The Embryology and Anatomy of the Cerebellum

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Abstract The cerebellum is an important structure in the central nervous system that controls and regulates motor and non-motor functions. It is located beneath the occipital lobe and dorsal to the brainstem. Today, we know much about its complex circuitry and physiology. The cerebellum has a well-defined and highly organized structure. The cortex of the cerebellum contains eight neuronal cell types and receives input from a variety of sites within the CNS and processes the information in a uniform manner. The cerebellum projects to a variety of different sites within the CNS to regulate motor function. Although much has been discovered regarding the complex architecture of the cerebellum, there are significant gaps in our understanding of the broader role of the cerebellum in brain function. In this chapter, we will review briefly the embryological development of the cerebellum and provide an overview of the anatomy of the cerebellum.

Keywords Cerebellum • Embryology • Anatomy • Histology • Function

Introduction

The cerebellum (latin: 'little brain') is located in the posterior cranial fossa and is involved in the regulation of posture, motor coordination, balance, and motor learning. More recently, it has been proposed that it also plays a role in emotion and cognition. The cerebellum consists of a midline region referred to as the vermis, a narrow paravermal area immediately adjacent to the vermis, and large hemispheres on either side. Well-defined fissures divide the cerebellum in a rostral caudal direction into an anterior lobe, posterior lobe, and flocculonodular lobe. The anterior and posterior lobes are divided further, into lobules and folia (in human), which greatly increases the surface area of the cerebellum. The cerebellum consists of a uniform

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layer of cortical grey matter overlying white matter that surrounds four pairs of cerebellar nuclei (CN). The cerebellar cortex consists of three layers: molecular layer, Purkinje cell layer, and granule cell layer. The molecular layer is the outermost layer and is largely a synaptic layer, containing the connections of a number of neurons (e.g., basket and stellate cells) with the dense dendritic arborizations of the Purkinje cells, whose cell bodies are the predominant component of the Purkinje cell layer. The innermost layer of the cortex is the granule cell layer containing Golgi cells, Lugaro cells, unipolar brush cells, and the highly abundant granule cells. Almost all of the neurons of the cerebellar cortex use either the excitatory neurotransmitter glutamate or the inhibitory neurotransmitter gamma-aminobutyric acid (GABA). Glutamate is used by the granule cells and unipolar brush cells while the remainder of the cortical neurons use GABA. The CN are primarily composed of large projection neurons that use glutamate as a neurotransmitter and project to nuclei of the thalamus and brainstem. These neurons represent the principal output of the cerebellum. A smaller number of CN neurons are GABA-ergic and project to the inferior olivary nucleus of the medulla. The cerebellum is considered an outstanding model in the research of neurogenesis and circuit assembly because of its well organized structure.

Embryology of the Cerebellum

During prenatal development of the nervous system, the central nervous system originates from the area of the ectoderm known as the neural plate. The neural plate thickens as a result of cell proliferation and then begins to invaginate and thus forms the neural groove. The invagination of the neural groove continues until the lateral edges of the neural groove (neural fold) fuse to form the neural tube through a process referred to as neurulation. As the edges of the neural groove fuse to form the neural tube, which detaches from the ectoderm, a population of the neuroectodermal cells dissociate from the neural fold as the neural crest cells [1]. The rostral extent of the neural tube develops into the prosencephalon, mesencephalon, and rhombencephalon. The prosencephalon undergoes further development to form the telencephalon and diencephalon. The mesencephalon does not undergo further division while the rhombencephalon divides into the metencephalon and myelencephalon. Caudal to the rhombencephalon, the neural tube develops into the spinal cord. The cerebellum develops from the dorsal portions (i.e., the alar plate) of the metencephalon and the neural folds, the latter referred to as the rhombic lips. The alar plate of the rostral metencephalon undergoes bilateral expansion in the dorsolateral region to form the rhombomere 1 (r1). These rostral extensions of alar plate eventually join in the midline to form the vermis of the cerebellum. As the cerebellum begins to form, initially from the dorsal r1, it rotates 90° before fusing at the midline as the vermis [2]. This rotation of dorsal r1 results in the conversion of rostral–caudal axis seen in the early neural tube, into the medial–lateral axis seen in the mature cerebellum (the wing-like bilateral cerebellar primordia) [3]. As the bilateral cerebellar primordia fuse, the midline vermis is derived from the rostro-medial ends while the cerebellar hemispheres are derived from the more caudo-lateral components of the rhombencephalon [4].

