

CASE REPORT

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Methanol Intoxication: Distribution in Postmortem Tissues and Fluids Including Vitreous Humor

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ABSTRACT: A 44-year-old man was found unconscious beneath an elevated rapid transit right-of-way. On admission to the emergency room, the patient was comatose in metabolic acidosis with high anion and osmolal gaps. The serum methanol was 583 mg/dL. The serum ethanol and ethylene glycol were negative. The patient was treated with ethanol, bicarbonate, and hemodialysis. He expired 40 h after admission. The postmortem methanol concentrations in body fluids were as follows: bile 175 mg/dL, vitreous humor 173 mg/dL, and blood 142 mg/dL. Urine was not available for analysis. Postmortem methanol concentrations in body tissues are given in decreasing order: brain 159 mg/100 g, kidney 130 mg/100 g, lung 127 mg/100 g, spleen 125 mg/100 g, skeletal muscle 112 mg/100 g, pancreas 109 mg/100 g, liver 107 mg/100 g, and heart 93 mg/100 g. The total amount of methanol in the gastric contents was 73 mg. Methanol determinations were performed on a Hewlett-Packard 5840A gas chromatograph with flame ionization detection using a glass column packed with 0.2% Carbowax 1500 on Carbopack C. The internal standard used was *n*-propyl alcohol.

KEYWORDS: toxicology, methanol, vitreous humor, metabolic acidosis, anion gap, osmolal gap, gas chromatography

Methanol is used as a solvent, a constituent of some antifreeze solutions, and a denaturant of ethanol [1,2]. Despite numerous reports of blindness or death caused by methanol [1-8], we have not found any report of vitreous humor methanol concentration. We are therefore reporting a fatal intoxication in which methanol concentration was determined in vitreous humor, blood, and ten other body fluids and tissues.

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Case Report

Police officers found a 44-year-old man unconscious beneath an elevated rapid transit right-of-way and transported him to the emergency room. His vital signs were as follows: temperature, 39.3°C (102.8°F); pulse, 84; respirations, 33; blood pressure, 88/0 mm Hg. On examination the patient was comatose and unresponsive to deep pain. He showed decorticate posturing and dysconjugate gaze. The pupils measured 7 mm and were fixed and unresponsive. The corneal reflex was absent. There was no spontaneous movement of the extremities. No deep tendon reflexes were elicited.

The serum glucose was 317 mg/dL with an intravenous infusion of 5% dextrose and water running. The urine gave a 4+ test for protein, a 2+ test for glucose, and a trace test for blood. Acetone was negative. There were one to two white cells and zero to one red blood cells per high power field. Bacteria, epithelial cells, and hyaline casts were seen. The white cell count was $12.9 \times 10^9/L$ with 73% neutrophils. The urea nitrogen was 11 mg/dL, the creatinine 1.4 mg/dL, the calcium 7.7 mg/dL, the phosphorous 4.4 mg/dL, and the bilirubin 0.3 mg/dL. The sodium was 145 meq/L, the potassium 5.4 meq/L, the chloride 101 meq/L, the bicarbonate 5.0 meq/L, the lactate 7.8 meq/L, and the osmolality 433 mOsm/kg. The pH was 6.79 and the P_vCO_2 27.8. The aspartate aminotransferase (SGOT) was 50 mU/mL, the lactic dehydrogenase 268 mU/mL, the alkaline phosphatase 120 mU/mL. Serum ethanol was negative. Serum ethylene glycol and acetone were negative. The serum methanol was 583 mg/dL. The anion gap was 39 meq/L; the osmolal gap 123 mOsm/kg.

Physicians treated the patient with bicarbonate, ethanol, and hemodialysis. He remained hypotensive during his entire hospitalization and expired 40 h after admission. At autopsy, the pathologist observed a recent ischemic infarct of the tip of the right temporal lobe of the brain. The liver weighed 3725 g and showed severe fatty change. The muscle of the left ventricle of the heart was hypertrophied. Microscopic tissue examination revealed pallor of the myelin of the retrolaminar optic nerves, bronchopneumonia, and pulmonary edema.

Methods

Alcohol analyses were performed by methods previously published [9]. All postmortem specimens, except vitreous humor, were steam distilled with *n*-propyl alcohol internal standard before gas chromatographic analysis for volatiles. Vitreous humor was analyzed similarly but without steam distillation.

Results and Discussion

Postmortem blood was negative for ethanol and acetone. Methanol concentration in postmortem blood was 142 mg/dL. Methanol concentration decreased during hospitalization from 583 mg/dL on admission to 142 mg/dL postmortem (Fig. 1). The average elimination rate was approximately 11 mg/dL per hour with hemodialysis.

