FREQUENCY OF DYSNATREMIA AND DYSKALEMIA IN CARDIAC SURGICAL INTENSIVE CARE UNIT

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ABSTRACT

Objective: To determine the frequency of dysnatremia and dyskalemiain cardiac surgical intensive care unit patients and to identify the factors associated with the changes in potassium and sodium levels.

Study design: Cross Sectional study.

Place and duration: Cardiac surgical intensive care unit (ICU) of Armed Forces Institute of Cardiology / National Institute of Heart Diseases (AFIC/NIHD) from July 2013 to November 2013.

Patients and Methods: Post-operative patients in cardiac surgical intensive care unit were selected through non probability convenient sampling. Demographic and clinical data was collected for all patients including: age, sex etc. Additionally, laboratory data such as potassium and sodium serum concentrations were recorded of day one of the first five post operative days.

Results: Out of 100 patients, 51% had dyskalemia, 33% had episodes of hypokalemia, and 19% had hyperkalemia. On the other hand 79% patients had dysnatremia, among them 71%had hyponatremia, and 8% had hypernatremia.

Conclusion: Dyskalemia and dysnatremia are common problems in cardiac surgical ICU with higher frequency of hyponatremia as compared to hypernatremia, and hypokalemia as compared to hyperkalemia

Keywords: Hyperkalemia, Hypernatremia, Hypokalemia, Hyponatremia, Intensive care

INTRODUCTION

Hyponatremia is decrease in serum Na concentration < 135 mmol/l caused by an excess of water relative to solute. Low plasma [Na+] represents a relative water excess in conjunction with impaired ability of the kidney to excrete electrolyte-free water. Removal of excess water by the kidney requires urinary dilution, which is compromised in virtually all patients in the ICU[1]. Heart failure, sepsis, shock, and multiple organ dysfunction syndrome impair glomerular filtration and enhance sodium and water reabsorption at the proximal tubule[2].Loop diuretics, thiazides, osmotic diuretics, and tubulointerstitial pathology reduce the reabsorption of sodium and chloride in the diluting segment;[3] and nonosmotic stimuli for vasopressin production and hypovolemia lead to increased water reabsorption in the collecting duct[1].

Hypernatremia is serum Na concentration > 150 mmol/l. Predisposing factors include the administration of sodium bicarbonate solutions to correct metabolic acidosis; renal water loss through a concentrating defect from renal disease or the use of diuretics or solute diuresis from glucose or urea; gastrointestinal fluid losses through nasogastric suction and lactulose administration, and water losses through fever, drainages, and open wounds[2].

Hypokalemia is defined as a serum potassium concentration less than < 3.5 mmol/l [3]. Major causes of hypokalemia include low dietary potassium intake, shift into the intracellular compartment, extrarenal potassium loss, and renal potassium loss[1]. Diuretics increaserenal potassium loss by inhibiting sodium reabsorption in the loop of Henle and in the distal nephron.

Hyperkalemia is defined as a serum potassium concentration greater than 5.0 > 5.0 mmol/l[3]. Hyperkalemia isobserved with the ingestion of either potassium supplements[4]or salt

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Received: 05 Feb 2014; Accepted: 05 Mar 2014

substitutes, or with the intravenous administration of a bolus of potassium chloride. Acute or chronic renal failure, hypoaldosteronism and potassium-sparing diuretics reduce the urinary excretionof potassium[5].

The risk of hyperkalemia is increased by the presence of a significant renal failure.[6] A shift of evensmall amounts of potassium from the intracellular to the extracellular compartment markedly increases kalemia, but not the total body potassium.

