UNIVERSITY HEALTH SYSTEM

Neurocritical Care Protocol for Hypertonic Saline Bolus and Continuous Infusion

Patients in the Neuro ICU are frequently given hypertonic saline for brain injuries when there is significant cerebral edema, elevated intracranial pressure or due to processes that lower Na+. Hyponatremia can worsen cerebral edema and hypernatremia has been shown to lower intracranial pressure. Hypertonic saline has been shown to be as efficacious as mannitol in managing elevated intracranial pressure. Care does need to be taken to dose hypertonic saline appropriately.

The following concentrations of hypertonic saline are available:
2%: may be given as a bolus or continuous infusion through a peripheral line
3%: may be given as a bolus or continuous infusion through a large bore (#18g or larger) peripheral line for maximum of 24 hours after which central venous access is required
23.4%: may be given emergently by a Neurocritical care or Neurosurgery provider through a central line

Patient must meet one of the following criteria:
1. Elevated intracranial pressure
2. Cerebral edema with mass effect
3. Hyponatremia from cerebral salt wasting
4. Hyponatremia from SIADH in patient with brain injury
5. Na+ >/= 135 mmol/L

Protocol: Orders for hypertonic saline must be placed by a member of the Neurocritical care team (physician or APP) on behalf of the faculty physician. A patient may only have one sodium goal listed.

1. Common Na+ goals used in the Neuro ICU (at the discretion of the treating physician):
   Goal 150-155 mmol/L
   Goal 145-150 mmol/L
   Goal 140-145 mmol/L
   Goal 135-145 mmol/L

2. Chemistry panel every 6 hours. If Na+ below ordered goal, bolus over 1 hour:
   → if patient < 50 kg, 150 ml of 3% OR 200 ml of 2%
   → if patient 51-100 kg, 250 ml of 3% OR 400 ml of 2%
   → if patient >100 kg, 500 ml of 3% OR 600 ml of 2%

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3. Neurocritical care team member to be notified if:
    - Na+ > 155 mmol/L
    - Na+ < 135 mmol/L
    - Na+ not within ordered range despite receiving hypertonic saline bolus
    - Concern for thrombophlebitis or extravasation of a peripheral line

4. Timing for weaning of Na+ goals is at the discretion of the attending Neurocritical care physician

Continuous Infusion of Hypertonic Saline:
For patients without central line: 1 mL/kg/hr of 2% hypertonic saline
For patients **with** central line: 1 mL/kg/hr of 3% hypertonic saline

23.4% Hypertonic Saline Bolus if needed emergently:
Given by slow IV push over 10 minutes through a central line
< 50 kg: 20 mL (order 30 mL syringe)
51-100 kg: 30 mL
>100 kg: 50 mL (order 30 mL syringe x 2)
*** 23.4% can only be administered by a Neurocritical or Neurosurgery provider attending physician**

Calculation reference:

3% NaCl = 513 meq Na+/L
Na+ deficit = 0.6 x weight (kg) x (change in Na+ desired)
Amount needed to increase serum Na+ by 3 meq/hr = 0.6 x weight x 3
Desired rate: amount needed (meq/hr)/concentration of saline (meq/L) x 1000

To raise Na+ by 3 meq/L:
< 50 kg (using weight of 40 kg)
0.6 x 40 x (3) = 72 meq Na+ needed
To increase by 3 meq/L/hr = 0.6 x 40 x 3 = 72 meq/hr
Desired rate = 72/513 x 1000 = 140 ml/hr (rounded to 150 ml over 1 hour)

51-100 kg (using weight of 70 kg)
0.6 x 70 x 3 = 126 meq Na+ needed
To increase by 3 meq/L/hr = 0.6 x 70 x 3 = 126 meq/hr
Desired rate = 126/513 x 1000 = 245 ml/hr (rounded to 250 ml/hr over 1 hour)

>100 kg (using 120 kg)
0.6 x 120 x 3 = 216 meq Na+ needed
To increase by 3 meq/L/hr = 0.6 x 120 x 3 = 216 meq/hr
Desired rate = 216/513 x 1000 = 421 ml/hr (rounded to 500 ml/hr over 1 hour)

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2% hypertonic saline: 342 meq Na+/L (please reference above calculations)
< 50 kg: 210 ml/hr -- round to 200 ml over 1 hour
51-100 kg: 375 ml/hr – round to 400 ml over 1 hour
>100 kg: 625 ml/hr – round to 600 ml over 1 hour

23.4%: 4000 meq/L (May be given by slow IV push over 10 minutes)
< 50 kg: 20 ml (order 30 ml syringe)
51-100 kg: 30 ml
>100 kg: 50 ml (order 30ml syringe x 2)
*** 23.4% can only be administered by a Neurocritical or Neurosurgery provider attending physician**

There is no absolute formula on how slowly to lower a patient's Na+ level back to normal range. However, we do know that letting Na+ levels drop too quickly can cause rebound cerebral edema. Lowering the Na+ range every 1-2 days and then ensuring normonatremia has been shown clinically to be safe.

References:

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