

The Determination of Carbon Monoxide in Blood Treated with Formaldehyde

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Received June 16, 1970

Summary. Addition of formalin to blood samples obtained at autopsy, as in the process of embalming yields adequate results with regard to carboxy-hemoglobin determinations. The determinations should be carried out as early as possible because of denaturation of sample storage.

Key-Words: Carbon Monoxide, Determination—Co-Bestimmung im Leichenblut.

Zusammenfassung. Es wird gezeigt, daß es durchaus möglich ist, tödliche Konzentrationen von Kohlenoxydhämoglobin in Leichenblut auch nach Zusatz von Formalin zum Blute nachzuweisen. Zusätze von 10% igem Formalin zu einer Endkonzentration von 0,25—9,0% Formaldehyd zu Blutproben mit 59—81% HbCO gaben in den meisten Fällen brauchbare quantitative Werte. Qualitative Resultate können immer erhalten werden und genügen in der Regel zur Begutachtung der Fälle. Die Analysen sollen aber so bald wie möglich ausgeführt werden, da beim Aufbewahren weitgehende Denaturierung eintritt.

When corpses are embalmed by (the injections) of formaldehyde solutions, denaturation of blood takes place. This study was undertaken in order to investigate the possibility of determining carbon monoxide under these circumstances.

Blood samples from the heart of individuals who had died from carbon monoxide poisoning were obtained at autopsy. Increasing amounts of 10% of formaldehyde solutions containing eosine were added to the blood samples. The resulting blood solutions were analyzed spectrophotometrically according to a method developed at our laboratory [1].

A total of 17 cases, 13 men and 4 women, were investigated. Five had committed suicide with gas, seven had inhaled car exhaust fumes, and five had died in fires.

Already at autopsy, the presence of carbon monoxide was shown by using a qualitative test (color reaction with formaldehyde).

The analytical results will be found in the table. In the first 11 cases, formaline was added to a final concentration from 2.5 to 90% (corresponding to 0.25 to 9% of formaldehyde). The last six cases were analyzed after addition of formaldehyde to give a final formaline concentration of 70, 80, and 90% respectively (7, 8 and 9% of formaldehyde). In each case, the result of the assay for untreated blood is also shown.

Considering the data of the first 11 cases we observed that the relative CO-saturation was higher in the formaline-treated samples in 6 instances, and lower

Table. *Analytical results obtained by spectrophotometric assay of blood samples from autopsy cases, with and without addition of formaline*

Case nr.	Time interval between death and autopsy (days)	Concentration of 10% formaldehyde solution (formaline) in per cent	Relative content of carbon monoxyhemoglobin (% HbCO)	
			without formaline	with formaline
1	7	2 ¹ / ₂	64	68
2	5	5	63	59
3	2	10	73	70
4	6	20	59	63
5	5	30	70	72
6	7	40	76	78
7	4	50	82	81
8	5	60	76	75
9	3	70	74	64
10	2	80	81	46
11	3	90	69	74
12	5	70, 80, 90	80	87, 94, 88
13	3	70, 80, 90	79	78, 86, 76
14	3	70, 80, 90	68	66, 76, 85
15	2	70, 80, 90	80	—, 92, 80
16	2	70, 80, 90	80	94, 94, 94
17	4	70, 80, 90	55	56, 51, —

in 5 instances. The differences were 1% HbCO (carbon monoxyhemoglobin) in 2 cases, 2% in 2, 3% in one case, and 4% in 3 cases. These differences are tolerable since the analytical error of the method used is $\pm 3\%$ HbCO [1].

However, in three instances of high concentration of formaline, larger deviations were observed: +5% in case 11, -10% in case 9, and -35% (!) in case 10. Repeated analyses did not show a relevant spread of results. This means that if the formaline concentration exceeds 60% (6% of formaldehyde), as is often the case in embalmed bodies, the values can not be expected to lie within $\pm 3\%$ HbCO, otherwise observed in using this particular analytical method.

Based on these experiences, a series of tests (cases 12-17) was run at high formaline concentrations (cf. table). The results show no definite trend: in some instances the treated samples show higher in others they show lower values. In general, it can be seen that reliable quantitative tests can not be carried out on samples of this kind. At formaline contents of above 70%, the blood was almost completely clotted, and it was exceedingly difficult to obtain analyzable hemoglobin solutions, either by centrifugation or by filtration.

A number of the blood samples analyzed were left standing for 1-2 days, either at +4° or at room temperature and a repeated analysis of these samples gave irregular and irreproducible results. A delayed analysis of formaline-treated blood samples can only yield qualitative results. Similar conditions exist when fresh autopsy blood with formaline concentrations exceeding 60% is analyzed.

Despite these circumstances, it can be stated that a chemical diagnosis of carbon monoxide poisoning is quite feasible after the embalming of the corpse with formaline solutions, even if exact quantitative data can not be obtained.

Reference

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