The neurons that reside within the cerebellum are derived from two distinct germinal zones: the ventricular zone and the rhombic lip. The ventricular zone is the neuroepithelium of the alar plate of the rhombencephalon that eventually forms the roof of the fourth ventricle. The neurons derived from the ventricular zone include the Purkinje cells, candelabrum cells, Golgi cells, Lugaro cells, stellate cells, and basket cells. All of these neurons use GABA as a neurotransmitter and reside in the outer two layers of the three layered cortex, except for the Golgi and Lugaro cells of the granular layer [5, 6]. The neurons derived from the rhombic lip use glutamate as a neurotransmitter. This includes the large neurons of the CN (projecting to the diencephalon and brainstem), unipolar brush cells, and granule cells, the most numerous cell in the brain.

Anatomy and Histology of the Human Cerebellum

Functional Divisions of the Cerebellum

The cerebellum is a highly organized structure that is attached to all three components of the brainstem (the midbrain, pons, and medulla) [7]. Fissures divide the cerebellum into three lobes in the rostro-caudal plane. The primary fissure, seen on the superior surface of the cerebellum, separates the anterior lobe from the posterior lobe, while the posterolateral fissure, seen on the inferior surface of the cerebellum, separates the large posterior lobe from the narrow and much smaller flocculonodular lobe. The flocculonodular lobe consists of bilateral extensions of cerebellar cortex called flocculi that are connected to the inferior portion of the vermis called the nodulus. During development, once the anterior and posterior lobes form, smaller lobules begin to form. The lobules undergo further infolding which leads to the formation of folia, which are particularly prominent in human cerebellum. The structure of the folia is consistent throughout the cerebellum, with a three-layered cortex overlying the white matter consisting of the axons projecting to and from the cortex (Fig. 1).

The cerebellum is organized into three functional divisions based on their connections to other brain sites and their respective roles in regulating movement and other non-motor functions. The phylogenetically oldest component of the cerebellum is the flocculonodular lobe. The cortex of this lobe receives input from the vestibular apparatus on the ipsilateral side as well as input from the vestibular nuclei of the brainstem. Therefore, the flocculonodular lobe is commonly referred to as the vestibulocerebellum. The connections of the vestibulocerebellar cortex to the vestibular nuclei are reciprocal, and the cortex of the vestibulocerebellum is the only component of the cerebellar cortex that sends projections directly to sites outside the cerebellum (i.e., the vestibular nuclei of the brainstem) [7]. The vestibulocerebellum participates in the control of balance and eye movements.

