



Accuration between Sodium and Potassium Serum Levels and Aqueous Humour in Patient with Senile Cataract

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ABSTRACT

Senile cataract is most commonly type of cataract. Senile cataract patients are estimated to reach 90 % of all cases of cataracts. In patients with senile cataract change the balance of sodium and potassium aqueous humor. Aqueous humor derived from serum, and aqueous humor is an essential nutrient for the lens, the canging at serum concentration also affects the aqueous humor. To determine the accuracy levels of aqueous humor sodium and potassium with serum sodium and potassium levels in patients with senile cataract. A ddiagnostic test has been conducted in the Polyclinic of Dr Mohammad Hoesin Hospital and at Polyclinic of Eyes Hospital Palembang starting in March 2016 until June 2016. There were 30 samples of patients with senile cataract who meet the inclusion criteria. The frequency and distribution of data are described in tables and sensitivity and specificity values will be cut point (cut- off point) to determine levels of sodium and potassium aqueous humor with sodium and potassium serum by using ROC curve. Aaccuracy rate is measured by the value of Kappa . Data were analyzed by using SPSS version 18.0. Of 30 patients with senile cataract had a mean age of approximately 64 years with a sex ratio of men and women is 2 : 1 . The accuracy values obtained from sodium aqueous humor level and sodium serum levels in patients with senile cataract is 0.267 and the accuracy of potassium aqueous humor level with potassium serum levels in patients with senile cataract was 0.6. The aaccuracy of sodium aques humor with sodium serum levels in patients with senile cataract had a sensitivity 8.3 % , followed by a specificity 100 % , positive predictive value (PPV) 100 % , negative predictive value (NPV) 21.4 % , a positive likelihood ratio and the ratio ∞ negative likelihood 0.917 while the accuracy of potassium aqueous humor with potassium serum levels in patients with senile cataract had a sensitivity 57.14 % , specificity 62.5 % , positive predictive value (PPV) 57.1 % , negative predictive value (NPV) 62.5 % , a positive likelihood ratio 1.523 and a negative likelihood ratio 0.686 in a row. It can be concluded that the accuracy of sodium aques humor with sodium serum levels in patients with senile cataract is slighty and accuracy of potassium aqueous humor with potassium serum levels in patients with senile cataract is moderate.

Keywords: Cataract, sodium, potassium, serum, aqueous humor and accuracy.

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INTRODUCTION

Senile cataract is most commonly type of cataract. Senile cataract patients are estimated to reach 90 % of all cases of senile cataract. Cataract is opacification of the lens that occurs due to the process of degeneration and usually starts at the

age of 40 years . The problem of senile cataracts is a serious in the health sector [1,2].

Aetiopathogenesis cataract is multifactorial and until now has not fully known. Many factors such as the aging process, changes in blood electrolyte levels, nutrition, radiation, metabolic disorders, protein aggregation, oxidative stress and genetics are suspected of being involved in the formation of cataracts. Aqueous humor is the main source of

food for the lens produced from the serum. Therefore, serum electrolyte concentrations directly affect electrolyte aqueous humor and here in after regulates the metabolism of the lens. Because aqueous humor derived from plasma, serum electrolyte abnormalities seems to be one risk factor for cataractogenesis [3-8].

The lens is an avascular tissue that it experiences tremendous physiological, all nutrients should be obtained from the surrounding fluid, as well as all the waste products that must be removed fluidity. Most of lens cells in adults experience a reduction in metabolic activity and epithelial membrane to regulate the hemostatic balance. On a normal lens has a lower sodium level (10 mmol / L) and high potassium level (120 mmol /L) otherwise on aqueous humor the sodium content approximately 150 mmol /L (high) and potassium approximately 5 mmol /L (low) . Sodium and potassium balance is maintained by a sodium pump activity with the participation of the enzyme $\text{Na} + \text{K} + \text{-ATPase}$ [9-16].

