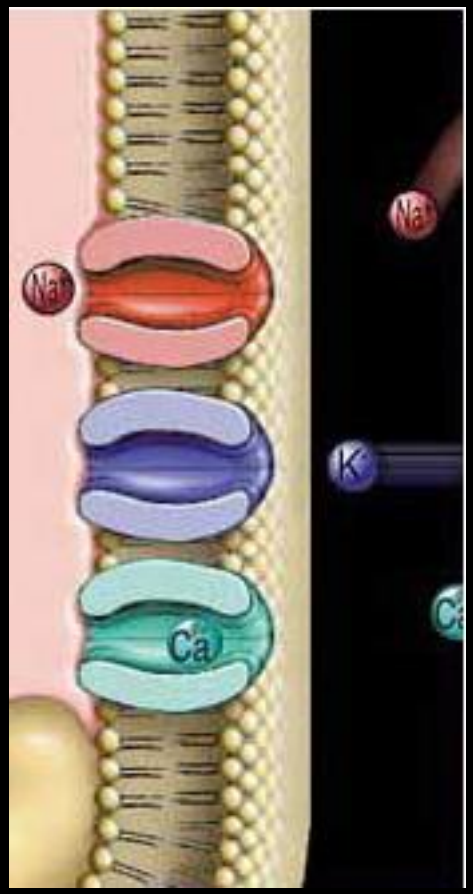


Neuromuscular junction

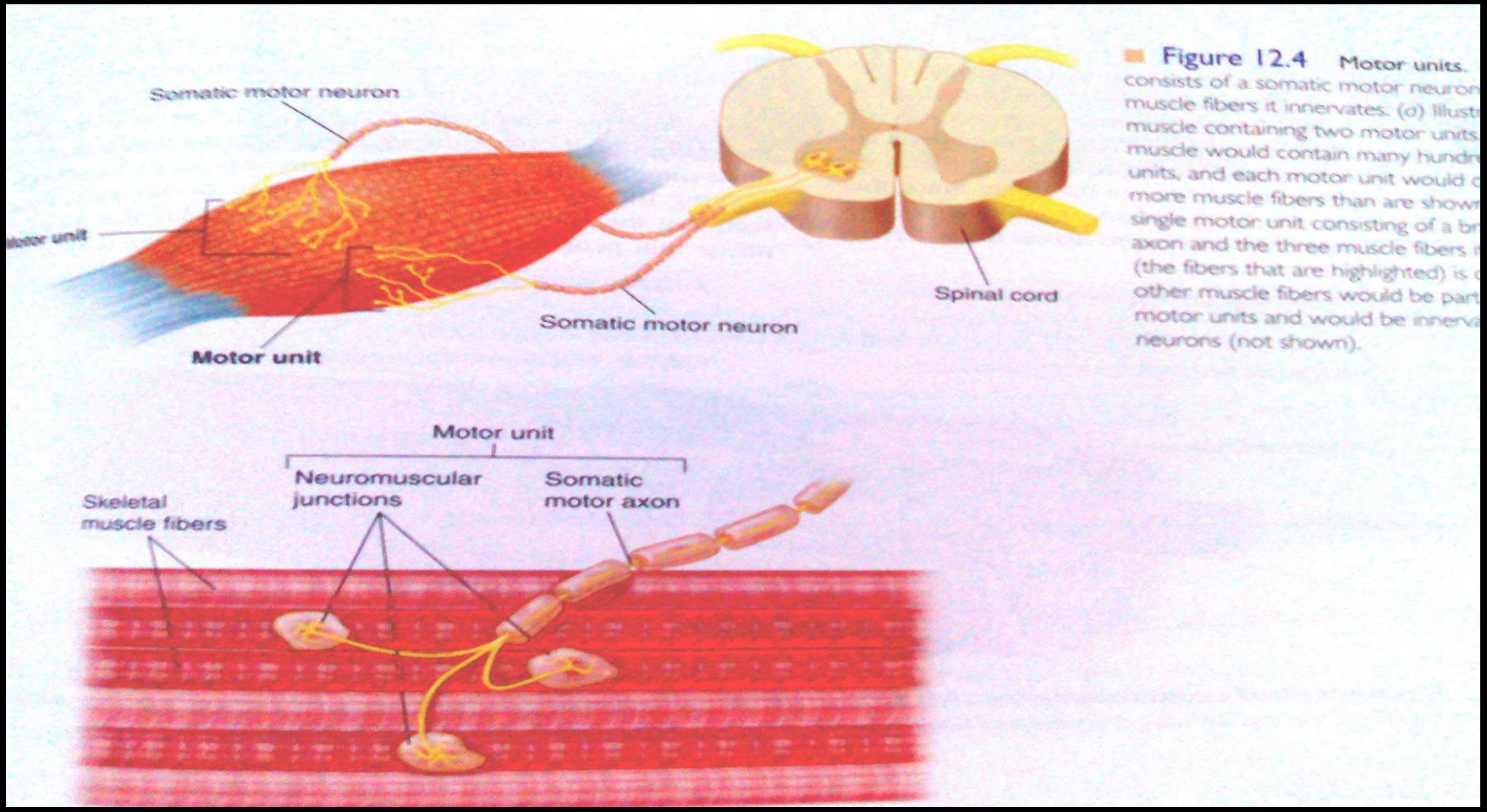
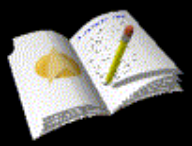


Figure 12.4 Motor units. consists of a somatic motor neuron muscle fibers it innervates. (a) Illust muscle containing two motor units. muscle would contain many hundr units, and each motor unit would c more muscle fibers than are shown single motor unit consisting of a br axon and the three muscle fibers i (the fibers that are highlighted) is c other muscle fibers would be part motor units and would be innerva neurons (not shown).

