Original Article

Effect of Cause of Death on Postmortem Cerebrospinal Fluid Electrolytes (K^+, $Na^+$and Cl^-) Concentration

Riasat Ali[1], Nasreen Akhtar[2], Mansoora Mirza[1], Syed Mudassir Hussain[1], Saman Ambreen[3] and Syeda Maira Hussain[1]

ABSTRACT

Objective: To find out the effect of cause of death on postmortem Sodium, Potassium and Chloride levels in cerebrospinal fluid.

Study Design: Observational study

Place and Duration of Study: This study was conducted at the Forensic Medicine Department, King Edward Medical University (KEMU), Lahore for a period of 6 months from December 2013 to June 2014.

Materials and Methods: Medicolegal autopsy cases were included in which the exact cause and time of death were known. A total number of consecutive 106 samples were collected. Unknown and putrefied dead bodies, Poisoning cases and Cases with head injuries were not included. Study was completed in 6 months.

Results: The K^+, $Na^+$and Cl^- levels are significantly affected by certain causes of death.

Conclusion: Biochemistry of Cerebrospinal Fluid alone may not be very useful in postmortem interval estimation.

Key Words: Postmortem interval, Cerebrospinal fluid, Potassium, Sodium, Chloride, Cause of death

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INTRODUCTION

The accurate estimation of the time of death is a critical investigational problem for the authorized medical officer while conducting medicolegal autopsy.[1]Several physical changes start in the dead body after death, known to our ancestors since ancient times and still continue to be used as the main parameters for the estimation of time since death such as cooling of the dead body, development of rigor mortis, development of lividity, etc.[2,3] Moreover, many chemical changes also start in the various body fluids after death. These body fluids are whole blood, serum, Cerebrospinal Fluid, aqueous humor, synovial fluid, and vitreous humor.[4,5]

Postmortem Cerebrospinal fluid electrolyte (Sodium, Potassium and Chloride) levels change with the passage of time and are useful for the estimation of time since death. The focus of this study is to determine the effect of cause of death on postmortem Cerebrospinal Fluidsodium, potassium and chloride ion concentration as these electrolytes are used to determine the time since death.[2]

[1.] Department of Forensic Medicine & Toxicology, King Edward Medical University, Lahore.
[2.] Department of Forensic Medicine & Toxicology, Al Aleem Medical College, Lahore.
[3.] Department of ENT, Benazir Bhutto Hospital, Rawalpindi.

Correspondence: Dr. Riasat Ali. Assistant Professor of Forensic Medicine & Toxicology, King Edward Medical University, Lahore.
Contact No: 0300-9649147
Email: dr.riasat423@gmail.com

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MATERIALS AND METHODS

This observational study was conducted at the Department of Forensic Medicine and Toxicology, KEMU, Lahore and completed in 6 months. Medicolegal autopsies conducted. Only those cases were included in which the exact time of death was given by the attending physician who issued Death Certificate, by the law enforcement agencies or near relatives.

Inclusion Criteria; Cases where the exact time of death was provided by the police, the attending physician or near relatives.

Exclusion Criteria; Unknown and putrefied dead bodies, poisoning cases and cases with head injuries

Sample size: A total number of consecutive 106 samples fulfilling the above mentioned inclusion criteria were taken from the cases brought to the mortuary.

Collection of cerebrospinal fluid: These samples were collected by opening the cranial cavity first, from Rt. or Lt. lateral ventricle of the brain by using Liver biopsy needle attached with 20 ml syringe and inserted in the posterior and dependent part of the lateral ventricle of brain up to 1.5 cm depth and as much of the

Cerebrospinal Fluid was aspirated as possible.[6,7] Samples were immediately transferred to the pathology lab, centrifuged and analyzed for sodium, potassium and chloride ions by Auto analyzer. On average, approximately 5-6 ml of Cerebrospinal Fluid was obtained from each subject. Only clear, transparent samples not containing any free tissue fragments were used for study. A detailed Proforma was used for each case to fill relevant information. The analysis of the samples was carried out in the laboratory of the Pathology Department, King Edward Medical University, Lahore.