A research on 5 samples aqueous humor from normal patients and 28 of the patients of senile cataract, analyzed levels of electrolytes (sodium , potassium and chloride). The average rate of electrolyte levels in aqueous humor cataract patients is higher than those the normal eye. The human aqueous humor with cataract there is a decrease of potassium level of about 25% of the level normal [17].

Several studies have shown significant differences between serum electrolyte levels in senile cataract patients compared with patients without cataracts. As we get older increased membrane permeability lens from damage pump activity of $\text{Na} + \text{K} + \text{ATPase}$, thus causing an increase in intracellular sodium on the lens. High levels of extracellular sodium make it harder pumps $\text{Na} + \text{K} + \text{ATPase}$ to maintain low levels of intracellular sodium is required to clear the lens. Variations in serum electrolytes can change the cation concentration of aqueous humor that can affect the metabolism of the lens, causing the formation of cataract [12-16,18,19]. This study was to determine the accuracy levels of aqueous humor sodium and potassium with serum sodium and potassium levels in patients with senile cataract

MATERIALS AND METHODS

A diagnostic test has been conducted in the outpatient of Dr Mohammad Hoesin Hospital and at outpatient of Specialized Eyes Hospital Palembang starting in March 2016 until June 2016. There were 30 samples of patients with senile cataract who meet the inclusion criteria. The study population was all cataract patients aged over 40 years who came to outpatient of Dr Mohammad Hoesin Hospital and Specialized Eyes Hospital in Palembang to be performed surgery to sample all of senile cataract patients who meet the inclusion. The protocol has been approved by Ethic Committee, Faculty Medicine of Sriwijaya University. All subjects who met the criteria were interviewed in order to identify ophthalmological examination. Serum samples were taken before surgery and aqueous humor samples taken intraoperatif then sent to a laboratory for examination levels of sodium and potassium using Beckman Coulter Unicel DXC600 & Synchron CX5PRO

The frequency and distribution described in tables or graphs. Sensitivity and specificity value will be cut point (cut-off point) to determine levels of sodium and potassium aqueous humor with sodium and potassium serum using ROC curve. Accuracy rate is measured by the value of Kappa. Data were analyzed using SPSS version 18.0

RESULT

General characteristics of subjects who suffer from senile cataract are shown in Table 4.1. Senile cataract patients had a mean age of approximately 64 years, with the proportion of the male sex as many as 20 patients (66.7%) whereas women as 10 patient (33.3%) a total of 24 subjects, (80%), of the patients of senile cataract in the right eye and 6 subjects (20%) of the patients of senile cataract in the left eye.

Education level in this study is elementary as many as 11 people (36.7%), followed by education universities were 10 people (33.3%) and a high school education were 7 people (23.3%) and secondary education were 2 people (6, 7%). While most types of occupation are employees of as many as 19 people (63.3%) followed by housewives were 6 people (20%) and farmers were 5 people (16.7%). Location cataract eye more on the right side than those the left with a ratio of 4: 1. The most

of cataract in this study were cataract nuklearis(10 patient) [20,21.]

Sodium and potassium levels were checked for both groups, then the average levels of sodium and potassium both groups were analyzed. With the Shapiro-Wilk normality test obtained probability value of each of sodium and potassium content of 0.000 and 0.001 (p <0.05), which means data distribution is not normal, because the data distribution was not normal then to compare the mean levels of sodium and potassium in both groups, we used the *Mann-Whitney* test. The results of the analysis can be seen in the table below.

Mann-Whitney test was obtained p value sodium levels is 0,000 (p <0.05) so it can be concluded that

there were differences between the mean levels between sodium serum and sodium aqueous humor senile cataract patients where aqueous humor sodium levels higher than those serum sodium level. As for calcium levels obtained p value is 0,841 (p> 0.05) so that it can be concluded that there are no differences between the mean levels potassium serum and potassium aqueous humor senile cataract patients.