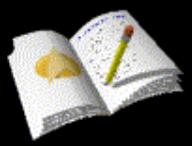
Synaptic transmission *

- Synapse is the junction between two neurones where electrical activity of one neurone is transmitted to the other



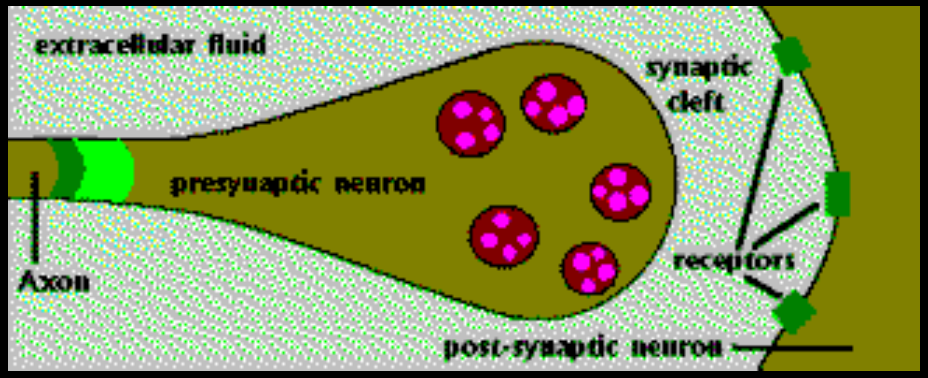
Steps involved

- AP at the synaptic knob -----» Ca channels open (increase Ca permeability) -----»
- release of neurotransmitter (NT) from synaptic knob to synaptic cleft -----»
- NT combines with specific receptors on the other membrane -----» postsynaptic potential -----» AP will result



Chemical Signals

- One neuron will transmit info to another neuron or to a muscle or gland cell by releasing chemicals called neurotransmitters.
- The site of this chemical interplay is known as the synapse.
  - An axon terminal (synaptic knob) will abut another cell, a neuron, muscle fiber, or gland cell.
  - This is the site of transduction – the conversion of an electrical signal into a chemical signal.

