
بسم الله الرحمن الرحيم

Nervous System

PNS *CNS*

Autonomic Nervous System

Introduction and Neurotransmitters

By

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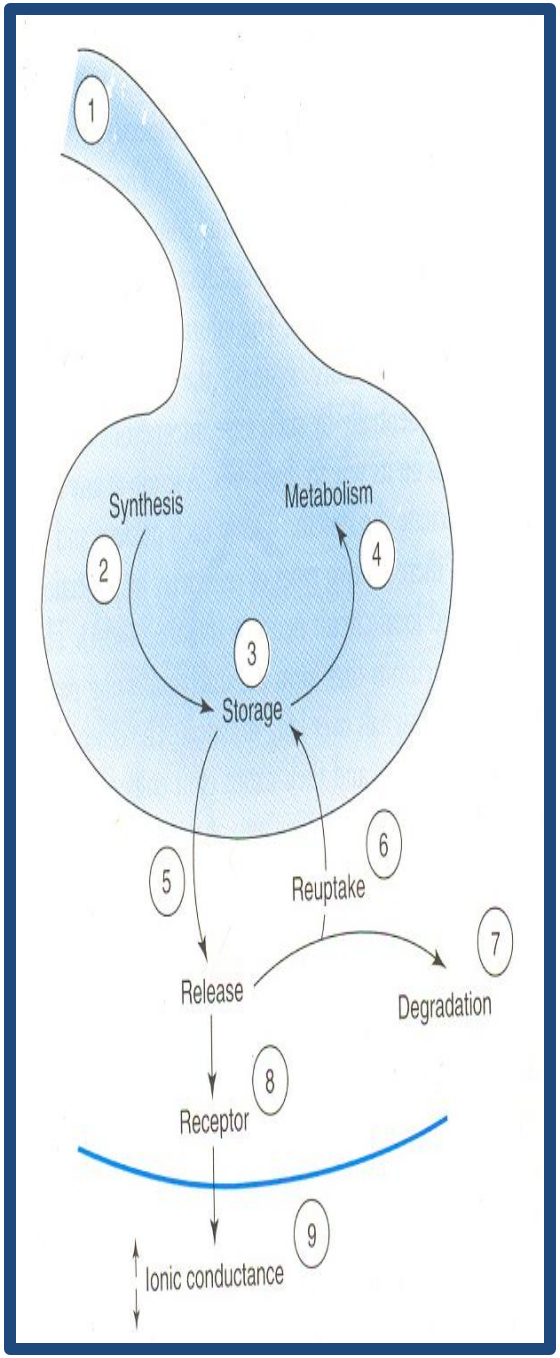
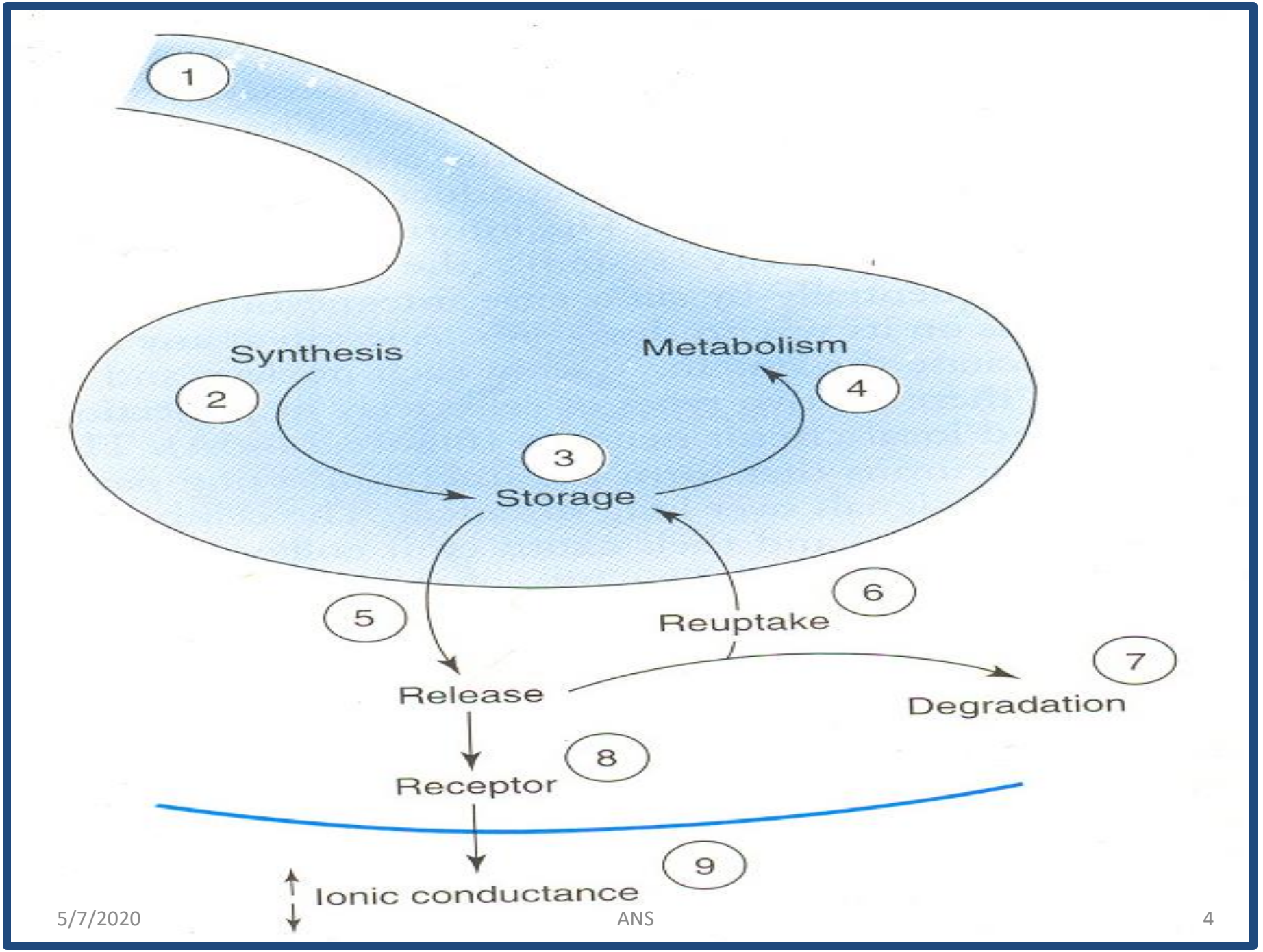
Steps in Neurohumoral Transmission;

