An Insight about Anatomical Aspect of the Cerebrum and Cerebellum

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Abstract

Background: The nervous system is formed of two parts that are central nervous system and peripheral nervous system. The brain and spinal cord known as the central nervous system, which are covered by the skull and vertebral column, respectively. The spinal and cranial nerves make up the peripheral nervous system. The brain is divided into three sections. The cerebrum, cerebellum, and brainstem are the three parts of the brain. The cerebral hemispheres are two half-balls that make up the cerebrum. Numerous folds called gyri characterize both hemispheres that seriously increases the surface area of the cerebral cortex. These gyri are divided by grooves known as sulci. The cerebrum is divided into white matter and grey matter. The grey matter forms the superficial cortex (cells of cerebral cortex). The white matter in the internal area is made up of nerve fibres that are categorised according to their path and connections. Voluntary movement, sensation interpretation, speech, memory, emotional and logical responses, and consciousness are all handled by the cerebral cortex. The cerebellum is the second largest part of the brain after cerebrum and the largest part of the hindbrain. The cerebellum takes its name from its diminutive of "cerebrum". This is typically observable in German, where it is termed Kleinhirn ("small brain"). Cerebellum is divided into superior surface and inferior surface by deep horizontal fissure that is found along the margin of the cerebellum. Superior vermis lies between the two cerebellar hemispheres on superior surface. The anterior part of superior vermis is the lingual that lies in contact with the superior medullary vellum, which is a thin sheet of white matter strained between the two superior cerebellar peduncles. While, the inferior vermis lies in vallecula, which is a deep groove between the two cerebellar hemispheres inferiorly.

Keywords: Anatomy, Cerebrum, Cerebellum

Introduction

The nervous system is formed of two parts that are central nervous system and peripheral nervous system. The brain and spinal cord known as the central nervous system, which are covered by the skull and vertebral column, respectively. The spinal and cranial nerves make up the peripheral nervous system **(1)**.

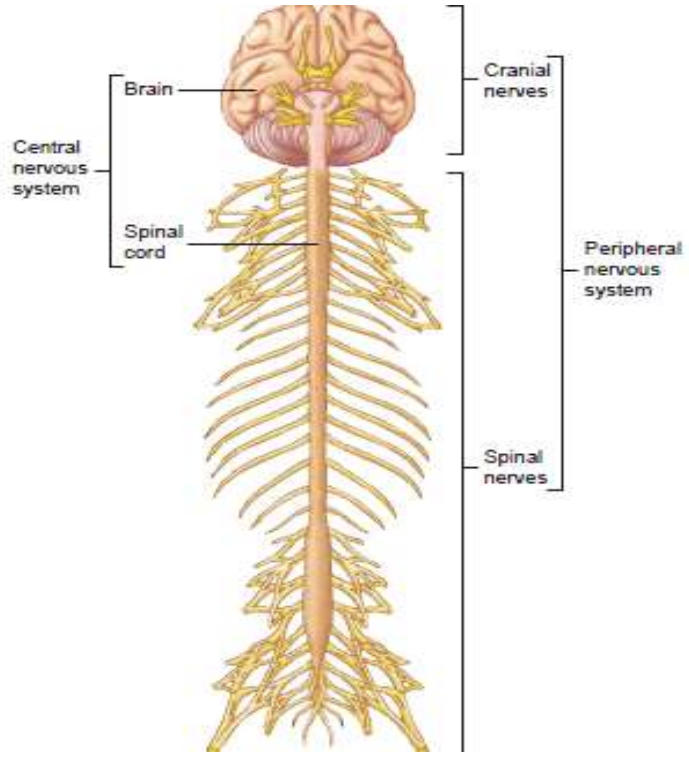

Fig. (1): Nervous system parts **(2)**.

The brain is surrounded by the meninges (dura, arachnoid, and pia mater), which are three connective tissue membranes that separate the nerve tissue from the bone. They protect the brain while also providing a structural framework for arteries, veins, and dural sinuses **(1)**.

The brain is divided into three sections. The cerebrum, cerebellum, and brainstem are the three parts of the brain. The cerebral hemispheres are two half-balls that make up the cerebrum. Numerous folds called gyri characterize both hemispheres that seriously increases the surface area of the cerebral cortex. These gyri are divided by grooves known as sulci (**3)**.

