Psychobiology Handout

STRUCTURE AND FUNCTION OF THE BRAIN

Psychiatric illness and the treatment of psychiatric illness alter brain functioning. Some examples of this are the following:

1. Monitoring of the external world
   - Altered sensory experience
     - e.g. hallucinations, illusions

2. Control over skeletal muscles
   - Movement disturbances
     - Extrapyramidal symptoms
     - Respiratory alterations
     - Slurred speech

3. Regulating internal muscles
   - Autonomic nervous system
     - blood pressure alterations
   - Parasympathetic nervous system
     - Anxiety
   - Endocrine regulation
     - Menstrual cycle irregularities
     - Stress response
   - Regulating basic drives
     - Overeating or undereating
     - Low sexual drive

4. Regulating sleep cycle
   - Sleep disturbance
   - Hypervigilance
   - Drowsiness

5. Mood
6. Neurotransmitter dysregulation
   - Serotonin
   - Norepinephrine

7. Conscious experience
   - Distorted thought patterns
     ➢ delusions
   - Disorganized speech
     ➢ Word salad

8. Memory
   - Inability to retain or recall past experience
   - Learning disorders

**CELLULAR COMPOSITION OF THE BRAIN**

Neurons
   - Specialized cells of the CNS
   - Respond to stimuli
   - Conduct electrical impulses
     ➢ Inward flow of sodium ions
     ➢ Outward flow of potassium ions
     ➢ Change in polarity
     ➢ Electrical charge from dendrite to axon

Release of neurotransmitters (NT)
   - NT released into synaptic cleft
   - NT attaches to surface of next neuron
   - NT then detaches and is destroyed is taken back up in original neuron to be reused or destroyed (reuptake)

**ORGANIZATION OF THE NERVOUS SYSTEM**

Brainstem
   - Regulates internal organs
     ➢ Vital functions
     ➢ Initial processing center for sensory information
     ➢ Reticular activating system (RAS)
       ➢ Sleep-wake cycles
       ➢ Focused mental activity
   - Determines emotional meaning of sensory stimuli
Cerebellum
- Regulates skeletal muscle coordination
- Maintains equilibrium

Cerebrum
- Responsible for mental activities
  - Conscious perception
  - Emotional states
  - Memory
  - Willful control of skeletal muscles
  - Language/communication
- Basal ganglia functions
  - Regulation of movement
- Amygdala and hippocampus functions
  - Emotions
  - Memory & learning
  - Basic drives

BRAIN IMPAIRMENT AND DISEASE

Frontal Cortex
- Schizophrenia
- Obsessive-Compulsive Disorder (OCD)

Prefrontal Cortex
- Depression

Limbic System
- Various disease symptomatology

MAJOR TARGETED NEUROTRANSMITTERS FOR PHARMACOLOGICAL RX

Monoamines
- Norepinephrine
- Dopamine
- Serotonin

Acetylcholine

GABA (gamma aminobutyric acid)
Corticotrophin-Releasing Hormone (CRH)

Endorphins

**MECHANISMIS OF ACTION OF PSYCHOTROPIC DRUGS**

Most psychotropic drugs act by either increasing or decreasing the activity of certain neurotransmitter systems.

**Antipsychotics**

1. Conventional (Standard, Typical or older drugs)
   - Phenothiazines and related classifications
     - Dopamine blockers
       - Motor disturbances due to basal ganglia blockade
       - Reduce the “positive” symptoms of Schizophrenia
     - Muscarinic blockers (acetylcholine)
       - Blurred vision, dry mouth, urinary retention, constipation
     - Alpha-1 receptor-blockers (norepinephrine)
       - Vasodilation & orthostatic hypotension
       - Ejaculatory failure
     - H-1 receptors (histamine)
       - Sedation
       - Weight gain

2. Atypical (Novel, newer drugs)
   - Very few, to no motor disturbances
   - Blocks D-2 in limbic system (not basal ganglia)
   - Target positive symptoms of Schizophrenia
   - Block receptors for serotonin
   - Target negative symptoms of Schizophrenia