Table-1: Association of dyskalemia and dysnatremia among patients (n = 100)

Dyskalemia	Hypokalemia	Hyperkalemia	Normokalemia	*p* values
Hyponatremia	17%	13%	41%	0.034
Hypernatremia	4%	2%	2%	
Normonatremia	12%	3%	6%	

Table-2: The risk of occurrence of dyskalemia in ICU patients in association with comorbidities, GI complications, medications and replacement therapies

Variables	Hypokalemia	Hyperkalemia	P values
Renal impairment	6 (18%)	6(33%)	0.829
Diabetes mellitus	7 (21%)	6 (33%)	0.342
Hypertension	15 (45%)	9 (50%)	0.756
Pulmonary disease	3 (9%)	2 (11%)	0.817
Fever	15 (45%)	5 (28%)	0.217
Diarrhea	4 (12%)	Nil	0.124
Normal saline (only)	2 (6%)	2 (11%)	0.521
Ringer lactate (only)	21(64%)	12 (67%)	0.829
Normal saline + ringer lactate	10 (30%)	4(22%)	0.536
Lasix	27 (82%)	17 (94%)	0.210
Potassium replacement therapy	28 (85%)	7 (39%)	< 0.001

Table-3: The risk of occurrence of dysnatremia in ICU patients in association with comorbidities, GI complications and medications

Variables	Hyponatremia	Hypernatremia	P values
Renal impairment	9 (13%)	4 (50%)	0.122
Diabetes mellitus	18 (25%)	2 (25%)	0.983
Hypertension	30 (42%)	6 (75%)	0.077
Pulmonary disease	4 (6%)	2 (25%)	0.049
Fever	19 (27%)	7 (88%)	0.0005
Vomiting	4 (6%)	Nil	0.466
diarrhea	3 (4%)	Nil	0.553
Normal saline (only)	5(7%)	Nil	0.438
Ringer lactate (only)	47(66%)	5 (62%)	0.834
Normal saline + ringer lactate	16(22%)	3 (38%)	0.348
Lasix	65 (92%)	8(100%)	0.392

PATIENTS AND METHODS

This cross-sectional study was carried out at cardiac surgical intensive care unit of Armed Forces Institute of Cardiology / National Institute of Heart Diseases (AFIC/NIHD) in Rawalpindi, Pakistan from July – Nov 2013.

Post-operative patients in cardiac surgical intensive care unit were selected through non probability convenient sampling. Patients who stayed < 48 hours in Intensive Care Unit were excluded from the research. Demographic and clinical data was collected for all patients including: age, sex and etc. Additionally, laboratory data such as potassium and sodium serum concentrations of day one were recorded. Normal serum concentrations of sodium and potassium were considered as 135-150 mmol/l and 3-5.5 mmol/l, respectively.

Co morbidities including renal impairement, diabetes mellitus, hypertension, pulmonary disease (mechanical/ventilator) were observed in addition to fever, diarrhea and vomiting. Medical profiles were screened for the presence of potassium replacements, loop diuretics, normal saline and ringer lactate. Data had been analyzed using Microsoft excel 2007. Descriptive statistics were used to describe the results. Chi-square test was applied to study association of dysnatremia and dyskalemia with different variables. A *p*-value < 0.05 was considered as significant.

RESULTS

Total 100 patients were included in the research. The mean age of the patients in the study group was 48.34 years (range: 16-75). Among the study group 76% were male and 24% were female. The average weight of the group was 68.62 kg (range: 32-100) and average height 159.69 cm (range: 183-148). 68% of the patients operated were suffering from TVCAD and 11% from the DVCAD

Out of 100 patients, 49% patients are normokalemic (3.5 - 5 mmol/l). Hypokalemia (K<3.5 mmol/l) developed in 33% patients and hyperkalemia (K>5 mmol/l) developed in 18% patients. Whereas 21% patients were normonatremic (135- 150 mmol/l) and 79% patients acquired dysnatremia, 71% patients acquired hyponatremia (Na < 135 mmol/l), and 8% patients acquired hypernatremia (Na > 150 mmol/l). (Table-1.)

