ASSESSMENT OF ELECTROLYTES FROM BODY FLUIDS TO CONTROL VARIOUS HUMAN DISORDERS

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ABSTRACT

Electrolytes are materials that carry electricity and are necessary for a number of processes, including as controlling pH levels, transferring nerve impulses, and preserving enough hydration. A study was conducted to analyze blood and urine samples of human subjects suffering from different disorders like Diarrhea or constipation, Fatigue, Headaches , Nausea and vomiting . Blood and urine samples were collected from 50 individuals suffering from various disorders and were residing in Sialkot region . Results obtained were correlated with variation of sodium, potassium, chloride, bicarbonate and calcium levels depending upon infections of human subjects. In order to buffer the blood and keep it from becoming too basic or acidic, electrolytes like phosphate and bicarbonate are useful. The body needs electrolytes to convey nerve impulses. Electrical impulses are the means by which the nervous system transmits signals from the brain to the body. Muscle weakness, cramping, and even convulsions may result from a disruption in nerve transmission caused by an imbalance in electrolytes.

Keywords; Human health electrolytes, Body pH, health disorder

INTRODUCTION

Cells use electrolytes, which are different kinds of ions like sodium, potassium, or chloride, to control the electric charge and movement of water molecules across the cell

membrane. The main ingredient in blood is water, and electrolytes are required for water to remain in the body's tissues and cells. The three major electrolytes involved in preserving the body's fluid equilibrium are sodium, potassium, and chloride. According to Dimeski (2012), potassium is the main electrolyte inside cells while sodium is the main electrolyte outside of them. By balancing out the body's positively charged ions, chloride is also a crucial electrolyte outside of cells and aids in maintaining appropriate fluid balance (Balk et al., 2017).

The transmission of nerve impulses inside the body depends on electrolytes, according to a paper by Berger et al. (2006). According to Brown et al. (2009) and Burger et al. (2011), the nervous system uses electrical impulses to transmit signals from the brain to the body. Electrolytes aid in the transmission of electrical impulses between nerve cells, especially sodium, potassium, and calcium. Nerve transmission can be interfered with without adequate electrolyte balance, resulting in cramps, muscular weakness, and even seizures (Binia et al., 2015; Bolland et al., 2014).

Electrolytes aid in regulating the body's pH levels, which are determined by the balance of acids and bases. They also assist maintain enough hydration and facilitate nerve communication. For optimum health, the body must maintain a pH of about 7.4, which is slightly alkaline. The blood is buffered by electrolytes like phosphate and bicarbonate, which keep it from becoming overly basic or too acidic (Casa et al., 2008; Chung et al., 2016).

Keeping the electrolyte balance in check is essential for general health and wellbeing. There are several causes of electrolyte imbalances, such as diarrhea, vomiting, excessive perspiration, and dehydration. A variety of symptoms, such as weariness, dizziness, disorientation, muscular weakness, and in extreme situations, cardiac arrest, can result from an imbalance in electrolytes (Cogswell et al., 2012; Dorner and Rieder, 2005).

Additionally, Egg et al. (2018) discovered that staying hydrated by consuming a lot of fluids—especially those that include electrolytes—is crucial to maintaining appropriate electrolyte balance. Because they can help replenish electrolytes lost via perspiration, sports drinks and electrolyte supplements can be especially beneficial for athletes or others participating in vigorous physical exercise. Maintaining electrolyte balance can also be aided by eating a well-balanced diet rich in fruits and vegetables.

One of the most crucial electrolytes for preserving the body's appropriate amounts of water is sodium. However, excessive salt consumption can raise blood pressure, which raises the risk of stroke and heart disease (Egg et al., 2019; Elin, 2010). It is advised to keep sodium consumption to a maximum of 2,300 mg daily, or 1,500 mg daily for people with high blood pressure or other medical disorders, in order to preserve a good sodium balance in the body (EU, 2012; Fang et al., 2016).