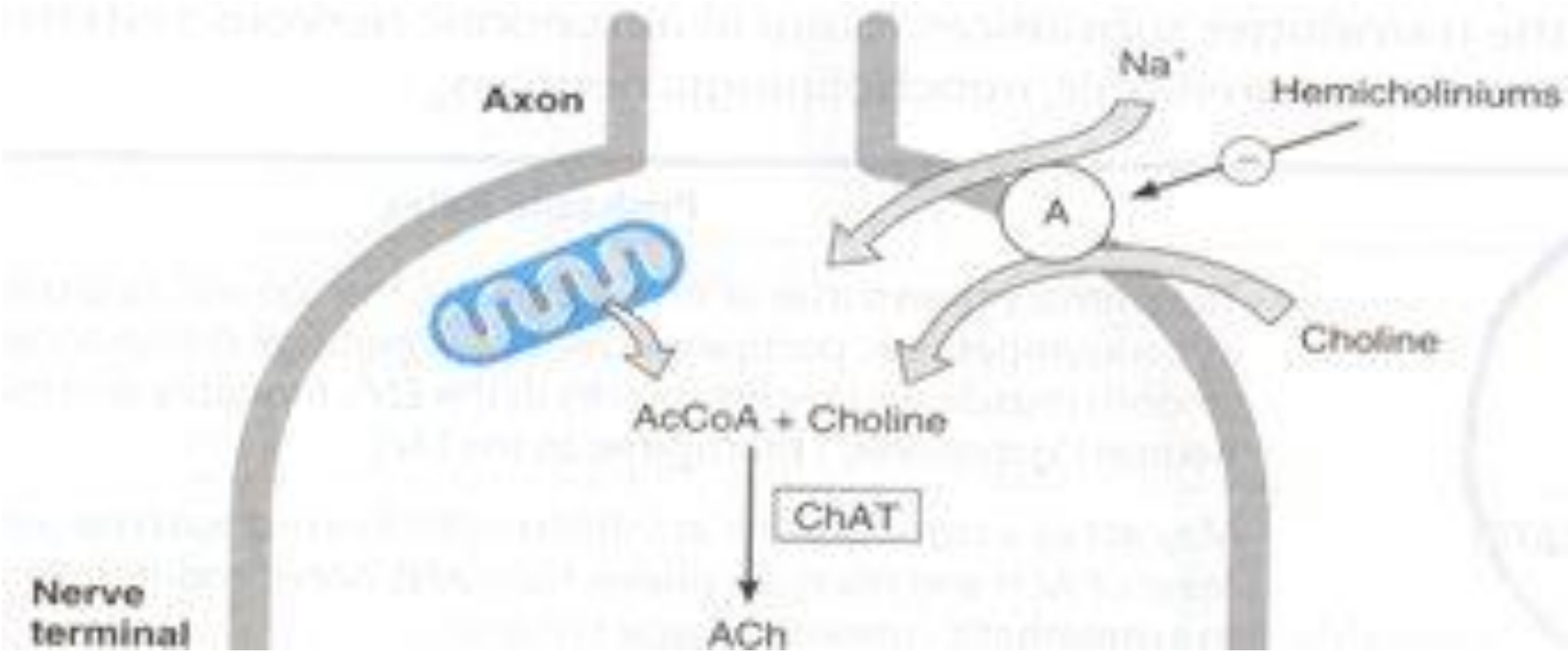
- **Synthesis of the neurotransmitters.**
- **Storage of the neurotransmitters.**
- ***Release.***
- ***Diffusion across Synapse.***
- ***Combination with Post junctional Receptors.***
- ***Production of the Post junctional Potentials.***
  - **EPSP (Excitatory post-synaptic (depolarization) potentials)**
  - **IPSP (Inhibitory post-synaptic (*hyperpolarization*) potentials)**
- ***Initiation of Post junctional Activity.***
- ***Destruction or Dissipation of the Transmitter.***



