COMPARISON OF POTASSIUM ELECTROLYTE LEVELS IN BLOOD SPECIMEN USING VACUUM TUBE CLOSE RED AND YELLOW AT TOTO KABILA HOSPITAL BONE BOLANGO DISTRICT

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ABSTRACT

Blood electrolyte levels in the tube will decrease after 30 minutes of blood collection due to the hemolysis process at a rate of about 7 mg/dl per hour. This study aims to determine the comparison of potassium electrolyte levels in blood specimens using red and yellow vacuum tubes at Toto Kabila Hospital, Bone Bolango Regency. The method in this study used descriptive with a quantitative approach and the method used in this study was accidental sampling with a sample of 30 patients who were to be studied.

The method in this study used a quantitative approach with a descriptive type of research and the sampling technique used was accidental sampling with a sample of 30 patients who were to be studied.

The results of the comparison of potassium levels in vacuum tubes with red lids and vacuum tubes with yellow covers showed normal potassium levels in 24 samples or (80%) and abnormal potassium levels in 6 samples or (20%) with the results of the Mann -With a test on comparisons of potassium levels in tubes with red caps and yellow caps showing that.0.099 > 0.05 so that it can be concluded that there is nothing significant about potassium examination using vacuum tubes with red lids and vacuum tubes with yellow lids.

Keywords: Electrolyte, Potassium, Vacuum Tube, Blood

INTRODUCTION

The human body, like other living things, is composed of various organ systems, dozens of organs, thousands of tissues and millions of molecules. Physically, the molecules that make up the human body can be divided into liquid types and solid molecular matrices. The function of fluids in the human body, among others, as a means of transporting nutrients, electrolytes and metabolic waste; as a component of cells, plasma, blood, and other body components; as a medium for regulating body temperature and the cellular environment [12].

In the body of a healthy individual about 60% of body weight is made up of water and is generally considered to exist in two main compartments; intracellular and extracellular fluids. The extracellular fluid compartment can be further divided into interstitial and intravascular fluid. Approximately 2/3 of the total body water is intracellular fluid and the rest is extracellular: 2/3 of extracellular fluid is inertial fluid and the remainder is

Submit: Okt 5th, 2021 Accepted: Dec 18th, 2021 Published: Dec 28th, 2021

intravascular fluid. So in the body of a normal adult with a body weight of 70 kg contains approximately 42 liters of body fluids, 28 liters is intracellular fluid and 14 liters extracellular fluid (plasma volume) and the rest is extravascular fluid and interstitial fluid [10].

Fluids and electrolytes are the largest components in the human body. Electrolytes including sodium (Na), potassium (K), chloride (Cl) are very important physiologically and can be monitored in the plasma. Potassium levels tend to be very high inside the cells (about 475.5 mEq/L) and low outside the cells (about 15.85 mEq/L), whereas sodium and chloride are low inside the cells and high outside the cells. The role of electrolytes in the human body is very important, because there are no metabolic processes that are independent or not affected by electrolytes. The functions of electrolytes include maintaining osmotic pressure and distribution (distribution) of water in various spaces (compartments) in body fluids, maintaining pH in the best (optimal) state, playing a role in oxidation-reduction reactions (ion transfer), and acting as an enzyme cofactor in catalytic process [5].

According to *the World Health Organization* (WHO), critical patients in the ICU due to fluid and electrolyte disorders are increasing every year, where it is recorded that 9.8-24.6% of critical patients are treated in the ICU per 100,000 population and deaths from critical to chronic illnesses in the world have increased by as much as 1.1-7.4 million people [13].

Maintenance of body fluid homeostasis is essential for the survival of all organisms. Maintenance of osmotic pressure and distribution of several fluid compartments of the human body is the main function of four major electrolytes, namely sodium ($Na^{+)}$), potassium ($K^{+)}$), chloride (Cl^-), and bicarbonate (HCO_3). Examination of the four major electrolytes is known clinically as an" electrolyte profile" [2].

