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Estimation of Time Since Death With Changes in Potassium Level in Pericardial Fluid

KEYWORDS: Electrolyte, Potassium, Pericardial fluid, Time since death

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ABSTRACT *Background: For investigation of crime it is very important to determine time since death. The time interval after death is very essential for the law authority, particularly when no witness is present at the scene of crime. An erroneous time of death can lead investigators in a wrong path especially in criminal cases. In fact the estimation of time since death posses a difficult problem faced by Forensic Pathologist.*
Materials and methods: Cases with known TSD & cause of death and Cases where clear Pericardial fluids were obtained.
Result: This prospective study was undertaken with an objective to establish a linkage between levels of electrolyte and time since death. 101 diff medico legal cases with known time since death formed for cohort of the study. The pericardial fluid collected in aseptic maneuver and analyzed for time since death through Spectrophotometer to record the level of electrolyte like Potassium. The time of death was confirmed from accompany relatives, police personnel and medical records. A gradual rise of potassium level at par the time since death is noted.
Conclusion: Potassium ion concentration increased with time since death at mean rate of 2.39meq/l/Hr. There was no effect of other parameters like age, sex on the variation of levels of potassium

INTRODUCTION:

For investigation of crime it is very important to determine time since death i.e. the interval between death & the time of Post-mortem examination is called Post-mortem interval.[1, 2] The time interval after death is very essential for the law authority, particularly when no witness is present at the scene of crime. An erroneous time of death can lead investigators in a wrong path especially in criminal cases. In this situation there seems to be a close link between alibis of a person i.e. under suspicion in the above situation mentioned. The suspect anyway could avoid by saying that he was not at the scene where the episode of crime occurred.[3] Unfortunately no definite or precise method by which actual time of death could be determined has been devised till date. In fact the estimation of time since death posses a difficult problem faced by Forensic Pathologist [4,5,6,7]. Efforts have been made to determine more a time since death accurate by observing chemical changes that occur in body fluids.[8] Post-mortem changes in the composition of various body fluids like blood, CSF, vitreous, synovial fluid, spinal fluid, and aqueous humor utilized in determining time since death.[9, 10]The routine methods to estimate TSD are cooling of body, changes in eye, vibices, rigor mortis, and decomposition changes, contents of stomach, bladder, bowels, & circumstantial evidence. From these approximate time of death can be estimated[1]. Though there are numerous studies done on other body fluids to find some correlation between TSD & change in electrolyte level[11, 12] but there are very few works done with pericardial fluid particularly in eastern part of India.

MATERIALS & METHODS

The Pericardial fluids were obtained from pericardial sac of cadavers coming for medico legal autopsy in 101 cases performed between December 2008 to November 2010 in Department of FM&T, MKCGMCH, Berhampur. The time of death was confirmed by Doctors, relatives, police personnel & death summary from documents.

Inclusion criteria: Cases with known TSD & cause of death could be ascertained and Cases where clear Pericardial fluids were obtained.

Exclusion criteria: Case with known chest disease or suspected trauma, Cases where pericardial fluids were contaminated with blood, Cases where process of putrefaction was in very advanced stage.

Procedure: Under aseptic conditions, thoracic cavity was obtained by removing the sternum. The pericardium was carefully obtained with a pair of clean scissors taking the precautions of avoiding any contamination of the pericardial fluid. The sample was aspirated by using a 10cc sterile syringe in a glass vial. The Pericardial fluid collected from the cadaver was centrifuged at room temperature at 500 revolutions per min for 5 minutes. Supernatant fluid was used for analysis. Standardization of instrument was done according to protocol provided by the manufacturer of instrument. Readings was taken in Spectrophotometer model 106 Systonic make.

Statistical analysis: All the data are analyzed using Graph Pad prism version 5.0. One way ANOVA with post- hoc turkey's test was done for inter group comparison. P value less than 0.05 considered statistically significant.

OBSERVATIONS :

K^+ level in relation to sex variation: Out of 101 cases studied 56 were males (55.55%) & 45 were females (44.45%). There was no significant difference in the K^+ levels in relation to sex variation. The mean potassium level

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in male cases is 29.91± 2.07 meq/L and the respective value in female is 29.75 ± 1.06 meq/L.

Potassium level in relation to age variation: The age of the cases studied ranged from 11 to 80 years and all the cases were divided into 7 groups with group interval of 10years as depicted in table no.1 The cases in the age group of 20- 30 years are 36 (35.64%), which is highest in number. There was no case observed in the age group 0 to 10 years. There was no significant variation ($p>0.05$) in pericardial potassium level in relation to age (table-1).

