E23 Limitations of the Assay: Gastroesophageal Reflux in BrAC Measurements

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After attending this presentation, attendees will come to understand how gastroesophageal reflux (GER) and an incompetent lower esophageal sphincter (LES) during a forced expiratory volume (FEV) maneuver limits the accuracy, reliability, and validity of a breath alcohol test result. Every analytical assay has limitations. Breath alcohol testing for breath alcohol concentration (BrAC) is no different.

This presentation will impact the forensic science community by increasing understanding of how the effects of GER disease (GERD) on a BrAC test is of paramount importance, in order to ensure that only those who are truly guilty are found guilty. This year's theme is "Relevant, Reliable, and Valid Forensic Science." As such, the validity of the BrAC quantification in an ethanol-based per se driving violation is crucial.

Key anatomical and physiological features of GERD will be presented and show how a forced exhalation can exacerbate gastric reflux through the lower esophageal sphincter and spuriously increase the BrAC test result. Since GER affects at least 10% of the U.S. population and up to 75% of affected individuals demonstrate few symptoms, many BrAC test results can be covertly inflated. Despite pharmacological treatment, the retrograde flow of gastric alcohol vapors into the esophagus occurs due to diffusion gradients and mechanical factors. The orifice between the esophagus and the stomach is normally regulated by involuntary smooth muscle (the LES) which controls the reflux of gastric contents/vapors. With chronic GERD the LES is weakened, allowing either constant or intermittent passage or ethanol vapors into the esophagus. These vapors combine with alcohol vapors that are exhaled from the lungs and airways as they merge together in the hypopharynx (throat). Gastric alcohol vapors are typically much more concentrated than those exhaled from the lungs and airways, which significantly inflate the cumulative exhaled ethanol concentration from both sources. The net effect depends on the type, amount, and concentration of ethanol consumed, as well as the presence/type of food in the stomach. The partition coefficient between gastric alcohol and its vapor is considerably lower than that for pulmonary capillary blood and alveolar air. Equations that employ these partition coefficients demonstrate that even a teaspoon (~5 ml) of gastric alcohol vapors from 5% (w/v) beer can raise a BrAC result from 0.07% to 0.09%. The inflated result would expectedly be even greater with hard spirits (40% w/v).

Combined alcohol vapors from the stomach and lungs are not adequately detected by the slope detector algorithms of evidentiary breath alcohol testing (EBT) instruments, because they are mixed together before they are exhaled. Unlike a belch, which may trigger an error message on EBT instruments, the insidious chronic release of gastric alcohol in GERD elevates the expiratory ethanol slope to a higher plateau than expected from lung-derived alcohol alone. Making matters worse, a deep inhaled breath, followed by a forced exhalation is required to provide an adequate breath alcohol sample to the EBT instrument. This maneuver alone causes the LES to become even less patent, because it increases intra-abdominal pressure which pushes against the stomach and LES. By its very design, the procedure for BrAC testing predisposes the GERD patient to even greater reflux, which goes undetected by the EBT device. Wider recognition of this problem will hopefully reduce the false charges of driving under the influence of alcohol, by educating the public that a *blood* alcohol test would be the forensically acceptable choice for persons affected by GER or GERD.

Breath Alcohol Content, GER/GERD, LES

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