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The realm of forensic toxicology in criminal justice system of India

Dr. K V K Santhy
Associate Professor of Criminal Law, NALSAR University of Law, Hyderabad, Telangana, India

Abstract
The discipline of forensic toxicology may be utilized to determine the cause of an incident by determining the presence of poisons and other harmful compounds. The chemical composition of each item is analyzed, and samples are collected from various sites (such as urine and hair) for positive identification. Substance metabolism, including absorption, distribution, and elimination, is the focus of forensic toxicology. Forensic toxicology examines the sites and mechanisms through which drugs exert their effects in the body. While forensic toxicology has various applications, drug and alcohol tests are perhaps the most common ones people associate it with. Forensic toxicologists are more concerned with the tools and methods used to conduct their investigations than with the legal implications of their findings.

Keywords: forensic toxicology, criminal trials, courts, evidence, expert witness

Introduction

The field of study known as toxicology examines the potentially harmful effects of chemicals and pharmaceuticals on living organisms. It is also the study of substances that are toxic when introduced (by accident or on purpose) to a living organism. The study of toxicology, involves the study of the harmful effects of substances on everything from human bodies to ecosystems. When the potential for adverse effects has administrative or medico legal ramifications, Forensic toxicology applies the scientific methods of toxicology and related fields like analytical chemistry, pharmacology, and clinical chemistry to investigate the situation and produce evidence that can be used in Legal proceedings. Drug analysis in biological materials, as well as the interpretation of such data, is now the domain of a totally contemporary science that relies on established and generally recognized scientific methodologies and processes. Many of the techniques it uses may be traced back to breakthroughs in clinical medicine and academic labs throughout the globe. Legal requirements are met by the use of forensic toxicology's findings on drug presence in tissues. There is some overlap, but forensic pharmacology may be thought of as the study of how drugs work and how long they stay in the bodily system for legal or medical purposes. In 1813, French scientist Mathieu Orfila published the first comprehensive study of forensic toxicology. His work in toxicology earned him the title "Father of Toxicology," and he was a respected member of Spain's scientific and medical communities. The need of strict quality control procedures and the requirement for reliable identifying documentation were major themes in his studies. The document also acknowledged the pharmacological, therapeutic, industrial, and environmental applications of forensic toxicology. Forensic toxicologists are more concerned with the tools and methods used to conduct their investigations than with the legal implications of their findings.

Forensic toxicology specializations

1. Postmortem toxicology

Analyzing and interpreting postmortem analyses of bodily fluids and organs is the focus of forensic toxicology. A coroner or medical examiner is called in to investigate deaths that are suspicious or cannot be explained. Toxicologists in the forensics field collaborate with pathologists and medical examiners to determine whether or not substances like alcohol, narcotics, or poisons had a part in a fatality. It is the job of the toxicologist to detect and measure the concentration of medicines and chemicals in bodily fluids and tissues. In performing this task, cutting-edge chemical and biological equipment is used for the detection, positive identification, and quantification of even trace levels of harmful chemicals. This data is utilized to determine the cause and manner of death; hence it is crucial that it be accurate, valid, and reliable. In ascertaining the correct cause and manner of death, which has substantial ramifications for public health and safety, requires forensically precise toxicology. The governmental and commercial labs undertake toxicological tests related to death investigations, with the latter often offering more comprehensive services and more specialized expertise.

2. Behavioral Toxicology

It is concerned with the behavioral and cognitive effects of drugs and alcohol, as well as the legal and health consequences of substance addiction. Investigations into drunk driving, vehicular assault and homicide, crimes supported by drugs, such as sexual assault, and investigations into collisions involving aircraft, vehicles, and ships may fall under this category. This area of research is also known as the behavior toxicology. In determing when, how much, and how impairing certain drug use patterns are, forensic toxicologists analyze drug and alcohol levels in biological samples, most often blood and urine but increasingly other matrices such as oral fluid, and hair. Toxicologists utilize the same analytical methods employed in many other research and medical facilities to isolate and purify drugs from diverse biological components before determining their precise concentrations. The use of

stimulants to improve performance and the abuse of legal or illegal drugs are two examples. The results and the interpretation of forensic toxicologists are regularly presented in court as expert testimony. Public criminal labs may do these tests, but in certain states, the health department is responsible.

