BHARATHIDASAN UNIVERSITY

# Program: M.Sc., Biomedical Science

Course Title : Neurobiology

# Acetylcholine

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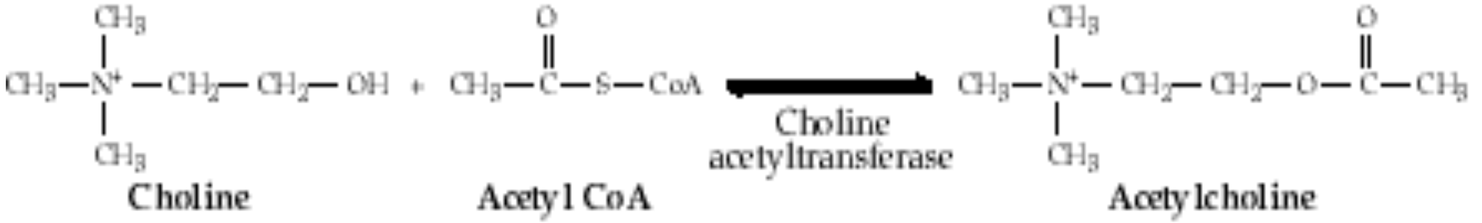
# Acetylcholine synthesis:

- In the cholinergic neurons acetylcholine is synthesized from choline. This reaction is activated by cholineacetyltransferase

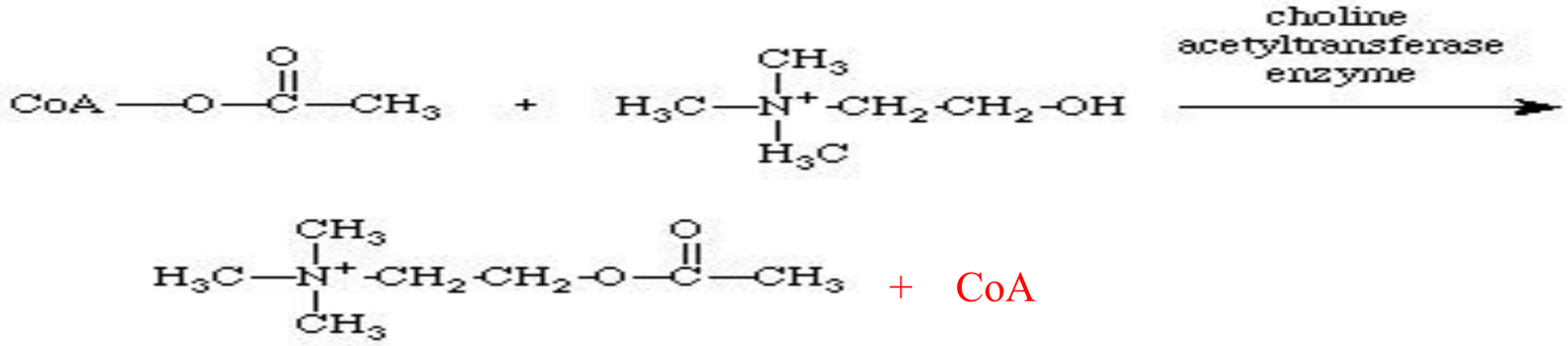



As soon as acetylcholine is synthesized, it is stored within synaptic vesicles.

# Acetylcholine Synthesis

Choline Acetyltransferase (ChAT)

