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Zinc Concentrations in Vitreous Humor: A Postmortem Study Comparing Alcoholic and Other Patients

REFERENCE: McDonald, L., Sullivan, A., and Sturner, W. Q., "Zinc Concentrations in Vitreous Humor: A Postmortem Study Comparing Alcoholic and Other Patients," *Journal of Forensic Sciences*, JFSCA, Vol. 26, No. 3, July 1981, pp. 476-479.

ABSTRACT: Postmortem vitreous humor samples from alcoholic and other patients were compared. Zinc concentrations were lower in the alcoholic group of patients as compared to those who were not alcoholic. These findings support previous studies that indicate a decreased concentration of zinc in other body tissues and serum in alcoholic patients.

KEYWORDS: pathology and biology, vitreous humor, postmortem examinations

It has been demonstrated that the analysis of postmortem body fluids has proven useful in the evaluation of premortem conditions [1]. The vitreous humor of the eye is often used as the fluid medium of choice because of its intact condition and slow autolytic destruction rate. It does not react with external substances in its undisturbed state other than during prolonged submersion [2].

Under normal circumstances, zinc concentrations are found to be constant throughout the various body fluids [3]. In alcoholic rats, "zincuria" is a common condition accompanied by zinc loss in the liver and muscle tissues [4]. In addition, significantly lower zinc levels in tissue and serum have been reported in human patients with alcoholic liver disease [5]. The purpose of this study is to compare the zinc concentrations in human postmortem vitreous humor of alcoholic and other patients.

Materials and Methods

Sudden and unexpected death was a criterion for any case's being included in this study. Thus, none of the cases used for data purposes had any record of survival in a hospital. A given case was labeled "alcoholic" if the death certificate listed the primary or secondary cause of death as "acute and/or chronic alcoholism." The designations of acute alcoholic intoxication, cirrhosis, and fatty liver were also used in this manner.

Vitreous humor samples are routinely analyzed for electrolytes and other chemical

Received for publication 7 Nov. 1980; revised manuscript received 7 Jan. 1981; accepted for publication 9 Jan. 1981.

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substances at the Office of the Medical Examiner of Rhode Island. They are collected with a #20-gauge needle with a sterile glass or plastic syringe. Samples are immediately refrigerated and eventually frozen at 0°C. Only those samples with at least 1 mL of crystal-clear fluid were used.

The method used to determine zinc concentration was that of Davies et al [6]. A 1-mL sample was diluted 1:1 with 25% trichloroacetic acid. The mixture was then centrifuged for 5 min at 3000 rpm. The zinc concentration in the clear supernatant was initially determined by the Perkin-Elmer Model 303 atomic absorption spectrophotometer at 214 nm. Each sample reading was plotted with standards having a known zinc concentration. Levels were determined for each sample in units of $\mu\text{g}/100\text{ mL}$ (water).

In some of the cases selected the zinc concentration was much higher than the spectrophotometer could accurately measure. A study of the case history revealed a treatment regimen (that is, medication) that could possibly distort electrolyte levels throughout the body.

Results

Data on 18 nonalcoholic cases reveal a mean \bar{m} zinc concentration of 108.22 $\mu\text{g}/100\text{ mL}$ with a range from 20 to 190 $\mu\text{g}/100\text{ mL}$. The normal range of zinc in serum is 55 to 150 $\mu\text{g}/100\text{ mL}$, and in urine from 50 to 1300 $\mu\text{g}/24\text{ h}$ [7]. The concentration of zinc in red blood cells is 1200 to 1300 $\mu\text{g}/100\text{ mL}$. The zinc value of 108.22 $\mu\text{g}/100\text{ mL}$ calculated from this study represents a range in values that overlaps with zinc values found in blood and urine (see Tables 1 and 2).

Forty-three alcoholic cases revealed a mean zinc concentration of 80.65 $\mu\text{g}/100\text{ mL}$ with a range from 15 to 146 $\mu\text{g}/100\text{ mL}$. Figures 1 and 2 graphically show the distribution of zinc concentrations in the samples tested. Calculated to a 95% confidence interval, a lower zinc concentration for alcoholics is demonstrated ($P < 0.05$).

Discussion

This study has revealed a lower zinc concentration in the vitreous humor of alcoholics than in other patients. Not only have other studies demonstrated a lower-than-normal zinc level in the tissue and serum of alcoholic patients, but a lower level of zinc has also been reported in patients with cirrhosis of the liver [7]. This is of importance because the enzyme alcohol dehydrogenase is responsible for the degradation of ethanol in the liver, and zinc is a necessary factor for the reaction to occur. Without zinc, the reaction cannot go to comple-

TABLE 1—Zinc concentrations in 18 nonalcoholic cases, where $\bar{m} = 108.22$, standard deviation $\sigma = 42.7$, $2\sigma = 85.4$, the 95% confidence level = $108.22 \pm 2.101\sigma$, and $P < 0.05$.

