Hypothalamus and autonomic system

- Functional overview of hypothalamus
- Autonomic motor system
  - Basic organization
  - Sympathetic and parasympathetic systems
  - Central network
- Neuroendocrine system

Hypothalamus

- Can support basic bodily functions (e.g., eating, body temperature control, defense) without cortex and thalamus
- Mediates homeostasis - maintains stability of physiological variables of the body (chemical, temperature, blood pressure, etc) under different external conditions and behavioral states
- Acts on three systems
  - Autonomic motor system
  - Endocrine system
  - Motivation system

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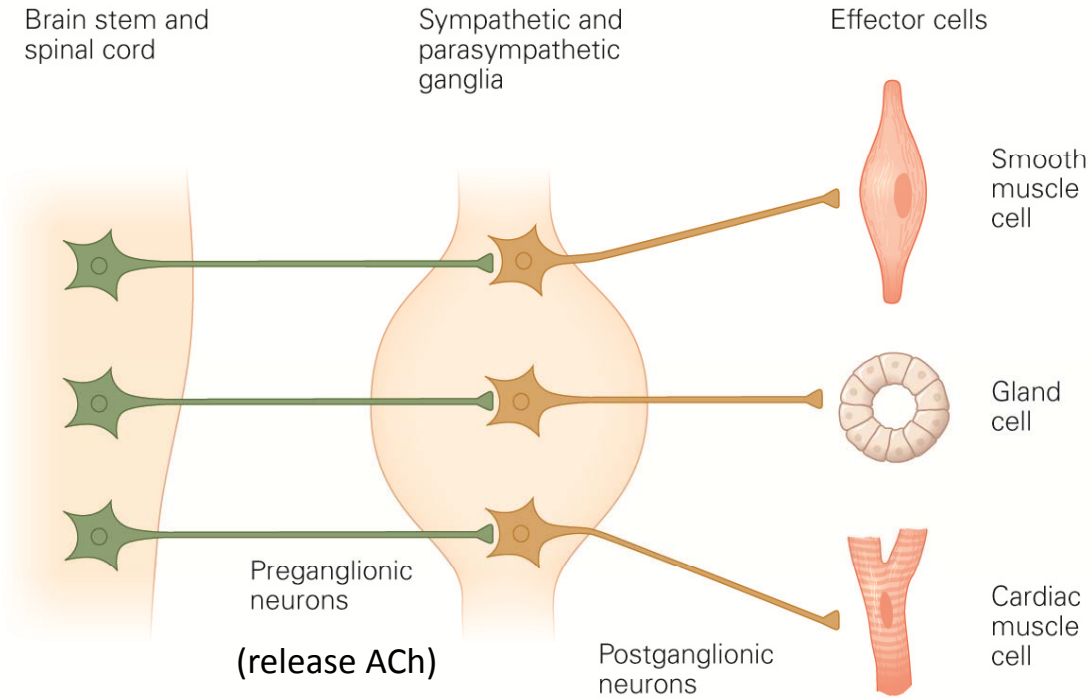
Autonomic motor system

