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Symptomatic Hyponatremia Following Tonsillectomy despite Using Isotonic Fluid

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Authors' contributions

This work was carried out in collaboration between all authors. Author YC designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SAL and YHY managed the analyses of the study. Author NYK managed the literature searches. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

Hyponatremia is the most common electrolyte imbalance in inpatients, but severe symptomatic hyponatremia has a higher mortality rate in compared to normal patients. Post-operative hyponatremia in children can usually occur following administration of hypotonic fluid. However, inappropriate secretion of the antidiuretic hormone can also be the cause of post-operative hyponatremia. The study presents a case of Sixyear girl, who developed symptomatic hyponatremia despite administration of lactated Ringer's solution after tonsillectomy. After electrolyte correction with 3% saline, the child recovered well without any further complications.

Keywords: Hyponatremia; ileus; tonsillectomy; seizure.

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1. INTRODUCTION

Hyponatremia is the most common electrolyte imbalance that can occur during hospitalisation and can be accompanied by severe neurological symptoms [1]. The common causes of hyponatremia after surgery in children include the use of hypotonic fluid such as dextrose solution and improper secretion of antidiuretic hormone (ADH) [1]. The study presents a case of hyponatremia with seizure and paralytic ileus after tonsillectomy in child in spite of using isotonic solution.

1.1 Presentation of Case

A six-year-old girl (21 kg of weight, 115 cm height) was scheduled for tonsillectomy for chronic tonsillitis. Pre-operative investigations indicated that the child was healthy and preanaesthetic evaluation was unremarkable. Pre-anaesthetic serum sodium (NA), potassium (K), and chloride (Cl) content were 139 mmol/l, 4.0 mmol/l, and 105 mmol/l, respectively. The duration of fasting was over 6 hours. Pre-medication was not given before the operation, and the child became anxious and crying out loudly when arrived at the operating room.

The patient was monitored with electrocardiography, pulse oximetry and non-invasive blood pressure measurements. Anaesthesia was induced with thiopental sodium (100 mg, 5 mg/kg) and fentanyl (100 µg, 5 µg/kg). After successful mask ventilation with oxygen, rocuronium (20 mg, 1mg/kg) was given intravenously, and the patient was ventilated with oxygen, nitrous oxide and sevoflurane. Orotracheal intubation was performed with 5.0 mm internal diameter endotracheal tube. Mask ventilation and orotracheal intubation were done without any difficulties. The operation and anaesthesia time were 40 minutes and 65 minutes, respectively. Ringer's lactated solution was infused with 200 ml during the fasting period, and 150 ml during the operational phase. After the operation, the patient was very anxious and crying severely at the post-anaesthetic care unit. However, her state of consciousness and respiration were good, and she was transferred to the general ward after 30 minutes. At ward, ringer's lactated solution was infused at 60 ml per hour (3 ml/kg/hour).

After four hours of operation, the patient was crying severely and vomited three times with

abdominal pain. Physical examination revealed abdominal distension as well as decreased bowel sound. The abdominal x-ray showed paralytic ileus along with a large amount of gastrointestinal gas (Fig. 1). In consultation with a pediatrician, Levine tube was inserted to for gastric decompression. After seven hours of operation, the patient suffered from drowsiness and generalised seizure for 3 minutes. Immediately, lorazepam (2 mg, 0.1 mg/kg) was administered intravenously and the patient was transferred to the intensive care unit with continuous oxygen supply via nasal cannula. The blood electrolytes measured at this time were: na= 120 mmol/l, k= 3.0 mmol/l, cl= 90.0 mmol/l. A total of 800 ml of ringer's lactated solution was administered since pre-operative fasting period. The maintenance fluid was changed to 0.9% saline with potassium chloride at the rate of 40 ml per hour (2 ml/kg/hour), and electrolyte correction started with 3% saline. Saline (3%) was infused at the rate of 5 – 20 ml per hour (0.25 – 1 ml/kg/hour) with check-up for electrolytes and serum concentration of sodium was increased after infusion of 3% saline for 10 hours. The infusion rate for na was 0.42 – 0.78 mmol/kg/hour. Serum na concentration at 17 and 24 hours of post-operative period was 125 mmol/l and 134 mmol/l, respectively. The urinary output was not measured until seizure, and the urinary output from postoperative 7 hours to 17 hours was 1100 ml. The urinary na was 81 mmol/l at postoperative 17 hours.