Case Number	Zinc Concentration, $\mu\text{g}/100\text{ mL}$	Case Number	Zinc Concentration, $\mu\text{g}/100\text{ mL}$
0445	117.6	0216	137.8
0123	117.6	0005	81.3
0006	146.6	0237	69.7
0002	100.0	0222	87.6
0013	82.4	0003	187.6
0437	67.6	0048	190.8
0125	67.6	0133	106.3
0237	125.0	0432	62.6
0174	118.6	0426	81.3

TABLE 2—Zinc concentrations in alcoholic cases, where $\bar{m} = 80.65$, standard deviation $\sigma = 32.53$, the 95% confidence interval = 2.019, and $P < 0.05$.

Case Number	Zinc Concentration, $\mu\text{g}/100 \text{ mL}$	Case Number	Zinc Concentration, $\mu\text{g}/100 \text{ mL}$
0432	75	0441	130
0174	85.9	0864	60
0110	75	0430	100
0133	100	0434	37.5
0446	75	0576	70
0180	37.4	0453	160
0620	87.6	1092	75
0613	100	0819	130
0228	81.3	0914	75
0638	90	1067	50
0658	65	0907	50
0629	35	0913	75
0641	125	0818	65
0751	80	0012	100
0713	100	0217	100
0519	50	0169	125
0014	35	0492	135
0071	125	0115	100
1083	75	0168	86.1
0567	37.5	0387	36
0508	31.3	0280	111
0671	31.3		

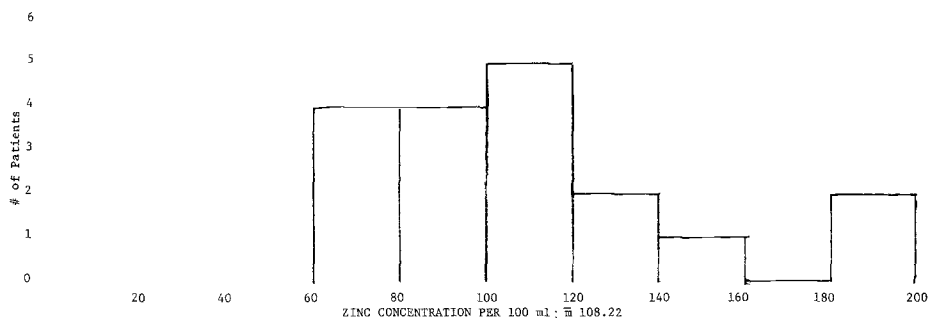


FIG. 1—Frequency histogram for nonalcoholic patients.

tion. Ethanol is degraded by a microsomal system that ultimately decreases fat catabolism. This build-up leads to fatty liver and eventually wasting away of muscle tissue.

The study by Sullivan and Lankford [7] shows increased zincuria and a low serum zinc level in alcoholic patients. Further testing must be done to see if a correlation exists between zinc levels in serum, vitreous humor, and urine in alcoholics. Possibly these zinc levels can be related to time of excess alcoholic ingestion, or perhaps even to nutritional deficits and other factors.

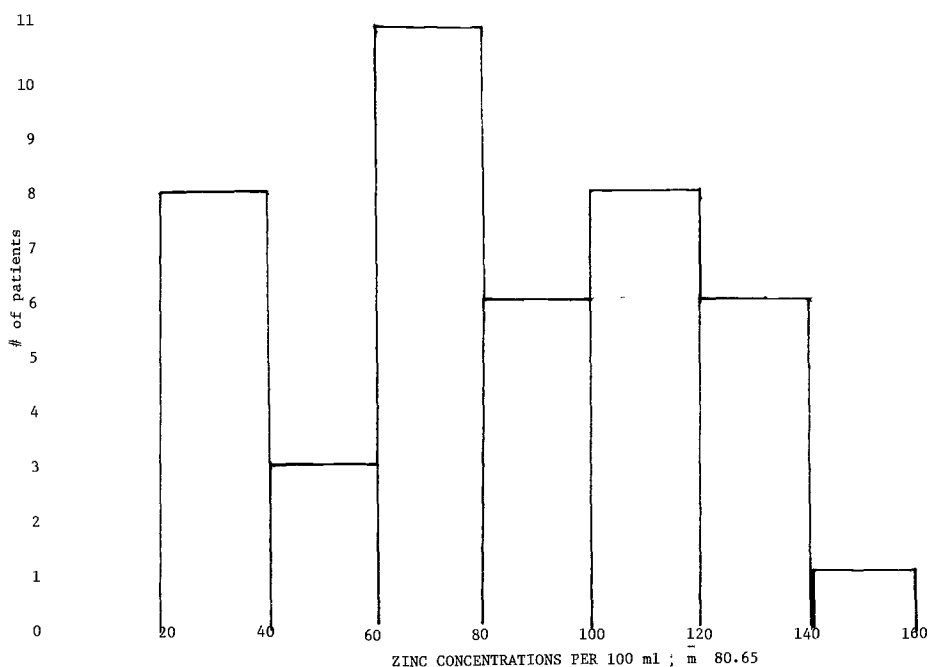


FIG. 2—Frequency histogram for alcoholic patients.

Conclusion

A lower zinc concentration in postmortem vitreous humor of alcoholic patients compared to other patients has been demonstrated. This finding is in keeping with reported lower zinc concentrations in other body tissues and serum of alcoholic patients along with an expected increased urine zinc level.

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