Lecture Outline

- Constituents
  - Midbrain
  - Pons
  - Medulla Oblongata

- External Features

- Internal features
Brainstem: Midbrain, Pons, Medulla oblongata
Brainstem - posterior view - contents of 4th ventricle:

- Habenular trigone
- Geniculate bodies
- Medial geniculate body
- Lateral geniculate body
- Dorsal median sulcus
- Superior cerebellar peduncle
- Locus ceruleus
- Medial eminence
- Facial colliculus
- Vestibular area
- Dentate nucleus of cerebellum
- Striae medullares
- Tenia of 4th ventricle
- Cuneate tubercle
- Gracile tubercle
- Dorsal median sulcus
- Lateral funiculus
- Cuneate fasciculus
- Gracile fasciculus

- Superior cerebellar peduncle
- Middle cerebellar peduncle
- Inferior cerebellar peduncle
- Superior medullary velum
- Trochlear nerve (IV)
- Superior colliculus
- Inferior colliculus
- Pulvinar of thalamus
- Pineal body
- 3rd ventricle
- Cerebellar peduncles
- Lateral recess
- Superior fovea
- Sulcus limitans
- Inferior fovea
- Trigeminal tubercle
- Hypoglossal trigone
- Vagal trigone
- Obex
Brainstem - posterolateral view:

Posterolateral view

- Thalamus (cut surface)
- Lateral geniculate body
- Optic tract
- Medial geniculate body
- Brachia of superior and inferior colliculi
- Cerebral crus
- Pons
- Trigeminal nerve (V)
- Middle cerebellar peduncle
- Vestibulocochlear nerve (VIII)
- Facial nerve (VII)
- Inferior cerebellar peduncle
- Hypoglossal nerve (XII)
- Accessory nerve (XI)
- Cuneate tubercle
- Gracile tubercle
- Dorsal roots of 1st spinal nerve (C1)
- Cuneate fasciculus
- Gracile fasciculus
Sagittal Section of Diencephalon and the brainstem

Median sagittal section

- Body of fornix
- Thalamus (in 3rd ventricle)
- Interventricular foramen (Monro)
- Anterior commissure
- Lamina terminalis
- Hypothalamic sulcus
- Midbrain tegmentum
- Cerebral aqueduct (Sylvius)
- Superior colliculus
- Tectal (quadrigeminal) plate
- Inferior colliculus
- Pons
- Medial longitudinal fasciculus
- 4th ventricle
- Choroid plexus of 4th ventricle
- Medulla oblongata
- Median aperture (foramen of Magendie)
- Decussation of pyramids
- Central canal of spinal cord
- Interthalamic adhesion
- Posterior commissure
- Habenular commissure
- Pineal body
- Splenium of corpus callosum
- Great cerebral vein (Galen)
- Lingula (I)
- Central lobule (II-III)
- Culmen (IV-V)
- Declive (VI)
- Folium (VII A)
- Superior medullary velum
- Inferior medullary velum
- Tuber (VII B)
- Pyramid (VIII)
- Uvula (IX)
- Nodulus (X)
- Choroid plexus of 4th ventricle
- Tonsil of cerebellum
- Vermis of cerebellum
Basic internal components of Brainstem

- Ascending/descending fibre pathways
- Cranial nerve nuclei
- Neuromodulatory nuclei
- Intrinsic nuclei
- Tegmental/Reticular nuclei
- All components found in each part of the brainstem.
Ascending and Descending fibre pathways.

- These fibres carry information in the form of ascending sensory, or descending motor pathways. E.g.
- Ascending trigeminal sensory pathway and the Descending pyramidal motor pathway.
Location of the Cranial nerve nuclei in the brainstem
Cranial Nerve Nuclei Functions

- Motor
- Parasympathetic
- General Sensory
- Special Sensory
- Combination of two or more of above
Neuromodulatory Nuclei

- Serve to modulate neuronal activity over large parts of the entire brain. E.g
  - Raphe nuclei (serotonergic),
  - Substantia nigra (dopaminergic),
  - Locus coeruleus (noradrenergic),
  - Area postrema (adrenergic), lateral dorsal tegmental and pedunculopontine (cholinergic)

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Doya K (2002) in Neural Networks
Intrinsic Nuclei

- Form connections and undertake functions within regions of the brainstem.
  E.g
  - **Inferior olive (IO)**
    - Region of correlation of impulses from cerebellum, spinal cord, cerebral cortex, and corpus striatum and channels into the cerebellum for the coordination of learned patterns of movement.
Reticular Formation (RF)

A continuous core that traverses the whole brainstem

Continuous below with the reticular intermediate spinal grey laminae.