Curve analysis done by receiver operating curve (ROC) to find the point of intersection (cut-off point) to get the value of sensitivity and specificity levels of sodium. Figure 4.1 is an ROC curve of sodium level senile cataract patients. The curve has a value of area under the curve (AUC, area under the curve) of 0.956 (CI 0.912.to0.999).

Table 1: Characteristics of Research Subjects

Characteristics	N = 30
Age , years , mean ± standard deviation	64,23±10,58
Gender	n (%)
• Man	20 (66,7%)
• Woman	10 (33,3%)
Education	n (%)
• Primary School	11 (36,7%)
• Junior High School	2(6,7%)
• Senior High School	7(23,3%)
• College	10 (33,3%)
Occupation	n (%)
• Housewife	6(20%)
• Employee	19 (63,3%)
• Farmer	5 (16,7%)
Location of Cataract	n (%)
• Right Eye	24 (80%)
• Left Eye	6 (20%)
Type of Cataract	
• Cataracts Nuklearis	10 (33,3%)
• Cataracts Kortikalis	3 (10%)
• Cataracts posterior Subkapsularis	8 (26,7%)
• Cataracts Matur	9 (30%)

Table 2: Comparison of Average Levels of Sodium and Potassium Serum and Aqueous Humor Senile Cataract Patients

Variable	Serum	Aqueos Humor	p value*
Sodium Mean ± SD	137,90±1,97 (133-141)	147,43±11,61 (139-179)	0,000
Pottasium Mean ± SD	4,17±0,52 (3,4-5,3)	4,22±0,55 (3,6-6,0)	0,841

* *Mann Whitney Test*, p = 0,05

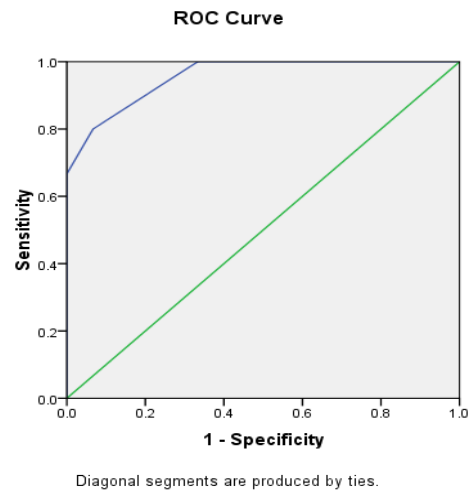


Figure1: ROC Curve Sodium Levels of Senile Cataract Patients

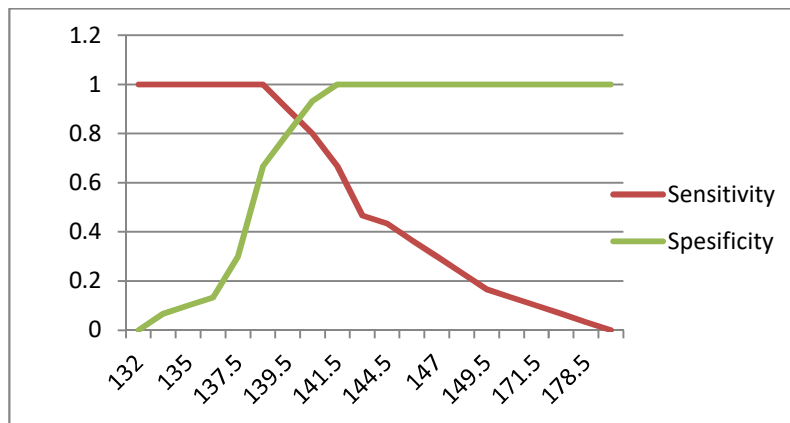


Figure 2: Curve intersection of sensitivity, specificity and sodium

Table 3: Table 2x2 value cut point sodium 140.5 mmol / L for a diagnostic test

Sodium Level	Aqueous Humor		Total
	≥ 140.5	< 140.5	
Serum	≥ 140.5	0	2
	< 140.5	6	28
Total	24	6	30