3. Preventing the usage of doping in sports

Most competitive and intramural sports governing bodies have developed restrictions regulating the use of performance-enhancing drugs in order to safeguard the health and welfare of amateur and professional athletes, to uphold an even and fair level of competition, and to prevent bookmaking fraud. The International Olympic Committee (IOC), World Anti-Doping Agency (WADA), and International Federation of Horseracing Authorities (IFHA) collaborate closely to guarantee that these rankings are always correct. When investigating the possible presence of illegal drugs like amphetamines, benzodiazepines, or ecstasy in a human body, forensic toxicologists use the same state-of-the-art analytical methods employed by other experts. Commercial and public recognized labs across the globe conduct these tests, while private labs test high school, collegiate, and other athletes.

4. Prevention of drug usage by employees at workplace

Workers' drug use poses serious threats to both their safety and the company's profitability. As a result, several jurisdictions have established laws making it unlawful for workers in safety-sensitive occupations to consume medications for recreational purposes or without a prescription. Drug testing in the workplace has become more common in recent years. Police officers, railway engineers, pilots, and other employees in delicate situations or in hazardous surroundings were the first to undergo testing; however, it has now expanded to many other professions. However, the testing must be carried out in accordance with various enforcing criteria (established by law through forensic agencies) that call for pre-employment, random, and for-cause drug testing, such as after an accident or a collision involving a moving vehicle. There have been numerous incidents of misconduct that led to persons being dismissed from their jobs despite the fact that they had nothing to do with drug usage, and this is likely due to the fact that accreditation programs seldom address drug testing in the workplace.

Types of samples used in systematic toxicological analysis (STA)

To conduct a reliable and comprehensive toxicological study, sampling is crucial. In most cases, the quality and authenticity of the specimen(s) used in a toxicology analysis will influence the results reliability and accuracy. When the findings of a forensic toxicological investigation are going to be utilized in a court of law, it is crucial that the samples be collected, processed, and stored correctly. Sample selection, availability and suggested specimen types, quantities to collect and transfer to laboratories expected to perform the systematic toxicological analysis, and criteria to provide quality assurance in sample collection are just some of the questions that arise when collecting samples for forensic toxicological analysis. In contrast to commonly used drugs or metabolites, STA is often employed to identify a "generic unknown." Toxicology reports of impairment need the presence of a substance of abuse within a valid specimen. Sampling serves an important role in forensic toxicology by providing a fragment of the total that can be tested and confirmed, interpreted with confidence, and retested if necessary. Therefore, it is important to acknowledge that sampling is context dependent.

1. Urine

It is typical practice in drug testing for employers and athletes to collect a urine sample from a living individual since it is fast and simple to collect. Toxic chemicals are not always reflected in a person's urine unless the person is under the effect of the drug when the sample is taken. Since it has a simple matrix, urine may be used for pre- and post-mortem drug screenings. Sampling volumes are set at 50 ml or the whole volume. To detect drugs and poisons, urine is often regarded as the most effective specimen.

2. Blood

Numerous analytical techniques may be used to blood, giving it an edge over matrices that do not have quite as much diversity. Most common hazardous chemicals may be detected and confirmed with a blood sample of just around 10 ml. For this reason, blood samples are preferred for determining blood alcohol content levels in instances of drunk driving since they provide the toxicologist a complete picture of the substances the person was exposed to just before the sample was taken. It is important to use gas-tight containers, and if at all feasible, tarred, cooled glass containers, while collecting tissue samples from a victim of gaseous or volatile chemical poisoning. If a blood sample can be frozen and analyzed at a later time, the results are more likely to be reliable.

3. Hair

It may be used as a toxicological technique to offer a history of drug exposure in a variety of contexts, including but not limited to: drug-facilitated sexual assault investigations, probation and parolee drug usage monitoring, insurance fraud investigations, and workplace drug testing. Substance misuse, even at large doses, may be detected in hair for a prolonged period of time. The transfer of blood-borne chemicals to the hair follicle, where they may be stored until they are needed, may provide an approximate chronology of drug use. However, widespread use of hair drug testing is still in its infancy. As an example, if two persons both tested positive for drug use, but one had darker, rougher hair, the other would have tested negative. This raises questions about potential racial bias in drug testing conducted using hair samples. Cutting hair from the top of the head (the vertex) as close to the scalp as possible, identifying the end of the hair that is closest to the scalp, and then tying the hair into a bundle yields around 100-200 mg of hair (with a rubber band, a twist knot, or thread. Hair is one of the most useful specimens for STA when there has been a significant delay between a probable drug or poison exposure and reporting it to authorities.

