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AUTO-BREWERY SYNDROME: IMPLICATIONS IN MEDICO-LEGAL PRACTICE

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Abstract: The authors report an unusual case of a driver who tested positive for alcohol proven by a breathalyzer during a random police road test. An initial hypothesis of auto-brewery syndrome was put forward, following a clinical exposure test and blood sample examination by a non-specific enzymatic method. However, this was later excluded by conducting a specialized glucose testing and examination of blood samples by gas chromatography in a forensic department. Because the number of such cases is insufficiently reported in the medico-legal literature, this case report and concise review of the literature delivers useful information necessary for a correct and professional approach, with a detailed proposal on how to definitively resolve this obscure problem of forensic alcohology.

Keywords: auto-brewery syndrome, gut fermentation syndrome, endogenous ethanol fermentation, drunkenness disease, breathalyzer positivity, forensic alcohology.

INTRODUCTION

The existence of endogenous alcohol production in the digestive tract has been known for several decades [1]. This condition is usually, but somewhat incorrectly, called Auto-Brewery Syndrome. It is also sometimes referred to as Gut Fermentation Syndrome [2] or Endogenous Ethanol Fermentation [1]. For drivers who tested positive for alcohol, the existence of auto-brewery syndrome may be an escape route in terms of explaining alcohol in their blood without acknowledging consumption [4]. The authors report an unusual case of declared auto-brewery syndrome of a driver stopped by the police with positive blood alcohol concentration.

CASE REPORT

A 26-year-old driver was randomly stopped by the police in the evening. Breath analysis (Draeger Alcotest 7510) revealed alcohol concentrations of 0.87 mg/l initially and 0.83 mg/l after a 15-minutes delay. Considering blood/breath alcohol concentration ratio of 2.1:1, breathalyzer values equated to blood alcohol concentration of 1.82 g/l and 1.74 g/l respectively. Blood sampling was not performed. The suspect, a casual drinker, insisted he had consumed only one beer that day. He further stated that he had repeatedly suffered from sudden states of fatigue and abdominal pain with occasional nausea. The surroundings noticed bad breath. He had also observed a very low tolerance to alcohol, when even with minimal alcohol consumption he observed a sharp deterioration in his general condition.

A clinician suspected auto-brewery syndrome. Therefore, under the supervision of physician and witnesses, the suspect underwent a shortened exposure test with glucose. Before the test, he had not consumed any alcohol for 24 hours and was given a blood draw in the morning, with a result of 0.00 g/l by an enzymatic method (alcohol dehydrogenase). Subsequently, he ingested 2 teaspoons of sugar and about 60 g of dark chocolate. After 1.5 hours, following the disinfection of the skin by ether to avoid potential corruption of the sample, blood sampling was performed again and examination in the biochemical laboratory revealed a concentration of 1.38 g/l of alcohol by an enzymatic method (alcohol dehydrogenase). The constant

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presence of the doctor and witnesses ruled out any ingestion of an alcoholic beverage. It was suggested that the police abolish prosecution.

The driver sought professional consultation at the Institute of Forensic Medicine. Triple testing was repeated at weekly intervals to verify or exclude auto-brewery syndrome. After exposure to sugar and chocolate on an empty stomach, a certified breath analyzer (Draeger Alcotest 7510) in the range of 1/2 hour - 1 hour - 2 hours - 3 hours did not detect a value other than 0.00 mg/l. Blood samples were taken respectively, examined by a specific method - gas chromatography, displaying the same results of 0.00 g/l. Thus, the presence of abnormal ethanol formation in the body was ruled out.

DISCUSSION

The first, although unverified, published case of suspected auto-brewery syndrome dates back to 1948 [5]. The phenomenon occurs due to an imbalanced composition of the intestinal microflora and a dietary mistake of consuming excessive amounts of carbohydrates. Due to the process of alcoholic fermentation in the intestine, ethyl alcohol is formed, which enters the bloodstream. This commonly occurs in healthy people with a common diet, where production of alcohol is negligible. In fact, the first passage of portal blood through the liver transforms the ethanol, leaving none in peripheral blood. In very rare cases, blood alcohol concentration can be detected, but these amounts usually do not exceed 0.001 g/l [6]. From the forensic standpoint, such levels are completely irrelevant, even in countries with zero tolerance for driving under influence [7]. Hence, in general, the blood alcohol level of a healthy person should be no different than 0.00 g/l [8]. Higher blood alcohol concentration values are described in the literature for liver diseases covering the full range from hepatitis to cirrhosis, or in diabetes mellitus [9], Crohn's disease, obesity [10,11], as well as in patients after gastrointestinal tract operations such as laparotomy or gastrectomy [12], chronic intestinal obstruction, or intestinal hypomobility [13], short bowel syndrome [11,14,15] and after long-term antibiotic use [11,16,17], inulin-based probiotics [18] or fiber diets [19]. The intestinal microflora that predominantly appears as the most important producer of alcohol is e.g. Candida albicans [20,21], or many other species such as Candida glabrata [14], Candida intermedia, Candida parapsilosis, Candida kefyr [15] and Candida krusei [20], Klebsiella pneumoniae [2,11,17], with Saccharomyces cerevisiae [14,15,22]. In patients with a combination of diabetes mellitus together with cirrhosis of the liver, a blood alcohol concentration of not higher than 0.102-0.104 g/l is described [9]. On the other hand, there are literature sources that state blood alcohol concentration of 2.00 g/l [11], or, even in a controlled experiment, an almost unbelievable 3.02-3.07 g/l [12], 3.7 g/l [1] or even 3.75-3.81 g/l [17].

