CHAPTER 14 AUTONOMIC NERVOUS SYSTEM

Autonomic Nervous System

- visceral motor
  - effectors
    - smooth muscle of organs
    - cardiac muscle
    - glands

- controls vital bodily functions
- autonomic = w/o consciousness
- sensory neurons

visceral reflex arc

- ANS is motor portion of visceral reflex arc
- receptor
- sensory neuron
- integration
- motor neuron
- effector

ANS vs somatic efferent

- # neurons
  - somatic
    - 1 neuron (myelinated axon)
  - ANS
    - 2 neuron chain (2nd axon unmyelinated)
- neurotransmitters
  - somatic
    - acetylcholine
  - ANS
    - acetylcholine and norepinephrine

ANS has 2 peripheral neurons

- 1st neuron
  - pre-ganglionic axon
    - cell body in spinal cord or brain

- 2nd neuron
  - post-ganglionic axon
    - cell body in autonomic ganglion
    - synapse with target cells / organ

ANS Divisions

- Sympathetic
  - Thoraco-Lumbar division
    - T1 – L2
    - danger
      - “fight or flight”
    - 3 E’s
      - emergency
      - excitement
      - exercise

- Parasympathetic
  - Craniosacral division
    - cranial and sacral nerves
    - normal maintenance
      - “rest and digest”
    - 2 R’s
      - refueling
      - removal
• sympathetic parasympathetic
  fight or flight rest and digest
• from CNS T1 – L2 CN and sacral n.
• response widespread very local
• branching a lot very little
• ganglion near CNS on effector organ
• postganglionic long axons short axons
• cell bodies lateral horn T1-L2 brain stem sacral spinal cord
• neurotransmitter norepinephrine acetylcholine

Parasympathetic division

• craniosacral division
  — cranial outflow cranial nerves III, VII, IX, X
  — sacral outflow sacral spinal nerves S2 – S4
• preganglionic cell bodies
  — cranial CN nuclei in brain
  — sacral sacral segments of spinal cord
• ganglion – on/near effector organ
• neurotransmitter acetylcholine

Parasympathetic – cranial outflow

• CN III oculomotor n
  pupil constriction; accommodation
  — ciliary ganglion to iris, ciliary body
• CN VII facial n.
  — pterygopalatine ganglion to lacrimal gland
  — submandibular ganglion to submandibular gland sublingual gland
• CN IX glossopharyngeal n.
  — otic ganglion to parotid gland

Parasympathetic – cranial outflow

• CN X Vagus n.
  to: all organs of thorax and abdomen to 1st ½ of lg. intestine
• originates in medulla oblongata
• intramural ganglia in walls of effector organs
• P-ANS plexuses

Parasympathetic – sacral outflow

• S2 – S4 spinal nerves
• preganglionic neurons
  — = pelvic splanchnic nerves
• to distal ½ lg intestine and rectum
  urinary bladder, ureters reproductive organs
sympathetic division

- thoraco-lumbar division  T1 – L2 spinal levels
- preganglionic neurons  cell bodies in lateral horn
  axons into ventral root
- postganglionic neurons  long, branching
  in all spinal nerves!
- neurotransmitter  norepinephrine

sympathetic ganglia

- 3 locations:
  - sympathetic trunk ganglia
  - prevertebral ganglia
  - adrenal medulla

sympathetic trunk ganglia

- next to vertebral column
- ganglia all connected  sympathetic chain
- 2 neurons synapse in ganglion
- white ramus communicans  connect to ganglion
  pre-ganglionic axon
- gray ramus communicans  ganglion to spinal nerve
  post-ganglionic axon
- plural:  rami communicantes

sympathetic trunk - extensions

- ganglia:
  - superior cervical ganglion  head
  - middle cervical ganglion  salivary, heart
  - inferior cervical ganglion  heart
  - thoracic ganglia  heart, lungs
  - lumbar ganglia  abdomen

prevertebral ganglia

- effectors are abdominal organs
- splanchnic nerves to prevertebral ganglia
- ganglia near abdominal aorta
  - celiac  liver, stomach, spleen, kidney
  - superior mesenteric  small and lg intestine
  - inferior mesenteric  distal lg intestine and rectum
  - inferior hypogastric  bladder, reproductive organs

adrenal medulla

- inner part of adrenal gland

- made of postganglionic cells
  - chromaffin cells

- from T5 – T8
- secrete hormones:
  epinephrine (adrenaline)
  norepinephrine
visceral reflexes

- visceral sensory → CNS → autonomic (motor)
- sensory info causes organ response w/o CNS control

- swallow
- cough; sneeze
- urination and defecation
- blood pressure → medulla vasomotor centers
- heart rate → medulla cardiac centers
- respiratory rate → medulla respiratory centers
- pupil reflex
- digestive functions (enteric nervous system)

central control

- Hypothalamus - main integration of ANS function

- higher affects on Hypothalamus
  - Limbic system - emotions
  - Cerebral cortex - frontal lobe - thoughts

Sympathetic functions

- heart rate
- respiratory rate
- iris
- blood vessels - muscles
- blood vessels - skin
- adrenal medulla
- digestive functions:
  - sphincters
  - urinary bladder

Parasympathetic functions

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