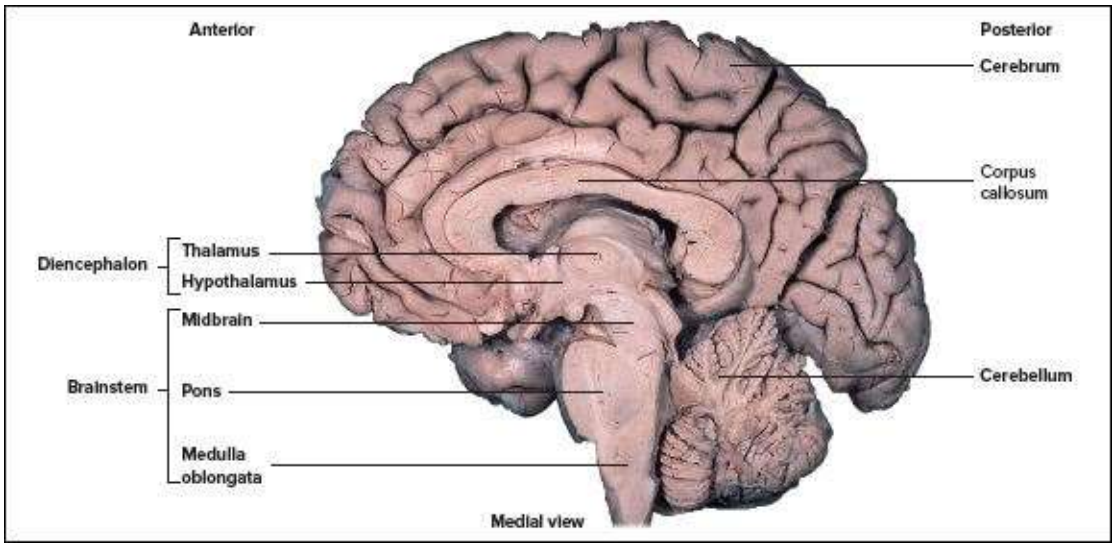

Fig. (2): Parts of brain **(1)**.

The longitudinal fissure is a deep groove, which separates the right and left hemispheres. The two hemispheres are connected at the bottom of this fissure by the corpus callosum, a bundle of nerve fibres. The frontal lobe is separated from parietal lobe by central sulcus (fissure of Rolando) and from temporal

lobe by lateral sulcus (fissure of Sylvius). The parieto-occipital sulcus separates the parietal lobe from the occipital lobe **(4)**.

Cerebral hemisphere has three aspects. The medial one is upright and flat. The superolateral aspect follows the skull vault concavity. The stem of the lateral sulcus divides the inferior aspect into orbital and tentorial regions. The concave orbital portion is located over the nasal and orbital roofs in the anterior cranial fossa. The tentorial portion is in the middle cranial fossa, above the tentorium cerebelli, which separates it from the cerebellum **(5)**.

In correspondence to the names of skull bones covering the hemisphere, the cerebral hemisphere is divided into four lobes: frontal, temporal, occipital, and parietal. A lateral fissure separates the temporal lobe from the remainder of the cerebrum, and deep within this fissure is the insula, which is commonly referred to as a fifth lobe. Only by retracting the overlaying cerebrum, it is visible **(6)**.

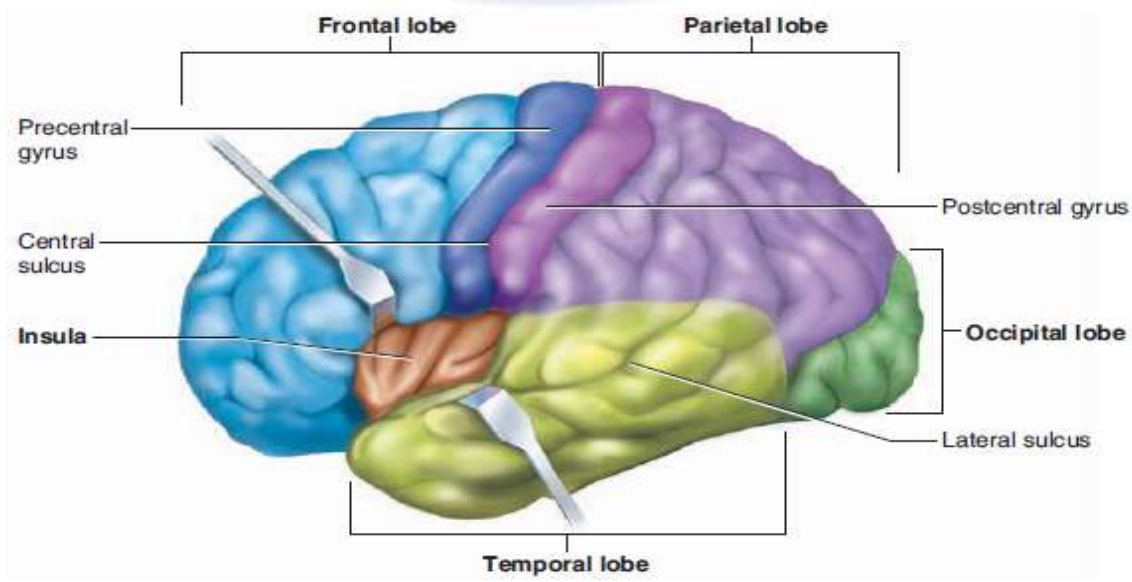

Fig. (3): Lobes of the cerebrum. The frontal and temporal lobes are retracted slightly to reveal the insula **(6)**.

