CHAPTER 13
Forensic Toxicology

Confidential Correspondence

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II. Chemical Evidence

Chapter 13: Forensic Toxicology

13.1. Introduction to Forensic Toxicology
   Introduction

13.2. Toxicology Basics and Pharmaceuticals
   Introduction
   Pharmacodynamics
   Pharmacokinetics
   Medicinal Toxicology
   Drugs, Poisons and the Human Body

13.3. Poisons and Toxins
   Introduction
   Method of Action
     Corrosive Poisons
     Metabolic Poisons

13.4. Drugs of Abuse
   Introduction
   Narcotics
   Hallucinogens
   Depressants
   Stimulants
   Steroids
   Drug Laws

13.5. Alcohol
   Introduction
   Alcohol Properties
   Alcohol Production
   Alcohol Toxicology
   Blood Alcohol Concentration (BAC)
   Legal Considerations

13.6. Practice of Forensic Toxicology
   Introduction
   Toxicology and Forensic Medicine
   Sample Collection

References and Bibliography
Glossary of Terms
Questions for Further Practice and Mastery
Chapter 13.1: Introduction to Forensic Toxicology

“What is there that is not a poison? All things are poison and nothing without poison. Solely the dose determines that a thing is not a poison.”

Paracelsus (a.k.a. Philippus Theophrastus Aureolus Bombastus von Hohenheim, 1493-1541)

Learning Goals and Objectives

Forensic Toxicology deals with both how drugs and poisons both act upon our bodies and how our bodies respond and act upon the foreign chemical. In this chapter, you will need to understand the following concepts:

- Pharmacodynamics and how a drug/poison works on a person;
- Pharmacokinetics and how a drug/poison is worked on by a person;
- What are drugs, medicines, poison, and toxins;
- What is mean by toxicity and how is it measured;
- What is a typical pathway of a drug through the body and what is ADME;
- How drugs and poisons can be metabolized;
- How new drugs are discovered and what is meant by “off-label” uses;
- What is meant by a corrosive and a metabolic poison and how they work;
- What is the scope and nature of the worldwide drug problem;
- What are narcotics, hallucinogens, stimulants, depressants, and steroids;
- What are the pharmacodynamics and pharmacokinetics of these drugs;
- What are club drugs and what is meant by Drug-Facilitated Sexual Assault (DFSA);
- What is the Controlled Substance Act and how are drugs placed into Schedules;
- What are the chemical properties of ethanol (alcohol);
- How are alcoholic beverages produced, consumed and abused;
- What are the toxicological properties of alcohol (ethanol);
- What is BAC and how is it measured;
- What is meant by presumptive and confirmatory drug testing;
- What is meant by the half-life and drug clearance time of a drug or poison;
- What is the role of a forensic toxicologist.

Introduction

Drugs are everywhere around us and in us in today’s society. They have a more profound effect on our everyday lives than ever before in history. Drugs help to keep us healthy, diagnose and manage diseases, reduce pain, cure infections, stem the spread of infectious illnesses, combat epidemics, and repair body tissues. They also change our moods, helps us to sleep better, make it easier to lose weight, and reduce our stress and anxiety levels. We expect and rely upon drugs to solve our everyday physical and psychological needs, both large and small. Even the food we eat is treated with drugs and...
other chemicals to make it more abundant, safe, and inexpensive. Through all this, we require our drugs to be safe, effective, fast-acting, and readily available. Humans today form a worldwide society that has developed and flourished largely because of the amazing advances in pharmaceutical medicines, agricultural chemicals, food additives, and bulk chemicals.

Pharmaceuticals – chemicals developed primarily to fill medical needs - can come from either natural sources, known by local healers for generations, or may derive from man-made processes at the end of a long and expensive discovery, testing, and manufacturing enterprise, monitored by stringent quality control measures. We look to science and technology to find new and better cures and remedies for both long-known and newly emerging needs and we hold our governments responsible for keeping us safe in the process. Bringing a new drug, herbicide, pesticide, or food additive to market, therefore, requires a complex partnership between science, technology, policy, ethics, business, and the law.

Today, the global pharmaceutical industry is estimated to be rapidly approaching the $1 trillion sales mark annually and is expected to continue to grow between four and seven percent per year into the foreseeable future. Thousands and thousands of medications are now available for all sorts of preventative, diagnostic, and therapeutic uses. Tens of millions of new compounds are screened every year in the never-ending quest for better and more effective medications to prevent, combat or treat diseases to help us live more healthier, happier and longer lives.

Our lives are also intimately intertwined with a vast array of chemicals designed to make our personal environment safer, kill unwanted pests, treat infestations, and protect our foods. Poisons and toxins fill a significant societal and personal need and have helped deal with many problems that have plagued humankind since the beginning of time. But they also, like pharmaceuticals, come with considerable risks and difficult problems.

Because of the ready availability of drugs and related chemicals, it should not be surprising that many of these compounds find their way into “off-label” uses – the use and abuse of drugs and poisons designed to fill a narrow medical or environmental need for a totally different, and often harm-causing, purpose. Chemicals intended to reduce the threat to our crops from pests can be used to intentionally injure someone else. Drugs designed for a well-focused biomedical health-care need are used for recreation, crime, or personal gain. Abused compounds range from anxiety-reducing drugs, such as diazepam (valium) and fluoxetine (Prozac), to psychoactive drugs, such as LSD and marijuana, to

An array of illicit drugs and chemicals surround our lives (http://technorati.com/lifestyle/article/new-study-drug-combos-can-be/).
club drugs to aid a personal assault, such as rohypnol and MDMA (Ecstasy), and the ubiquitous mood-changing abuse of alcohol, with tens of thousands of examples in between. Our worldwide legal systems - police, courts and prisons - are clogged with cases either directly or indirectly involving drugs and chemicals of abuse. One recent estimate suggested that between 80% and 90% of all criminal cases involved some type of drug or alcohol usage that either caused or aggravated the criminal activity.

Because of the pervasive influence of inappropriately used and consumed drugs, poisons, and other chemicals, the field of toxicology plays a central role in every forensic laboratory. Toxicology is the study of the harmful effects of chemicals on living organisms, including both how the chemical affects a person and how the body responds and acts upon the chemical. Forensic toxicology, specifically deals with the study of substances that are used in a manner in conflict with the law.

In this chapter, we will explore the field of forensic toxicology. We must begin, of course, by looking at how drugs and poisons are developed and how they are designed to work in the body. Then, we will examine how these substances are used in a criminal fashion for decidedly “off-label” uses. Next, because of its immense consumption, we will examine the toxicology of one specific substance: alcohol. Finally, we will explore how forensic toxicology is practiced in real life.