COMPARISON OF EXAMINATION OF SODIUM ELECTROLYTE LEVELS IN SERUM USING RED CAP VACUUM TUBES AND YELLOW CAP VACUUM TUBES AT TOTO KABILA HOSPITAL BONE BOLANGO DISTRICT

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ABSTRACT

Sodium is an essential nutrient for maintaining blood volume, regulating water balance in cells and maintaining nerve function. Sodium examination generally uses serum as a specimen. Serum is a liquid component of blood that no longer contains blood cells and clotting factors. The purpose of this study was to compare the results of examining sodium electrolyte levels in serum using a red-covered vacuum tube and a yellow covered vacuum tube at Toto Kabila Hospital, Bone Bolango Regency.

The method in this study uses a quantitative approach with a descriptive type of research. The sampling technique used in this study was purposive sampling with a total sample of 30 patients.

Comparison ResultsExamination of sodium electrolyte levels in serum using a red lid vacuum tube and a yellow lid vacuum tube contained 9 Normal Samples and 21 Abnormal Samples with the Mann-Whitney Test results showing that the significant value was > 0.05 or P = 0.312, so it can be concluded that there was no the difference between the red cap vacuum canister and the yellow cap vacuum canister.

Keywords: Electrolyte, Sodium, Red And Yellow Vacuum Tubes

INTRODUCTION

Maintenance of body fluid homeostasis is essential for the survival of all organisms. Maintenance of osmotic pressure and distribution of the various fluid compartments of the human body are the main functions of the four major electrolytes, namely sodium, potassium, chloride and bicarbonate. Examination of the four major electrolytes is known clinically as an electrolyte profile [15].

Body fluids consist of water and electrolytes. Body fluids are divided into extracellular and intracellular fluids. Extracellular fluid includes plasma and interstitial fluid [11].

Electrolytes play an important role in the human body, because almost all metabolic processes in the human body are influenced by electrolytes. Maintenance of osmotic pressure and distribution of several fluid compartments of the human body is the main function of the four major electrolytes, namely sodium (Na^+), potassium (K^+), chloride (Cl^-), and bicarbonate (HCO_3^-). Electrolytes are needed to maintain the electrochemical potential of cell membranes which can ultimately affect the function of nerves, muscles, and cell activities such as secretion, contraction, and various other metabolic processes [9].

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The most influential effect of electrolyte examination is potassium compared to sodium. Sodium in the human body requires a minimum of 200-500 mg every day to keep salt levels stable. The amount of sodium in the body is a reflection of the balance of incoming and outgoing sodium [14].

Sodium is a mineral found in the body and in many foods. Sodium is an essential nutrient for maintaining blood volume, regulating water balance in cells, and maintaining nerve function. The body's sodium balance is controlled by the kidneys by increasing or decreasing sodium in the urine. Under normal circumstances, sodium excretion in the kidneys is regulated so that a balance is maintained between intake and output with a stable extracellular fluid volume [11].

Sodium examination generally uses serum as a specimen. Serum is a liquid component of blood that no longer contains blood cells and clotting factors. The use of serum in clinical chemistry is wider than the use of plasma. This is because the serum does not contain external ingredients, such as the addition of anticoagulants so that the components contained in the serum are not disturbed by their activities or reactions. Serum is obtained after the blood is allowed to coagulate in a vacutainer tube and is centrifuged to precipitate all the cells [6].

Sodium (Na^+) is the most abundant cation in the extracellular fluid, the amount can reach 60 mmol per kg body weight and a small portion (about 10-14 mmol/L) is in the intracellular fluid. Under normal circumstances, renal sodium excretion is regulated so that a balance is maintained between intake and output and the extracellular fluid volume remains stable. More than 90% of the osmotic pressure in the extracellular fluid is determined by salts, particularly in the form of sodium chloride (NaCl) and sodium bicarbonate ($NaHCO_3$). So changes in osmotic pressure in the extracellular fluid reflect changes in sodium concentration. The difference in sodium levels in the extracellular and intracellular fluids is due to the active transport of sodium out of the cell which exchanges with the entry of potassium into the cell (Na, K pump) [5].