The cerebrum is divided into white matter and grey matter. The grey matter forms the superficial cortex (cells of cerebral cortex). The white matter in the internal area is made up of nerve fibres that are categorised according to their path and connections. Voluntary movement, sensation interpretation, speech, memory, emotional and logical responses, and consciousness are all handled by the cerebral cortex **(6)**.

The ventricles are four chambers in the brain that are filled with CSF produced by the choroid plexus. CSF moving around the brain is around 150 mL and is changed every 8 hours. It acts as a cushion to protect the brain. There are four ventricles in the brain: two lateral ventricles, a third ventricle, and a fourth ventricle **(7)**.

The brain has a high level of vascularity. Despite receiving 15% of the heart blood flow (about 750 mL/min), it makes up only 2% of body weight. Moreover, it consumes about 25% of the oxygen and glucose in the body. Apart from its importance to the brain, it is also a source of dangers, the most common of which are bacterial toxins. For this reason, there is a blood-brain barrier **(5)**.

Internal carotid arteries and vertebral arteries supply blood to the brain. Vertebral arteries are branches of subclavian arteries. On the anterior aspect of the pons, the union of the two vertebral arteries forms the basilar artery **(1)**.

Two terminal branches of the basilar artery arise at the upper border of the pons; they are the left and right posterior cerebral arteries. To supply the cortex, the internal carotid artery is divided into anterior and

middle cerebral arteries at the anterior perforated substance of the brain. Additionally, it provides the anterior choroidal arteries, posterior communicating arteries and striate arteries **(4)**.

Circle of Willis is a circular anastomosis that occurs between the internal carotid arteries and the basilar arteries at the infundibulum of the pituitary stalk. Middle, anterior, and posterior cerebral arteries exit from the circle of Willis supplying the cerebrum. Almost all the lateral surface of the cerebral hemispheres is distributed with the middle cerebral artery. On the medial surface just above the corpus callosum, the frontal and parietal lobes are supplied by the anterior cerebral artery. The posterior cerebral artery supplies the occipital lobe from all surfaces, inferior temporal gyrus (except temporal pole) and the medial surface of the temporal lobe **(5)**.

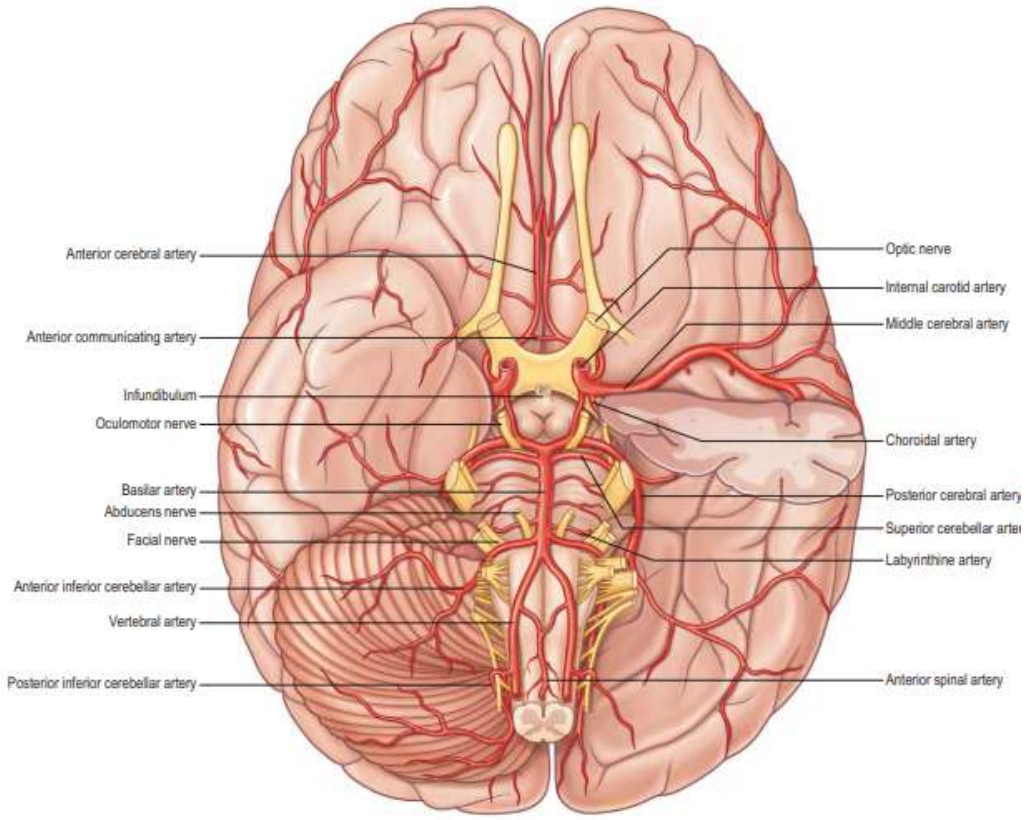

Fig. (4): The arteries on the base of the brain **(5)**.

