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Role of Forensic Toxicology

- Toxicology is the study of drugs and poisons, and their interactions with or effects on the body
- A drug is a natural or synthetic substance that is used to produce physiological or psychological effects
- Forensic Toxicology is the application of toxicology to the law, including
 - Workplace or Forensic Drug Testing
 - Postmortem Toxicology
 - Human Performance Testing



Toxicology of Alcohol

- Approximately 40% of traffic deaths in the U.S. are alcohol-related (Flinn, 2012)
- Toxicologists have had to develop specific procedures for measuring the degree of alcohol intoxication
- Methods for diagnosis must be defensible within the framework of the legal system

Toxicology of Alcohol (continued)

- Metabolism involves the body's ability to break down chemicals. There are three steps:
 - Absorption
 - Alcohol appears in the blood minutes after consumption
 - Alcohol slowly enters the body's bloodstream and is carried to all parts of the body

Toxicology of Alcohol (continued)

- Metabolism (continued)
 - Distribution
 - When absorption is complete, alcohol becomes distributed uniformly through the “watery” parts of the body
 - Factors affecting absorption and distribution are
 - Speed of consumption
 - Percentage of alcohol content
 - Quantity of alcohol consumed
 - Quantity and type of food present in the stomach

Toxicology of Alcohol (continued)

- Metabolism (continued)
 - Elimination
 - The body begins to eliminate alcohol as it is circulated through the bloodstream
 - There are two mechanisms for elimination
 - Oxidation, which occurs in the liver
 - Excretion through breath, urine, and perspiration

Toxicology of Alcohol (continued)

- To determine the blood alcohol level, analyzing brain tissue would be best. However, brain tissue is not available from a living individual, so blood alcohol concentrations are used. Blood and brain concentrations are directly proportional
- Measuring the quantity of alcohol consumed can be done by analyzing either blood or breath



Toxicology of Alcohol (continued)

- Testing for Intoxication
 - Breath testing
 - The most widespread method
 - The Breathalyzer measures alcohol content in alveolar breath (deep within the lungs)
 - It requires no less than 1.1 to 1.5 liters of breath to ensure that “deep-lung” breath is measured
 - For accuracy, avoid “mouth alcohol,” such as that from belching, regurgitation, or recent mouthwash



Toxicology of Alcohol (continued)

- Testing for Intoxication (continued)
 - Field Sobriety
 - A preliminary test performed to ascertain the degree of a suspect's physical impairment and whether further tests are justified



Toxicology of Alcohol (continued)

- Testing for Intoxication (continued)
 - Field Sobriety (continued)
 - Psychophysical tests
 - Horizontal-gaze nystagmus
 - Walk and turn
 - One-leg stand



Toxicology of Alcohol (continued)

- Testing for Intoxication (continued)
 - Field Sobriety (continued)
 - Preliminary Breath Test
 - A handheld breath tester that uses a fuel cell to measure alcohol content
 - Should establish probable cause for requiring more thorough breath or blood tests



Toxicology of Alcohol (continued)

- Blood Analysis
 - Calculated with a high degree of accuracy by use of gas chromatography which separates alcohol from any other chemicals
 - Collection and preservation of blood
 - Before the penetration of the needle, the area must be cleaned with non-alcoholic disinfectant
 - Refrigerate the blood until it is delivered to the lab
 - Effects on the collected blood
 - Storage temperature
 - Presence of a preservative, such as sodium fluoride
 - Amount of time in storage
 - Postmortem blood should be collected from a variety of body sites if it is available at all



Toxicology of Alcohol (continued)

- Blood Alcohol Laws (Morgan, 2012)
 - The Department of Transportation recommended that states adopt .08% blood alcohol concentration as the legal measure for drunk driving
 - This percentage has been adopted by all 50 states
 - .08% only applies to noncommercial drivers; for commercial drivers, it is .04%
 - An implied consent law is used to prevent a person from refusing to take a blood or breath test based on self-incrimination rights



Role of the Toxicologist

- Studies body fluid, tissue, and organs for drugs and/or poisons
- May conduct postmortem pathological examinations, and examination of personal effects and empty containers, etc.
- May have extremely minute quantities to test
- Must detect, identify, quantify, and assess toxicity

Collecting and Preserving Toxicological Evidence

- When possible, collect both blood and urine
 - Collect two voids (samples) of urine in separate specimen containers
 - Collect a sample of blood if a physician or registered nurse (RN) is available (the amount depends upon the type of test to be conducted)



Techniques in Toxicology

- Drugs are chemicals that are categorized as either acids or bases
 - An acid is a compound that donates hydrogen ions
 - A base is a compound that accepts hydrogen ions
 - The pH scale measures the strength of acids and bases
 - The scale measures from 0 – 14
 - 7 is neutral; the farther the number is away from 7, the stronger the acid or base
 - Below 7 are acids and above 7 are bases



Techniques in Toxicology (continued)

- Screening Tests
 - Thin Layer Chromatography (TLC)
 - Separates out molecules that move up a thin coated plate
 - This test has both a solid and a liquid phase
 - The distance each component travels is based on the characteristics of that substance
 - It is then compared to known samples
 - Gas chromatography uses the same process as TLC except it has a moving liquid and a moving gas phase
 - Immunoassay is based upon specific drug-antibody reactions; this is the best method for detecting low drug levels

Techniques in Toxicology (continued)

- Confirmation Test
 - Gas chromatography/Mass spectrometry
 - The gas chromatography is completed first
 - Then each separated component enters the mass spectrometer where the sample is broken into fragments for identification

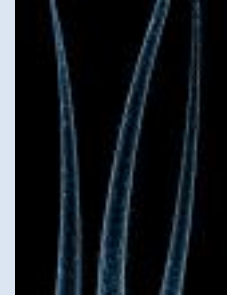


Techniques in Toxicology (continued)

- Detecting Drugs in Hair

- Drugs remain in the

- Bloodstream up to 24 hours
- Urine up to 72 hours



- Drugs can become permanently entrapped in a hair's hardening protein

- As hair grows, the drug's location on the hair shaft becomes a marker for the time of drug intake

- Some drugs may enter a hair's surface from environmental exposure or sweat. This can cause a problem with the accuracy of the test

Techniques in Toxicology (continued)

- Detecting Non-drug Poisons
 - Heavy metals such as arsenic and mercury may be detected
 - Carbon monoxide is one of the most commonly encountered poisons



Techniques in Toxicology (continued)

- Significance of Toxicological Findings – once a drug is identified, the toxicologist must assess its influence on the behavior of the individual

Resources

- Saferstein, Richard. *Forensic Science: An Introduction*. New Jersey: Pearson Prentice Hall, 2008
- Saferstein, Richard. *Forensic Science: An Introduction*. 2nd ed. New Jersey: Pearson Prentice Hall, 2011
- Saferstein, Richard. *Criminalistics: An Introduction to Forensic Science*. 8th ed. Upper Saddle River, NJ; Pearson Prentice Hall, 2004
- <http://en.wikipedia.org/wiki/Entomotoxicology>
- http://www.brad21.org/bac_charts.html
- Do an Internet search for the following:
 - Coroner Attributes Michael Jackson's Death to Propofol by Ashley Surdin
 - Statistics on Alcohol Related Deaths by Mary Flinn
 - Alcohol and Driving Laws by Lee Morgan
 - drunkdrivingdefense general bac