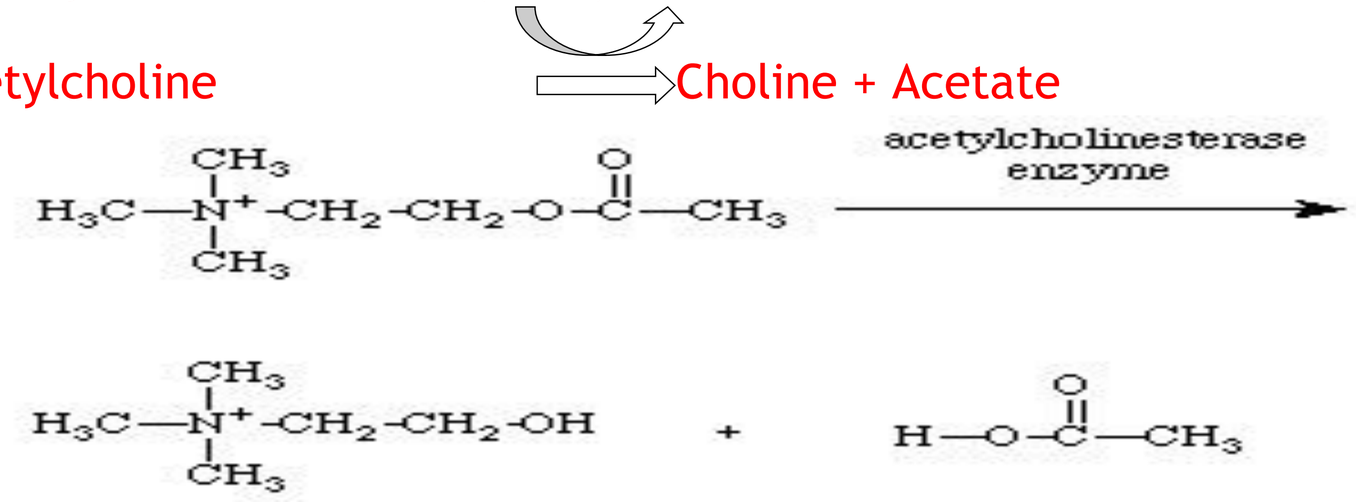
Acetyl CoA + Choline ⇌ Acetylcholine + CoA




# Degradation

Acetylcholine Esterase (AchE)

Acetylcholine ⇌ Choline + Acetate



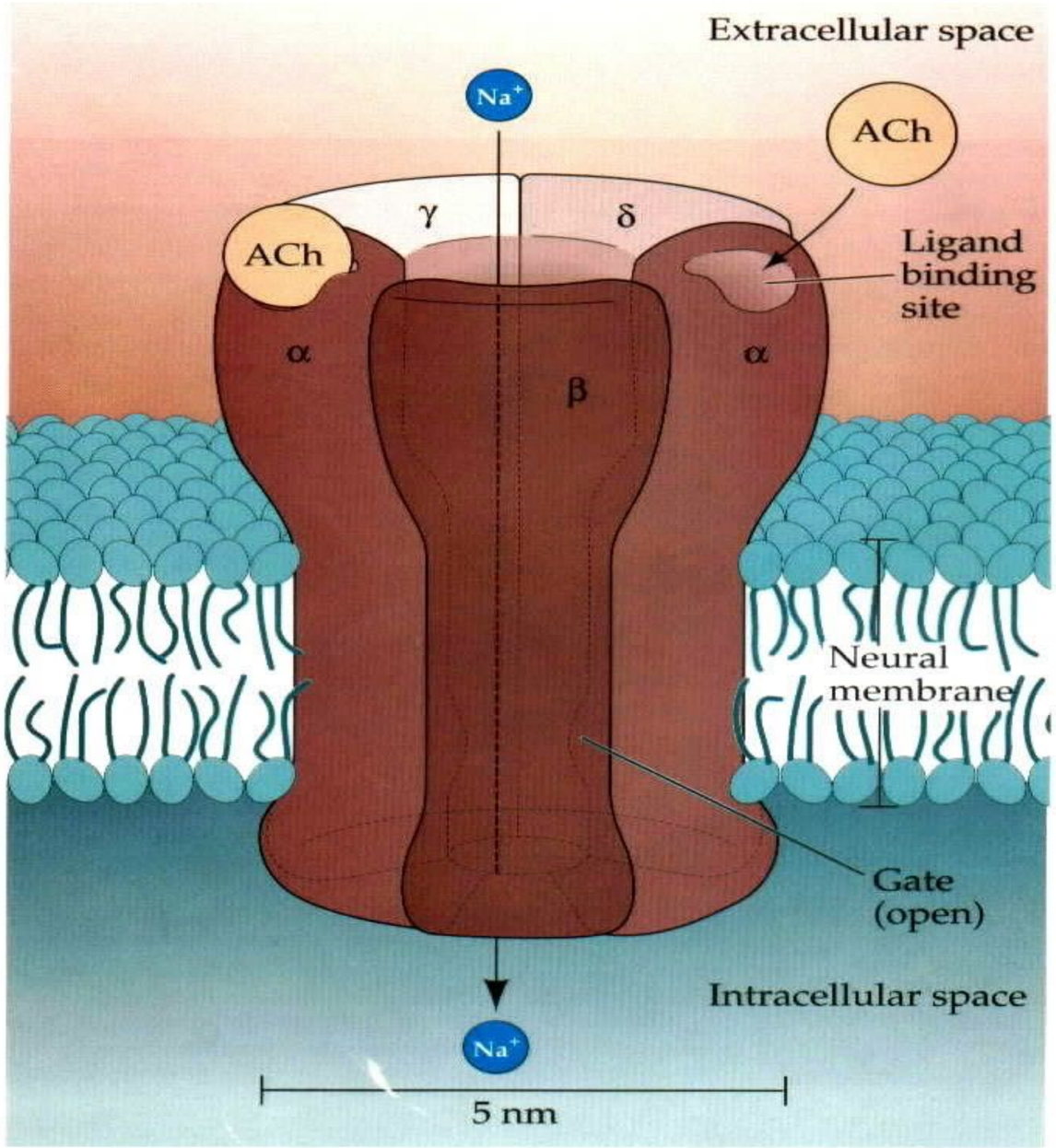
# Removal of Acetylcholine from the synaptic cleft:

