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# Patient Safety Tip of the Week

# July 2, 2024 Iatrogenic Hyponatremia

Hospital-acquired hyponatremia can be a serious patient safety issue. There are many causes of hyponatremia and the nature and severity of symptoms of hyponatremia depend upon the rapidity with which it develops. Rapidly progressive hyponatremia can lead to confusion, seizures, obtundation, and even death from cerebral edema. Equally important is appropriate management of hyponatremia, since too rapid correction can lead to osmotic demyelination syndrome (formerly known as central pontine myelinolysis) which can have significant neurological sequalae.

Two recent reports from Canada (ISMP Canada 2024, Manderville 2024) found that errors in IV fluid management and monitoring were the prime causes of hospital-acquired hyponatremia in most cases. Unintended IV infusion of hypotonic fluids is the major culprit. The ISMP Canada article identified cases where normal saline (alone or in combination with D5W) was ordered but instead patients were given hypotonic solutions like ½ normal saline or D5W alone. ISMP Canada notes that the errors were identified by nurses during routine checks (e.g., when changing an empty IV solution bag, at change of nursing shift, or when a patient was transferred from another unit), thus preventing harm in most cases. But there was one incident with the patient experiencing a decreased level of consciousness, and another incident documented the error as continuing undetected for 3 days.

ISMP Canada noted the following contributing factors to incidents in which an isotonic fluid was ordered, but a hypotonic IV fluid was given in error:

- incorrect storage of the IV solutions on the IV storage cart (e.g., D5W½NS with 20 mmol/L KCl stocked where NS with 20 mmol/L KCl was supposed to be stocked)
- similar appearance of IV bag labels
- IV fluid not included in the medication administration record (MAR)
- delays in the identification of possible symptoms of hyponatremia
- lack of laboratory monitoring that might have identified the incorrect IV solution sooner
- challenges in differentiating symptoms of hyponatremia (e.g., confusion) from other conditions with similar symptoms

Manderville et al. (Manderville 2024) note that labelling of IV solutions may be misleading. The confusion often revolves around the concepts of "tonicity" and "osmolality". They reviewed commonly used IV products used in Canada and the US. They found several examples of isotonic and hypotonic IV solutions that were designated as "hypertonic" both in the product monograph and on individual bags of IV fluid. Of 28 products reviewed, 27 had incorrect information in their respective monographs, labelling, or both. Of the 18 hypotonic fluids reviewed, 11 (61%) were incorrectly labelled as "hypertonic" on the IV bag.

Manderville et al. note that tonicity is a property of a solution with reference to a particular membrane, whereas osmolality is a property of a solution that is independent of any membrane. Solutes such as dextrose (which can freely enter the cell under normal conditions) contribute to the osmolality of a solution, but they do not alter tonicity.

Pediatric patients, postoperative patients, and older adults are the populations most at risk of hyponatremia due to use of hypotonic IV fluids. Mandeville et al. note that issues related to antidiuretic hormone (ADH) are often present in hospitalized patients. They often have risk factors for non-osmotic release of ADH, including pain, nausea, stress, and certain medications. In the setting of increased ADH, the free water available in hypotonic IV solutions can rapidly lead to clinically significant hyponatremia. The American Academy of Pediatrics and the Canadian Paediatric Society recommend the use of isotonic IV solutions as the standard for fluid maintenance in children, with the recognition that hypotonic IV solutions can be used in specific circumstances but only with careful monitoring. That has led some pediatric hospitals to restrict hypotonic solutions to only certain area, like pediatric critical care units.

ISMP Canada has multiple recommendations (for hospital systems, nurses, and pharmacists):

- Consider incorporating an alert in CPOE systems about the risk of acute hyponatremia with hypotonic IV fluids when these are used for maintenance therapy, especially in pediatric patients.
- Review the types and quantities of IV solutions needed in clinical areas to reduce risk of selection errors. For example, the Canadian Paediatric Society recommends that hypotonic fluids containing less than ½ NS should not be generally available on pediatric wards.
- Ensure mechanisms are in place to check that the types of IV solutions provided to nursing units are correct (e.g. bar-coding technology).
- Unless treating a clinical condition or a specific fluid or electrolyte disturbance, and provided there are no contraindications, clinicians should prescribe isotonic IV fluids, to reduce the risk of hyponatremia. The Canadian Paediatric Society recommends that D5W 0.9% NaCl (D5W NS) be initiated as the maintenance fluid when serum electrolyte levels are not yet available. Hypotonic fluids containing less than 0.45% NaCl should not be used for routine maintenance fluid therapy.

- Both the Canadian Paediatric Society and the American Academy of Pediatrics recommend isotonic fluids for routine maintenance, with the recognition that in certain specific circumstances, hypotonic IV solutions may be used, but only with careful monitoring.
- Ensure regular electrolyte monitoring.
- Regularly review the need for IV fluid therapy. If the patient has adequate oral intake of fluids, medications, nutrients, and calories, consider deprescribing any unneeded IV infusion. (**We like this one**. All too often we continue unnecessary IV fluids, sometimes to satisfy criteria for continued hospitalization!).
- If acute hyponatremia is identified, avoid overly rapid correction. (See our November 23, 2021 Patient Safety Tip of the Week "The Perils of Hypertonic Sodium Chloride").
- Nursing Teams should ensure the particular IV fluid and rate of infusion are checked against the MAR and/or nursing care plan at the beginning of each shift.
- Ensure that any IV fluid administered is appropriate for the patient's clinical status.
- Close monitoring and documentation of vital signs, serum electrolytes, and the patient's volume status (intake and output) are essential in preventing hospital-acquired hyponatremia.
- For the pediatric population, weight should be documented daily.
- Immediately report any critical laboratory results to the most responsible physician.
- Pharmacy Teams should confirm a valid indication and monitor electrolyte results when hypotonic fluids are prescribed for at-risk patients.

These are just a few select recommendations. See the ISMP Canada article itself for the full list of recommendations.

The management of acute hyponatremia is beyond the scope of today's column. We refer you to the excellent review on diagnosis and management of hyponatremia by Adrogué et al. (Adrogué 2022). We also refer you to our November 23, 2021 Patient Safety Tip of the Week "The Perils of Hypertonic Sodium Chloride" for a discussion on use of hypertonic sodium chloride.

**References**:

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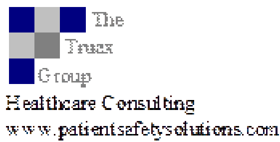


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