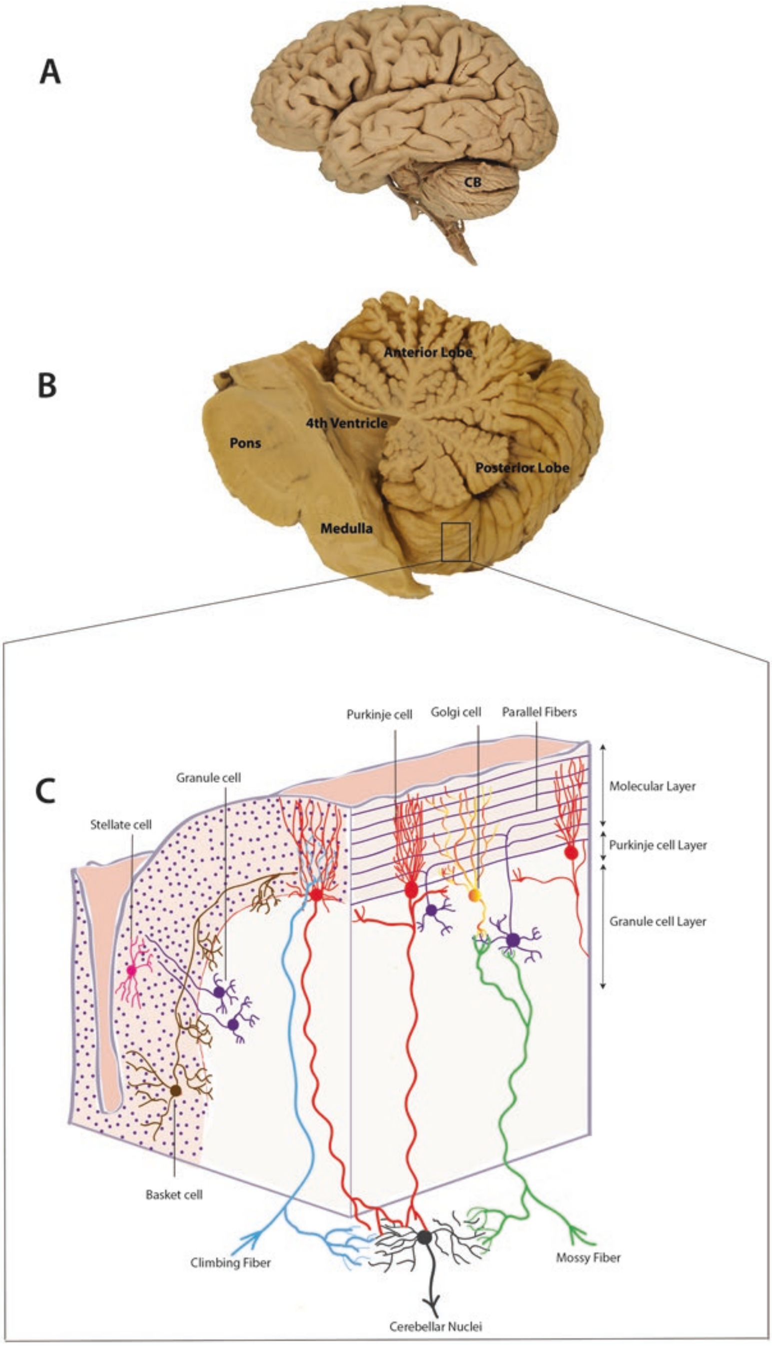

Fig. 1 (**A**) Location of the cerebellum in situ. (**B**) Hemisected view of the cerebellum showing the vermis, the locations of the anterior and posterior lobes, and its anatomical relationship to the brainstem. (**C**) Schematic representation of the cerebellum showing the mossy fibre and climbing fibre inputs to the cerebellar cortex. The mossy fibres contact the granule cells and send collaterals to the cerebellar nuclei while the climbing fibres make contact with the dendrites of the Purkinje cells and may also send projections to the cerebellar nuclei. The granule cells project to the molecular layer and bifurcate to form the parallel fibres that contact the Purkinje cell dendrites as well as the basket cells and stellate cells. The Golgi cells receive input from mossy fibres and also project into the molecular layer of the cortex

The second functional component of the cerebellum consists of the midline vermis of the anterior lobe and a narrow portion of cortex on either side of the vermis referred to as the paravermal cortex. This component is referred to as the spinocerebellum as the bulk of the input to the spinocerebellum is provided by ascending tracts in the spinal cord. The spinocerebellum receives input from the dorsal spinocerebellar tract that transmits proprioceptive, cutaneous, and pressure information from the lower extremity (on the ipsilateral side) [7]. It also receives input from the cuneocerebellar tract, which carries somatosensory information from the upper extremity.

A third major input into the spinocerebellum is the ventral spinocerebellar tract. It transmits information regarding the activity of circuits within the spinal cord involved in regulating motor activity. Additionally, the spinocerebellum also receives inputs from a number of brainstem nuclei including the reticular formation. The spinocerebellum participates in regulating axial and proximal limb muscle musculature involved in balance, posture, and locomotion.

The third and largest functional component of the cerebellum is the pontocerebellum (also referred to as the cerebrocerebellum). It is also the phylogenetically newest component of the cerebellum. It consists of the large hemispheres immediately lateral to the spinocerebellum and receives input principally from the contralateral cerebrum, via the pons. Descending corticopontine fibres from widespread areas of the cerebral cortex (particularly frontal and parietal lobes) project to pontine nuclei of the basilar pons [7]. The neurons of these nuclei send their projections across the midline to project to the cortex of the pontocerebellum. The pontocerebellum is particularly well developed in higher mammals and participates in regulating the coordination of the distal limb musculature as well as playing a role in motor learning.

