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The Use of Vitreous Humor for Determination of Ethyl Alcohol in Previously Embalmed Bodies

For about a decade the vitreous humor has been increasingly in chemical analysis in an attempt to determine the postmortem interval or to evaluate the premortem level of various constituents with the intent of obtaining information helpful in determining the cause of death.

In 1966, Sturner and Coumbis [1] published a paper evaluating the possibility of quantitating ethyl alcohol in vitreous humor and correlating it with blood levels. Additional papers on this subject [2-4] have established the validity of this procedure. The ease of obtaining vitreous humor, its relative postmortem chemical stability, and the fact that it can be handled without special processing for alcohol analysis by gas chromatography have all made this a desirable procedure to follow.

This procedure has been extremely helpful in cases of aircraft, traffic, and industrial accidents involving extreme trauma, and in fires.

In few large jurisdictions in this country, where all medicolegal deaths are handled by experienced workers in a central location, the information that we are about to present may be of little practical value. We have found in our jurisdiction that unfortunate circumstances do arise, as will be related.

Interest in this matter was first raised in the case of a traffic accident involving a senior executive of a large corporation, who was on duty at the time of the accident and who was travelling from a resort area to his home base. It was important for a number of reasons to determine whether or not he had been drinking.

Unfortunately, the mortuary employee who handled the case did not understand the situation and, despite all rules and regulations as well as a deputy coroner's specific instruction, he embalmed the body without initially obtaining a blood sample uncontaminated by embalming fluid. Fortunately, the embalming fluid was free of ethyl alcohol, as are almost all commercial embalming fluids at this time. Upon toxicologic examination following a postmortem examination, the subject's remaining intravascular blood, the urine, the brain, and vitreous humor were all negative for ethyl alcohol. This event, however, stirred an interest in trying to ascertain whether vitreous humor was significantly changed by the embalming process. With that in mind, we undertook the following study.

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Materials and Method

Vitreous humor is withdrawn from the eye through the lateral sclera using Vacutainers® No. 4851, with a Vacutainer® holder-needle No. 489. Where it is practical to do so, a sample is obtained from one eye prior to embalming. A blood sample is obtained prior to embalming in all cases and, in all the reported cases, a sample from one or both eyes was obtained following embalming.

Two or three samples obtained (blood and one or two vitreous humor samples) are injected serially into a Carle Basic Gas Chromatograph (sold by Carle Instruments, Inc., Fullerton, Calif.), Model 9000, with a Westronic Recorder (Westronic Inc., Fort Worth, Texas), Model YSW 11E, using methyl ethyl ketone as an internal standard and working against weighed ethyl alcohol standards in serial dilutions. In Table 1 it will be seen that in Cases 1 through 8, a blood alcohol determination was done on a specimen

TABLE 1—Summary of findings in 38 determinations of postembalming vitreous alcohol levels.

Case Number	Blood Alcohol, g%	Preembalming Vitreous Alcohol, g%	Postembalming Vitreous Alcohol, g%	Postembalming Vitreous Methyl Alcohol, g%
1	0.12	0.08	0.06	0.08
2	0.31	0.25	0.20	0.42
3	0.27	0.29	0.25	0.26
4	0.16	0.18	0.17	0.25
5	0.32	0.31	0.33	0.33
6	0.21	0.21	0.22	0.06
7	0.13	0.10	0.07	0.23
8	0.10	0.08	0.07	0.20
9	0.02	0	0	0.15
10	0	0	0.34	0.12
11	neg.	...	neg.	not recorded
12	neg.	...	neg.	not recorded
13	neg.	...	neg.	not recorded
14	neg.	...	neg.	not recorded
15	neg.	...	neg.	not recorded
16	neg.	...	neg.	not recorded
17	neg.	...	neg.	not recorded
18	neg.	...	neg.	not recorded
19	neg.	...	neg.	not recorded
20	0.12	...	0.07	0.26
21	0.08	...	0.07	0.10
22	0.04	...	0.07	0.25
23	0.06	...	0.07	0.08
24	0.30	...	0.27	0.08
25	0.10	...	0.12	0.06
26	0.22	...	0.25	0.15
27	0.17	...	0.17	0.12
28	0.15	...	0.15	0.04
29	0.14	...	0.14	0.05
30	0.13	...	0.13	0.05
31	0.17	...	0.15	0.29
32	0.06	...	0.09	0.12
33	0.34	...	0.30	0.09
34	0.02	...	0.02	0.12
35	0.07	...	0.08	0.16
36	0.08	...	0.15	0.08
37	0.14	...	0.15	0.07
38	0.12	...	0.18	0.15

removed prior to embalming, a preembalming vitreous humor analysis was performed, and a postembalming vitreous humor analysis was done. In these cases, the correlation between blood alcohol and preembalming vitreous humor alcohol fell within the range that has been presented in the literature [1-4]. In Case 9 there was a low level of alcohol in the blood and both preembalming and postembalming vitreous humor samples were negative for ethanol. Case 10 presented an unusual artefact which will be mentioned later and is not further evaluated. There were nine cases in which blood alcohol and the postembalming vitreous humor alcohol were both negative. The remaining 19 cases are presented in Table 1, with the preembalming blood alcohol and the postembalming vitreous humor alcohol compared.

The methyl alcohol levels in the postembalming specimen have been given in order to indicate that there is a considerable diffusion of embalming fluid into the vitreous, but that the degree of this diffusion does not correlate with either a higher or lower level of alcohol in the vitreous than in the blood.

Case 10, in which the blood alcohol and the preembalming vitreous estimations were negative but the postembalming ethyl alcohol level was 0.34 percent, was accounted for by the fact that the embalmer had cleansed the globus of the eye with ethyl alcohol on a cotton swab prior to placing an eye cap in position. This practice is no longer used in our jurisdiction.

Discussion

This technique may be of value in cases where a body has been embalmed through mischance or misunderstanding before an uncontaminated blood sample can be obtained. Since, after embalming, there is no way of determining how much of the intravascular content is blood and how much is embalming fluid or diluent, that material cannot be used to evaluate the blood alcohol.

Urine is relatively valueless, since a time constant is almost never available. The examination of tissues such as brain for evaluation of alcohol content requires manipulation before they can be used. Vitreous humor is easy to handle, can be used directly in the gas chromatograph, and is known to reflect blood alcohol levels in many studies that have been done on vitreous removed prior to embalming. We have demonstrated that after embalming, the vitreous still retains a considerable usefulness in the determination of alcohol.

We do not claim a high degree of mathematic precision for this technique, but we do believe that, within rather wide bounds, it will reflect whether or not a subject had been using alcohol prior to death and give an approximation as to what the premortem blood alcohol was.

Summary

A technique for determining ethyl alcohol levels in vitreous humor after embalming is described. The results show almost as good a correlation with preembalming blood ethyl alcohol determinations as do vitreous humor ethyl alcohol determinations performed prior to embalming.

References

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