Research & Reviews: Journal of Clinical and Medical Case Studies

Introduction to Forensic Toxicology

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Commentary

Received: 07-Jan-2022, Manuscript No. JCMCS-22-52122; **Editor assigned:** 10-Jan-2022, Pre QC No. JCMCS-22-52122 (PQ); **Reviewed:** 24-Jan-2022, QC No. JCMCS-22-52122; **Accepted:** 27-Jan-2022, Manuscript No. JCMCS-22-52122 (A); **Published:** 03-Feb-2022, DOI: 10.4172/J Clin Med Case Stud.7.1.004.

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INTRODUCTION

Toxicology and related sciences such as analytical chemistry, pharmacology, and clinical chemistry are used in forensic toxicology to aid medical and legal investigations into death, poisoning, and drug usage. The main points of interest in forensic toxicology are the acquisition and interpretation of results, not the legal conclusion of the toxicological examination or the technology used. Toxicological testing can be performed on a variety of compounds. Any evidence found at a crime scene that may narrow the search, such as pill bottles, powders, trace residue, and any available chemicals, must be examined by a forensic toxicologist. The forensic toxicologist must determine which toxic compounds are present based on the facts and samples supplied.

Since it is rare for a chemical to remain in its original form once within the body, distinguishing the substance ingested is typically complicated by the body's natural activities. For example, heroin is rapidly metabolised into another substance and then into morphine, necessitating a thorough examination of characteristics such as injection marks and chemical purity to validate a diagnosis. While a pill or other authorised dose of a medicine may have grams or milligrams of the active component, an individual sample under inquiry may only contain micrograms or nanograms.

Drugs and pharmaceuticals are typically detected in biological samples through an initial screening followed by confirmation of the compounds, which may involve a quantification of the substances. Different analytical procedures are used for screening and confirmation, however this is not always the case. To provide correct and undeniable results at all times, any analytical method used in forensic toxicology should be thoroughly validated by undertaking a validation of the method. The technique of testing used is heavily reliant on the type of chemical expected to be discovered and the material on which the testing is conducted. Typically, poisons are classified using a classification scheme that includes destructive agents, gases and volatile agents, metallic poisons, non-volatile organic agents, and miscellaneous.

For the detection of volatile chemicals, Gas Chromatography-Mass Spectrometry (GC-MS) is a commonly used analytical technique. Electron Ionization (EI) and Chemical Ionization (CI) are the most common ionization techniques used in forensic toxicology, with EI being favored in forensic analysis due to its precise mass spectra and extensive library of spectra. Chemical ionization, on the other hand, can increase sensitivity for some molecules with strong electron affinity functional groups.

The polar and less volatile chemicals can be analysed using Liquid Chromatography-Mass Spectrometry (LC-MS). For these analytes, derivatization is not required, as it is in GC-MS, which simplifies sample preparation. LC-MS offers more selectivity and sensitivity than immunoassay screening, which usually requires validation with another approach. As a result, the likelihood of a false negative result in immunoassay drug screening with synthetic cannabinoids is decreased. The high instrumentation cost of LC-MS is a disadvantage when compared to other analytical techniques such as GC-MS. Recent advancements in LC-MS, on the other hand, have resulted in improved resolution and sensitivity, which aids in the interpretation of spectra to identify forensic analytes.

The degradation of the organic substance by chemical or thermal oxidation is commonly used to evaluate substances suspected of containing a metal. This leaves the metal in the inorganic residue to be recognised and quantified, which can be done using procedures like the Reinsch test, emission spectroscopy, or X-ray diffraction. Unfortunately, while this identifies the metals present, it also destroys the original complex, making it more difficult to figure out what was eaten. The toxicity of various metallic compounds varies significantly.