- **In order to ready the synapse for another impulses:**
- 1) The neurotransmitters, which are released from the synaptic vesicles, are hydrolyzed by enzyme present in the synaptic cleft “Acetylcholinestrase” giving choline, which poorly binds to acetylcholine receptors.

**Acetylcholinestrase**

**Acetylcholine + H2O ⟶ Choline + H+ acetate**

- 2) The empty synaptic vesicles, which are returned to the axonal terminal bulb by endocytosis, must be filled with acetylecholine.




A Nicotinic Acetylcholine Receptor

# Binding of acetylcholine to the postsynaptic receptors:

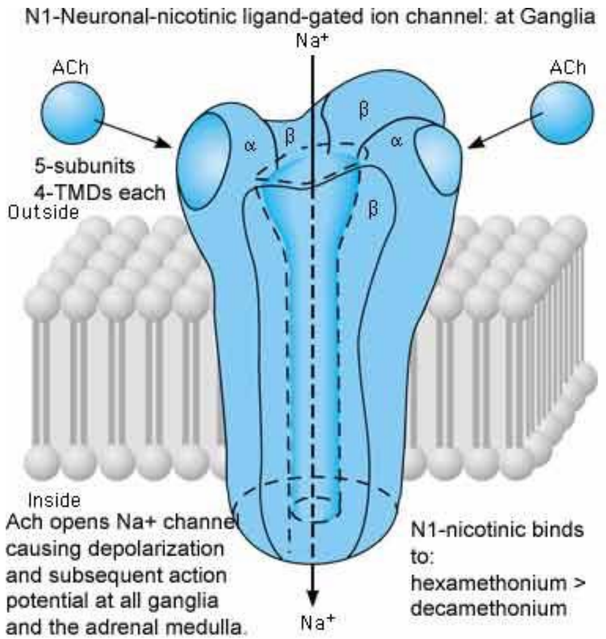
- The postsynaptic membrane of the receptor dendrite has specific cholinergic receptors toward which the neurotransmitter diffuses. Binding of acetylcholine trigger the opening of ion channels in the postsynaptic membrane initiating action potential that can pass in the next axon.

▪**<u>Acetylcholine receptors:</u>**

▪ <u>Acetylcholine receptors</u> are ion channels receptors made of many subunits arranged in the form [(α2)(β)(γ)(δ)].

· When Acetylcholine is not bounded to the receptors, the bulky hydrophobic leu side close the central channels preventing the diffusion of any ions.

· Binding of two acetylcholine molecules to the receptors will rotate the subunits in which the smaller polar residues will line the ion channel causing the influx of Na+ into the cell and efflux of K+ resulting in a depolarization of the postsynaptic neuron and the initiation of new action potential.



# Chemicals that Act on ACh Systems

## black widow spider venom

stimulates release of ACh

## botulinum toxin

blocks release of ACh

## curare

blocks ACh nicotinic receptors

## insecticides

AChE inhibitors

atropine as antidote

blocks muscarinic receptors

# Clinical Aspects of ACh Systems

## Alzheimer's disease

loss of ACh neurons in
the basal nucleus of Meynert

Aricept—ACh agonist