CALCULATION OF BLOOD ALCOHOL CONCENTRATIONS IN CRIMINAL DEFENDANTS

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Criminal defense attorneys frequently represent defendants known to be drinking heavily at the time of an offense. Often there are strong indications that the defendant's drinking was to such a level that his or her ability to function, think, and plan actions were seriously impaired. If the state has not obtained and provided evidence as to the defendant's degree of intoxication, it becomes incumbent upon the defense to establish the level of intoxication. The North Carolina Supreme Court has held that:

> "A defendant who wishes to raise an issue for the jury as to whether he was so intoxicated by the voluntary consumption of alcohol that he did not form a deliberate and premeditated intent to kill **has the burden of producing evidence, or relying on evidence produced by the State, of his intoxication**. Evidence of mere intoxication, however, is not enough to meet defendant's burden of production. He must produce **substantial evidence** which would support a conclusion by a judge that he could not form a deliberate and premeditated intent to kill. (State v. Mash, 1988; emphasis added; ref. 1)"

The problem is how to present these issues to a judge and a jury in such a way that they have credibility. One way to present such evidence regarding alcohol is by presenting the defendant's blood alcohol concentration (BAC). If an individual's BAC is known, it can be scientifically stated how much was consumed and what the effects of that level of

consumption has on such issues as memory, motor coordination and criminal intent. In the majority of cases, no BAC is available to the attorney and, in the absence of this critical information, there is no basis to raise relevant issues regarding impaired functioning. Without this data, lay witnesses must be relied upon to testify as to the defendant's level of intoxication. These observations of the defendant's actions and behavior are seldom effective because they are not based on objective criteria, but can become effective if supported with expert opinion grounded in fact. There exist accepted scientific principals which allow the calculation of a BAC after the fact in cases where blood specimens were not collected for testing or a breath test was not employed near the time of the offense. This calculation is best accomplished and presented in the form of expert testimony by an accepted expert in the field of pharmacology in order to maximize its impact.

It is not enough that testimony indicate that the defendant was intoxicated. In order to prevail on a theory that a defendant's level of intoxication negated his ability to form specific intent, it is necessary that the evidence show "[t]hat the defendant was so intoxicated at the time that he committed the crime **that he was utterly unable to form the necessary specific intent**...the trial court is not required, however, to instruct the jury concerning the defense of intoxication **when the evidence does not tend to show that the defendant was completely intoxicated as to be utterly unable to form the specific intent necessary at the time the crime was committed**." (State v. Williams, 1983; emphasis added; ref. 2) A psychiatrist called to testify as to defendant's capabilities will be better prepared if given an accurate estimate of defendant's blood alcohol level. Thus, expert testimony as to a defendant's blood alcohol concentration at the time of criminal activity combined with interpretation of that level as to affects on cognitive abilities can be very effective. Testimony by lay witnesses that a defendant was "drunk" usually is insufficient without support from accepted experts.

The calculation of a blood alcohol concentration is relatively straight forward and is illustrated by the hypothetical case below. The more specific the information that can be obtained from the defendant and witnesses, the more reliable and accurate the calculation will be. Thus, brands are important. Wine may be 11-12% alcohol by volume, or it may be fortified to 18%. Likewise, some brands of regular beer are about 4% alcohol, but malt liquor may be as high as 6% and in North Carolina draft beer is limited to 3.4% by law. A "bottle" of liquor may mean a pint (usually 375 ml, but can be 500 ml), a fifth (750 ml), a quart (945 ml), or a liter (1,000 ml). A "bottle of malt liquor" may mean 12 oz, 32 oz or 40 oz (known as "40's" on the street). The following hypothetical case is based on experience from five different cases in the state of North Carolina.

Case Presentation:

Mr. John Smith, a 21 year old white male, was arrested as he returned to his apartment at 2:00 a.m. after a long night of drinking. He had vague memories of being in a fight, but did not understand fully why the police were arresting him. During questioning, he asked whether his friend was all right. The interrogating officer noted that the suspect smelled

of alcohol and would not stay focused on his questions. No breath test or drug screen was performed. Mr. Smith was placed in a cell until arraignment.

