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Intoxications as Interpretation Tools in Forensic Cases

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Editorial Note

According to The International Association of Forensics Toxicologists (TIAFT), toxicological analysis is one of the basic tasks in forensic investigations. The activities related to forensic toxicology include the detection, identification and quantification of substances of forensic interest, and the interpretation of results. The latter is linked to the evidentiary purpose; that is, which are the questions directing the analysis and which is the intended purpose of the evidence.

Estimating the duration for which a person has been exposed to a substance or the time elapsed since a substance was last consumed provides crucial information for the toxicological exam interpretation, especially in cases related to environmental crime, poisonings, and psychopharmacological crimes. Due to the complexity in toxicological interpretation required for forensic purposes, toxicologists are interested in having tools such as mathematical models where drug or metabolite concentrations in a biological sample can be used to distinguish acute from chronic consumption and/or to accurately establish the timeframe of intoxication. Some of the strategies which contribute to such tools are described below.

Methods to Distinguish Acute

Accordingly, the first step towards identifying an acute intoxication is to fully understand the elimination kinetics of the parent drug and/or its metabolites. Understanding how a substance biotransformed and removed from the body can result mathematical relationships i.e. ratios of concentrations of xenobiotic (P) and its metabolites (M) or P/M ratios of concentrations in different biological matrices, which in theory can differentiate between a recent exposure from an earlier one. For example, benzodiazepines, especially diazepam, commonly found in drugged drivers, is metabolized via CYP2C19 to desmethyldiazepam; a high P/M ratio between diazepam and its metabolite indicates an acute intake.

A complex scenario is presented in the prosecution of chronic users; in some cases, the prosecuted might get a different sentence if addiction or dependence is proved. A positive toxicological test might not necessarily be related to acute intoxication, especially when it comes to the abuse of lipophilic drugs where users might test positive even after several weeks of abstinence (i.e. cannabinoids[4]), and in the cases of chronic consumption, the drug's pharmacokinetics might be altered.

The simplest methods for backtracking calculations are derived from basics pharmacokinetics. After administration, the concentration of drug in blood rises to a maximum (Cmax) during the absorption phase and begins to decline during the distribution and elimination processes, usually adjusting to an exponential curve that relates plasma concentration and time.

If the details of the curve are known, it is possible to predict drug concentrations at any point on the curve. However, calculations are often restricted to the elimination phase unless details of dose and time of administration are known. Some information is needed to allow the curve to be defined and difficulties arise if insufficient information is available.

Typically, all that is known is the concentration of the drug of interest measured in a blood specimen at a given time. The shape of the curve in the elimination phase can adopt a variety of forms, depending on the dose of substance taken and its distribution and metabolism. For most drugs, the rate of elimination depends on the concentration of drug present and a constant proportion of the drug is eliminated in a given time interval and the curve is exponential

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