ALBUMIN USE IN THE NEUROSCIENCE - ICU:

By:

Augusto Parra, M.D., M.P.H., F.A.H.A, Director of Neurocritical Care

and

Colleen Barthol, Pharm.D., BCPS, Clinical Pharmacist, Neurosurgical ICU
UTHSCSA, San Antonio TX
I. Albumin 5% Solution:

- **Background:**
  - **Aneurysmal Subarachnoid Hemorrhage:**
    - Natriuresis and intravascular volume depletion can occur after SAH and are risk factors for the development of delayed cerebral ischemia associated with vasospasm.
    - Crystalloids and colloids, primarily normal saline and albumin, are most frequently used to maintain normovolemia or even hypervolemia as part of “triple H” (Hypertension, Hypervolemia, Hemodilution) therapy if vasospasm is detected.
    - Albumin has neuroprotective properties. It appears to have antioxidant characteristics and direct effects on vascular endothelial permeability. Some animal studies have shown improved neurologic function, reduced volume of cerebral infarct and swelling when used in the setting of ischemic stroke.
    - Albumin improves cerebral blood flow in animal models and may help in improving collateral flow in the penumbra area after cerebrovascular ischemia.
    - Risk of vasospasm is highest during the first 10 days post SAH and total fluids should be adjusted to maintain target CVP 6-8 during this time. If the patient develops delayed vasospasm, hypervolemia with CVP goal of 8-12 should be targeted.
  
  - **Acute Ischemic Stroke / TIA:**
    - Albumin has neuroprotective properties. It appears to have antioxidant characteristics and direct effects on vascular endothelial permeability. Some animal studies have shown improved neurologic function, reduced volume of cerebral infarct and swelling when used in the setting of ischemic stroke.
    - Albumin improves cerebral blood flow in animal models and may help in improving collateral flow in the penumbra area after cerebrovascular ischemia.
    - Albumin may be utilized to maintain normovolemia or induce hypervolemia when clinically indicated if there is evidence of flow failure associated with acute ischemic stroke.
Protocol:
- Use albumin 5% IV 250 ml bolus every 2-4 hrs PRN for CVP less than 6 cm H₂O when target CVP is 6-8 (normovolemia).
- Adjust maintenance IV fluids in 25% increments if patient is requiring frequent albumin boluses (i.e. more than 2 consecutive doses).
- Use albumin 5% IV 250 ml bolus every 2-4 hrs PRN for CVP less than 8 cm H₂O when target CVP is 8-12 (hypervolemia).
- Adjust maintenance IV fluids in 25% increments if patient is requiring frequent albumin boluses (i.e. more than 2 consecutive doses).

Monitoring:
- Continuous CVP monitoring through subclavian or internal jugular central catheter or Swan Ganz catheter
- Clinical assessments of respiratory status and cardiovascular status
- Hourly neurological assessments

II. Albumin 25% Solution:

Background:

Albumin 25% solution information:
- Albumin (Human) 25% solution is a sterile, nonpyrogenic preparation of albumin in a single dosage form for intravenous (IV) administration. Each 100 ml of this solution contains 25 g of albumin and is prepared from human venous plasma using the Cohn cold ethanol fractionation process. This solution has been adjusted to physiological pH with sodium bicarbonate and/or sodium hydroxide and stabilized with sodium acetyltryptophanate and sodium caprylate. The sodium content is 145 ± 15 mEq/L. This solution contains no preservative and none of the coagulation factors found in fresh whole blood or plasma. Albumin (Human) 25% solution is a transparent or slightly opalescent solution which may have a greenish tint or may vary from a pale straw to an amber color.
- This product is heated for 10 hours at 60°C to minimize the likelihood of Hepatitis C transmission. This procedure has been shown to be an effective method of inactivating hepatitis virus in albumin solutions.
even when those solutions were prepared from plasma known to be infective.

- Albumin 25% 50 ml solution has the oncotic equivalence of 250 ml of citrated plasma.
- Albumin works as an intravascular volume expander and is able to efficiently draw volume from the interstitial space into the intravascular space in contrast to crystalloid solutions.
- Total dose should not exceed 2 g/kg/24 hrs (600 ml of 25% albumin for a 70 kg adult).
- Caution in patients with a history of heart failure, renal insufficiency, stabilized chronic anemia since they can develop circulatory volume overload. Allergic reaction to albumin is a specific contraindication.
- Warnings: The product is made of human albumin and may contain infectious agents (e.g., viruses) that can cause disease. There are several manufacturing steps to prevent the presence of infectious agents in this solution:
  - Screening plasma donors for prior exposure to certain viruses.
  - Testing the solution for the presence of certain vital infections.
  - Inactivation and removal of certain viruses from the albumin solution.
  * Despite of these measures there is still a small risk for infectious transmission.
- Acceptable diluents for 25% albumin are NS and D5W solutions.

