



- **Corticonuclear or corticobulbar pathway**: both are the same but corticobulbar was used in the past when it was thought that cortical fibers were going to cranial nerve nuclei present in the medulla only.
- **7th cranial nerve (facial nerve)**:
 - **It has 2 types of control on facial expressions**:
 - ✓ Voluntary control: example on this is when you ask a person to smile and he smiles (smiling on command).
 - ✓ Spontaneous (extrapyramidal pathway): example on this is telling a joke to a person and he smiles involuntary (this type is expressing emotions).
 - Notes:
 - ❖ *If a person has a cortical damage* → he can smile spontaneously but when you ask him to smile voluntary → he cannot do it.
 - ❖ *If the cortex is intact but there is a damage to the extrapyramidal tract* → a person can smile voluntary but not spontaneously.
 - **The corticobulbar tract is considered as an upper motor neuron (UMN) which is controlling**:
 - ✓ Upper part of the face → bilaterally.
 - ✓ Lower part of the face → contralaterally.
 - **The nuclei of the facial nerve are present in the pons.**
 - **If a patient is presented with a lesion which caused paralysis of half of the face** → this is a lower motor neuron lesion at the same paralyzed side of the face (in the facial nucleus at the lateral part of pons).
 - **If a patient is presented with a lesion in corticobulbar tract** → there will be no paralysis of upper part of the face (because it is compensated by the other intact corticobulbar tract) but the lower part of the face will be paralyzed contralaterally (at the opposite side of the lesion).
 - ✓ E.g. if the right lower part of the face is paralyzed → there is an upper motor neuron lesion in the left corticobulbar tract.
- **Collateral inhibition**: when you want to move your finger → the muscles surrounding your finger must be relaxed so movement occurs smoothly which means that the pyramidal tract reaching the lower motor neuron of your finger is going to inhibit adjacent motor cortex of the muscles surrounding your finger.
 - **Remember that fibers contributing to the pyramidal tract are coming from**:
 - ✓ Primary motor cortex: 30%
 - ✓ Pre-motor cortex and supplementary area: 30%
 - ✓ Somatic sensory area: 40%
 - **Pyramidal tract targets**:
 - ✓ Red nucleus in midbrain: rubrospinal tract.
 - ✓ Lower motor neurons in the spinal cord.
 - ✓ Nuclei of reticular formation: reticulospinal tract.
 - ✓ Superior colliculi in midbrain: tectospinal tract.
 - ✓ Vestibular nuclei: vestibulospinal tract.
- **Corticobulbar tract**:
 - Fibers are arising in the cortex and terminating in the nuclei of cranial nerves. There are 12 cranial nerves, 3 of them are sensory and thus they are not supplied by the corticobulbar tract (these are cranial nerves: 1, 2 and 8).
 - **The main function of corticobulbar tract is for swallowing and speech.**
 - **It has a direct innervation to the following cranial nerves**:
 - ✓ 5 (trigeminal).
 - ✓ 7 (facial).
 - ✓ 11 (accessory).
 - ✓ 12 (hypoglossal).
 - **It has an indirect innervation for those cranial nerves controlling eye movement (command is coming to them from frontal eye field). Those nerves are:**



- ✓ 3 (occulomotor).
- ✓ 4 (trochlear).
- ✓ 6 (abducens).

- **Nucleus ambiguus is giving innervation to the following cranial nerves:**

- ✓ 9 (glossopharyngeal).
- ✓ 10 (vagus).
- ✓ 11 (accessory).

- **The corticobulbar tract is an upper motor neuron (as it was mentioned previously) providing bilateral innervation for cranial nerve nuclei. Therefore, it is rare to have an UMN lesion which will produce difficulty in swallowing and speech. Exceptions from this rule are:**

- ✓ Facial nerve: in which there is bilateral innervation only in the upper part of the face.
- ✓ Muscles of the eye which are under the control of frontal eye field.
- ✓ Hypoglossal nerve.

- **Nucleus ambiguus:**

- **It is providing motor function for 9th, 10th and 11th cranial nerves (as it was mentioned previously).**
- Motor fibers from these nerves will go mainly to the pharynx, larynx, soft palate and upper part of esophagus.
- **It the soft palate is paralyzed → it will be depressed leading to:**
 - ✓ Nasal speech: passage of air which is producing voice through the nasal cavity.
 - ✓ Nasal regurgitation: passage of food through nasal cavity.
- **If the right side of the soft palate is paralyzed → uvula will be deviated to the left side (toward the normal side).**

Note: all of these clinical manifestations mentioned above occur when there is a lesion to the cranial nerve nucleus itself (bulbar palsy). If the lesion is in the corticobulbar tract, there will be no effect because there is bilateral innervation unless the lesion occurs bilaterally to this tract (pseudobulbar palsy).

