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GEORGIA traffic PROSECUTOR

A Publication of the Prosecuting Attorneys' Council of Georgia Traffic Safety Program

···> our mission

The goal of PAC's Traffic Safety Program is to effectively assist and be a resource to prosecutors and law enforcement in keeping our highways safe by helping to prevent injury and death on Georgia roads.

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GC/MS= gas chromatography/ mass spectrometor
Photo courtesy: Georgia Bureau of Investigation

feature article >

Established in 1952 as the second statewide crime laboratory in the United States, the Division of Forensic Sciences (DOFS) provides scientific support to the Criminal Justice System of Georgia. Laboratory scientists and technicians in specialized disciplines collect, analyze, and interpret all aspects of physical evidence for officers, investigators, and prosecutors throughout the state. In the feature article, the DOFS addresses many areas of concern regarding testing procedures, timeliness of results and interpretation of these findings in impaired driving cases.

additional features

A Peek Behind the Curtain: How the Crime Lab Handles Traffic Toxicology Cases

By Mary Jo Brasher, Teresa Bull, Lisa Callahan, Leigh Champion, Troy Dettmering, Donald Dicks and Mike Morrison of the Georgia Bureau of Investigation.

The Georgia Bureau of Investigation Division of Forensic Sciences (GBI-DOFS) Toxicology discipline provides analyses of biological materials for their alcohol, drug and poison content. These samples may originate from either the State's Implied Consent Law (traffic cases) or the Post-mortem Death Investigation Act (post-mortem cases). The section's toxicologists also assist during trials and hearings by providing professional, expert testimony statewide. Human performance toxicology is the primary concern for traffic cases, and analysis is focused on illicit drugs and medications that may impair safe operation of a motor vehicle. The focus of post-mortem cases is on drug interaction and toxicity. Since the analytical and interpretive goals of these two types of cases are not the same, it follows that cases are handled slightly differently. The focus of this discussion will be on traffic related cases.

Toxicologists consider several factors in order to determine how best to process the evidence submitted. The nature of the case, the quantity and type of evidence submitted, the specific requests from the officer/agent, and the outcome of screening tests are evaluated to determine the best course of toxicological analysis.

Blood and urine are the most commonly submitted biological specimens in traffic cases. Generally, blood specimens are first analyzed for alcohols using headspace-gas chromatography (HS-GC). Further testing for drugs is performed only when a check for drugs is requested on the paperwork submitted by the officers and the alcohol level is less than 0.08 g/100mL. All traffic fatalities, regardless of the alcohol level, are checked for drugs. Specific requests or other information provided by the officer/agent is evaluated by the toxicologist to see if additional testing is warranted. GHB or huffing compounds (generally referred to as volatiles) *must* be specifically requested or indicated. Also many common prescription medications are not considered to impact driving performance (e.g. antibiotics, sexual performance drugs (Viagra®), hypertension, or cholesterol reduction medications) and so are not part of traffic toxicology testing. Currently the laboratory cannot perform analysis of biological specimens for LSD or psilocybin (found in mushrooms).

Toxicology case work at GBI-DOFS is a two step process: screening followed by confirmation analysis. All toxicology testing begins with an Enzyme Immunassay (EIA) test. Enzyme immunoassay is a technique using antibodies developed to interact with specific drug classes. EIA is specific only within a drug class, but cannot single out a particular drug. Currently the laboratory tests for up to six drug classes: cocaines, amphetamines, cannabinoids (marijuana), benzodiazepines (Xanax®, Valium®), barbiturates and opioids (morphine, Lortab®). Other common drugs such as Oxycontin®, Soma®, Ambien® or methadone are not detected using EIA which further stresses the need for more information from the officer about their possible presence. Recently, as a result of a generous grant from the Governor's Office of Highway Safety (GOHS), the GBI-DOFS headquarters' lab has begun screening submitted blood specimens using a technique called Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS) for many of the drugs that are potentially impairing but invisible to the EIA. In early 2008 the LC/MS/MS screening of blood specimens will be done statewide.

As an example, EIA can indicate the presence of an opioid but is unable to determine if it is morphine or hydrocodone. It is GC/MS or LC/MS/MS that provides the information necessary for the toxicologist to identify the opioid as being hydrocodone rather than morphine.

continued >

This newsletter is a publication of the Prosecuting Attorneys' Council of Georgia. The "Georgia Traffic Prosecutor" encourages readers to share varying viewpoints on current topics of interest. The views expressed in this publication are those of the authors and not necessarily of the State of Georgia, PACOG or the Council staff. Please send comments, suggestions or articles to Fay McCormack at fmccormack@pacga.org or Patricia Hull at phull@pacga.org.