Another crucial electrolyte that facilitates the regulation of fluid balance in the body is potassium. Additionally, potassium affects how muscles contract and how quickly the heart beats. Eating a diet high in potassium can lower the risk of hypertension and assist maintain appropriate electrolyte balance. Sweet potatoes, avocados, bananas, and spinach are foods that are high in potassium. Another important electrolyte that is necessary for healthy bones, muscles, and nerve transmission is calcium (Glace, 2002). Osteoporosis risk can be decreased and appropriate electrolyte balance maintained by eating a diet high in calcium. Foods high in calcium include fortified cereals, leafy greens, and dairy products. (Graudal et al., 2012, Grossschadl et al., 2012). Therefore current study will be conducted with following aims and objective To assess level of electrolytes in the blood samples of various groups of human subjects, Assessment of electrolytes

from urine samples of human subjects , Investigation of various human disorders on basis of levels of electrolytes in human body.

MATERIAL AND METHODS

Sample collection and processing

Total 100 Blood and urine samples (50 each) were collected from human subjects suffering from different disorders like (1)Confusion and irritability, (2) Diarrhea or constipation, (3)Fatigue, (4)Headaches, (5)Nausea and vomiting. The samples were collected from different areas of Rawalpindi regions. The ethical committee of university granted permission to conduct research work on blood and urine samples of human subjects (Armstrong and Johnson (2018; Zhang, 2018). Blood samples were collected in syringes from veins of human subjects and transferred into a tube containing anticoagulant (preferably EDTA), mixed well in tube and were immediately centrifuged. Two milliliters of the material were placed in a simple gel tube, centrifuged for five minutes at 10,000 rpm, and then stored at a lower temperature until additional procedures were carried out. The analyzers were utilized to test the electrolytes in the blood samples' supernatant serum (Balk et al., 2017; Madias and Shah 2014).

In clinical laboratories, electrolyte analyzers are commonly used to asses the electrolyte levels in patients' blood samples. This information is critical for diagnosing and managing conditions such as dehydration , kidney and heart disorders and acid-base imbalance

The midstream urine samples were collected in a sterile container, centrifuged, and subjected to additional analysis using a RAL Ion SP3 Flame photometer and a biochemistry analyzer, respectively, to determine the concentration levels of electrolytes, specifically potassium (K) and sodium (Na), in the samples (Hamouti et al., 2014). The Beckman Coulter analyzer was used in

accordance with the manufacturer's instructions, and the analysis was conducted using proprietary Synchron buffer and reagents. When analyzing electrolytes from various samples, the ISE electrolyte buffer and ISE electrolyte analyzer were employed (Han et al., 2017).

Statistical analysis

After analysis of blood serum and urine samples data obtained statistically analyzed by using method reported by Steel and Torrie (1980)

RESULTS AND DISCUSSION

Samples of blood and urine were collected from different groups of human subjects , those were suffering health disorders like (1)Confusion and irritability, (2) Diarrhea or constipation, (3)Fatigue, (4)Headaches, (5)Nausea and vomiting were collected and analyzed (Hamouti et al., 2014 Han et al., 2017 Olza et al., 2017). Results regarding concentrations levels of sodium, Potassium, Calcium, Bicarbonates, Chloride and phosphates obtained from blood serum and urine samples of human subjects from Sialkot regions are presented in tables 1 to 5 and figures, 1 -5.

Table 1. **Average values of electrolytes analyzed from blood serum and urine of patients suffering from Confusion and irritability**.

Electrolytes	**Blood serum**	**Urine**	**Reference values**
Sodium(Na^+)	157.00 mmol/L	223mmol/L	Blood 135-145 mmol/L Urine 40-220 mmol/L
Potassium (K^+)	4.9 mmol/L	133 mmol/L	Blood 3.7 -5.1 mmol/L Urine 25.0-125 mmol/L
Chloride (Cl^-)	98.00 mmol/L	265.0 mmol/L	Blood 97.0-105.0 mmol/L Urine110.0-250.0 mmol/L
Bicarbonate (HCO^-3)	34 mmol/L	-	Blood 22-30 mmol/L Urine-
Calcium (Ca^{++})	11.2 mg/dl	8.5 (mmol/ L	Blood 8.5-10.2 mg/dl Urine Upto 7.49mmol/ L
Phosphate (PO_4)	4.9 mmol L	44. 00 (mmol/L	Blood 2.5 – 4.8 mmol/L Urine 12.90-42.0 mmol/L

Average values of electrolytes analyzed from Blood serum and urine of

10 patients from Rawalpindi areas

Table 2. **Average values of electrolytes analyzed from blood and urine of patients suffering from Diarrhea / constipation.** .