Sodium is the most abundant cation in the extracellular 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, especially in the form of sodium chloride (NaCl) and sodium bicarbonate (NaHCO3). 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 in exchange for potassium entering the cell (Na, $K^{+ \text{ pump)}}$. The amount of sodium in the body is a picture of balance [3].

Potassium ($K^{+)}$ is a very important cation for various functions of the human body. These electrolytes are more numerous in the intracellular fluid (intracellular fluid) than the extracellular fluid (extracellular fluid). Normal levels of potassium in the blood range from 3.5 to 5.1 mEq. The daily intake of potassium is 40-60 mEq. About 80-90% of potassium is excreted in the urine and 8% in the feces. Sources of potassium can be obtained from fruits, fruit juices, vegetables, or potassium supplements. Bananas and dried fruit are rich in potassium [5].

The amount of potassium in the body is a reflection of the balance of potassium in and out. Intake of potassium through the digestive tract depends on the amount and type of food, adults normally consume 60-100 mEq of potassium per day [5].

Potassium is filtered at the glomerulus and then reabsorbed in the proximal tubule as much as 65% and reabsorbed with sodium and chloride in the loop of Henle about 25-30%, especially in the thick segment where potassium undergoes active co-transport [5].

Principal cells of the late distal tubule and cortical collecting tubules are the most important sites for regulation of potassium excretion. The process of potassium secretion from the blood into the tubular lumen begins with uptake from the cell interstitium by the sodium-potassium ATPase pump in the basolateral membrane so that potassium can enter the tubular cells. The sodium-potassium ATPase pump in the basolateral membrane creates a state of high intracellular potassium concentration, while also supplying the driving energy for the passive diffusion of potassium from the cell into the tubular lumen. The rate of passive diffusion of potassium is also influenced by the permeable nature of the luminal membrane because in it there are special channels for the diffusion of potassium ions into the tubular fluid [8].

If the potassium level is less than 3.5 mEq/L it is called hypokalemia and if it exceeds 5.1 mEq/L it is called hyperkalemia. Lack of potassium ions can cause the heart rate to slow down. an increase in serum potassium of 4-5 mEq/L can cause cardiac arrhythmias, even higher concentrations can cause cardiac arrest if the potassium level increases it is called hyperkalemia, if the potassium level decreases it is called hypokalemia [9].

The amount of potassium in the intracellular fluid is more than the fluid outside the cells. To reach the equilibrium membrane potential potassium cooperates with sodium. Every three sodium ions leave the intracellular fluid, two potassium will enter the intracellular fluid. The kidneys regulate the amount and concentration of most of the ions in the extracellular fluid (Sherwood, 2014). Excretion is influenced by the potassium filtration rate (GFR multiplied by plasma potassium concentration), the rate of potassium reabsorption and the rate of potassium secretion by the tubules. The normal potassium filtration rate is about 75 mEq/day (GFR: 180 L/day times the plasma potassium level of 4.2 mEq/L) [3].

Hyperkalemia (high blood potassium level) a condition where the blood potassium concentration is more than 5.5 mEq/L. Hyperkalemia is a condition where there is too much potassium in the blood. Most of the potassium in the body (98%) is found in cells and organs. Only a small amount [9].

Reduced renal excretion of potassium This event occurs due to hypoaldosteronism, renal failure, depletion of effective circulating volume, use of cyclosporine. In patients who experience hyperkalemia, signs and symptoms will be found including nausea, abdominal cramps, oliguria, tachycardia, which ultimately if not followed up causes bradycardia, weakness, and numbness (tingling in the limbs) [9].

Hypokalemia (low blood potassium level) is a state of blood potassium concentration below 3.5 mEq/L caused by a reduced amount of total body potassium or a disturbance in the transfer of potassium ions into cells [9].

Inadequate intake of potassium Old people only eat toast and tea, heavy alcohol drinkers so they rarely eat and don't eat and drink properly by mouth or are accompanied by other problems such as giving diuretics or giving a low-calorie diet in a weight loss program can cause hypokalemia [9].