Cerebellar Cortex

The cortex of the cerebellum is remarkable in its uniformity and segregates into three layers: the outer molecular layer, the Purkinje cell layer, and the inner granule cell layer [6]. The molecular layer contains stellate cells and basket cells but is dominated by the dendrites and axons of other neurons. The molecular layer receives input from neurons of the inferior olivary nucleus of the medulla, and these fibres are referred to as climbing fibres. The climbing fibres make abundant excitatory synaptic connections with the proximal dendritic tree of Purkinje cells [8]. The molecular layer also receives abundant excitatory input from the granule cells of the cerebellar cortex. Granule cells send their axonal projections to the molecular layer cortex where the axons bifurcate and form parallel fibres that run parallel to the cortical surface and make synaptic connections with the dendritic tree of numerous Purkinje cells. The stellate cells of the molecular layer are inhibitory interneurons that use GABA as a neurotransmitter, and these cells are located primarily in the outer part of the molecular layer. These cells also receive input from parallel fibres and make synaptic contacts with the dendritic tree of Purkinje cells. Finally, the basket cells of the molecular layer also use GABA as a neurotransmitter and are located in the inner portion of the molecular layer. Basket cells receive excitatory input from the parallel fibres of the granule cells and make abundant inhibitory connections on the cell bodies of Purkinje cells in a basket-like manner.

The Purkinje cell layer consists of the large cell bodies of the Purkinje cells, which send an extensive dendritic tree into the molecular layer, and candelabrum cells. The dendritic tree of a single Purkinje cell receives excitatory inputs from a single climbing fibre of the inferior olivary nucleus and numerous inputs from parallel fibres of the granule cells. The Purkinje cell is of particular importance because it represents the sole output of the cerebellar cortex. It uses GABA as a transmitter and projects almost solely to the CN. The exception to this rule is the Purkinje cells of the vestibulocerebellum that also project to the vestibular nuclei of the brainstem. Interspersed between the Purkinje cells within this layer are candelabrum cells that are also GABA-ergic neurons that send their dendritic projections into the molecular layer. The functional significance of these cells is poorly understood.

The granule cell layer is the innermost layer of the cortex and consists of granule cells, Golgi cells, unipolar brush cells, and Lugaro cells. The granule cells are the most abundant neuron in the human nervous system and are packed tightly within the granule cell layer. They receive excitatory input from mossy fibres, which are the principal input into the cerebellum. Mossy fibres originate from numerous sites within the nervous system, including pontine nuclei, nuclei of the reticular formation, vestibular nuclei, and the fibres of the spinocerebellar tracts of the spinal cord. The granule cells, which use glutamate as a neurotransmitter, extend their axons into the molecular layer where they bifurcate into the aforementioned parallel fibres and connect with the dendritic tree of up to hundreds of Purkinje cells. The activity of the granule cells plays a critical role in determining the activity of the Purkinje cells. Additionally, the parallel fibres of the granule cells also shape the activity of other cell types of the cerebellar cortex, including Golgi, stellate, and basket cells. The Golgi cells are relatively large cells that are more abundant in the superficial portion of the granule cell layer, nearer to the Purkinje cell layer [9]. These are also GABA-ergic neurons and extend their dendrites into the molecular layer where they receive synaptic input from the parallel fibres of the granule cells. The Golgi cells also make synaptic connections to the granule cell dendrites, thereby providing a source of inhibition to the granule cell. Unipolar brush cells are neurons within the superficial part of the granule cell layer and like granule cells use glutamate as a neurotransmitter. These cells are more abundant in the vestibulocerebellum than other parts of the cerebellum and are closely associated with mossy fibres and project to granule cells and other unipolar brush cells. The final cell intrinsic to the cerebellar cortex is the Lugaro cell. These are GABA-ergic neurons found primarily in the superficial portion of the granule cell layer. Their dendrites may extend into the molecular layer, while their axon is restricted to the granule cell layer where they make connections with Golgi cells.