The determination of cut-off point value of sodium is done by making the curve between the sensitivity, specificity and sodium levels. Figure 4.2 is a point of intersection of the sodium curve. The image obtained values which have the most excellent sensitivity and specificity is the value of 140.5 mmol / L. From table 4.3 above, the value of sodium above the cut point had a sensitivity of 8.3%, a specificity of 100%, positive predictive value (PPV) of 100%, negative predictive value

(NPV) of 21.4%, a positive likelihood ratio of ∞ and negative likelihood ratio of 0.917. Accuracy levels of sodium aqueous humor with sodium serum in senile cataract patients is 0.267, which means the degree of conformity of measurement (reliability) is enough. Figure 4.3 is an ROC curve potassium level of senile cataract patients. The curve has a value of area under the curve (AUC, area under the curve) 0.515 (CI 0.366 to 0.664).

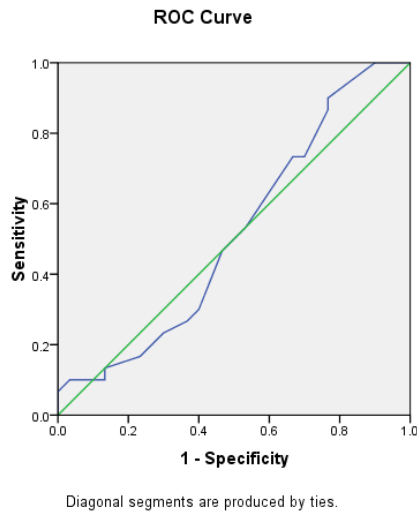


Figure 3: Potassium Levels ROC curve senile cataract patients

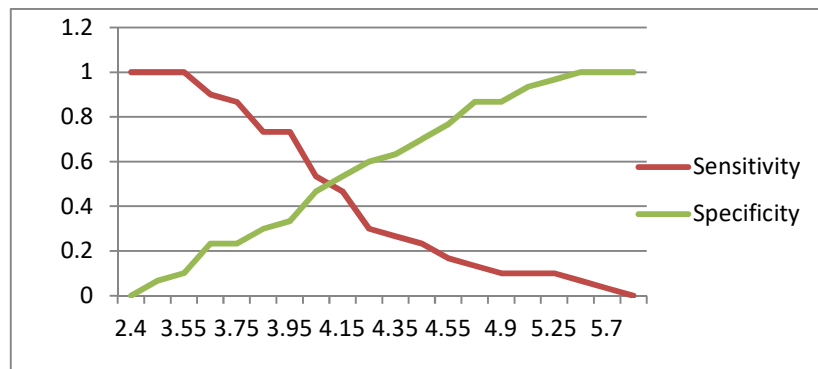


Figure 4: Kurva intersection of sensitivity, specificity and potassium levels

Table 4: Table 2x2 potassium value cut-off point of 4.15 mmol / L for a diagnostic test

Potassium Levels	Aqueous Humor		Total	
	≥ 4.15	< 4.15		
Serum	≥ 4.15	8	6	14
	< 4.15	6	10	16
Total	14	16	30	

The determination of cut-off point value of potassium is done by making the curve between the sensitivity, specificity and potassium levels. Figure 4 is a point of intersection of the potassium. From the table 4.4, the value above the cutoff point of potassium had a sensitivity of 57.14%, specificity 62.5%, positive predictive value (PPV) of 57.1%, negative predictive value (NPV) of 62.5%, a positive likelihood ratio of 1.523 and a

curve. The image obtained values which have the most excellent sensitivity and specificity is the value of 4.15 mmol / L.

ratio negative likelihood 0.686. Accuracy levels of potassium aqueous humor with potassium levels of senile cataract patients were 0.6, which means the degree of conformity of measurement (reliability) is moderate.

