

Correlation between Vitreous Potassium Levels and Postmortem Interval of Corpse in Sanglah Central Hospital Denpasar

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Abstract: One of the most important things in Forensic medicine is doing autopsy on corpse which has a function to evaluate the internal organs of human body that cannot be assess by external examination. Both are done to estimate the time of death. This study was conducted to find the correlation of vitreous potassium levels and postmortem interval of corpse in Sanglah Central Hospital Denpasar and determine the linear regression of both variables. The study was carried out in two steps, 1) Collection of vitreous samples in Autopsy room of Forensic Department, Sanglah Central Hospital Denpasar, 2) Examination of Potassium levels in Clinical Pathology Laboratory, Sanglah Central Hospital Denpasar. The samples were taken out from lateral limbus of the right eye by using 3 ml syringe and 18G needle. Almost 0.5 – 2.5 ml of clear vitreous was aspirate. This sample then checked by ion selective electrode methods. Ten samples collected have done statistical analysis. The data was normally distributed. Pearson's correlation coefficient was $r=0.810$. Determinant coefficient $R^2=0.656$ and linear regression equation was $y= 0,81x + 3,659$ (y, potassium levels; x, postmortem interval). The equation to estimate postmortem interval by using vitreous potassium level was $1,23[K+] - 4,5$. Thus, it is concluded that there is strong correlation between vitreous potassium levels and postmortem interval of corpse in Sanglah Central Hospital Denpasar. The increase of postmortem interval causes the increase of vitreous potassium levels.

Keywords: Potassium, Vitreous, Post-mortem.

I. INTRODUCTION

Death can occur as a natural death and unnatural death. Unnatural death usually has a strong relation with law violation, such as negligent, suicide and murder. Unnatural death should be examined to obtain the information of who is death, who is responsible, where the murder take place, when it happens and how it happens. Information that obtain when external examination and autopsy is really important for court to give the exact punishment. Because of that, the information of the time when the corpse was died is really important.^[1,2]

Understanding the process of murder is really important by the police by doing Autopsy. Autopsy is come from Greek words that have the meaning of "Seeing with one's own eyes". Autopsy is known as medical procedure to slice the corpse body to see and examine the internal organ and found the biological proof about the cause of death, mechanism of death, time of death that can help the police to estimate the way of death, whether its natural or unnatural death.^[3]

The corpse that found unnatural, the time of death estimated by Forensic doctor is really important. In forensic medical practice, the estimation of early sign of death and late sign of death is really important. But the sign of death that obtain by external examination does not enough to know the exact time of death. They usually influenced by internal and external factor, so we need a good parameter that does not influenced by those factors. One organ that interesting to observe is the vitreous body. But in Indonesia there is no study has been done about vitreous body.^[4]

II. MATERIAL AND METHODS

This is an analytical observational study using the cross-sectional method. This research conducted in September 2016 until January 2017 in Autopsy Room, Forensic Department, Sanglah Central Hospital Denpasar. Samples were taken from corpse which post mortem interval was known using consecutive sampling method.

The inclusion criteria of the sample were corpse which informed consent were given by the family. The corpse was died in Sanglah Central Hospital or from another hospital if the time of death was known. All of the sample were Indonesian. The exclusion criteria of the sample were patient who died cause by metabolic disease such as Diabetes mellitus, hypertension and chronic kidney disease.

Data taken was a primary data. The vitreous humour was taken by aspiration using 18G needle. A clear vitreous humour was aspirated until 0.5 – 2.5 ml. the liquid was checked by using Ion Selective Electrode Method. Collected data was computed with SPSS ver. 24 and analysed using the normality study and the correlation and regression method.

III. RESULT AND DISCUSSION

a. Result

Samples that fulfilled inclusion and exclusion criteria were 10 corpses. Table 1 are the sample code, sex, post-mortem interval and vitreous potassium levels of each samples.

Table 1: Data of Postmortem Interval and Vitreous Potassium Levels

Sample Code	Sex	Postmortem Interval (Hours)	Vitreous Potassium Levels (mmol/L)
PL-004	Male	3.25	6.40
PL-005	Female	2.42	4.00
PL-006	Male	4.16	6.40
PL-007	Female	2.25	6.10
PL-008	Male	2.67	6.20
PL-009	Male	5.67	9.50
PL-010	Female	3.00	7.00
PL-011	Female	3.33	6.20
PL-012	Female	4.42	7.20
PL-013	Female	6.67	8.30

Based on calculation, sample age was in 18 – 71 years old range and the mean was 44.5 years old. Post-mortem interval was between 2.25 – 6.67 hours and the mean were 3.78 hours. Based on laboratories checking using the Ion Selective Electrode method the vitreous potassium levels were between 4.0 – 9.5 mmol/L and the mean was 6.73 mmol/L. Table 2 shows the descriptive analysis of post-mortem interval and vitreous potassium levels.

