IMPACT OF HYPERNATREMIA & HYPONATREMIA IN CRITICALLY ILL PATIENTS

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ABSTRACT

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Abstract: ***Background: -*** Hyponatremia & hyperntremia are common in patients admitted in intensive care unit (ICU) with prevalence approaching 20-30%. Recent data reveal that both hypo-and hypernatremia present on admission to or developing in the ICU are independent risk factors for poor prognosis

Objective:- Relation of sodium disorders to length of ICU stay, Duration of mechanical ventilation and Mortality in ICU.. ***Methods: -*** study was conducted on 400 patients admitted in a medical-surgical ICUs in Kasr AL Aini Teaching hospital during the period from 1 st of July 2011 till December 2011.All patients admitted to the ICU during the period of the study were included. **Exclusion criteria** 1. Patients stay less than 24-hours in the ICU.2. Patients who received renal replacement therapy during their ICU admission.3. Patients who experienced multiple sodium disturbances (hypernatremia & hyponatremia) during their ICU stay. The following data will be collected, Demographic (age, sex) ,Clinical (admission diagnosis, admission Acute Physiology and Chronic Health Evaluation (APACHE) II score, Vital signs 12-lead ECG and Serum Na: Measure serum sodium directly using ion-specific electrodes to eliminate the pseudohyponatremia, laboratory artifact seen in hyperproteinemia and hyperlipidemia. Serum sodium is measured at 12-hr interval.

Results: Our results demonstrate that hyponatremia and hypernatremia are common in critically ill patients. We identified 137 (34.25 ٪) patients with hyponatremia and 63 (15.75٪) patients with hypernatremia. We could observe that increasing APACHE II scores, fluid balance disturbances, and mechanical ventilation are associated with ICU sodium disturbances.Patients with hypernatremia and hyponatremia had higher APACHE II scores compared with eunatremic patients (19, 15 and 10, respectively p=0.001). Our results are in agreement with the report of Stelfox et al in 2008. The length of ICU stay was

longer in hypernatremic and hyponatremic patients compared with eunatremic patients (14 and 11 versus 5 days,respectively , p= 0.0001). There were higher incidence of mortality in patients with hypernatremia (39.7٪) and hyponatremia (19٪) compared with eunatremic group (13%) (p= 0.0001). An observation is that patients with hypernatremia carry the highest mortality risk. ***Conclusion:-*** Our study confirmed the association between sodium disturbances and poor survival outcomes among critically ill patients. Our data indicates that hypernatremia and hyponatremia were independent risk factors that affect the length of stay and mortality in the ICU.

Key words:- Hyponatremia , hyperntremia & APACHE II score

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Abbreviations

ACE	Angiotensin-converting enzyme
ADH	Antidiuretic hormone
AIDS	Acquired immune deficiency syndrome
AQP	Aquaporin
ANP	Atrial Natriuretic Peptide
ARC	AIDS-related complex
AVP	Arginine Vasopressin
AVPR2	Arginine vasopressin receptor 2
BNP	Brain Natriuretic Peptide
CHF	Congestive heart failure
CNS	Central Nervous System
COPD	Chronic obstructive pulmonary disease
CSW	Cerebral Salt Wasting
DDAVP	Desmopressin acetate
EABV	Effective arterial blood volume
EAH	Exercise-associated hyponatremia
ECF	Extra-Cellular Fluid
ECV	Extracellular Volume
GFR	Glomerular Filtration Rate
HHS	Hyperosmolar hyperglycemic syndrome
ICF	Intra-Cellular Fluid

ICU	Intensive Care Unit
IDDM	Insulin dependent diabetes mellitus
JG Cells	Juxtaglomerular Cells
LOS	Length of stay
MV	Mechanical ventilation
NDI	Nephrogenic diabetes insipidus
NIDDM	Non insulin dependent diabetes mellitus
NSAIDs	Nonsteroidal anti-inflammatory drugs
Posm	Plasma Osmolarity
SIADH	Syndrome of Inappropriate Antidiuretic Hormone
TURP	Transurethral resection of the prostate
VRAs	Vasopressin receptor antagonists
VWF	Von Willebrand Factor

Introduction

Introduction

Hyponatremia & hyperntremia are common in patients admitted in intensive care unit (ICU) with prevalence approaching 20-30%. Recent data reveal that both hypo-and hypernatremia present on admission to or developing in the ICU are independent risk factors for poor prognosis **(Rosner MH& Ronco C, 2010)**.

