UTILITY OF POSTMORTEM VITREOUS BIOCHEMISTRY

[1] P. Paranitharan & [2] *Michael S. Pollanen

[1]Department of Forensic Medicine, Faculty of Medicine Ragama &
[2] Provincial Forensic Pathology Unit, Office of the Chief Coroner, Ontario, Canada and*
Department of Laboratory Medicine and Pathobiology, University of Toronto

Introduction

The analysis of chemical constituents of the body fluids is useful in many deaths due to metabolic and biochemical disturbances. Indeed, postmortem vitreous biochemistry has been studied in the past in relation to both determining the cause and time of death. Much of the reported work was concentrated on the latter by analyzing the rising potassium levels with postmortem interval. There are different formulae available to calculate the time period following death.[1-4].

Postmortem vitreous analysis for biochemical disturbances that may have caused death is more useful and is widely utilized in medicolegal practice. Little has been published in this area since the early 1990s.[5] A recent study addressed the problem defining reference values in vitreous fluid as mirror of blood.[6] However, the vitreous fluid is a well protected fluid. It is less subjected to putrefaction and contamination compared to other body fluids, the postmortem biochemical changes occur slowly in the eye, and the fluid can be easily obtained. Thus, the vitreous fluid is an important substrate for analysis.

We present the results of a retrospective study to determine the utility of vitreous fluid analysis in medicolegal autopsies in which the vitreous sample was sent for analysis. We conclude that postmortem vitreous biochemistry is useful in selected cases of diabetes mellitus and renal disease but it is not likely cost effective to perform postmortem vitreous biochemistry if only for exclusionary purposes.

Materials and Methods

One-hundred consecutive cases of medicolegal autopsy from the Toronto Forensic Pathology Unit at the Office of the Chief Coroner for Ontario were used for this retrospective study. In each case, the vitreous fluid was collected using a standard collection technique and sent to a clinical biochemistry laboratory for quantities of sodium, potassium, chloride, urea, creatinine, glucose and the presence of ketones. In the other eight cases, the pathologist only requested ethanol determination, thus biochemical testing was performed in 92 cases. The vitreous biochemical results were classified using Coe's criteria for the: *dehydration pattern* (concomitant increase in sodium and chloride with a moderate elevation of urea nitrogen; Na^+ > 155 meq/L, Cl^- > 135meq/L, Urea > 40mg/dl); *uremic pattern/renal failure* (urea nitrogen and creatinine levels are appreciably increased without a corresponding increase in sodium and chloride values with urea > 150 mg/dl); *low salt pattern / hyponatremia* (low sodium and chloride with relatively low potassium; K^+ < 15 meq/L, Na^+ < 135 meq/L, Cl^- < 105 meq/L); *decomposition pattern* (low sodium and low chloride but there is accompanying high vitreous potassium > 20 meq/L); and *diabetic ketoacidosis pattern* (elevated levels of glucose with presence of ketones; glucose > 200mg/dl).

In each case the vitreous fluid analysis was determined to provide information in one of three categories: (i) contributory to the cause of death (results clarified the cause of death); (ii) non-contributory to the cause of death (results analysis provide no information that influenced decision about the cause of death); or (iii) exclusionary evidence (the lack of a detected abnormality provided influence the decision on the cause of death, e.g., exclusion of diabetic ketoacidosis).

Results

Table 1 *– Analysis of Vitreous Fluid Reports*

Vitreous Fluid Pattern	Number
Exclusionary evidence	62
Renal failure	10
Diabetic ketoacidosis	9
Decomposition	7
Hyponatremia	3
Dehydration	1

The following figures illustrates whether the analysis of vitreous humor is helpful in formulating the final cause of death.

