ALCOHOLS

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Principles of Toxicology

- **Toxicology**: study of the adverse effects of chemicals on living organisms.

- Also drugs can be considered toxic compounds if exceeds the therapeutic limit

- Lethal Dose (LD<sub>50</sub>): the dose at which 50% of which who took the dose will die
**DEFINITIONS**

- **Drug Tolerance**: when increasingly large doses of the drug produce less and less effects.

- **Drug Dependence**: When Individual cannot function normally in the absence of the drug.

- **Drug Withdrawal**: development of symptoms when a drug is abruptly discontinued.
  - Only individuals who are dependent experience this.

- **Drugs idiosyncrasies**: to describe unanticipated drug reactions.
  - Mostly Allergic Reaction.
Alcohols: a group of organic liquids which have a particular chemical grouping (OH). Named according to the length of the carbon backbone.

Ethanol is by far the commonest alcohol. Alcohol is used throughout most societies to affect mood and to alleviate discomfort. It is an addictive drug.
Characteristics
1) found in beer (4-5%), wines (7-15%), spirits (40-60%)
2) fermented carbohydrates
3) colourless fluid, pleasant smell
4) easily is solved in water, insoluble in fat

Uses
Disinfectant
Solvent in paints, perfumes
Fuel
Preserving biological specimen
Psychoactive drinks (fermentation/distillation)
Why alcohol is important in forensic medicine?

- most commonly used drug in the world,
- numerous point of contact of medico-legal pathology
- Its abuse is a prime in -accident -homicides
- adjuvant to many other toxic substances
- lead to pathological changes in target organs and contribute to death directly or indirectly.
Allowed intake: Men and Women

- **Safe** 3-4 units/day (21-28 u/week) (for a men) & 2-3 u/d (14-21 u/w) for women
- **Hazardous** 21-50 u/w 14-35 u/w
- **Dangerous** > 50 u/w > 35 u/w
SPECTRUM OF ALCOHOL USE / ABUSE

- **Social drinker** - drinks *occasionally* (not frequent)
- **Heavy drinker** - drinks *regularly and heavily* (Men > 7 units/day, Women > 5 units/day).
- **Binge drinker** - drinks *irregularly and heavily*.

- **Alcohol abuser ("problem drinker")** - drinking causes physical, psychological and social problems.

- **Dependent or addicted drinker ("alcoholic")** - has subjective awareness of compulsion to drink; exhibits prominent drink-seeking behavior; becomes tolerant to alcohol; obvious physical, psychological and social problems.
Alcohol Absorption
*completed 1-3 hrs

20% Stomach

80% Upper Small Intestine
Increase Absorption

- Empty Stomach
- Gasterectomy
- 10 - 20% concentration is the optimum

Decrease Absorption

- Food in Stomach
- Higher Concentration of Alcohol
DISTRIBUTION AND EQUILIBRIUM

- Tissue rich in water → take more Alcohol from blood than tissues rich in fat

- Women on average have a smaller body mass than men. They also have a higher proportion of body fat. As a result of these 2 factors women have a lesser volume of water in the body (or lean body mass) into which the alcohol can distribute.
ELIMINATION OF ALCOHOL

- Alcohol is eliminated through all bodily routes of excretion.
  - 5% in the breath.
  - 5% in the urine.
  - Negligible amounts of alcohol in sweat and feces under normal circumstances.
  - 90% broken down in the body, mostly in the liver, by liver enzymes including hepatic alcohol dehydrogenase (AlcDH). Oxidation of the products (acetaldehyde and acetic acid) finally yields carbon dioxide and water.
THE EFFECTS OF ALCOHOL ON THE BODY (PATHOPHYSIOLOGY)

- Alcohol is completely miscible with water, enters all cells (except adipocytes) and is toxic to all cells.

Clinical Features of Alcohol Intake:
1. Acute alcohol intoxication
2. Pathological intoxication
3. Alcohol abuse
4. Alcohol dependence
5. Alcohol withdrawal:
Acute alcohol intoxication

- This is a transient condition due to acute ingestion of alcohol. Alcohol is a nervous system depressant.

  It causes loss of memory, confusion, disorientation, in-coordination and slurring, stupor and coma. Depression of vital centers controlling breathing (respiratory centre) and blood pressure (vasomotor Centre) may cause death.

Stages of Intoxication

1. Excitement (<100)- to be less critical and to lose control over one's moral integrity, feeble jokes.

2. Confusion (100-200)- a tendency to come to grief over longer words owing to slight in-coordination, to slur speech, to lose control over finer movements, slight blurring of vision, and inability to perform coordinated acts, such as writing or driving a car.