   **Side-effect Profiles**
   - Clozapine
     - Agranulocytosis
     - Convulsions (infrequent)
     - Drowsiness
     - Hypersalivation
     - Tachycardia
     - Dizziness
Risperidone
- Orthostatic hypotension
- Sedation

Quetiapine
- Alpha-1 blockade effects
- Muscarinic blockade effects
- Minimal EPR effects
- Weight gain
- Sedation

Olanzapine
- No agranulocytosis
- Other S/E similar to clozapine
- WEIGHT GAIN (very severe problem)

Mood Stabilizers

1. Lithium
   - Unknown mechanism of action
   - Likely stabilizes electrical activity of brain by interaction with Na & K
   - Fluid balance disturbances
   - Cardiac dysrhythmias, convulsions, tremor
   - Requires close monitoring of lithium blood levels

2. Anticonvulsants
   - Alter electrical conductivity in the brain
   - Reduce the firing rate of neurons
   - Reduce mood swings of bipolar disorder
   - Drugs used include:
     - Tegretol (carbomezapine)
     - Depakote (divalproex sodium)
     - Klonopin (clonazepam)
     - Strongly sedating

Antidepressants

A deficiency of norepinephrine or serotonin or both is thought to be a causative factor in depression.

1. Typical (Standard) Antidepressants
   - Tricyclics (TCA’s)
     - Block reuptake of norepinephrine and to a lesser extent, serotonin thus increasing amounts of both in the synapse
     - Block muscarinic receptors
- Block histamine-1 receptors
- Names of TCA’s:
  - Anafranil (clomipramine)
    - Used for OCD also
  - Elavil (amitriptyline)
  - Tofranil (imipramine)
    - Used also for panic attacks
  - Pamelor (nortriptyline)

- Selective Serotonin Reuptake Inhibitors (SSRI’s)
  - Block the reuptake of serotonin
  - Minimal or no effect on other monoamine transmitters
  - Minimal blocking of muscarinic and H-1 receptors
  - Also used for OCD
  - Names of SSRI’s:
    - Prozac (fluoxetine)
    - Zoloft (sertraline)
      - Used also for social phobia
    - Paxil (paroxetine)
    - Citalopram (Celexa)

- Monoamine Oxidase Inhibitors (MAOI’s)
  - Inhibit the enzyme MAO from degrading monoamine neurotransmitters
  - Increase the availability of monoamine NT’s in the synapse
  - Risk of hypertensive crisis
    - Monoamine oxidase (MAO) in the liver is also inhibited
    - Tyramine injected in food cannot be degraded in the liver without MAO
    - Tyramine builds up to dangerous levels and goes into bloodstream
    - Increased tyramine in the blood can cause a life-threatening hypertensive crisis
    - Tyramine containing foods must be eliminated when a patient is on an MAOI
  - Names of MAOI’s:
    - Nardil (phenelzine)
    - Parnate (tranylcypromine)

2. Atypical (Novel) Antidepressants

- Mechanism of action is not clearly defined
- Act on serotonin by increasing and decreasing levels at different stages of neurotransmission
- Minimal affect on norepinephrine
- Names of Atypical Antidepressants
  - Desyrel (trazodone)
    - Orthostatic hypotension
    - Sedation
    - Minimal anticholinergic effects
  - Serzone (nefazodone)
    - No orthostatic hypotension
    - No sedation
- **Effexor (venlafaxine)**
  - Useful in severe depression
  - May cause anxiety, nausea and vomiting, dizziness
  - Impotence in males

- **Remeron (mirtazapine)**
  - Sedation and weight gain
  - Dry mouth and constipation

- **Wellbutrin (bupropion)**
  - Headache, insomnia, nausea, restlessness

**Antianxiety / Anxiolytics**

- Enhance GABA
- Sedative-hypnotic effect
- Reduction of anxiety
- Reduces seizure activity
- Reduces neuronal overexcitability in alcohol withdrawal
- Impairs motor activity, attention span, and judgment

- **Names of benzodiazepines:**
  - Valium (diazepam)
  - Klonopin (clonazepam)
  - Ativan (lorazepam)

- **Non-benzodiazepine:**
  - BuSpar (Buspirone hydrochloride)
  - Reduces anxiety
  - Minimal sedative-hypnotic effects