Communication is the key to a timely and complete toxicology report. Without case information, the toxicologist must cast a wide net for potential drugs which is more time consuming and less efficient. With good information the toxicologist working your case can focus more quickly in on the drug(s) in question, conserving evidence and time.

A few answers to frequently asked questions:

Should blood or urine be submitted?
For alcohol analysis, blood is the only specimen the GBI-DOFS laboratory tests routinely for traffic cases. For toxicology both blood and urine should be submitted whenever possible. The blood alcohol kits contain two grey stopper tubes and a plastic bottle for urine.

How much is needed for testing?
In order to ensure that sufficient sample is available for testing, the two blood tubes should be submitted full and the urine container at least half full. The amount necessary for testing varies from case to case depending on how many different drugs are found.

Where can blood alcohol kits be obtained?
Blood alcohol kits may be obtained from Substance Abuse Specialists, Inc. by calling 1-888-999-7274.

What drugs are included in routine testing?
Traffic cases are routinely screened at GBI-DOFS for up to six classes of drugs by EIA: cocaine, amphetamines, marijuana, barbiturates, opioids and benzodiazepines. Blood is also screened by LC/MS/MS for common drugs (e.g. Oxycontin®, Soma®, Ambien® and methadone) that do not show up in the EIA screen. If you are unsure testing for a specific drug was performed, contact the reporting toxicologist.

How do I contact the reporting toxicologist?
The final report has the name and phone number of the reporting scientist.

What is taking so long?
Several things can lengthen the time it takes to properly work a toxicology case. Incomplete, missing or incorrect information can delay the time it takes before a case is started. As the number of cases with multiple drugs increases, the time needed to complete these more complex cases has increased as well. Full implementation of LC/MS/MS for both types of cases will help to decrease turnaround times.

Marijuana: A Complicated Drug

Marijuana is second only to alcohol in the frequency it is encountered in traffic related toxicology cases. The drug's effect on the psychomotor skills needed to safely operate a motor vehicle have been clearly demonstrated in several studies. In particular, consumption of marijuana leads to lapses in critical thinking and judgment needed for the rapid decision making required to safely drive. While the effect on driving is apparent, as you will see, marijuana's pharmacology and interpretation of analytical findings is quite complex.

Marijuana is the common name for the plant *cannabis sativa*. Like many botanically derived preparations, there are actually a number of compounds found in marijuana. The most forensically important class of compounds are the cannabinoids, especially delta-9-tetrohydrocannabinol (THC). THC is the major psychoactive ingredient in cannabis and it is for effects caused by THC that marijuana is consumed. The effects of THC on the central nervous system (CNS) can include depression, sedation, stimulation and even psychedelic (capable of altering perception thought and feeling) properties. THC works by acting on specific places within the brain called cannabinoid receptors. The location of the cannabinoid receptors within the brain and body directly correlate with physiological, psychomotor and cognitive effects. These effects include alterations in cognition, perception, memory, learning, motor skills, body temperature regulation and food uptake. Fine muscular quaking, reddening of the conjunctiva (blood shot eyes) and rapid heart beat are some outwardly observable manifestations. The onset of the physiological and behavioral effects is observed almost as soon as smoking begins with the subjective high lasting for several hours.

To understand the challenges faced by law enforcement in fighting marijuana DUI, one must first have a reasonable knowledge and understanding of the complex pharmacokinetics of THC. Pharmacokinetics, simply put, is how a drug acts in the body once it is consumed; the absorption, distribution, metabolism and elimination.