The brain's venous drainage is divided into deep and superficial veins, both of which have thin walls devoid of muscle tissue and valves. The inner layer of the dura and the arachnoid are pierced by these veins, which drain into the dural venous sinuses. Deep cerebral veins drain the inside of the cerebral hemisphere, while superficial cerebral veins drain the cerebral cortex. Three groups of superficial veins have been identified: superior, middle, and inferior. Superior cerebral veins drain the superomedial and superolateral surfaces of the cerebral hemisphere. They drain into the superior sagittal sinus. . The superficial middle cerebral vein drains the majority of each hemisphere's lateral surface and drains into the cavernous sinus. Each cerebral hemisphere's inferior and inferomedial surfaces drain into the inferior cerebral veins. **(4)**.

These veins anastomose with middle cerebral veins and basal veins and drain into the cavernous, transverse, and superior petrosal sinuses. The drainage of insula is handled by the deep middle cerebral vein. The corpus striatum has striatum veins that drain it. The orbital surface of the frontal lobe is drained by the anterior cerebral vein. The basal vein is formed when the last three veins join. The two basal veins drain into the great cerebral vein **(5)**.

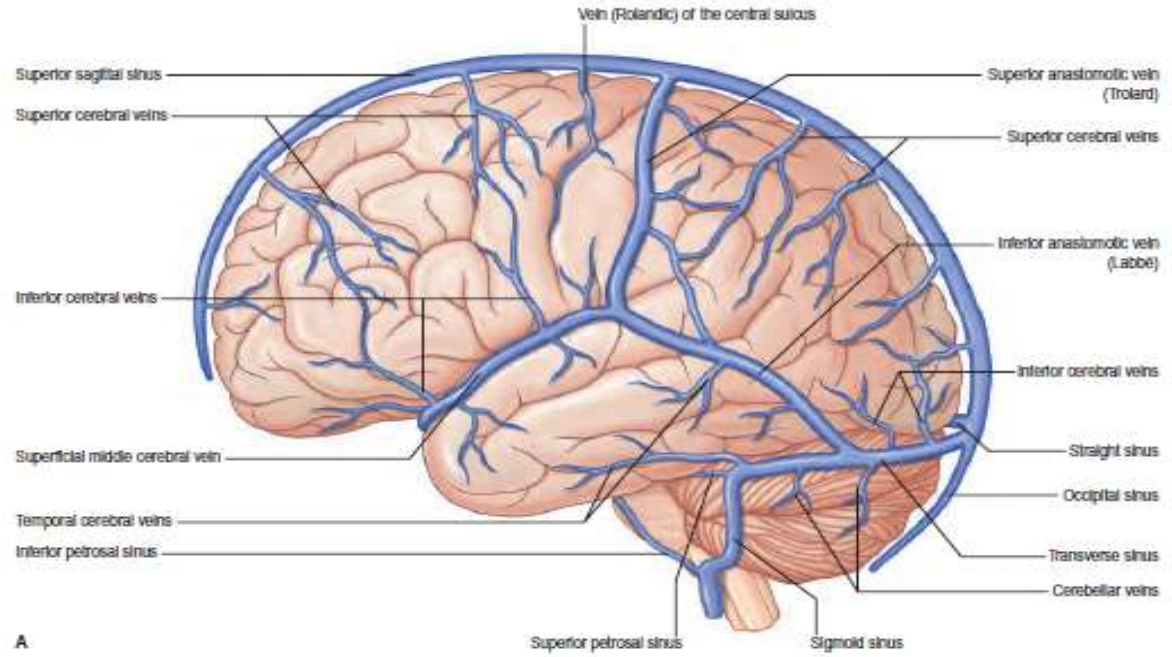

Fig. (5): Veins and sinuses of the brain, viewed from the lateral side **(5)**.

