WATER AND ELECTROLYTE IMBALANCE IN HEAD AND NECK SURGERY

Essay

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presented by

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بسم الله الرحمن الرحيم

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صدق الله العظيم
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Fluid and electrolyte balance control is an integral part of the care of surgical patients. Many diseases, injuries and operative trauma often impose a great impact on the physiology of fluids and electrolytes within the body (Shires and Canizaro, 1986).

The proper management of fluid and electrolyte balance is an essential feature of good peri-operative care. Because many head and neck surgical procedures interfere with the patients' ability to ingest food and fluids for a protracted length of time, the otolaryngologist must develop skill in prescribing specific fluid and electrolyte therapy (Greenberg et al., 1986).

Pre and postoperative care in the patient undergoing head and neck surgery is dictated by the type and extent of the surgical procedure planned. If the patient is to undergo extensive laryngeal surgery or an operation that may produce fistulous tracts or inability to swallow for several days, this results in changes of distribution of fluid and electrolytes in the body. Surgery related to thyroid or parathyroid disorders, or pituitary surgery may also result in fluid and electrolyte imbalance (Marieb, 1981).Therefore, thorough understanding of fluid and electrolyte balance and hyperalimentation methods is one of the corner-stones of surgical management.

AIM OF THE ESSAY

Reviewing the literatures dealing with the problems of fluid and electrolyte balance in head and neck surgery, with spot light on the relevant points of the physiology and causes of water and electrolyte imbalance in head and neck surgical patients. Also, focusing on how to detect and to manage such problems.

REVIEW OF THE

LITERATURE

PHYSIOLOGY OF WATER AND ELECTROLYTE BALANCE

In an average young adult male, total body water (TBW) makes about 60% of body weight, and in the young adult female 55% (Bradury, 1973).

This may vary greatly among individuals primarily because of differences in the ratio of lean body mass to adipose tissue. The percentage of total body water is inversely proportional to the degree of obesity. Also, with increasing age, there is a steady decline in TBW as a proportion of body weight, it reaches a low value in geriatric patients of about 52% in men and 46% in women (Edelman and Leibman, 1959). Total body water may be divided into two major functional compartments. The intracellular compartment accounts for 55% of body water and the extracellular 45%.

Extracellular water is further divided into a rapidly equilibriating compartment (the functional extracellular fluid space), and a very slowly equilibriating space. The former is composed of plasma and interstitial fluid which together represent approximately 27% of TBW or 16% of body weight. Slowly equilibriating extracellular water is found in bone, cartilage, connective tissue and transcellular spaces where it is present as cerebrospinal fluid, synovial fluid and intraluminal fluid of the gastrointestinal tract. Practically speaking, slowly equilibriating extracellular water doesn't equilibriate with plasma, so, it does not enter into problems of fluid and electrolyte balance (Edelman and Leibman, 1959).

Electrolyte content:

Extracellular fluid:

The predominant cation of ECF is sodium, total body sodium is about 4500 mEq of which about 2800 mEq are exchangeable (Hays, 1972). Normal extracellular sodium concentration is 135 - 145 mEq/L. Other cations present in significant concentrations are potassium, 3.5 to 5.0 mEq/L and calcium 4.5 to 5.5 mEq/L. Major corresponding anions in ECF are chloride, 95 to 106 mEq/L and bicarbonate 22 - 28 mEq/L.

Intracellular fluid:-

Potassium and magnesium are the major cations of intracellular fluid and are present in concentrations of approximately 160 and 25 mEq/L respectively, sodium concentration is only about 10 mEq/L. The predominant intracellular anions are phosphate and sulphate, approximately 100 and 20 mEq/L respectively, bicarbonate and chloride together contribute about 10 mEq/L. Intracellular proteins exert a net negative charge of 55 mEq/L and makes up most of the difference between cation and anion content (Hays, 1972).