Mr. Smith awoke at 8:00 a.m. and wanted to know how he came to be in jail. He was shocked and dismayed to learn that he was accused of murdering his friend, Mr. Brown, at just after 12:00 midnight. He claimed no memory of a fight or using a pistol. He remembered that he had gone to his friends' house around 6:00 p.m. where Mr. Smith and two friends finished half of a bottle (a fifth or 750 ml) of Jack Daniels: each drinking shot for shot during an hour and each consumed a 12 oz. can of Schlitz Malt Liquor. The three men picked up another friend and went to a pizzeria where they had two large pizzas and three pitchers of beer. The third friend from the original drinking bout nursed one beer as he felt he already had enough. Mr. Smith remembers that he gave his keys to someone else to drive his car, but cannot remember the route they took in order to get to a party which one of them had heard about. According to witnesses from the party, Mr. Smith and his friends arrived shortly after 8:30. Mr. Smith vaguely remembers having a couple of beers and some wine, but it is not possible to get clear answers from him. Witness accounts indicate that he actually had at least 4 cans of Budweiser and about half of a fifth bottle of Mad Dog 20/20, but only a small amount of snack food to eat. Around 11:30 p.m., both Mr. Smith and Mr. Brown left the party while arguing with one another. Witnesses say they were going to John's apartment, but both men had to use the furniture and the door jam to support themselves as they left. One witness spoke to Mr. Smith just before leaving and stated that his eyes would not stay focused on her and his speech was definitely slurred. Neither man returned to the party.

The defense attorney is frustrated by the vagueness of Mr. Smith's story. Why can he not remember events much after 10:00 p.m.? The police say he was able to walk when they brought him to the station. However, they did say they would not have allowed anyone in his condition to drive a motor vehicle. No breathalyser test was administered and no drug toxicology was performed.

Calculation of Blood Alcohol Concentrations:

Is it possible to determine from this information just how intoxicated Mr. Smith was at different times during the night and to form an opinion as to whether Mr. Smith was capable of forming criminal intent? The answer is, "Yes." The absorption, distribution and metabolism of ethanol as well as the effect of different concentrations of ethanol on cognitive abilities is well described in pharmacology and other medical literature (see 3 and 4).

The calculation of approximate blood alcohol levels is fairly straight forward if the amounts and times of consumption are established. The basic parameters are available in The Pharmacological Basis of Therapeutics on page 1740 (4). On average, ethanol distributes in 0.54 liters/kg of body weight and is cleared from the body at 0.12 g/kg per hour. The calculation then requires that the amount of beverage consumed be expressed in milliliters (ml) and multiplied by the percent strength and by the density of ethanol, 0.789 g/ml, to determine the grams of alcohol consumed. For example, if a 40 oz. bottle

of malt liquor were consumed, then that would represent 40 oz x 29.5 ml/oz x 5.5% x 0.789 g/ml = 51.2 g of pure ethanol (the concentration of malt liquors ranges between 5% and 6%). If consumption was during the previous hour, subtract an estimate for the amount remaining in the stomach, and then subtract 0.12 g/kg times the body weight in kg and times the number of hours since the start of drinking (the average healthy 70 kg man clears 8.4 g of alcohol per hour). The clearance may be increased by 20% for an experienced drinker in order to account for induction of the liver enzymes which metabolize alcohol. The remainder is the amount of alcohol distributed in the body. This number is divided by the volume of distribution, 0.54 l/kg times body weight, to yield g alcohol/l. The volume of distribution may be slightly larger for males than females and will be larger for lean as opposed to obese subjects: a more conservative estimate for a young lean male subject would use a larger value of 0.63 l/kg (5).

Light drinkers usually "feel" the presence of alcohol in their system by the time they reach 40 mg%. When the blood alcohol concentration exceeds 200 mg%, memory begins to deteriorate significantly and even chronic alcoholics have major disruption of memory when the BAC reaches 250 mg% (4,6,7).

