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An LC–MS-MS Method for the Analysis of Carfentanil, 3-Methylfentanyl, 2-Furanyl Fentanyl, Acetyl Fentanyl, Fentanyl and Norfentanyl in Postmortem and Impaired-Driving Cases

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Abstract

In July of 2016, carfentanil (CF) emerged in Northeast Ohio resulting in over 25 deaths within a 30-day period. A total of 125 deaths have occurred in Summit County and Cuyahoga County has reported 40 deaths, relating to the presence of CF either alone, or in combinations with heroin and fentanyl. Prior to this surge in CF cases, positive fentanyl enzyme-linked immunosorbent assay (ELISA) screening results were increasing in number. Many were negative for fentanyl confirmation by gas chromatography-mass spectrometry. Fentanyl analogs such as CF, acetyl fentanyl (AF), 2-furanyl fentanyl (2-Fu-F) and 3-methylfentanyl (3-MF) may be present in these cases. Some fentanyl analogs like CF and 3-MF do not cross-react with the Immunalysis ELISA fentanyl assay. With the emergence of potent synthetic fentanyl analogs, questions arose as to how to interpret their very low concentrations or absence in the blood in relation to cause of death. Driving under the influence of drugs (DUID) blood specimens had also tested positive for CF by reference laboratories. A liquid chromatography–tandem mass spectrometry method was developed to identify and quantify fentanyl, norfentanyl (NF) and four analogs: AF, 2-Fu-F, 3-MF and CF. The method has been utilized to quantify these fentanyl analogs in blood and vitreous humor in authentic antemortem and postmortem cases. Calibration curves were established between 0.10–4.0 ng/mL (NF, AF, 3-MF, 2-Fu-F and CF) and 1.0–40 ng/mL for fentanyl. In total, 98 postmortem cases analyzed produced the following blood concentration ranges: CF (0.11–0.88 ng/mL), 3-MF (0.15–1.7 ng/mL), 2-Fu-F (0.15–0.30 ng/mL), AF (0.14–0.16 ng/mL), fentanyl (1.1–15 ng/mL) and NF (0.10–3.7 ng/mL). Only CF, fentanyl and NF were detected in a statistically significant subset DUID population of 26 cases producing concentration ranges between 0.11 and 0.47 ng/mL, 1.0 and 9.8 ng/mL, and 0.11 and 3.5 ng/mL, respectively.

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