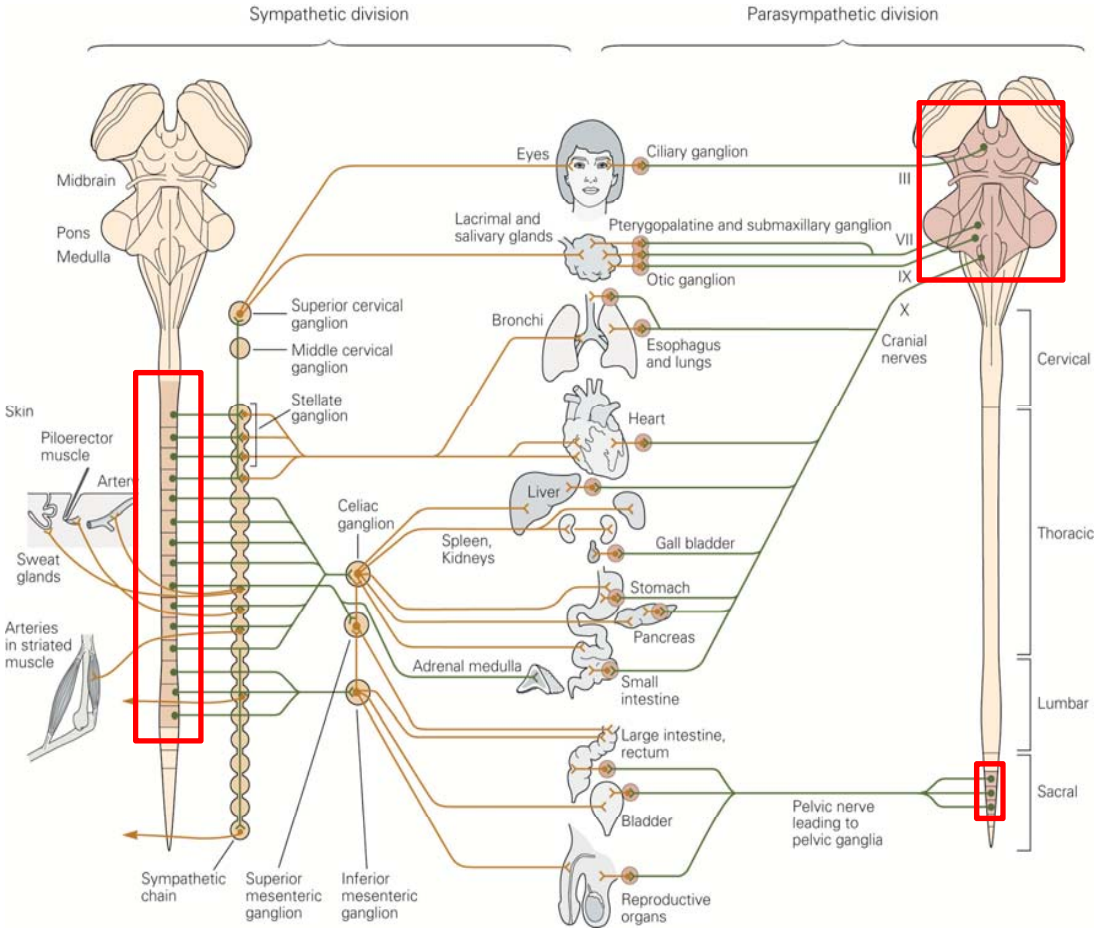
- Controls heart muscle, smooth muscle, exocrine glands