Excessive excretion of potassium There are many ways that potassium can be excreted from the body. Vomiting, nasogastric tube insertion, diarrhea and use of laxatives are factors that cause excessive potassium expenditure [9].

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 [8].

The amount of chloride in the body is determined by the balance between incoming and outgoing chloride. Intake of chloride depends on the amount and type of food. The content of chloride in food is the same as sodium. Adults normally consume an average of 50-200 mmol of chloride per day, and excretion of chloride in the feces is about 1-2 mmol per day. Stomach or intestinal drainage in diarrhea causes chloride excretion of up to 100 mmol per day. Chloride levels in sweat vary, averaging 40 mmol/L. In excessive sweating, chloride loss can reach 200 mmol per day [8].

Examination of sodium, potassium and chloride levels using the ion selective electrode (ISE) method is the most frequently used. 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 was developed earlier in the history of ISE technology, namely examining diluted samples [3].

Sample handling starts from tube selection. The sample handling process actually begins before the sample is taken/collected, namely in the selection and preparation of sample tubes/containers. Blood sample tubes, for example, depending on the type of examination to be carried out later, require different special additives to keep the sample stable until it is examined. To distinguish the tube based on additives, the tube cap is given a different color, such as red, yellow, purple, green, etc. The color of the tube cap and additives has been standardized, so even though they are produced by different factories, they still follow the same conditions [11].

An ion of unknown value at a known concentration of ion. 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 [3].

The red cap tube and the yellow cap tube both have the same type of examination and have the function of separating serum and blood cells, one of which is potassium electrolyte examination. different to keep the sample stable until examined [11].

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 lid vacuum 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 [6].

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 [3].

Yellow lid vacuum tubes or serum separator tubes (SST) were introduced with a composition of silica clot activator and polymer gel to help the blood clotting process faster and reduce centrifugation time. Gel is used to separate serum from blood. The gel component is very influential on the concentration of analytes. The gel must maintain the same physical and chemical properties over the desired period of use [4].

Factors that affect potassium checking on the tube are letting the blood in for too long which allows the metabolism of blood electrolytes in the sample by blood cells. Blood electrolyte levels in the tube will decrease after 30 minutes of blood collection due to the hemolysis process at a rate of approximately 7 mg/dl per hour [4].

In inspection laboratory specifically inspection chemical blood that sample blood must quick checked not enough from two o'clock by get results which accurate and adequate. Then the technique of separating serum without centrifugation is after it is done venous blood sampling, blood is put in a tube without anticoagulants, then the blood is allowed to clot for two hours to form serum spontaneously, Immediately separate the serum into the tube then checked rate electrolyte blood in a manner photometric. Delay inspection especially in samples that do not have anticoagulants can impact the results is not accurate, too long a delay will cause physical changes and chemicals which can be a source of errors in examinations such as decline potassium levels [4].

The specific gravity of the gel should ideally be between 1.03-1.09 g/cm3. The specific gravity of serum is in the range of 1.026-1.031 g/cm3 and the specific gravity of clot is in the range of 1.092-1.095 g/cm3. Serum specific gravity increases due to hyperproteinemia or radiocontrast color, so that the serum will not float on the gel. Besides that, Faught's research showed that there were differences in the specific gravity of the separating gel used in the SST tubes and in the tube lots. Gels can also leach materials, such as gel bits and silicone grease into the specimen and interfere with the test [6].

If a sufficient amount of blood volume is added to prevent blood clotting (anticoagulant) in a container, such as a tube, then centrifuge at a speed of 3,000 rotations per minute (rpm) for 30 minutes, after that there will be a part of the liquid that separates from the corpuscular part [1].

RESEARCH METHODS

This research approach is with a quantitative approach, because to find out an analysis in the form of these numbers, namely how many results of examining potassium electrolyte levels using red lid vacuum tubes and yellow lid vacuum tubes at Toto Kabila Hospital, Kab. Bone Bolango.

Type of data in this study Researchers used primary data with the results of the number of potassium examinations in the Toto Kabila Hospital Laboratory. As for the secondary data, the data obtained from literature searches, literature and previous research data.

