Forensic Aspects of Ethanol

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BRAIN BREW

Brewed especially for BRAIN 85
The XII Int Symposium on Cerebral
Blood Flow and Metabolism
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Definitions

- **Alcohol**—Ethyl alcohol CH$_3$CH$_2$OH
- **Proof**—1/2 of 1 percent
- **Drink Equivalent**—
  - EtOH contained in:
  - 12 oz beer, 4 oz of wine, 1 oz 80 proof spirits
- **Alcoholic**
  - Someone who continues to drink after adverse consequences
  - Someone who drinks more than his doctor.
Terms

- Delerium tremens
  - Staggers & jags, gin fits
- Alcohol poisoning
- Werneke’s encephalopathy
- Korsakoff’s psychosis
- Marciafava-Bignami disease
- Central pontine myelinolysis
- Cirrhosis
- Pancreatitis
How Much Is Too Much?

- Varies by individual
- No known “safe” amount
  - 2 glasses/day
  - No known safe amount in pregnancy
- 15 mg/kg/day/>15 years
- “Moderate” 30-40 mg/kg/day
Acute Ethanol Intoxication

- Drink equivalent increases BAC by 0.02
- 0.02-0.08 “buzz”
- 0.08-0.1—Statutory limit for intoxication
- 0.1-0.3
  - “Stupor”
- 0.4-0.7
  - “Coma”
- 0.3-north
  - Death
Delerium Tremens

- DT’s, staggers and jags, gin fits
- Withdrawal seizures 48-72 hours post drinking
- DT hallucinations & autonomic instability
- Withdrawal slowly, with benzodiazepines or ethanol
Effects of Alcohol

- **Direct effects**
  - Neurotoxicity
  - Glial toxicity

- **Indirect effects**
  - Nutritional deficiencies
  - Metabolic derangements
  - Liver failure

- **Behavioural effects**
  - Trauma
  - Stupidity

- **Other**
  - Infections
  - Seizures
Direct Effects on the Brain

- Seen in symptomatic patients
- Brain shrinkage
  - Decreased brain volume
  - Decreased brain weight
  - Pericerebral space
# Gross Measurements

<table>
<thead>
<tr>
<th></th>
<th>Brain weight (g)</th>
<th>PCIS %</th>
<th>Grey matter (ml)</th>
<th>White matter (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td>1433</td>
<td>7.8</td>
<td>654</td>
<td>484</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>1415</td>
<td>8.8</td>
<td>666</td>
<td>476</td>
</tr>
<tr>
<td><strong>Alc</strong></td>
<td>1352*</td>
<td>10.6*</td>
<td>620</td>
<td>451*</td>
</tr>
<tr>
<td><strong>Alc + Cirr</strong></td>
<td>1321*</td>
<td>15.6*</td>
<td>659</td>
<td>464</td>
</tr>
<tr>
<td><strong>Alc + WK</strong></td>
<td>1310*</td>
<td>16.1*</td>
<td>614</td>
<td>404*</td>
</tr>
</tbody>
</table>

* signif.
Direct Effects on Neurons

- Neuronal loss
- Decrease in dendrite complexity
Cerebellar Atrophy

**Prevalence**
- 26.8% of alcoholics
- 38.6% of alcoholics with Werneke’s

**Gross findings**
- Superior vermal atrophy

**Microscopic findings**
- Reduction in white matter
- Fewer, less complex Purkinje cells
Vermal Atrophy
Direct Effects on Myelin

- Thinner myelin sheaths
- Glia myelinate more axons
- Decreased myelin complexity in rats
- Frontal lobes preferentially affected
Nutritional Deficiencies

- Beri beri: $B_{12}$
- Pellagra: Niacin
- Kwashiorkor: Protein
- Scurvy: C
Scurvy

Pale skin

Loss of teeth

Sunken eyes

Vitamin B3

An inability to absorb niacin (vitamin B3) or the amino acid tryptophan may cause pellagra, a disease characterized by scaly sores, mucosal changes and mental symptoms.

Thiamine deficiency (Beriberi)

Common early manifestations

- Loss of reflexes in knees & feet
- Paresthesia
- Numbness of feet
- Painful tender muscles
- Foot drop
- Wrist drop
- Great weakness

Dyspnea, ophthalmoplegia

Edema

Wernicke's Syndrome

Ophthalmoplegia

→ Confusion

→ Coma

→ Death

Dry Beriberi

Emaciation

Aphonia may appear (Poor prognosis; vagus nerve involved)

Dilatation of right heart; heart failure
Alcohol and Malnutrition

- Alcohol provides enough calories to live
- Don’t need to eat
- Upper limit of human consumption
  - 3 cases of beer—13 L
  - 6 bottles of fortified wine—4.5 L
  - 4 fifths of spirits—4 L
- Fortification in Australia
Alcohol

- One of the best way to preserve and transport your crops is to turn them into liquor
- You can drink your bread
- It is concentrated and preserved
Thiamine Deficiency