DISCUSSION

In this study, the mean age of the patients of senile cataract was 64.23 ± 10.58 years. The results are consistent with data from other research that gets results that senile cataract patients are generally aged between 60-69 years. Study in the United States found a prevalence of senile cataract increased by 5% at age 65 years and 50% at over 70 years [22, 23]. In India found the average age of senile cataract patients was 65.8 ± 1.7 years [24]. In China reported a mean age of senile cataract patients was 61 ± 10.3 years [2]. Age is the most important risk factor for the occurrence of senile cataract. Where the increase of age followed by an increase in the degree of maturity or senile cataract lens opacities [25]. Similarly, the lens of the eye which will be amended in accordance with the increase in age, where there is a complex mechanism that causes changes in the lens and lens fiber formation will also be more susceptible to oxidative stress, thus decreasing lens clarity and going senile cataract [26,27]. Moreover, with age and the presence of continuous exposure by agents from the outside, resulting in the accumulation of excessive free radicals and will cause disruption of antioxidant protection mechanisms eyepiece [27]. Proportion of patients with senile cataract in this study obtained male gender higher than in women (2:1). In general, it is said that men have a risk of senile cataract is greater than women. It is probably because men do more outdoor activities. Outdoor activity associated with the number of ultraviolet light exposure experienced by a person, especially in the tropics with the high intensity of sun exposure [28].

Other studies conducted in different countries get different results depending on gender predilection in senile cataract patients. Research in the US found a group of women suffering from senile cataract more than men in significant [28]. Japanese study found the ratio of men and women suffering from senile cataract are 1:8 and senile cataract patients who have undergone surgery are dominated by women aged over 65 years [29]. The difference results in this study may be exacerbated in Indonesia more dominant men work outside the home than women, because women Indonesia more to become a housewife and so the risk of senile cataract is greater in males than in females. Education level in this study is elementary as many as 11 people (36.7%). The results of this study do not differ from research in Malaysia were found

most senile cataract patients have low levels of education [30]. Education levels can be linked with the speed to obtain medical care in which patients with higher education levels are generally faster seek health care, which is more common senile cataract at a stage earlier, while patients with low levels of education mostly senile cataract was found in the mature stage, making it more risky for complications occur either before or at the time of cataract surgery [27,31].

The most type of work is a employees as much as 19 people (63.3%). The results of this study differ from studies on senile cataract where research in India found 90% of patients with senile cataract work in agriculture [34]. Some researchers argue that the principal nonprofessional jobs associated with low socioeconomic level. People with lower socioeconomic status are more prone to cataract [33]. However, some researchers linked to the length of patient work doing outdoor activities were subsequently linked to the duration of exposure to ultraviolet light is experienced. The longer the outdoor activity will lead to greater exposure to ultraviolet rays obtained [27,34]. Exposure to ultraviolet light on the lens will trigger oxidative reactions that produce excess free radicals that both directly or indirectly cause damage to components of the lens, so the lens clarity decreases and occurred cataract [18]. In the research work is the employee most likely caused employees have a higher education level than the work of farmers and housewives so that awareness to a larger medical examination.

Sodium serum levels in this study was 137.90 ± 1.97 (133-141) mmol / L , while the content sodium aqueous humor was 147.43 ± 11.61139 to 179 mmol / L . It can be seen that there is a distinction has sodium levels less than 10 points between the serum and aqueous humor levels in patients with senile cataract. The levels of potassium in which potassium serum levels in this study was 4.17 ± 0.52 (3.4 to 5.3) mmol / L , while potassium aqueous humor was 4.22 ± 0.55 (3.6 to 6 , 0) mmol / L . It can be seen that there is little difference in levels of potassium, approximately 0.05 points between the serum and aqueous humor levels in patients with senile cataract. This difference is not significant so that we can conclude that there are differences between the mean potassium serum and aqueous humor senile cataract patients. Sodium levels in the lenses increased significantly, while potassium levels

decreased in senile cataract, but aqueous humor and electrolytes serum did not change significantly. The more mature cataracts increased levels of sodium in the lens and reverse declining levels of potassium during cataract formation. At the beginning of the cataract, lens sodium content increased on average almost three times higher than the normal value. In mature cataract lenses sodium levels increased by almost ten times, while potassium decreased by almost one-fifth of the normal lens [18, 19].