3. Stupor (>200)- the dead drunk stage from which the subject can only be aroused in response to strong stimuli.

- Physical clues are blood-shot eyes, dilated pupils, rapid bounding pulse, physical inco-ordination and nystagmus (jerking eye movements) on lateral gaze.
COMPLICATIONS OF EXCESSIVE ALCOHOL INTAKE

Physical, psychological and social complications are not confined to alcoholics, they can affect any individual who drinks heavily for a prolonged period.

a) Physical

2. Liver: fatty liver; alcoholic hepatitis; alcoholic cirrhosis.

3. Cardiovascular System: hypertension; cardiomyopathy and wet beri-beri (thiamine deficiency).

4. Central Nervous System: cerebral atrophy (alcoholic dementia); Wernicke-Korsakoff Syndrome due to thiamine (vitamin B deficiency); cerebellar degeneration, central pontine myelinosis, and peripheral neuropathy.

5. Metabolic Effects: imbalance of metabolism of many bodily compounds including glucose, uric acid, phosphate, magnesium, potassium, fats and proteins.


Healthy Liver

Unhealthy Liver

Depicts a liver with Cirrhosis which is a serious liver disease commonly caused by alcohol abuse.
MORE ABOUT ALCOHOL EFFECT

Skin = vasodilation and hypothermia
Respiratory = aspiration pneumonia
Blood = anemia and leukopenia
GIT = liver cirrhosis, pancreatitis, gastritis, peptic ulcer, portal varices
Reproductive:
♂ = Irregular period, breast & genital atrophy
♀ = Loss of libido, decrease sperm count, testicular atrophy
Pregnancy = spontaneous abortion, fetal alcoholic syndrome, delayed mental and motor development in child lactating from alcoholic mom,
b) Psychological
- Anxiety, depression, high suicide risk, dementia, pathological jealousy, alcoholic hallucinosis, sexual dysfunction.

c) Social
- Marital & family problems, including domestic violence, Work problems, unemployment, Road accidents and crime.
ALCOHOL AND CANCER

-Liver CA or hepatocellular ca:
  Is one of the most common cancers in the world
  Majority of People who get HCC have cirrhosis
  -Ethanol increase risk of breast and prostate CA
  -Ethanol aid CA development with known Hepatitis B & C
CAUSES OF DEATH IN CHRONIC ALCOHOLICS

1. **Trauma.** The largest group (26%).
   Fire deaths were the most common. Drunken falls were frequently followed by fatal head injury. Murder, Road traffic accidents (pedestrians), Drowning, Accidental poisonings.

2. **Incidental Natural Disease** (25%). Ischemic heart disease, cerebral hemorrhage, chronic obstructive airways disease and malignancy.

3. **Alcohol Related Disease** (22%). Bronchopneumonia and lobar pneumonia are the commonest. Cirrhosis of the liver due to ruptured varices or hepatic failure. Many of these deaths occur in hospital and are excluded from forensic practice. Alcoholic cardiomyopathy and pancreatitis are other rarely reported causes of death.

4. **Acute Intoxication** (24%).
   Possible mechanisms of death from simple intoxication:
   1. Simple depression of the respiratory centre in lower brain stem by alcohol itself.
   2. Inhalation of vomit due to coma.
   3. Postural asphyxia (obstruction of the upper airway by the swallowed tongue during coma.

5. **'Obscure' cause of Death** is noted in a variable proportion of cases, up to 10%.

6. **Hypothermia** may follow severe intoxication or injury.
Post mortem redistribution of unabsorbed alcohol in the stomach (or in the airways following aspiration of stomach contents) passing by diffusion into central blood vessels (heart, inferior vena cava, pulmonary artery, pulmonary veins, aorta).

- There can be up to 400% difference between central & peripheral sites. Blood should be taken from peripheral veins (femoral vein in pelvis) to avoid this possible art effect.

Post mortem Microbial alcohol production. Activity due to bacteria & yeast present in the bloodstream, acting on glucose and lactate, can result in spurious alcohol production in the body or within a specimen tube (in vitro).

- Production favored by warm environment, septicemia (bacteria in bloodstream at time of death), hyperglycemia (substrate for fermentation), severe disruptive trauma (allows spread of bacteria).
- Production inhibited by refrigeration, use of Fluoride/Oxalate preservative in collection tube (prevents further fermentation).
DRINKING AND DRIVING

- 10% of all accidents involving injury result from driving with excess alcohol.
- 33% of drivers and motor cyclists killed are over the legal limit.
- 1,000 people are killed every year. 30,000 are injured.

Regulations:
- It is considered a criminal offense if driving while intoxicated
  - Blood Alcohol concentration that is considered illegal by country:
    - USA ~ >0.08% (8g in 10 liters)
    - UK ~ > 80 mg/100ml
    - Jordan ~ 0.00
THANK YOU