Chemistry essays - saline and fluids in the body

Saline and Fluids

Using saline as an example, outline the importance of solutions in the body and what is the concentration of ‘ normal saline’ and how the concentration of saline is controlled in the body and what effects on the cells an increase in saline concentration would have.

Our bodies are fifty tosixty percent water, which therefore makes water an essential fluid for ourbodies. The main transporting agent in our body is the cells, and solutions arenecessary to execute functions such as:

Chemical balance

Circulation of blood

Transporting nutrients to the cells

Elimination of waste

respiration

The main component ofthe blood, perspiration, saliva, mucus, lymphatic fluids and digestive juicesis water. The function of water also ensures the lubrication of the joints, that the muscles, skin, and organs is moisturized. The temperature of the bodyis also aided by water.

Two thirds of water is situatedwithin the cells – intracellular, and one third of water is found in the sitesbetween the cells – interstitial and in the blood plasma. The composition ofsolutes in the intracellular and extracellular water can vary. A highconcentration of potassium ions is found in the intracellular cells, and a highconcentration of sodium and chloride ion is found in the extracellular cells.

It is precarious to thesurvival of the human body that the accurate balance of fluids and salts ismaintained and the right pH – acid balance. If the body loses fluids and salts, then dehydration can occur, and this can cause the concentration of salts toalter causing electrolyte imbalance.

One of the mostimportant solutions in the body is saline, which is a solution consisting ofsodium chloride and distilled water. Salt plays a perilous function in the accurateoperation of the human body, as well as all other forms of life. The averageperson contains about eight ounces of salt, which facilitates muscles to contract, digestion to occur, the floe of blood, wounds to repair and fluids to beproperly regulated. A litre of isotonic or ' normal' (0. 9%) saline contains 154mmol of NaCI, comparable to 9 g of salt or 3. 6 g of sodium.

The regulation of salineand water equilibrium in the body is an example of homeostasis. Homeostasis isthe preservation of balance, or constant conditions, in a biological organismby means of habitual mechanisms that neutralize influences tending towarddisequilibrium. The correct composition of extracellular fluids and watercontent in the body is maintained by the important role played by the kidneys. Osmolarityis the amount of particles dissolved in a certain volume of fluid. Theosmolarity of fluid can be altered by the volume of fluid or by the quantity ofsolute molecules. In the duration of a day, the kidneys will manage 180 litersof blood, and will produce 1. 5 liters of urine. The volume of water excreted bythe kidney is regulated by the anti-diuretic hormone – (ADH: also referred toas vasopressin; diuresis means water loss and is therefore referred to as awater loss hormone.

If the concentration offluid in the body drops below normal, the osmoreceptors in the hypothalamuswill recognize the resulting increase in osmolarity. ADH will be released bythe hypothalamus, in response to the change in osmolarity. The amount of fluidvolume lost must be replaced by drinking additional fluid, thus ensuring thatosmolarity returns to equilibrium and recovering the fluid loss.

If the concentration offluid in the body increases above normal, this will also modify the osmolarityof the circulating fluids. The decrease in osmolarity is regulated by thehypothalamus, which stops producing ADH. In the absence of ADH, the kidney permitsfluid loss from the body. The kidney consists of numerous nephrons in which itfilters solutions, and then selectively reabsorbs or secretes different plasmacomponents. The entire composition of the nutrient molecules and most of thewater will be reabsorbed, and returned to the bloodstream.

The major extracellularsalt is NaCl. The levels of osmolarity of the circulating body fluids aredetermined by the sodium and the chloride content. The kidney establishes theconcentration of Na^{+} loss from the body (Cl^{-} or anadditional anion will proceed Na^{+}, so if Na^{+} levels aremonitored – anion levels counteract automatically). If there is inadequate Na^{+} inside the body, this will be identified by the kidney, which commences acomplex series of events, established as the renin/angiotensin/aldosterone pathway. In response to a decreased concentration of Na^{+}, the kidney dischargesrenin into the blood. Renin acts on a plasma protein, angiotensinogen changingit into angiotensin I

Angiotensin I is asubstrate for a changing enzyme, found widely in the lungs, which changes itinto angiotensin II. Angiotensin II has remarkable biological activity, causingthe release of aldosterone acting on the adrenal cortex. Aldosterone is ahormone that operates on the kidney to inhibit Na^{+} loss from thebody. Inversely, should there be an excess of Na^{+} in the body, adecrease in renin discharge will lead to a deterioration in the aldosterone concentrationsand an increase in Na^{+} deficiency in the urine. Variation in the Na^{+} concentration is a protracted process than that of circulating fluid levels andmay require hours to days for completion.

The obstacle between theextra – and intra – cellular compartments is known as the cell membrane. Watercan occur liberally through biological membranes but many solutes cannot. Whenone section has a larger concentration of solutes, the direction of the flow ofwater is from the section with the depleted concentration to the section withthe larger concentration. This process is known as osmosis. Osmosis is the migrationof water from an area of high water concentration through a semi-permeablemembrane to a region of low water concentration.

In a hypotonic solutionof saline, the concentration of the solute molecules outside the cells is lowerthan that the concentration of solutes inside the cell. This in turn willenable the water to diffuse into the cell, until equilibrium is established. This flow of water into the cell causes the cell to swell.

References

1. Stryer, L. Biochemistry (4th Edition). Freeman, New York. 2000

2. Campbell, M. K. Biochemistry, (2nd Edition) Saunders College Publishing, 1995

3. Parsons, R. GCSE Double Science: Biology Revision Guide – Higher (GCSE Double Science)Coordination Group Publications (2001)

4. Clancy, J. McVicar, A, Baird, N. Perioperative Practice: Fundamentals of HomeostasisRoutledge, an imprint of Taylor & Francis Books Limited (2002)

5. Revise ASBiology (Revise AS Study Guide S.) Letts Educational Ltd (2004)

6. Chiras, D. Human Biology: Health, Homeostasis and the Environment Jones and BartlettPublishers International (1994)