

Lecture 25 -- Cerebellum -- Martin

Lecture Plan

- 1) Cerebellar clinical signs
- 2) functional anatomy (mediolateral zones)
- 3) cerebellar functions

Cerebellar clinical signs (PNS: p. 849-850; Fig. 42-16)

- 1) hypometria and delayed movement onset
- 2) ataxia
- 3) impairments in rapid alternating movements

Functional anatomy of the cerebellum

Motor hierarchy

- influences motor behavior not by driving motoneurons directly, but rather by its influence on the motor pathways
- Cerebellum—neither high nor low, but all levels

Anatomy of the cerebellum (fig. 42-1, 2, 3)

Cortex—folia, many many neurons

Anterior lobe (limbs and trunk)

Posterior lobe (limbs and trunk)

Flocculonodular lobe

3 pairs of deep nuclei (fastigial, interposed, dentate)

Peduncles—Inputs and outputs—superior, middle, and inferior

Cerebellar inputs (Fig. 42-4-6)

Climbing fibers, from inferior olivary nucleus

Mossy fibers, from various sources (spinal cord, vestibular nuclei, pontine nuclei, etc.)

Input-output organization

Inputs directed both to deep nuclei and cortex

Cortical output from Purkinje cells only; INHIBITORY

Purkinje cells project to deep nuclei (and vestibular nuclei)

Deep nuclei (EXCITATORY) project to motor systems

Medio-lateral cerebellar zones and their connections

1. Spinocerebellum (p. 841-844)

Vermis and fastigial nucleus

Intermediate hemisphere and interposed nuclei

2. Cerebro-cerebellum (p. 845-847)

Lateral hemisphere and dentate nucleus

3. Vestibulocerebellum (pg. 841)

Flocculonodular lobe and vestibular nuclei

Cerebellar functions

1) Anticipatory control (pg. 843-844; Figure 42-13)

2) Motor learning and adaptation (p. 847-849)

Defects in adapting movements—controlling movements in a flexible way to better suit the task

3) Role of cerebellum in motor cognitive functions and emotions

Complex motor strategies

Active tactile explorations
Cerebellar cognitive affective disorder

Overall Conclusions

- Unlike pyramidal lesions, which produce weakness/paralysis, cerebellar lesions produce disorders of coordination, learning, and motor cognition
- Role in automating movements, adapting movements to task demands
- Purely mental processes underlying movement control and possibly independent
- Cognition and emotions??
- No single function: mostly motor, but functions may apply to many types of behavior

Cerebellar Cortex Circuitry Addendum

2 principal excitatory inputs

Climbing fibers

Mossy fibers

Cerebellar cortex excitatory circuits

Inferior olivary nucleus → **Climbing fiber** → Purkinje cells

various nuclei → **Mossy fibers** → Granule cells (Parallel fibers) → Purkinje cells

Key Points:

Cerebellar circuitry—cortical and deep nuclei—**same for different anatomical divisions**

Functional distinctions based on **different inputs and outputs** rather than different circuitry

Purkinje cell is the **output neuron** of the cerebellar cortex; and is **inhibitory**

One cerebellar excitatory neuron (granule cell), rest are inhibitory

Neurons of the cerebellar cortex:

Projection (inhibitory): Purkinje projects to deep nuclei

Excitatory interneuron: Granule synapse on Purkinje neuron

Inhibitory interneurons: Basket, Golgi, Stellate synapse on Purkinje neurons

Relevant reading: ch. 42 in “Principles”