

The Melting Pot - A Case Study in Forensic Toxicology

Cheryl L. Golson, BS, CLS, M. Douglas Bearden, MA, CLS (NCA), MT (ASCP) and George B. Kudolo, PhD, FAIC, FACB

Department of Clinical Laboratory Sciences
UT Health Science Center, San Antonio

Corresponding author:

George B. Kudolo, PhD

Department of CLS-MS 6246, UT Health Science Center,
7703 Floyd Curl Drive, San Antonio, TX 78229-3900

Case summary: A 33-year old black man, last seen alive around midnight, was found unresponsive by his brother at 6:20 am. He had bloodshot eyes with obvious scleral hemorrhages and a brownish purge was protruding from his nose and mouth. Paramedics pronounced him dead at the scene. Drug paraphernalia was found which included a baggie with brownish granular substance, a syringe, and a spoon with possible drug residue. However, IV drug use could not be confirmed due to the inability to break rigor mortis in the arms. What was the cause and manner of death?

Results & Discussion: The postmortem toxicology report from the medical examiner's office (Table 1) showed that the decedent had ingested alcohol, several prescription medications, and two drugs of abuse. First of all, ethanol was detected and confirmed in both the femoral blood and vitreous humor specimens. The vitreous humor is protected from the systemic circulation and therefore drug levels found in this chamber, especially ethanol, accurately reflects antemortem levels in forensic toxicology.¹ There is a very close relationship between the vitreous humor and the blood alcohol levels as seen in the decedent. The results clearly show that the decedent was legally drunk (legal limit is 0.08 g/dl (or %). At 0.168 g/dl, this would be consistent with severe central nervous system (CNS) depression, impaired motor function and decreased blood flow to the brain.²

Benzoylcegonine, detected in both the blood and urine specimens, is a metabolite of cocaine. Cocaine has a very short half-life (1-2 hours) and, unless it was recently ingested, may not be detectable. However, benzoylcegonine has a relatively longer half-life (6-8 hours) and is a reliable indicator of cocaine use. Cocaine is a potent CNS stimulator, however approximately two hours after use a period of debilitating exhaustion may occur.³ The decedent's blood was positive for the opiates drug screen (ELISA method). In forensic toxicology it is important to determine whether the presence of opiates was from licit or illicit sources. Confirmation by GC/MS showed the presence of codeine and monoacetylmorphine (6-MAM). Promethazine, an antiemetic (Phenergan) may also be available over-the-counter as a cough syrup in combination with codeine and alcohol. Illicit heroin (diacetylmorphine) is an opiate with a very short half-life (9-20 minutes) and for that reason may not be detected but is metabolized to 6-MAM, morphine (half life, 2-3 hours) and codeine. However, the ingestion of codeine, as with

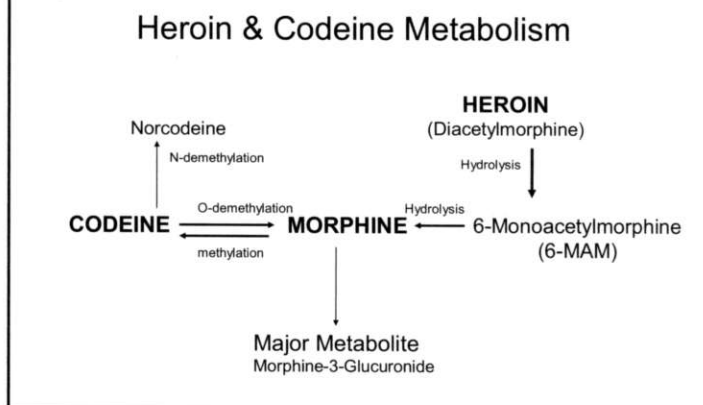
promethazine, may produce morphine but never 6-MAM (Table 1). Therefore, the presence of 6-MAM confirms heroin use in the decedent.⁴

Diazepam (Valium) is a benzodiazepine (active metabolite, nordiazepam) prescribed for anxiety or muscle spasms.⁵ Carisoprodol (metabolite, meprobamate) is a muscle relaxant that may be available in combination with aspirin (Equagesic®) or codeine for pain management.⁶ Co-ingestion of alcohol and other CNS depressants with carisoprodol is strongly discouraged by the manufacturer.