In this study the population, namely all patients who carried out electrolyte examination, namely 30 patients. The sample used is a portion of patients who carry out electrolyte examinations. The sample method used was accidental sampling where sampling was taken by chance at the place where this research was conducted.

Data analysis is the difference test and the *t* test, which is to see whether there are differences in the results of examining K $^{+electrolyte\ levels}$ at Toto Kabila Hospital, Bonebolango Regency. by him, the data was tested first in the SPSS program with the normality test or method.

RESEARCH RESULT

Table 1. Frequency Distribution of Potassium Levels in Red Cap Tubes

Results of Potassium Levels	Frequency	Percentage (%)
Normal	27	90 %
Abnormal	3	10 %
Total	30	100 %

Source: Primary Data, 2022

Based on table 4.1 above, it shows that the potassium level in the normal red cap tube is 27 samples with a percentage of 90%. While abnormal potassium levels were 3 samples with a percentage of 10%.

Table 2 Frequency Distribution of Potassium Levels in Yellow Closed Tubes

Results of Potassium Levels	Frequency	Percentage (%)
Normal	24	80 %
Abnormal	6	20 %
Total	30	100 %

Source: Primary Data, 2022

Based on table 4.2 above, it shows that the potassium level in the normal yellow cap tube is 24 samples with a percentage of 80%. While abnormal potassium levels were 6 samples with a percentage of 20%.

Table 3. Mean Rank Value

Variable	Average	N
Red tube	34.22 %	30
Yellow tube	26.78 %	30

Source: Primary Data, 2022

Based on table 4.3 above, the comparison of the value of potassium levels in red and yellow cap tubes with a total sample of 30. The average value of potassium levels using red cap tubes is 34.22% mg/dl while the average value of potassium levels in tubes yellow lid which is 26.78% mg/dl.

Table 4. Normality Test Results for Potassium Levels in Tubes with Red Caps and Yellow Caps

Results of Potassium Levels	*Shapiro-Wilk*		
	Statistics	Df	Sig.
Red Cap Tube	.976	30	.000
Yellow Lid Tube	.892	30	.000

Source: Primary Data, 2022

Based on table 4.4 above, it shows that from the results of the *Shapiro-Wilk test,* the results are.0.00 <0.05. So it can be concluded that the data obtained is not normally distributed. Then, for abnormal data, a non-parametric test is carried out, namely the *Mann-Whitney test.* For the tests used in analytical research, this study used the Mann-Withnay test, which was preceded by a normality test.

Table 5. Mann-Withnay Test Results for Potassium Levels in Tubes with Red Caps and Yellow Caps

Results of Potassium Levels	Significant level	Information
	0.099	Significant

Source: Primary Data, 2022

Based on table 4.5 above, it shows that the results of the comparative analysis on the comparison of potassium levels in the red and yellow lid tubes are.0.099 > 0.05 from the results obtained by the null hypothesis (H 0) which means accepted and the alternative hypothesis (Ha) which means accepted. reject, so it can be concluded that the data obtained there is no significant difference (significant, namely the truth value of a hypothesis accepted or rejected) in examining potassium electrolyte levels using a red lid vacuum tube or a yellow lid vacuum tube.

DISCUSSION

Electrolyte examination is a type of blood chemistry examination that is very important not only for diagnostic purposes but for evaluating the course of the disease. The choice of anticoagulant must be considered in order to obtain an ideal specimen for examination. Examination of potassium, sodium, chloride using serum levels will be greater than in plasma heparin, because during the clotting process potassium will be released from red blood cells. Examination of sodium, potassium, chloride using heparin plasma is affected by fibrinogen so that it can affect the examination results. The sample for this study were patients who performed an electrolyte examination which would see potassium levels in the red and yellow cap tubes in the laboratory at Toto Kabila Hospital, BoneBolango Regency using serum, and this study used the ISE (ion selective electrode) *method.*

Based on the results of the research described above, it shows that the results of the comparative analysis on the comparison of potassium levels in the red and yellow lid tubes are.0.099 > 0.05 from the results obtained by the null hypothesis ($H_{0)}$ which means that it is accepted and the alternative hypothesis (Ha) which means rejected, so it can be concluded that the data obtained there is no significant difference in examining potassium electrolyte levels using a red lid vacuum tube or a yellow lid vacuum tube.

