Forensic toxicology

An interdisciplinary science dealing with the adverse effects of drugs and chemicals on various biological systems in a medical−legal context. The forensic toxicologist may work with a medical examiner or coroner in order to determine the role that a particular chemical compound may have played in a death. The forensic toxicologist's activities may also involve assessing emergency room patients, helping to determine suitability of an individual for employment or promotion, screening for performance−altering drugs in athletes, and working with law enforcement agencies, for example, performing tests to determine if a driver operated a motor vehicle under the influence of drugs. The forensic toxicologist is involved not only in the analysis of body fluids and tissue for drugs and poisons but also in the interpretation of the resulting information in a judicial context.

Specimens and samples

Because of the medical−legal context of forensic toxicology, specimens must be maintained under a "chain of custody." Each sample must be accompanied by a paper trail allowing for the tracing of the specimen to its origin. The external portion of the chain of custody should contain information such as the collector, date, time, storage (place and conditions), courier, and time and date of delivery to the laboratory. Once the specimen has been accepted by the toxicology laboratory, an internal chain of custody tracks the persons having access to the samples and the procedures applied to those tissues. Each analysis must then be validated. Validation is an exhaustive accumulation of evidence that a given procedure will produce accurate results.

Sources of samples

Death unattended by a physician or occurring under violent, unusual, or sudden unexplained conditions happens in approximately 20% of the population and requires a thorough medical−legal investigation. The forensic toxicologist provides for the isolation of chemicals from biological samples and the subsequent analysis to determine whether a chemical agent played a role in the cause of death. At autopsy, the forensic pathologist collects postmortem specimens (such as blood, brain, liver, kidney, stomach contents, and bile, and on occasion, lung, bone, hair, fingernails, and fat). Following the extraction of chemicals from tissues, these substances are identified and quantified. The distribution of chemicals in the body provides information about the mode of exposure (for example, ingestion, injection, or inhalation) and the time of exposure relative to death. Of growing importance to the field of forensic toxicology is the analysis of metabolites related to the parent drugs. The forensic toxicologist working in a drug abuse program, emergency room, clinical laboratory, or workplace program is limited to specimens such as blood, urine, and vomitus, which are more easily collected from living patients. Recent publications have explored the use of hair, sweat, and oral fluids as potential forensic specimens.

Analytical techniques

Immunoassays for various drugs and classes of drugs have become commercially available, and equipment has been perfected for automating these procedures. Therefore, immunoassay tests may be used by the forensic toxicologist as the first line of testing. Traditionally, the toxicologist has used a number of isolation techniques such as steam distillation, selective solvent extraction, and microdiffusion, depending on the tissue and the analyte. The use of solid−phase extraction has become commonplace and is applicable to semiautomated procedures. Once the substance has been isolated from the biological specimen, techniques such as chromatography (thin−layer, paper, gas, or liquid), spectrophotometry (colorimetric, ultraviolet, visible, and infrared), and immunoassays can be applied to qualitatively and quantitatively determine the drug. The combination of gas chromatography (and more recently, high−performance liquid chromatography) with mass spectrometry is presently accepted as the "gold standard" of analysis.

Drugs, driving, and traffic safety

One application of forensic toxicology that emerged during the 1990s, concomitant with increased emphasis on traffic safety, is the determination of the role of drugs and alcohol on the ability to operate a motor vehicle. Working with law enforcement agencies, the forensic toxicologist has assumed the vital role of providing scientific confirmation of the conclusions reached by the trained drug recognition expert. Analytical methods have been developed and applied to provide unquestioned identification of drugs and their metabolites as well as dependable quantification. The law

enforcement officer may be able to recognize the signs and symptoms of a particular drug; however, the forensic toxicologist can best relate the drug at a given concentration to human psychomotor performance.

Interpretation

Once the analytical information has been collected, the forensic toxicologist must interpret the finding with reference to a cause of death or another set of medical−legal circumstances, such as workplace testing or accusation of driving under the influence of alcohol or drugs. Toxicological data can be obtained from pharmaceutical manufacturers, published literature, or various registries. The greatest challenge facing the forensic toxicologist is the interpretation of cases involving combinations of drugs and chemicals and their complex interactions. See also: Forensic chemistry; Forensic medicine; Toxicology

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For Further Study

Topic Page: Chemistry: Analytical chemistry

Topic Page: Medicine: Forensic science

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Additional Readings

- Society of Forensic Toxicologists (SOFT)
- American Academy of Forensic Sciences (AAFS)
- *Journal of Analytical Toxicology*
- *Journal of Forensic Sciences*


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