Electrolytes	**Blood serum**	**Urine**	**Reference values**
Sodium(Na^+)	154.00 mmol/L	237mmol/L	Blood 136-146 mmol/L Urine 40-220 mmol/L
Potassium (K^+)	4.5 mmol/L	135 mmol/L	Blood 3.7 -5.1 mmol/L Urine 25.0-125 mmol/L
Chloride (Cl^-)	107.00 mmol/L	156.0 mmol/L	Blood 97.0-105.0 mmol/L Urine110.0-250.0 mmol/L
Bicarbonate (HCO^-3)	35 mmol/L	-	Blood 22-30 mmol/L Urine-
Calcium (Ca^{++})	9.5 mg/dl	8.7 (mmol/ L	Blood 8.5-10.2 mg/dl Urine Upto 7.49mmol/ L
Phosphate (PO_4)	5.1 mmol L	47. 00 (mmol/L	Blood 2.5 – 4.8 mmol/L Urine 12.90-42.0 mmol/L

Average values of electrolytes analyzed from Blood serum and urine of 10 patients from Rawalpindi areas.

Table 3. **Average values of electrolytes analyzed from blood serum and urine of patients suffering from Fatigue.**

Electrolytes	**Blood serum**	**Urine**	**Reference values**
Sodium(Na^+)	152.00 mmol/L	226mmol/L	Blood 136-146 mmol/L Urine 40-220 mmol/L
Potassium (K^+)	5.2 mmol/L	134mmol/L	Blood 3.7 -5.1 mmol/L Urine 25.0-125 mmol/L
Chloride (Cl^-)	107.00 mmol/L	264.0 mmol/L	Blood 97.0-105.0 mmol/L Urine110.0-250.0 mmol/L
Bicarbonate (HCO^-3)	37 mmol/L	-	Blood 22-30 mmol/L Urine-
Calcium (Ca^{++})	10.7 mg/dl	8.5 (mmol/ L	Blood 8.5-10.2 mg/dl Urine Upto 7.49mmol/ L
Phosphate (PO_4)	5.3 mmol L	46. 00 (mmol/L	Blood 2.5 – 4.8 mmol/L Urine 12.90-42.0 mmol/L

Average values of electrolytes analyzed from Blood serum and urine of 10 patients from Rawalpindi areas.

Table 4. Average values of electrolytes analyzed from blood serum and urine of patients suffering from Headaches.

Electrolytes	**Blood serum**	**Urine**	**Reference values**
Sodium(Na^+)	145.00 mmol/L	225mmol/L	Blood 136-146 mmol/L Urine 40-220 mmol/L
Potassium (K^+)	5.9 mmol/L	137 mmol/L	Blood 3.7 -5.1 mmol/L Urine 25.0-125 mmol/L
Chloride (Cl^-)	98.00 mmol/L	247.0 mmol/L	Blood 97.0-105.0 mmol/L Urine110.0-250.0 mmol/L
Bicarbonate (HCO^-3)	31 mmol/L	-	Blood 22-30 mmol/L Urine-
Calcium (Ca^{++})	9.6 mg/dl	8.5 (mmol/ L	Blood 8.5-10.2 mg/dl Urine Upto 7.49mmol/ L
Phosphate (PO_4)	4.9 mmol L	45. 00 (mmol/L	Blood 2.5 – 4.8 mmol/L Urine 12.90-42.0 mmol/L

Average values of electrolytes analyzed from Blood serum and urine of 10 patients from Rawalpindi areas.

