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A CONCISE REVIEW ON THE DEVELOPMENTAL GENETICS OF THE CEREBELLUM AND THE GENETIC BASES OF KNOWN CEREBELLAR DISORDERS

BY

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ABSTRACT

The cerebellum is an important structure in the central nervous system (CNS) that regulates and controls motor and non-motor functions. The human cerebellum develops over a long period of time, extending from the early embryonic period until the first postnatal years. This protracted development makes the cerebellum vulnerable to a broad spectrum of developmental disorders.

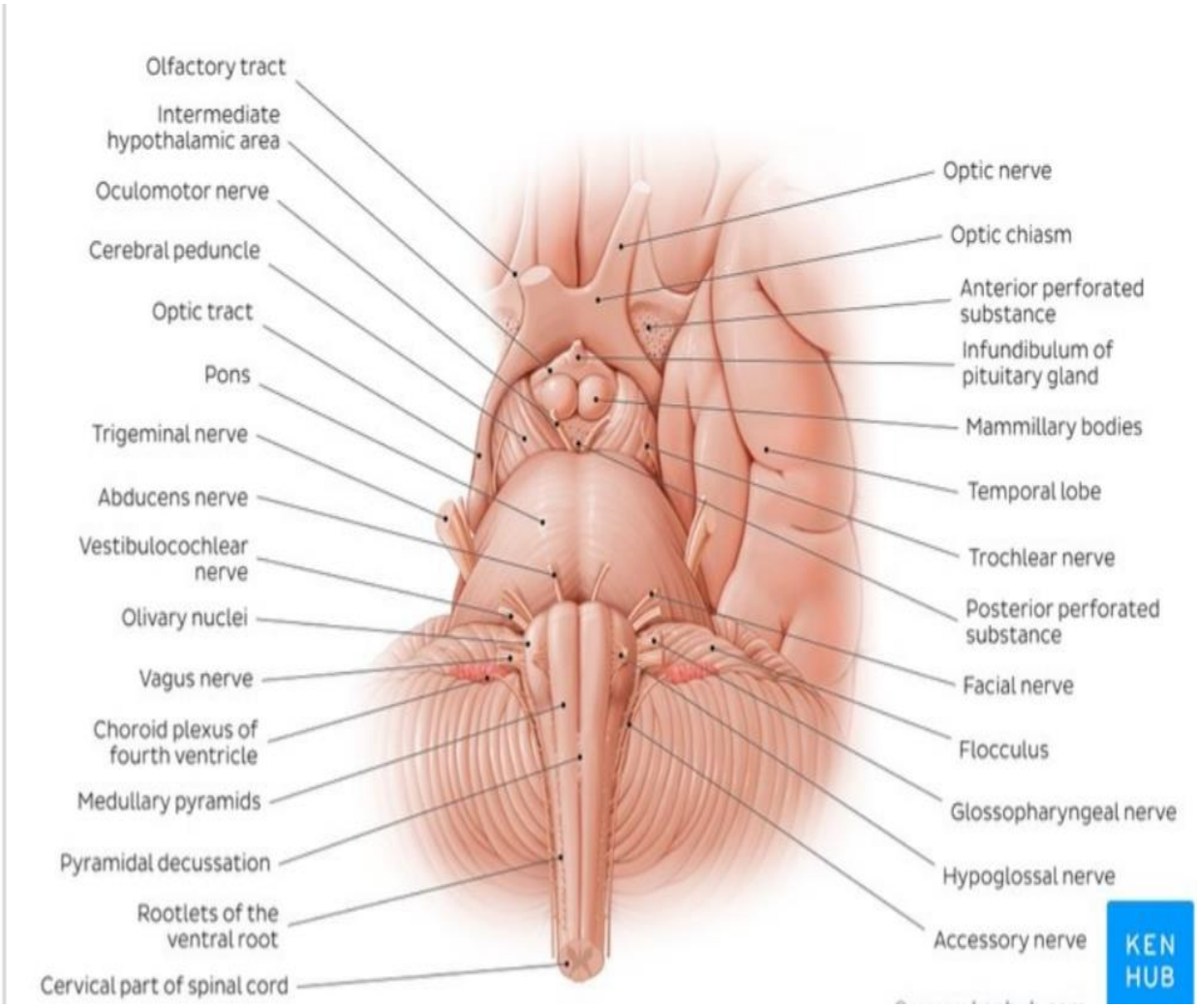
INTRODUCTION

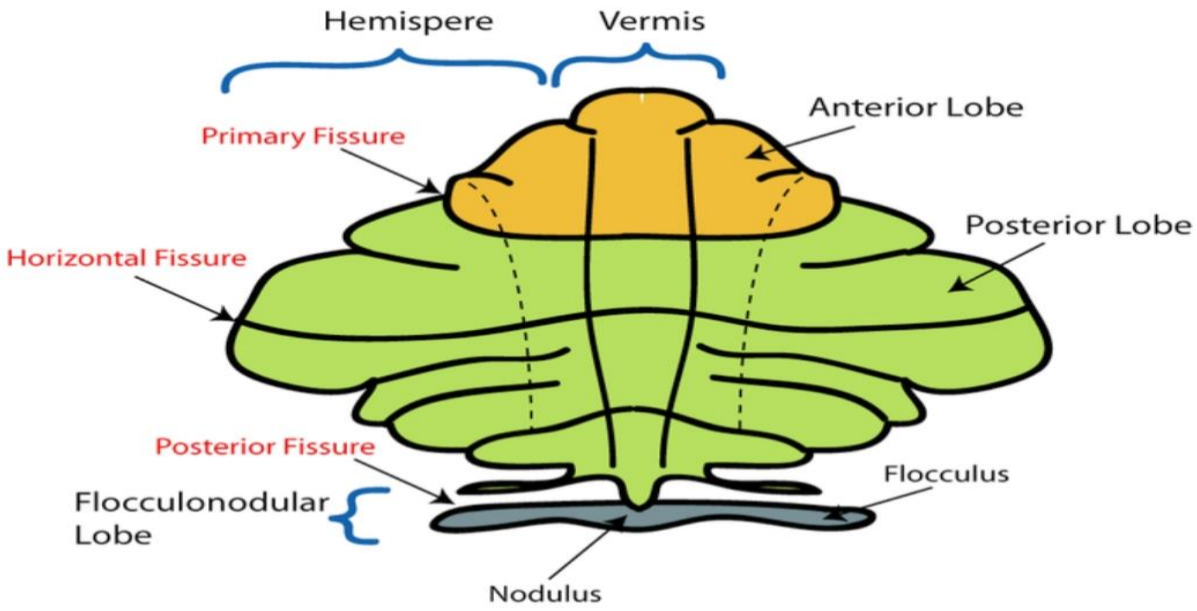
The cerebellum, or ”little brain”, is a major feature of the hindbrain of all vertebrates. It is the second largest part of the brain and it lies inferior to the cerebrum and posterior to the brain stem. It occupies most of the posterior cranial fossa. The cerebellum is separated from the cerebrum by the Transverse Fissure and it is separated from the posterior part of the cerebrum by Tentorium Cerebelli.

1.1 FUNCTIONS OF THE CEREBELLUM

- The cerebellum functions in the coordination of voluntary movements such as posture, coordination, etc.
- It takes memory of habits and motor activities.
- It controls emotional responses.
- The cerebrum functions in balancing the body.
- It is involved in the initiation of activities.

1.2 STRUCTURE OF THE CEREBELLUM


Olfactory tract
Intermediate hypothalamic area
Oculomotor nerve
Cerebral peduncle
Optic tract
Pons
Trigeminal nerve
Abducens nerve
Vestibulocochlear nerve
Olivary nuclei
Vagus nerve
Choroid plexus of fourth ventricle
Medullary pyramids
Pyramidal decussation
Rootlets of the ventral root
Cervical part of spinal cord
Optic nerve
Optic chiasm
Anterior perforated substance
Infundibulum of pituitary gland
Mammillary bodies
Temporal lobe
Trochlear nerve
Posterior perforated substance
Facial nerve
Flocculus
Glossopharyngeal nerve
Hypoglossal nerve
Accessory nerve
KEN HUB