  Preganglionic → postganglionic→ effector cells

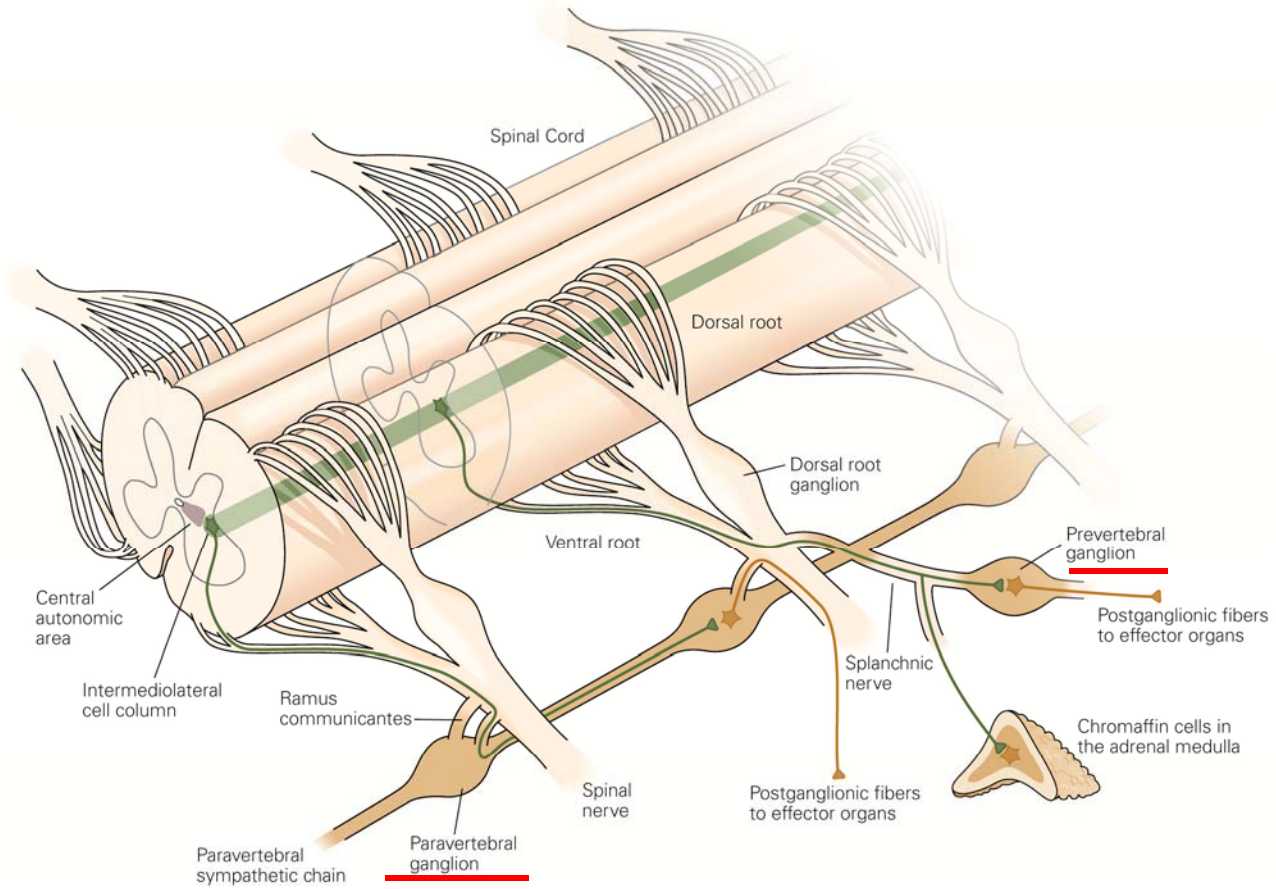
- Largely involuntary (different from somatic motor system), but coordinated with somatic motor system and linked to motivation and emotion



- Preganglionic neurons are organized in 3 zones (red boxes)
- Postganglionic neurons
  - Sympathetic ganglia are organized in a chain near the spinal cord
  - Parasympathetic ganglia lie near the organs they innervate
  - Enteric ganglia regulates gastrointestinal tract



Sympathetic ganglia



- Preganglionic cells
- Postganglionic cells

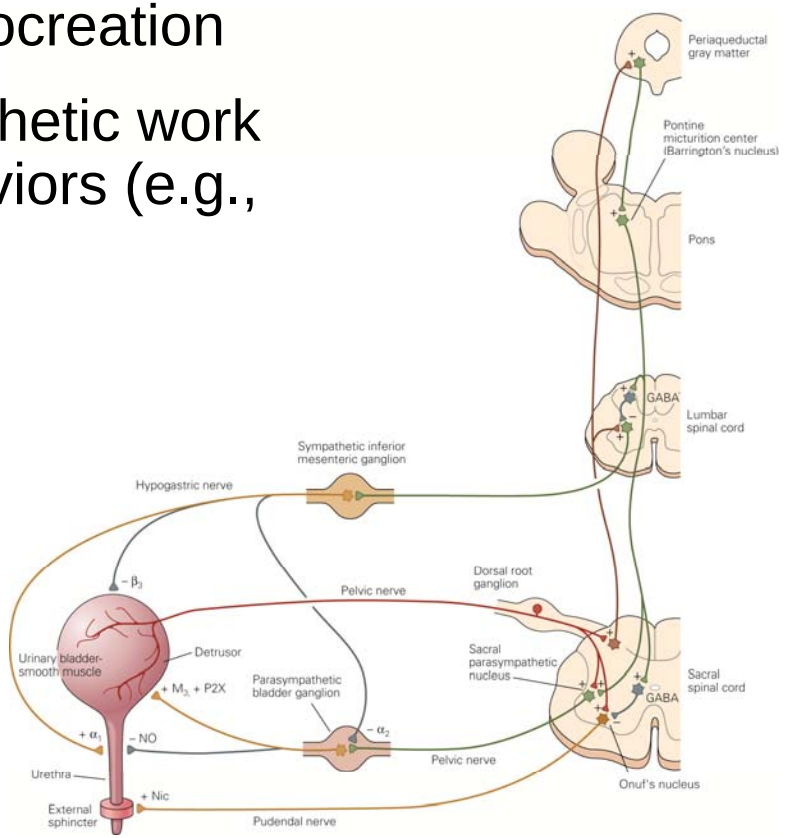
Roles of sympathetic and parasympathetic systems