Table 5. Average values of electrolytes analyzed from blood serum and urine of patients suffering from Nausea and vomiting.

Electrolytes	**Blood serum**	**Urine**	**Reference values**
Sodium(Na^+)	148.00 mmol/L	232mmol/L	Blood 136-146 mmol/L Urine 40-220 mmol/L
Potassium (K^+)	4.6 mmol/L	135 mmol/L	Blood 3.7 -5.1 mmol/L Urine 25.0-125 mmol/L
Chloride (Cl^-)	98.00 mmol/L	112.0 mmol/L	Blood 97.0-105.0 mmol/L Urine110.0-250.0 mmol/L
Bicarbnate (HCO^-3)	35 mmol/L	-	Blood 22-30 mmol/L Urine-
Calcium (Ca^{++})	9.8 mg/dl	9.4 (mmol/ L	Blood 8.5-10.2 mg/dl Urine Upto 7.49mmol/ L
Phosphate (PO_4)	5.7 mmol L	45. 00 (mmol/L	Blood 2.5 – 4.8 mmol/L Urine 12.90-42.0 mmol/L

Average values of electrolytes analyzed from Blood serum and urine of 10 patients from Rawalpindi areas.

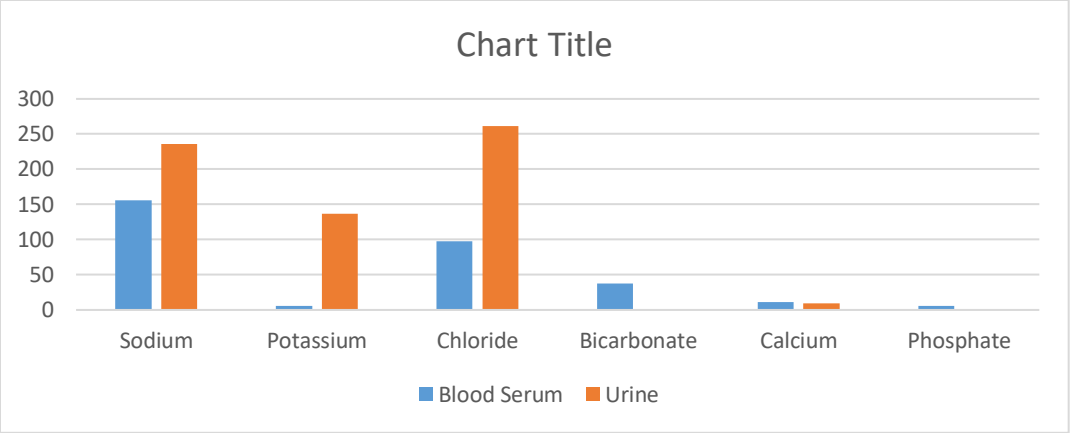

Figure 1. Level of electrolytes in human subjects suffering from confusion and irritability.

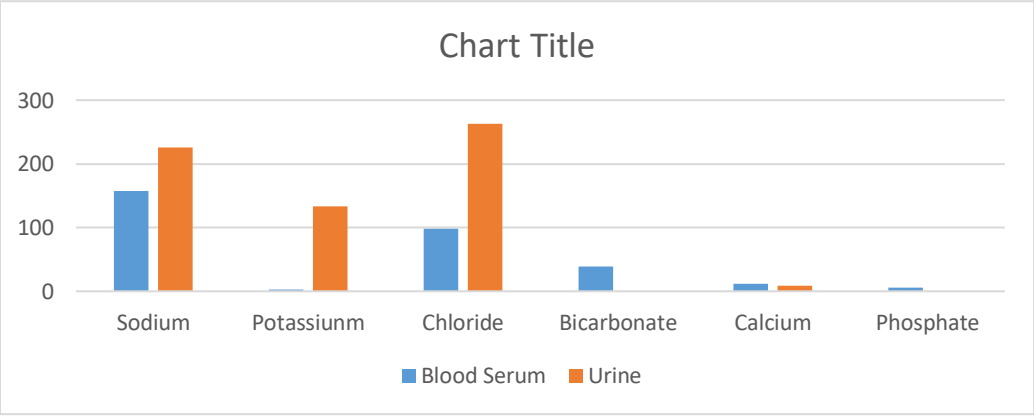

Figure 2. Comparison of electrolytes level in patient suffering from Diarrhea / constipation.

