitations unique to an institution or type of practice. Every healthcare professional using

these Guideline Profiles is responsible for evaluating the appropriateness of applying them in a clinical setting.

TRUST Scorecard

Composition of Guideline Development Group (GDG)

Multidisciplinary GDG Members	**Yes**
Methodologist Involvement	**Yes**
Incorporation of Patient and Public Perspective	

Systematic Review of Evidence

Literature Search	
Study Selection	
Evidence Synthesis	

Foundations for Recommendations

Strength of Evidence Grade	
Description of Benefits and Harms of Recommendations	
Summary of Evidence Supporting Recommendations	
Strength of Recommendations Rating	
Clear Articulation of Recommendations	

Funding Source

Yes

Disclosure and Management of Financial Conflicts of Interests



External Review



Updating



Copyright © 2025 ECRI