

Carboxyhemoglobin Concentrations in Fire Victims and in Cases of Fatal Carbon Monoxide Poisoning*

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Summary. The study comprises an eleven-year autopsy material of 141 cases from the Institute of Forensic Medicine, Oslo.

The fatal level of carboxyhemoglobin concentration is calculated from cases of pure carbon monoxide poisoning. Carboxyhemoglobin concentrations below this level are found in approximately thirty percent of the fire victims. Alcohol intoxication, present in many fire victims, is not related to low carboxyhemoglobin concentrations.

Zusammenfassung. Untersucht wurden 141 Fälle während einer 11-jährigen Zeitspanne am Institut. f. gerichtl. Med., Oslo. Die tödliche CO-Hb Konzentration wurde von Fällen seiner CO-Vergiftung abgeleitet. CO-Hb Konzentrationen unter diesem Wert wurden in ungefähr 30 % von Brandleichen gefunden. Alkoholisierung scheint keinen Einfluß auf die niedrigere CO-Hb Konzentration zu haben.

Key words. Carbon monoxide Poisoning – Carboxyhemoglobin concentrations.

What minimum concentration of carboxyhemoglobin can be regarded as fatal? This is a problem to the forensic pathologists when low carboxyhemoglobin values are found at autopsy. To gain more knowledge about this problem, we have reexamined our autopsy reports for deaths connected with carbon monoxide in the last eleven years.

Material and Methods

The material consists of 141 autopsies, 113 men and 28 women. It is divided into two main groups: One group includes 54 apparently healthy people who died of carbon monoxide poisoning, mostly suicides by means of exhaust. The other group consists of 87 fire victims, of whom 72 had heavy burns and 15 were not burnt. The ages range from 13 to 95 years, average 50 years in both groups. Children under age ten are omitted. Three different analytical methods are used during the last eleven years, Wolff's method [1] (1965–69), Maehly's method [2] (1969–Nov. 75), and gas chromatography [3] (the last months).

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Table 1. The relationship between age and post mortem HbCO concentrations in cases of fatal carbon monoxide poisoning

Age	number of persons	mean HbCO concentration in % (SD)
Less than 40 years	11	74 (5)
Between 40 and 50 years	12	74 (7)
Between 50 and 60 years	18	70 (11)
More than 60 years	13	65 (12)

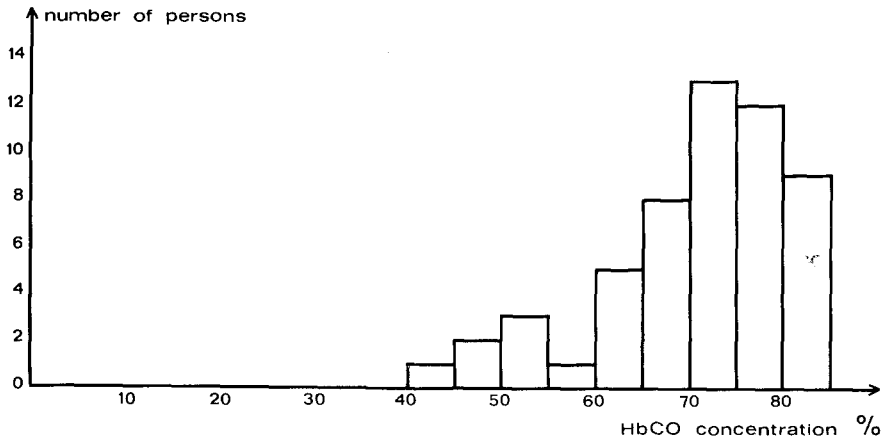


Fig. 1a. Post mortem carboxyhemoglobin concentrations in 54 cases of fatal carbon monoxide poisoning

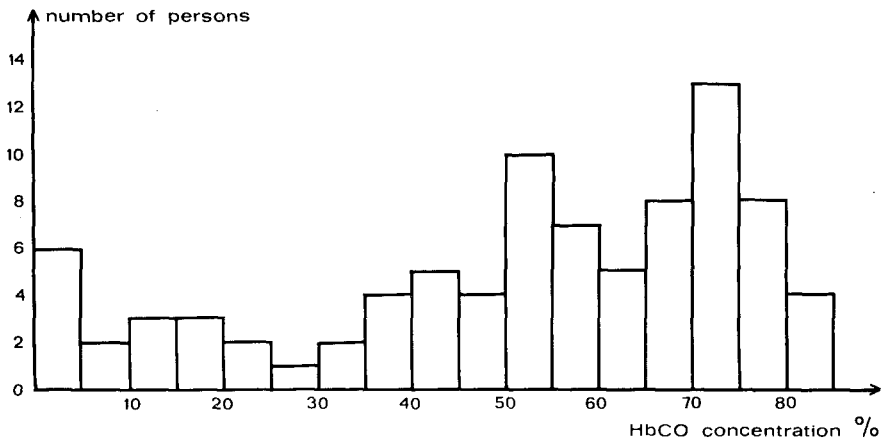


Fig. 1b. Post mortem carboxyhemoglobin concentrations in 87 fire victims

Results and Discussion

The carboxyhemoglobin concentrations in 54 cases of fatal carbon monoxide poisoning are shown in Figure 1a. The mean fatal HbCO concentration in this group is 70% (SD10%), and the lower fatal HbCO level is 45% (98% confidence limit). In most of the cases little or no blood alcohol was detected at autopsy.

The relationship between age and HbCO concentration is shown in Table 1. In persons under 50 years the HbCO concentrations show relatively small variations, and only 4 out of 23 died with a concentration below 70%. The older age groups show large variations in fatal HbCO concentrations.

