SOME ELECTROLYTE DISTURBANCES IN MECHANICALY VENTILATED PATIENTS

Thesis

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Degree of Chest Disease

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The body is generally tolerant of our crude attempts to control its fluid and electrolyte content, particularly when the kidneys are functioning normally. However if the basic principles of management are not understood, or careless mistakes are made, serious abnormalities will result. The important constituents to be considered are water, sodium, potassium, magnesium and phosphate. (Simmons, Shkaduik, 1964)

It is worth stressing that severe alkalaemia associated with potassium and chloride losses may occur after assisted ventilation and can precipitate serious cardiovascular and neurological complications (Hudson et al., 1973).

The vast majority of intensive care patients are unable to drink and will require intravenous fluid replacement but most intensive care patients are stressed and tend to retain both sodium and water. This is exacerbated by artificial ventilation. (Shizgal and Frose, 1980).

There are many reasons for hypophosphataemia in ventilated patient in an intensive care unit including lack of nutrition, inadequate phosphate supplement, therapy with nebulised B2 agonists and raised catecholamine (James, 1977).

Phosphate depletion is associated with a decreased concentration of adenosine triphosphate in skletal muscle and may result in muscle weakness thus the patient becomes dependent on mechanical ventilation until the serum phosphate concentration comes within the normal range (Tommy storma, 1984).

The aim of the following work is to study the effect of mechanical ventilation on the serum level of sodium, potassium and phosphaorus in the respiratory intensive care unit.

REVIEW OF LITERATURE

Basic Data on Electrolytes

Electrolytes:

They are the chemical compounds dissolved in the body fluids. they are called electrolytes because they contain small electrically charged particlas called icns.

Pure distilled water has no electrolytes and does not conduct an electric current. If a small amount of sodium chloride is added to the distilled water, the resulting salt solution does conduct electricity.

When dissolved in water, many acids, bases and salts ionize and become electrolytes.

When electrolytes are disscolved in water, they split inter electrically charged atoms or groups of atoms. These atoms and groups of atoms that are referred to by the term icns.

Since ions have an electrical charge, they are classified as either negative or positive.

Negative ions are called anions, positive ions are called cations.

There are several ways to express electrolyte quantities.

The term milliequivalent has come into widespread use because it is convenient and precise and because electrolyte quantities can be expressed on the basis of their combining activity. The system of milliequivalents makes it possible to compare one compound directly with another. Electrolytes are usually measured in milliequivalents per liter (mEq/L) (Stroot et al., 1975).

The physiologic and chemical activity of electrolytes depend on:

1. Number of particles present per unit volume (moles or millimoles "mmol" per liter).

2. Number of electric charges per unit volume (equivalents or milliequivalents per liter).

3. Number of osmotically active particles or ions per unit volume (osmoles or milliosmoles (mo) per liter).

The use of terms grams or milligrams per 100 millititers expresses the weight of the electrolytes per unit volume but does not allow a physiologic comparison of solutes in a solution.

Mole:

Mole of a substance is the molecular weight of that substance in grams. Electrolytes of the body fluids than may be expressed in terms of chemical combining activity or "equivalents". An "equivalent" of an ion is its atomic weight expressed in grams divided by the valance (Schwartz et al., 1984).

Sodium and Water

Water Physiology

The kidneys of a normal 70-kg human will maintain a total body water volume of 42 liters. this is equal to approximately 60 percent of the total body weight. Twenty-eight liters of this water is intracellular contains potassium as its principal cation, and has an osmolality equal to that of the extracellular water. The 14 liters of extracellular water is composed of intravascular plasma water as well as interstitial water around cells. (Berl, 1976).

Patients may sequester large amounts of fluid in the skin, bowel, peritoneal cavity, or extremities. this fluid will have an electrolyte composition similar to plasma. this type of fluid loss is difficult to measure or even estimate. Measurement of cardiac filling pressures and cardiac output may be necessary to assess such a patient's volume status (Feig & Curdy, 1977).

Since the capillary wall does not restrict Na movement, an ultrafiltrate of plasma moves across the capillary membrane. The factors controlling ultrafiltrate movement of plasma across capillary membranes are the hydrostatic pressure the major outward driving force, the major inward flow of fluid (interstitial to vascular) is driven by the colloid osmotic pressure gradient. (Oh Carroll 1985).

The major function of Na andcl and HCo3- is to keep water out of cells, so mentain ECF volume.

The particles that determine ICF volume are large macromolecular anions and K+. (Kregenow, 1981).

There is an obligatory loss of 0.8L of water each day therefore, mechanisms are needed to ensure this minimum water intake and to excrete any excess water.

Adequate water intake is ensured by the CNS thirst center. A rise in tonicity of only 1.2% provides a powerful urge to drink. Antidiureti hormone (ADH) limits water excretion. A rise in the tonicity or a fall in the effective blood volume causes ADH release from the posterior pituitary. For dilute urine to be excreted, ADH must be absent. ADH produce urine with maximum osmolality and usually a minimum volume. (Jamison & Oliver, 1982).

Sodium Physiology

The body containe close to 40 mmol Na/Kg, and 94% is in the ECF. The major role of Na is to serve as an osmole restricted to the ECF Na content determines the ECF volume, with ECF volume expansion, There is excess total body Na, with ECF volume contraction thre is a Na deficit.

The renal response to ECF volume contraction is the excretion of NaCl -free urine. (Anderson, 1978).

The major renal mechanisms preventing Na excretion when the ECF volume is low are reduced GFR, enhanced proximal Na reabsorption, aldosteron-stimulated Na reabsorption and increased mudulary collecting duct Na reabsorption.

When Na loal is added, renal mechanisms are called into play to cause a naturesis, these include increased GFR, a relatively deminished proximal Na reabsorption, suppression of aldosterone release and the release of ANF (atrial naturitic factor) (Rector, 1984).

Hyponatremia

It is Na below lower limit of normal (136 mM)

Etiology:

Hyponatremia with serum osmolality not low:

a. Pseudohyponatremia: (In hyperlipidemia)

Na is dissolved only in the water phase of plasma. The presence of excassive quantities of nonaqueous volume in the plasma causes a fall in the Na: total volume ratio Na content is the same, it is just distributed in a different volume (Anderson, 1986).

b. *Hyponatremia due to hyperglycemia:*

In this case, the water content of the ECF rises because glucose draws water out of muscle cells by osmosis (Rose, 1986).

Hyponatremia with hypoosmolality:

a. *ECF volume contracted:* Hyponatremia is almost always due to reduced water excretion in the face of a hypotonic intake. Loss of Na lower the Na : H2O ratio and more indirectly result in ECF volume contraction and as a result, ADH release from posterior pituitary. ADH prevents the excretion of diluted urine and can produce hyponatremia.

b. *ECF volume Not Contracted:*

A patient need not have a reduced ECF volume to have ADH release. Even if the total ECF volume is normal or high, the vascular component may not be "Pumped in an optimum fashion" by the heart or the ECF volume is distributed such that there is insufficient volume in the vascular space. This occure in some oedema states (e.g. hypoalbuminemia), A second type of maldistribution occurs when the arterial volume is low and the venous volume is high (Robinson, 1985).