Mr. Smith's consumption of alcohol began at about 6:00 p.m. and the murder occurred close to 1:00 a.m. In between, witnesses indicate that he consumed the following:

Half of a 750 ml bottle of Jack Daniels split three ways-- 125 ml X 45% = 56.3 ml of ethanol

One 12 oz can of Schlitz Malt Liquor-- 12 oz X 29.5 ml/oz X 5.5% = 19.5 ml of ethanol

One pitcher of Budweiser-- 60 oz X 29.5 X 3.4% = 60.2 ml of ethanol

Four 12 oz cans of Budweiser-- 4 X 12 oz X 29.5 X 4.5% = 63.7 ml of ethanol

One-half of a fifth of Mad Dog 20/20-- 375 ml X 18% = 67.5 ml of ethanol

total ethanol consumed = 267.2 ml X density of ethanol 0.789 g/ml

= 210.8 g of ethanol

Mr. Smith stands 5 feet 10 inches, weighs 145 lb or 65.9 kg and has no evidence of renal or liver disease, which can alter the volume of distribution or metabolism of ethanol. The volume of distribution of ethanol is essentially in body water and is given as 0.54 liters/kg. However, this is an average for both males and females: to adjust for a healthy lean male, a value of 0.63 liters/kg will be used or 41.5 liters total for his body weight.

Unlike most drugs, ethanol is metabolized at a fixed rate per hour instead of a fixed percentage. Although Mr. Smith does not meet criterion for alcoholism, his weekly binges of drinking on weekends makes him an experienced drinker, thus, his metabolic rate may be somewhat higher due to induction of enzymes and the rate needs to be

adjusted for his weight. Therefore, the rate must be adjusted for his weight and his drinking history. The average for his weight would be 7.91 g/hr, but with an allowance of 20% for induction of enzymes, a value of 9.59 g/hr will be used. This provides for a more conservativeestimate of the blood alcohol levels. There also needs to be an allowance for the amount of alcohol left in his stomach. Alcohol can be absorbed from both the stomach and the intestines, although on an empty stomach most is absorbed from the intestines because of the greater surface area.

Metabolism of ethanol-- 7 hr X 9.59 g/hr = 66.4 g of ethanol

Allowance for stomach contents = 30.0 g of ethanol

amount of ethanol subtracted from total = 96.4 g of ethanol

amount of ethanol distributed in body = 114.4 g of ethanol

Divide by volume of distribution (41.5 liters) = 2.76 g/liter

= 0.276 g/dl or 276 mg%

This conservative calculation indicates that at the approximate time of the murder, Mr. Smith was severely intoxicated with alcohol. Both the metabolic rate and the allowance for stomach contents are generous. Furthermore, he may have consumed more than witnesses have seen and can testify to. From this calculation and the observed behaviors, it is possible to diagnose Mr. Smith as having Acute Alcohol Intoxication as defined by the DSM-IV (8) which lists four criteria that must be met:

A. Recent ingestion of alcohol

B. Inappropriate or maladaptive behavior

C. Any one or more of the following symptoms--slurred speech, incoordination, unsteady gait, nystagmus (inability to track objects with the eyes), impairment of concentration or memory, and stupor or coma

D. No evidence of organic brain disease or other drugs which may account for the behavior

The relationship between BAC and behavioral effects is depicted in Figure 1. Although this figure depicts the effects on a light drinker, given the very high BAC for Mr. Smith, it is reasonable to assert that his memory of events would have been severely impaired. Further, it is reasonable to assert that Mr. Smith was not capable of forming an intent to commit a crime. His ability to make new memories would be largely disrupted and it is not possible to carry out a plan that one cannot remember. His actions were largely instinctive and impulsive during this time. His claim to be in an alcoholic blackout is substantiated by this calculation. It is important that neither the police, prosecutors, nor

defense attorneys give Mr. Smith information that he can incorporate into a false memory. Otherwise, it becomes difficult to separate what he really remembers about events from what he thinks he remembers and from what he is guessing.

Conclusion

Having an accurate BAC is a valuable tool for the defense counsel. It can be used as the basis for a diminished capacity defense or as a strong mitigating factor in a capital case. In addition, a similar calculation may be performed for witnesses in order to give the court a better understanding of the reliability and credibility of testimony. A presentation to a jury with your client's scientifically calculated BAC and an explanation of exactly what that means raises your claim of diminished capacity from a matter of speculation to an established scientific fact. This evidence is most powerfully presented as a combination of scientific analysis supported by lay witnesses who can describe the defendant's behavior. The ability to present concrete evidence to the jury through expert testimony regarding the level of impairment that your client was laboring under at the time of the offense can make a significant difference in the degree of culpability assigned to your client. In a capital case this could mean the difference between life or death.