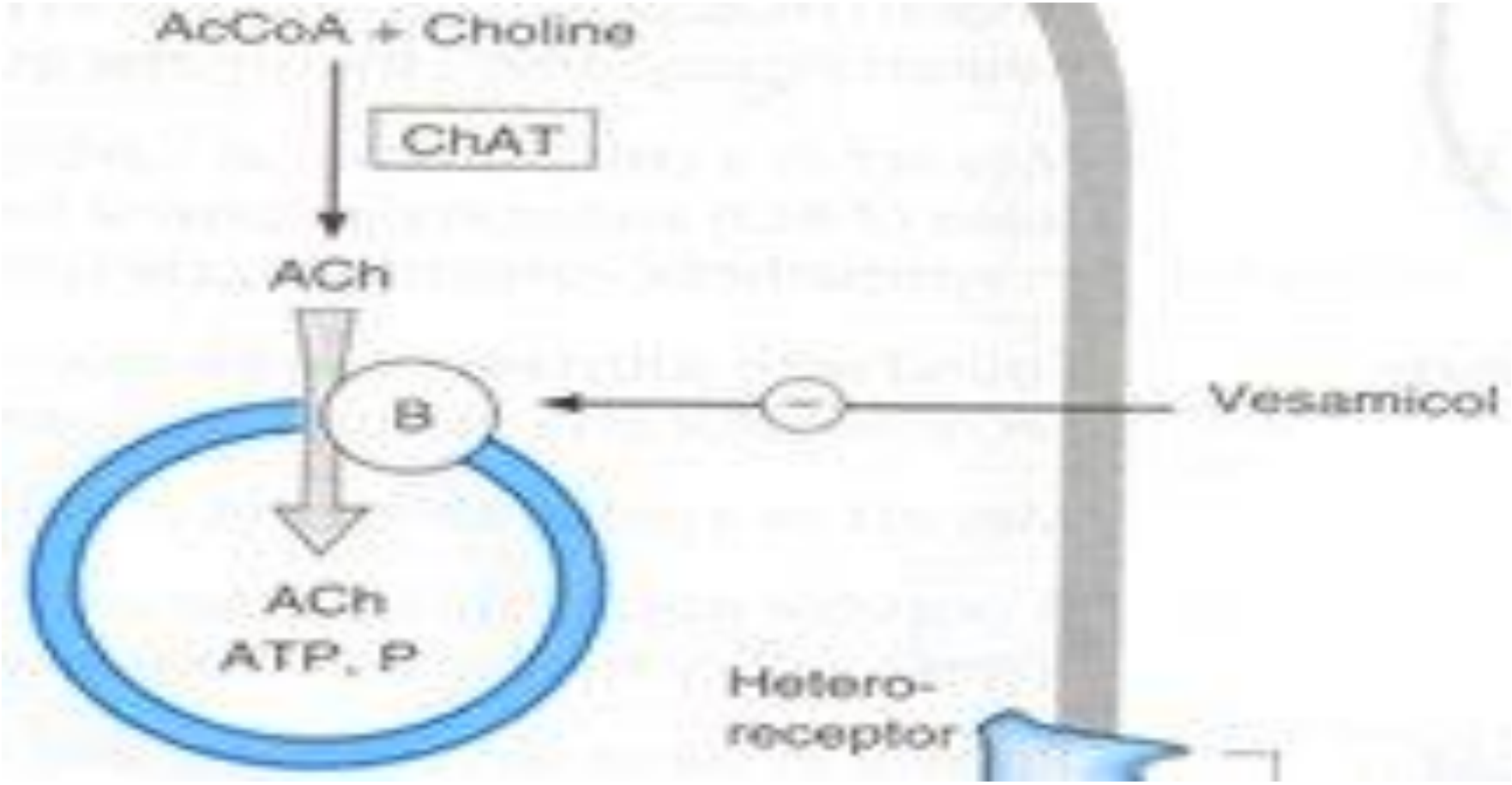

1
Synthesis
2
Metabolism
4
3
Storage
5
Reuptake
6
7
Release
Degradation
8
Receptor
9
Ionic conductance

➢ *Synthesis & storage of Neurotransmitter;*

- Neurotransmitter is **synthesized in the axonal terminal** and **stored in the vesicles**.
- **Cholinergic neuron;**
  - **Transport of choline** into nerve terminal by a Na+ dependent membrane **choline transporter.**
  - **Rate limiting step, blocked** by research drug **hemicholinium.**