RESULTS

The data analysis was done by using SPSS v-21 (SPSS-Inc, Chicago, USA). Regression and correlation analysis was applied. P-value ≤ 0.05 was considered as statistically significant. Mean, SD, frequencies and percentages were calculated. Finally, t-test was used to determine if any two data sets are significantly different or not.[8-12]In this study data of 106 cases was obtained. The mean PMI in hours was 12.43 ± 4.44 with range of 5 to 23.45 hours. The mean potassium was 6.06 ± 1.99 with range of 3.1 to 11.5 mEq/L, and mean sodium was 124.2 ± 6.36 with range of 108 to 138 mEq/L. The mean age was 32.5 ± 9.69 with range of 12 to 61 years. Data analysis showed that the majority of cases were males 79.25% (84 cases) and females were only 20.75% (22 cases). Gender distribution of the 106 cases used in this study. The average age of male cases was 33.81 years and female average age was 27.50 years.

Table No.1: Different causes of death in the studied cases

Cause of Death	No of Cases	%tage of Cases
Firearm Injury	80	75.47%
Blunt Weapon Injury	5	4.72%
Asphyxial Death	17	16.04%
Sharp Edge Weapon Injury	4	3.78%

The Table 1 shows that Firearm Injuries are the predominant (75.47%) cause of death in the present study. Then Asphyxia (16.04%), followed by Blunt Weapon Injury (4.72%), and Sharp Edge Weapon Injury (3.75%).

Generally the potassium level is not significantly dependent on the cause of death. But there is a significant effect on the potassium (K^+) levels when making a comparison of death due to firearm injuries verses asphyxia and firearm injuries verses blunt weapon injuries. Statistical analysis revealed that K^+ level is slightly higher in the cases reported with death due to firearm related injuries. Whereas, K^+ level is slightly lower in the cases reported with death due to asphyxia.

Table No.2: Effects on potassium levels due to different causes of death

Statistical Analysis for K^+ Levels			
Comparison	**t – value**	**p – value**	**Signifi-cance**
Firearm injury and Asphyxia cases	3.41	P<0.05	Signifi-cant
Firearm injury and Sharp edge weapon injury cases	0.49	p>0.05	NS
Firearm injury and Blunt weapon injury cases	1.8	P<0.05	Signifi-cant
Asphyxia and Sharp edge weapon injury cases	1.47	p>0.05	NS
Asphyxia and Blunt weapon injury cases	0.42	p>0.05	NS
Sharp edge weapon injury and Blunt weapon injury cases	1.21	p>0.05	NS

Table No.3: Effects on sodium levels due to different causes of death

Statistical Analysis for Sodium (Na^+) Levels			
Comparison	**t – value**	**p – value**	**Signifi-cance**
Firearm injury and Asphyxia cases	1.2	p>0.05	NS
Firearm and Sharp edge weapon injury cases	0.05	p>0.05	NS
Firearm injury and Blunt weapon injury cases	2.0	P<0.05	Signifi-cant
Asphyxia and Sharp edge weapon injury cases	0.911	p>0.05	NS
Asphyxia and Blunt weapon injury cases	0.56	p>0.05	NS
Sharp edge weapon injury and Blunt weapon injury	1.47	p>0.05	NS

Similarly, t-test was applied to evaluate the effect of different causes of death on sodium (Na^+) levels. It is shown in Table 03 that there is a significant effect on the sodium levels when making a comparison of death cases due to the firearm injuries verses blunt weapon injuries.Na^+ level is slightly higher in the cases reported with death due to blunt weapon injuries.

Finally, the t-test was applied again to evaluate the effect on Chloride (Cl^-) levels due to different causes of death. The results in table 04 indicate that generally the chloride level is also not dependent on the cause of death. There is only a significant effect on the Chloride levels when making a comparison of death cases due to the sharp edge weapon injuries against the firearm

injuries and asphyxia and Cl^- level is slightly higher in the sharp edge weapon cases.