Promethazine is a highly addictive drug that is glorified in "rap music" with lyrics that refer to "sipping on syrup, sizzurup and purple drank"⁸ and has been implicated in several celebrity deaths.^{9, 10}

Taken together, the present case illustrates the growing incidence of multiple drug ingestions (polypharmacy) resulting in fatal outcomes. First of all, the co-ingestion of cocaine and alcohol yields cocaethylene in the body which has proven to be more potent than either alcohol or cocaine alone.¹¹ Peak promethazine plasma levels for therapeutic purposes are 0.011 - .023 mg/L and levels above 0.10 mg/L are fatal.⁸ Since whole blood is used for drug analyses in the forensic toxicology laboratory, it is important to determine what the plasma levels for

Fig. 1.



promethazine would have been. Assuming a hematocrit of 45-50%, the decedent's blood value (0.05 mg/L) would give a plasma level of approximately 0.10 mg/L, which is at the lethal level. Also, promethazine exhibits anticholinergic properties by blocking acetylcholine action⁸ much like the botulinum toxin, inhibiting acetylcholine action resulting in paralysis, which in the pulmonary bed, may prove fatal.^{12, 13}

Conclusion: The cause of death was promethazine overdose exacerbated by multi-drug toxicity, and the manner of death was accidental. This case illustrates that a melting pot of benign medicines such as a cough mixture, and a host of properly prescribed drugs and alcohol is a recipe for a fatal outcome.

References

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Table 1

Alcohols (Ethanol)	
Femoral blood	0.149 g/dl
Vitreous humor	0.168 g/dl
Specimen: Femoral blood	
Acid/neutral drugs	None detected
Alkaline drugs	
Meprobamate	+
Carisoprodol	+
Codeine	+
Promethazine	0.05 mg/L
Diazepam	0.32 mg/L
Nordiazepam	0.38 mg/L
Benzoyllecgonine	+
Opiates	+
Morphine	0.14 mg/L
Codeine	+
Monoacetylmorphine	+
Specimen: Urine	
Codeine	+
Monoacetylmorphine	+
Benzoyllecgonine	+

(+) denotes the presence of the drug but was not quantitated because levels were less than the limit of quantitation (LOQ). Drug levels were confirmed and quantitated using gas chromatography/mass spectrometry (GC/MC). The screen test for opiates was performed using the ELISA method.

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management administrators, nursing practitioners, clinicians, information services personnel, public health departments, and the beneficiary of clinical laboratory testing services—the patient.

Product Development will create patient safety literature for the public and providers; standardized protocols to achieve standardized measures both measuring and reporting laboratory patient safety; and a registry and repository—a place to report best practices in clinical laboratory science and collect success stories, and to collect and report data regarding the level of safety of clinical laboratories.

Research is mandatory to develop a standard definition of an error in clinical laboratory testing services. It is imperative to identify the type of errors that occur, how and where they occur in the Total Testing Process, their impact and if there are situations or health care settings that are more prone to error. Once there is a broad understanding of errors in the clinical laboratory testing process, methods and protocols to improve the quality—i.e. ameliorate the error prone processes—need to be developed, examined and reported to clinical laboratory practitioners, clinicians and patients. Understanding, through research, is imperative for developing the products necessary to improve clinical laboratory patient safety.

As ASCLS moves forward in its implementation of the Patient Safety Strategic Plan we need your comments and your participation. If you have an interest in helping, please contact ASCLS President Scott Aikey at saikey@comcast.net or Cathy Otto at ottoc@ohsu.edu.