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POTASSIUM CHANGES IN PERICARDIAL FLUID AND ITS CORELATION WITH TIME SINCE DEATH.

Forensic Medicine

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ABSTRACT

The time interval after death is essential for the law authority, particularly when no witness is present at the crime scene. A wrong time of death can lead investigators on the wrong path, especially in criminal cases. There are many post-mortem changes through which time since death can be deduced. The body fluids which can be used to estimate the time since death through its biochemical changes include blood, pericardial fluid, cerebrospinal fluid, vitreous humor, aqueous humor, and synovial fluid. This study aimed to assess the time since death from potassium changes in pericardial fluid. It was a retrospective study of 100 on 100 cases brought for a medico-legal autopsy to the Department of Forensic Medicine & Toxicology, Tertiary care hospital. There was variation in Potassium level in mmol/L with time since death but no effect of age or sex on the change of Potassium level. There was a linear relationship between Potassium Concentration and Time since the death. Potassium ion concentration increases with time since death at a mean rate of 2.864 mmol/L in different causes of death.

KEYWORDS

Potassium; Pericardial Fluid; Time Since Death; Cause of Death

INTRODUCTION

The time interval after death is essential for the law authority, particularly when no witness is present at the crime scene. A wrong time of death can lead investigators in the wrong path, especially in criminal cases. There are many post-mortem changes through which time since death can be deduced. The interval between the death & the time of post-mortem examination is called Post-Mortem Interval[1].

The body fluids which can be used to estimate the time since death through its biochemical changes include blood, cerebrospinal fluid, vitreous humor, aqueous humor, synovial fluid etc[2].

The advantages of considering pericardial fluid are as follows:

1. It exists in a closed cavity, hence chances of contamination are minimal
2. Sample can be easily obtained.
3. Sufficient quantity is available[3].

The pericardial fluid is a product of ultrafiltration and is considered to be drained by the lymphatic capillary bed mainly. The composition of pericardial fluid is difficult to define having specific characteristics just like the pleural fluid. Volumetric studies have shown that the pericardial fluid volume is directly analogous to the amount of size in adult humans about 20-60 ml. Regarding the cell population studies in human normal pericardial fluid have shown the presence of heterogeneous cell populations. There are mesothelial cells, lymphocytes (53%), granulocytes (31%), macrophages (12%), eosinophils (1.7%) and basophils (1.2%). The studies show that the pericardial fluid is considered a plasma ultrafiltration product, like other serosal cavity fluids. Studies in grey hounds showed that the concentrations (in mmole kgr H2O..) of Na^+ 150 plus minus 0.72, Cl^- (123.2 plus minus 0.71), $Ca2^+$ (1.92^+ minus 0.04), and $Mg2^+$ (0.85 plus minus 0.09) were lower in the pericardial fluid than in the plasma. On the contrary, the concentration of K^+ was higher than the plasma, which was attributed to the k^+ leakage from the myocardial interstitial towards the pericardial cavity during systole. The pericardial fluid osmolarity was lower than the plasma[4].

The correct determination of time since death is an important goal in the medico-legal investigation. Recent advances in estimating the time since a death have enabled us to determine postmortem intervals more precisely. Earlier methods were based on body cooling, rigor mortis, changes in the eye, putrefaction, and contents of the stomach. These methods were not so prominent and only an approximate time could be estimated. Due to the lack of precision, the focus has now been shifted to biochemical, degradation methods which are based on systematic pathophysiological changes and found to be more accurate as the effect of external conditions are less in these methods. This study describes the estimation of time since death through body fluids i.e, pericardial fluid and changes occurring in Potassium for estimating time since death [4].

Numerous studies have been conducted to estimate the time since death from the biochemical changes of various body fluids. However very few studies have been done on pericardial fluid, hence this study is focused on the estimation of time since death from biochemical changes in the pericardial fluid.