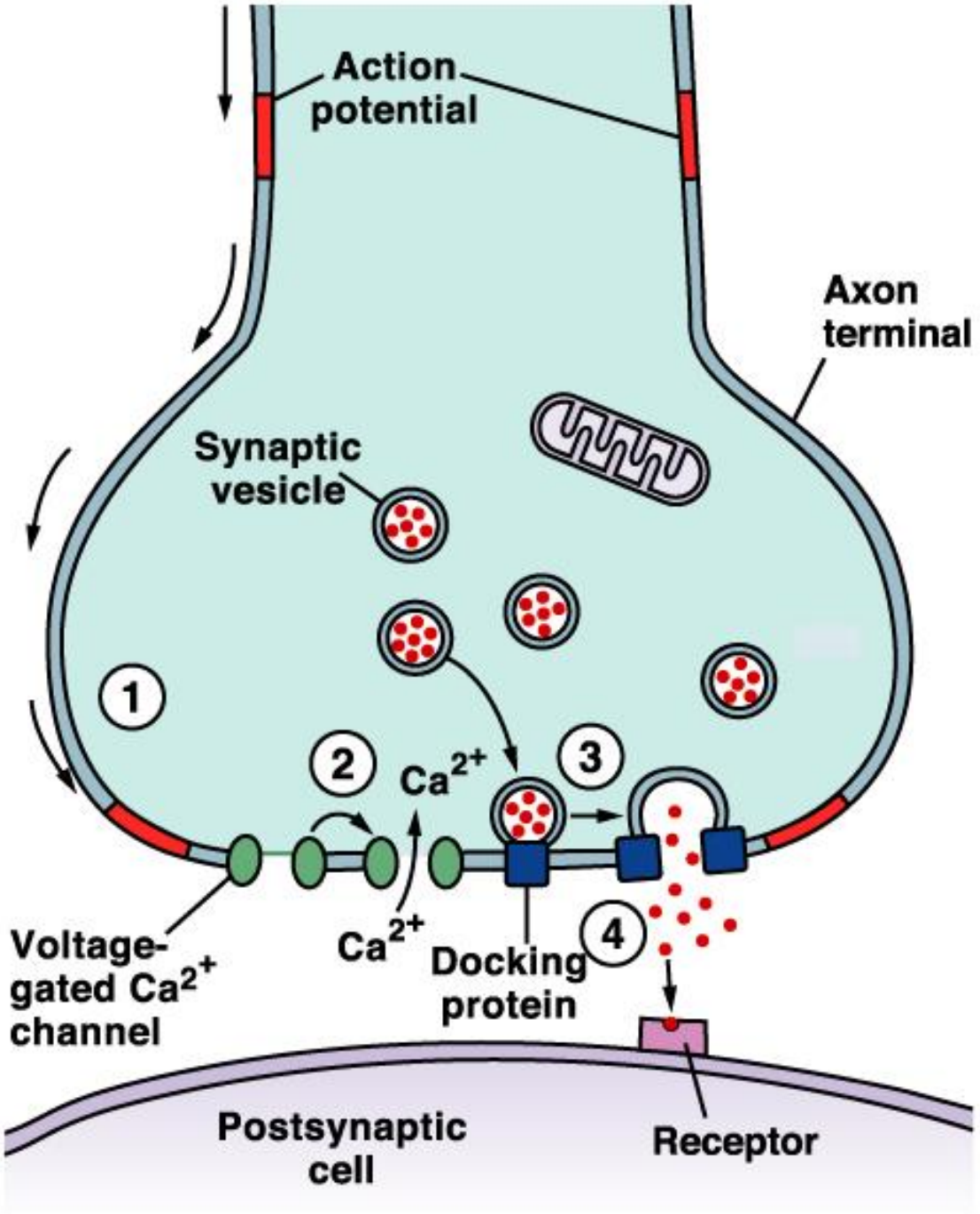


Synaptic Transmission

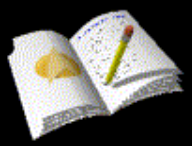
An AP reaches the axon terminal of the presynaptic cell and causes V-gated Ca^{2+} channels to open.

Ca^{2+} rushes in, binds to regulatory proteins & initiates NT exocytosis.

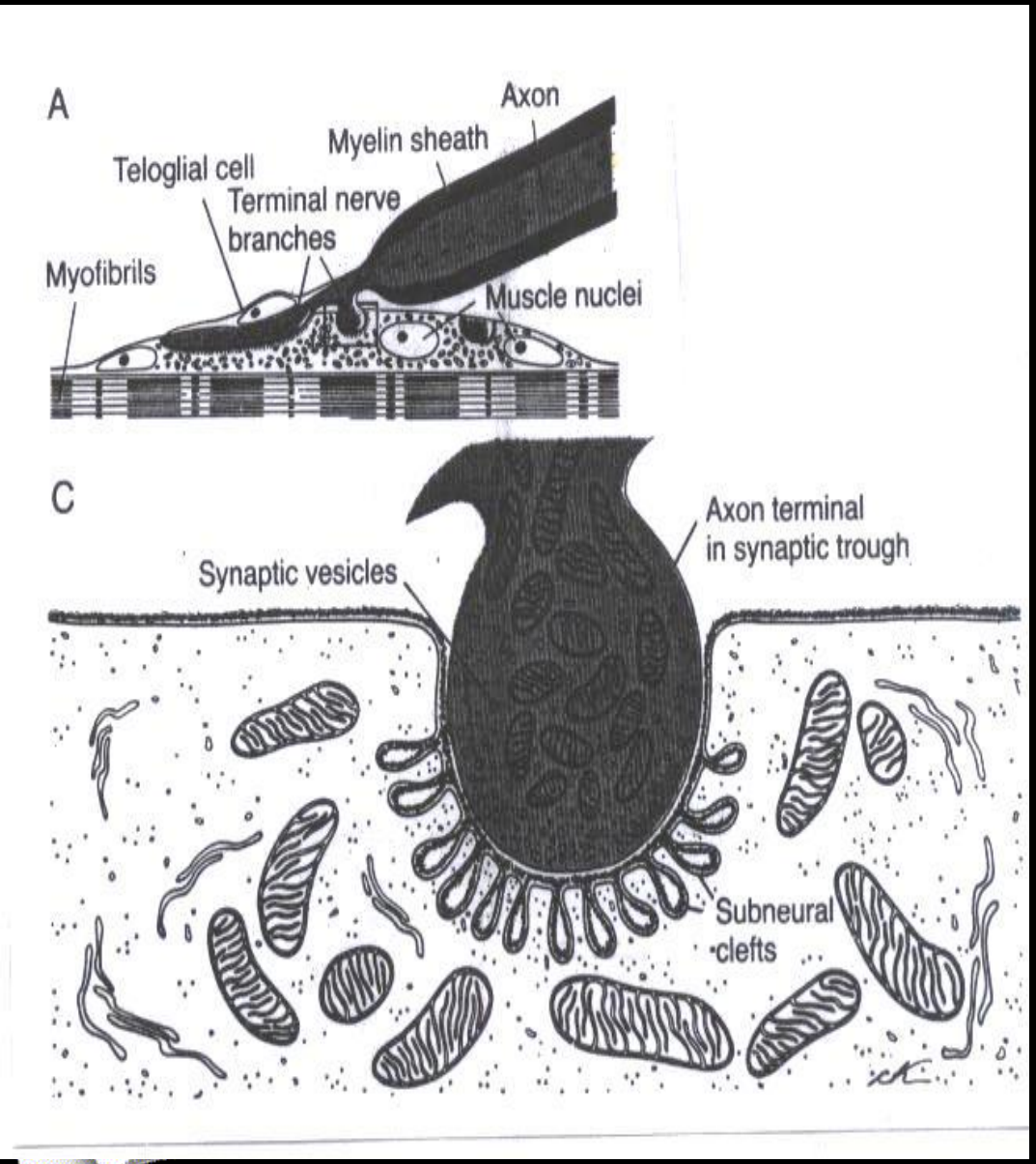
NTs diffuse across the synaptic cleft and then bind to receptors on the postsynaptic membrane and initiate some sort of response on the postsynaptic cell.



NEUROMUSCULAR JUNCTION AND NEUROMUSCULAR TRANSMISSION OF NERVE ACTION POTENTIAL



The Neuromuscular junction consists of



A/ Axon Terminal : contains around 300,000 vesicles which contain the neurotransmitter acetylcholine (Ach).

