Forensic Pathology and Ethanol

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Chief Medical Examiner
CT OCME
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Goals

- Chronic Ethanol Abuse
- BAC
- Death Certification and Ethanol
Specimens

- Blood (peripheral preferred)
- Vitreous
- Urine
- Bile
- Gastric Contents
- Liver
- Brain
- (Hair)
Blood

- NaF
  - Anticoagulation
  - BE
  - Antimicrobial

- Site: Peripheral
  - Postmortem redistribution
Vitreous

- **Electrolytes:**
  - Postmortem blood not reliable
  - Glucose (>200 mg/dL)
  - K/Na/Cl/Urea/Cr

- **Ethanol (lags BAC)**

- **Post-mortem time estimate (K)**
Ethanol
“People do die the way they live; Death investigation would be chaos if the situation was otherwise.”

Luke and Riddick
Alcohol Associated Deaths in D.C.
JFS, 493;1978
BAC

- 0 - 0.05% Sober
- 0.05 - 0.15% Subclinical
- 0.15 - 0.25% "Stimulation"
- 0.25 - 0.35% Confusion
- 0.35 - 0.45% Stupor
- >0.45% Coma
Effect of Alcohol on Likelihood of Causing a Crash

- **Current Legal BAC Limit**:
  - BAC of 0.08

- **Former BAC Limit**:
  - BAC of 0.10

**Likelihood of Causing a Crash Compared to BAC of Zero**

- **Blood Alcohol Concentration (%)**
Ethanol

- 0.1gm% = 100 mg/dL
- 1 oz whisky (50%) = 4 oz wine = 12 oz beer
- 1 equivalent => raises BAC 0.02% in a 70 Kg man
- 1 equivalent => raises BAC 0.04% in a 35 Kg man
- Ethanol degraded at 0.015%/hr
People who routinely drink ethanol may become used to the effects of ethanol and so they mask their intoxication better than a person who rarely drinks ethanol.
Ethanol distributes in total body water.

- 1:1 Whole blood (Forensic specimen)
- 1:1.2 Plasma* (Hospital specimen)
- 1:1.3 Vitreous** (at equilibrium)
- 1:1.4 Ureter (Be wary of urine)

*Gives higher value than whole blood

**Vitreous ethanol lags BAC by 1-2 hours
Whole Blood vs. Plasma

DUI (whole blood): 0.080 gm%

Hospital Plasma: 0.090 gm%

\[
\frac{0.090}{1.2} = 0.075
\]

Equivalent whole blood: 0.075 gm%
Subject SP, 24 y, 73 kg

- Empty Stomach
- Full Stomach

BLOOD ETHANOL, mg/dl

TIME AFTER START OF DRINKING, h
Ethanol and Putrefaction
Ethanol and Putrefaction

- “Smellbad” Study
  Zumwalt et al, 1982, JFS 549-54
- Up to 0.22gm% due to putrefaction
- Bacterial fermentation
Putrefied Decedent

Blood: Ethanol .10 gm%
Vitreous: Ethanol .09 gm%
Urine: Ethanol .13 gm%
BE Not detected
Putrefied Decedent

Blood:   Ethanol   0.09 gm%
Vitreous: Ethanol   Not detected
Urine:   Ethanol   Not detected
         BE        Not detected
<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Substance</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood</td>
<td>Ethanol</td>
<td>0.04 gm%</td>
</tr>
<tr>
<td></td>
<td>Cocaine</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>BE</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>Cocaethylene</td>
<td>0.01</td>
</tr>
<tr>
<td>Vitreous:</td>
<td>Ethanol</td>
<td>Not detected</td>
</tr>
<tr>
<td>Urine:</td>
<td>None available</td>
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Death Certification and Ethanol
MANNER of DEATH vs. CAUSE of DEATH
Substance Abuse

- **Acute = Accident**
  - Acute intoxications are accidents (cocaine, opiates)

- **Chronic = Natural**
  - Natural complications of chronic abuse (cirrhosis).

- **Ethanol = Exception**
  - Acute intoxication is natural in a chronic alcoholic (usually).
  - Acute intoxication is accidental in non-alcoholic.
  - Acute intoxication with any other alcohol is accidental.
Common Cause of Death Statements

“Accidents”

- Acute heroin intoxication.
- Acute intoxication due to the combined effects of methadone, heroin, and cocaine.
- Acute and chronic substance abuse (methadone, benzodiazepines, and cocaine).
- Bronchopneumonia complicating anoxic encephalopathy due to acute heroin intoxication.
Chronic Intravenous Drug Abuse

Chronic IVDA is a Disease (Natural).
Acute exacerbations are chemical injuries (Accidents).
Toxicology and Death Certificates:

Do not mention result unless:

- It makes a physiologic contribution to death.
  - Acute Opiate Intoxication
  - Cocaine and intracerebral bleed
- Circumstances do not make sense without it.
  - Choking on bolus of food.
  - Drowning in a bathtub.
## Death Certificate

**PART 1**

<table>
<thead>
<tr>
<th>P</th>
<th>a. Immediate Cause</th>
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<tbody>
<tr>
<td>A</td>
<td><strong>BLUNT INJURY OF HEAD</strong></td>
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**PART 2**

d. Other significant conditions contributing to death but not resulting in the underlying cause

**MANNER: ACCIDENT**
# Death Certificate

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### PART 2

**MANNER: ACCIDENT**

7f. How injury occurred

**MOTOR VEHICLE COLLISION**
## Death Certificate

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<td><strong>ACUTE ETHANOL INTOXICATION</strong></td>
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**MANNER: ACCIDENT**

**7f. How injury occurred**

**MOTOR VEHICLE COLLISION**
# Death Certificate

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## PART 2

**MANNER: ACCIDENT**

7f. How injury occurred

**MOTOR VEHICLE COLLISION**
Choking

- Neurologically intact, sober adults do not choke to death.
- Always need an underlying cause:
  - Alcohol intoxication (Cafe coronary)
  - ALS, MS, Parkinson, Alzheimer, Psychiatric.
- Aspiration because person is dying vs. dying from aspiration.
COURT
Toxicology

The person may have been under the influence of alcohol but he died of the GSW of the head, the alcohol played no physiologic role in his death. He would have died of this GSW of the head whether he was intoxicated or not.
Toxicology

We can describe common effects of drugs but cannot predict in a particular person how they will react to drug X at concentration Y.

BAC calculations