- Sympathetic – arousal, defense, escape (fight-or-flight)
- Parasympathetic – eating, procreation
- Sympathetic and parasympathetic work together during various behaviors (e.g., micturition reflex)

  • Parasympathetic – contracts bladder & relaxes urethra

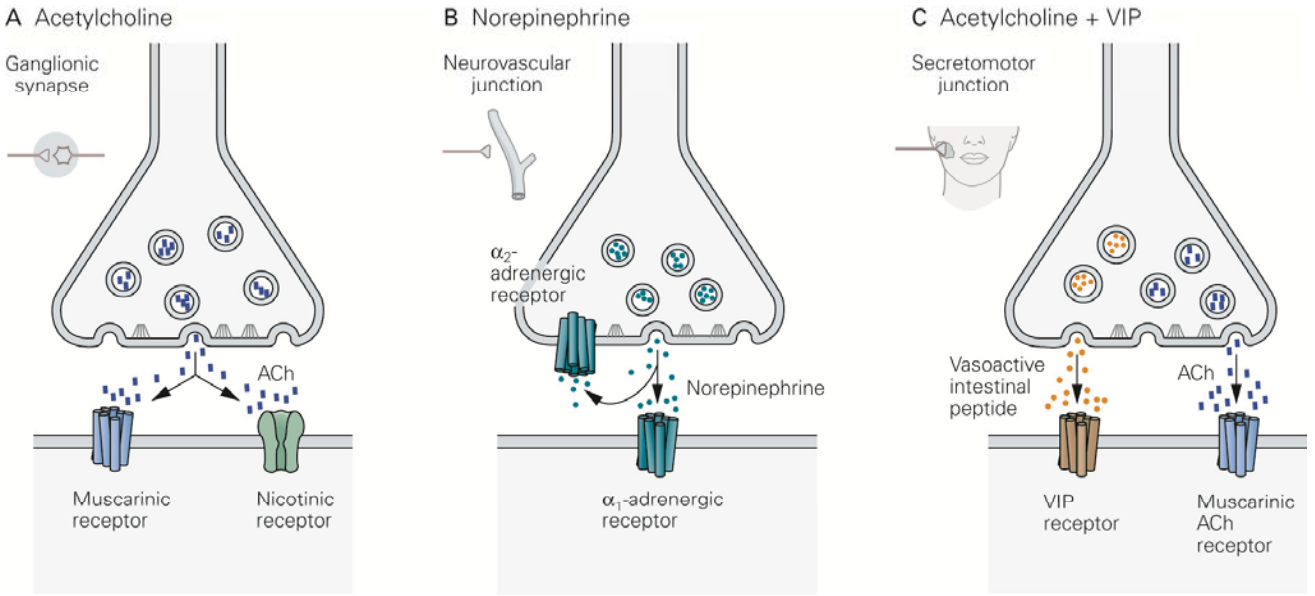
  • Sympathetic – stimulates urethra & inhibit parasympathetic

  • Sensory signal (bladder full) activates the pontine micturition center, activates parasympathetic pathway