Table 2: Range, Mean and Standard Deviation of Post-mortem interval and Vitreous potassium levels using SPSS

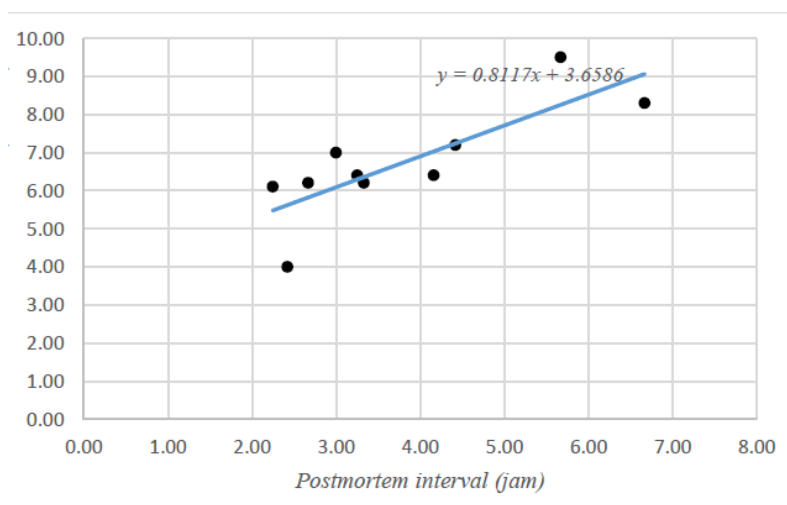
	Range	Mean ± SD	Number of Sample
Postmortem Interval	2.25 – 6.67	3.784 ± 1.45	10
Vitreous Potassium levels	4.0 – 9.5	6.73 ± 1.45	10

Pearson's correlation coefficient was 0.81 and statistically significant, or in another word Vitreous potassium levels and postmortem interval have a very strong correlation (>0.6). calculation of Pearson's correlation coefficient is shown on table 3.

Table 3: Calculation of Pearson's Correlation Coefficient using SPSS

		Postmortem interval	Vitreous Potassium
Postmortem interval	Pearson correlation	1	0.810
	Sig. (2-tailed)		0.004
	N	10	10
Vitreous potassium	Pearson correlation	0.810	1
	Sig. (2-tailed)	0.004	
	N	10	10

The linear regression of those two variables is $y = 0.81x + 3.659$ with standard of error ± 0.9 hours. The linear regression equation has slope 0.812 or in another word vitreous potassium increase 0.812 mmol/L every hour. Picture 1 show you the linear regression equation of Postmortem interval and Vitreous potassium levels.



Picture 1. Graphic of linear regression between Post-mortem interval and Vitreous potassium levels

In this research, from reverse of the linear regression equation that has been calculate, the formula to estimate post-mortem interval from the data of vitreous potassium levels is:

$$\text{Post-mortem Interval} = 1.23 [K^+] - 4.5$$

In this research, the intervening variables are ethnic, clinical procedure (autopsy or external examination) was controlled by research design and the inclusion and exclusion criteria. Research about post-mortem vitreous analysis have been done by some researcher, but no research done in Indonesia, yet. Corresponding research have been done in some country such as India, Canada, and United States. Some relevant research shown in table 4. [5,6,7]

Researcher	Linear Regression Equation	Postmortem Interval Estimation Equation
Salam, et al. (2012)	$y = 0.72x - 6.57 (r = 0.61)$	$PMI = 1.337[K^+] + 9.050$
Mihailovic, et a. (2012)	$y = 0.36x + 4.35 (r = 0.927)$	$PMI = 2.749[K^+] - 11.978$
Tumram N.K., et al. (2014)	$y = 0.68x + 7.43 (r = 0.526)$	$PMI = 2.71[K^+] - 20.19$
Rathinam, et al. (2016)	$y = 0.465x + 2.00 (r = 0.867)$	$PMI = 2.14[K^+] - 4.30$

b. Discussion

Based on another research shown in table 4, the correlation between post-mortem interval and vitreous potassium level is very strong. Analysis of sex, difference of chosen eyes (right or left) do not have significant difference by statistical analysis. Some hypothesis say that increase in vitreous potassium levels cause by the influx of electrolyte from choroid vascularisation and retina cells. This cause the high potassium concentration intracellular wash out by diffusion to vitreous body. All of the research shown in table 4 use Ion Selective Electrode methods to measure the potassium levels in vitreous humour. Ion Selective Electrode is the method that recommended by World Health Organization to measure the electrolyte concentration in Hospital Laboratories and Clinical Chemistry practice.

Study by Zilg, et al. about Vitreous body analysis after death. They analyse the glucose and electrolyte levels and got different result. The study by Zilg use 3076 samples and use blood gas analysis. From this study, the potassium levels in Vitreous body increase by exponential to the increase of post-mortem interval. After a week, the potassium levels in vitreous humor relatively stable in 35 mmol/L. The equation was $[K^+] = 29,91[1 - e^{-0,22PMI}] + 4.73e^{-0,22PMI}$ [8,9]

When the post-mortem interval equal to 0, the equation of linear regression gives different value of vitreous potassium levels. This have been seen by Kokavec, et al. and they make another research about antemortem analysis of vitreous potassium levels. This research has been done by analyse the vitreous humour of patient in intraocular operation. The mean of vitreous potassium concentration is 5.73 mmol/L. It is found that this corresponded in estimation using potassium. [10,11]

This research also uses relatively small number of samples, so another future research is needed to increase the sample number. Future study needed to understand whether the estimation of post-mortem interval by using vitreous potassium levels is in linear regression or exponential regression. This hopefully can give more accurate estimation of post-mortem interval and can support the data from external examination.

IV. CONCLUSION

Based on result and discussion of this study, the correlation of vitreous potassium levels and post-mortem interval is very strong shown by the Pearson's correlation of 0.81. The increase of post-mortem interval causes the increase of vitreous potassium levels.

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