**Homework3-2020**

1. List the steps involved in chemical neurotransmission.
2. Loading transmitter into vesicles.
3. The mobilization of vesicle to plasma membrane.
4. An action potential induces opening of voltage-gated Ca2+ channels
5. Ca2+ concentration increase in cytoplasm.
6. Fusion between vesicle membrane and plasma membrane.
7. Neurotransmitters were released into synaptic cleft.
8. Interaction between neurotransmitters and receptor.
9. Opening or closing of ion channels on postsynaptic membrane.
10. Increasing or decreasing of ion current changes postsynaptic membrane potential and causes other biological effects.
11. Removal or degradation of transmitters.
12. Retrieval of vesicular membrane from plasma membrane.
13. What is the significance of the quantal nature of MEPPs? What is the evidence that EPPs are composed of MEPPS?
14. MEPPs give researchers new insights: **1)** MEPPs may be the smallest unit of neurotransmitter induced potential change **2)** build the foundation to discover synaptic vesicle. **3)** prove that the release of neurotransmitter is not a continue process.
15. **A.** Giving stimulation to presynaptic neuron in low Ca+ concentration condition, we can detect the amplitude of EPPs is much lower than control group. And the amplitude is approximate to MEPPs.

**B.** The EPP amplitude is quite similar to the mathematic expectation of Poisson distribution, which is usually used to describe occurrence of unitary events. Thus, we can determine that EPPs are composed of the smallest unit of potential change which is equal to MEPPS.

1. What lines of evidence suggest that neurotransmitters are released from synaptic vesicles?
2. Experiments indicate that each fusion of vesicle causes a MEPP on presynaptic membrane.
3. Scientists observed the fusion of vesicles though TEM
4. It has been demonstrated that a rise in presynaptic Ca2+ is necessary and sufficient for neurotransmitter release. What experimental evidence supports the claim that Ca2+ is necessary? Sufficient?

**Necessary**: There are two experiments can prove the necessity of Ca2+.

1. Researchers use Ca2+ channel blocker to treat squid giant presynaptic terminal to remove the increasing of Ca2+ concentration. After the treatment, the change of postsynaptic membrane potential is disappeared.
2. After inject Ca2+ chelator into squid giant presynaptic terminal, we can observe similar phenomenon on postsynaptic membrane.

**Sufficient**: After inject Ca2+ into squid giant presynaptic terminal directly, we can observe change of postsynaptic membrane potential. This experiment proved that Ca2+ is sufficient to transmitter release.

1. What is the difference in release of peptide and classical small-molecule neurotransmitter?

From result of some experiments, researchers discovered that low-frequency stimuli can only involve the release of classical small-molecule neurotransmitter, whereas the release of peptide transmitter needs high- frequency stimuli.

1. Indicate how each of the following are involved in neurotransmitter secretion:

SNAP-25

Synaptobrevin

Synaptotagmin

Which one is key in the regulation of transmitter release by Ca2+?

**SNAP-25** (on vesicle membrane) and **Synaptobrevin** (on vesicle membrane) can interact with Syntaxin (on plasma membrane) to form a macromolecular complex to attach vesicle membrane and plasma membrane.

When voltage-gated Ca2+ channels open to increase Ca2+ concentration, **Synaptotagmin**’s Ca2+ binding site can bind Ca2+ to change its conformation. This change trige the fusion of membrane so that neurotransmitter can be release.

So **Synaptotagmin** is key in the regulation of transmitter release by Ca2+.

**Key Terms**

acetylcholine (ACh)

botulinum toxin

clathrin

co-transmitter

dynamin

end plate

end plate current (EPC)

end plate potential (EPP)

EPSP

excitatory

gap junction

inhibitory

large dense-core vesicles

miniature end plate potential (MEPP)

neurotransmitter

postsynaptic current (PSC)

postsynaptic potential (PSP)

presynaptic

small clear-core vesicle

SNAP-25

synaptic cleft

synaptic vesicle

synaptic vesicle cycle

synaptobrevin

synaptotagmin