Brain Spinal cord

PERIPHERAL NERVOUS SYSTEM

Somatic Autonomic

Sympathetic Parasympathetic

CENTRAL NERVOUS SYSTEM

Brain Spinal cord

1/28/2014

Life-sustaining and life-protecting reflexes. Overdose deaths usually due to drug action in the medulla, interfering with regulation of breathing or cardiovascular function.

Motor coordination and balance. Drug action on cerebellum may cause slurring, stumbling, loss of balance.

Drug action in hypothalamus affects appetite, hormone levels, sexual function, autonomic emotional responses.

#1 Medulla

#2 Cerebellum

#3 Hypothalamus

The “4 F’s”

Structures Controlled by the ANS

1

2

3

#3 Hypothalamus

The “4 F’s”

Drugs in hypothalamus affect appetite, hormone levels, sexual function, autonomic emotional responses.
#4 Reticular Formation
Arouses brain for waking consciousness
A.k.a. “Reticular activating system”

Drug stimulation here may prevent sleep. Drug interference here can cause loss of consciousness.

#5 The Limbic System - Emotion Control System

- Fornix
- Thalamus
- Hypothalamus
- Amygdala
- Mamillary body
- Hippocampus

#6 Dopamine Pleasure/Reward System (aka mesolimbic pathway)
- Bundle of dopamine (DA) neurons from midbrain thru hypothalamus & nucleus accumbens, then on to cortex and limbic system

#7 Basal Ganglia or Extrapyramidal Motor System
- Initiating voluntary movements & keeping undesired movements in check

#8 Cortex
Drug action here affects judgment & reasoning, self-control, sensation/perception, contact with reality.
Neuron

Function depends on electrical messages within the neuron (the “nerve impulse” or “action potential”) and chemical messages between cells.

Synaptic Transmission

Cleaning Up Neurotransmitter

- Transmitter must be removed from synapse after its release & activation of receptors.
- Most neurotransmitters are recycled thru a process called “reuptake” – transported back into axon ending to be used again
- Less often an enzyme breaks down transmitter into inactive components.
- Clean up is critical to normal nervous system function.

Seven Processes in Neurotransmitter Action

The “Big Seven” (Best Known Neurotransmitters That our Psychoactive Drugs Will Influence)

- Acetylcholine (ACH)
- Norepinephrine (NE)
- Dopamine DA)
- Serotonin or 5-Hydroxytryptamine (SHT)
- GABA
- Endorphin
- Glutamate

http://www.uni.edu/walsh/neurotransmitters.html
• Acetylcholine (ACh)
  • neurons using ACh = “cholinergic neurons”
  • Where do you find them?
    • Nerves to skeletal muscle
    • Parasympathetic N.S.
    • Learning and memory areas of brain
  • some drugs (Cognex (tacrine), Aricept, Reminyl) increase Ach actions
  • others (“anticholinergics”) block its action

• Norepinephrine (NE)
  • Where do you find NE neurons?
    • Sympathetic N.S.
    • Brain areas involved in appetite, arousal, mood
  • Some drugs activate NE receptors (“sympathomimetics”)
  • others block NE receptors (e.g. “beta-blockers”)

• Dopamine (DA)
  • Very closely related to NE (“catecholamines”) and both NE & DA loosely related to serotonin (“monoamines”)
  • Where is it found?
    • basal ganglia (motor control)
    • limbic system (emotion, mood and “reward”)
    • frontal cortex (judgment & reasoning)
    • hypothalamus link to pituitary gland (hormone control)
  • some drugs increase DA (l-dopa)
  • others block DA (antipsychotics)

• Serotonin or 5 Hydroxytryptamine (5HT)
  • found in
    • sleep & pain suppression areas of brain,
    • in limbic system (mood)
    • in sensory processing areas
  • several drugs increase 5HT (antidepressants)
  • 5HT blockers are used to decrease nausea (e.g. Zofran)

• GABA
  • best known inhibitory transmitter
  • widely distributed in CNS
  • seems necessary to keep neuron activity “in check” - without enough of it you might suffer from excessive neural activity causing anxiety or epilepsy
  • several drugs increase the effects of GABA (benzodiazepines, alcohol)

• Glutamate
  • Amino acid which acts as an excitatory transmitter almost everywhere in the CNS
  • PCP blocks some glutamate receptors
Endorphins

- Peptide family of transmitters which decrease pain perception and elevate mood
- Narcotic analgesic drugs act on endorphin receptors

Ways Drugs May Affect Neurons

- Drugs may affect any of the normal neuron processes
  - Production of transmitter
  - Storage of transmitter in vesicles
  - Release of transmitter
  - Binding & action of transmitter at receptor sites
  - Elimination of transmitter by reuptake or enzymatic breakdown
- Drugs exert these actions by binding to proteins involved in these functions.
- The study of how drugs exert their effects on cells is “pharmacodynamics”

Drugs & Receptor Sites

- AGONIST: A drug that triggers or increases the usual synaptic effects of a transmitter
  - E.g. A drug which fits post-synaptic receptor sites and mimics action of transmitter
- ANTAGONIST: A drug prevents or decreases the usual synaptic effects of a transmitter
  - E.g. A drug which fits receptor site but does not trigger a response. This drug is a BLOCKER.

Drug Actions

- AGONIST examples:
  - Narcotic pain relievers fit and activate opioid receptors mimicking the action of normal endorphin.
  - Nicotine fits into & stimulates ACh receptor sites, arousing the cortex like ACh
- ANTAGONIST examples:
  - Haldol blocks DA receptors in schizos
  - Naloxone blocks opiate receptors
  - Atropine & curare (discussed earlier) block different types of ACh receptors