Cerebral computed tomography (CT) and magnetic resonance imaging (MRI) were performed to confirm the central pontine myelinolysis (PDE), which may be caused by excessive central secretion of ADH and rapid correction for hyponatremia and doesn't showed any significance. The child was discharged on 5th day of post-operation and recovered well without any neurological complications.

2. DISCUSSION

Hyponatremia is usually defined as serum sodium < 135 mEq/L [2]. Most hyponatremia has mild symptoms and improves spontaneously, but severe hyponatremia has a mortality rate of ~ 60 times higher in compared to normal patients [3]. Symptoms may be seen in hyponatremia includes instability, nervousness, headache, helplessness, nausea, and vomiting. Central nervous symptoms predominately cause severe hyponatremia including; lethargy, headache, nausea, vomiting, disorientation, agitation,

seizures, coma, cerebral herniation and respiratory arrest [2,4].

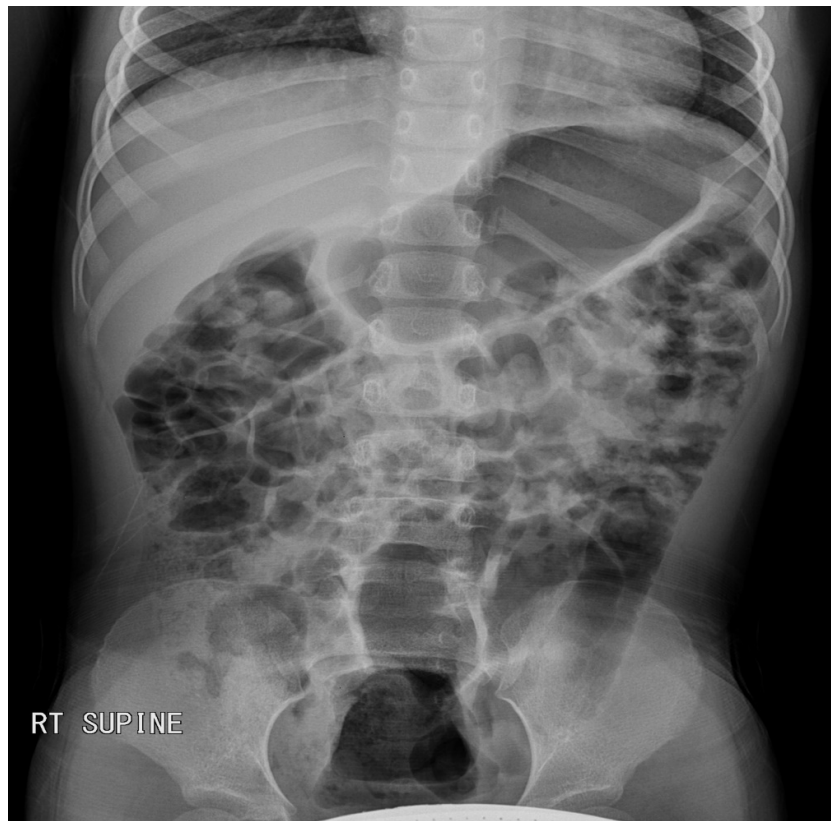
Hyponatremia occurred after surgery is caused by water intoxication through excessive water ingestion, that exceeds the ability of kidneys to excrete, even though the total sodium amount is normal [1,5]. Therefore, hyponatremia usually occurs after surgery, after administration of hypotonic fluid such as a glucose solution containing low or no electrolyte [1]. In addition, hyponatremia can be occurred due to an abnormal increase in ADH after surgery [6,7]. This might be attributed due to an increase in osmolarity, but non-osmotic stimuli such as positive pressure ventilation during surgery, hypoxia, postoperative state, pain, stress, nausea, vomiting, and other stimuli may also increase the secretion of ADH [8,9].