There was no difference between the red cap and yellow cap vacuum tubes because none of the specimens underwent hemolysis and the separation of serum from cellular elements occurred perfectly, both in specimens that were collected using red and yellow cap tubes. Although the difference in the red cap tube is when the freezing time is longer than the yellow cap tube.

The results of the study showed that the patients examined were based on age 21-69 years, and based on gender, there were 25 male samples and 5 female samples.

Then, based on the results of interviews with 30 patients, there were several patients who did not routinely carry out electrolyte checks, especially on potassium examinations, so they often felt headaches, weakness, nausea, and diarrhea. Therefore, these patients are advised to always routinely check their health conditions by carrying out frequent checks or checking electrolyte levels regularly as recommended in order to avoid hypokalemia and hyperkalemia.

Normally rate potassium also written patient no have a history of other diseases that can interfere with potassium levels. Potassium levels go down or up, the patient's glucose level can occur increased. If the patient has some other disease which can affect the potassium levels will also rise as well down. For this reason, it is important to provide adequate food and fluid intake sufficient for potassium balance, so that potassium remains at normal levels normal.

The difference between the two tubes can be seen from the red cap tube which is a tube without an anticoagulant and a gel separator so that the blood coagulates naturally. The ideal sample freezing time is 60 minutes and centrifuged at 2500 rpm for 10 minutes. while the yellow cap vacutainer tube is a tube without anticoagulant and contains a gel separator. Samples were frozen within 30 minutes and centrifuged at 3500 rpm for 10 minutes.

While the yellow lid vacuum tube or serum separator tubes (SST) after being centrifuged, the separating gel is between blood cells and serum which is influenced by various characteristics of the tube such as specific gravity, pressure, viscosity, density and tube material. Besides that, it can also be caused by temperature, centrifuge speed, acceleration, deceleration, storage and factors from the patient, for example being on heparin therapy, low hematocrit, high protein and serum specific gravity. The specific gravity of the gel should ideally be between 1.03-1.09 g/cm3. The specific gravity of serum is in the range of 1.026-1.031 g/cm3 and the specific gravity of clot is in the range of 1.092-1.095 g/cm3. Serum specific gravity increases due to hyperproteinemia or radiocontrast color, so that the serum will not float on the gel. Besides that, Faught's research showed that there were differences in the specific gravity of the separating gel used in the SST tubes and in the tube lots. Gels can also leach materials, such as gel bits and silicone grease into the specimen and interfere with the test.

This can be interpreted that the two tubes have different advantages. 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.

Factors that affect potassium checking on the tube are letting the blood in for too long which allows the metabolism of blood electrolytes in the sample by blood cells. Blood electrolyte levels in the tube will decrease after 30 minutes of blood collection due to the hemolysis process at a rate of approximately 7 mg/dl per hour [9]. And in taking the serum, care must be taken to avoid hemolysis, especially hemolysis can change the concentration of potassium and can cause interference with other test methodologies.

Therefore, in an examination it is required to provide reliable results which will later be used as a reference in the diagnosis of something disease by a specialist, this can happen if you can avoid mistakes by paying attention to standard operating procedures and paying attention to the factors that affect the results and the stages in an inspection.

CONCLUSION

Based on this research, it can be concluded that:

1. Examination of potassium levels using a red lid vacuum tube with a sample of 30 found results, namely 27 normal and 3 abnormal.
2. Examination of potassium levels using a vacuum tube with a yellow lid with a sample of 30 found results, namely 24 normal people and 6 abnormal.
3. in vacuum tubes with red lids and vacuum tubes with yellow lids, it is alternative hypothesis (Ha) which means rejected, then the data obtained there is no significant difference to the examination of potassium using a vacuum tube with a red lid and a vacuum tube with a yellow lid.

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