Table 1 shows the concentration of methanol in various body tissues and fluids, and the ratios of the concentrations in blood to tissues or fluids. The concentrations compare favorably to those reported for methanol fatalities [2, 4, 5–8, 10]. The concentration of methanol in the vitreous humor was 173 mg/dL. Harger et al [10] indicated that the distribution of methanol was similar to that of ethanol. The methanol blood to vitreous humor ratio was 0.82; this compares favorably with the ethanol blood to vitreous humor ratio of 0.89 that Coe reported [11].

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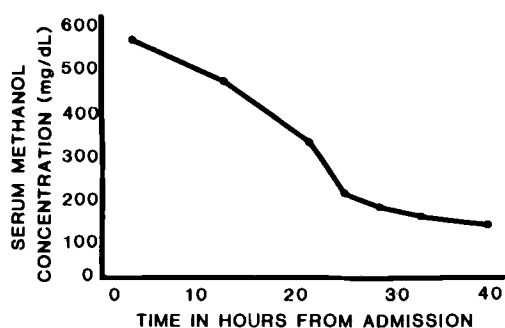


FIG. 1—Methanol concentration over time.

TABLE 1—Distribution of methanol.

Specimen	Methanol Concentration, mg/dL or mg/100 g	Ratio of Concentrations in Blood to Tissue or Fluid
Bile	175	0.81
Vitreous humor	173	0.82
Brain	159	0.89
Blood	142	1.00
Kidney	130	1.09
Lung	127	1.12
Spleen	125	1.14
Skeletal muscle	112	1.27
Pancreas	109	1.30
Liver	107	1.33
Heart	93	1.53
Gastric contents	73-mg total	...
Urine	N.A.	...

References

- [1] Gilman, A. G., Goodman, L. S., and Gilman, A., Eds., *The Pharmacological Basis of Therapeutics*, sixth ed., Macmillan Publishing Co., Inc., New York, 1980, pp. 386-387.
- [2] Baselt, R. C., *Disposition of Toxic Drugs and Chemicals in Man*, second ed., Biomedical Publications, Davis, CA, 1982, pp. 491-494.
- [3] Chew, W. B., Berger, E. H., Brines, O. A., and Capron, M. J., "Alkali Treatment of Methyl Alcohol Poisoning," *The Journal of the American Medical Association*, Vol. 130, No. 2, Jan. 1946, pp. 61-64.
- [4] Keeney, A. H. and Mellinkoff, S. M., "Methyl Alcohol Poisoning," *Annals of Internal Medicine*, Vol. 34, No. 2, Feb. 1951, pp. 331-338.
- [5] Bennett, I. L., Jr., Cary, F. H., Mitchell, G. L., Jr., and Cooper, M. N., "Acute Methyl Alcohol Poisoning: A Review Based on Experiences in an Outbreak of 323 Cases," *Medicine*, Vol. 32, No. 4, Dec. 1953, pp. 431-463.
- [6] Swartz, R. D., Millman, R. P., Billi, J. E., Bondar, N. P., Migdal, S. D., Simonian, S. K., Monforte, J. R., McDonald, F. D., Harness, J. K., and Cole, K. L., "Epidemic Methanol Poisoning: Clinical and Biochemical Analysis of a Recent Episode," *Medicine*, Vol. 60, No. 5, Sept. 1981, pp. 373-382.
- [7] Kane, R. L., Talbert, W., Harlan, J., Sizemore, G., and Cataland, S., "A Methanol Poisoning Outbreak in Kentucky," *Archives of Environmental Health*, Vol. 17, No. 1, July 1968, pp. 119-129.
- [8] Tonkabony, S. E. H., "Postmortem Blood Concentration of Methanol in 17 Cases of Fatal Poisoning From Contraband Vodka," *Forensic Sciences*, Vol. 6, No. 1/2, Aug./Oct. 1975, pp. 1-3.
- [9] Wu Chen, N. B., Schaffer, M. I., Lin, R.-L., Kurland, M. L., Donoghue, E. R., Jr., and Stein, R. J.,

- "The General Toxicology Unknown. I. The Systematic Approach," *Journal of Forensic Sciences*, Vol. 28, No. 2, April 1983, pp. 391-397.
- [10] Harger, R. N., Johnson, S. L., and Bridwell, E. G., "Detection and Estimation of Methanol, with Results in Human Cases of Methanol Poisoning," *The Journal of Biological Chemistry*, Vol. 123, Suppl. 50-51, March 1938, pp. 1-11.
- [11] Coe, J. I. and Sherman, R. E., "Comparative Study of Postmortem Vitreous Humor and Blood Alcohol," *Journal of Forensic Sciences*, Vol. 15, No. 2, April 1970, pp. 185-190.

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