



## 28<sup>th</sup> Lecture

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# Brain Transmitters

**PHYSIOLOGY TEAM – 430**

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## Brain Transmitters

- **Acetylcholine (ACh):**

- **Location:**
  - ✓ Basal Forebrain (Mainly nucleus basalis)
  - ✓ Ponto-Mesencephalic Cholinergic Complex
- **Synthesized by:** reaction of Choline & Acetyl-CoA
- After being released → Rapidly hydrolyzed into Choline & Acetate by Acetylcholinesterase
- Receptors (Nicotinic & Muscarinic) are present in large numbers in the brain
- **Functions:**
  - ✓ Consciousness (Wakefulness/Sleep states)
  - ✓ Learning
  - ✓ Memory
- Defect in brain cholinergic system → causes dementia (Loss of memory "Alzheimer's disease")

- **Norepinephrine (NE) & Epinephrine:**

- **Location:**
  - ✓ Locus Cereulus
- **Synthesized by:** Amino acid Tyrosine
- Axons of noradrenergic neurons from Locus Cereulus form the Locus Cereulus System
- After binding to receptors: Either one of two:
  - ✓ Re-uptake into presynaptic neuron then degraded by MAO intracellularly (Major mechanism of inactivation)
  - ✓ Inactivated by COMT extracellularly in postsynaptic membrane
- **Functions:**
  - ✓ Constitutes part of RAS (Alertness)
  - ✓ Fight-Flight situations
  - ✓ Together with the serotonin, if are in decreased levels → Depression

- **Dopamine (DA):**

- **Synthesized by:** Tyrosine
- Inactivated by: MAO + COMT (Like NE)
- In Brain, Dopaminergic neurons comprise:

- 1) **Nigrostriatal System:**

- Originate from **Substantia Nigra** and project to Striatum (Basal Ganglia)
- **Function:**
  - ✓ Motor control
  - If decreased → it will cause Parkinson's disease

- 2) **Mesocortical System:**

- Originate from **Ventral Tegmental Area (VTA)** and projects to nucleus accumbens and limbic system
- Functions:
  - ✓ Pleasure
  - ✓ Reward
  - ✓ Addiction
- Overstimulation of its receptors will give Schizophrenia-like psychotic symptoms

- **Glutamate:**

- **Function:**
  - ✓ Major excitatory amino acid in the brain
  - ✓ Involved in Long-Term Potentiation (LTP)
  - ✓ Memory storage
- Excessive glutamate activity → Epilepsy, Stroke, MS and Alzheimer's

- **GABA:**

- **Function:**

- ✓ Major inhibitory amino acid in the Brain
  - Drugs such as diazepam (Valium) stimulate the inhibitory action of GABA receptors
  - Therefore, Diazepam is used for:
    - ✓ Anxilytic (anti-anxiety)
    - ✓ Sedative drug
    - ✓ Muscle relaxant
    - ✓ Anticonvulsants drug

- **Serotonin:**

- **Location:**

- ✓ Raphe Nuclei

- **Function:**

- ✓ Induction of sleep
  - If decreased → it will cause depression
  - If increased → induces Hallucinations