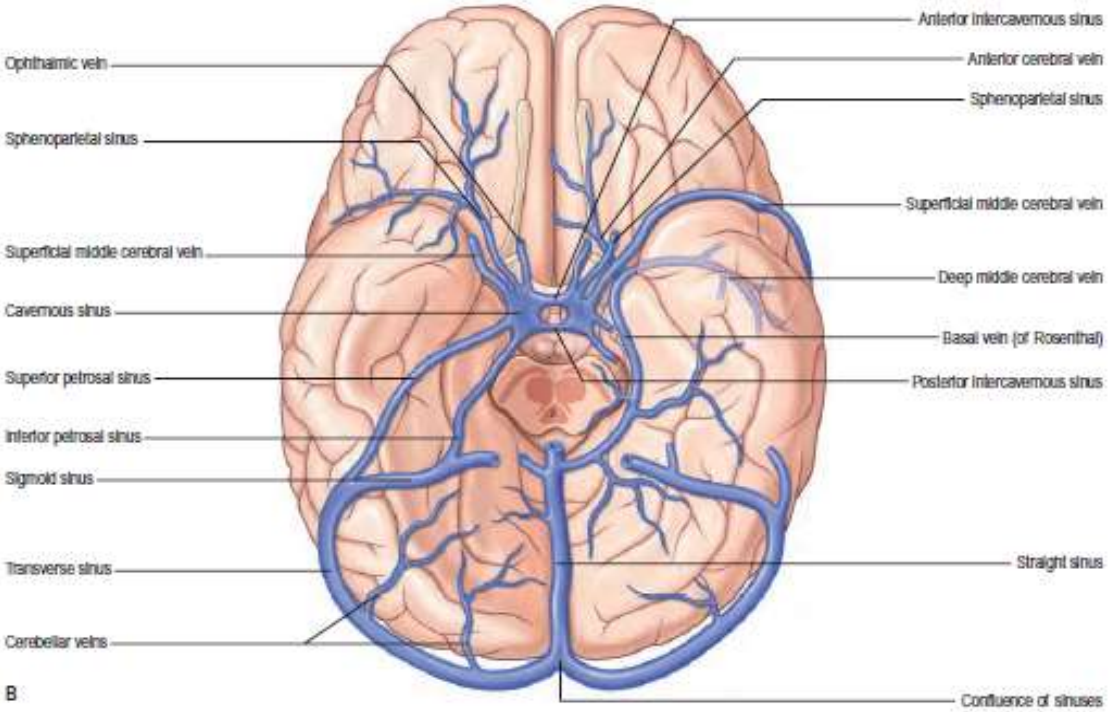

Fig. (6): Veins and sinuses on the inferior surface of the hemisphere **(5)**.

♦ **Human Cerebellum:**

The cerebellum is the second largest part of the brain after cerebrum and the largest part of the hindbrain. The cerebellum takes its name from its diminutive of "cerebrum". This is typically observable in German, where it is termed Kleinhirn ("small brain"). **(6)**.

The cerebellum looks like a butterfly structure, its central part is a constricted area called the vermis and the lateral parts as wings are the two cerebellar hemispheres. The cerebellum lies in inferior part of the posterior cranial fossa. The cerebrum separated from cerebellum below by a transverse fissure enclosing dural fold, which called tentorium cerebelli. It is separated from the pons and medulla anteriorly by the cavity of fourth ventricle **(8)**.

The cerebellum's weight makes up virtually one-tenth of the whole brain's weight. The cortex of the cerebellum has multiple folds or folia. Each fold has a core of white matter that covered by a thin layer of gray matter. The branching pattern of the folia referred to be as the arbor vitae. If the cerebellar cortex stretched, would be roughly half that of the cerebral cortex. If the cortex were unfolded into a flat sheet, it would increase one meter lengthy due to the presence of folding in the cerebellum surface **(5)**.

Three pairs of peduncles connect the cerebellum and brainstem: superior peduncles, middle peduncles, and inferior peduncles. These peduncles are made of thick bundles of nerve fibres, which carry signals from and to the cerebellum. The superior peduncles connect cerebellum with midbrain. Pons relates to cerebellum by middle ones. Finally, the cerebellum is connected to medulla oblongata by inferior cerebellar peduncles **(6)**.

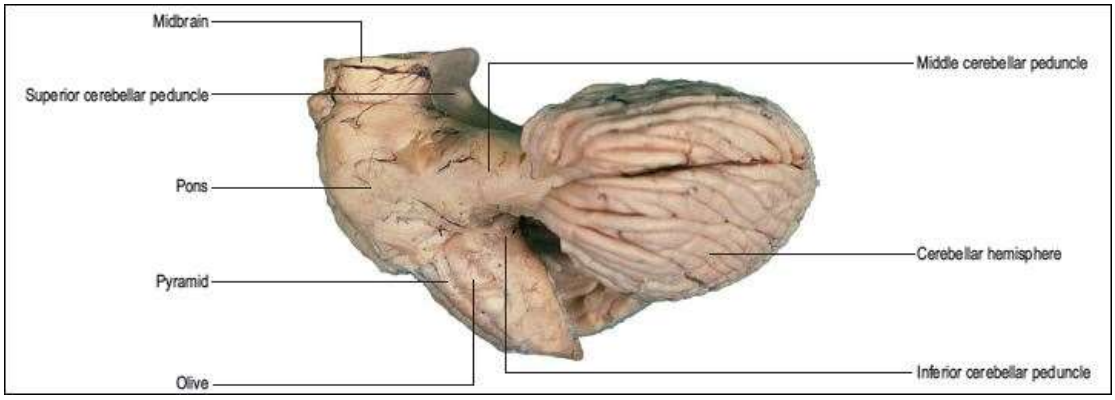

Fig. (7): Cerebellum. Lateral view of the cerebellum and cerebellar peduncles connecting to the brainstem **(9)**.

