Autonomic Nervous System

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Nervous System

- **Central Nervous System**
  - brain & spinal cord

- **Peripheral Nervous System**
  - Cranial and peripheral nerves
    - Somatic nervous system
      - voluntary movement
    - Autonomic
Central Nervous System

Peripheral Nervous System

Somatic Nervous System

Autonomic Nervous System

Parasympathetic

Sympathetic

Alpha Receptors

Beta Receptors
Autonomic Nervous System

- Responsible for control of involuntary or visceral bodily functions
  - cardiovascular
  - respiratory
  - digestive
  - urinary
  - reproductive functions
- Key role in the bodies response to stress
Automonic Nervous System

- **Sympathetic nervous system**
  - allow body to function under stress
  - fight or flight

- **Parasympathetic nervous system**
  - controls vegetative functions
    - feed or breed or rest and repose
    - constant opposition to sympathetic system
Autonomic Nervous System

Parasympathetic:
- Constricts pupil
- Stimulates salivation
- Inhibits heart
- Constricts bronchi
- Stimulates digestive activity
- Stimulates gallbladder
- Contracts bladder
- Relaxes rectum

Sympathetic Ganglia:

Sympathetic:
- Dilates pupil
- Inhibits salivation
- Relaxes bronchi
- Accelerates heart
- Inhibits digestive activity
- Stimulates glucose release by liver
- Secretion of epinephrine and norepinephrine from kidney
- Relaxes bladder
- Contracts rectum
Major components

- Neuron
  - Sensory - Afferent
  - Motoneurons - Efferent

- Neurotransmitter
  - chemical substance which travels across a synaptic junction to act on a target cell.

- Effector Organs
  - specific tissues stimulated by the autonomic nervous system
Neuron

Sensory  Motoneuron
Neurotransmitters

- **Autonomic Nervous system**
  - activated by reflex centers located in the brain and spinal cord

- **Reflex arc**
  - complete circuit of nerves involved in an involuntary movement
  - From the stimuli to the effector organ
Neurotransmitters

- **Norepinephrine**
  - Post-ganglionic Neurotransmitter for the sympathetic Nervous system

- **Acetylcholine**
  - pre-ganglionic Neurotransmitter for both systems
  - Post-ganglionic neurotransmitter for the parasympathetic nervous system
Junction of Pre and Post synaptic neurons

- Neurotransmitter produced in presynaptic membrane
- Moves across synaptic space
- Binds with receptor on postsynaptic membrane
- Causes impulse potential
Synapse

Electric Current

Preganglionic Neuron

Neurotransmitter

Postganglionic Neuron

Rejuventated Electric Current

Neuroreceptor

MAO
Neurologic Conduction

- **Initiation**
  - Sensory bodies initiate impulse
    - depolarization
    - Afferent impulse

- **Conduction**
  - impulse is conducted along neuron to Synaptic Junction
  - Neurotransmitter is released
Neurologic Conduction

- **Synaptic Activity**
  - neurotransmitter is released
  - crosses synaptic cleft
  - Stimulates receptors on next neuron
  - Immediately, neurotransmitter is inactivated by enzyme (cholinesterase)
  - Action Potential is initiated along 2nd neuron

- *impulse travels down efferent neuron to Effector Gland or muscle*
Sympathetic

- Thoracolumbar
- Conduction takes place along very short neurons, effecting directly on gland or muscle

Parasympathetic

- Vagus Nerve
- Main regulator of Automatic functions
- Neuron pathways are much longer, making this a slower system
Reflex Arc

- **Craniosacral**
  - brain to affecter organ
  - parasympathetic nervous system

- **Thoracolumbar**
  - ganglia are located near the spine
  - makes for a quicker response
  - Sympathetic nervous system
Reflex Arc

- Reflex Arc
- complete circuit of nerves involved in involuntary movement
Sympathetic Nervous System

Thoraco-lumbar System

norepinephrine stimulates receptor directly

Terminal of postganglionic Fiber

synaptic junction ACh released
Sympathetic Stimulation

- stimulate sweat glands
- constrict peripheral vessels
- increase blood to skeletal muscles
- increase **chronotropic** and **inotropic** effects
- bronchodilation
- stimulation of NRG production
- reduce blood flow to abdomen
- decrease digestive activity
- relax smooth muscle in wall of bladder
- release glucose stores from liver
Adrenal Medulla

- This area of the nervous system is also stimulated by the release of norepinephrine.
  - This releases
    - noradrenalin & adrenalin
  - These are released into the body to also react with receptors and prolong the effects of sympathetic stimulation
Sympathetic Receptors

- As norepinephrine is released, it travels across the synaptic cleft and interacts with adrenergic receptors.
  - Epinephrine will also stimulate these receptors.
- Two Types of Sympathetic Receptors:
  - adrenergic
  - dopaminergic
Adrenergic Receptors

- **Alpha 1**
  - Peripheral Vasoconstriction
  - Positive inotropic effect
  - Negative chronotropic effect

- **Alpha 2**
  - Peripheral vasodilation
    - limits release of norepinephrine
  - stimulated by excessive amounts of Norepinephrine in synaptic cleft
Adrenergic Receptors

- **Beta 1**
  - positive *inotropic* effect on heart
    - increased contractility
  - positive *chronotropic* effect on heart
    - increased heart rate
  - positive *dromotropic* effect on heart
    - automaticity
Adrenergic Receptors

**Beta 2**
- Peripheral vasodilation
- Bronchodilation
- Uterine smooth muscle relaxation
- GI smooth muscle relaxation
- **Sympathomimetics**
  - meds that stimulate the sympathetic nervous system
- **Sympatholytics**
  - inhibit the sympathetic system
- **Alpha or Beta agonist**
  - stimulate Alpha sites
- **Alpha or Beta antagonists**
  - block effects of Beta stimulation
Parasympathetic Nervous System

- **Stimulation Results in:**
  - pupillary constriction
  - secretion by digestive glands
  - increased smooth muscle activity along GI tract
  - bronchoconstriction
  - reduced HR & negative Inotropic effects
Parasympathetic Nervous System

Craniosacral System

Vagus Nerve

ACh released

Post-ganglionic Fibers

Preganglionic Fibers
- **Parasympathomimetics**
  - stimulate parasympathetic nervous system
  - Physostigmine
    - Anticholinesterase inhibitor
      - OD of Atropine, Tricyclic Antidepressants, CO poisoning
      - Some research on improving Alzheimer's disease

- **Parasympatholytics**
  - block action of parasympathetic system
  - Atropine Sulfate
    - parasympathetic blocker
Cholinesterase inhibitors

Cholinesterase breaks down excess Acetylcholine shutting down the parasympathetic system. Exposure to some organophosphates (fertilizers) or biochemical weapons such as Sarin, Soman, Tabun bind up cholinesterase, preventing the system from shutting down and causing the signs below.

- **Salivation**
- **Lacrimation** (teary eyes)
- **Urination**
- **Defecation**
- **Gastric disturbance**
- **Emesis**

Antidote would be a Parasympathetic Blocking drug such as Atropine Sulphate.
Propranolol

- Pure Beta Blocker
- What effects will it have on Heart?
- What are some benefits in AMI?
- What are some potentially hazardous side effects?
Epinephrine

- **Alpha & Beta stimulator**

- **Alpha Effects**
  - arterioles in Bronchioles constrict
    - reducing edema
  - Peripheral vasoconstriction
    - increased B/P

- **Beta Effects**
  - Beta 1 - increases heart rate & CO
  - Beta 2 - bronchiole smooth muscle relaxes
    - increases lung capacity