Clinical Guidance

Paediatric Critical Care: Hypertonic Sodium Chloride

Summary
This guideline is for the use of hypertonic sodium chloride. It gives advice on the indications for use, preparation, advantages of use and risks. If available always use "ready-made" hypertonic sodium chloride solutions (i.e. 2.7%) in preference to mixing 3%, they can be used interchangeably.

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This clinical guideline has been produced by the South Thames Retrieval Service (STRS) at Evelina London for nurses, doctors and ambulance staff to refer to in the emergency care of critically ill children.

This guideline represents the views of STRS and was produced after careful consideration of available evidence in conjunction with clinical expertise and experience. The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient.

Change History		
Date	Change details, since approval	Approved by
April 2022	Updated references, minor formatting changes, removal of indication - renoprotective agent.	ELCGC June 2022
May 2026	No change to content	PCGC May 2026

Paediatric Critical Care

Hypertonic Sodium Chloride

South Thames RETRIEVAL SERVICE

Indication for Use

- **Osmotherapeutic agent** for treatment of **cerebral oedema** and raised intracranial pressure (e.g. head injury, DKA).
- Treatment of symptomatic **hyponatraemic seizures**[1].
- **"Small volume" resuscitation** for shock[2].

Mechanism of Action

- Hypertonic sodium chloride is a crystalloid fluid composed of sodium chloride dissolved in water with a higher sodium concentration than normal blood serum.
- When given intravenously, hypertonic sodium chloride causes a shift of fluid down the osmotic gradient created by the sodium differential, from the intracellular to the extracellular space.
- Hypertonic sodium chloride therefore acts as an intravascular volume expander, increases plasma sodium concentration and reduces brain water.
- Plasma sodium of up to 170mmol/L has been targeted to control ICP.

Hypertonic sodium chloride compared to mannitol

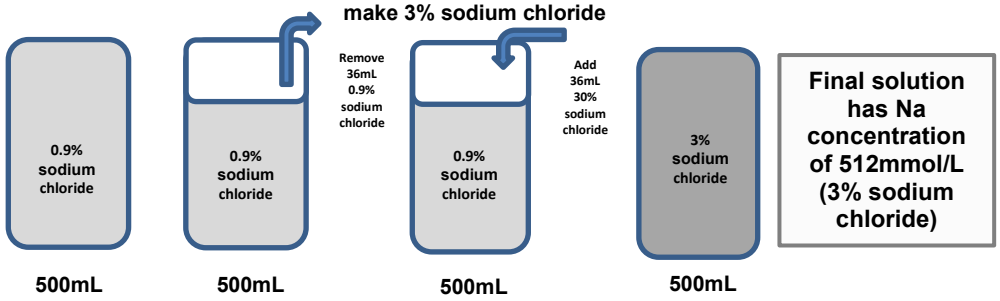
- Hypertonic sodium chloride is more effective than mannitol for treatment of children with intra-cranial hypertension[3].
- Hypertonic sodium chloride may produce less "rebound" intracranial hypertension after administration when compared to mannitol, which cannot be easily removed from intracellular space.
- Hypertonic sodium chloride directly increases plasma Na, therefore changes in blood osmolality can be easily monitored by tracking the plasma Na level. The effect of mannitol on plasma osmolality can only be estimated using an osmole gap.
- Mannitol has significant side effects, including hypotension and an osmotic diuresis. It can precipitate acute renal failure and may not be excreted in oligo-anuria[4].
- Hypertonic sodium chloride does not cause obligatory osmotic diuresis and hence preserves/ augments plasma volume, increasing cerebral and end-organ perfusion pressure[4]. It is therefore reno-protective compared to mannitol.

Dose of 3% sodium chloride or pre-made 2.7% sodium chloride

- Administer **3mL/kg of IVI** of 3% sodium chloride (over 10 - 20 minutes) via central (preferable) or peripheral vein.
  (NB: use same volume (3mL/kg) even if pre-made 2.7% sodium chloride solution is used - clinical difference is negligible).
- Dosing may be repeated as clinically indicated.
- 3mL/kg may increase plasma Na by approximately 2 - 3mmol/L – may see greater increase if a large diuresis occurs. Check plasma Na if any doubt on the rate of Na increase.
- For hyponatraemic seizures, there is no fixed threshold above which seizures stop, usually increasing Na by 3 - 7mmol/L is adequate.
- An acute rise in plasma Na at a rate less <10mmol/L in 24 hours is estimated to be safe.

PREPARATION OF 3% SODIUM CHLORIDE USING 30% SODIUM CHLORIDE

Remove 36mL 0.9% sodium chloride from 500mL bag and add 36mL 30% sodium chloride to bag to make 3% sodium chloride



Use "ready-made" 2.7% hypertonic sodium chloride solutions if available in preference to mixing 3% to reduce risk of drug preparation errors

Do not connect the 500mL bag of 3% sodium chloride directly to the patient IV line (risk of serious sodium overdose if full bag accidently infused). Always withdraw the prescribed volume of 3% sodium chloride and administer to the patient separately.

In case of accidental overdose of 3% sodium chloride: STOP the infusion and contact STRS for immediate advice

- **DO NOT attempt to correct high sodium with free water or 0.45% sodium chloride (risk of sudden drop in brain osmolality**
- **Measure plasma sodium every hour for trend**

References:

1) Madias et al, N Engl J Med. 2000 25;342):1581-9
2) Liu S, Ren X, Gun L, Zhang Q, Zhang J, Zhu Y. [Effect of 3% hypertonic saline as early fluid resuscitation in pediatric septic shock]. Zhonghua Er Ke Za Zhi. 2015 Aug;53(8):599-604. Chinese. PMID: 26717658.
3) "Mannitol vs 3% Hypertonic Saline in Children with intracranial hypertension: review of the current evidence." Arch Dis Child: first published as 10.1136/archdischild-2021-rcpch.197 on 30 September 2021
4) "RCT of 20% Mannitol vs 3% Hypertonic Saline in Children with Raised ICP due to acute CNS infections." Paediatric Critical Care Medicine December 2020 • Volume