Hemispere
Vermis
Anterior Lobe
Primary Fissure
Posterior Lobe
Horizontal Fissure
Posterior Fissure
Flocculus
Flocculonodular Lobe
Nodulus

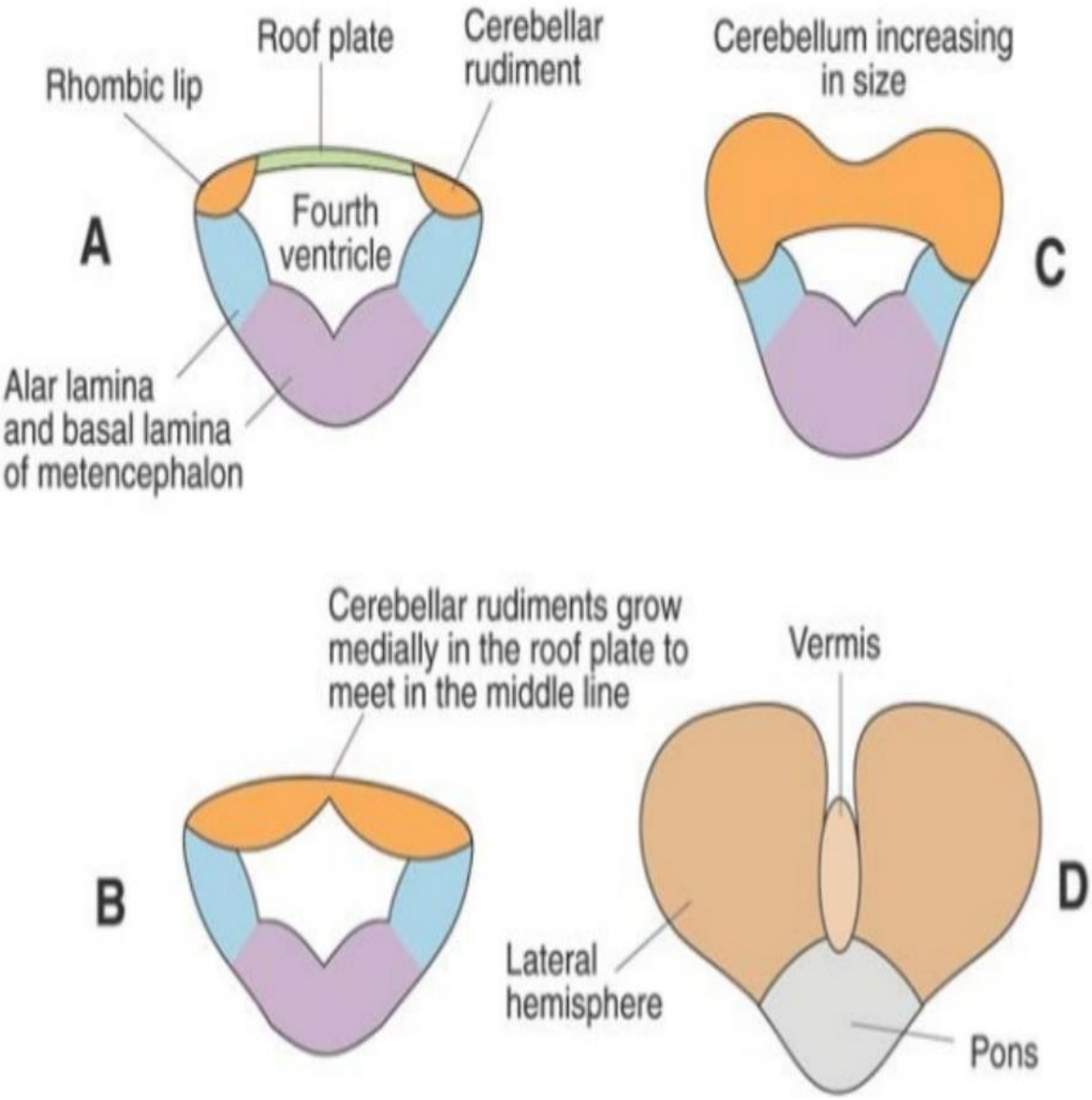
BODY

2.1 DEVELOPMENT OF THE CEREBELLUM

The cerebellum is formed from the posterior part of the alar plates of the metencephalon. On each side, the alar plates bend medially to form rhombic lips. As the rhombic lips enlarge, they project caudally over the roof plate of the fourth ventricle and they unite with each other in the midline to form the cerebellum.

