

Hyperchloremic Metabolic Acidosis Following Total Gut Irrigation with Normal Saline in Pediatric Patients: A Rare Occurrence

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Abstract

Use of 0.9% sodium chloride for total gut irrigation (TGI) through nasogastric route is an effective method of bowel preparation in children undergoing colorectal surgeries. TGI with normal saline (NS) can result in nausea, vomiting, abdominal distension, and mild electrolyte imbalance; however, hyperchloremic metabolic acidosis has not been documented. We report two cases of hyperchloremic metabolic acidosis in children posted for colorectal surgery following TGI with NS who were successfully managed.

Key words: Acidosis, anion gap, anorectal malformation, balanced salt solution, pediatrics, rectovaginal fistula, water-electrolyte imbalance

INTRODUCTION

Total gut irrigation (TGI) through nasogastric route is a rapid, safe, and effective method of bowel preparation in children undergoing colorectal surgeries.^[1] Various solutions available for TGI include Ringer lactate, polyethylene glycol, and mannitol but 0.9% sodium chloride (normal saline [NS]) is widely used because it is safe, effective, affordable, and readily available.^[2]

The side effects observed after TGI with NS are nausea, vomiting, abdominal distension, weight gain, and mild electrolyte imbalance.^[3-5] We have not come across any report of hyperchloremic metabolic acidosis following TGI with NS. We report two cases of hyperchloremic metabolic acidosis following TGI with NS.

CASE REPORTS

Case report 1

A 3-year-old healthy male child weighing 15 kg was posted for Duhamel procedure for Hirschsprung disease. His preoperative hemoglobin was 11 g/dl, serum sodium (Na) 140 mmol/L, and chloride (Cl) 100 mmol/L. An evening before surgery, TGI

was started through nasogastric tube and 4.5 L of NS was used over a period of 10 h. On the morning of surgery, the child was found to be lethargic. He vomited once before induction of general anesthesia. The surgery was uneventful. On completion of surgery, the patient was reversed with intravenous (IV) neostigmine 50 mcg/kg and 10 mcg/kg glycopyrrolate. After reversal though the child had adequate tidal volume, but he was not responding to commands or moving his limbs. An arterial blood gas sample (ABG) which was sent to rule out electrolyte imbalance showed pH 7.05, PaO₂ 92.4 mmHg, PaCO₂ 40 mmHg, Na 132 mmol, K 3.5 mmol/L, Cl 117 mmol/L, bicarbonate (HCO₃) 11 mmol/L, and base excess (BE)-18.9.

An IV infusion of 5% dextrose in water with 50% of the calculated amount of sodium bicarbonate (NaHCO₃) was started. The child showed improvement and started responding

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to commands and was extubated. His ABG after NaHCO₃ infusion was pH 7.35, Na 134 mmol/L, K 3.4 mmol/L, Cl 104 mmol/L, HCO₃ 15.8 and BE 8, PaO₂ 90 mmHg, and PaCO₂ 37 mmHg. Thereafter his recovery was uneventful, and the child was discharged from the hospital on the 7th postoperative day.

Case report 2

A 6-year-old female child weighing 19 kg was scheduled for limited posterior sagittal anorectoplasty for anovestibular fistula. Her preoperative hemoglobin was 12.4 g%, serum Na 138 mmol/L, and Cl 102 mmol/L. An evening before surgery TGI was started with NS and total volume used was 7.5 L over a period of 10 h. On the morning of surgery, the child was lethargic and not communicating. She vomited once in the preanesthetic room. Her ABG showed pH 7.11, PaO₂ 93.5 mmHg, PaCO₂ 33.6 mmHg, HCO₃ 11.0 mmHg/L, BE 16.4, Na 132 mmol/L, K 3.2 mmol/L, and Cl 115 mmol/L. An IV infusion of 5% dextrose in water with 50% of the calculated NaHCO₃ was started. The child started showing improvement, became active and started communicating. The ABG after NaHCO₃ infusion showed pH 7.36, Na 135 mmol/L, K 3.6 mmol/L, HCO₃ 20 and BE 5.

DISCUSSION

Hyperchloremic metabolic acidosis has been reported after rapid IV infusion of large volumes of NS intraoperatively^[6] and in critically ill patients admitted to ICU.^[7]

NS is composed of 154 meq/L of Na and 154 meq/L of Cl and hence is considered to be electrically neutral. When NS is infused, an equal amount of Na and Cl is added to the plasma. The plasma Cl increases to a greater degree because normal plasma Cl levels are less than Na. This leads to narrowed strong ion difference (SID) and decreased net positive ion charge. Reduced SID leads to proton degeneration which is a compensatory response to restore charge equilibrium. This physiological process manifests as a decreased pH.^[8]

The principle of TGI is that most of NS is unabsorbed. The increased intraluminal volume stimulates peristalsis throughout the bowel which leads to clearing of fecal matter from colon and rectum.^[3] The average duration of bowel preparation with NS depends on the rate of infusion and is 3.45 h (2) 7.3 h (1) at the infusion rates of 70 ml/kg/h and 30 ml/kg/h, respectively.

In our institute, NS 30 ml/kg/h is used for bowel preparation because this rate is associated with lesser complications of TGI. In our first patient, it took around 10 h to prepare the bowel and the total volume of NS used was 4.5 L. It appears that the rate of infusion was not constant but probably >30 ml/h which resulted in significant absorption of NS from the gut. Since the returning effluent was not clear, hence longer time

was required for bowel preparation. In our second patient, the absorption of NS from the bowel probably occurred because of the partial obstruction due to the narrow opening of the anovestibular fistula.

Hyperchloremic metabolic acidosis is often iatrogenic and has been found to be associated with increased eicosanoid release in the renal tissue which may be the cause for decreased gastric mucosal perfusion,^[9] renal vasoconstriction and decreased glomerular filtration rate. It has also been associated with impaired coagulation, need for HCO₃ buffering and use of more blood products. A large observational study, however, did not show that hyperchloremic metabolic acidosis was worse than no metabolic acidosis.^[10] Therefore, though not considered a predictor of outcome or mortality, it may be associated with hemorrhage risk, transfusion of more blood components and resource utilization.

Both our patients had an uneventful recovery with appropriate management. These two cases of hyperchloremic acidosis after TGI highlight the need to monitor the flow rate of NS used for TGI and monitor these children not only for electrolyte imbalance but also hyperchloremic acidosis.

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Conflicts of interest

There are no conflicts of interest.

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