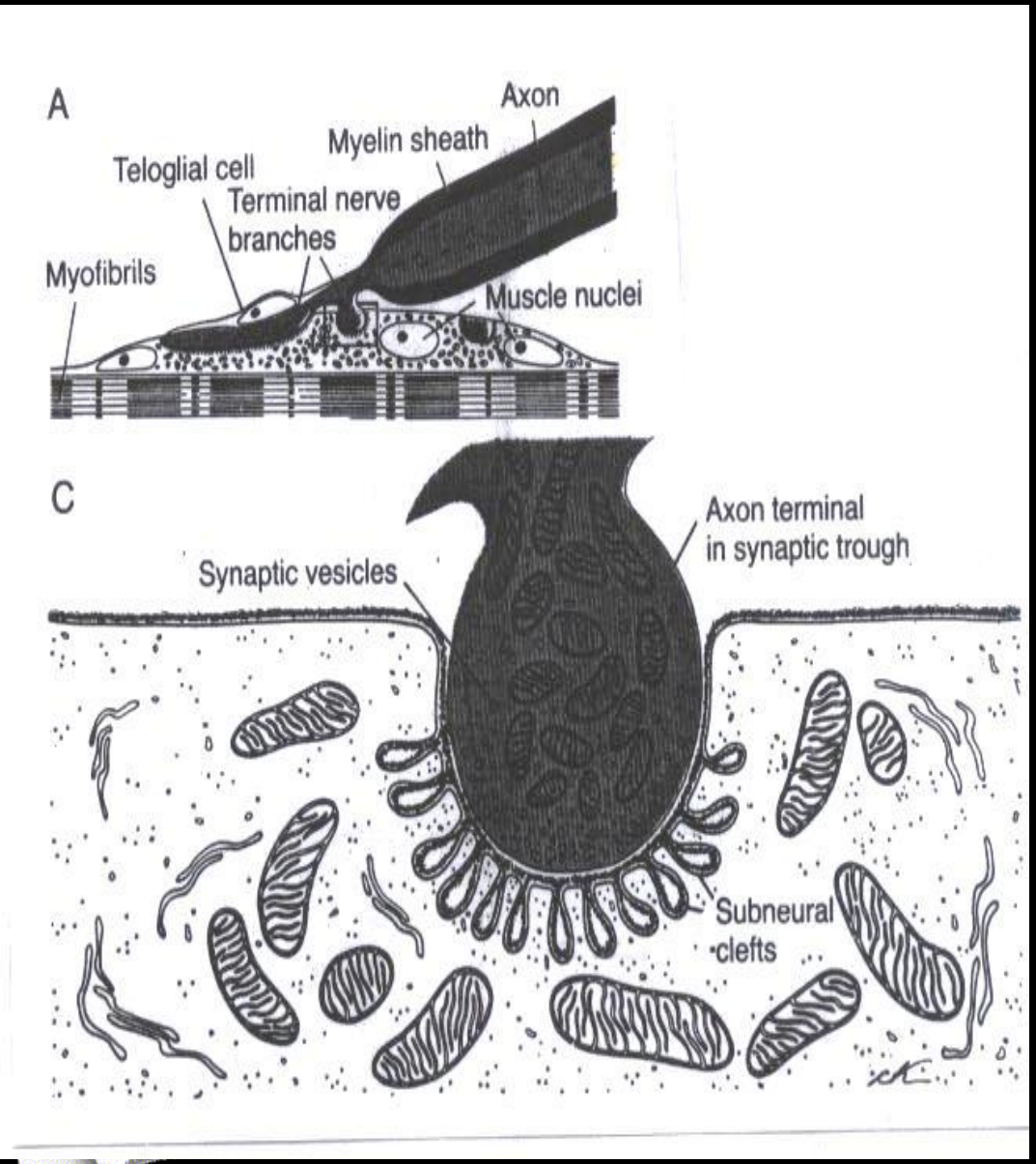
B/ Synaptic Cleft :

20 – 30 nm (nanometer) space between the axon terminal & the muscle cell membrane. It contains the enzyme cholinesterase which can destroy Ach .

C/ Synaptic Gutter (Synaptic Trough)