Sodium at standard temperature and pressure is a silvery soft metal which reacts with oxygen in air to form grayish white sodium oxide unless immersed in oil or inert gas, which are the usual storage conditions. Sodium metal can be easily cut with a knife and is a good conductor of electricity and heat, having only one electron in its valence shell, resulting in weak metallic bonds and free electrons, which carry energy. Due to its low atomic mass and long atomic radius, sodium is the 3rd lowest density metallic element of all metals and one of only three metals that can float in water, the other two being lithium and potassium. The melting (98°C) and boiling (883°C) points of sodium are lower than those of lithium but higher than those of the heavier alkali metals (potassium, rubidium, and cesium), following a periodic trend down the group from top to bottom. This property changes dramatically with increasing pressure: at 1.5 Mbar, the color changes from silvery to black; at 1.9 Mbar it becomes transparent with a red tint; and at 3 Mbar, sodium is a clear, transparent solid. All of these high pressure allotropes are insulators and electrids. Sodium is a clear and transparent solid. All of these high pressure allotropes are insulators and electrids [7].

A positive flame test for sodium produces a bright yellow color. In a flame test, sodium and its compounds produce a yellow color because sodium's excited 3s electrons emit photons as they return from 3p to 3s; The wavelength of this photon is on the D line around 589.3 nm. spin–orbit interactions involving electrons in the 3p orbital split the D line into two, at 589.0 and 589.6 nm; a very fine structure involving both orbitals leads to more lines [13].

In humans, sodium is an essential mineral that regulates blood volume, blood pressure, osmotic balance and pH; the minimum physiological requirement for sodium is 500 milligrams per day. Sodium chloride (NaCl) is the main source of sodium in food, and is used as a condiment and preservative in commodities such as pickles and beef jerky; for Americans, most sodium chloride comes from processed foods. Other sources of sodium are naturally present in food and food additives such as monosodium glutamate (MSG), sodium nitrite, sodium saccharin, baking soda (sodium bicarbonate), and sodium benzoate [15].

The Ministry of Health of the Republic of Indonesia stipulates that the Nutrition Adequacy Rate for sodium is 1500 mg per person per day, but the average Indonesian consumes sodium (from salt alone) of around 5300 mg/day (equivalent to 15 grams of salt with 90% NaCl content); not including other sources of sodium such as MSG. Research reveals that lowering sodium intake to 2 g per day tends to lower systolic blood pressure by about two to four mm Hg. It has been estimated that such a reduction in sodium intake would reduce cases of high blood pressure by 9 to 17% [15].

The renin–angiotensin system regulates the amount of fluid and sodium concentration in the body. Reduction in blood pressure and sodium concentration in the kidneys results in the production of renin, which in turn produces aldosterone and angiotensin, retaining sodium in the urine. As the sodium concentration increases, renin production decreases, and the sodium concentration returns to normal. Sodium ion (Na+) is an important electrolyte in neuronal function, and in osmoregulation between cells and extracellular fluid. This is accomplished in all animals by Na^+/K^+-ATPase, active transporters that pump ions against gradient, and sodium/potassium channels. Sodium is the most common metal ion in extracellular fluid [4].

Very low or very high sodium levels in humans are known in medicine as hyponatremia and hypernatremia. This condition may be caused by genetic factors, aging, or prolonged vomiting or diarrhea [5].