Cause of death: The cause and mode of death as observed in the cases studied were varied & included RTA, Poisoning, asphyxia, burn, natural disease etc. as summarized in table no.2 Cause of death due to poisoning constituted the highest no of cases, i.e. 40 in number out of 101(39.6%) next to this were the trauma cases (RTA and fall from height) which constituted 28.7% cases (29 cases out of 101). (table-2)

Relation of TSD with changes in K^+ level in pericardial fluid: Pericardial fluid was studied by using spectrophotometer for estimation of K^+. The respective values were examined to find any relation of TSD with change in K^+ level (Table no. 3). The potassium level in pericardial fluid increased gradually from mean 17.14 ± 1.27 meq/L at 0 - 6 hours to 44.72 ± 2.04 meq/L at 18-24 hours and these changes were found to be statistically significant in comparison to the value at 0-6 hours (Graph no.1). (table-3)

Out of 101 cases studied in this present work, there were 29 cases (28.7 %) with death due to some form of trauma and 40 cases (39.6 %) with death due to poisoning. As these cases formed the bulk of the total cases studied, they were considered to be taken for study of change in K^+ level in relation to TSD.

Poisoning case: The potassium level in pericardial fluid increased gradually from mean 16.67 ± 2.24 meq/L at 0 - 6 hours to 44.67 ± 1.04 meq/l at 18-24 hours and these changes were found to be statistically significant in comparison to the value at 0-6 hours (Graph no.2).

Trauma case: The potassium level in pericardial fluid increased gradually from mean 17.91 ± 3.39 meq/L at 0 - 6 hours to 48.5 ± 6.77 meq/L at 18-24 hours and these changes were found to be statistically significant in comparison to the value at 0-6 hours (Graph no.3).

In the preceding chapter emphasis has been laid down in the exact time of death recording either from hospital records or from the investigating police officer & relatives of the cases or both. Out of total no. of 1562 cases comes for autopsy only 409(26.22%) cases having known TSD whereas 749(48.01%) cases having not known time of death from any source. But 402(25.77%) no. of cases having probable time of death but cannot say exactly from any source.

DISCUSSION

According to Jens skou 1957 Na^+K^+ ATPase is an integral part of Na^+K^+ pump and that the splitting of ATP provides the energy needed for the active transport of Na^+ - K^+ ions across the plasma membrane. The level of enzymatic activity is quantitatively correlated with the extent of ion transport and the Na^+K^+ ATPase and the pump are tightly associated with plasma membrane. Any condition (i.e. anoxia) which affects the activity of ion pump will result in loss of K^+ from the cell and increase the Na^+ ion so this might be the cause of increase in K^+ concentration in extracellular body fluid including pericardial fluid after death.

Selection of body fluid: Advantage of pericardial fluid over vitreous humor, CSF and synovial fluid is that it is easily obtainable in a reasonable large volume and over blood is that it is less prone for microbial contamination and bacterial degradation. A comparative study with previous works is furnished below. (table-4)

Selection of cases: The study represented by either sex in a fairly good number 56 male vs 45 female which remove the sex bias while selecting the similarly all the cases studied were spread over a wide age range from minimum age 11 year to maximum of 80 years. Variation of potassium in relation to gender it is found that there had no variation of the level of potassium in pericardial fluid in relation to sex. Though sex variation of potassium level in vitreous slightly higher in female in comparison to male as studied by Dalbir singh et al in 2001, but there is no significant in potassium level in relation to sex by previous study on pericardial fluid by same author in 2006 and by B V subramanium.

Variation of potassium level in relation to age: No significant relation in potassium level in comparison to other. Mean k^+ level in 10-20 years & >60 years was low in comparison to others age groups. No statistical significance found. These findings re corroborate with that of V. Garg et al.

Relation of TSD in comparison to change in k^+ level: An increasing trend in level k^+ of up to 24 hours with a mean rise of 2.39 meq/l/hr. The increasing trend also described by Dalbir singh et al.

Relation of TSD in comparison to change in k^+ level in selected case: Follow same trend as observed in all cases both in trauma & poisoning case. No previous study reported about any diff in the variation k^+ level in pericardial fluid among diff groups with diff cause of death.

CONCLUSION:.