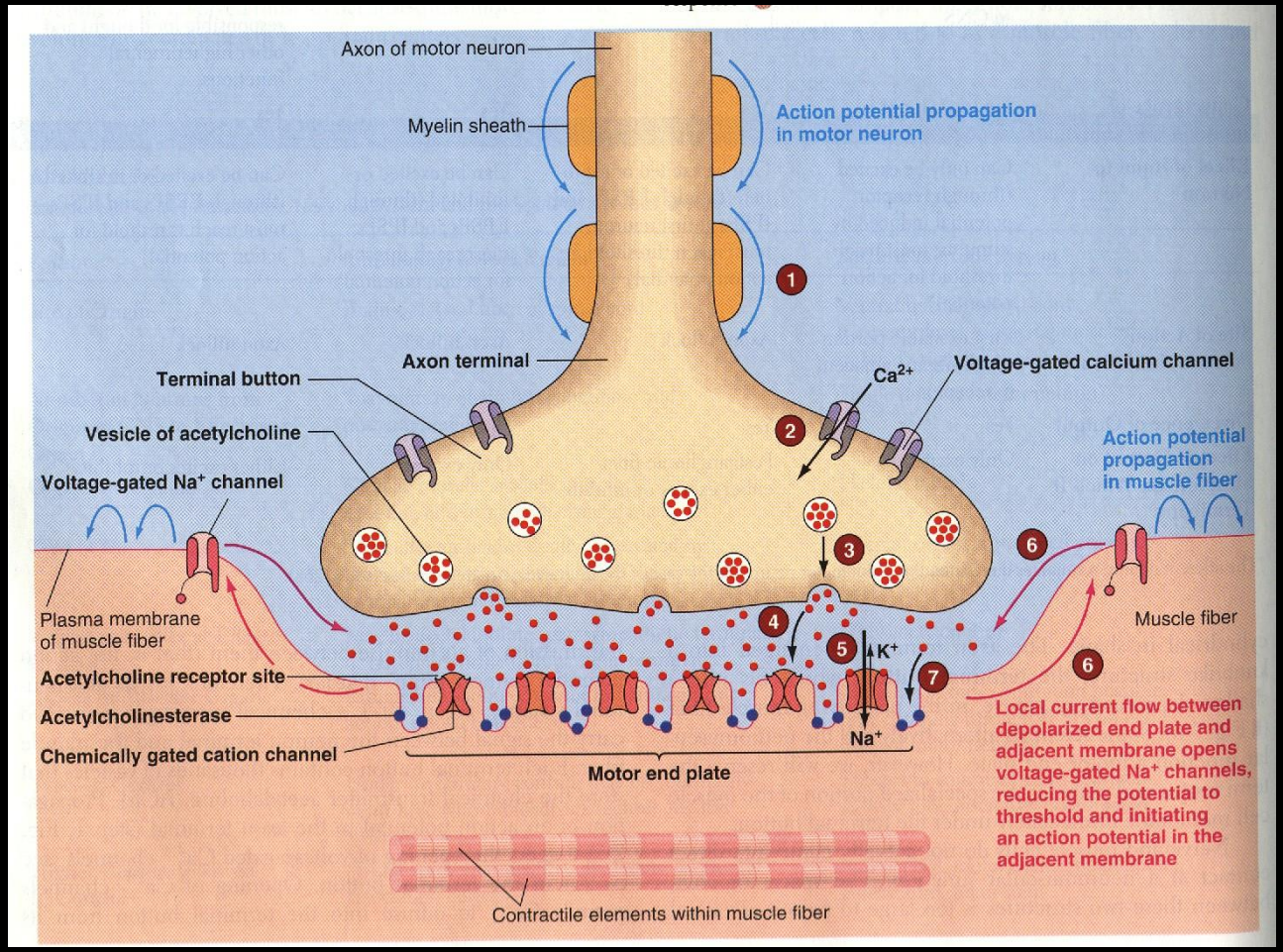
It is the muscle cell membrane which is in contact with the nerve terminal . It has many folds called **Subneural Clefts** , which greatly increase the surface area , allowing for accomodation of large numbers of Ach receptors . Ach receptors are located here .

The Neuromuscular junction consists of



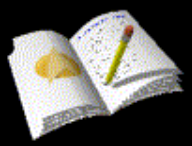
- **The entire structure of axon terminal , synaptic cleft and synaptic gutter is called " Motor End-Plate " .**
- **Ach is synthesized locally in the cytoplasm of the nerve terminal , from active acetate (acetylcoenzyme A) and choline.**
- **Then it is rapidly absorbed into the synaptic vesicles and stored there.**
- **The synaptic vesicles themselves are made by the Golgi Apparatus in the nerve soma (cell-body).**
- **Then they are carried by Axoplasmic Transport to the nerve terminal , which contains around 300,000 vesicles .**

Neuromuscular transmission

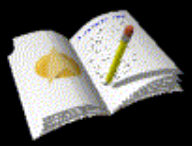


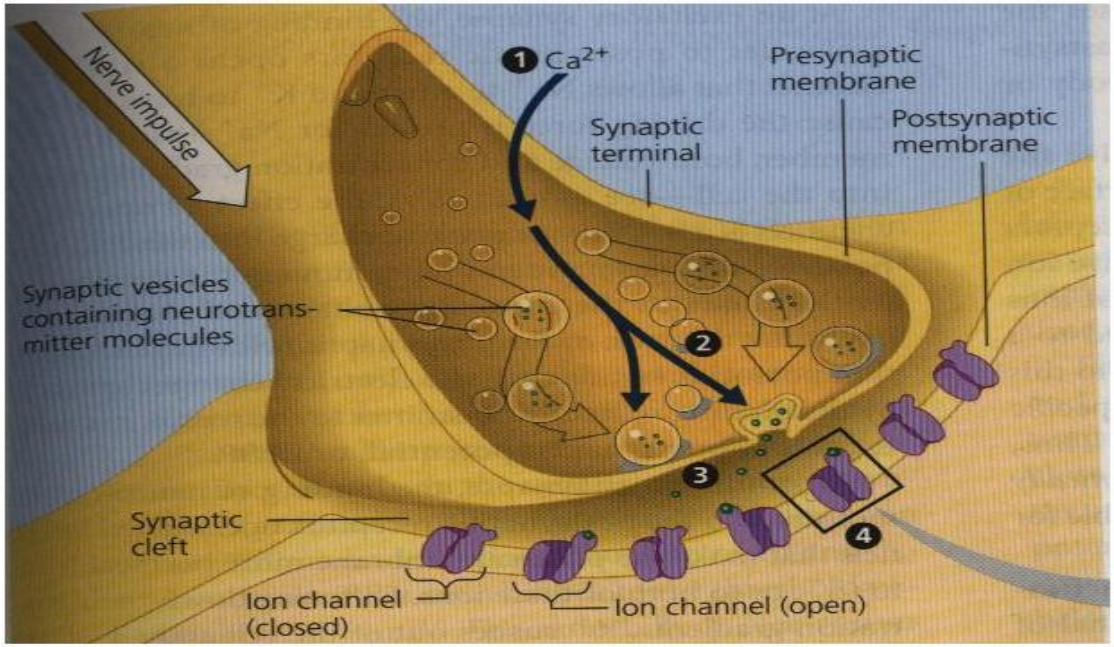
- -synaptic gutter has subneural folds to increase surface area . Has Ach gated channels (where Ach bind) at motor end plate in
- post-synaptic membrane