There are twenty known isotopes of sodium, but only 23Na is stable. 23Na is created in the process of burning carbon in stars by fusing two carbon atoms together; this requires a temperature above 600 megakelvins and a star with a mass of at least three times that of the sun. Two cosmogenic, radioactive isotopes are by-products of cosmic ray spallation: 22Na with a half-life of 2.6 years and 24Na, a half-life of 15 hours; all other isotopes have half-lives of less than one minute. Two nuclear isomers have been discovered, the longest-lived of which is 24mNa with a half-life of about 20.2 milliseconds. Acute neutron radiation, such as from a crunch accident, converts some of the stable 23Na in human blood into 24Na;

The sodium atom has 11 electrons, one more than in the very stable noble gas configuration of neon. Therefore, and because of its low first ionization energy of 495.8 kJ/mol, it is much easier for the sodium atom to lose its last electron and become positively charged than it is to gain one electron to become negatively charged. This process requires so little energy that sodium is easily oxidized by removing its 11th electron. In contrast, the second ionization energy is very high (4562 kJ/mol), because the 10th electron is much closer to the nucleus than the 11th electron. Consequently, sodium usually forms ionic compounds as the Na+ cation [15].

The amount of sodium in the body is a picture of the balance between incoming sodium and excreted sodium. Normal sodium levels in the body are 135-145 mmol/L. The entry of sodium originating from the diet through the mucosal epithelium of the digestive tract by the process of diffusion and excretion through the kidneys, digestive tract or sweat on the skin [7].

One study found that people with or without hypertension who excrete less than 3 grams of sodium per day in their urine (and therefore consume less than 3 g/day) have a higher risk of death, stroke, or heart attack than those who excrete 4 to 5 grams per day. Levels of 7 g per day or more in people with hypertension are associated with higher mortality and cardiovascular events, but this is not known for people without hypertension. The United State of Food and Drug Administration (US FDA) states that adults with hypertension and prehypertension should reduce daily intake to 1.5 g [15].

Excess levels of sodium in the body can be caused by excessive salt consumption, while a lack of sodium in the bloodstream occurs, due to fluid imbalance and accumulating in the body. This fluid buildup can dissolve sodium so that its levels are reduced, body cells can also experience swelling due to high fluid levels, and can be a life-threatening condition [11].

Electrolyte examinations that are often requested by clinicians to assess the balance of electrolyte levels in the body are sodium (Na), potassium (K) and chloride (Cl) examinations. The most influential effect of electrolyte examination is potassium compared to sodium. Sodium in the human body requires a minimum of 200-500 mg every day to keep salt levels stable. The amount of sodium in the body is a reflection of the balance of incoming and outgoing sodium [14].

Potassium is an ion that maintains the electrolyte balance in the human body. Potassium can also maintain the membrane potential for the life of a cell. (Siregar, 2014). Potassium also functions in protein synthesis, muscle contraction, nerve conduction, hormone secretion, fluid transport and fetal development [15].

Chloride is the main anion in the extracellular fluid. The amount of chloride in a normal adult is about 30 mmol per kg of body weight. About 88% of chloride is in the extracellular fluid and 12% in the intracellular fluid. Chloride concentrations in infants are higher than in children and adults. The Gibbs-Donnan balance results in a higher chloride level in the interstitial fluid than in the plasma. Chloride can pass through the cell membrane passively. The difference in chloride levels between interstitial fluid and intracellular fluid is caused by potential differences on the outer surface and in the cell membrane. The normal value of chloride in the body is 98-108 mmol/L [15].

Based on observations made in several clinical chemistry laboratories, there are differences in the use of different types of tubes to collect blood. Some use red lid vacuum tubes and some use yellow lid vacuum tubes. For clinical chemistry laboratories that use red lid vacuum tubes because these tubes are cheap and can be used repeatedly, while for clinical chemistry laboratories that use yellow lid vacuum tubes because the blood clotting process is faster and produces more serum [10].

Serum is obtained from blood specimens without added anticoagulants by separating the blood into 2 parts using a centrifuge, after which the blood is left to freeze for approximately 15 minutes. After centrifugation, blood clots of irregular shape will appear and if the clotting is perfect, the blood clot will be released or can easily be released from the tube wall. In addition, you will also see the liquid part of the blood. This part, because it is separated from the blood clot, is no longer murky red but clear yellow. The blood clot consists of all the figurative elements of blood that have undergone a spontaneous clotting or coagulation process, so that they are separated from the clear yellow solution element [15].