The cerebellum has an intraventricular portion (cells proliferating from the ventricular zone) and an extraventricular portion (cell proliferating from the external germinative layer) during development. Before the end of the third month, the min mass of the cerebellum is extraventricular.

At the 12^{th} week, a small midline portion, the vermis and two lateral portions, the cerebellar hemispheres, may be recognized. The neuroblasts derived from matrix cells in the ventricular zone migrate towards the surface of cerebellum and give rise to neurons forming the cerebellar cortex.



2.2

PRIMARY VESICLE	PRIMARY DIVISION	SUBDIVISION	ADULT STRUCTURE

1. Forebrain Vesicle	Prosencephalon	Telencephalon	Cerebral hemisphere, basal ganglia, hippocampus
		Diencephalon	Thalamus, Hypothalamus, Pineal Body, Infundibulm.
2. Midbrain Vesicle	Mesencephalon	Mesencephalon	Tectum, Tegmentum, Crus Cerebri
3. Hindbrain Vesicle	**Rhombencephalon**	**Metencephalon** **Myelencephalon**	**Pons, Cerebellum** **Medulla Oblongata**

2.3 CEREBELLAR DISORDERS

Cerebellar disorders have various causes like,

- Developmental cause
- Vascular
- Infective
- Neoplastic
- Demyelinating
- Nutritional deficiency
- Trauma
- Degenerative
- Drugs and toxins
- Metabolic

There are various signs of cerebellar damage and they include;

- Vertigo; a sudden internal or external spinning sensation, often caused by moving your head too quickly
- Ataxia; a condition where a person lacks muscle control during voluntary movements, such as picking up an object or walking
- Nystagmus; involuntary oscillation of the eyes, characterized by a slow phase, followed by a fast phase.
- Intentional tremor
- Slurred speech
- Hypotonia; diminished tone of skeletal muscle associated with decreased resistance of muscle to passive stretching
- Exaggerated broad based gait
- Disdiadochokinesia; is an impaired ability to perform rapid alternating movements, movements are irregular with a rapid loss of range and rhythm especially as speed is increased.

There is a mnemonic for it, which is "VANISHED"

A. ATAXIA

This is a condition where a person lacks muscle control during voluntary movements, such as picking up an object or walking. Persistent ataxia usually results from damage to the part of the brain that controls muscle coordination (cerebellum). Damage, degeneration or loss of nerve cells in the cerebellum results in ataxia. The cerebellum comprises two portions of folded tissue situated at the base helps with balance as well as eye movements, swallowing and speech. Diseases that damage the spinal cord and peripheral nerves that connect your cerebellum

to your muscles can also cause ataxia. Causes of ataxia include; head trauma, stroke, cerebral palsy, autoimmune diseases, etc.

B. DISDIADOCHOKINESIA (DDK)

Is a medical term used to describe difficulty performing quick and alternating movements, usually by opposing muscle groups. **DDK** most often comes from a disturbance in the cerebellum. The cerebellum is a large part of the brain that controls voluntary muscle movements, posture, and balance. It's thought that people with **DDK** are unable to switch opposing muscle groups on and off in a coordinated manner.

C. DYSMETRIA

This is the inability to judge distance and when to stop. Loss of ability to turn off movement at a particular mark. The actual cause of **dysmetria** is thought to be caused by lesions in the **cerebellum** or by lesions in the proprioceptive nerves that lead to the **cerebellum** that coordinate visual, spatial and other sensory information with motor control.

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