MATERIAL AND METHODS :

A study was conducted on 100 cases brought for a medico-legal autopsy to the Department of Forensic Medicine & Toxicology, Tertiary Care Hospital from May 2020 to May 2022, and the material for the study is Pericardial fluid collected from Cadavers. The details of the case were collected from post-mortem records. The inclusion criterion was All hospital-admitted medico-legal cases and brought dead cases (in which the apparent time of death is known) sent for post-mortem examination at a post-mortem center, or tertiary care hospital. The exclusion criteria consisted of Decomposed bodies, Extensive burns, blast cases and cases where pericardial fluid is likely to be contaminated with blood due to any Pathology. Under aseptic conditions, the thoracic cavity was opened by removing the sternum. The pericardium was carefully accessed with a pair of clean scissors to avoid contamination of the pericardial fluid. The sample was aspirated by using a 10cc sterile syringe in a glass vial. Separate fluid was taken in the sterile container/plane tube with all precautions for processing each 6 hourly for the same body and kept in cold storage. The purpose of processing the fluid every 6 hours was to see whether any change had taken place in ion concentration in pericardial fluid. The Pericardial fluid collected from the cadaver was centrifuged at room temperature at 500 revolutions per minute for 5 minutes. The supernatant fluid was used for analysis. The Purpose of Centrifuging the fluid was to obtain the Supernatant fluid for analysis, this means the usually clear liquid overlying material deposited by settling

precipitation or centrifugation must be obtained for analysis. Standardization of the instrument was done according to the protocol provided by the manufacturer of the instrument. Readings were taken in the Ion Electrolyte machine Elite Electra Medical. Standardization of the instrument and quality control before each reading was done according to the protocol provided by the manufacturer of the instrument.

Data analysis was done using IBM SPSS 22. A P value < 0.05 was considered statistically significant. Data were expressed in mean standard deviation to express the limits of deviations from the left and right sides of data.

RESULTS

The age of the cases studied ranged from 10 to 90 years and all the cases were divided into 8 groups with group intervals of 10 years as depicted in table no.1 The cases in the age group of 50- 60 years were 24 (24%), which was the highest in number. Followed by 16 (16%) cases were belonged to the 60-70 years of age group. At the time of post-mortem mean Potassium concentration in Pericardial fluid in mmol/l was observed as 22.38±2.19 in the 10-20 year age group, 31.12±3.27 in the 20-30 year age group, 33.89±1.44 in 30-40 year's age group, 33.09±3.20 in 40-50 year's age group, 34.77±1.69 in 50-60 years age group, 20.34±6.67 in 60-70 years age group, 18.04±1.11 in 70-80 age group and 18.1±0.8 in 80-90 year's age group. The lowest Potassium concentration was 18.04 and the highest potassium concentration was 34.77. Using one-way ANOVA distribution of Potassium according to the age group is found to be significant with p<0.0001.(Table-1).

The cause and mode of death as observed in the cases studied were varied & included Cardiac disease, Pneumonia, head injury, pulmonary tuberculosis, hemorrhage, etc. as summarized in table no.2 Cause of death due to cardiac diseases constituted the highest no of cases, i.e. 38 in number out of 100(38%) next to this were the pneumonia cases which constituted 15% cases (15 cases out of 100). (Table-2)

Constant Increase in Potassium ion is seen after PM and after 6-24 hrs, in case of Cardiac disease, Pneumonia, Head injury, Pulmonary Tuberculosis, and Haemorrhage case, in all the above causes constant Increase in Potassium ion is seen and same Increasing trend is seen in all the four causes. There is a linear relationship between Potassium Concentration and Time since death. Increase in Potassium ion and Time since death. (Table 3)

