

Branch, A

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diffuse reddening of the mucosa of stomach

Lactace high
Fermt low

Methanol
Brain
Cyanosis
Depression
Exp. Vitamin

Acute Methyl Alcohol Poisoning

Observations in Some Thirty Cases

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ANYONE who has been through an epidemic can appreciate our position when in June 1944, within a period of three days, thirteen people in Saint John died from drinking methyl alcohol and over thirty were admitted to the Saint John General Hospital for treatment while another ninety were examined in the out-patient department on the broadcast advice of the Royal Canadian Mounted Police. As similar outbreaks of acute methyl alcohol poisoning have occurred before in large cities and may occur again, we believe that it is worthwhile to recount our experiences, particularly as it appears that, if given in time, therapeutic measures will save lives and avert blindness.

The beginning of the "epidemic", was first brought to the attention of one of us (A.B.) in his capacity as medical examiner for the coroner when the latter telephoned him on Friday morning, June 16th, and asked him to investigate the cause of death of an East Indian seaman which had occurred in a boat in port about to sail. Before the autopsy had been completed, another call was received, this time from the west-end coroner, requesting examination of the body of a longshoreman, and shortly afterwards the first coroner ordered that the body of a man dying in the hospital also be examined. It was not until the early afternoon, when we were completing our toxicological examination on the first body, that the history of the drinking of methanol was reported. This accelerated our finding of methyl alcohol in the stomach and blood of the first case and later of the other two. Resemblances to an epidemic were shown: fulminating deaths occurred from large doses or as a result of individual susceptibility; those with more resistance or lower dosage lived longer before succumbing; some survived after being seriously ill; and, finally, some showed little or no symptoms. That the factors influencing symptoms and recovery are not as simple as this will be discussed later.

Autopsy disclosed a combination of findings which should at least suggest acute methyl alcohol poisoning. There was marked oedema of the brain, not merely the "wet" brain so frequently seen postmortem, but a degree of oedema which caused the pia arachnoid to bulge as if at the bursting point when the head is in the usual position for removing the brain. There was noticeable cyanosis; the blood in the heart and vessels was unclotted and had a peculiar colour like red ink, or more exactly like a sample of old haemolized blood, such as is received by mail in the winter and obviously has frozen and thawed out. Finally, there was a diffuse reddening of the mucosa of the stomach, particularly marked in the rugae. These findings were practically constant in all the five cases autopsied and were the only common denominator in the group. The alcohol

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content in the heart's blood varied from 0.10 to 0.29 per cent and methyl alcohol was present in the stomach contents (table 1).

At the hospital the clinical staff had heard of the deaths from methyl alcohol poisoning and soon discovered many patients seeking admission with symptoms which had a monotonous similarity. Except in cases in coma these symptoms and signs were great apprehension, shortness of breath, a burning sensation over the area of the stomach or crampy abdominal pain, flushed face, bounding pulse, restlessness, thirst, perspiration, pain in the eyes, blurred vision and dilated, fixed pupils. Histories, when obtainable, revealed that there had been drinking on an average of 36 hours previously (24-72 hours). Stomachs were washed out and the washings sent to the laboratory for examination. When the diagnosis warranted it, 50 per cent glucose was administered. Sometimes concentrated plasma was given to withdraw fluid from the tissues. Then the kidneys were flushed with normal saline. The clinician in charge, D. J. T., soon noticed (1) that the patients who "went bad" showed symptoms of acidosis and he ordered CO_2 combining power estimations of the blood; low values of

TABLE I

GROSS AUTOPSY FINDINGS IN METHYL ALCOHOL POISONING

Case	Stomach	Blood	Appearance	Brain	Stomach	Heart's Blood
1	Positive	0.297%	(E. Indian)	Oedema	Congested	Unclotted
2	"	0.239%	Cyanotic	"	"	"
3	"	0.10%	"	"	"	"
4	"	0.19%	"	"	"	"
5	"	0.21%	"	"	"	Some clot

Analysis of 11 samples of seized liquor:

8 samples contained 97 - 99 per cent methyl alcohol.

3 samples contained 32, 51 and 91 per cent respectively.

16 and 13 volumes per cent in two of the most severely ill patients were found, and Ringer lactate solution was given intravenously to relieve the severe acidosis.

This treatment resulted in dramatic and immediate clinical improvement. From this point on, CO_2 combining power estimations of the blood were made in all suspected cases and alkali was administered intravenously to those showing values of less than 50 volumes per cent. The clinician also observed that considerably less lactate was required to restore the CO_2 combining power of the blood to normal than would be anticipated from the tables given by Hartman when the body weight and CO_2 combining power values are known. This led us to consider that the acidosis was a retention acidosis and in two of the subsequent patients with CO_2 combining powers in the 40's, we obtained high readings for blood lactic acid. On Monday, June 19th, in reviewing the recent literature we fortunately came across an editorial in the British Medical Journal (2) which quoted extensively from an article by Roe published in Acta Medica Scandinavica (3). The original journal has only recently been received from Professor I. Holmgren of Stockholm, the editor to whom our thanks are due.

CO₂ combining power) and in two cases found high lactic acid values in the blood. From these observations he postulated that the clinical symptoms of acute methyl alcohol, including the retinal damage, is due to a lactic acid acidosis and furthermore that the intensity of the clinical symptoms varies directly with the degree of the acidosis. He suggested as a working hypothesis that this lactic acid accumulation is due to cessation of the functioning of the respiratory enzyme by the formic acid formed as the methyl alcohol is oxidised by the body cells.