- **Nucleus solitarius:**

- **It receiving sensory input of taste from:**
 - ✓ 7th CN (facial nerve): transmitting taste sensation form anterior 2/3 of the tongue.
 - ✓ 9th CN (glossopharyngeal nerve): transmitting taste sensation from posterior 1/3 of the tongue.
 - ✓ 10th CN (vagus nerve): transmitting taste sensation from posteriormost part of the tongue.
- **It is receiving other inputs:**
 - ✓ Chemoreceptors and mechanoreceptors in carotid body: 9th CN.
 - ✓ Chemoreceptors and mechanoreceptors in aortic bodies: 10th CN.
 - ✓ General visceral afferents from: heart, lungs, airways, GI system, pharynx and liver. These inputs mediate:
 - ❖ *The Gag reflex.*
 - ❖ *Carotid sinus reflex and aortic reflex.*
 - ❖ *Cough reflex.*
 - ❖ *Several respiratory reflexes and reflexes of GI system regulating motility and secretions.*
- **Outputs are going mainly to:**
 - ✓ Hypothalamus.
 - ✓ Amygdala.

- **Decorticate posture:**

- **In normal situations the cortex is inhibiting:**
 - ✓ Red nucleus: which normally functions to cause flexion of the arm.
 - ✓ Vestibular nucleus: which normally functions to cause extension of the leg.

Note: if there is a lesion above the red nucleus → this will result in arm flexion and leg extension (this is known as decorticate posture).



- **Decerebrate posture:**
 - **It occurs if the lesion is below the red nucleus** → in which there will be inhibition of flexors but no inhibition to extensors (so the patient will be presented with extension of arm and leg). → this is known as decerebrate posture.
- **The skull is considered as a closed box which contains:**
 - **Brain tissue.**
 - **Blood.**
 - **Cerebrospinal fluid (CSF).**

Note: an increase in anyone of these contents will result in increased intracranial pressure:

 - ✓ Increase in brain tissue: tumor.
 - ✓ Increase in blood: hemorrhage.
 - ✓ Increase in cerebrospinal fluid: hydrocephalus.
- **If a patient is suffering from increased intracranial pressure, the following will occur as a response:**
 - **Production of CSF will be decreased.**
 - **Reabsorption of CSF will be increased.**
 - **Distention of dura.**
 - **Displacement (brain parenchyma is pushed away).**
- **Cerebral Perfusion Pressure (CPP) = Mean Arterial Pressure (MAP) – Intracranial Pressure (ICP).**
 - **Automatic regulation of blood flow:** when there is increased blood pressure → constriction of vessels will occur to maintain a constant blood flow (and the opposite is true). Note: this process is functional within the range of 60-140 mmHg (if the blood pressure is more than 140 mmHg or less than 60 mmHg this process is not effective in maintaining constant blood pressure).
 - **Metabolic regulation of blood flow:** blood flow will be affected when there are changes in PCO_2 , PO_2 or pH.
 - ✓ If the patient is suffering from acidosis (increased H^+): this will lead to vasodilation and depressed neural activity.
- **20% of our energy is spent by the brain in resting condition to maintain:**
 - **Oxygen supply to grey mater.**
 - **Adaptation of local perfusion to local brain activity.**
 - **Life of neurons.**
- **Shallow water blackout:** unconsciousness caused by cerebral hypoxia because the person does not feel an urgent need for breathing (there is low CO_2 caused by prior hyperventilation).
- **Oxygen deficiency:**
 - Oxygen level in the brain is much higher than needed → decreased concentration is not important unless there is severe hypoxia.
- **Sympathetic nervous system:**
 - During severe exercise → middle sized arteries will constrict to reduce blood flow and preventing rupture of small arterioles.
- **Stroke can be classified to:**
 - **Occlusive** (caused by atherosclerosis or embolism).
 - **Hemorrhagic** (associated with hypertension and aneurysm).
 - **Watershed:** occurring in the borders of vascular zones → the blood flow is reduced, these areas are usually affected because normally there is little blood flow in them.
- **Lateral medullary syndrome:** occlusion mostly to vertebral artery or less often to posterior inferior cerebellar artery (posterior spinal artery in caudal medulla).
- **Medial medullary syndrome:** vertebral and anterior spinal arteries.

Note: that occlusion of vertebral artery can cause both (lateral and medial) medullary syndromes.