Tables

Table No.1: Case Distribution According To Age

Age group	Mean age	No of cases	Percentage	Potassium(mmol/L)
10-20	18±0.00	3	3	22.38±2.19
20-30	23.2±2.89	10	10	31.12±3.27
30-40	34.3±2.72	15	15	33.89±1.44
40-50	44.2±3.05	15	15	33.09±3.20
50-60	54.2±3.05	24	24	34.77±1.69
60-70	64.75±3.17	16	16	20.34±6.67
70-80	72.3±2.96	15	15	18.04±1.11
80-90	82.5±3.54	2	2	18.1±0.8
Total	-	100	100	-

Table No. 2: Distribution Of Cases According To Cause

Cause of death	No. of cases	Percentage
Cardia disease cases	38	38
Pneumonia cases	15	15
Head injury cases	12	12
Pulmonary tuberculosis cases	8	8
Hemorrhage cases	8	8
Hepatic encephalopathy	5	5
Poisoning	2	2
Cerebral infarct	2	2
Others	10	10
Total	100	100

Table No. 3: Distribution Of Time Since Death And Changes In Potassium In All Cases

Time since death	Change Obtained by regression	0-6 hr Increase in	6-12 hr Increase in	12-18 hr Increase in Potassium	18-24 hr Increase in
	mmol/L	Potassium mmol/L	Potassium mmol/L	mmol/L	Potassium mmol/L
Reduction in Mean Potassium in Cardiac disease case	2.864	21.84±8.02	24.59±8.32	27.49±8.33	30.42±8.11
Reduction in Mean Potassium in Pneumonia	2.864	20.37±8.20	23.12±8.13	26.02±8.45	28.95±8.56
Reduction in Mean Potassium in Head injury	2.864	26.09±8.51	26.84±8.37	31.74±8.41	34.47±8.11
Reduction in Mean Potassium in Pulmonary Tuberculosis cases	2.864	25.32±4.56	28.07±4.63	30.97±4.78	33.90±4.98
Reduction in Mean Potassium in Hemorrhage case	2.864	32.98±6.80	37.73±6.94	38.63±6.40	41.56±6.22

DISCUSSION

The advantage of pericardial fluid over vitreous humor, CSF, and synovial fluid is that it is easily obtainable in a reasonably large volume, and over blood is that it is less prone to microbial contamination and bacterial degradation.

In the present study age distribution starts from 18 years old pm case to 85 years old pm case, the majority of cases belonged to 50 to 60 years age groups (24%). Using One way ANOVA distribution of Potassium ions according to age group was found to be significant with p<0.0001. Using One way ANOVA distribution of Potassium according to age group in males & females was found to be significant with p<0.0001.

Sahoo Niranjan et al reported no significant relation in potassium level in comparison to others. Mean k+ level in 10-20 years & >60 years was low in comparison to other age groups. No statistical significance was found.

While studying time since death in relation to changes in potassium levels in Pericardial fluid. The regression equation for change in potassium level in Pericardial fluid is plotted. The constant change of 2.864 is obtained in the Cardiac disease case, Pneumonia case, Head injury case, Pulmonary Tuberculosis case, and Hemorrhage case. (p-value -0.001)

A comparison for the study done on the same subject for work done by various authors is shown below,

Authors	Potassium level
Botezatu 1977 [5]	Increased
Balasooriya et al 1984 [6]	Significantly Increased with time
D k pattnaik 1986 [7]	Increased 4 to 7 times within 22
Jayashree et al 2000 [8]	Increased 0.71meq/l /hr
D singh 2006 [9]	Increased 0.68 meq/l/hr
Sahoo Niranjan [10]	Increased by 2.39 meq/l/hr
Present study	Increased by 2.864 mmol/L

CONCLUSION:

The use of Pericardial fluid has proven as a better option for estimating the time since death,

There was no effect of age or sex on the change in Potassium level.

Potassium ion concentration increases with time since death at a mean rate of 2.864 mmol/L in different causes of death.

Limitation:

The study should be conducted in huge samples.

The study should be conducted in varied regions to find the relation of time since death with changes in electrolytes.

Conflict of Interest : None

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