Autonomic Nervous System

• How does this relate to rest of nervous system?
• What are its anatomical characteristics?
• What is its function?
• How can we use aspects of the ANS to understand/control health issues?

Overview of NS

• CNS: brain and spinal cord
• Peripheral NS
  – Afferent Sensory
  – Efferent Motor
    • Somatic Motor and Autonomic NS

Motor systems

• Somatic Motor NS
  – Skeletal muscle
    – “voluntary”
    – Always excitatory
• Autonomic NS
  – Cardiac and smooth muscle, glands
    – “Subconscious”
    – Excitatory and inhibitory
    – 3 subdivision

Autonomic NS (ANS)

• Sympathetic (SNS)
• Parasympathetic (PSNS)
• Enteric (in gastrointestinal system)
• ANS influences all physiological regulatory systems
• Even skeletal muscle blood supply

Reflexes

• Somatic reflexes
  – e.g. withdrawal reflex, stretch reflex
• Visceral reflexes involved in homeostasis
  – e.g. baroreceptor reflex controls heart and arteries

Other differences in ANS and somatic NS

• Main neurotransmitters
• Nerve terminal with effector (neuromuscular junction vs varicosities)
• Synapses outside CNS in ganglia
• Speed/integration
• “tone”
• See Fig 17.1
SNS vs. PSNS (Figs 17.2 and 17.3)

- Origin: thoracolumbar vs craniosacral
  - Note Vagus nerve, PSNS fibers to viscera
- Ganglia: close vs. far from spinal cord
  - Sympathetic trunk ganglia & prevertebral ganglia vs terminal ganglia
- Preganglionic axon: short vs long
- Neurotransmitters: Acetylcholine (Ach) and norepinephrine (NE) vs Ach
  - (cholinergic and adrenergic)

Differences in SNS and PSNS, cont.

- Distribution: everywhere vs. head, thorax, abdomen and pelvis
- Pre:post: 1:20 vs 1:4 (diverge to many effectors vs. localized within effector)
- Function:
  - SNS: mass activation, emergency (fight or flight response)
  - PSNS: discrete homeostatic, “vegetative” or “housekeeping” functions

Adrenal Gland - special case of SNS

- Modified post-ganglionic cells
- SNS activates
- Release epinephrine (E) and NE (1:4)
- Hormones in blood
- Extend the fight or flight response
- Important in liver to increase blood glucose

Adrenal Medulla

- Iris (dilate vs. constrict pupil)
- Ciliary muscle to focus (far vs. near)
- Salivary glands (viscous vs. dilute saliva)
- Heart rate (increase vs decrease)
- Bronchioles (dilate vs. constrict)
- GI tract motility and secretions (inhibit vs stimulate)

Sympathetic vs parasympathetic fibers & neurotransmitters

Dual innervation (more control with brake and accelerator)
Some effectors only have one type of input

- Most arterioles (SNS)
- Mucus gland in lungs (PSNS)
- Hair follicles (SNS)

Neurotransmitters (NT) and receptors of ANS

- Basis for much of pharmacology
- Drugs to modify or mimic ANS
- Effect of NT determined by cell membrane receptor and how cell responds
  - Agonist (mimic)
  - Antagonist (block the receptor)

Cholinergic neurons

- Nicotinic receptors (always excitatory)
  - Agonist = nicotine
  - Antagonist = curare
  - Found in skeletal muscle and autonomic ganglia
- Muscarinic Receptors (excitatory or inhibitory)
  - Agonist = muscarine
  - Antagonist = atropine, scopolamine
  - Found in PSNS postganglionic fibers, few SNS fibers (e.g. sweat glands)

(also see Fig 17.6)