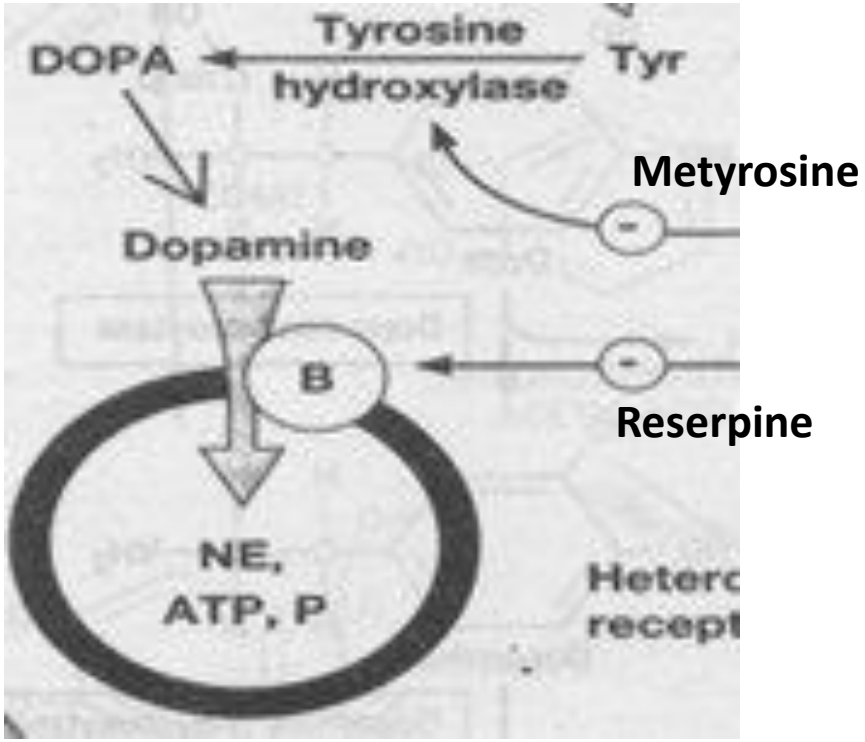


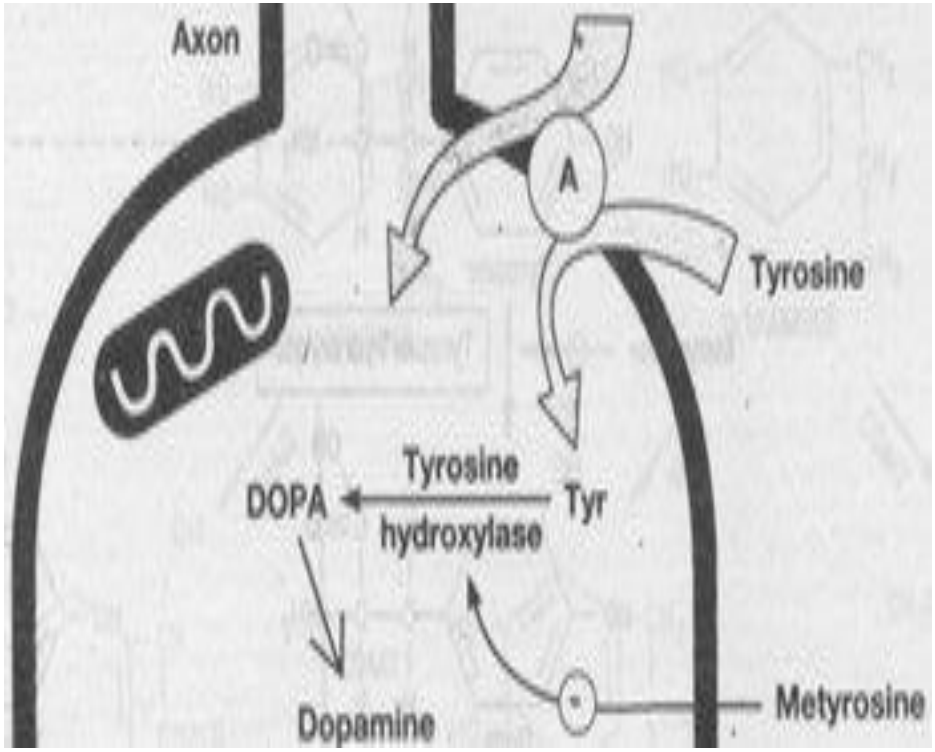
- ***Storage of Ach.***
  - **Ach. is stored in the vesicles**.
    - Smaller **clear vesicles** (1000 – 50000) contain most of the Ach.
    - A small number of **dense core vesicles** contain a high concentration of peptide cotransmitters.



Adrenergic neuron.

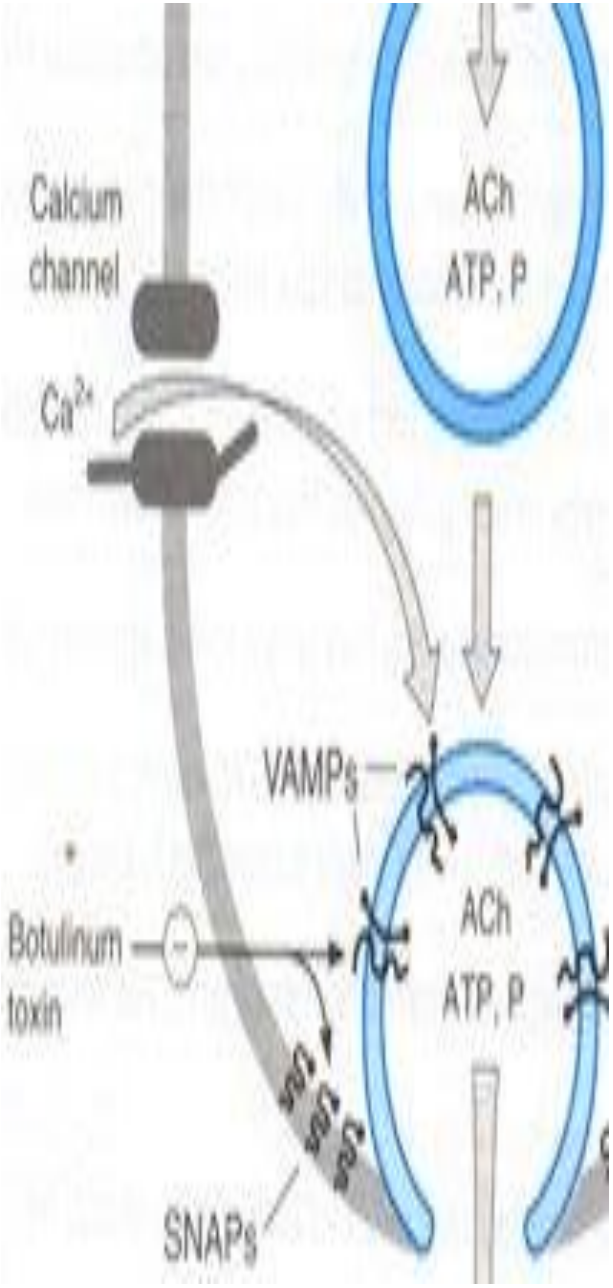
- **Tyrosine** is transported into cytoplasm of adrenergic neuron.
- Hydroxylated to **DOPA** by tyrosine hydroxylase.
- Decarboxylated to form **dopamine.**
- Hydroxylated on the side chain by **dopamine β hydroxylase** to form **norepinephrine.**
- Methylated to form **epinephrine in adrenal medulla.**





