



ELSEVIER

Legal Medicine 7 (2005) 15–23

LEGAL
MEDICINE

www.elsevier.com/locate/legalmed

Biochemical background of ethanol-induced cold susceptibility

Grzegorz Teresiński*, Grzegorz Buszewicz, Roman Mądro

Chair and Department of Forensic Medicine, Medical University of Lublin, ul. Jaczewskiego 8, 20-090 Lublin, Poland

Received 13 August 2003; received in revised form 22 April 2004; accepted 5 July 2004

Available online 19 August 2004

Abstract

The process of cooling is always associated with the depletion of energetic reserves and burning the ketone bodies covers the tissues' needs. Ethanol shows antiketonaemic effects changing the cellular redox potential, inhibiting β -oxidation of fatty acids, stimulating the release of insulin and inhibiting the release of its antagonist. The aim of the study was to determine whether the cooling process of the organism in the presence of ethanol intoxication may be related to inhibition of the physiological mechanism of ketogenesis induced by hypothermia. The study involved the 67 autopsy cases from 1996 to 2002, in which the circumstances of death indicated the effects of overcooling. This was confirmed on the basis of the data from the Prosecutor's Offices. Then, the chromatograms of autopsy blood alcohol determinations were analyzed and the acetone levels recorded. The analysis supported the hypothesis that the severity of ketosis is inversely proportional to the blood ethanol concentration. Furthermore, it demonstrated that signs of prolonged cold exposure were less frequently observed in unsobber persons (frostbites, gastric hemorrhages). Increased sensitivity of intoxicated individuals to cold may be related not only to the dilation of the peripheral vessels, inhibition of shivering thermogenesis caused by muscle relaxation, central nervous system depression and behavioral factors but also to the antiketonaemic effects of ethanol.

© 2004 Elsevier Ireland Ltd. All rights reserved.

Keywords: Hypothermia markers; Ketone bodies; Ethanol; Thermogenesis

1. Introduction

In Poland, according to the estimated data of the Chief Police Office, overcooling of the organism still results in many deaths (1998/1999—225,

1999/2000—154, 2000/2001—112, 2001/2002—305, 2002/2003—312). The data reveal that in the majority of such cases overcooling was accompanied by insobriety. As it is well known, ethyl alcohol accelerates the heat loss due to the dilation of the peripheral blood vessels and relaxes the muscles, which inhibits shivering thermogenesis [1,2]. Moreover, ethanol facilitates the heat loss due to its behavioral effects (feeling of warmth and comfort) and depression of the central nervous system [3–5].

The results of our previous studies [6] indicate, however, that accelerated cooling process is likely to have some biochemical background since ethanol

Abbreviations: Ac-Ac, acetoacetate; Ac-CoA, acetyl coenzyme A; BAC, blood alcohol concentration; FFA, free fatty acid; HbA1c, glycated hemoglobin; β -HBA, β -hydroxybutyrate; NADH, nicotinamide adenine dinucleotide, reduced form; NAD, nicotinamide adenine dinucleotide.

* Corresponding author. Tel./fax: +48-81-747-6427.

E-mail address: grzdyl@asklepios.am.lublin.pl (G. Teresiński).

inhibits the production of ketone bodies, which are relevant energetic substrates in the organism exposed to low temperatures. Our observations concerning this issue were based on the prospective evaluation of only 16 cases in which the circumstances of death suggested the effects of overcooling.

Thus, the aim of the present study was to verify (on the basis of retrospective analysis of a larger number of cases) the hypothesis that insobriety accelerated the cooling process in the organism by inhibiting the physiological mechanism of hypothermia-induced ketogenesis. Moreover, we decided to check if the ethanol consumption affected the prevalence of the macroscopic signs of overcooling.

2. Material and methods

The autopsy cases in which the circumstances of death suggested possible effects of overcooling in the pathomechanism of death were selected from the material of the Department of Forensic Medicine in Lublin collected between 1996 and 2002. Moreover, all archival chromatograms of alcohol determinations for which blood was collected in the other prosectoria of our region (our Department performs ethanol blood tests for the whole region) were examined and the cases with markedly increased acetone level were selected (above 500 $\mu\text{mol/l}$) as this level is the only biological hypothermia marker detectable during the routine blood tests carried out by using gas chromatography [6]. On the basis of the files from the Prosecutor's Offices of our region, the cases in which the circumstances of death definitely suggested overcooling were chosen.

Although in several cases the ethanol level was found to be very high (which theoretically (however, in Polish population, theoretically fatal ethanol concentrations are often found in living persons—e.g. among the pedestrian victims of car hits the percentage of BAC > 4‰ in adults reaches up to 16% and over a half of them was hit in the standing position [6]) could be considered the cause of death), they were still included in the analyzed group as these individuals were definitely exposed to cold before death and died in the late phase of alcoholaemia (the ethanol levels in blood and urine were found to be similar after taking into account the degree of

hydration of these media). The majority of the victims froze to death on their way home after walking a long distance or while consuming alcohol in low temperature. The person with the highest ethanol blood level (5.1‰) was carried outside the building where, according to several witnesses, kept sleeping (snoring) for some hours and nobody helped him [6].

After such a selection, further analysis included 67 death cases—59 men and 8 women whose age ranged from 16 to 72 years (mean 47) and who died at temperature near or lower than 0 °C (temperature could only be estimated as the deaths usually occurred at night and the bodies were found next morning after the person had been missing or left home).

The levels of acetone and ethanol were read out from the archival chromatograms performed by using the gas chromatograph Fisons 8160 and autosampler HS-800 Fisons/CTC Switzerland, which were stored on CD-ROMs. The examinations were conducted by the headspace technique using the constant internal standard (*iso*-butanol). This enabled us to plot the additional calibration curve for acetone, which was used to determine (post hoc) the concentrations of this compound in the blood samples collected from the cadavers (reintegration of files was performed using the Chrom-Card 1.21 for Windows, CE Instruments, Italy).

The retrospective character of the study did not allow us to verify other possible reasons of acetonaemia but hypothermia because not in all cases the histopathological examinations were performed and only some of them were subjected to extended toxicological tests. Moreover, due to a relatively short period of blood storage after examinations, the determination of HbA1c levels (this kind of examination in the whole period studied has not been routinely performed yet) [6,7] was not possible and diabetes could be excluded only on the basis of the information from the family members.

In 16 victims, the concentrations of acetoacetate (Ac-Ac) and β -hydroxybutyrate (β -HBA) were also measured (in 11 of those victims BAC was greater than 1‰). These cases were compiled in the previous paper [6].

The control group consisted of the material collected from the corpses of 30 persons (including 9 alcoholics) who did not stay at low temperatures and died due to mechanical injuries, fatal asphyxia,

Download English Version:

<https://daneshyari.com/en/article/10254594>

Download Persian Version:

<https://daneshyari.com/article/10254594>

[Daneshyari.com](https://daneshyari.com)