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Does Hyponatremia Matter in Orthopedic Patients and How Should We Deal with It? Prevalence, Timing, Causes and Outcomes of Hyponatremia in Hospitalized Orthopaedic Surgery Patients

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Introduction

Hyponatremia, defined as serum sodium <135, has been associated with increased mortality in surgical orthopedic patients [1]. This article describes an investigation done at Penn State Hershey Medical Center over one year with 1067 surgical orthopedic patients. The purpose of the study was to determine the prevalence, timing, causes and outcomes of hyponatremia in this population.

Of the 1067 patients, seven percent presented to the hospital already hyponatremic and thirty percent became hyponatremic mostly within the first forty-eight hours post-operatively. Seventy-eight percent of patients with hyponatremia were discharged from the hospital still hyponatremic.

After evaluating medications, comorbidities, weight and gender, older age was found to be the most significant variable for patients presenting with hyponatremia (p=0.003). Compared to patients who maintained normonatremia, average age 60 years old, patients who presented with hyponatremia were on average 67 years old. Age was also a significant factor in patients who developed hyponatremia post-operatively, average age 62 years old (p=0.012). Spine surgery and hip arthroplasty were most often associated with hyponatremia (p<0.001).

The amount of lactated ringers (LR) solution (sodium content 130 mEq/L) infused during surgery was also significantly related to the development of hypernatremia. The Odds Ratio of developing hyponatremia per 10 ml/kg LR infused was 1.16, 95% CI=1.05 to 1.27, p=0.002. Patients who presented to the operating room already hyponatremic received the least amount of LR and had the least decrease in their postoperative serum sodium level (2.2 $\pm$ 2.5 mEq/L). Patients who became hyponatremic postoperatively had the greatest decrease in serum sodium (6.6 $\pm$ 2.7 mEq/L) and received the most LR. In the bivariate analysis, operating time, blood loss and LR solution were statistically significant. However, in the final multivariable logistic regression analysis, only the amount of LR solution remained significant.

Both groups of patients with hyponatremia had significantly longer length of hospital stays and higher hospital costs. After correcting for the effects of age, comorbidities and medications, those patients who presented to the hospital with hyponatremia had a higher rate of hospital discharges to skilled nursing and rehabilitation facilities.

Two major factors play a role in developing hyponatremia in the post-operative orthopedic patient. The first is blood loss hypovolemia which triggers the release of arginine vasopressin (AVP, also called antidiuretic hormone, ADH) that increases water resorption in the kidney in order to maintain blood pressure. Normally, AVP is released in response to elevated serum osmolarity, increasing water retention and increasing the thirst drive. Surgery however, produces non-osmotic stimulus for AVP release. Positive pressure ventilation, stress, nausea, pain, fever, proinflammatory cytokines, and pain medications are examples of non-osmotic stimulants for AVP secretion. This non-osmotic, non-hypovolemic stimulus of AVP is termed SIADH (syndrome of inappropriate ADH.)For hypovolemia, resuscitation with 1-2 L of high sodium containing fluid like normal saline (0.9% saline) is the treatment of choice. However, for euvolemic patients who have a nonosmotic stimulus for AVP release, infusing normal saline can actually lower their serum sodium even lower, as the kidney will hold onto more of the water than the sodium. For these patients, fluid restriction and high sodium diet which can include sodium-chloride tablets 6-9gms per day in divided doses is the treatment of choice. To determine which mechanism is at play in the patient, an algorithm using the serum and urine osmolarity, and urine sodium can be used.

Hyponatremia is frequently present in orthopedic surgical patients. It is associated with adverse outcomes. Avoiding hypotonic and sodium-poor solutions and even excessive amounts of isotonic fluid can help prevent hyponatremia in the perioperative setting and improve clinical outcomes. Once hyponatremia occurs it is important to assess the mechanism causing the hyponatremia. If the patient is under-resuscitated, isotonic saline infusion is required. If the patient is euvolemic with SIADH, then water restriction and sodium replacement is necessary. Understanding the mechanism of hyponatremia in orthopedic patients and being attentive to perioperative intravenous fluids can make a difference in patients' clinical outcomes.

Reference

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