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LETTER TO THE EDITOR

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Comments on the paper entitled "Concentration dependency of the BAC/BrAC (blood alcohol concentration/breath alcohol concentration) conversion factor during the linear elimination phase" by H.-T. Haffner et al.

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Dear Sir,

We commend the authors of this study for their extensive and detailed work in this area (Haffner et al. 2003). The authors have demonstrated that 1) Q is inversely proportional to the BrAC, 2) as BrAC increases, the closer Q approaches asymptotically the value of $1/\kappa$, and 3) because in the majority of cases (11/12) the Q/BrAC relation was fit best by a hyperbolic function, it was suggested that the determination of BAC from low BrACs would be affected disproportionately if a dose-specific value of Q was not utilized. The authors advise that the latter point may have potential forensic implications, i.e., the lower the BrAC, the greater the underestimation of the BAC.

While the experimental design in this study excels in terms of internal validity, e.g., i.v. alcohol administration, it is at the expense of external validity, i.e., generalizability to forensic scientists in other countries. Although the conversion factor Q is applied specifically to the BAC during the linear elimination phase, blood was not actually analyzed. Rather, serum was analyzed, then converted to a BAC equivalent based on a serum/blood conversion factor of 1.2, which as stated by the authors, is required for the forensic determination of BAC in Germany. Because the serum/blood alcohol conversion factor can vary between 1.04 and 1.26 (Winek and Carafagna 1987; Shajani et al. 1989; Jones et al. 1990; Charlebois et al. 1996), the use of a unitary factor exists as a confounding factor in the determination of Q.

Regarding the potential implication of the nature of Q, as derived in this study, it is our opinion that the forensic impact would be minimal. The elimination of alcohol from blood over a wide concentration range demonstrates zero order kinetics; however, at very low concentrations (≤10 mg/100 ml), elimination proceeds exponentially, i.e., with first order kinetics (Welling et al. 1977). The difference between the reported average values of $Q_{0.25}$ and $Q_{0.55}$ is approximately 6.5%. Because 1) Q can be applied only to the linear portion of the elimination phase, and 2) the deviation of Q from $1/\kappa$ is hyperbolic at low BrACs, the BrACs that would be influenced to the greatest extent would range approximately from 10 to 50 mg/100 ml. Therefore, BrAC in the range of 10–50 mg/100 ml will underestimate the actual BAC by approximately 6–10%.

Another limitation on the international application of Q is the units, which were pro mille, or wt/wt. In other countries, e.g., Canada, United States, and the United Kingdom, BAC is expressed in units of wt/v, typically milligrams or grams of alcohol in 100 ml of blood. For Q to be applied in these other countries, the units of pro mille must be converted into wt/v by multiplying by the relative density of whole blood, which ranges from 1.0523 to 1.0604 (Geigy Scientific Tables 1984).

The authors attempted also to control for differences in breath temperature by adjusting the BrAC to the equivalent concentration expected at 34°C. Measurement of breath temperature and conversion to a standard temperature of 34°C currently is not used extensively in other countries (Jones and Andersson 1996). Therefore, the addition of the uncorrected BrACs would have been more useful for international application.

In conclusion, Q, as derived in this study, is not a BAC/BrAC conversion factor but a BAC (wt/wt, converted from a serum alcohol concentration)/BrAC (adjusted to 34°C) conversion factor. Therefore, is the utility of Q limited to only Germany?

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