Cerebellum (Small brain)

- Posterior part of hind brain
- In adult it weighs around 150 gm
- Situated in posterior cranial fossa behind the pons & medulla separated from them by fourth ventricle
- From the cerebrum it is separated by tentorium cerebelli
Subdivisions

Cerebellum consist of a part lying near the midline called the vermis & two lateral hemisphere

• Two surfaces
  superior
  inferior

• On superior surface there is no distinction between vermis & hemisphere

• On inferior surface vermis lies in depth of vallecula

• Vermis is separated from corresponding hemisphere by paramedian surface
• Surface of cerebellum is marked by parallel running fissures
• They divide the surface into narrow **Folia**
• Section of the cerebellum cut at right angle to the folia axis has the appearance of tree so given the name of **Arbor vitae**

• Some of the fissures are deep. They divide the cerebellum into lobes which is constituted by smaller lobules
• Like cerbrum it also has a superficial layer of grey matter the cerebellar cortex

• Because numerous fissures are present the actual cerebellar cortex is much more then what is seen on surface

• Cerebellar notches
  Anterior
  Posterior
Fissures-
primary fissure
Horizontal fissure
posterolateral fissure
Lobes- anterior lobe
Middle lobe
Posterior lobe
• Functional areas of cerebellar cortex
  Vermis- Movement of the long axis of the body namely neck, shoulders, thorax, abdomen & hips
• Paravermal areas- control the muscles of distal part of the limbs especially the hands & feet
• Lateral zone is concerned with the planning of sequential movements of the entire body & is involved with the conscious assessment of movement errors
Morphological & functional divisions –

**Archicerebellum- flocculonodular lobe & lingula** Oldest part. Chiefly vestibular in connection. Controls the axial musculature & bilateral movement used for locomotion & maintenance of equilibrium

**Paleocerebellum- Anterior lobe** (-lingula)+ pyramid & uvula. Connections are spinocerebellar. Controls tone, posture, & crude movement of limbs.

**Neocerebellum- Middle lobe**-(pyramid & uvula). Corticocerebellar in connections. Concerned with regulation of fine movements
Grey matter of cerebellum
- Dentate nucleus (neocerebellar)
- Emboliform nucleus (paleocerebellar)
- Globose nucleus (paleocerebellar)
- Fastigial nucleus (archicerebellar)
White matter of cerebellum-
   a. Consist of Afferent fibers entering the cerebellum
   b. Projection fibers from cerebellar cortex to the cerebellar nuclei
   c. Commissural fibers connecting the two cerebellar hemispheres
   d. Fibers from the cerebellar nuclei to centers outside the cerebellum
• Cerebellar afferent fibers from cerebellar cortex
• Cerebellar afferent fibers from the spinal cord & internal ear
Cerebellar efferent fibers

Cerebral cortex

Corticospinal fibers

Thalamus

Red nucleus

Rubrospinal tract

Superior cerebellar peduncle

Middle cerebellar peduncle

Inferior cerebellar peduncle

Reticular formation

Corticospinal tract

Decussation of pyramid

Rubrospinal tract

Reticulospinal tract

Dentothalamic pathway

Globose-emboliform-rubral pathway

Cerebellar cortex

Deep cerebellar nuclei

Fastigial vestibular pathway

Fastigial reticular pathway

Vestibular nucleus

Vestibulospinal tract

Corticospinal tract
Scheme to show main connections of the cerebellum
Cerebellar peduncle-Bundle of efferent & afferent fibers which are grouped together in three bundle on each side connecting cerebellum to medulla, pons & midbrain. Near the upper end of medulla inferior cerebellar peduncle lies between superior cer. Ped. (medial) & middle cer. Ped. (lateral)
Cerebellar peduncle-

Inferior cerebellar peduncle

**Afferent fibers**

Posterior spinocerebellar tract
Cuneocerebellar tract
Olivocerebellar tract
Parolivocerebellar tract
Reticulocerebellar tract
Vestibulocerebellar tract
Anterior external arcuate fibers from arcuate nuclei
Striae medullares
Trigeminocerebellar fibers

**Efferent fibers**

Cerebellovestibular
cerebelloolivary
cerebelloreticular
Middle cerebellar peduncle-
Pontocerebellar fibers

Superior cerebellar peduncle-
Afferent fibers - Efferent fibers

ventral Spinocerebellar tract
Tectocerebellar tract
Rubrospinal tract
Trigeminocerebellar
Hypothalamocerebellar
Coerulocerebellar fibers

Cerebellorubral fibers
Cerebellothalamic fibers (DEG)
Cerebelloreticular fibers (F)
Cerebellooolivary (DEG)
Cerebellonuclear (MLN)
Fibers to hypothalamus & subthalamus

Fibers to hypothalamus & subthalamus
Structure of cerebellar cortex-

Three layers
a. Molecular layer
b. Purkinje cell layer
c. Granular layer

Neurons of the cerebellum

Purkinje cells
Granule cells
Outer stellate cells
Basket cells
Golgi cells
Brush cells
Functional organisation of cerebellar cortex
Function of cerebellum: Coordinator of precise movement by continually comparing the output of motor area of cerebral cortex with the proprioceptive information received from the site of muscle action, it is able to bring about adjustment by influencing the activity of the lower motor neuron.

It also sends back information to the motor cortex to inhibit the agonist muscle & stimulate the antagonist muscle thus limiting the extent of voluntary movement.
• **Applied anatomy**- A lesion in cerebellar hemisphere gives rise to sign & symptom that are limited to **the same side (ipsilateral)** of the body

• **Sign & symptom**- **acute** lesion produce sudden severe symptom and signs, but patient can recover completely from large lesions In **chronic** lesions sign & symptom are much less severe
  - Hypotonia- the muscle loss resilience to palpation. Shaking produces excessive movement at terminal joint. It is due to loss of cerebellar influence on the stretch reflex.
  - Postural changes & alteration of gait- Head is often rotated & flexed & shoulder on the side of lesion is lower wide base stance often stiff legged to compensate for the loss of muscle tone. On walking person staggers towards the affected side
- **Ataxia** - Muscle contract weakly & irregularly. Tremor occur on doing the fine movement like buttoning clothes Muscle group do not work harmoniously so there is decomposition of movement. Past pointing occurs

- **Dysdiadochokinesia** - Inability to perform alternating movements regularly & rapidly

- **Disturbances of reflexes** - Pendular knee jerk because of loss of cerebellar influence on stretch reflex

- **Disturbance of ocular movement** - Nystagmus Ataxia of ocular muscles. Easily seen when eye is deviated to the horizontal direction
• **Disorders of speech**- Dysarthria, Ataxia of the muscles of the larynx. Articulation is jerky & the syllables are separated from one another & slurred. Speech is explosive.

• **Vermis syndrome**- Occurs in children. Medulloblastoma of vermis causes vestibular symptom. Muscle in coordination in axial region. Tendency to fall forward & backward