4. Oral Fluid

Forensic toxicologists are increasingly looking at oral fluid as a means of demonstrating recent drug use, whether in clinical settings or while investigating suspected of driving under Influence. Fluid from the mouth cavity is often taken because it is non-invasive, easy to collect, and does not

intrude on a person's privacy throughout the drug determination process. It contains several substances in amounts similar to those found in blood. Passive diffusion is thought to transport most drugs into the oral fluid, also known as the ultra-filtrate of blood. The concentration of protein-bound medications and medicines is lower in oral fluid because of the body's inherent protein-binding processes.

5. Vitreous humor

It is a specimen obtained following a death. Postmortem toxicology is aided by autopsy materials because they provide a more refined analytical approach when particular drugs or poisons are suspected of having played a role in the death. Location in an anatomically isolated and protected portion of the body (behind the lens of the eye) and exceptional stability as a biological fluid make vitreous humor less prone to develop putrefactive modifications after death. All of the vitreous fluid in each patient's eye should be removed individually. Glucose, urea nitrogen, uric acid, creatinine, salt, and chloride may all be measured in vitreous humor after death. In order to evaluate diabetes, fluid status, electrolyte imbalance, postmortem delay, and state of renal function prior to death, these tests must be carried out.

6. Gastric Contents

Postmortem and clinical examinations may benefit from the collection of gastric content as a specimen. The vast majority of people who are exposed to medicines or toxins do so via ingestion. Due to this checking the stomach is a must for diagnostic purposes. The collection of materials without using any kind of preservative is necessary in this regard. Those pills and tablets that did not make it through your digestive system should be sorted and stored in plastic pillboxes. After the abdominal cavity has been opened, the stomach may be removed, and its contents emptied into a container and recorded. Tablet fragments, herbal debris, and the like should be separated, dried (maybe on cellulose tissue), and placed in a secure location. Taking a sample of gastric contents requires homogenization since they are not uniform.

7. Tissues

The toxicologist may usually get more contexts for their findings from the tissue samples taken during postmortem examinations. Correct examination of a tissue samples may be crucial in STA for identifying or validating a previously unidentified causal agent. It is important to act swiftly when taking tissue samples and store them in sealed containers. The most often obtained postmortem organs are the liver, kidney, brain, lung, and spleen.

Relevancy of forensic toxicology in law

Toxicology as a currently a branch of forensic science is dedicated to the study of drugs, both illegal and legal ones like alcohol. The discipline of forensic toxicology may be utilized to determine the cause of an incident by determining the presence of poisons and other harmful compounds. The chemical composition of each item is analyzed, and samples are collected from various sites (such as urine and hair) for positive identification. Substance metabolism, including absorption, distribution, and elimination, is the focus of forensic toxicology. Forensic toxicology examines the sites and mechanisms through which drugs exert their effects in the body. While forensic toxicology has various applications, drug and alcohol tests are perhaps the most common one’s people associate it with. This kind of inspection is routine in the transportation sector and in many businesses. Intentional or unintentional drug overdoses are another use. Toxicology testing is also a way to track down drivers whose blood alcohol content is over the legal limit. Sexual assaults using drugs are yet another area where forensic toxicology has proven useful. In modern times, several different medicines are used to incapacitate the victim before a sexual assault is committed. Toxicology testing can identify the substance that was administered, allowing the victim to get the most appropriate care.

Substances and toxins abound in our modern environment, and many of them have negative effects on our ability to participate in work and daily life. In postmortem examinations, forensic toxicology is used to determine whether or not the death was caused by an overdose of a substance. Forensic scientists can identify chemicals and establish a pattern of usage with the use of forensic toxicology tests. Poisoning is a prevalent cause of death, and it is often used as a method of suicide, murder, and accident. The abuse of agents like pesticides, insecticides, medicines, and chemicals is more likely now that they are readily available. Commonly used toxins include aconite, strychnine, calotropis, oleander, copper, mercury and arsenic. The samples of body fluids and tissues are analyzed at the forensic toxicology lab to help with this identification process. Expert toxicologists conduct studies, compile reports, and testify in court regarding the significance of the findings.