The imperative to develop strategies to detect, prevent or correct ICU-acquired sodium disorder is made clearer by a series of recent reports demonstrating a strong, independent correlation between the development of dysnatremia and poor outcome **(Funk GC et al.,2010).**

Hypernatremia a water balance disorder encountered in about 6 to 9% of critically ill patient, has been associated with an increased risk of death and complication in some recent retrospective studies in general intensive care units **(Stelfox HT et al.,2008).**

Because thirst is powerful protective mechanism, restricted access to water is nearly always necessary for the development of hypernatremia. Several factors can predispose patient in ICU to hypernatremia: the administration of hypertonic sodium bicarbonate solution; renal water loss through a concentrating defect from renal disease or the use of diuretics or solute diuresis from glucose or urea in patients on high protein feeds or in a hypercatabolic state

Hyponatremia is the most common electrolyte disorder and, depending on the definition and frequency of testing, has recently been reported to occur in about 30-40% of hospitalised patients **(Upadhyay A et al.,2006).**

For hyponatremia to develop, a relative excess of water in conjunction with underlying condition that impair the kidney's ability to excrete water is required. Stimuli for the release of arginine vasopressin (AVP) and hence impairment of water excretion are so frequent in

hospitalized patient, especially in those in the ICU, that virtually all patients are at risk of hyponatremia. Thus, the most important factor resulting in hospital-acquired hyponatremia is administration of hypotonic fluids to a patient with impaired urine-diluting capacity **(Ayus JC et al.,2008).**

Treatment of either hypo or hypernatremia can be associated with serious complications, particularly if rapid correction is done. Therefore, slow correction is a must in the treatment (***Stelfox et al., 2008).***

Aim of the work

To study relation of sodium disorders to:

1. Length of ICU stay.
2. Mechanical ventilation.
3. Mortality in ICU.

Chapter 1:
Sodium homeostasis

SODIUM HOMEOSTASIS

The body contains 45-75% by weight of water; the range reflects the differences in body composition between the different demographic groups, male and female, young and old. Adipose tissue contains up to 10% water; lean tissue contains 70-75% water. In young adult males, body water is about 60% of body weight and in young adult females, who have a higher percentage of body weight as fat, about 50%. With age, the proportion of body weight made up of water decreases because lean tissue mass declines and tends to be replaced with adipose tissue. In the newborn, the figure is nearer 80-85% owing to a relative expansion of the extracellular fluid (ECF) volume **(*Iain Campbell*,2009).**

Two main fluid spaces exist – the intracellular fluid (ICF) and the extracellular fluid (ECF)**.** The latter is further separated into the intravascular space (plasma volume), the interstitial space (which includes lymph) and transcellular fluid, which is formed by the transport activity of cells: pleural, pericardial, peritoneal, cerebrospinal and gastrointestinal fluids. **Table (1-1)** summarizes the water content of the body and the distribution of fluid between the main body spaces: the proportion of body water to total body weight is affected by age, gender and fat content **(Michael D. Penney,2008)**.

Intracellular Fluid Compartment

About 28 of the 42 liters of fluid in the body are inside the 75 trillion cells and are collectively called the intracellular fluid. Thus, the intracellular fluid constitutes about 40 percent of the total body weight in an “average” person.

The fluid of each cell contains its individual mixture of different constituents, but the concentrations of these substances are similar from one cell to another. In fact, the composition of cell fluids is remarkably similar even in different animals, ranging from the most primitive microorganisms to humans. For this reason, the intracellular fluid of all the different cells together is considered to be one large fluid compartment **(Guyton AC and Hall JE ,2006)**.