Within the cerebellar cortex, the connections and links between the parallel fibres of granule cells and the dendrites of inhibitory cells such as Purkinje cells and others, and the connections between the mossy fibres and Purkinje cells (and other neurons), make a unique and uniform microcircuitry observed with great consistency in all parts of the cerebellar cortex.

Cerebellar Nuclei (CN)

There are four pairs of CN embedded within the white matter of the cerebellum (dentate, emboliform, globose, and fastigial) that receive input from the cerebellar cortex as well as the collaterals of fibres projecting to the cerebellar cortex [10]. The first cerebellar neurons generated are neurons of the CN. These cells originate from the rhombic lip and migrate tangentially to the nuclear transitory zone (NTZ). The CN constitute the sole output of the cerebellum (excepting some of the Purkinje cells of the vestibulocerebellum), and they receive the output of the cerebellar cortex from the inhibitory Purkinje cells. In addition to the inhibitory inputs from the Purkinje cells, the CN receive the collateral excitatory inputs from mossy fibres and climbing fibres projecting to the cortex. The majority of CN neurons are excitatory neurons that project to sites outside the cerebellum, including the thalamus, red nucleus, reticular formation, and vestibular nuclei. However, a small population of CN neurons are GABA-ergic, and these neurons project to the inferior olivary nucleus.

The fastigial nucleus is the smallest and most medial of the CN. The neurons of this nucleus receive input from the Purkinje cells of the vestibulocerebellum (i.e., flocculonodular lobe). In addition, the fastigial nucleus also receives input from Purkinje cells of the vermis that receive input from the vestibular apparatus either directly or indirectly via the vestibular nuclei. The neurons of the fastigial nucleus project to the brainstem vestibular and reticular nuclei. As mentioned previously, some of the Purkinje cells of the flocculonodular lobe also send direct (inhibitory) projections to brainstem vestibular nuclei.

Lateral to the fastigial nuclei are the globose and emboliform nuclei, also referred to collectively as the interposed nuclei. These nuclei receive input from the Purkinje cells of the vermis and paravermal areas of the anterior lobe of the cerebellum, which in turn receives input from the cuneate nucleus (via the cuneocerebellar tract) and the accessory cuneate nucleus and Clarke's nuclei (via the dorsal spinocerebellar tract). The interposed nuclei send projections primarily to the red nucleus of the midbrain and the ventrolateral nucleus of the thalamus. The latter nucleus relays this information to the primary motor, supplementary motor, and pre-motor cortices of the frontal lobe.

The dentate nucleus is the largest and most lateral of the CN. It receives inhibitory input from the Purkinje neurons of the large lateral hemispheres and excitatory input from the collaterals of the climbing fibres and mossy fibres projecting to the lateral hemispheres that have their origin in the inferior olive and basilar pontine nuclei, respectively. The neurons of the dentate nucleus project to the red nucleus and the ventrolateral nucleus of the thalamus, which relays the information to the motor cortices of the frontal lobe.

Cerebellar Peduncles

The cerebellum connects to the midbrain, pons, and medulla via three peduncles: the superior, middle, and inferior peduncles, respectively [7, 11]. The superior cerebellar peduncle consists primarily of efferent fibres from the dentate and interposed nuclei projecting to the contralateral red nucleus and ventral lateral nucleus of the thalamus. The cerebellar efferents of the spinocerebellum that project to nuclei of the reticular formation also pass through this peduncle. The cerebellar afferents contained within this peduncle are primarily the fibres of the ventral spinocerebellar tract that project as mossy fibres to the granular layer of the spinocerebellum and send collateral branches to the interposed nuclei.

The middle cerebellar peduncle is a massive bundle of afferent fibres connecting nuclei in the basilar pons to the contralateral cerebellar cortex. These fibres project as the mossy fibres to the granular layer of the large lateral hemispheres and send collateral branches to the dentate nucleus.