Drugs enter the body usually by one of three common routes of administration: orally, intravenously, or smoking. When a drug is consumed it then travels to the blood stream. Absorption is the rate at which a drug travels to the blood stream once ingested. Distribution is the process by which a drug moves throughout the body in the blood and into body tissues including the brain. Smoking is the most common route of administration for cannabinoids. The amount of THC absorbed can vary greatly depending on an individuals smoking technique and THC content of the marijuana being smoked. When a marijuana cigarette is smoked, the active component, THC, immediately enters the blood stream from the lungs. The THC level rapidly climbs in the blood peaking during the smoking process. As THC is absorbed it also begins to move from the blood to body tissues and metabolizes (breakdown). THC is a highly lipophilic (fat-loving) drug. It quickly moves out of the watery blood and into the fatty tissues of the body including the brain. The resulting precipitous decline in blood THC levels may even begin during the smoking process. THC that remains in blood is metabolized first to less active 11-Hydroxy-Ä9-tetrahydrocannabinol (THC-OH) and further to the inactive 11 nor-9-Carboxy- Ä9-tetrahydrocannabinol (THC-COOH). These compounds are more easily excreted or eliminated by the body. THC that has accumulated in the fatty tissue is then slowly reabsorbed back into the blood where the process of metabolism occurs again. The long blood detection times observed for the cannabinoid class of drugs are attributed to this phenomenon of redistribution and further complicate the determination of time of ingestion. Once metabolized to THC-COOH, the body filters it from the blood in the kidneys and excretes it as waste in the urine. It follows that prolonged detection times in the blood corresponds to longer detection times in the urine as well.

LC/MS/MS= liquid chromatography/tandem mass spectrometor. Photo courtesy: Georgia Bureau of Investigation

The pharmacokinetics of cannabinoids was studied in Huestis's 1992 articles, the most referenced papers on the topic of blood detection of cannabinoids. In these studies the process of ingestion and metabolism of THC was monitored in six male subjects in a controlled environment. The study observed that after controlled ingestion of marijuana, peak concentrations of the active drug THC can occur within 10 minutes of smoking and concentrations dropped rapidly after the peak was achieved. After 1-2 hours THC was no

longer detectable in blood. The inactive metabolite, THC-COOH, steadily increased as THC decreased. The study recorded the time to peak THC-COOH levels ranging of 32 minutes to 4 hours in blood after marijuana smoking. THC-COOH persisted for several hours at detectable levels after the cessation of smoking. This study as well as others demonstrates that the rapid increases of THC in the blood during marijuana smoking correlates well to the onset of the subjective "high", but that the effects of marijuana remain even as THC levels become undetectable. The level of the pharmacologically inactive metabolite, THC-COOH, increases during the period of the maximum psychomotor effect, but can remain detectable longer than the subjective "high" lasts. Detection of THC-COOH in urine certainly indicates the subject has been exposed to marijuana, and detection time can overlap the period of the subjective high. Detection of THC-COOH in urine has been shown to vary from 12 hrs to 36 hours (or more) depending on the subject and potency of marijuana. Questions as to how much, exactly when, or the degree of impairment are not answered by these results.

The complexities of THC pharmacokinetics observed even in controlled settings only highlight the challenge faced by toxicologists in interpreting real world situations. Factors such as the volume, depth, and length of inhaling; exhalation, potency of marijuana, subject's height, weight, past drug experience, frequency of use, and physical health all contribute to how a subject's body is going to react to the drug. It may be possible for the urine to be positive, and the blood to be negative. It can be frustrating to officers to observe a subject smoking marijuana at roadside, exhibiting clear indications of impairment and draw the blood soon after, only to get a negative result from the chemical test. It is probable that the subject's THC-COOH levels have not yet reached a detectable level.

The GBI-DOFS Toxicology discipline uses two different tests to screen for and confirm cannabinoids in blood and urine. The immunoassay is the screening test for cannabinoids. The immunoassay result is for "total" cannabinoids which can include parent THC and all related metabolites (THC-OH, THC-COOH). The confirmation testing method currently used by the crime laboratory is GC/MS. THC-COOH is the metabolite identified and quantified by GC/MS for suspected marijuana use since it can be detected in the blood longer than other cannabinoid metabolites and is believed to provide reasonable indications of recent use.

The crime laboratory has developed criteria that must be met before a case can be reported positive for THC metabolite. In order for the immunoassay screen to be declared indicatively positive for cannabinoids the level must exceed a threshold value called a "cut-off". The current GBI cut-off for cannabinoids is 100 ng/mL in urine and 25 ng/mL in blood. Results below the cut-off value are considered to be "negative". Confirmation analysis by GC/MS for THC-COOH must also be greater than a threshold value of 25 ng/mL in urine and 10 ng/mL in blood. The GC/MS threshold is lower than that of the immunoassay since only a single cannabinoid (THC-COOH) is confirmed.