- Potassium ion concentration increased with time since death at mean rate of 2.39meq/l/Hr.
- There was no effect of other parameters like age, sex on the variation of levels of potassium
- There was no variation among different causes of death in terms of pericardial potassium level

The determination of TSD is a challenging job for the Forensic Pathologist because of varied reasons. Many factors are responsible for these variations resulting difficulties in exactly pinpointing TSD. Electrolyte imbalance following death is also taken as tool by diff workers for estimating TSD; the present study reflects the same. K^+ level reflect a positive finding in estimating TSD especially within 24hr following death. More & more works have been suggested, taking up more & more electrolytes equal in no in various body fluids using modern techniques for the purpose of ascertaining the time of death.

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CONFLICT OF INTEREST : NIL
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TABLES AND GRAPHS

TABLE NO.1: CASE DISTRIBUTION ACCORDING TO AGE

AGE GROUP	MEAN AGE (in Years)	NO. OF CASES	PERCENT-AGE	POTAS-SIUM (in meq/L)
10 – 20	15.36 ± 0.56	14	13.86	21.75**±2.49**
20- 30	23.56 ± 0.47	36	35.64	32.87**±1.93**
30 – 40	32.63 ± 0.58	16	15.84	32.03**±4.99**
40 – 50	44.13 ± 0.55	16	15.84	32.22**±2.73**
50 – 60	53.5 ± 0.83	10	9.9	34.23**±3.74**
60 – 70	67.78 ± 3.24	9	8.91	17.29**±2.21**

p>0.05(ns), value expressed in mean+- SEM One way ANOVA with followed by turkey's test

TABLE NO.2: DISTRIBUTION OF CASES ACCORDING TO CAUSE

CAUSE OF DEATH	NO OF CASES	PERCENTAGE
RTA	20	19.8
BURN	16	15.84
POISONING	40	39.6
SNAKE BITE	6	5.94
FALL FROM HEIGHT	9	8.9
NATURAL DISEASE	7	6.93
HANGING	3	2.97

TABLE NO. 3: TSD IN RELATION TO POTASSIUM LEVEL IN PERICARDIAL FLUID

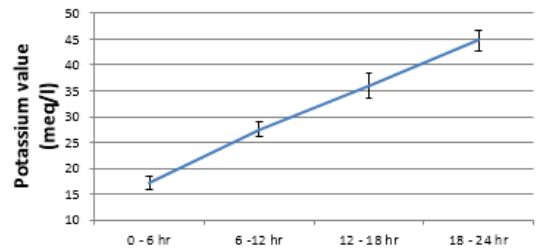
TSD(in hr)	K^+ (meq/l)	Mean rise of K^+ in meq/l/hr	K^+ (meq/l) in Poisoning case	K^+ (meq/l) in Trauma case
0-6	17.14 ± 1.27	2.75	16.67 ±2.24	17.91 ± 3.39
6-12	27.55 ± 1.47	2.81	36.23 ± 0.78	25.94 ±1.86
12-18	35.9 ± 2.42	1.98	41.25 ± 2.95	34.15 ± 3.79
18-24	44.72 ± 2.04	2.02	44.67 ± 1.04	48.5 ± 6.77

P<0.05(s), value expressed in mean+- SEM One way ANOVA with followed by turkey's test

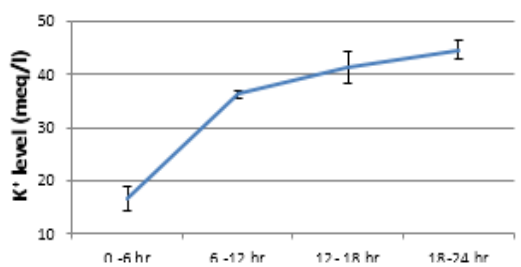
TABLE-4: COMPARATIVE STUDY

Authors	Potassium level
Botezatu 1977	Increased
Balasooriya et al 1984	Significantly Increased with time
D k pattnaik 1986	Increased 4 to 7 times within 22 hours
Jayashree et al 2000	Increased 0.71meq/l /hr
D singh 2006	Increased 0.68 meq/l/hr
Present study	Increased by 2.39 meq/l/hr

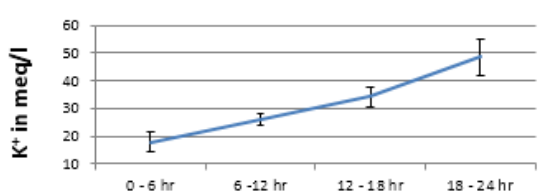
GRAPH NO. 1: TSD IN RELATION TO POTASSIUM LEVEL IN PERICARDIAL FLUID



GRAPH NO. 2: CHANGES IN K^+LEVEL IN RELATION TO TSD AMONG POISONING CASES



GRAPH NO. 3: CHANGES IN K^+ LEVEL IN RELATION TO TSD AMONG TRAUMA CASES



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