Without suggesting the mechanism by which the retention of lactic acid occurs, our findings would corroborate Roe's observations that there is such an

TABLE II
LABORATORY FINDINGS IN ACUTE METHYL ALCOHOL POISONING

Blood	H.E.	A.C.	W.C.	F.N.	J.H.	C.G.	L.D.*
CO ₂ Combining Power:							
Before Treatment	13	16	35	51	48	65	55
After Treatment	41	49	64	59	61	64	
Non-Protein Nitrogen	37	38	34	41	38	41	39
Urea Nitrogen	11	13	10	14	11	14	12
Uric Acid	5	4	3	3	1	2	1.7
Creatinine	4	1.3	0.8	1.4	3.2	1.0	1.3
Alcohol	12.7%	13%	12%	11.7%	10%	10.4%	24%
Total Proteins			4.3			4.9	
Albumin			4.1			4.1	
Icterus Index			9.2			6.2	
Van den Bergh:							
Indirect			.22			.22	
Direct			.27			.44	
Chlorides					467		
Cholesterol					145		
Haemoglobin	88%						
Red Cell Volume	49	52	50	47		56	55
Clotting Time	4	3	3	3½		3½	3½
Bleeding Time	1½	2	3	2		1	3
Lactic Acid					74.3		
Formic Acid Urine					6.2		
Spinal Fluid		Cells 3					
		Normal					
Ethyl Alcohol given		Yes					
Methanol Stomach	0		+		±	+	

*Ethyl alcohol poisoning for comparison

acidosis and that this can be relieved by the administration of suitable alkalis in an amount proportionate to the degree of acidosis as evidenced by the CO₂ combining power of the blood. The sequence of events leading up to the classical symptoms of acute methyl alcohol poisoning is ingestion of a sufficiently large amount which is absorbed as methyl alcohol, symptoms of some degree of intoxication, an interval of some 36 hours practically symptom-free, and then the appearance of the symptoms of toxicity enumerated above. The symptom-free interval corresponds to the period in which the toxic formic acid is being formed by oxidation of the absorbed methyl alcohol. The final conclusion, that the pathological lesions including the macular degeneration are due to the

that the nerve plates disappear from the muscles in rigor mortis as lactic acid accumulates and that it has been shown experimentally that lactic acid injected into the muscles of living rats rapidly produces a degeneration of the nerve plates (4). The treatment of the symptoms, including the amblyopia, is thus primarily the immediate treatment of the acidosis.

We are not able to state that alleviation of the acidosis alone is sufficient treatment of methyl alcohol poisoning since in all our cases we used the therapy, outlined above, of intravenous injections of saline to flush the kidneys after 50 per cent glucose solution or concentrated plasma had been administered for the purpose of withdrawing fluid from the tissues. It would also appear that washing out the stomach is of use, as there is evidence that methyl alcohol is secreted by the stomach. In another hospital where three cases were treated solely by washing out the stomach and filling it with large quantities of alkali (soda bicarbonate) no deaths occurred, although one patient was considered very seriously ill on admission.

EYE LESIONS

The development of partial or complete degeneration of the ganglion cells of the retina leading to partial or complete blindness has always been a concomitant to acute methyl alcohol poisoning (5). Roe explains this apparent selective action on the retina on the basis of the susceptibility of the retina cells to change in hydrogen concentration and anoxia, especially in the presence of light. All our cases showing eye symptoms were shaded from light and given Vitamin B₁, as well as alkali. Of the five original cases with eye lesions who have been followed for four months, in only one is there a reduction in the visual field.

The other suggestion for therapy, mentioned by Roe, is that the early use of ethyl alcohol will reduce symptoms. We tried this in some of the later cases but can draw no conclusions. The basis for this therapy is that ethyl alcohol is absorbed more readily by cells than is methyl alcohol and consequently the latter, being absorbed slowly, is eliminated without causing acute toxic effects.

FACTORS INFLUENCING THE DEGREE OF ACIDOSIS

We have so far not had a sufficient response to a questionnaire to discuss the various factors mentioned by Roe. These include the influence of increased metabolism, ethyl alcohol, and fluid intake. Roe adduces evidence to show that all these directly influence the degree of acidosis and, with the actual amount of methyl alcohol consumed, are important factors to be borne in mind. Thus patients who stay at rest in bed appear to show less acidosis than those who do a hard day's work following the drinking. Similarly, those who drink ethyl alcohol along with methyl alcohol, or whose intake of fluids—water or beer—is great, also are less liable to develop acidosis. In the case of the one woman who died in the Saint John epidemic, there seems authentic information that she took only one drink of methanol, but did not drink any ethyl alcohol nor did she get much water. The other cases who recovered are also known to have drunk

SUMMARY

Evidence is accumulating which would suggest that the symptoms and pathological lesions of acute methyl alcohol poisoning are due to a degeneration of nerves, including those of the retina, caused by the acidosis of retained lactic acid. Dramatic clinical improvement, including alleviation of eye symptoms, follows the injection of alkali in an amount sufficient to restore to normal the CO_2 combining power of the blood. Adjuvant measures, such as washing out the stomach, shading of the eyes, and administration of thiamine chloride where eye symptoms are exhibited, are also recommended. It is likely, too, that 50 per cent glucose solution and concentrated serum followed by normal saline intravenously are of assistance in increasing elimination. Examination of the blood for non-protein nitrogen, urea nitrogen, uric acid and creatinine showed normal values which led us to believe that there was no impaired kidney function. Similarly, Van den Bergh and icteric indices, and estimations of clotting and bleeding time were within normal limits, excluding extensive damage to the liver and haematopoietic system (table 2). The Saint John epidemic is peculiar in that with the treatment of the acidosis there have been practically no residual eye lesions in the recovered cases.

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