Alcohol the Brain
and Other Effects
Current Alcohol Use

Most people who drink today are social drinkers. Factors that affect the extent of alcohol consumption include:

- **Cost**: (as cost levels increase, consumption tends to decrease)
- **Age**
- **Social norms for area, culture, and ethnicity**
  - Rural community patterns; Areas with high density of liquor outlets
  - College Students (binge drinking highest)
  - Ethnicity- 61% of blacks abstain; 59% of Latinos; 38% Whites; Native American have wide tribal variance
Alcohol Beverages

Ethyl Alcohol (the drinkable alcohol) is produced when certain yeasts, the carbon, hydrogen, and oxygen of sugar and water are transformed in a process called *Fermentation*. Natural processes produce alcohol contents up to 14%--distillation can increase this.

A Standard Drink represents just over 1 oz of absolute alcohol. This is equal to the alcohol in:

- One 12 oz (5% alc) Beer
- One 6 oz glass of fortified wine (12-17% alc)
- One hard liquor drink made with 1.5 oz of 80 proof liquor
The Pharmacology of Alcohol

The breakdown of alcohol in the liver is as follows:

- Alcohol is converted to Acetaldehyde by alcohol dehydrogenase.
- Acetaldehyde is then converted to Acetic Acid by acetaldehyde dehydrogenase.
- Acetic Acid, Water, and CO₂ are eliminated through the Kidney.

Males and Females absorb ETOH at different rates:
- Avg male body larger and has more water
- Men have more gastric ADH
- Birth control pills and hormone levels may increase ETOH absorption for some women
Neurotransmitters

neurotransmitter effects when alcohol is consumed.

dopamine makes you happy
endogenous opioids make you euphoric and feel no pain

glutamate the main excitatory neurotransmitter
GABA – the main inhibitory neurotransmitter
Alcohol Neuronal Activity

1. Alcohol is ingested.

2. The brain’s natural endogenous opioids are first released from the arcuate nucleus, which activates the areas of the brain known as the ventral tegmental area and the nucleus accumbens.
Alcohol Neuronal Activity

3. In response to this increased endogenous opioid activity, dopamine is released.

4. Since dopamine is a main reward neurotransmitter, increases in the nucleus accumbens makes the drinker feel good.

5. The brain remembers those good feelings caused by the dopamine and alcohol.

6. The brain desires to repeat the behavior again to get the same good feelings.
Another Neuronal Activity
(at the same time…)

1. Alcohol is ingested.

2. GABA, a major inhibitory neurotransmitter, effects are increased and creates an imbalance in the brain.

3. The brain is constantly trying to maintain a balance of inhibitory and excitatory signals so homeostasis can be achieved, and this effective “increase” in GABA caused by alcohol creates an imbalance.

4. The excitatory signals of glutamate are overridden by alcohol’s inhibition of the NMDA receptor, and the body generally slows down.
5. So, the brain increases the amount of NMDA receptors available for glutamate, in hopes that more opportunities for activation will yield more activity. This process is called upregulation.

6. Net effect, the body slows down in a progressive manner from fine activities to gross/global activities
PHYSICAL EFFECTS OF CHRONIC ALCOHOL INGESTION

Gastrointestinal- Alcohol interferes with GI functioning (direct injury to tissue) and promotes malabsorption of nutrients:

- Thiamine- deficiencies contributes to CNS problems
- Niacin- dermatitis, diarrhea, dementia
- Folate- peripheral neuropathy; anemia
- Zinc and Magnesium- needed for healthy cellular functioning; deficiency leads to muscular irritability and possible seizure
- Vitamins A, D and K- malnutrition and alcohol induced organ damage
PHYSICAL EFFECTS OF CHRONIC ALCOHOL INGESTION- Cont.

- Hepatic- Enlargement of liver with cirrhosis occurs in 5-10% of alcoholics
- Pancreas- Nutritional abnormalities, fat accumulation, overall state of inflammation
- Cardiovascular- elevated BP, HR, cardiomyopathy
- Endocrine- Hypoglycemia followed by hypoglycemia; dehydration; disrupts sex hormone production
- Musculoskeletal- inflammation, necrosis, and nerve damage
- Blood- interferes with iron metabolism-anemia
There are a couple of medications that can help...

Acamprosate

Naltrexone
How Does Acamprosate Work?

- When alcohol is not present in a dependent’s body:
  1. Glutamate behaves normally.
  2. But there are more NMDA receptors due to upregulation, so there is more glutamate activity than normal.
  3. Since glutamate is the main excitatory neurotransmitter, the normal balance between inhibitory and excitatory is altered, resulting in alcohol withdrawal.
How Does Acamprosate Work?

During alcohol withdrawal, the depressant effects of alcohol are no longer present to counteract the effect of the increased glutamate activity, which is complicated by decreased GABA function.

- Symptoms such as...
  - hallucinations
  - tremors/seizures
  - insomnia
  - dysphoria
  - mood disturbances
  - anxiety

...can become a powerful motive for people to resume their drinking.
How Does Acamprosate Work?

- reduces glutamate activity by “monitoring” the amount of glutamate that can react at the NMDA receptors
- limits the amount of glutamate released by the neuron

\[ \text{A} = \text{acamprosate} \]

Pre-Synaptic Neuron

Post-Synaptic Neuron

\[ \text{NMDA Receptor} \]

\[ \text{Glutamate} \]
How Does Acamprosate Work?

Normal
- Inhibition (GABA)
- Excitation (Glutamate)

Acute Alcohol Intake
- Alcohol

Tolerance
- Alcohol
- Adaptation

Acute Withdrawal
- Adaptation

Post-Acute Withdrawal
- Adaptation

Normalcy Restored
- A
How Does Naltrexone Work?

Naltrexone is an opioid receptor antagonist and blocks opioid receptors.

By blocking opioid receptors, the “reward” and acute reinforcing effects from dopamine are diminished, and alcohol consumption is reduced.