➢ *Release of the Neurotransmitter;*

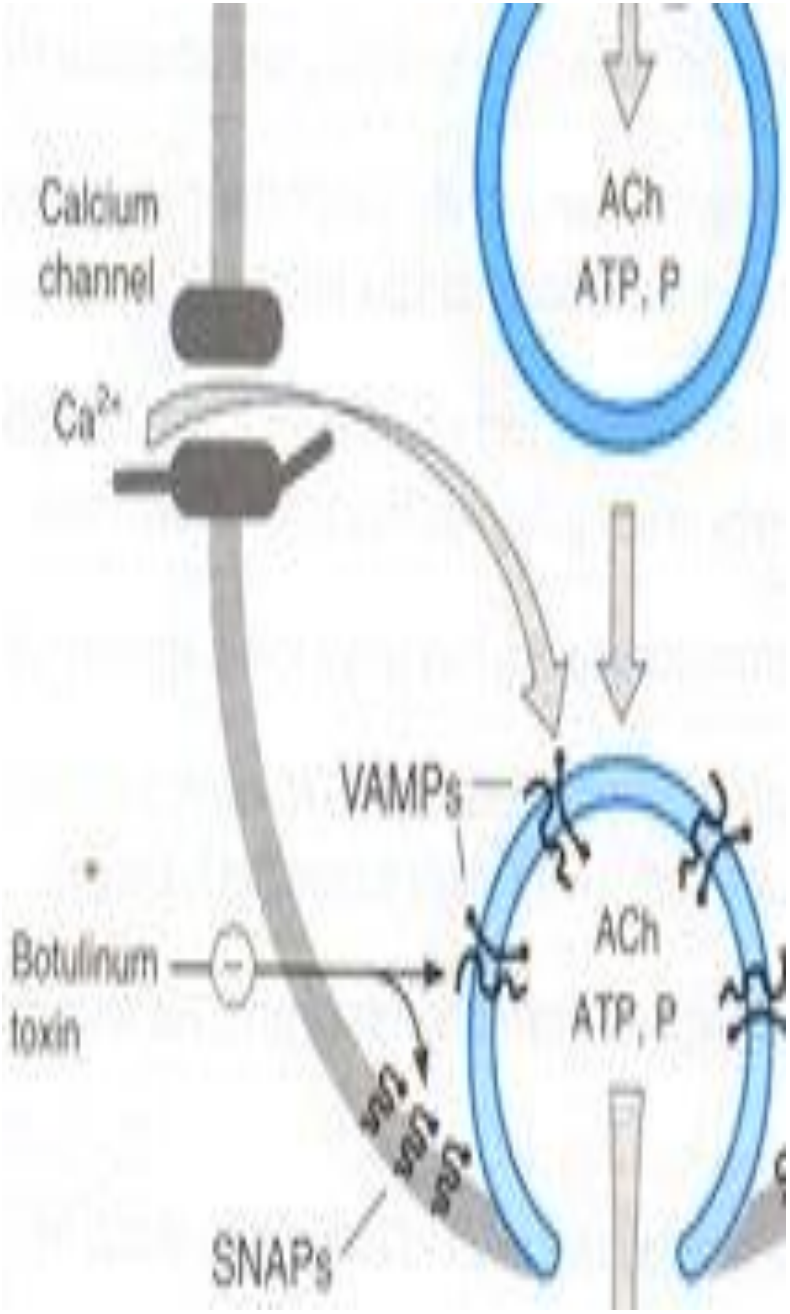
- With the arrival of the nerve action potential at the axonal terminal, there is **Influx of calcium ion.**
- Influx of calcium ions (Ca++) triggers the interaction between
  - Proteins associated with the vesicle's membrane (VAMPs, vesicle associated membrane protein--- **synaptobrevin, synaptotagmin**) **and**



- Proteins associated with the nerve ending membrane (SNAPs, synaptosome associated proteins --- **SNAP25, syntaxin** and others).

– Vesicular membrane fuses with the terminal membrane.