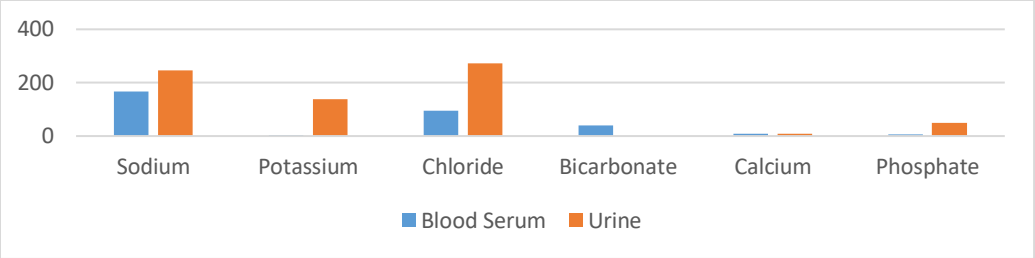

Figure 3. Comparison of concentration levels of electrolytes in human subjects suffering from Fatigue

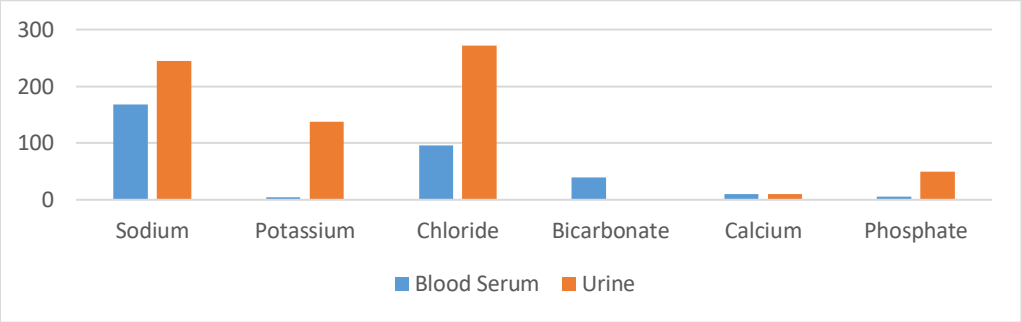

Figure 4. Comparison of concentration levels of electrolytes in human subjects suffering from Headaches

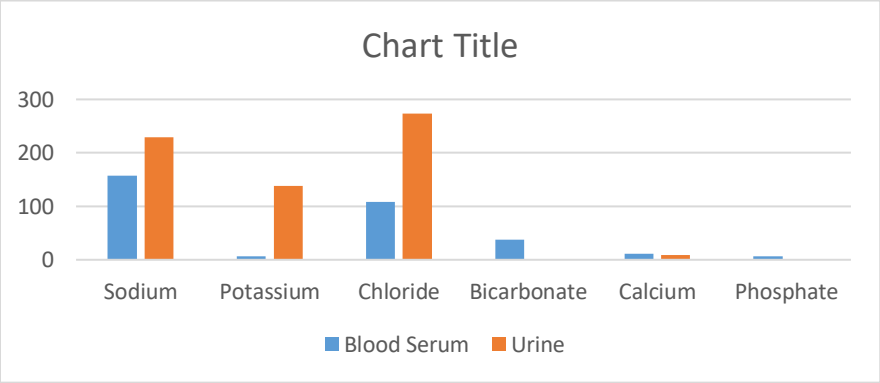

Figure 5. Comparison of electrolytes level in patient suffering from Nausea and vomiting.

