

## CEREBELLUM

### I. OVERVIEW

- a. Monitors voluntary motor output + receives sensory feedback → adjusts ongoing activity → synergy, coordination
- b. Functions are ipsilateral (sensory input crosses midline, output crosses back)
- c. Cerebellum has no direct connections with lower motor neurons → lesions affect coordination, do not produce paralysis

### II. ANATOMY

#### a. Vestibulocerebellum (archicerebellum)

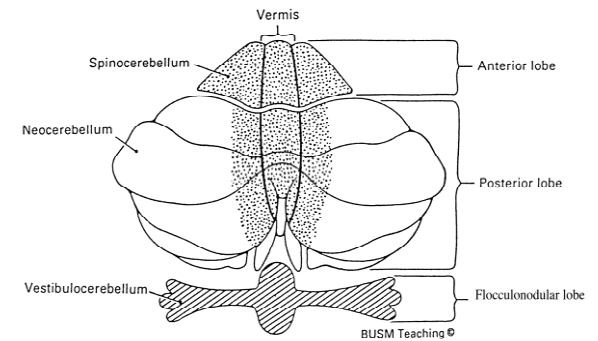
- i. **Nodulus** (midline structure) + 2 lateral **flocculi** (conn by thin band of white matter) = **flocco-nodular lobe**
- ii. Maintains equilibrium, proper adjustment of anti-gravity muscles
- iii. Connections to Vestibular nuclei, reticular formation
- iv. Damage → problems with movement related to gravity

#### b. Spinocerebellum (paleocerebellum)

- i. **Vermis** (midline connection that fuses two hemispheres of cerebellum) + **anterior lobe** (sep by primary fissure)
- ii. Posture reflexes, equilibrium of axial and limb musculature
- iii. Connections to red nucleus, spinocerebellar and olivocerebellar systems
- iv. Damage → ataxia; problems with gait, reaching

#### c. Neocerebellum (pontocerebellum)

- i. **Posterior lobe** (2 cerebellar hemispheres)
- ii. Fine voluntary movements of distal musculature; equilibrium and posture
- iii. Connections to entire cerebral cortex (via pons), motor cortex (via thalamus)
- iv. Damage → intention tremor, problems targeting, problems with alternation/switching, ?cognitive/emotional discoord.



### III. MICROCIRCUITRY

#### a. Layers of cerebellar cortex (superficial to deep)

- i. Molecular layer
  1. **Stellate cells** – excitatory input from parallel fibers → inhibitory on Purkinje dendrites
  2. **Basket cells** – excitatory input from parallel fibers → inhibitory on Purkinje somata
- ii. Purkinje cell layer
  1. **Purkinje cells** - excitatory input from parallel fibers → inhibitory (GABA) on deep cerebellar nuclei

Cytoarchitecture and microcircuitry is constant for all regions of cerebellum. Different functions are a result of different input/output.

- a. fan-like dendrites oriented in sagittal plane (perpendicular to parallel fibers)
- 2. **Golgi cells** - excitatory input from parallel fibers → inhibitory on mossy fibers
- iii. Granule cell layer
  - 1. **Granule cells** – only excitatory cells; send axons to molecular layer → branch and run as **parallel fibers**, terminate on dendrites of Purkinje cells
- b. Connections
  - i. Afferents
    - 1. **Climbing fibers** – from inferior olive, climb dendrites of Purkinje cells, terminate as excitatory synapses
    - 2. **Mossy fibers** – from all other sources, excitatory synapses on granule cells (therefore excite Purkinje) and DCN
  - ii. Efferents (deep cerebellar nuclei)
    - 1. **Fastigial nucleus** - most medial
    - 2. **Globose and Emboliform nuclei** (in animals, just one = interposed nucleus)
    - 3. **Dentate nucleus** – largest, most lateral
  - iii. Mossy and climbing fibers also directly synapse on deep cerebellar nuclei → output of DCN is of balance of excitation from mossy/climbing fibers and inhibition from Purkinje cells

#### IV. PATHWAYS

Pathway	Afferents	Motor discharge info	Cerebellar subdivision (Compare input, compute corrections)	Deep cereb nucleus	Send info to...
Vestibulocerebellum	Vestibular apparatus to ICP	Vestibular nuclei to ICP	Flocco-nodular lobe (mossy fibers)	Purkinje cells to fastigial nucleus	Vestibular nuclei → regulates descending motor activity in LVST, MVST; also ReST
Spinocerebellum	DSCT to ICP; cuneocerebellum; VSCT to SCP (proprioception)	Contralateral red nucleus to RuST, ION	Anterior lobe and vermis (mossy and climbing fibers)	Purkinje cells to globose and emboliform nuclei *also fastigial	Contralateral red nucleus (via SCP) → modulates output of rubrospinal tract *to ReST (posture adjustment)
Neocerebellum	Contralateral motor cortex to contralateral pontine nuclei via CST To cerebellum via ipsilateral MCP		Posterior lobe	Dentate nucleus	VL of thalamus (via SCP) → Motor and premotor cortex of precentral gyrus → modulates output of corticospinal tract

\*also ION conveys afferent input from all sources directly to Purkinje cells