Medical Neuroscience | Tutorial Notes

Upper Motor Neuronal Control—Brainstem

Map to Neuroscience Core Concepts[1]

NCC1. The brain is the body's most complex organ.

NCC3. Genetically determined circuits are the foundation of the nervous system.

NCC4. Life experiences change the nervous system.

Learning Objectives

After study of the assigned learning materials, the student will:

1. Discuss the neural centers that give rise to medial descending projections from the brainstem to lower motor neurons.

Tutorial Outline

I. Motor Control Centers in the Brainstem: medial components for somatic motor control

- A. **vestibular nuclei**
  - 1. descending projections from the vestibular nuclei reach the medial ventral horn via medial and lateral vestibulospinal pathways (see **Figures 14.11** [2] & **17.2A**)
    - a. medial: to the upper cervical cord that regulates head and neck position
    - b. lateral: to motor neurons in the medial ventral horn that excite extensor muscles in the trunk and limbs
      - i. this pathway mediates balance adjustments and maintenance of an upright posture
      - ii. although this is called the "lateral vestibulospinal" projection, its termination is still within the *medial* motor neuron pools that innervate more proximal musculature
  - 2. these projections provide *sensory feedback* from the vestibular system that adjusts posture given changes in the movements of the head
- B. **reticular formation**
  - 1. a complicated network of neurons (reticular means "net") located in the core (i.e., tegmentum) of the brainstem (see **Figure 17.12** and **Box 17D**)

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[1] Visit **BrainFacts.org** for *Neuroscience Core Concepts* (©2012 Society for Neuroscience) that offer fundamental principles about the brain and nervous system, the most complex living structure known in the universe.

[2] Figure references to Purves et al., *Neuroscience, 5th Ed.*, Sinauer Assoc., Inc., 2012. [click here]

a. few discrete nuclei are easily recognized anatomically

b. clusters of neurons are scattered among long bundles of axons

2. descending projections from various pools of neurons synapse on interneurons in the medial ventral horn (see **Figure 17.11B**)

a. gives rise to *feedforward adjustments* of posture that anticipate changes in body biomechanics (see **Figures 17.1`3** & **17.14**)

b. reticular neurons receive input from "higher" motor centers in the cortex that account for anticipatory adjustments (see **Figure 17.15**)

3. among the other important functions of the reticular formation are:

a. regulation of sleep and wakefulness

b. regulation of general levels of arousal (and possibly attention)

c. coordination of lower motor neuronal pools in the brainstem and spinal cord (e.g., "gaze" centers for eye movements; see **Figure 20.8**)

d. control of critical cardiovascular and pulmonary functions

e. control of diverse visceral motor activities (e.g., micturition, defecation, vomiting, glandular secretions)

C. **superior colliculus** (see **Figure 20.9**)

1. integrates sensory information and produces *reflexive gaze shifts* toward sensory stimuli that usually require postural adjustments

2. projects (mainly indirectly) to the medial ventral horn of the cervical enlargement (via connections through the reticular formation) to coordinate *orienting response* of head and neck

STUDY QUESTION

Imagine that you are a runner at the starting line of a race and you are anticipating the sound of the starter's signal. You are in the "ready … set" posture awaiting the "go" signal. Your body is ready for action at the sound of that signal. Which descending tract provides the appropriate signals that prepare the body for action in advance of the "go" signal?

A. medial vestibulospinal tract
B. lateral vestibulospinal tract
C. lateral corticospinal tract
D. reticulospinal tract
E. tectospinal tract