Currently, electrolyte examination in the clinical laboratory is carried out using the ion selective electrode (ISE) method. This ISE method is the most frequently used method. Data from the College of American Pathologists (CAP) in 5400 laboratories that examine sodium and potassium, more than 99% use the ISE method. The ISE method has good accuracy, the coefficient of variation is less than 1.5%, the calibrator is reliable and has a good quality assurance program. There are two types of ISE, namely direct ISE and indirect ISE. Direct ISE checks directly on plasma, serum and whole blood samples. This method is generally used in emergency laboratories. The indirect ISE method developed earlier in the history of ISE technology, namely examining diluted samples [15].

Electrolyte analyzers focus on the laboratory's need to provide sample results economically. The unique electrode design combined with precise control of the calibrator volume ensures low-cost operation and fast test results. The way to measure this tool is to use an ion selective electrode (ISE). Where in this tool there are 4 electrodes namely Na^+ electrode, K^+ electrode, Cl^- electrode and Reference electrode. The electrolyte analyzer can detect inorganic salt ions, calcium ions in small material samples. The working system of the electrolyte is when electrolyte ions enter the electrode, an electric potential arises in proportion to the concentration of electrolyte ions, then the electric potential is amplified and converted through the processor to a value of electrolyte concentration. The working principle of this tool is that the sample will be pulled by an electrode that is sensitive to these ions. Then a reference electrode is used to compare the rise and fall of the potential [15].

The principle of measuring the electrolyte analyzer is basically a tool that uses the ISE method to calculate the ion content of a sample by comparing the ion content of an unknown value with a known ion level. The selective ion membrane on the device reacts with the sample electrolyte. The membrane is an ion exchanger, reacting to changes in ion electricity causing changes in the membrane potential [15].

Blood collection tubes have some limitations. These limitations include imprecise performance in prolonged storage of blood samples and difficulties for separation of blood serum from corresponding RBCs. In addition, prolonged contact between serum and blood cells can change the color of the serum from yellow to red. To overcome this problem, vacutainer serum separator (SST) containing silica and polymeric gels for serum separation was introduced. The serum separating gel located at the end of the tube acts as a stable chemical and physical barrier between the serum and the clotted blood [1].

In general, there are two types of vacutainer tubes that are often used, namely vacutainer tubes with red caps (plain) which are tubes without anticoagulants and gel separators so that blood coagulates naturally. The ideal sample freezing time is 60 minutes and centrifuged at 2500 rpm for 10 minutes. Meanwhile, the yellow cap vacutainer tube is a tube without anticoagulant and contains a gel separator. The sample froze within 30 minutes and was centrifuged at 3500 rpm for 10 minutes [3].

Vacutainer is a vacuum test tube made of glass or plastic, when attached to a needle, blood will flow into the tube and stop flowing when a certain volume has been reached. The use of a vacutainer is more advantageous because there is no need to divide the blood sample into several tubes, just one injection can be used for several tubes alternately [2].

The size of the vacuum tube volume is adjusted to the desired sample volume, type of examination, type of blood sample (venous blood), patient's age and condition of the patient's veins. Vacuum tubes are differentiated by the color of the lid. Tubes with color codes provide a sign regarding the addition of additives in the tube. The addition of these additives can be in the form of anticoagulants such as oxalate, citrate, EDTA and heparin [8].

The advantage of the red lid vacuum tube is that it can be used repeatedly, while the yellow lid vacuum tube is generally disposable so that it will increase the cost of purchasing the tube. The advantages of the yellow cap tube are that it is easy to use, requires a short time, produces more serum, limits the danger of aerosols, requires one step, uses the main tube for sampling and one label [2].

RESEARCH METHODOLOGY

The research approach used by researchers is quantitative research whose analysis focuses more on numerical data, namely the results of sodium electrolyte examination using red lid vacuum tubes and yellow lid vacuum tubes at Toto Kabila Hospital, Bone Bolango Regency.