Table-2 shows the risk of occurrence of dyskalemia in ICU patients in association with comorbidities, GI complications, medications and replacement therapies. Table-3 shows the risk of occurrence of dysnatremia in ICU patients in association with comorbidities, GI complications, medications and replacement therapies

DISCUSSION

Hyponatremia is the most common electrolyte disorder in hospitalized patients. Up to 40% of the overall population of hospitalized patients has hyponatremia at admission[7]. In our study 79% of the patients had dysnatremia, 90% (71) of them acquired hyponatremia. Hyponatremia may be due to chronic organ dysfunctions (that is heart failure or liver dysfunction) but also du to diuretic use, syndrome of inappropriate antidiuretic hormone (ADH) secretion, adrenal insufficiency, and cerebral or renal salt wasting syndromes[8,9]. In our study 13% of hyponatremic patients were suffering from renal impairment, 42% from hypertension, 25% from diabetes mellitus, 27% from fever, 5% from pulmonary disease and 3% from diarrhea.

Several prospective studies in children and adults have shown that administration of 0.9% NaCl is effective prophylaxis against the development of hyponatremia. Even in patients with SIADH and hyponatremia, administration of normal saline does not aggravate hyponatremia[21]. A meta-analysis of 550 postoperative patients was conducted, 50 of whom were children, managed with either 0.9% NaCl or a more-hypotonic fluid. Hyponatremia was effectively prevented by 0.9% NaCl, whereas more hypotonic fluids including Ringer's lactate consistently caused a drop in serum sodium level[22]. Ringer's lactate, which has a sodium concentration of 130 mmol/l, is hypotonic to

plasma water and can produce hyponatremia[23]. 92% of them were consuming lasix, 66% ringer lactate only, 5% normal saline only and 16% were consuming both (normal saline and ringer lactate)

Although less frequent than hyponatremia, several studies demonstrated hypernatremia to be common at ICU[10–13]. Since thirst and free access to water are the most important mechanisms that prevent hypernatremia, critically ill patients and older patients are at high risk for this disorder[10,8]. Higher prevalence has been reported in geriatric or critically ill patients[14–17]. In our study 10% had hypernatremia. According to Palevsky[18], water intake is also impaired in hospitalized patients because of debility, altered sensorium, sedation, or intubation. These patients are at increased risk for hypernatremia if care is not taken to prescribe adequate free water replacement. Increased free water losses may occur as pure water loss (fever, hyperventilation, diabetes insipidus) or the result of hypotonic fluid losses (burns, gastrointestinal losses, diuretic therapy, osmotic diuresis). Our study also demonstrates a close association between hypernatremia and the risk factors as 50% of hypernatremic patients where suffering from renal impairment, 75% from hypertension, 25% from diabetes mellitus, 88% from fever, 25% from pulmonary disease. 94% of them were consuming lasix, 63% ringer lactate only and 37% were consuming both normal saline and ringer lactate.

In our study 51% of the patients had dyskalemia of them, 19% had hyperkalemia. According to Kokko and Tannen,[19] hyperkalemia is most common seen in the setting of renal insufficiency and acute renal failure is frequently seen in ICU patients in our study 33% of Hyperkalemic patients were suffering from renal impairment, 50% from hypertension, 33% from diabetes mellitus, 15% from fever, 11% from pulmonary disease. Ninety four percent of hyperkalemic patients were consuming lasix, 39% potassium replacement therapy, 67% ringer lactate only, 11% normal saline only and 22% both (normal saline and ringer lactate).

A retrospective analysis of approximately 58000 hospitalized patients over a 3-year period revealed that 20% of patients had a serum potassium concentration less that 3.5 mmol/l during their hospital admission[20]. In our study percentage of hypokalemia is increased to 33% in which 18% of hypokalemic patients where suffering from renal impairment, 45% from hypertension, 21% from diabetes mellitus, 45% from fever, 7% from pulmonary disease and 12% from diarrhea.

Eighty two percent of hypokalemic patients were consuming lasix, 85% potassium replacement therapy, 64% ringer lactate only, 6% normal saline only and 30% both (normal saline and ringer lactate).

CONCLUSION

Dyskalemia and dysnatremia are common problems in cardiac surgical ICU with higher prevalence of hyponatremia as compared to hypernatremia, and hypokalemia as compared to hyperkalemia

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