- **Neuro-ICU Indications:**
  - Albumin 25% has been of great aid in the hemodynamic stabilization of patients with evidence of hypoalbuminemia and evidence of clinically relevant interstitial edema and diminished intravascular space. There is evidence of positive physiological effects of 25% albumin in scenarios with important hypoalbuminemia like cirrhosis and nephrotic syndrome. The effect of albumin 25% raising the oncotic pressure disappears a few days after discontinuation if the primary process that induces hypoalbuminemia persists.
  - I have had experience in using this product in combination with diuretics in Neuro-ICU patients with important neurological insults (ICH, SAH, stroke, trauma) and evidence of hypoalbuminemia (serum albumin <=3) and symptomatic interstitial edema. Patients with severe neurological insults have in many instances an important systemic inflammatory response syndrome (SIRS). [9] Many of this
patients are also hypercatabolic and sometimes malnourished during the acute phase of hospitalization. The great majority of these patients have evidence of proteinuria on a 24 hr urine collection (Parra A. unpublished data). These and other factors may contribute to this transient hypoalbuminemic state, which can be associated with increased morbidity and mortality. [10], [11] No randomized trials have been done in this population. I am planning to study this formally in the near future.

- Similar observations were reported in a clinical trial by Martin et al. They studied the combined administration of albumin and furosemide in a prospective, randomized, placebo-controlled study of 38 ARDS patients and demonstrated that this therapeutic strategy increased diuresis and weight loss. They also observed an improvement in oxygenation, which, however, was not persistent over time, as well as long-term improvement in hemodynamic stability. [12]

- **Protocol:**
  - Use albumin 25% IV bolus every 6-12 hrs PRN for 24 to 72 hr periods in combination with furosemide +/- chlorothiazide.
    - **Initial Dose Regimen:**
      - Albumin 25% 50ml IV bolus over 1 hr, followed by 10 mg of furosemide IV (30 min after). Repeat this regimen every 12 hrs.
      - If goal is not achieved, the frequency of administration may be increased to every 6 hrs.
      - If still the 24 hr diuresis and clinical goals are not achieved, increase the dose of furosemide to 20 mg IV and then 40 mg IV per administration.
      - If still the 24 hr diuresis and clinical goals are not achieved, add chlorothiazide 250-500 mg IV 15 minutes after each dose of furosemide to potentiate the diuresis.
    - The goal is to achieve at least 500-1000 ml negative balance per 24 hrs in patients with symptomatic interstitial edema (e.g., pulmonary edema, pleural effusions, anasarca, ascites, abdominal compartment syndrome etc.)
    - Reassess patient every 24 hours clinically and physiologically to assess the need for continuation of this therapy.

- **Monitoring:**
Continuous CVP monitoring through subclavian or internal jugular central catheter or Swan Ganz catheter. The patients are maintained normovolemic (CVP 6-8) unless there is therapeutic indication for hypervolemia.

Clinical and radiological assessments of interstitial edema, cardiovascular volume status, fluid balance, respiratory function and renal function

Weekly assessments of serum albumin and pre-albumin

Hourly neurological assessments

Weekly assessments of proteinuria if evidence of proteinuria on initial 24 hr urine collection

Albumin frequency and diuretic doses are adjusted stepwise according to individual patient’s response and tolerability

Daily chem10 assessments

Electrolyte replacement protocol

Chest X-ray daily for intubated patients and at least once a week for non-intubated patients (as clinically indicated)

Discontinuation of this therapy:

- Serum Cr>=1 in patients with normal serum creatinine at baseline
- Clinical and / or physiological evidence of cardiovascular volume overload (CVP >8 if patient’s goal is normovolemia or CVP >12 if goal is hypervolemia). Evidence of worsening pulmonary edema on clinical assessment or radiological studies.
- Clinical goal is achieved (interstitial edema is no longer clinically relevant and cumulative balance excess is corrected)
- Evidence of clinically relevant adverse events related to albumin, furosemide and chlorothiazide are encountered
References


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