Hyponatremia occurred despite using the isotonic fluid until 2 hours before the operation and 7 hours after the operation. In addition, there is no possibility of water intoxication since the patient did not ingest or administer a large amount of water pre- or post-operation. However, severe stress, vomiting, pain, fear, and reduced

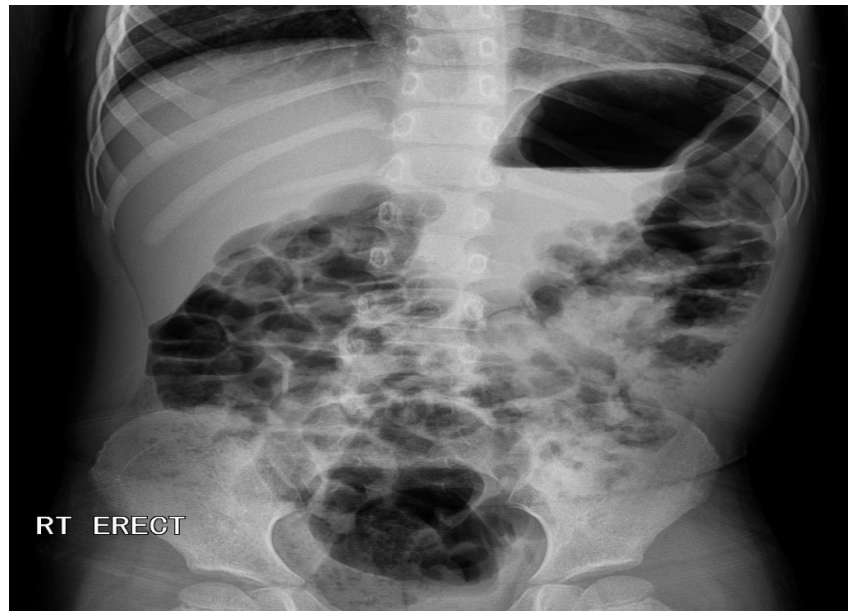
pressure on the heart due to positive pressure ventilation during surgery may also have stimulated ADH secretion. In this case, post-operative paralytic ileus also caused electrolyte and fluid loss, and the pain and vomiting symptoms may have stimulated ADH secretion.

The cause of postoperative ileus is numerous. Post-operative increase in sympathetic tone is the cause of inhibition of normal bowel motility. Operations that need bowel manipulation are also known to cause transient changes to immune function that can promote bowel dysmotility, and opioid have significant inhibitory effects on bowel activity [10]. In this case, N₂O used during inhalation anaesthesia may have increased the gas volume in the gastrointestinal tract [11], inhalation anaesthetics and fentanyl may also contribute to gastrointestinal motility by lowering gastrointestinal motility and gastric emptying [12]. A large amount of intragastric gas associated with pain-induced sympathetic stimulation and paralytic ileus may directly reduce gastrointestinal motility.

The intestinal gas is caused by swallowing the mouth (70%), diffusion from the blood into the



(a)



(b)

Fig. 1. Abdominal radiograph shows severe ileus with massive air in stomach, small bowel and large bowel (a) Supine view, (b) erect view

gastrointestinal tract (20%) and bacterial fermentation (7-10%) [13]. Additionally, the possibility of air inflation during intubation could be considered. In this case, the mask ventilation of the patient was very easy, and the intubation was done at once without gastric intubation. In addition, as the patient had no underlying disease or habit which had a large amount of gas in the gastrointestinal tract, the authors reported that the patient was crying and swallowing extremely before and immediately after surgery. It is assumed that a large amount of aerophagia occurred during the process.

Acute hyponatremia with neurological symptoms within 12 hours has a high risk of cerebral oedema, brain hernia, and mortality, therefore hypertonic saline should be administered to prevent rapid osmotic pressure differences between the brain and plasma. It is also reported that rapid correction of serum sodium value may lead to central pontine myelinolysis, so it should be administered slowly to raise the serum sodium concentration within 1-2 mmol/L hourly [14,15].

3. CONCLUSION

The patient had severe hyponatremia after surgery despite using isotonic fluid. This might be due to the electrolyte and fluid loss due to

paralytic ileus seen in the patient and inappropriate secretion of ADH for post-operative state, pain, nausea, vomiting and stresses. The child was crying severely due to anxiety and pain during pre- and post-operation period in compared to other cases, and it seemed that she swallowed a large amount of air during the process. Therefore, the anesthesiologist should be more actively involved in patient's anxiety and pain relief during pre- and post-operation period, and the possibility of post-operative hyponatremia should be considered in advance.

CONSENT AND ETHICAL APPROVAL

According to the policy of my hospital, consent or ethical approval is not required for this case report.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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