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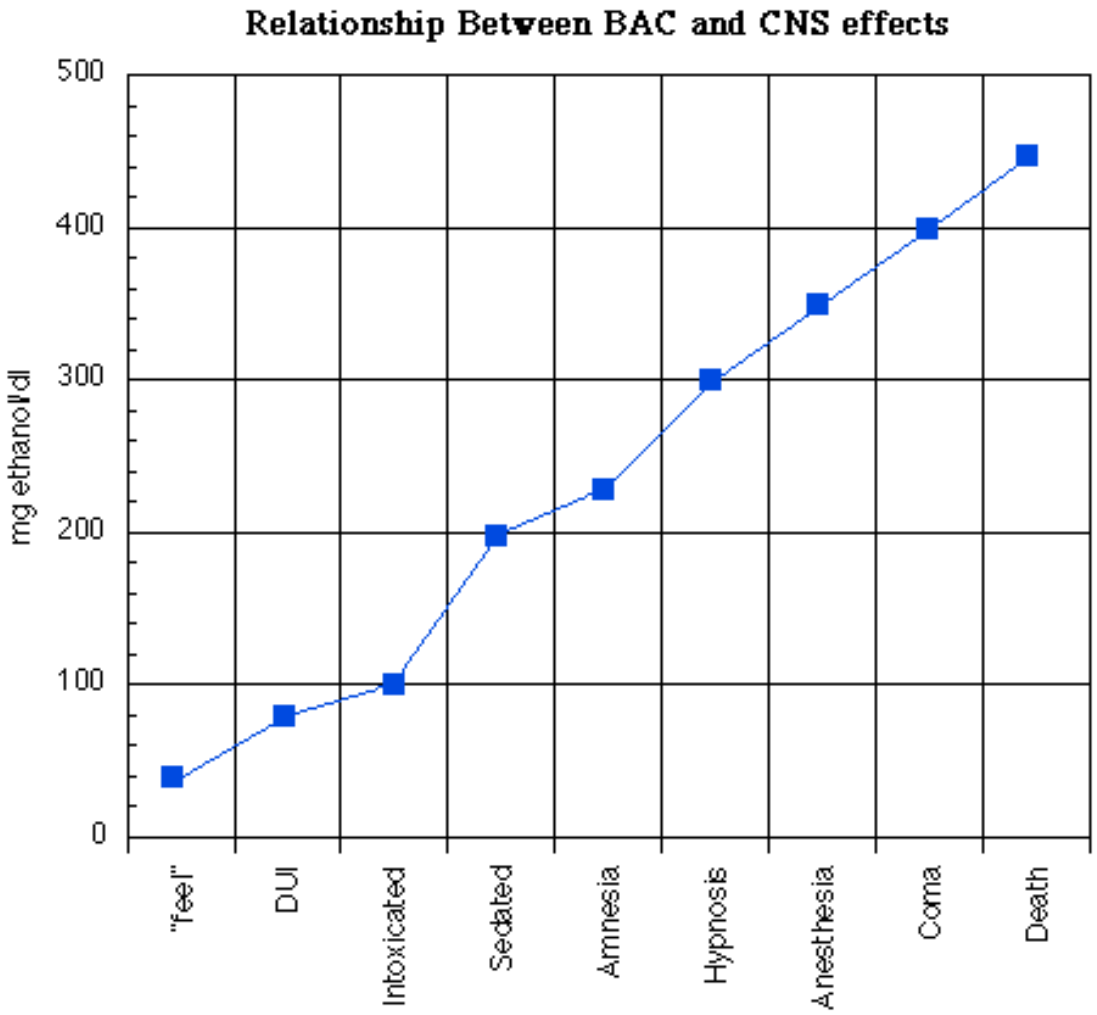

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Figure 1. The relationship between blood alcohol concentration (BAC) and the central nervous system (CNS) effects of ethyl alcohol. Effects at concentrations under 200 mg/dl (200 mg% or 0.20 g/dl) are based on expected responses of a "light" drinker in a laboratory setting as the BAC is progressively increased. Death due to acute alcohol poisoning can occur at concentrations above 400 mg/dl, but cases of patients walking into the emergency room with a BAC over 500 mg/dl have occurred. The degree of environmental stimulation and previous drinking experience will shift the curve upward at lower concentrations. However, even the chronic alcoholic suffers impairment of memory by 80% or more at a BAC of 250 mg/dl (7).