- synaptic cleft (filled with ECF & Ach estrase enzyme)



- **Secretion of acetylcholine(Ach) by nerve terminals (Ca dependent exocytosis)**
- **1- AP reach nerve terminal-----open Ca channels------Ca influx------- Ca attract vesicles to nerve terminal membrane , they rupture& release Ach to synaptic cleft(Ca dependent exocytosis)**

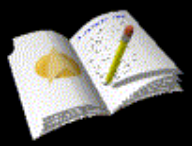



Nerve impulse
1 Ca^{2+}
Presynaptic membrane
Synaptic terminal
Postsynaptic membrane
Synaptic vesicles containing neurotrans-mitter molecules
2
3
4
Synaptic cleft
Ion channel (closed)
Ion channel (open)

2- Ach bind to channels---------- then it open

3-, Na flow to inside

4-Destruction of Ach by Ach estrase enzyme into choline & acetate go to nerve terminal to be re-used



- Ach combines with its receptors in the subneural clefts. This opens sodium channels → & sodium diffuses into the muscle causing a **local**,**non-propagated** potential called the " **End-Plate Potential (EPP)"**, whose value is 50 – 75 mV.
- This EPP triggers a **muscle AP** which spreads down inside the muscle to make it cntract .

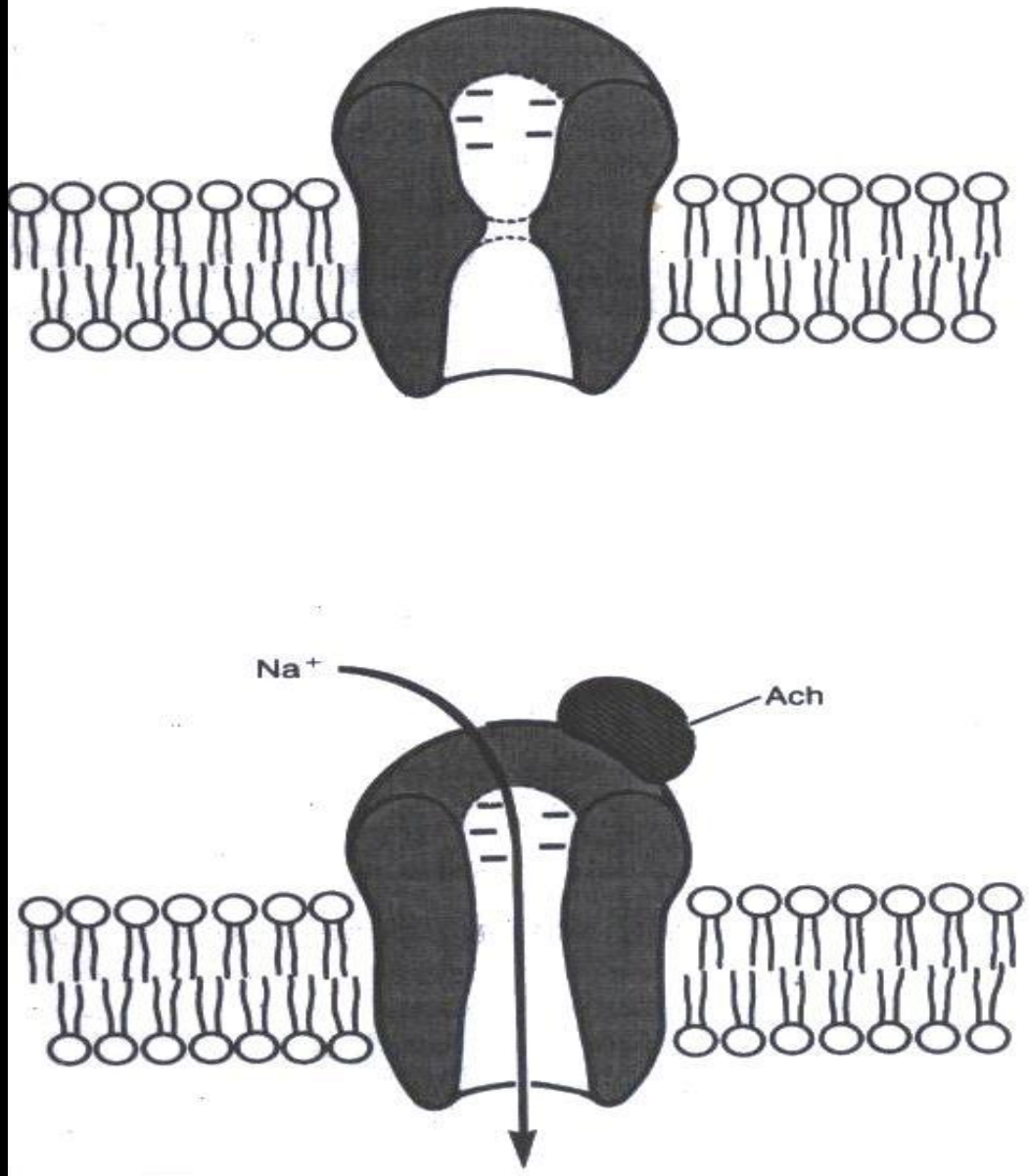
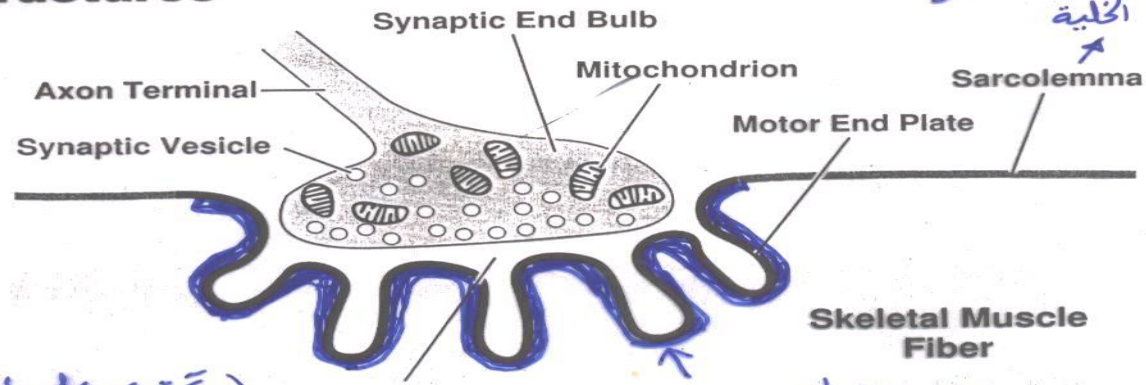