Figure 1

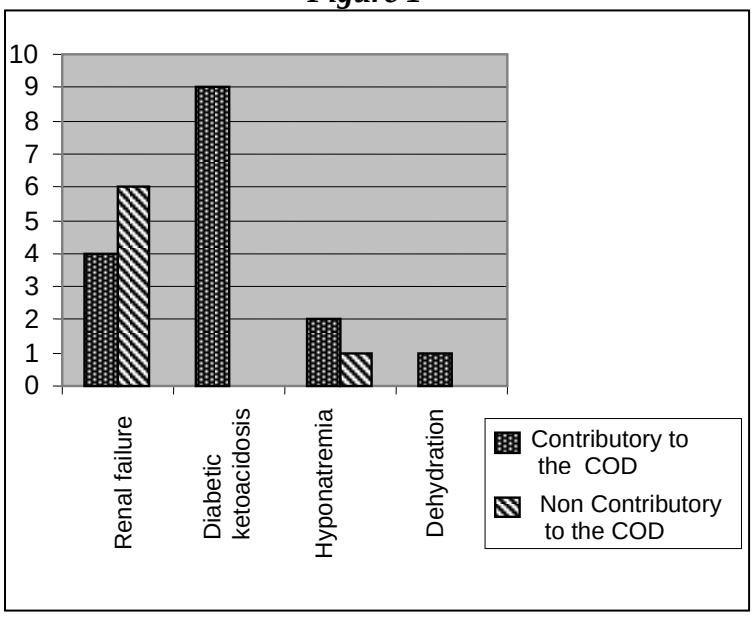
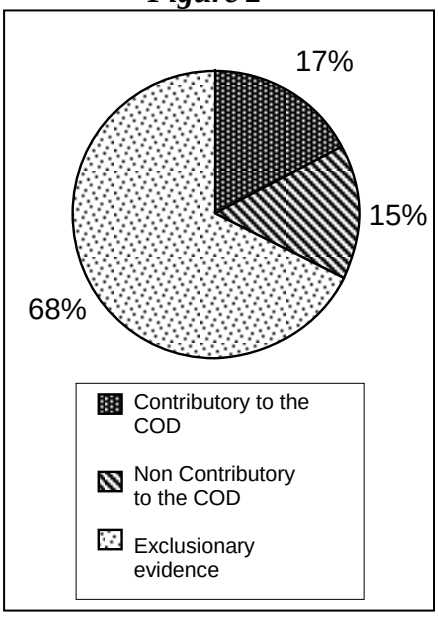


Figure 2



Discussion

The vitreous humor and the forensic applications is still an area of interest to many who are involved in medico legal autopsies. Coe has done extensive research and he had formulated several guidelines, based on which the results of the biochemical analysis on vitreous were studied.[5] But currently there are not much new data added in the vitreous studies. The scope of the study is to see how effective and useful the results of vitreous analysis in formulating the final cause of death.

The data was analysed considering two important factors. Whether the electrolytes levels helped in arriving a cause of death, and the category in which they are grouped according to Coe's checklist. Out of the hundred results eight were not included

because they mainly considered the ethanol levels and not electrolytes.

According to table 1 the majority (68%) of the results does not fall into any of the categories according to Coe. The values are within normal range and they were ordered by the pathologists as exclusionary evidence to rule out any existing diseases based on information in the history and incidental autopsy findings. They were not ordered merely to find the cause of death where the anatomical findings are negative, e.g; diabetic ketoacidosis

If we analyse the different patterns like the renal failure, diabetic ketoacidosis, hyponatremia and dehydration pattern they are contributing to the cause of death (*Figure:1*) but not all of them. In cases of diabetic ketoacidosis almost 100% are contributing to the cause of death. A pathologist who doesn't have a significant anatomical finding for the cause of death or highly suspicious of diabetic ketoacidosis is successful in incorporating the vitreous humor findings in the cause of death statement or as the sole cause of death. Out of ten cases of renal failure four cases contributed to the final cause of death. Almost all of them were incorporated in the final death statement along with other contributing factors and not as a sole cause of death. In other six cases there were other significant anatomical causes or toxicological findings were present. Therefore they were not incorporated in the final cause of death. In the hyponatremia pattern, out of three cases two were incorporated. In the dehydration pattern it was not incorporated in the cause of death statement but it had a significant contribution towards arriving at a final cause of death statement.

Even though as an overall the value of doing a vitreous humor analysis is for exclusionary evidence. (*Figure :2*) The analysis was very useful in suspected diabetic cases. (*Figure:1*)

In cases of exclusionary evidence almost all the cases had a definite anatomical cause of death or they were part of screening drug intoxication and the cause of death was due to drug intoxication. Some cases were unascertained.

The other issues involved in this is how cost effective in ordering vitreous humor as exclusionary evidence in cases where there is definite anatomical cause of death. This is to just confirm the existence of a disease from the history or autopsy findings. From this study it is clear that majority of reports came as normal.

In conclusion in selected diabetic cases and kidney diseases where the suspicion is high in arriving at a cause of death the probability of getting a positive report is very high. Whereas there is less value and less cost effective in ordering vitreous studies when a definite anatomical cause exists and just for exclusionary purposes.

Reference

1. Jaffe F. Chemical post mortem changes in the intraocular fluid. Journal of Forensic Science; 1962:231-237
2. Stephens RJ, Richards RG. Vitreous humor chemistry: the use of potassium concentration for the prediction of postmortem interval. Journal of Forensic Science 1987; **32** (2): 503-9
3. Govekar G. Study of potassium in vitreous in relation to time since death and cause of death. Journal of Forensic Medicine. 1997; **14** (1): 26-28
4. James RA, Hoadley PA, Sampson BG. Determination of postmortem interval by sampling vitreous humor. American Journal of Forensic Medicine and Pathology 1997; **18** (2): 158-62
5. Coe JI. Postmortem Chemistry Update. Emphasis on Forensic Application. The American Journal of Forensic Medicine and Pathology. 1993; **14**(2): 91-117
6. Madea B, Musshoff F. Postmortem biochemistry. Forensic Science International. 2007 Jan; 17: 165-71