This research is included in the type of analytical observational research with a cross sectional approach. Analytical research is research that looks for relationships between variables, namely by conducting an analysis of the data that has been collected. This type of research wanted to see the results of examining sodium electrolyte using a red lid vacuum tube and a yellow lid vacuum tube at Toto Kabila Hospital, Bone Bolango Regency.

The population of this study were all patients who had electrolyte checks at the Toto Kabila Hospital, Bone Bolango Regency.

The sample of this study were some of the patients who had electrolyte checks at the Toto Kabila Hospital, Bone Bolango Regency, namely as many as 30 samples with criteria in calculating the sample size.

Data analysis is presented in tabular form. To see whether there are differences in the results of examining the Na+ electrolyte using various vacuum tubes, tests are carried out with the Difference Test or t' test using a computerized system with the Statistical Package for the Social Sciences (SPSS) version 25.0 application.

RESEARCH FINDINGS

Table 1. Distribution of Examination Results for Sodium Electrolyte Levels in Red Closed Vacuum Tubes

Variable	Average	Frequency	Percentage (%)
Normal	136,4	9	30%
Abnormal	137,3	21	70%
Total	132,4	30	100%

Source: Primary Data 2022

Based on table 1 above, the examination of sodium electrolyte levels that was declared normal was 9 samples with a percentage of 30% and those that were declared abnormal were 21 samples with a percentage of 70%.

Table 2. Distribution of Examination Results for Sodium Electrolyte Levels in Yellow Closed Vacuum Tubes

Variable	Average	Frequency	Percentage (%)
Normal	130.7	9	30%
Abnormal	131.4	21	70%
Total	133,3	30	100%

Source: Primary Data 2022

Based on table 2 above, the examination of sodium electrolyte levels that was declared normal was 9 samples with a percentage of 30% and those that were declared abnormal were 21 samples with a percentage of 70%.

Table 3. Normality Test Results Examination of Sodium Electrolyte Levels

Color Cap Tube	Shapiro-Wilk		
	statistic	Df	Sig
Red cap vacuum canister	0.881	30	0.003
Yellow lid vacuum tube	0.890	30	0.005

Source: Primary Data 2022

From the results of the normality test, it was found that the significant value was <0.05, so it was concluded that the data was not normal, so it was continued with the non-parametric test, namely the Mann-Withney Test.

Table 4. Distribution of Mann-Withney Test Results

Methods for Examination of Sodium Electrolyte Levels	Sig level	Information
Quantitative	0.312	Significant

Source: Primary Data 2022

From the results of the Mann-Whitney test to calculate the comparison between the red lid vacuum tube and the yellow lid vacuum tube, it was found that the significant value was > 0.05 or P = 0.312 so that it could be concluded that there was no difference between the red lid vacuum tube and the yellow lid vacuum tube.

DISCUSSION

Based on the data distribution of sodium electrolyte levels in red lid vacuum tubes and yellow lid vacuum tubes in Tables 1 and 2, there were 9 normal patients (30%) and 21 abnormal patients (70%) who were the largest population in this study. This is due towhen fluids and sodium in the body are out of balance, it could be because there is too much fluid in the body or because the sodium levels in the body are not enough. So that at the time of laboratory examination, sodium levels in patients can be said to be abnormal (abnormal).

Electrolytes are chemicals that produce electrically charged particles called ions when they are in a liquid solution and electrolytes enter the body through food, drink, and intravenous fluids and are distributed to all parts of the body [14].

Sodium is the most abundant cation in the extracellular fluid. The amount can reach 60 mEq per kilogram of body weight and a small portion (10-14 mEq/L) is in the intracellular fluid [11].

To check sodium electrolyte levels in the laboratory, a sample in the form of serum is needed. Serum is obtained by centrifugation or centrifugation. To get the serum, a blood container called a vacuum tube is needed. In these vacuum tubes, active substances are usually added which have one or more specific functions for certain inspection purposes. One of the active substances used in the vacuum tube is a clotting activator. These clotting activators can activate and enhance the blood clotting process. The vacuum tube containing the coagulation activator has a yellow cap filled with a gel that separates serum and plasma. To obtain serum, apart from using a vacuum tube filled with gel, you can also use a plain vacuum tube without adding additives [3].

