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Dead sober or dead drunk?

May be hard to determine

Assessing the validity of an alcohol concentration in a postmortem blood sample can be complex. Appreciating the difficulties, some experts challenged the result of 38 mmol/l (175 mg/100 ml) found in Mr Henri Paul, the driver of Princess Diana's car in her fatal car crash. In the current review of the Hillsborough football stadium disaster, by Lord Justice Stuart Smith, the meaning of alcohol concentrations in those deaths is also likely to be disputed. Although the technical aspects of measuring ethanol in body fluids are much the same in the living and the dead,(1) the interpretation of results obtained from necropsy samples is confounded by several problems.

The two most important are microbial alcohol production and alcohol diffusion from gastric residue or airways contaminated by vomitus. Distinguishing between alcohol ingestion in life and microbial production after death is a common problem.(2) Within a few hours of death gut bacteria penetrate the portal venous system and, after about six hours, contaminate the systemic vessels.(3) In the blood, glucose and lactate provide the substrates for microbial ethanol production by a pathway opposite to that of its catabolism in the living body.(4) High environmental temperatures after death, terminal hyperglycaemia, terminal septicaemia, abdominal trauma, and severe trauma with wound contamination all provide particularly fertile conditions for ethanol synthesis.

At room temperature blood ethanol values of around 33 mmol/l (150 mg/100 ml) can be reached in a few days, although more typically values are below 15 mmol/l (70 mg/100 ml).(5) Disruption of the body of a severity commonly seen in aircraft accidents carries a high risk of postmortem alcohol production.(6) The train driver in the Moorgate tube disaster, in London, had alcohol concentrations ranging from 4.4 to 17.4 mmol/l (20 to 80 mg/100 ml) in four blood samples, reflecting the erratic nature of this postmortem artefact. Collecting the blood sample into a tube containing fluoride will inhibit further alcohol production by micro-organisms but will not undo the damage already done.

Given the seriousness of the problem and the potential legal importance of the analytical result, it is important that ethanol measurements in postmortem blood are corroborated by analyses of other body fluids. Vitreous humour from the eye(7) and bladder urine(8) are helpful here. Vitreous, which is easily obtained, is valuable because it is well protected from bacterial infiltration after death.(9) Similarly, urine is useful because it normally contains little or no substrate for bacterial conversion to ethanol. Consequently, the presence of ethanol in vitreous and urine is a good indicator of alcohol consumption and its absence an indicator of artefact in the matching blood sample.(10) After the USS Iowa explosion a blood ethanol concentration of 41.3 mmol/l (190 mg/100 ml) in one victim was discounted as postmortem artefact in the light of a negative urine result.(11) A vitreous analysis was made on Mr Henri Paul and corroborated his blood alcohol result, but in the Hillsborough deaths no analyses of vitreous or urine were made, leaving the blood results open to contention.

Postmortem diffusion of alcohol from stomach contents, or from airways contaminated with gastric material,(12) is another confounding factor. Individuals dying soon after drinking may have significant amounts of unabsorbed alcohol in the stomach at the moment of death. Passive diffusion of alcohol from the stomach and small bowel, which is the mechanism of absorption in life, continues after death, artefactually raising blood ethanol concentrations in the heart and great vessels.(13) Consequently, alcohol concentrations in blood from the heart and torso vessels may be significantly higher than in blood from peripheral vessels. These differences between sampling sites can exceed 400%.(13,14) For this reason, necropsy blood samples should be obtained from a peripheral vessel, such as femoral vein, never from the heart or great vessels and particularly not from blood allowed to pool in the pericardial sac, chest cavity, or abdominal cavity.(15)

Blood analysis for alcohol is the commonest request in forensic toxicology and is positive in around one third of all unnatural deaths.(16) Good practice requires that the blood samples are taken from a peripheral vessel and that corroborating analyses are performed on vitreous as well as bladder urine, if it is available. Even then, interpreting the analytical results may be difficult and sometimes inconclusive.(11)(16) Distinguishing the dead sober from the dead drunk is not as simple as it may seem.

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