Neurotransmitters – part 3

Anatomy 36
Unit 2
Pathophysiology and Pharmacology

**Pathophysiology**

Disorders of physiological processes associated with disease or injury

Identifying what is not working correctly and why

**Pharmacology**

The uses, effects and mechanisms of drug actions

Treating disorders with medication therapies
Pathophysiology of Chemical Messengers

• Some people have chemical imbalances (*pathophysiology*)

• There are numerous types of medications to help to correct those imbalances to bring the levels back into the normal range (*pharmacology*)
  
  • There are medications that will **INCREASE** neurotransmission
    • Increase the activity of the postsynaptic cells
  
  • There are medications that will **DECREASE** neurotransmission
    • Decrease the activity of the postsynaptic cells
INCREASING Neurotransmission

• Make the NT *more* available
  • Increase the availability of NT for receptor activation
  • Use an agonist NT
    • An exogenous form of the NT
    • A synthetic version of the NT
  • Use a precursor so the body could make more of the NT
• Use a chemical that increases the affinity of the NT
• Prevent the clearance of the NT
  • Prevent reuptake
  • Inhibit the enzymes that deactivate the chemical messenger
**DECREASING** Neurotransmission

- Make the NT *less* available
  - Decrease the availability of NT for receptor activation
- Block the receptors for the chemical messenger
Cardiovascular Disorders

- Hypertension treatments
  - Beta blockers, alpha blockers
  - Diuretics
  - ACE inhibitors

- Hypotension treatments
  - Alpha agonists
  - Sympathomimetics
  - DDCI (dopa-decarboxylase inhibitor)

- Congestive heart failure treatments
  - Beta blockers
  - ACE inhibitors
  - Aldosterone antagonist
Learning Disorders

• There are 2 neurotransmitters implicated in ADHD
  • Norepinephrine
  • Dopamine

• Adderall
  • Amphetamine type of stimulant
  • Increases levels of NE and DA

• Ritalin
  • Stimulant
  • Increases levels of NE and DA

Video: 2-Minute Neuroscience: Amphetamines

Video: Stimulants (Ritalin and Adderall) Explained in 3 Minutes
Neurodegenerative Disorders

• Parkinson’s Disease
  • The disease results in a death of dopaminergic neurons in the substantia nigra
  • Symptoms: loss of smell, tremors, rigidity, bradykinesia, impaired posture and balance, changes in speech and writing
  • Treatments: L-Dopa, cholinesterase inhibitors (increases cognitive function), anticholinergics

• Videos
  • Putting it all together - Pathophysiology of Parkinson's disease | NCLEX-RN | Khan Academy
  • 2-Minte Neuroscience: Parkinson’s Disease
  • Pharmacology - DRUGS FOR ARKINSON'S DISEASE (MADE EASY)
Neurodegenerative Disorders

- Alzheimer’s Disease
  - Initially affects neurons in the entorhinal cortex (communicates with the hippocampus, involved in memory) and the hippocampus
  - Later affects to other parts of the brain including the cortex
  - 2 proteins become toxic to neurons
    - Tau proteins form tangles inside the neuron
    - Beta-amyloid proteins form plaques between neurons
  - Neurons begin to die and the brain shrinks

- Videos
  - How Alzheimer’s Changes the Brain
  - Mechanisms and secrets of Alzheimer's disease: exploring the brain
  - Pharmacology - DRUGS FOR ALZHEIMER'S DISEASE (MADE EASY)
Mood Disorders

**CHEMICAL CONTROL OUR EMOTIONS**

- Schizophrenia: dopamine
- Anxiety: serotonin
- Happiness: oxytocin
- Depression: norepinephrine
- Love: epinephrine
- Stress: norepinephrine
Mood Disorders

- Depression
  - Low levels of Serotonin implicated in depressed mood
    - Treatment includes SSRI’s
    - Selective serotonin reuptake inhibitor
  - Low levels of NE and DA also implicated in depressed mood
    - Tricyclics antidepressants
    - MAOI’s

- Anxiety
  - Benzodiazepines prescribed to calm your mind with increased anxiety (Xanax, Valium, Ativan)
  - Bind to GABA receptors and make them more sensitive to GABA
  - Benzodiazepines are also used as muscle relaxers

Videos:

Pharmacology - ANTIDEPRESSANTS - SSRIs, SNRIs, TCAs, MAOIs, Lithium (MADE EASY)

Pharmacology - BENZODIAZEPINES, BARBITURATES, HYPNOTICS (MADE EASY)
TOP 3 SUBSTANCES USED BY COLLEGE STUDENTS IN 2016

78.9%  39.3%  9.9%

ALCOHOL  MARIJUANA  ADDERALL
Alcohol

• Alcohol is a depressant
• In the brain, alcohol decreases Glutamate (Glu) and increases GABA
• Increases the amount of Dopamine (DA) in the reward pathway
• Alcohol affects many parts of the brain
  • Cortex
  • Midbrain
  • Cerebellum
  • Hypothalamus
  • Pituitary
  • Medulla

Your Brain on Drugs: Alcohol
Marijuana

- Marijuana has a chemical in it called **THC** (tetrahydrocannabinol) that resembles a naturally producing chemical in your brain called **anandamide**

- Anandamide
  - Regulates pain, appetite suppression, pleasure, reward
    - Found in chocolate
  - Causes the sensation of happiness
  - Binds to cannabinoid receptors in the brain
Cocaine

• Acts on your limbic system – reward and motivation
  • Primarily affects the VTA (nucleus accumbens), hippocampus, amygdala

• Cocaine Inhibits reuptake of DA
  • Blocks the dopamine transporter
  • Increases the amount of Dopamine (DA) available
  • Also inhibits reuptake of 5-HT and NE

• Nicotine, Amphetamines work similarly

2-Minute Neuroscience: Effects of Cocaine
MDMA or Molly or Ecstasy

- Increases level of Serotonin (5-HT)
  - Also NE and DA
- Reverses the activity of serotonin reuptake transporters (SERTs)
  - Causes efflux of Serotonin
- Video
  
  Your Brain On MDMA