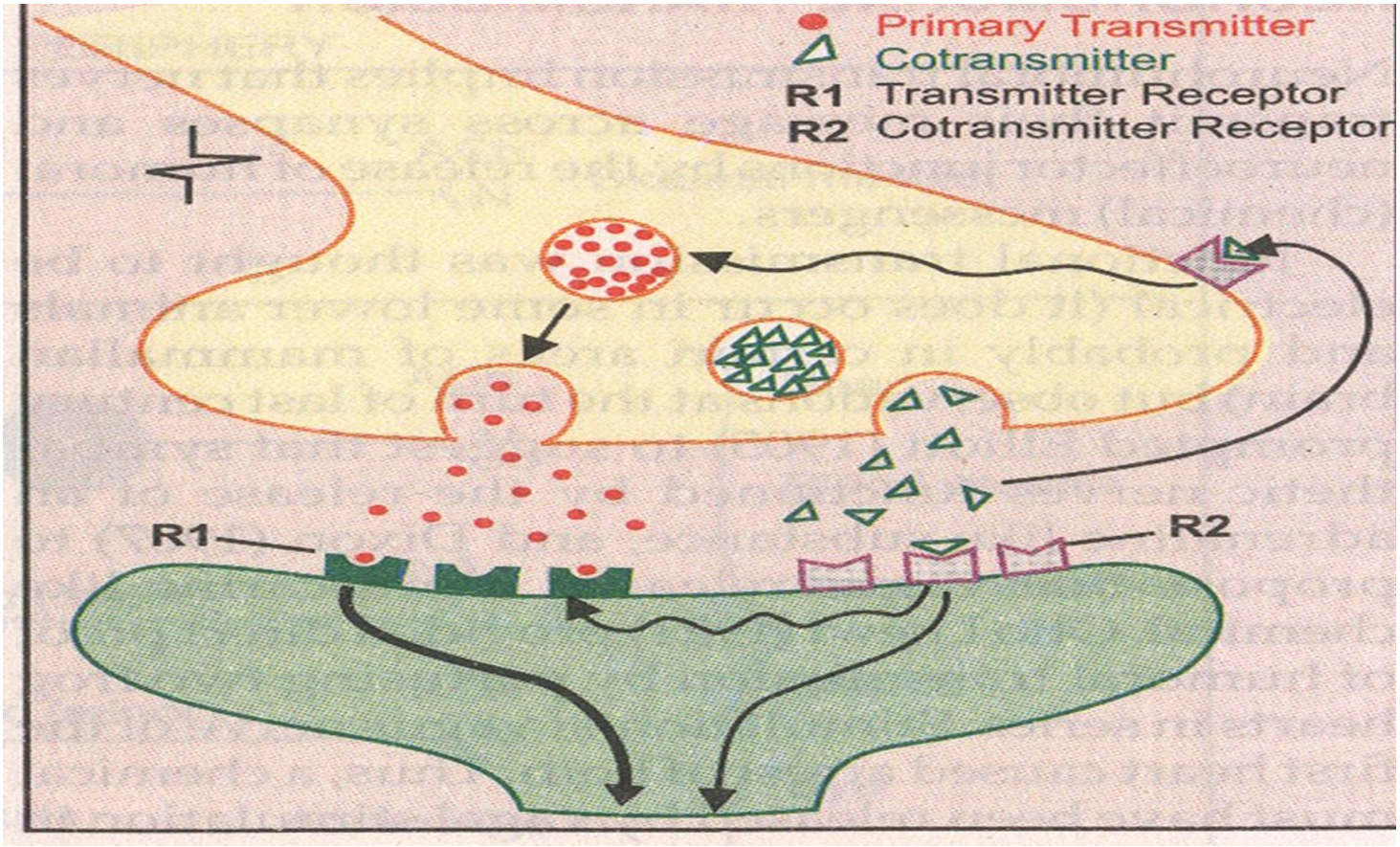
– Discharge of contents of vesicles in the synaptic cleft by process of **exocytosis.**