Divisible, on basis of cytoarchitectonic, chemoarchitectonic and functional criteria, into 3 longitudinal columns: median; medial, mostly large reticular neurones; lateral, small to intermediate neurones
Characteristics of RF

- Ill-defined collections of neurones and fibres with diffuse connections
- Their conduction paths are difficult to define, often complex and polysynaptic,
- They have ascending and descending components that are partly crossed and uncrossed.
- Components are associated with somatic and visceral functions
Functions of Reticular Nuclei

- Coordination of muscles movements
- Modulate pain sensation
- Eye movements
- Conscious state
- Speed of reflexes
- General level of alertness
- Regulation of feeding, respiration, circulation
- Drug induced vomiting
Midbrain – External Features

Swellings
Peduncles
Cranial Nerves/
Nuclei
Anterior Perforated space
Midbrain: Components

- 4 parts
- 1. Tectum/Colliculi
- 2. Tegmentum
- 3. Substantia Nigra
- 4. Basis pedunculi
Midbrain: level of superior & Inferior colliculi
**Fibre Pathways -**
- medial longitudinal fasciculus, lateral and medial lemniscus, corticobulbar and corticospinal tracts.

**Cranial Nerve Nuclei -**
- III (oculomotor) and IV (trochlear)

**Neuromodulatory nuclei -**
- dorsal raphe (serotonergic), substantia nigra and ventral tegmental area (dopaminergic)

**Intrinsic Nuclei -**
- superior and inferior colliculi, red nucleus, periaqueductal gray matter.

**Tegmental/Reticular Nuclei -**
- parabrachium, cuneiform, subcuneiform
Swellings
Pontomedullary junction
Cranial Nerves/
Nuclei
**Pons - components**

2 main parts

1. Dorsal sensory/motor tegmental portion
2. Ventral pontine nuclei
Fibre Pathways -
- brachium conjunctivum, tegmental and lemniscal tracts, corticospinal, corticopontine, pontocerebellar.

Cranial Nerve Nuclei -
- V (trigeminal, motor and sensory), VI (abducens), VII (facial) & VIII (vestibulocochlear – part)

Neuromodulatory nuclei -
- raphe (serotonergic), locus coeruleus (noradrenergic), lateral dorsal tegmental and pedunculopontine (cholinergic)

Intrinsic Nuclei -
- pontine gray, cochlear nuclei

Tegmental/Reticular Nuclei -
- oral pontine, caudal pontine, pontine reticulotegmental.
Medulla – External Features

Sulcus Swellings CN Nuclei
Medulla Oblongata: Components

- Composed mostly of continuations of fibre tracts of spinal cord & various cranial nerve nuclei (VIII – XII).
Fibre Pathways -
- pyramidal tract, tectospinal tracts, various spinal related tracts

Cranial Nerve Nuclei -
- VIII (vestibulocochlear – part), IX (glossopharyngeal), X (vagus), XI (accessory), XII (hypoglossal)

Neuromodulatory nuclei -
- ventral raphe (serotonergic)

Intrinsic Nuclei -
- inferior olivary nucleus, dorsal vagal motor nucleus, area postrema

Tegmental/Reticular Nuclei -
- parvocellular reticular area, gigantocellular nucleus, central medullary nucleus, paramedian and lateral reticular nuclei.
Fig 17.20
MRI of brainstem
A - medulla
B - pons
C - midbrain
Questions

- What are the five basic components (contents) of the brainstem?
- Enumerate the functions of the reticular nuclei?
- List the external features of the medulla oblongata (pons or medulla)
- Using a diagram, depict the anatomic structures in a cross-section of the midbrain at the level of the superior colliculus.
- Compare and contrast the intrinsic and cranial nerve nuclei present at the levels of the superior and inferior colliculi of the midbrain