However, some authors completely exclude these conditions, even in individuals who suffer from metabolic disorders such as diabetes, or serious liver diseases such as hepatitis or cirrhosis. As in healthy individuals, they point out that reliable laboratory methods did not reveal any blood alcohol concentration in the medical history of such patients other than 0.00075-0.00076 g/l [21], or 0.033-0.034 g/l in men, and 0.030-0.031 g/l [23] or 0.032-0.035 g/l in women [24]. Even in diabetics, the concentration of alcohol in the blood does not correlate with the level of glucose in the blood. Blood alcohol concentration is described in diabetics at 0.00249-0.00252 g/l, while in the control group of healthy blood alcohol concentration individuals a mean value of 0.0036-0.0038 g/l was found [25]. This is completely irrelevant for forensic purposes. Serious authors therefore claim that it is impossible to safely prove auto-brewery syndrome other than by a confirmatory test, i.e. an increased blood alcohol concentration after a glucose test [3,13,17,26-27].

In our case, the underlying cause of the discrepancy between ethanol levels of the subject could have been the use of non-specific method by the clinician. The method employed is based on oxidation of ethanol by alcohol dehydrogenase. Alcohol dehydrogenase requires the coenzyme nicotinamide adenine dinucleotide (NAD+) which is reduced during reaction (NADH). Both alcohol dehydrogenase and NAD+ are added into serum sample, followed by the spectrophotometric analysis of NADH. However, other endogenous enzymes, such as lactate dehydrogenase, utilize NAD+ as the coenzyme for their oxidation activity. These enzymes could be responsible for cross-reacting with the exogenous alcohol dehydrogenase, leading to false-positive ethanol readings in specimens [28]. Given the potential of cross-reactivity and false-positive readings with the alcohol dehydrogenase method, it is recommended that gas chromatography be the primary method used for quantifying ethanol concentration in serum due to its higher specificity. If gas chromatography yields positive results, alcohol dehydrogenase enzymatic reaction can then serve as a supplementary verification method.

The existence of endogenous alcohol production is currently an indisputable fact. This happens even in a completely healthy organism, and it is probably the reason why the human individuals developed central nervous system tolerance to ethyl alcohol in the course of evolution. However, fermentation in the intestine in larger quantities, which could entail forensic consequences, is completely eliminated by some authors [21,23]. This is partly due to the fact that the alcohol produced in the digestive tract first enters the portal system, and the metabolic and detoxifying activity of the liver significantly reduces it. Thus, the ethanol formed reaches the peripheral venous blood only in a very low concentration, which does not reach a value of the order of thousandths g/kg (per mille). Although there is literary data that speak of levels almost unbelievable, these are rather sporadic articles in journals, the scientific value and, above all, the credibility of which the authors of this article are not entirely sure of. However, the existence of auto-brewery syndrome cannot simply be dismissed.

In their practice, the authors begin to encounter (in Czech Republic 1x, in Slovak Republic 2x) that the defense attempted to exculpate its client on the basis of auto-brewery syndrome when driving a motor vehicle under the influence of alcohol. Since it seems that this phenomenon could gradually begin to spread in the legal practice, the authors of this article, based on their own experience, propose a relatively simple procedure in the form of a mandatory control experiment that will help in the assessment of a particular case and hopefully in time will help to definitively eliminate or confirm the myth cases of extreme auto-brewery syndrome.

This experiment must be carried out within a short period of time after the incident in order to detect possible abnormalities in the digestive tract (e.g. inflammation) that may change over time (e.g. healing, inflammation).

The experiment steps could be as follows:

1. The person to be examined must fast completely before the test.

2. Control of blood alcohol concentration at the beginning of the experiment will be carried out using a certified breath analyzer - zero result is a must-have condition.

3. Subsequent application of three tablespoons of standard crystalline sugar (18 grams) are washed down with a small amount of water (about 0,5 dl.)

4. The first measurement taken after 30 minutes.

5. The second measurement taken after 1 hour.

6. The third measurement taken after 2 hours or even longer.

Note: Measurements are carried out by breath analysis using an evidence-certified breathalyzer. In case of a positive result of the breath analysis, it is necessary to immediately take venous blood and examine it using a specific methodology - gas chromatography (the use of enzymatic or other non-specific methods is indicated only as a verification method).

Interpretation of results:

1. If the result of the breath analysis is negative, it is not necessary to perform blood sampling - the possibility of endogenous ethanol production at higher levels is not proven in the body.

2. If the result of the breath analysis is positive and the subsequent result of the blood sample examination is also positive - the endogenous production of ethanol is confirmed with all legal consequences. It is then necessary to advise the patient to undergo an examination aimed at diseases of the digestive tract.

The authors believe that only in this way can this somewhat mysterious phenomenon of forensic toxicology be solved and the possible existence of auto-brewery syndrome in practice confirmed or ruled out once and for all.

In conclusion, the above test is in absolute accordance with the principle succinctly formulated in 2020 by Murat Akbaba: „Those who are aware of this condition may falsely rely on it as a method to avoid penalties. On the other hand, genuine patients suffering from this condition may be caught by traffic control and become victims of the condition. For that reason, a meticulous and planned approach should be taken to verify the condition and to ensure that it is not overlooked" [12].

Conflict of interest

The authors declare that they have no conflict of interest.

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