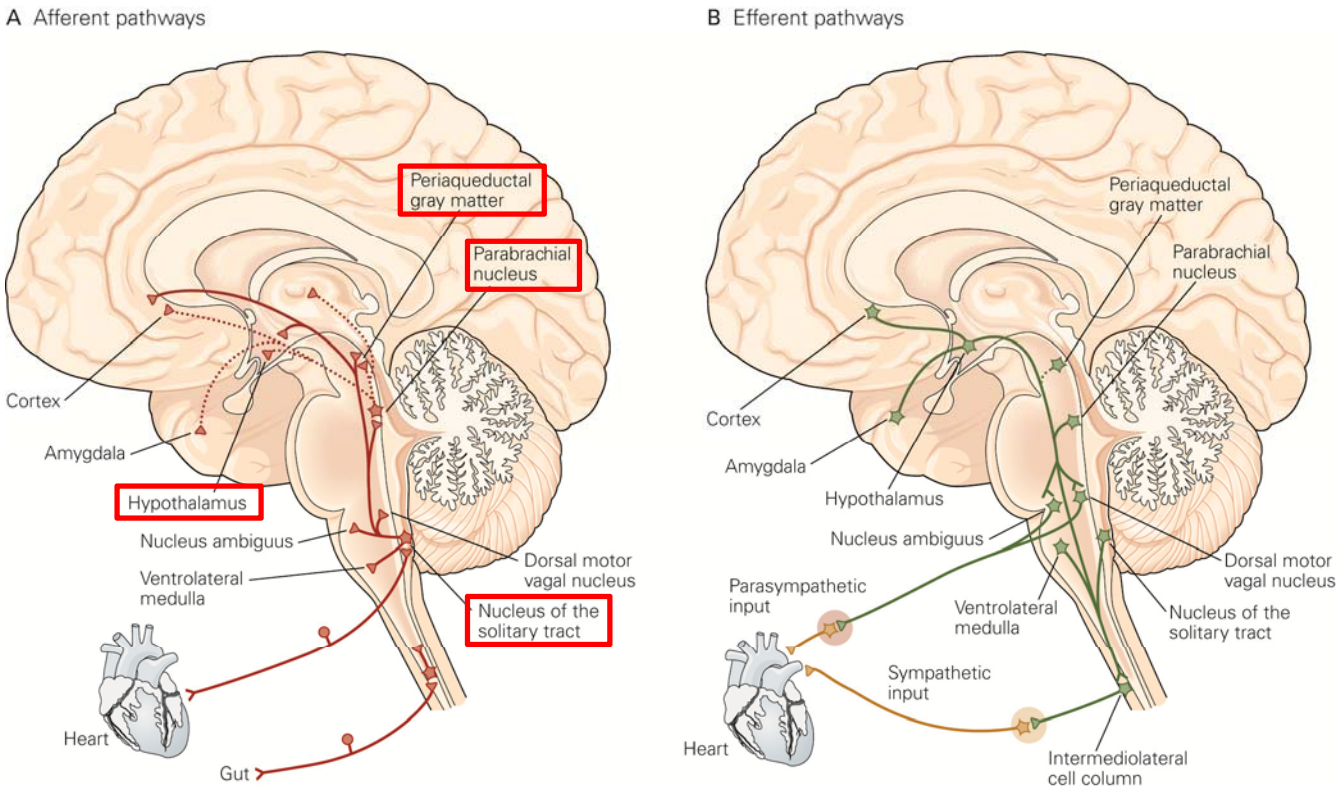
Synaptic transmission

- One transmitter can act on multiple receptor types in the same postsynaptic cell
- One transmitter can act on both presynaptic terminals and postsynaptic cells
- Each cell often co-releases multiple transmitters



Central autonomic network

- Afferent information – distributed from nucleus of the solitary tract to pons (PB), midbrain (PAG), and forebrain (hypothalamus)
- Efferent information – all the central structures project directly to the preganglionic neurons



