Studies on phosphatidylethanol - a promising biomarker for the detection of harmful ethanol consumption - and its possible use for abstinence monitoring

Summary

Background: As harmful drinking is a main problem in contemporary society – especially in road traffic safety – alcohol biomarkers detectable in body fluids can give information about risky drinking habits and alcohol abuse. Therefore, biomarkers are for example used for the medical evaluation of the driving aptitude after drunken driving and withdrawal of the driving license.
A new biomarker in this field is the phospholipid phosphatidylethanol (PEth). It is already detectable after single consumption of about 50 g ethanol – which we could show recently in a preliminary pilot study. An LC-MS/MS method has been developed, which allows the detection and quantification of several PEth homologues at concentrations down to 10 ng/mL, and which has the potential for being used in clinical laboratories on a large scale. Correlations found for PEth and for other biomarkers are promising. As PEth has an elimination half time of four to ten days in blood, it is possible to detect regular risky drinking behavior, as well as alcohol abuse, also when - due to fast elimination - low or no blood alcohol concentrations are found. Furthermore, dried blood spots can be used for analysis of PEth, but need to be evaluated for capillary blood by method comparison.

Aims: Due to the new legal cut-off by "via sicura" in Switzerland (which will be introduced in July 2014) – of 1.6 g/kg ethanol in blood (before 2.5 g/kg), the evaluation of this "state marker" is very urgently needed, to make fast decisions, if somebody has a regular, problematic drinking behavior and needs further traffic medical-evaluation. After a profound scientific evaluation, this biomarker shall be used in traffic medicine to uncover high-risk drinking besides other markers (such as ethyl glucuronide in hair, which is prone to manipulation by chemical hair treatment). DBS sampling shall be evaluated parallel to venous blood analysis.

Hypothesis: Uncovering alcohol abuse and risky consumption habits by use of PEth at an early stage will assist in the prevention of drunken driving, which will elevate road traffic safety, and may also reduce consequential costs of undiscovered alcohol addiction. PEth in blood can be used for determination of consumption habits (seldom to regular, high-risk consumption and regular abuse), and is more specific and sensitive for abstinence monitoring than EtG in hair.

Methods: A controlled drinking study, which will lead to 1 g/kg ethanol in blood, will be performed with 24 volunteers, organized by the Institute of Forensic Medicine Bern; as part of this study the method development for the detection of biomarkers in dried blood spots (DBS) will be further investigated. In addition, blank blood samples from abstinent volunteers (approx. 50) and from "social alcohol consumers" (approx. 150) will be collected to determine the specificity of PEth for monitoring abstinence and consumption habits. In this context, also a pilot drinking study with low amounts of alcohol (2 to 4 g ethanol per day) – which may represent hidden alcohol in nutrients (equivalent to alcohol free beer, over-ripe vegetable etc.) will be performed.

Expected value: Information about the detection window and the pharmacokinetics of PEth will be obtained. Reference values will be obtained for abstainers and also for consumers with socially-accepted consumption habits. After evaluation of the DBS sampling method, this will be a less invasive and faster method for blood sampling, thus making it possible for non-medical staff to collect samples.
In combination with previous studies with patients from alcohol withdrawal programs, thresholds of PEth concentrations can be defined for differentiation of alcohol consumption habits, which can be relevant for different fields (e.g., withdrawal and maintenance therapy or for use in traffic medicine).