The cut-off levels serve several purposes: establish a limit for analytical testing, narrowing time frame of usage, and addressing concerns about passive inhalation. All chemical tests have an analytical limit due to instrumental and procedural capabilities. As noted before, THC-COOH levels increase during the period of the high and then begin to decline slowly over time. Setting a higher cut-off narrows the time frame since last usage. Passive inhalation can occur when someone is exposed to smoke from burning marijuana rather than from direct, intentional ingestion. "Passive inhalation" presents an interpretive situation which must be avoided. Based on controlled studies, the laboratory has set cut-offs to help distinguish between someone in the proximity of marijuana smoke who did not intentionally ingest marijuana from someone who intentionally consumed marijuana

Each state or municipality crime laboratory has their own reasoning for setting their cut-off levels. Sometimes it is due to *per se* DUI laws, and sometimes they are set due to instrumentation detection limits. The GBI crime laboratory believes that the current cut-off levels for cannabinoids are set based on a consideration of analytical capability and with a clear understanding of the pharmacology of cannabinoids.

Interpretation of cannabinoid results placed in the context of a real world DUI stop draws together all the aspects discussed so far: pharmacology, pharmacokinetics, and testing methods. Several challenges now manifest themselves when one tries to interpret the findings of the toxicology lab relative to marijuana. The type of specimen submitted to the laboratory and the cut-off level will determine the narrowness of the time window since the last use of marijuana. Since the confirmed analyte, THC-COOH, is inactive and can be detected in the blood and urine for a longer time than the high lasts, toxicologists are unable to conclude definitively that someone was under the influence in the *absence* of observed manifestations or behavior. Another challenge arises as to whether a person is an occasional user of marijuana or a chronic user as metabolites persist longer in chronic users than occasional users due to an accumulation of THC in fatty tissue. Mathematical models for predicting the time interval since last use require analysis for analytes other than THC-COOH and are based on clinical data from non-chronic use of marijuana. It is for this reason the GBI crime lab does not currently employ those models to interpret results.
Generally speaking, the toxicologist must speak broadly in interpreting lab results on a particular case concerning marijuana. The toxicologist cannot speak as to a specific time of use, nor give direct correlations of quantity of drug versus psychomotor performance. The toxicologist can, however, testify that the subject did personally ingest marijuana in the very recent past and discuss whether the manifestations observed by the officer in an individual are consistent with the use of marijuana. Importantly GBI-DOFS toxicologist can describe for a jury how psychomotor effects of marijuana (THC) can negatively impact a person's ability to safely operate a motor vehicle.

The Authors. Front row: Lisa Callahan, Leigh Champion, Mary Jo BrasherBack row: Mike Morrison, Donald Dicks, Troy Dettmering, Teresa Bull. Together these scientists have more than 70 years of experience with DUI toxicology cases.

Trend of Fatalities in Georgia, 2002 - 2006

	2002	2003	2004	2005	2006
Total Crashes	1,524	1,603	1,634	1,729	1,693
Alcohol-Related Crashes	533	483	536	562	604
Single Vehicle Crashes	787	831	810	909	916
Non-Junction Crashes	1,167	1,229	1,210	1,304	1,291
Within Intersection Crashes	283	274	288	308	278
Intersection-Related Crashes	25	33	36	41	44
Speeding Involved Crashes	313	328	335	340	407
Pedestrians	161	156	153	150	148
Pedalcyclists	13	18	20	23	19
Large Truck Involved Crashes	198	232	248	229	232
Roadway Departure Crashes	871	953	974	1,001	940
Passenger Car Occupants	708	739	721	728	710
Light Truck/Van Occupants	493	508	558	613	595
Total Occupants (Not Including Motorcyclists)	1,260	1,322	1,345	1,403	1,357
Motorcycle Riders	85	103	111	144	154

Courtesy: National Highway Traffic Safety Administration

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····> fact:

Drunk driving is the nation's most frequently committed violent crime, killing someone every 30 minutes. Because drunk driving is so prevalent, about three in every ten Americans will be involved in an alcohol-related crash at some time in their lives. In 2006, an estimated 17,602 people died in alcohol-related traffic crashes in the USA. These deaths constituted 41 percent of the nation's 42,642 total traffic fatalities.

-Statistics courtesy NHTSA (www.nhtsa.gov)

The "Georgia Traffic Prosecutor" addresses a variety of matters affecting prosecution of traffic-related cases and is available to prosecutors and others involved in traffic safety. Upcoming issues will provide information on a variety of matters, such as ideas for presenting a DUI/Vehicular Homicide case, new strategies being used by the DUI defense bar, case law alerts and other traffic-related matters. If you have suggestions or comments, please contact Editors Fay McCormack or Patricia Hull at PAC.