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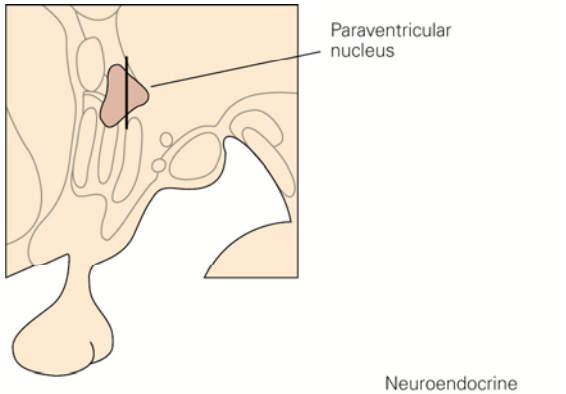
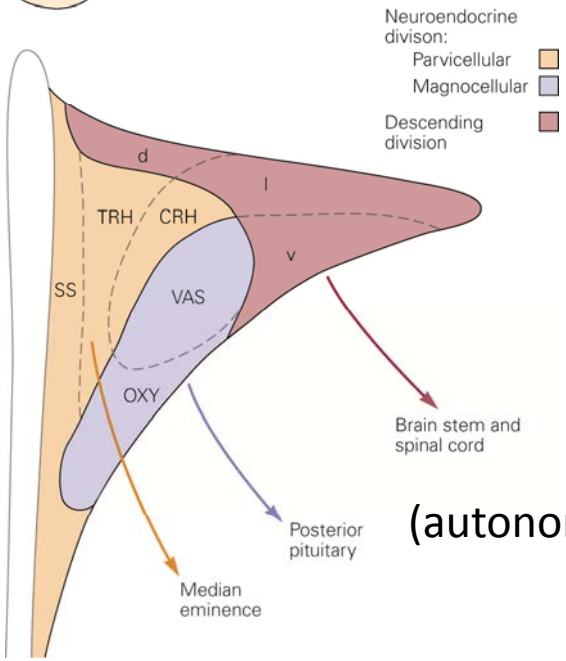
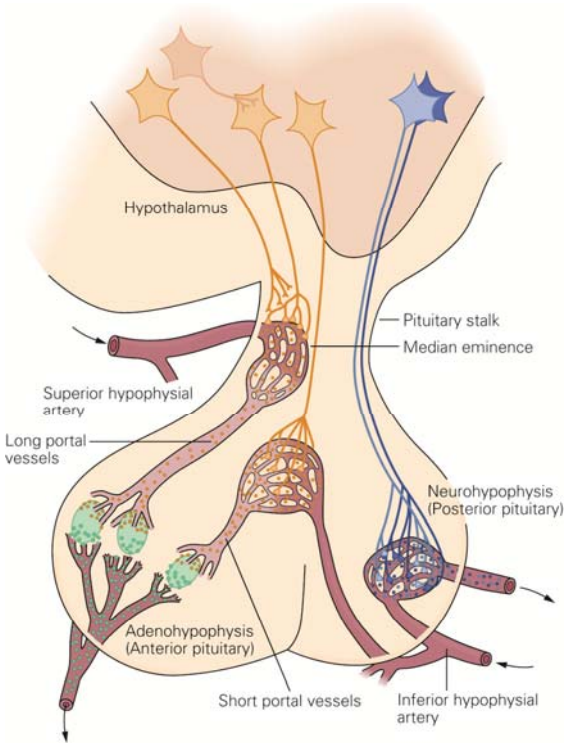
Neuroendocrine systems in paraventricular nucleus of hypothalamus

- Magnocellular neurons
  - Project to posterior pituitary
  - Release oxytocin and vasopressin (blood pressure, water balance, milk release)
- Parvicellular neurons
  - Project to median eminence to control anterior pituitary hormone secretion
  - Release corticotropin-releasing hormone (CRH), thyrotropin-releasing hormone (TRH), somatostatin (SS), etc.
  - Common pathway for centrally mediated stress response (HPA axis)

CRH release (hypoth.) → ACTH release (ant. pituitary) → cortisol release (adrenal cortex)







(autonomic