The gel contained in this vacuum tube can assist in the blood clotting process and shorten the centrifugation time to obtain serum. This vacuum tube with gel is easy to use and produces more serum. The time needed for blood to clot using a yellow lid vacuum tube is 5 minutes, whereas if you use a red lid vacuum tube it will take 15-30 minutes for the blood to clot. In addition, this yellow lid vacuum tube prevents mixing between the serum and red blood cells that have been separated and can reduce the risk of glycolysis, whereas in the red lid vacuum tube the possibility of glycolysis is greater due to the absence of a barrier between the serum and red blood cells. Serum is not separated immediately. Besides that,

Vacuum tubes with red caps and vacuum tubes with yellow covers are used when taking blood from patients for blood chemistry, immunology, serology tests and red lid vacuum tubes are also used for blood banks.

As forSampling was done by Acidental Sampling method. The research process takes placefor 14 (fourteen) days, starting on July 28 and ending on August 10, 2022. So to check sodium electrolyte levels in patients, researchers first observed patients who were at Toto Kabila Hospital.

Furthermore, these patients were met directly by researchers in providing an explanation of the intent with the objectives of this study and were asked for their willingness to participate as respondents in this study. If the patient agrees, the researcher will conduct an interview with the patient and give informed consent which is then filled in and signed by the respondent. After the patient agreed, the researcher took venous blood to examine the sodium electrolyte for the respondent. The number of samples or respondents obtained was as many as 30 people presented in tabular form.

After the venous blood is taken, the blood is put into a vacuum tube with a red lid and a yellow lid vacuum tube, then the blood is centrifuged, after centrifuging the serum is put into the serum cup, then a sodium electrolyte examination is carried out using an electrolyte balio auto basic, the researcher writes or records the results obtained into the result sheet that the researcher has prepared.

Based on the research results obtained at the study site, that of the 30 samples taken, examination of sodium electrolytes in vacuum tubes with red lids and vacuum tubes with yellow lids was declared normal as many as 9 samples and those that were declared abnormal were 21 samples.

After calculations using statistical tests show that the results of a comparative analysis on comparison of examination of sodium electrolyte levels is 0.312, which means that P is greater than the alpha value of 0.05, from the results obtained the null hypothesis (H0) which means accepted and the alternative hypothesis (Ha) which means rejected so that it can be concluded that the data obtained did not have a significant difference. It was found that the concentration of sodium electrolyte in the serum had stability up to 4 hours at room temperature, either in the red lid vacuum tube or the yellow lid vacuum tube where the serum had been separated. Both tubes will experience a significant decrease in sodium electrolyte levels over a period of 12 hours. In the red cap vacuum tube, if the serum that has formed is not immediately separated into another container, will cause glycolysis. In previous studies, the average results of electrolyte examination at sodium levels were p=0.437. The material for examination is serum using equal amounts of red cap vacuum tubes and yellow cap vacuum tubes. So that there is no significant difference between the results of the examination on specimens that are accommodated using a red lid vacuum tube and a yellow lid vacuum tube.

There is no difference in the red cap vacuum tube and the yellow cap vacuum tube, so the two tubes are used as needed because the red cap vacuum tube can be used repeatedly and the yellow lid vacuum tube is easy to use and does not require a long time to produce serum.

CONCLUSION

Based on the results of the research that has been done, it can be concluded that:

1. Examination of sodium electrolyte levels in serum using a red lid vacuum tube showed that 9 samples (30%) were normal and 21 samples (70%) were abnormal.
2. The results of examining sodium electrolyte levels in serum using a yellow lid vacuum tube showed that 9 samples (30%) were normal and 21 samples (70%) were abnormal.
3. There is no difference in the results of examining sodium electrolyte levels in the red and yellow lid vacuum tubes as stated from the results of the Mann-Whitney Test SPSS calculation.

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