Osmotic pressure, Osmolality and tonicity:-

Osmotic pressure may be defined as the tendency of water to move across a semipermeable membrane from a more dilute to a more concentrated solution. It is measured as the difference in hydrostatic pressure necessary to prevent such movement. Osmolality is the concentration of the solute in solution/ Kg of the solvent.

The normal osmolality of both ECF and ICF is about 285 to 295 m Osm/Kg. Sodium salts account for 90 to 95% of the osmolality of plasma. Interstitial fluid, and potassium salts contribute a majority of intracellular osmotic forces. All solutions that have the same osmolality are isosmotic. An isotonic solution is one that is physiologically isosmotic with cell fluid, when it is substituted for ECF, there is no net transfer of water into or out of cells.

If ECF is made hypotonic or hypertonic, there will be a net movement of water into or out of cells until osmotic concentrations are equal.

However only water, and not sodium or potassium ions is free to move into and out of cells in order to restore osmotic equilibrium.

There is a slight difference in osmotic pressure between the intravascular and interstitial fluid compartments, owing to the higher concentration of protein within the intravascular space. This pressure is referred to as the colloid osmotic or oncotic pressure (COP), it is this difference in pressure that prevents excessive fluid loss from capillaries. In states of protein deficiency or abnormal capillary permeability to protein, plasma oncotic pressure is decreased (Pitts, 1974).

In most conditions, the plasma osmolality (P osm) may be estimated by the following formula:-

P Osm = 2 P_{Na} (mEq/L) + Blood glucose (mg/dl)/18 + BUN (mg/dl)/2.8 (Goldberg, 1981).

The tonicity or effective osmolality which is the concentration of those solutes which have the capacity to exert an osmotic force across membranes and thereby initiate a movement of water into or out of cells, depending upon the gradient. Thus, since urea and some other low molecular weight substances such as ethanol and methanol rapidly penetrate cells according to there passive concentration gradients, they exert no effective osmotic force across most body membranes (Goldberg, 1981).

Normally, the liver, kidney , and lungs modify the intravascular compartment. This compartment is in equilibrium with the other two compartments. Osmosis , diffusion, equilibrium, Starling's forces and sodium pump are factors important in physiological control of body fluids (Twigley and Hillman, 1985).

WATER BALANCE

Davidson (1987) stated that: in a healthy subject water intake and output vary considerably but average daily water requirement in an adult is about 1500 ml/m^2 or 2600 ml/day. Water intake is via oral fluids, the water content of food and from metabolism. He also mentioned that insensible water loss from body surface and lungs is about 1000 ml/day, water loss via the skin varies greatly depending on body temperature, muscular activity and environmental temperature and humidity. In temperate climates, it is about 600 ml/day. Saturation of expired air with water vapour results in about 400 ml loss /day via the lungs. The kidneys excrete about 1500 ml/day, excreting unwanted solutes by active transport. Gastrointestinal loss is about 100 ml/day.

Bevan (1978) stated that the control of water balance is dependent on the integration of thirst mechanisms, antidiuretic hormone secretion and the ability of the kidney to modify the concentration of the urine. He also mentioned that when osmolality is increased, ADH is released from the posterior pituitary gland. ADH acts at the collecting and to a lesser extent at the distal convoluted tubules, rendering them permeable to water which then passes into the hypertonic medullary interstitium to the renal venous circulation and so, a small volume of concentrated urine is excreted. Secretion of ADH persists until sufficient water is retained to restore plasma osmolality to normal values. The reverse occurs when osmolality falls.

Many non-osmotic factors are known to stimulate or inhibit ADH release, and several of these are important to fluid homeostasis of surgical patients. The most significant is the release of ADH in response to isosmotic contraction of extracellular water and / or plasma volume through aortic atrial , and renal baroreceptors. Also, pain, emotional stress, hyperthermia, drugs such as opiates, anaesthetics, B-agonists and cholinergic agents and renin-angiotensin