The cerebellum is divided into three lobes (anterior, middle, and flocculo-nodular lobe). The primary fissure presents on the cerebellum's superior surface as a wide V-shaped fissure. It divides the cerebellum into anterior lobe and posterior lobe (at times known as the middle lobe). The largest portion of the cerebellum is the posterior lobe that lies between two fissures: the uvulo-nodular and primary fissures. Anterior to the uvulo-nodular fissure, there is the flocculo-nodular lobe **(3)**.

Cerebellum is divided into superior surface and inferior surface by deep horizontal fissure that is found along the margin of the cerebellum. Superior vermis lies between the two cerebellar hemispheres on superior surface. The anterior part of superior vermis is the lingual that lies in contact with the superior medullary vellum, which is a thin sheet of white matter strained between the two superior cerebellar peduncles. While, the inferior vermis lies in vallecula, which is a deep groove between the two cerebellar hemispheres inferiorly **(4)**.

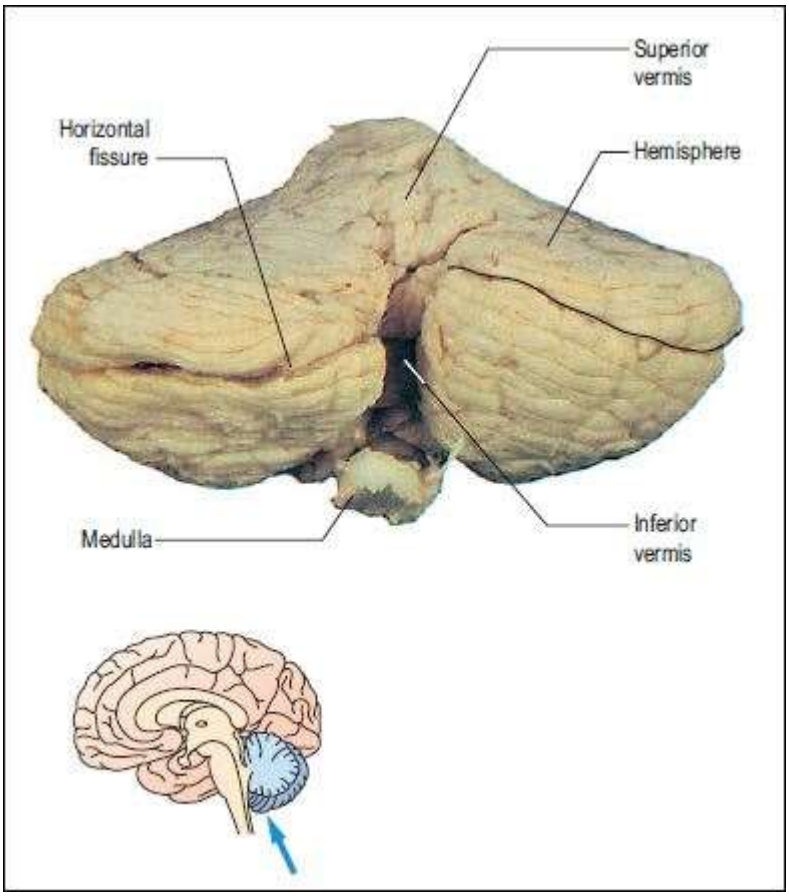

Fig. (8): Superior surface of cerebellum **(9)**.

The superior vermis lobules belonging to the anterior lobe are from anterior to posterior: lingula, central lobule and culmen. Central lobule is separated from Lingula anteriorly by the precentral fissure and from culmen posteriorly by the preliminary fissure. In each hemisphere, the central lobule and culmen are continuous bilaterally, with an attached lateral extension. From posterior to anterior, the inferior vermis is divided into the four lobules: tuber, pyramid, uvula, and nodule. The pyramid is separated from tuber posteriorly by the luno-gracile fissure and from biventral lobules by the secondary fissure. On each side of the medulla oblongata, the tonsils seen as spherical structure overhang foramen magnum **(5)**.