Results about analysis of blood and urine samples are given in the tables 1-5 and Figures 1-5. Several researchers have reported that various human disorders related to electrolyte imbalances are affected by high sodium (hypernatremia), low sodium (hyponatremia), high

calcium (hypercalcemia), low calcium (hypocalcemia), high chloride (hyperchloremia), low hypochloremia), high magnesium (hypermagnesemia), and low magnesium (hypomagesemia) (Hamouti et al., 2014; Han et al., 2017). Whereas high bicarbonate indicates conditions of acidosis (Olza et al., 2017; Park et al., 2016).

Numerous illnesses and drugs that interfere with the body's natural fluid balance can result in electrolyte imbalances (Park et al., 2017).

One of the most prevalent electrolyte imbalances is hyponatremia. As with hepatic cirrhosis and congestive heart failure, it may be brought on by a reduction in the amount of blood in circulation. Hyponatremia can also be brought on by conditions that result in elevated levels of the antidiuretic hormone (ADH), such as hypothyroidism, adrenal insufficiency, and syndrome of inappropriate ADH secretion (SIADH). Hyponatremia is brought on by primary polydipsia (i.e., excessive water consumption), inadequate dietary salt intake that raises blood volume, hyperglycemia, and dyslipidemia. On the other hand, hypernatremia is typically brought on by medications (like lithium), excessive saline intake, unreplaceable fluid loss through the skin and gastrointestinal tract (GI) (such as excessive perspiration, vomiting, or diarrhea), and infrequently, after excessive physical activity that causes water to move into cells. Hypokalemia can occur during extensive vomiting or after using loop diuretics, and is typically brought on by inadequate nutritional intake or unreplaced fluid loss from the GI tract and urine, respectively. Because of the massive release of potassium from cells, hyperkalemia can be observed in metabolic acidosis situations. It can also be observed in insulin insufficiency, diabetic ketoacidosis, beta-blocker usage, or during chemotherapy cell death, when intracellular reserves of potassium are released. Aldosterone shortage, aldosterone resistance, or decreased potassium excretion from the kidneys (as in acute or chronic renal illness) can also result in elevated potassium levels (Vaskonen, 2003).

Most often, hypochloremia occurs following significant gastrointestinal fluid loss and renal fluid loss with diuretics. When the body's capacity to regulate excessive chloride is compromised, when fluid losses outweigh chloride losses, or when serum bicarbonate levels are low and chloride levels are high, hyperchloremia may result. Hyperchloremia and low bicarbonate levels may indicate respiratory alkalosis or normal anion gap metabolic acidosis (Willett et al., 2019).

Acid-base disruptions cause a change in bicarbonate levels. In primary metabolic alkalosis, bicarbonate levels rise, and in primary respiratory acidosis, they serve as a compensatory mechanism. According to Willett et al. (2019), bicarbonate declines in response to primary respiratory alkalosis as well as primary metabolic acidosis.

Hypoparathyroidism, which is usually observed after surgery following thyroidectomy (i.e., after thyroid removal), might result in hypocalcemia because of the frequent unintentional injury caused by their close proximity to the thyroid. Malnutrition or malabsorption can also result in severe vitamin D insufficiency, which can cause hypocalcemia. Hypercalcemia can occur in people with cancer, hyperparathyroidism, or those using lithium or thiazide diuretics (WHO, 2015; Zhang, 2018).

Hypomagnesemia is more uncommon in those who drink too much alcohol and can occur after GI or renal fluid losses. Increased magnesium consumption can result in hypermagnesemia, either orally (for example, after taking drugs that contain magnesium, including antacids and laxatives) or more frequently, intravenously (Woo and Paik, 1999).

People with vitamin D insufficiency, hyperparathyroidism, and refeeding syndrome—a potentially lethal illness that produces sudden changes in fluids and electrolytes in malnourished

patients after reintroducing food—can have low blood phosphate levels. Conversely, hypoparathyroidism and chronic renal illness can result in hyperphosphatemia.

A wide range of symptoms can accompany electrolyte imbalances, ranging from deadly arrhythmias to total asymptomativity. A complicated clinical presentation may result from the combination of one or more electrolyte abnormalities in people with many medical problems. The indications and symptoms that are more unique to each electrolyte imbalance, however, usually appear first (Woo and Paik, 1999).

