Testing for Driving Under the Influence of Ethanol: Misleading Results Caused by Ether

To the Editor:

The correlation between driving under the influence of alcohol (DUI), medication, or illicit drugs and the occurrence of traffic accidents is well recognized. Threshold concentrations for intoxicating substances in a driver's blood, such as legal and illegal drugs and organic solvents, have not yet been regulated. The statutory limits of blood-alcohol concentration, however, are well defined in most countries (e.g., 0.50 g/L in Belgium and France, 0.80 g/L in the U.K., 0.20 g/L in Sweden, and 0.80 and 1.00 g/L in the U.S.) (1). This communication describes a DUI case in which the suspect was not driving under the influence of alcohol but of ether.

The suspect, a 43-year-old man, was involved in a traffic accident at 4:15 pm. He was subjected by the police to a breath-alcohol screening test with a Breath-analyser Seres 679 T-B at 6:12 pm. The result exceeded the upper limit of the breath test (i.e., 2.0 mg/L) corresponding with a blood-alcohol level greater than 4 g/L (2). The suspect was then examined by a physician according to a standard protocol used for suspected drunk drivers. During this examination, normal coordination test results were obtained, and no breath-alcohol smell was observed. Upon questioning about prior intake of alcohol or drugs, the suspect denied intake of alcohol but admitted sniffing 300 mL ether between 2 and 4 pm. A venous blood sample was taken at 8:30 pm and submitted to our laboratory for toxicological analysis.

The blood sample was immediately titrated following the procedure of Casier and Delaunois (3), which is still the official legal method for blood-alcohol determination in Belgium. An alcohol level of 0.24 g/L was found. Considering the appropriate time correction, this level corresponded to a blood-alcohol concentration of 0.87 g/L at the time of the accident. Because this concentration was much lower than the one suggested by the breath test, additional analyses of the blood sample were performed using an enzymatic alcohol dehydrogenase assay (ADH, Syva-Emit®) and a headspace gas chromatographic method with flame ionization detection (GC–FID) (4,5). A negative result for alcohol was obtained with both methods. However, a large, unknown peak was observed in the GC chromatogram. This peak was identified as ether after comparison of the retention time with those of several volatile organic compounds (VOCs) present in a reference standard mix. The peak identity was confirmed by a mass spectrum during an additional GC-MS analysis. Quantitation of ether in the blood sample was performed after slight modification of chromatographic conditions and subsequent validation of the headspace GC–FID method. A concentration of 0.10 g ether/L blood was thus determined.

How can the blood and breath test results be rationalized? Obviously, ether interfered with the Breath-analyser Seres 679 T-B and the Casier-Delaunois titration method resulting in a false-positive blood-alcohol concentration. The Breath-analyser Seres 679 T-B measures IR absorption at a single wavelength of 9.5 μm. The use of this wavelength was proposed as an alternative to the measurement at 3.4 μm, which corresponds to the stretching vibration of the C–H bond and is not specific for alcohol (6). A second approach to increase specificity was the development of instruments monitoring IR absorption at two analytical wavelengths (3.39 and 3.48 μm) (2). However, none of these alternatives provided a foolproof solution. For the 9.5 μm instruments, this is illustrated by the described case, in which the apparent alcohol response of ether on the Breath-analyser Seres 679 T-B was due to the overlap of the C-O stretching vibration of alcohol and ether in the 9.5-μm wavelength region (6,7). Nevertheless, the technical manual of the apparatus claims that "...measuring at 9.5 μm guarantees that the Breath-analyser is not sensitive to potentially interfering solvents...". Dual wavelength instruments are somewhat more specific, mainly with respect to the interference of acetone. The interference of ether with the Casier-Delaunois titration method could be attributed to oxidation of the compound by the sulphochrome mixture (8).

In contrast to these techniques, a correct blood-alcohol result was obtained with the ADH and headspace GC–FID methods. This confirms the specificity of the latter methods for blood-alcohol determination. However, as with the ADH method, the presence of ether was not detected, and headspace GC analysis proved to be a superior technique for the differentiation of alcohol from other VOCs.

From our observations, we conclude that the results of the existing IR-based breath-alcohol screening tests have to be interpreted with caution. The use of a more sophisticated detection system, such as measurement and correlation of IR absorption at multiple appropriate wavelengths, can improve the reliability of the results. In addition, the confirmation of positive breath-alcohol screening results with a specific GC technique for blood alcohol is advised, especially with respect to the legal consequences of DUI.
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References