- Thiamine pyrophosphate is a coenzyme in carbohydrate metabolism
- Decarboxylation of alpha-keto acids
- Sources grain and organ meats
- Alcoholism combination of poor intake and poor absorption
Wernicke-Korsakoff Clinical

- **Wernicke’s encephalopathy**
  - Aphasia
  - Aphonia,
  - Nystagmus,
  - Ophtamopeligia

- **Korsakoff’s syndrome**
  - Confusion
  - Retrograde amnesia
  - Confabulation
Wernike’s Encephalopathy

- **Gross**
  - Acute hemorrhagic polioencephalitis
  - Atrophy and hemorrhage of mamillary bodies

- **Microscopic**
  - Neuronal loss serotonergic neurons
  - Loss of myelinated fibers
  - Glial scar
Mammillary Body Hemorrhage
Marchiafava-Bingami

- Crude red wine “dago red”
- Acute onset convulsions and death
- Necrosis and demyelination of corpus callosum
- Cerebellar peduncles, optic nerve
FIGURE 11-5. Marchiavava-Bignami syndrome of necrosis of the corpus callosum may be a pathophysiological cousin to central pontine myelinolysis. This lesion can be seen in experimental hyponatremia just as one can see central pontine myelinolysis.
Hemorrhage of Corpus Callosum
Central Pontine Myelinolysis

- 75% in alcoholics hospitalized for other reasons (Iatrogenic)
- Clinical
  - Mental status decline, quadriperesis, CN (eye)
- Rapid correction of hyponatremia
  - >20 mEq in 24 hours
- Loss of myelin in the central pons
- Recovery is rare
Central Pontine Myelinolysis
Methanol Ingestion

- Wood alcohol cheaper than ethanol
- Formaldehyde toxicity
  - Alcohol dehydrogenase converts methanol to formaldehyde
- Optic nerve damage
- Putamen hemorrhage
FIGURE 11-7. Methanol ingestion results in bilateral hemorrhagic necrosis of the putamen.
Alcoholic Neuropathology is Neuropathology of Trauma

- Complication of drinking
  - Falls
  - Accidents
  - DWI, WWI, BWI, BWI
- Complication of behaviour
  - Disinhibition
Trauma

- Contusions
- Olfactory nerve destruction
- Temporal pole destruction
- Falls
- Fights
Systemic Pathology

- Cirrhosis
- Pancreatitis
- Alcoholic cardiomyopathy
Cirrhosis

- Even BAC .04 can elevate GGT
  - Acute Fatty Liver
- Long term drinking
- Sequelae of alcoholic hepatitis
  - Regenerating nodules
  - Separated by fibrous bands
  - Start as portal-portal bridging
Fatty Liver
Micronodular Cirrhosis
Micronodular Cirrhosis
Hepatoma
Eosophageal Varices
Pancreatitis

- Acute pancreatitis
- Inflammation of pancreas
- Auto-digestion of pancreas
Ranson Criteria

- **At admission:**
  - age in years > 55 years
  - white blood cell count > 16000 /mL
  - blood glucose > 11 mmol/L (>200 mg/dL)
  - serum AST > 250 IU/L
  - serum LDH > 350 IU/L

- **After 48 hours:**
  - Haematocrit fall > 11.344%
  - increase in BUN by 1.8 or more mmol/L (5 or more mg/dL) after IV fluid hydration
  - hypocalcemia (serum calcium < 2.0 mmol/L (<8.0 mg/dL))
  - hypoxemia (PO2 < 60 mmHg)
  - Base deficit > 4 Meq/L
  - Estimated fluid sequestration > 6 L

- The criteria for point assignment is that a certain breakpoint be met at anytime during that 48 hour period.

- **Interpretation**
  - If the score ≥ 3, severe pancreatitis likely.
  - If the score < 3, severe pancreatitis is unlikely

- **Or**
  - Score 0 to 2: 2% mortality
  - Score 3 to 4: 15% mortality
  - Score 5 to 6: 40% mortality
  - Score 7 to 8: 100% mortality
Pancreatitis
Complications of Pancreatitis

- Acute (early) complications of pancreatitis include
  - Shock
  - Hypocalcemia
  - Hyperglycemia
  - Dehydration, and kidney failure

- Respiratory complications
  - Pleural effusion
  - Atelectasis
  - Pneumonitis
  - ARDS

- Infection
Memnmonic

- Get Smashed
  - Gallstones
  - Ethanol
  - Trauma
  - Steroids
  - Mumps
  - Autoimmune causes
  - Scorpion venom
  - Hyperlipidaemias
  - ERCP
  - Drugs
Alcoholic Cardiomyopathy

- Large, dilated left ventricle
  - Dilated cardiomyopathy
  - Floppy, globoid heart

- Associated with chronic alcoholism
  - Possibly viral
  - Direct EtOH toxicity
    - Men ages 35-55
Lung

Liver

Normal ventricles

Enlarged left and right ventricles due to dilated cardiomyopathy
Alcoholic Cardiomyopathy
It’s not the model year, it’s the mileage

At 1,184,880 miles, a 1957 Mercedes-Benz is listed in the Guinness Book of World Records as the world’s most durable car.