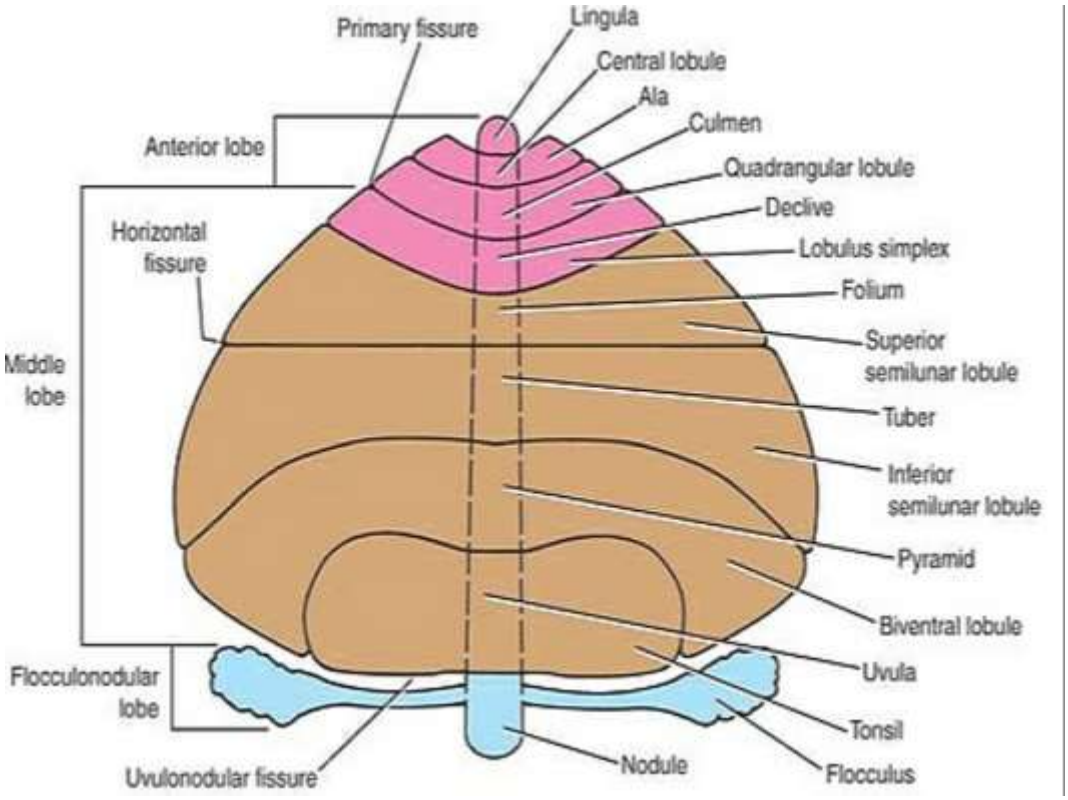

Fig. (9): Diagram representing the flattened view of the cerebellar cortex showing the main cerebellar lobes, lobules, and fissures **(10).**

Moreover, **Sinnatamby (4)** added that the nodule situated on the fourth ventricle's roof. The flocculus is a slender white matter band capped with grey matter that projects laterally from each side of the nodule. The nodule and two lateral flocculi form the flocculo-nodular lobe.

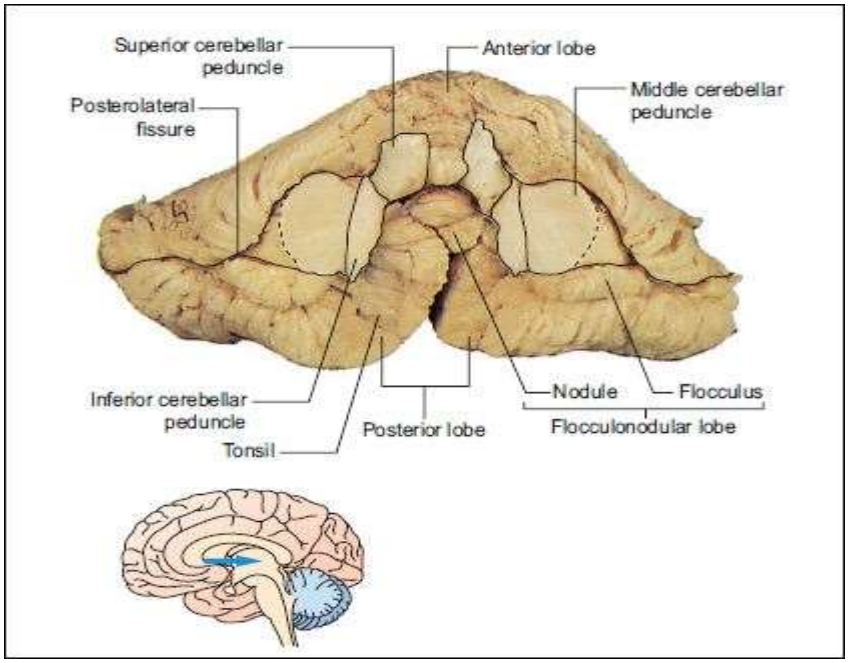

Fig. (10): Anterior and inferior view of cerebellum (flocculo-nodular lobe) **(9)**.