Regulatory framework in India relating to forensic toxicology

Legislators could not have foreseen the far-reaching impact that modern science and technology would have on forensic science and the administration of justice when they enacted the Indian Evidence Act of 1872 (IEA) and the Code of Criminal Procedure of 1973 (Cr PC). The IEA, however, allows evidence of the opinions of people (referred to as "experts" under the Act itself) specially versed upon a point of foreign law, science, art, or as to identity of handwriting or finger impressions, the opinions upon such issue. As a result, the reports of the expert in connection to the results of forensic toxicology later became acceptable. When deciding how much weight to give expert testimony, it is important to take into account factors including the competence of the expert and the accuracy of the underlying study. The courts would benefit from a joint statement describing the areas of agreement and disagreement between the experts, given that expert witnesses may attest to facts within their area of competence. Expert testimony may only be used as supplementary evidence if the science is already questionable. Therefore, these evidences must always be taken into account along with physical and circumstantial evidence.

According to Article 53 of the Cr PC, which deals with, Examination of the accused by Medical Practitioner at the request of the Police, blood samples may be obtained if the police have a warrant. If an officer has probable cause to believe that a medical examination of an accused person may provide evidence about the conduct of a crime, the officer may request that the accused person be examined by a medical professional. Therefore, a licensed physician shall conduct such an examination of the person arrested as is

reasonably necessary to ascertain the facts which may afford such evidence, and any other person acting in good faith in his aid and direction shall use such force as is reasonably necessary, all at the request of a police officer not below the rank of sub-inspector. According to Section 53A of the Cr PC anybody who may be a suspect in a rape case must undergo a medical examination. The updated Explanation now includes the modern practice of analyzing physiological fluids such as blood, blood stains, semen, sputum, swabs, sweat, hair samples, and fingernail clippings using DNA profiling and forensic chemistry. The Courts have more jurisdictions to safeguard fairness in criminal proceedings than Section 53, which only handles medical exams of the accused at the request of a public official.

Conclusion

Forensic science is a broad field that draws on many other scientific disciplines to provide evidence that may be used in court. This may be related to a judicial proceeding or police inquiry. Drug use has become such a major and societal problem that it is generally agreed that chemical testing of biological samples from individuals is the most objective technique to determine drug use. Drug testing backed by forensic science is becoming more common within the criminal justice system. Toxicological analysis is therefore a method of determining the severity of a drug's or a combination of drugs' effects on a human being. Toxicological results are used to assess the cause and circumstances of a person's death, the most severe kind of impairment. Every year, a disturbing number of people's remains are found in locations that make no sense, such as their own beds, the beds of strangers, squats, and the open ground. The presence of items like empty pill bottles, alcohol bottles, or drug-taking equipment at the scene of a death may indicate that drugs or alcohol had a role in the victim's death. The Forensics Labs receives several cases from coroners and police agencies seeking toxicological analysis. Suspicious deaths in healthcare facilities may be more difficult to investigate because of the difficulty in interpreting high amounts of a prescription drug in a person who has developed a resistance to its effects.

Toxicological data is commonly used to assess or explain impairment in performance, which may help identify whether or not a motorist has been driving under the influence of ethanol (alcohol) and/or drugs. In addition, drug and alcohol tests may be utilized to determine if the suspect's or victim's actions, behavior, or attitude could have been different if they had been impaired. Protection of people and animals against toxic compounds, as well as the improvement of insecticides, chemotherapeutic treatments, and other pharmaceuticals, are just a few of the numerous real-world uses of toxicology.

Since the turn of the century, the field of forensic toxicology has seen a period of rapid technical and intellectual development. Although it still has some ways to go before it can fully replace other methods of investigation, forensic toxicology is widely relied upon because of the important part it has played in bringing about justice and solving criminal cases. Despite these restrictions, the court and the public at large rely on the forensic examination's and reports' conclusions. Due to the fact that crime manifests itself in various ways as society develops and gets more complex, forensic toxicology research are expanding. In light of this, it is necessary to conduct a study using contemporary scientific methods. The discipline of forensic toxicology meets this societal demand.

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