For instance, delirium (a mental illness marked by disorientation and disturbed attention, disordered speech, and hallucinations) or headaches are neurological symptoms of hyponatremia. The quick overcorrection of hypernatremia can result in osmotic demyelination syndrome, which can cause cerebral edema, particularly if hyponatremia develops rapidly. Individuals who suffer from hypernatremia, however, could be restless and unable to sleep. The lowering of extracellular fluid volume caused by hypernatremia may result in tachycardia or tachypnea, which might impact their heart and respiratory rate. Muscle weakness and cramps are indications of both hypokalemia and hyperkalemia, potassium abnormalities that can potentially impact the heart muscle and result in arrhythmias. While hyperkalemia can result in diarrhea or stomach discomfort, hypokalemia can also produce constipation (WHO, 2015).

Calcium imbalances can cause nebulous symptoms including cramps, nausea, and weakness. When the upper arm is compressed with a blood pressure cuff, hypocalcemia can cause the Trousseau sign, which is characterized by an involuntary contraction of the hand and wrist muscles (Willett et al., 2019). Due to the fact that hypomagnesemia and hypokalemia are often linked, treating hypomagnesemia may come before treating electrolyte abnormalities. Reduced awareness, disorientation, muscle weakness, and lack of reflexes are the main symptoms of

hypermagnesaemia (Williams et al., 2018). Any phosphate level imbalance typically results in numbness, weakness, and cramping in the muscles. It can also impact bone density, causing the bones to become softer or weaker. Headaches, exhaustion, and any other symptoms associated with the underlying acid-base imbalance are common manifestations of bicarbonate abnormalities. Most chloride imbalances don't cause any symptoms. Uncertain symptoms like disorientation or edema may be observed in situations with extremely high or extremely low chloride levels (Vaskonen, 2003). A detailed examination of medical and personal history is frequently required to detect any electrolyte imbalance. If the person is not mentally capable of responding (for example, due to hyponatremia), additional information gathered by family members may also be beneficial. Because they are often the source of electrolyte imbalances, it is important to analyze prescription drugs (such as antibiotics like amphotericin B or diuretics like furosemide) in order to make a diagnosis. Confirming the diagnosis also requires measuring the blood's electrolyte levels, which may be done with a complete metabolic panel blood test. The acid-base status can also be ascertained by ordering an arterial blood gas (ABG) test. Due to their complicated clinical appearance, mixed electrolyte, acid-base, and fluid abnormalities are common and can be difficult to detect (Trichopoulou et al., 2007).

To address each electrolyte imbalance, a separate strategy is needed. The best method to return the electrolytes to their normal levels is to treat the underlying reason. It might be beneficial to provide fluids intravenously and restore any electrolytes that are lost. Small dietary adjustments, such as increasing fruit and vegetable intake or using a sports drink to boost hydration and restore electrolyte balance, can help address minor electrolyte imbalances. Since there might be serious repercussions for the individual, it is important to constantly evaluate the rate at which the imbalance is rectified. For instance, cerebral edema may result from the quick treatment of

hypernatremia (Thorning et al., 2016). Variations in the electrolyte levels, which are electrically charged molecules that maintain bodily functions, are known as electrolyte imbalances. As a result, any imbalance can result in a wide range of symptoms, including deadly arrhythmias, personality changes, reflex changes, and disorientation, weariness, and muscular weakness. Blood tests, clinical appearance, and history are used to make the diagnosis, whereas the underlying cause determines the course of treatment (Zhang, 2018).

Conclusion

The electrolytes levels usually causes muscle cramping, weakening, and numbers of other complication those might be serious if untreated for long time. A deficiency in certain electrolytes can impact bone density, leading to weaker or softer bones. In addition to any additional symptoms associated with the underlying acid-base imbalance, headaches and tiredness are common manifestations of bicarbonate problems. Chloride imbalances often don't cause any symptoms. Uncertain signs like disorientation or edema may be observed in situations when the levels of chloride are excessively high or low.

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