The inferior cerebellar peduncle contains fibres connecting the cerebellum to the medulla and consists of the restiform body and the juxtarestiform body. The juxtarestiform body primarily consists of the reciprocal connections of the cerebellum and the vestibular nuclei. The afferent fibres within the juxtarestiform body form the mossy fibres projecting to the granular layer of the vestibulocerebellum. The efferent fibres of the juxtarestiform body include Purkinje cell axons of the vestibulocerebellum and the projections of the fastigial nucleus to vestibular and reticular nuclei of the brainstem. The restiform body contains fibres projecting from the brainstem and spinal cord to widespread areas of the cerebellum. This includes fibres of the dorsal spinocerebellar tract and cuneocerebellar tract projecting to the spinocerebellar cortex as mossy fibres with collateral projections to the interposed nuclei. In addition, fibres originating in the inferior olivary nucleus projecting to the molecular layer of the cerebellar cortex as climbing fibres (with collateral projections to the dentate nucleus) are also contained within the restiform body. The inferior olivary nucleus receives inputs from spinal, vestibular, cranial, and cortical descending signals. The neurons of the inferior olivary nucleus relay somatosensory and noxious stimuli. A single climbing fibre of the inferior olivary nucleus projects to a few Purkinje cells, while each Purkinje cell makes synaptic connections with only one climbing fibre.

The cerebellar cortex also receives projections from a variety of areas of the brain including the locus coeruleus (noradrenergic fibres), raphe nuclei (serotonergic fibres), mesencephalic tegmentum (dopaminergic fibres), and the hypothalamus (histaminergic fibres) [7, 11]. These inputs to the cerebellum terminate in all three layers of the cerebellar cortex as well as the CN. These projections to the cerebellum are commonly referred to as neuromodulatory cerebellar afferents and are thought to decrease the activity of Purkinje cells. The precise distribution and development of these afferent projections to the cerebellum is not well understood. Further research is required to better understand their role in cerebellar function.

Cerebellar Function

The function of the cerebellum can be broadly divided into three categories as set by the three functional divisions described above.

The vestibulocerebellum consists of the midline nodulus and the bilateral floccule [7, 11]. The mossy fibres projecting to the cortex originate in the vestibular ganglion of the vestibular apparatus and the vestibular nuclei of the brainstem. The Purkinje cells of the cortex send inhibitory projections to the fastigial nucleus as well as the ipsilateral vestibular nuclei. The fastigial nucleus, which serves as the principal cerebellar nucleus of the vestibulocerebellum, sends excitatory bilateral projections to the vestibular nuclei. These connections to the vestibular nuclei pass through the inferior cerebellar peduncle. These projections play an important role coordinating the vestibular ocular reflex via the ascending vestibular nuclei projections contained within the medial longitudinal fasciculus to control eye movement in response to vestibular feedback. The vestibular nuclei also send fibres descending the spinal cord as the vestibulospinal tract. These fibres play a critical role in maintaining balance through activation of the anti-gravity muscles of the lower body. The fastigial nucleus also sends ascending projections via the superior cerebellar peduncle to the ventrolateral nucleus of the contralateral thalamus. This information is subsequently relayed to the corticospinal neurons of the anterior corticospinal tract (medial motor system) involved in maintaining posture and balance through activation of the axial musculature. Lesions of the vestibulocerebellum are often characterized by nystagmus and vertigo, resulting from dysregulation of the connections between vestibular nuclei and brainstem nuclei regulating eye movement. Lesions of the fastigial nucleus are also commonly associated a wide-based gait as a result of instability or ataxia of the axial musculature.

The spinocerebellum consists of the midline vermis and paravermal areas of the cerebellum [8]. The mossy fibres projecting to the cortex are largely the fibres of the spinocerebellar and cuneocerebellar tracts. To a lesser extent, the spinocerebellum also receives input from reticular, vestibular, and pontine nuclei. Although the interposed nuclei receive the bulk of the collateral fibres derived from the ascending inputs into the spinocerebellar cortex, the fastigial nucleus also receives some these collaterals. Similarly, the Purkinje cell axons of the paravermal areas of the spinocerebellar cortex project primarily to the interposed nuclei while the vermal areas project to the fastigial nucleus. The fibres projecting from the interposed nuclei exit the cerebellum via the superior cerebellar peduncle. The majority of these fibres project to the ventral lateral nucleus of the contralateral thalamus, and this information is relayed to supplementary motor, pre-motor, and primary motor cortex involved in regulating the limb musculature. The descending projections of these cortical areas will primarily form the lateral corticospinal tract (i.e., the lateral motor system). The interposed nuclei also send projections to the red nucleus and the reticular nuclei to effect changes in the descending rubrospinal and reticulospinal fibres involved in regulating the activity of the spinal cord motor neurons projecting to the upper and lower limbs. The vermal areas of the spinocerebellum that project to the fastigial nucleus are primarily involved in regulating axial musculature. As described above, the fastigial nucleus projects to the reticular and vestibular nuclei of the brainstem and the ventrolateral nucleus of the thalamus. Lesions of the vermal portion of the spinocerebellum are characterized by axial muscle instability, while lesions of the paravermal portions of the spinocerebellum produce ataxia affecting the upper and lower limbs.