Figure 7–3 The *acetylcholine channel:* Above, while in the closed state. Below, after acetylcholine has become attached and a conformational change has opened the channel, allowing excess sodium to enter the muscle fiber and excite contraction. Note the negative charges at the channel mouth that prevent passage of negative ions.

NEUROMUSCULAR JUNCTION

هذه المنطقة يتولد فيها ال A.P. الذي هو يطيع قانون ALL-OR-NONE وغير متدرج و ينتشر في كل أنحاء الخلية

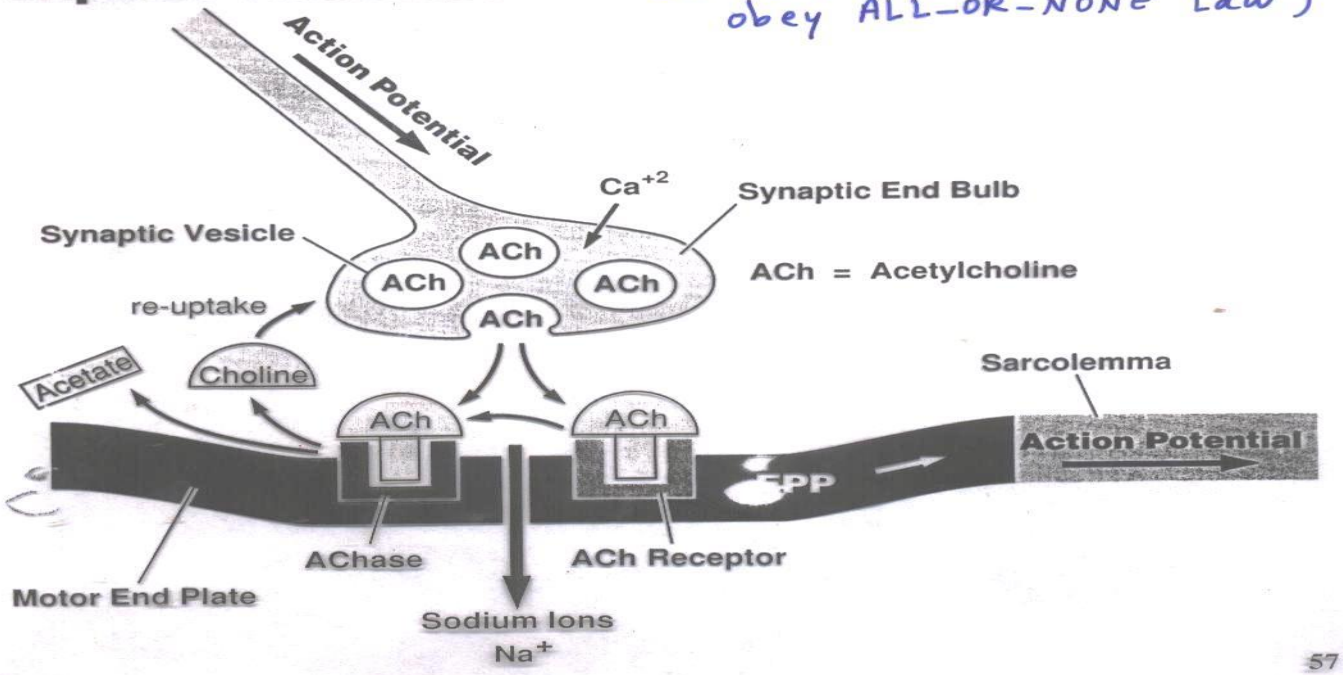
Structures



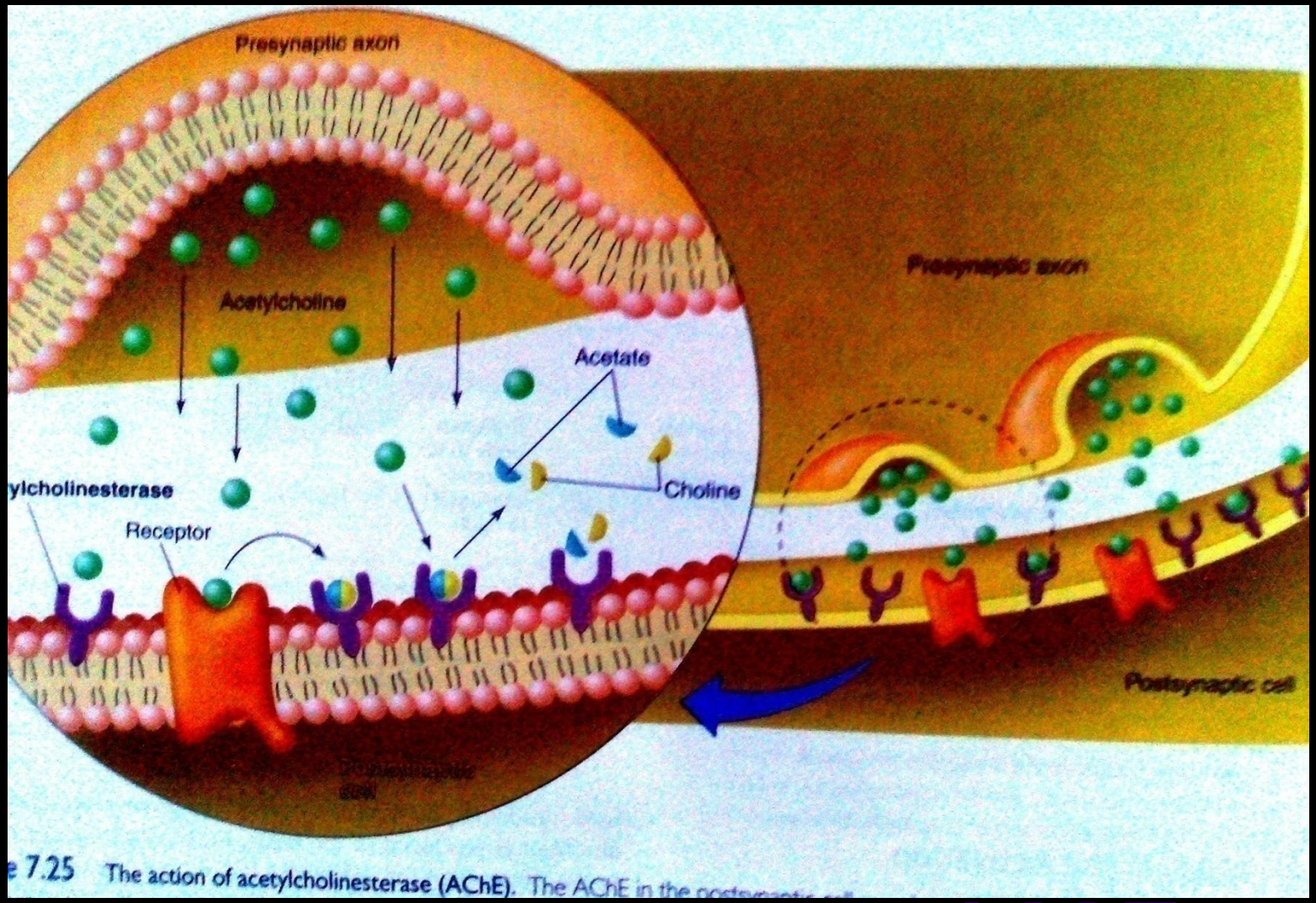
(تحتوي على ال Cholinesterase)

هذه المنطقة يتولد فيها ال END-PLATE POTENTIAL (Graded, does not spread, can be summated, does not obey ALL-OR-NONE Law)

Impulse Transmission



Destruction of Ach



e 7.25 The action of acetylcholinesterase (AChE). The AChE in the

Drugs that act on the neuromuscular junction

1-Drugs that act on muscle fiber by Ach like action:-

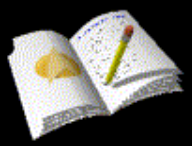
METHACHOLINE- CARBACOL- NICOTINE

they act for minutes or hours—as they do not destructed by Ach estrase enzyme .

2-Drugs that block transmission at neuromuscular junction:-

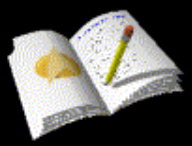