The mechanisms that control the water and electrolyte balance, is important in maintaining lens clarity. In this study, there are increased levels of sodium and potassium were significantly more likely due to the level of maturity or type of cataract varied from all samples where there are differences in the level of membrane permeability lens and pump Na + K + ATPase. This study found cases of cataract immature (nuklearis, kortikalis and subkapsularis posterior) more (70%) than in mature cataracts. Cut point value of sodium in this study was 140.5 mmol / L in which the value of accuracy levels of sodium aqueous humor with sodium serum levels in patients with senile cataract is 0.267, which means the degree of conformity of measurement (reliability) is sufficient. In this study, a sensitivity of 8.3% and a specificity of 100%, this means the ability to detect sodium serum levels of sodium aqueous humor \geq 140.5 is 8.3%, while the ability of sodium serum levels to determine that the sodium aqueous humor levels $<$ 140.5 is 100%.

In this study, also obtained positive predictive value (PPV) of 100% and a negative predictive value (NPV) of 21.4%, this means the possibility of a person to have sodium aqueous humor levels \geq 140.5 when sodium serum \geq 140.5 is 100%, while the likelihood of someone have sodium aqueous humor levels $<$ 140.5 when sodium serum $<$ 140.5 is 21.4%. Positive likelihood ratio of ∞ and negative likelihood ratio of 0.917 can be explained that the comparison between the proportion of sodium aqueous humor and serum \geq 140.5 is ∞ and comparison between the proportion of sodium aqueous humor and serum $<$ 140.5 is 0.91 Cut-off point value of potassium in this study was 4.15 mmol / L in which the value of accuracy levels of potassium aqueous humor with sodium serum levels in patients with senile cataract is 0.6, which means the degree of conformity of measurement (reliability) is moderate.

Furthermore, a sensitivity of 57.14% and a specificity of 62.5%, this means the ability of serum potassium to detect potassium levels \geq 4.15 aqueous humor amounted to 57.14%, while the ability of potassium serum levels to determine that the levels of potassium aqueous humor $<$ 4.15 by 62.5%. In addition, it obtained positive predictive value (PPV) of 57.1% and negative predictive value (NPV) of 62.5%, this means the possibility someone has potassium aqueous humor levels \geq 4.15 when serum potassium is \geq 4.15 is 57, 1%, while the likelihood of someone have potassium aqueous humor level $<$ 4.15 when the potassium serum $<$ 4.15 was 62.5%. Positive likelihood ratio of 1.523 and a negative likelihood ratio of 0.686 can be explained that the comparison between the proportion of potassium aqueous humor and serum \geq 4.15 is 1.523 and the ratio between the proportion of potassium aqueous humor and serum $<$ 4.15 is 0.686.

CONCLUSION

The value of the accuracy between the sodium aqueous humor and sodium serum of senile cataract patients was 0.267 and the accuracy of potassium aqueous humor with potassium serum of senile cataract patients was 0.6. The sensitivity between sodium aqueous humor and sodium serum level was 8.3%, followed by specificity of 100%, positive predictive value (PPV) of 100%, negative predictive value (NPV) of 21.4%, a positive likelihood ratio of ∞ and a negative likelihood ratio of 0.917 and accuracy potassium aqueous humor with potassium serum levels in patients with senile cataract had a sensitivity of 57.14%, specificity 62.5%, positive predictive value (PPV) of 57.1%, negative predictive value (NPV) of 62.5%, 1.523 Likelihood ratio of positive and negative likelihood ratio 0.686

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Conflict Of Interest

There is no conflict of interest in this study.

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