Table No.4: Effects on chloride levels due to different causes of death

Statistical Analysis for Chloride (Cl^-) Levels			
Comparison	**t – value**	**p – value**	**Significance**
Firearm injury and Asphyxia cases	0.67	p>0.05	NS
Firearm injury and Sharp edge weapon injury	1.73	P<0.05	Significant
Firearm and Blunt weapon injury cases	0.7	p>0.05	NS
Asphyxia and Sharp edge weapon injury cases	1.84	P<0.05	Significant
Asphyxia and Blunt weapon injury cases	0.17	p>0.05	NS
Sharp edge weapon and Blunt weapon injuries cases	1.63	p>0.05	NS

DISCUSSION

Cerebrospinal fluid is an inert, isolated and well protected body fluid and it can be used to estimate the postmortem interval. The Cerebrospinal Fluid electrolytes (sodium and potassium) are valuable biochemical markers in postmortem interval estimation.[2]

In this study the samples were collected with great care. The cerebrospinal fluid was drawn gently and the researcher tried to obtain as much fluid as possible. It is important to collect the Cerebrospinal Fluid as much as possible to get accurate levels for all the salutes.[6,7] This technique of sampling is helpful in avoiding wrong results as literature highlighted that certain factors such as sampling techniques and analytical apparatus may lead to wrong potassium level.[7,13-15]In the present study careful sampling was done to avoid the tissue contamination. Only crystal transparent samples free from tissue debris were included in the study. Ordinary Regression Equations were devised using the data of 106 samples. Gamero et al. studied the precision of estimating the time since death comparing different equations and determined their degree of accuracy.[13]

In this research, there were four different causes of death. Firearm Injuries were the major cause of death followed by Asphyxia, Blunt Weapon Injury, and Sharp Edge Weapon Injury. The statistical analysis indicates that generally the potassium level is not significantly dependent on the cause of death. Results indicate that the K^+ level is slightly higher in the cases reported with death due to firearm related injuries. Whereas, K^+ level is slightly lower in the cases reported with death due to asphyxia. Similarly, Na^+ level is slightly higher in the cases reported with death due to blunt weapon injuries and Cl^- level is slightly higher in the death cases due to the sharp edge weapon injuries.

CONCLUSION

This study showed that the postmortem cerebrospinal K^+, Na^+ and Cl^- levels are significantly affected by certain causes of death. Biochemistry of Cerebrospinal Fluid alone may not be very useful in postmortem interval estimation.

Author's Contribution:

Concept & Design of Study:	Riasat Ali
Drafting:	Nasreen Akhtar, Mansoora Mirza
Data Analysis:	Syed Mudassir Hussain, Saman Ambreen, Syeda Maira Hussain
Revisiting Critically:	Riasat Ali, Nasreen Akhtar
Final Approval of version:	Riasat Ali

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Saukko P, Knight B. Knight's Forensic Pathology. 3rd ed. London, United Kingdom: Edward Arnold (Publishers) Ltd; 2004.p.216-20
2. Yadav J, Deshpande A, Arora A, Athawal BK, Dubey BP. Estimation of time since death from CSF electrolyte concentration in Bhopal region of central India. Legal Medicine 2007;9(6):309-13.
3. Awan NR. Principles and Practice of Forensic Medicine and Toxicology. 2nded. Lahore, Pakistan: Zubair Pakistan; 2018.
4. Saugstad OD, Olaisen B. Postmortem hypoxanthine levels in the vitreous humour, an introductory report. F Sci Int 1978;12:33-6.
5. Tumram NK, Bardale RV, Dongre AP. Postmortem analysis of synovial fluid and vitreous humour for determination of death interval: A comparative study. F Sci Int 2011;204(1):186-90.
6. Lie JT. Changes of potassium concentration in the vitreous humor after death. J Med Sci 1967; 254:136-42.
7. Coe JI, Apple FS. Variations in vitreous humor chemical values as a result of instrumentation. J F Sci 1985;30:828-35.

8. Zimmerman DW. Teacher's Corner: A Note on Interpretation of the Paired-Samples t Test. J Educ Behavioral Statistics 1997;22(3):349-60.
9. Mankiewicz R. The Story of Mathematics. Princeton, New Jersey, USA: Princeton University Press; 2004.
10. Madea B, Henssge C, Hanig W, Gerbracht A. References for determining the time of death by potassium in vitreous humor. F Sci Int 1989; 40(3):231-43.
11. Foerch JS, Forman DT, Vye MV. Measurement of potassium in vitreous humor as an indicator of postmortem interval. Am J Clin Pathol 1979; 72:651-52.
12. Gamero LJJ, Romero JL, Ramos HM, Arufe M, Vizcaya M. Precision of estimating time of death by vitreous potassium - comparison of various equations. F Sci Int 1992;56(2):137-45.
13. N Akhtar, R Ali, AR Malik, A Asghar, K Aziz. Pak J Med Health Sci 2015;9(1), 88-92.