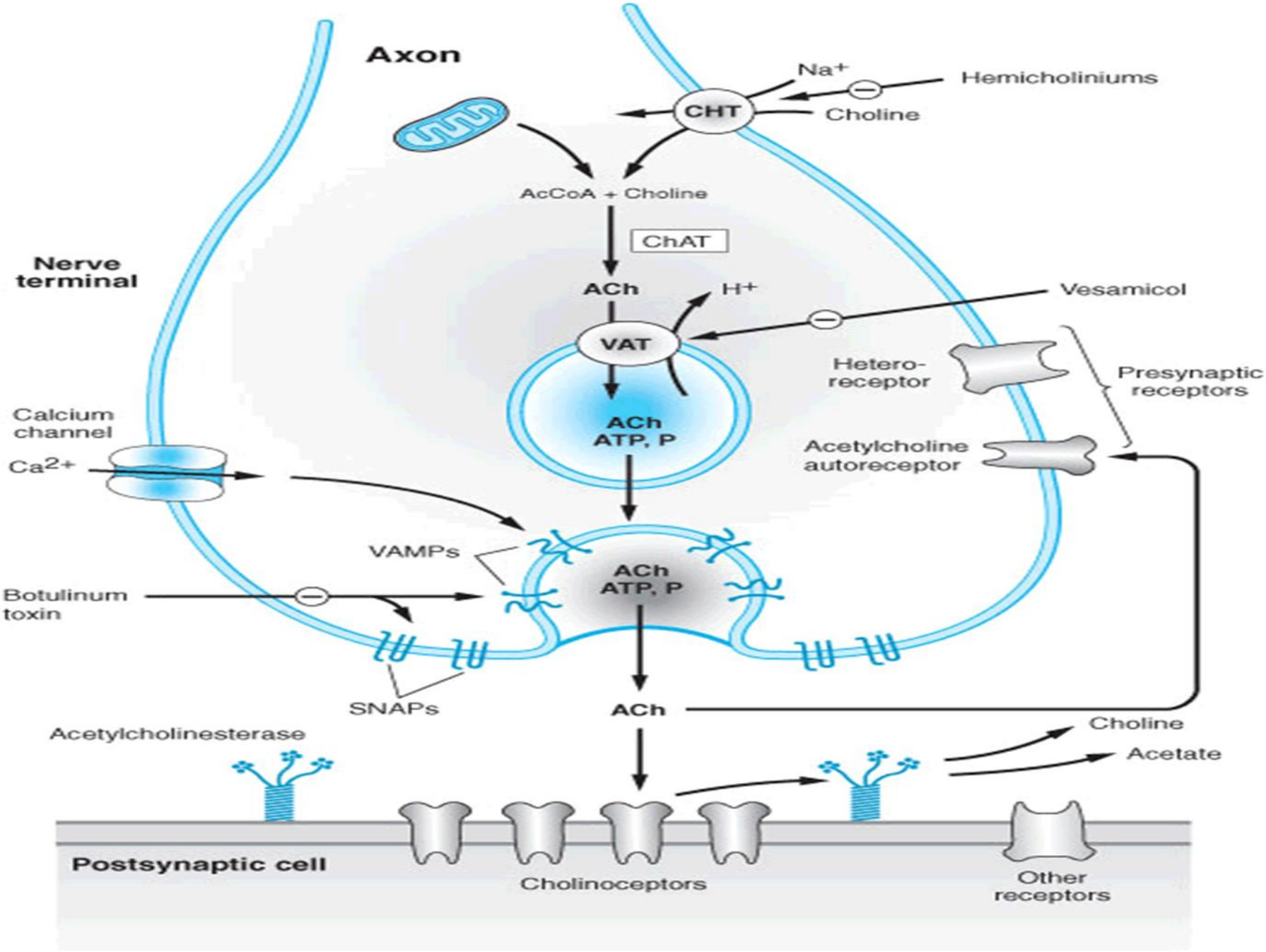


Release of the Neurotransmitter;

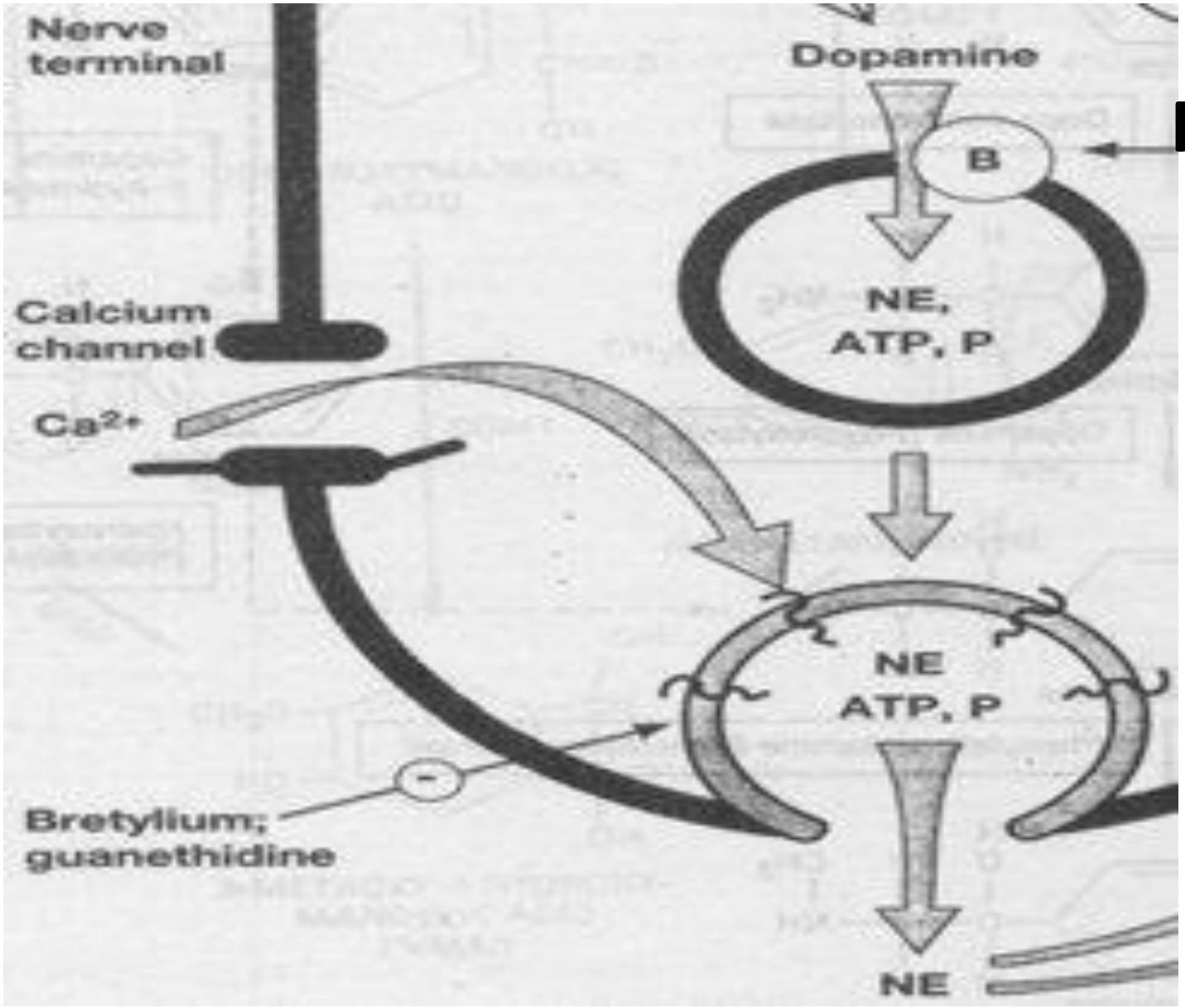
Cholinergic Neuron;

- **Somatic motor nerves – several hundreds quanta of ACh.**
- **Autonomic ganglia** --- small amount released by one depolariztion.
- Several **cotransmitters** are released at the same time.
- **Botulinum toxins** alter these proteins to prevent the release process.