CURARE & CURARIFORM like drugs.

act by competitive inhibition to Ach at its receptors & can not cause Depolarization.



3-Drugs that stimulate transmission at neuromuscular junction by inactivation of Ach estrase enzyme:-

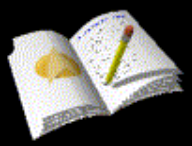
- **A-Neostigmine ,prostigmine and physostigmine:- inactivates Ach estrase enzyme temporarly**
- **b- di-isopropyl –florophosphate(nerve gas poison) inactivates Ach estrase enzyme for days & weeks -------death because of respiratory muscle spasm**



Myasthenia Gravis

--Diseases of adult females affects eyelid,extra ocular.bulbar and proximal limb muscles

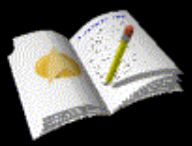
-presents with ptosis -,dysarthria,dysphagia, and proximal limb weakness in hands& feet.



-An autoimmune disorder

- body form antibodies against Ach - receptors. Patients have 20% of number of Ach receptors .

-the EEPs are too small to trigger action - potentials & the muscles can not contract.



Treatment:-

Administration of an inhibitor of acetyl cholinesterase temporarily

-prostigmine or neostigmine

- allowing more ACh to remain at the neuromuscular junction to bind to the remained Ach receptors.& allow contraction

*