Three arteries supply the cerebellum. They are superior, anterior inferior and posterior inferior cerebellar arteries. On the surface of the cerebellum, they anastomose with each other; however, the cerebellum perforating branches are end arteries **(5)**.

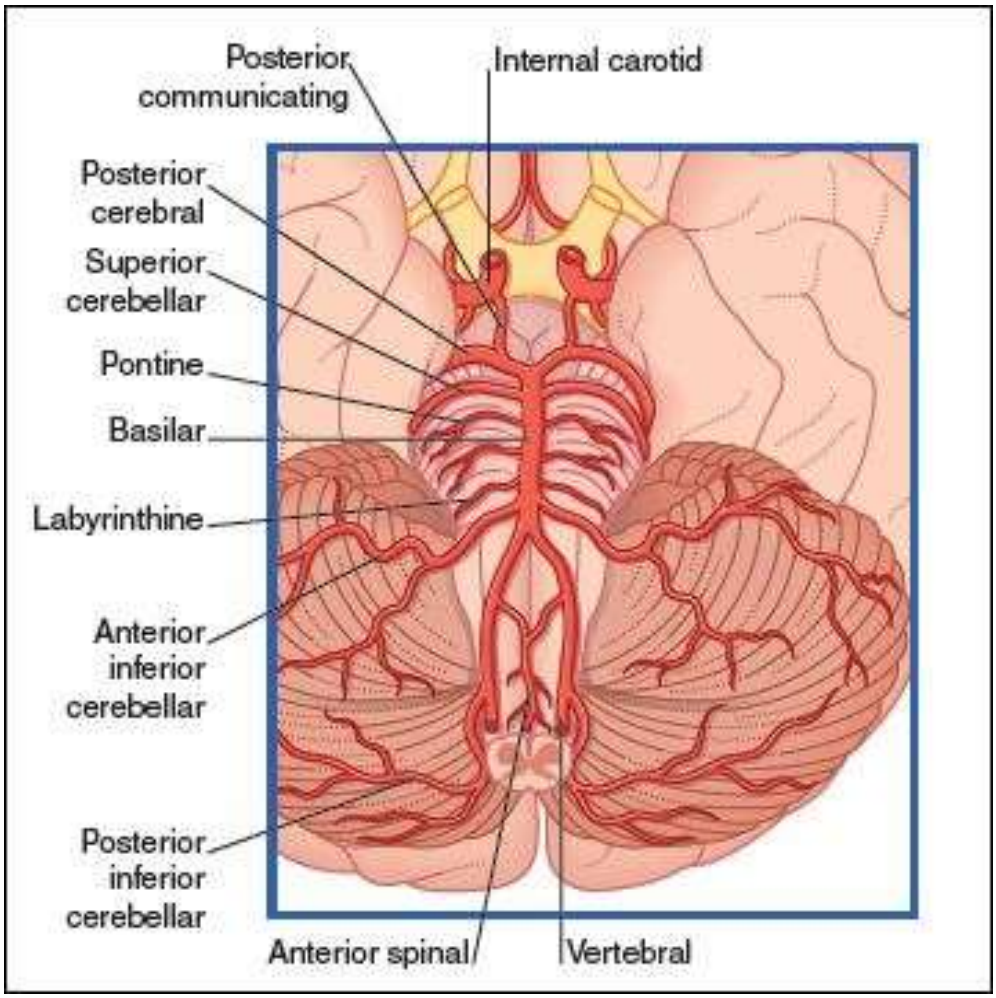

Fig. (11): Vascular supply to the cerebellum **(11)**.

The superior cerebellar artery originates from the basilar artery. The artery runs posterior and lateral around the cerebral peduncles. Its name proposes as it supplies most of the cerebellum superior surface and the superior cerebellar peduncle **(12).**

Anterior inferior cerebellar artery (AICA) is also a branch from basilar artery. AICA originates from a single trunk most of the time, but it may appear as two branches. The AICA commonly supplies the anterior part of inferior surface of the cerebellum, middle peduncle of cerebellum, the flocculus and infero-lateral part of the pons, but this depending upon if the PICA is dominant **(13)**.

The posterior inferior cerebellar artery (PICA) is the largest branch of the vertebral artery and the most tortuous artery in the body. It makes the fourth ventricle's choroid plexus and supplies the posterior part of the cerebellar hemispheres and the inferior vermis **(14)**.

The superior and inferior groups of cerebellar veins run over the cerebellum surface. Superior cerebellar veins run either antero-medially through the superior vermis to the straight sinus, great cerebral vein or laterally to the transverse sinuses and superior petrosal sinuses. A little median vessel goes posterior on the inferior vermis to enter the straight or sigmoid sinus as part of the inferior cerebellar veins. The inferior petrosal sinuses and occipital sinus are joined by lateral running veins **(15)**.

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