Axon
Na+
Hemicholiniums
CHT
Choline
AcCoA + Choline
ChAT
Nerve terminal
ACh
H+
Vesamicol
VAT
Hetero-receptor
Presynaptic receptors
Calcium channel
Ca2+
ACh ATP, P
Acetylcholine autoreceptor
VAMPs
ACh ATP, P
Botulinum toxin
SNAPs
ACh
Choline
Acetylcholinesterase
Acetate
Postsynaptic cell
Cholinoceptors
Other receptors

Adrenergic neuron;

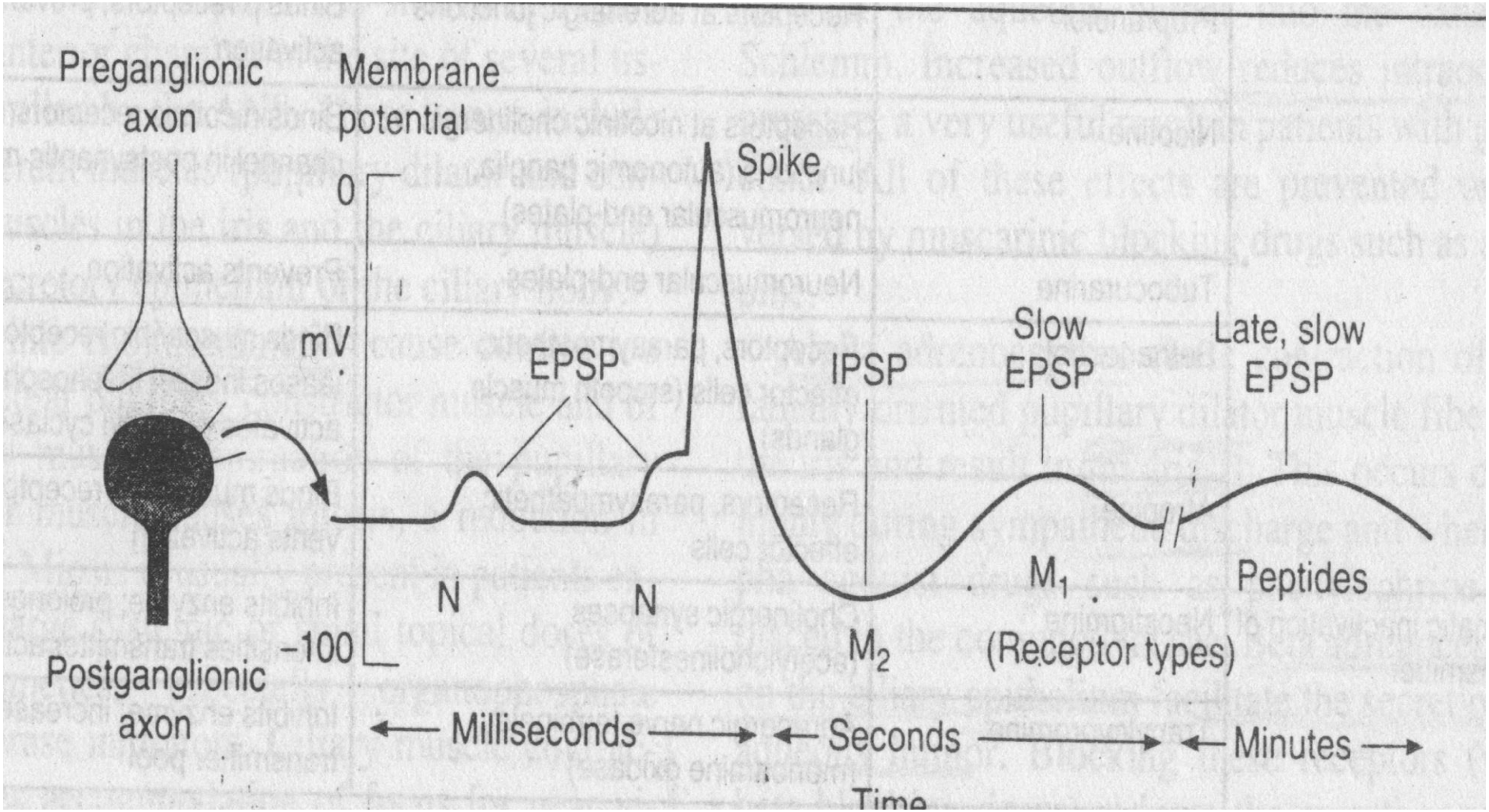


Reserpine

➢ Combination with Post junctional Receptors.

- **Neurotransmitters released in the synaptic cleft diffuse through the cleft and combine their specific postsynaptic receptors ----- activating or inhibiting them, thus producing EPSP or IPSP.**

➢ Postjunctional potentials; **EPSP or IPSP.**




Thank You