The post mortem carboxyhemoglobin concentrations found in 87 fire victims are presented in Figure 1b. In this group 28 persons (32%) died with a HbCO concentration below 45%, and in these cases other factors than CO poisoning have probably contributed to or caused death.

Fifty-four per cent of the fire victims were alcohol intoxicated. Figure 2 shows the HbCO concentrations in fire victims (47 persons) with a post mortem blood alcohol level above 1‰. A shift in HbCO concentrations towards lower values would be expected if alcohol contributes to death. As seen from Figure 2 this is not the case; the distribution pattern of fatal HbCO concentrations is approximately the same for alcohol intoxicated persons as for the whole group. In one case a high concentration of meprobamat (230µ per ml. blood) was found. The carboxyhemoglobin concentration was 62%.

The importance of burning is seen from Figure 3a, which shows the post mortem HbCO concentration in 72 burnt corpses. In 23 of these (32%) the carboxyhemoglobin concentration is below 45%. Disease may have been the major cause of death in only two of these cases. In the remaining cases with low HbCO values burning is the most likely cause of death. Of the fifteen fire victims that died without being burnt (Fig. 3b) five died with low HbCO values. In three of these cases heart disease was detected, in one case a severe bronchopneumonia, and in the fifth case a heavy alcohol intoxication.

The value of a retrospective study of this kind is limited. The source of blood submitted for HbCO determination is not recorded, and a systematic screening for drugs

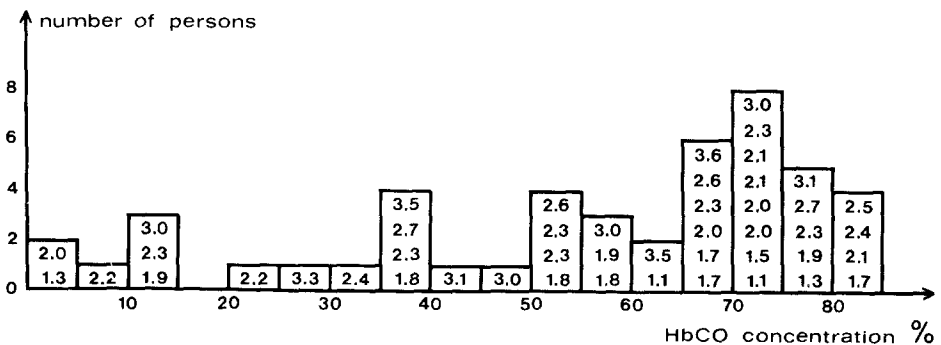


Fig. 2. Post mortem carboxyhemoglobin concentrations in 54 alcohol intoxicated fire victims. The figures within the columns indicate the post mortem blood alcohol concentration (‰) in each case

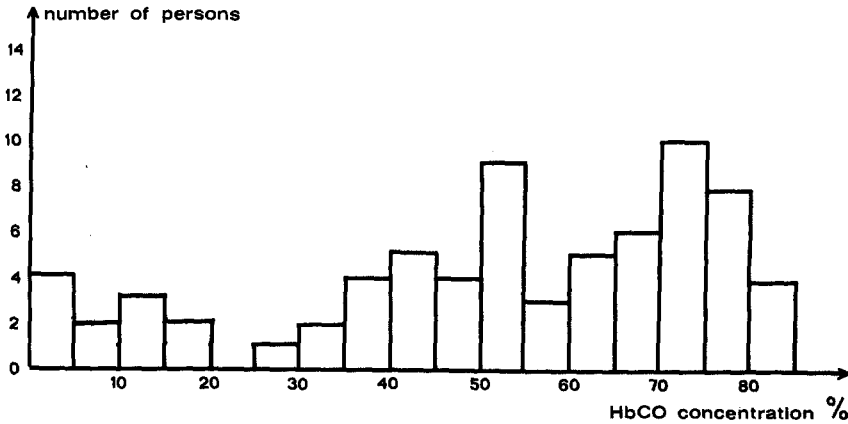


Fig. 3a. Post mortem carboxyhemoglobin concentrations in 72 burnt fire victims

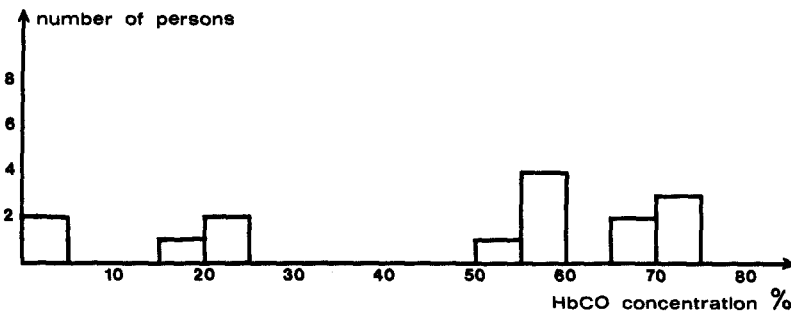


Fig. 3b. Post mortem carboxyhemoglobin concentrations in 15 not burnt fire victims

has not been done. Furthermore, analysis for cyanide has not been performed even though such poisoning may occur in fire victims, due to the formation of cyanide when certain synthetic materials burn. Carboxyhemoglobin concentrations are determined by three different methods, but a comparison between Wolff's and Maehly's method gave approximately the same distribution pattern of fatal HbCO concentrations. At the present time very few cases have been analysed by gas chromatography.

Nevertheless, the data presented allow certain conclusions:

1. Carbon monoxide poisoning is probably not the cause of death when post mortem carboxyhemoglobin concentration is below 45%.
2. Burns rather than carbon monoxide poisoning is the main cause of death in at least thirty percent of the fire victims.
3. Alcohol intoxication does not seem to influence the fatal HbCO concentration.
4. A low post mortem carboxyhemoglobin concentration is often found in victims suffering from disease.

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