



The Cerebellum Little Brain

Psychology 372

Physiological Psychology

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Overview

- Is located behind the Medulla and Pons
- Contains only 10% of the Brain's volume
- Contains more than 50% of the brain's neurons
- Appears similar to the cortex
- Also has two hemispheres
- Is connected to the Pons by three bundles of axons called the Cerebellar Peduncles.
- Superior (Brachium Conjunctivum)
- Middle (Brachium Pontis)
- Inferior (Restiform Body)

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Function Overview

- Basically evaluates and adjusts motor movement while it is in progress.
- Does a lot of integration and evaluation of incoming information.
- Is very important for balance and motor learning

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Has Three Distinct Regions

- Cerebellar cortex.
 - Is the outer covering
 - Is composed mostly of Gray Matter
- Internal White Matter
 - Are Myelinated Axons/Fiber Tracts
- Three pairs of Deep Nuclei
 - Fastigial
 - Interposed
 - Globose
 - Emboliform
 - Dentate
- Nuclei receive information from the cerebellar cortex
- Nuclei send information to the cerebellum and to other brain structures.

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Three Major Tracts of Neurons Connect to the Brain Stem

- inferior Cerebellar Peduncle
- Middle Cerebellar Peduncle
- Superior Cerebellar Peduncle
 - Has the most connections
- Most input begins in deep nuclei

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Anatomically

- Cerebellum surface has many parallel convolutions called Folia (leaves) that run from side to side
- Has three distinct lobes separated by two fissures

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Posteriolateral fissure

- Separates the body of the cerebellum from the Flocculonodular lobe
- Is the primary fissure in the body of the cerebellum
- Separates the anterior lobe from the posterior lobe
- Lobes are important functionally

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Fissures

- Define a ridge in the midline called the vermis
- On each side of the vermis are the cerebellar hemispheres
 - Hemispheres are divided into intermediate and lateral regions.
 - Each is important for specific motor functions

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- Is most primitive
- Gets information from vestibular areas of the brain.
 - Semicircular canals
 - Otoliths
- Is extremely important for balance and eye movements

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Damage

- Problems with eye movements during head rotations
- Problems with limbs and body structures during standing or walking
- Have problems maintaining balance
- Patients separate legs but the move their legs irregularly and often fall
- Can move arms and legs accurately when lying down or when their head is supported

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Vermis

- Gets information from visual auditory and vestibular areas.
- Also gets information from somatic sensory areas as well.
- Helps control the proximal muscles of the body and limbs.
- Generally governs posture, locomotion, and gaze.

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Intermediate Zone

- Gets somatosensory information from limbs
- Helps control distal muscles of the limbs and fingers

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Vermis and Intermediate Zones
(Spinocerebellum)

- Receives information from the spinal cord.
- Also gets information from ventral and dorsal spinocerebellar tracts.
- Receives information from the leg muscles and joints
- Sends information to structures that develop into the rubrospinal and corticospinal tracts.

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Function

- Influences limb muscles and muscles in the body
- Don't get limb deceleration - so you get overshoot of the system
- Is especially important for rhythmic activity during locomotion
- Also contains inverted somatotopic maps that are inverted
 - E.g., head is at the bottom in the vermis

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Cerebrocerebellum

- Are lateral parts of the hemispheres
- Only receives information from the cortex
- Is involved with planning and mental rehearsal of complex motor actions and
- Conscious assessment of movement errors.
- Has a very important role in perceptual and cognitive functioning

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Damage

- Disrupts motor planning and prolongs reaction times
- Have to plan out every movement before doing it.

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Example, tapping tests on Halstad Reitan

- Rhythm is irregular and the motions vary in duration and force.
- Medial cerebellar lesions interfere only with accurate execution of the response
- Lateral cerebellar lesions interfered with the timing of the events
- Timing was also disrupted in other cognitive tasks as well

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Question

- Is one tone longer than another?
- Is the speed of an object faster than another?
- Dentate also is important for tasks requiring complex spatial and temporal judgments
- Is essential for conducting complex motor movements

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Some Disorders

- Lots of disorders
- Diagnosis is often done symptomatically
- Examples
- Hypotonia
 - Knee jerk
 - You flex but the leg does not come back smoothly
 - Instead oscillates several times
- Ataxia
 - Lack of coordination
 - Also get a delay in initiating responses with the affected limb
 - Also get errors in the range and regularity of movement

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e.g., Hand Alternation Task

- Have fingers hit alternate palm of the hand
 - Get tremor when you are trying to stop the movement
- Problem occurs when antagonistic muscles are trying to stop the movement.

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Overall Damage to Cerebellum

- Generally, results in jerky, exaggerated, erratic motor movements.
- Movements are also poorly coordinated.

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