The pontocerebellum consists of the lateral hemispheres of the cerebellum and constitutes the largest of the three functional components of the cerebellum. The mossy fibres projecting to the pontocerebellar cortex are almost entirely crossing pontocerebellar fibres. These fibres originate in the pontine nuclei of the contralateral basilar pons and enter the cerebellum via the middle cerebellar peduncle. These fibres send collaterals exclusively to the dentate nucleus, which also receives input from the Purkinje fibres of the pontocerebellum. The fibres of the dentate nucleus exit the cerebellum through the superior cerebellar peduncle. These fibres cross the midline within the tegmentum of the caudal midbrain and continue rostrally where some fibres enter into the red nucleus. The neurons of the red nucleus project to the inferior olivary nucleus of the medulla, which projects back to the pontocerebellum and dentate nucleus forming a feedback loop to the cerebellum. The majority of the fibres originating from the dentate nucleus continue past the red nucleus to the thalamus. The fibres terminate on neurons in the ventrolateral nucleus and to a lesser extent in the ventroanterior nucleus of the thalamus. The thalamic neurons contacted by the neurons of the dentate nucleus project rostrally to a large portion of the motor cortices, with an emphasis on the primary motor cortex. The descending neurons from the primary motor cortex form a large component of the lateral motor system. These projections play a critical role in coordinating the muscle activation required for performing fine motor skills of the distal extremities, particularly of the upper limb. The cortical areas regulated by the thalamic relays of the dentate nucleus also play an important role in the planning of motor activity. Lesions of the pontocerebellum are characterized by a decreased ability to control the distance, velocity, and power of movement performed by the extremities. Lesions of the pontocerebellum are commonly characterized by intention tremor and difficulty in performing rapid alternating movements of the hand (e.g., pronation and supination). The latter deficit is referred to as dysdiadochokinesia. These deficits underscore the importance of the pontocerebellum in regulating fine motor skills.

Blood Supply of the Cerebellum

The cerebellum is supplied with arterial blood via three cerebellar arteries: the posterior inferior cerebellar artery (PICA), the anterior inferior cerebellar artery (AICA), and the superior cerebellar artery (SCA) [12]. These arteries are derived from the vertebral–basilar arterial system that supplies the posterior circulation of the brain. The bilateral vertebral arteries pass through the foramen magnum and shortly after entering the cranium, the PICA branches off the vertebral artery. The

PICA supplies the cortex of the posterior portion of the inferior cerebellum and the inferior portion of the underlying white matter. It also supplies the fibres of the inferior cerebellar peduncle. The vertebral arteries fuse in the midline, near the junction of the pons, and the medulla, to form the basilar artery, and the AICA branches off the basilar artery immediately anterior to this junction. The AICA supplies the cortex of the anterior portion of the inferior cerebellum and the underlying white matter. Distal branches of the AICA may extend into the lateral portion of the dentate nucleus. The AICA also supplies the posterior part of the middle cerebellar peduncle, while circumferential branches of the basilar artery supply the anterior portion of the middle cerebellar peduncle. The most lateral edge of the inferior surface of the cerebellum is generally the watershed area of the PICA and the AICA.

The SCA attaches to the basilar artery immediately posterior to the bifurcation of the basilar artery into the paired posterior cerebral arteries. The SCA supplies the superior surface of the cerebellum and the bulk of the white matter of the cerebellum. It also supplies the CN except for the lateral portion of the dentate nucleus that may be supplied by the AICA. The SCA also supplies the superior cerebellar peduncle together with branches of the posterior cerebral artery.

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