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A Review on Forensic-Toxicology

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Description

This article reviews current applications of various hyphenated low- and high-resolution mass spectrometry techniques in the field of therapeutic drug monitoring and clinical/forensic toxicology in both research and practice. They cover gas chromatography, liquid chromatography, matrix-assisted laser desorption ionization, or paper spray ionization coupled to quadrupole, ion trap, time-of-flight, or Orbitrap mass analyzers [1].

The Z-drugs zolpidem, zopiclone, and zaleplon were hailed as the innovative hypnotics of the new millennium, an improvement to traditional benzodiazepines in the management of insomnia. Increasing reports of adverse events including bizarre behavior and falls in the elderly have prompted calls for caution and regulation. Z-drugs have significant hypnotic effects by reducing sleep latency and improving sleep quality, though duration of sleep may not be significantly increased. Z-drugs exert their effects through increased γ-aminobutyric acid (GABA) transmission at the same GABA-type A receptor as benzodiazepines. Their pharmacokinetics approach those of the ideal hypnotic with rapid onset within 30 min and short half-life (1–7 h). Zopiclone with the longest duration of action has the greatest residual effect, similar to short-acting benzodiazepines. Neuropsychiatric adverse events have been reported with zolpidem including hallucinations, amnesia, and parasomnia. Poisoning with Z-drugs involves predominantly sedation and coma with supportive management being adequate in the majority. Flumazenil has been reported to reverse sedation from all three Z-drugs. Deaths from Z-drugs are rare and more likely to occur with polydrug overdose. Z-drugs can be detected in blood, urine, oral fluid, and postmortem specimens, predominantly with liquid chromatography–mass spectrometry techniques. Zolpidem and zaleplon exhibit significant postmortem redistribution. Zaleplon with its ultra-short half-life has been detected in few clinical or forensic cases possibly due to assay unavailability, low frequency of use, and short window of detection. Though Z-drugs have improved pharmacokinetic profiles, their adverse effects, neuropsychiatric sequelae, and incidence of poisoning and death may prove to be similar to older hypnotics [2].

Forensic toxicology concerns the application of toxicology to situations that may have medicolegal review, and as a consequence, results must stand up to scrutiny in a court of law. There are primarily three subdisciplines of forensic toxicology. Postmortem toxicology, more recently referred to as death investigation toxicology. Behavioral or human performance toxicology, which concerns Impaired driving as a result of alcohol and/or drugs consumption. Drug-facilitated sexual assault cases. Doping control. Screening of athletes for performance-enhancing substances is monitored by the World Anti-Doping Agency. In this category must be included equine and canine toxicology testing, because entire laboratories are dedicated to this specific purpose. Forensic workplace drug testing or drug urinalysis, which is performed as a preemployment and/or random monitoring of employees for illicit drugs or court-ordered testing of convicted drug offenders. Forensic Toxicology is composed of Postmortem Toxicology, Human Performance Toxicology and Drug Urinalysis [3].

Forensic toxicology and forensic medicine are unique among all other medical fields because of their essential legal impact, especially in civil and criminal cases. New high-throughput technologies, borrowed from chemistry and physics, have proven that metabolomics, the youngest of the “omics sciences”, could be one of the most powerful tools for monitoring changes in forensic disciplines. Metabolomics is a particular method that allows for the measurement of metabolic changes in a multicellular system using two different approaches: targeted and untargeted. Targeted studies are focused on a known number of defined metabolites. Untargeted metabolomics aims to capture all metabolites present in a sample. Different statistical approaches (e.g., uni- or multivariate statistics, machine learning) can be applied to extract useful and important information in both cases. This review aims to describe the role of metabolomics in forensic toxicology and in forensic medicine [4]. This paper reviews procedures for the detection or quantification of drugs, pesticides, pollutants, and/or their metabolites relevant to clinical and forensic toxicology, doping control, or biomonitoring using gas chromatography–mass spectrometry with negative ion chemical ionization (GC-MS-NICI). Papers written in English between 1995 and 2000 are reviewed. Procedures are included for the analysis of the following halogen-containing or derivatizable compounds in common biosamples, such as whole blood, plasma, or urine, and in alternative matrices such as sweat, hair, bone, or muscle samples of humans or rats: benzodiazepines, cannabinoids, opioids, acetylsalicylic acid, angiotensin-converting enzyme inhibitors, ketoprofen, methylphenidate enantiomers, tegafur, zacopride, anabolic steroids, chlorophenols, chlorpyrifos, hexachlorocyclohexanes, organochlorines, and polychlorinated biphenyls. The principal information on each procedure is summarized in three tables to facilitate the selection of a method suitable for a specific analytic problem [4].

Forensic toxicology is a field of science dedicated to a wide range of chemical, analytical, pharmacological, toxicological and physiological matters with relevance to administrative and judicial procedures. The progress of analytical methodology and an ever better understanding of the effects of drugs and poisons on humans have opened many new possibilities for research and application in this area. Since the publication of the first edition in 1999, Principles of Forensic Toxicology has been an established source of information for students and practitioners alike. The 5th edition reviewed here has been updated and expanded by addition of seven new chapters to accommodate recent developments. It is a multi-author work with contributions from 43 authors including the editors and many other leading experts in the field. Recently, the American Academy of Forensic Sciences (AAFS) announced through their Academy

Standards Board (ASB) the publication of ANSI/ASB Standard 036, Standard Practices for Method Validation in Forensic Toxicology. As noted in the forward, the document serves as an update to a similar document published by the Scientific Working Group on Forensic Toxicology (SWGTOX). One benefit of this new document is that it was developed through an ANSI-approved standard development process [5].

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