生物物理学 II　Handout No. 3

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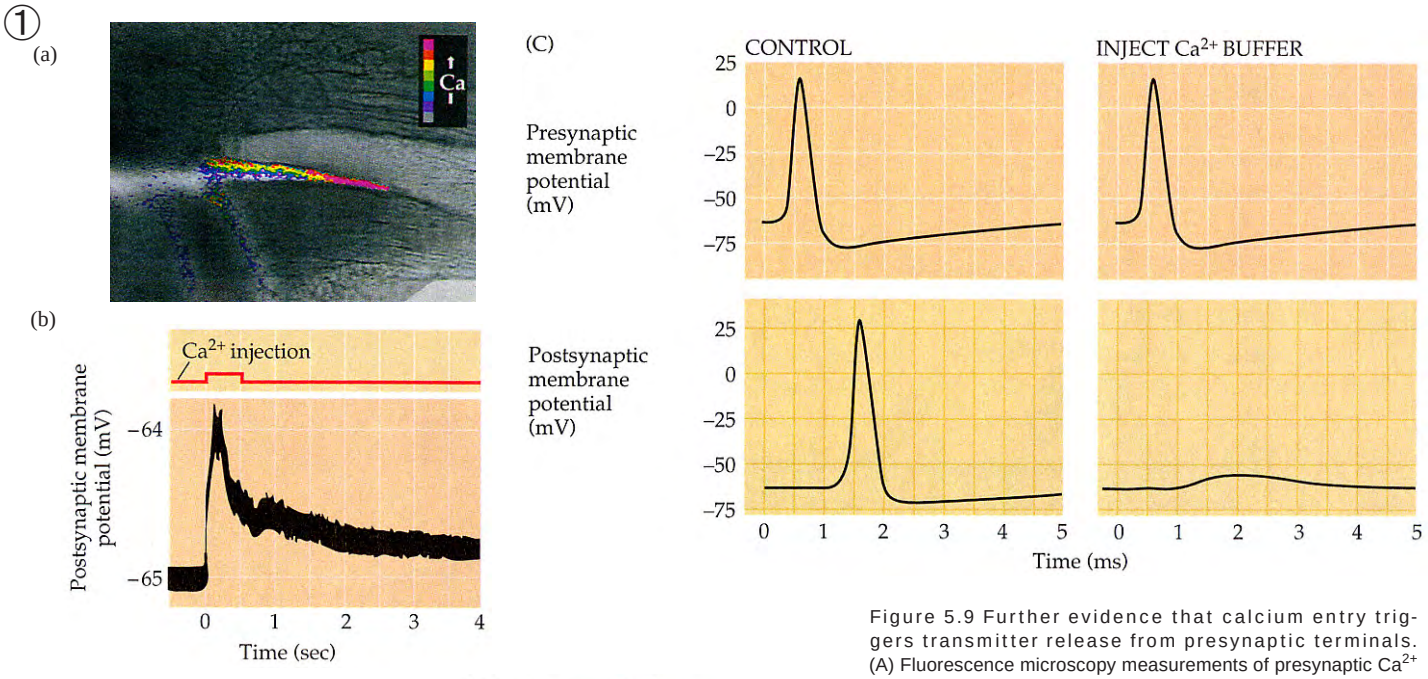

Figure 5.9 Further evidence that calcium entry triggers transmitter release from presynaptic terminals. (A) Fluorescence microscopy measurements of presynaptic Ca^{2+} concentration at the squid giant synapse. A train of presynaptic action potentials causes a rise in Ca^{2+} concentration, as revealed by a dye (fura-2) that fluoresces more strongly when the Ca^{2+} concentration increases. (B) Microinjection of Ca^{2+} into a squid giant presynaptic terminal triggers transmitter release, measured as a depolarization of the postsynaptic membrane potential. (C) Microinjection of BAPTA, a Ca^{2+} chelator, into a squid giant presynaptic terminal prevents transmitter release. (A from Smith et al., 1993; B after Miledi, 1971; C after Adler et al., 1991.)

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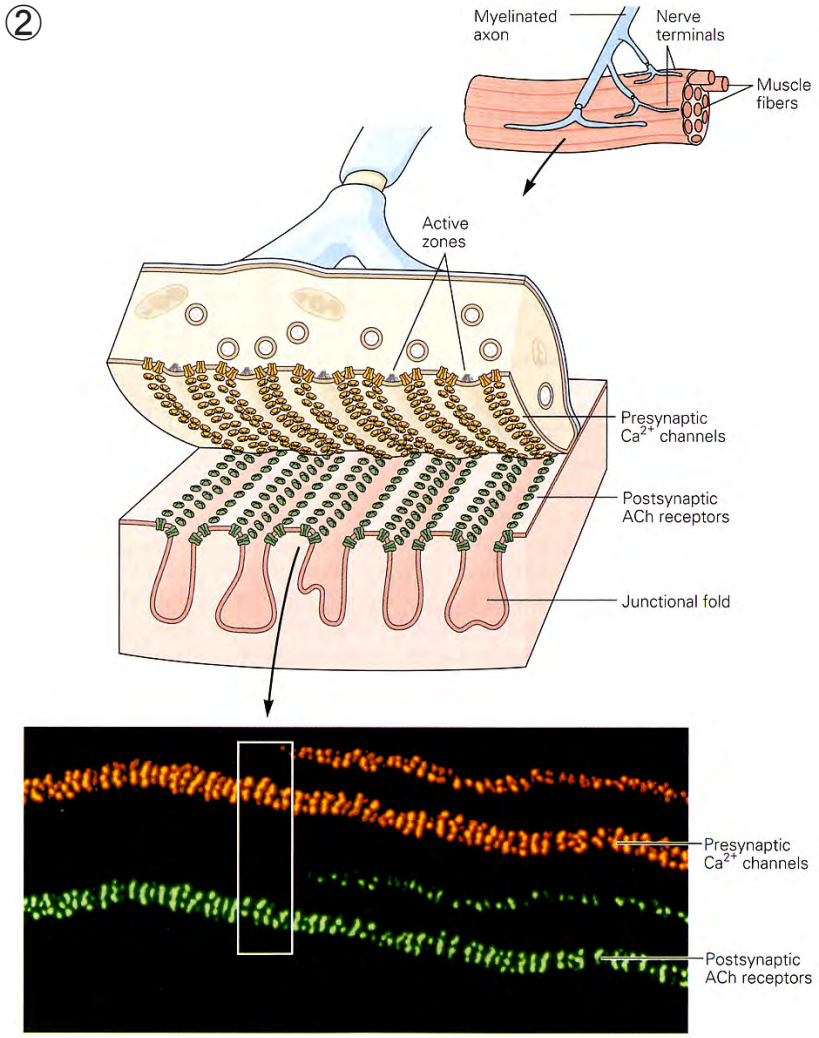

Figure 14-5 Calcium channels are concentrated at the neuromuscular junction in regions of the presynaptic nerve terminal opposite clusters of acetylcholine (ACh) receptors on the postsynaptic membrane. The fluorescent image shows the presynaptic Ca^{2+} channel in red, after labeling with a Texas red-coupled marine snail toxin that binds to Ca^{2+} channels. Postsynaptic ACh receptors are labeled in green with borondipyromethane difluoride-labeled a-bungarotoxin, which binds selectively to ACh receptors. The two images are normally superimposed but have been separated For clarity. The patterns of labeling with both probes are in almost precise register, indicating that the active zone of the presynaptic neuron is in almost perfect alignment with the postsynaptic membrane containing the high concentration of ACh receptors. (From Robitaille et al. 1990.)

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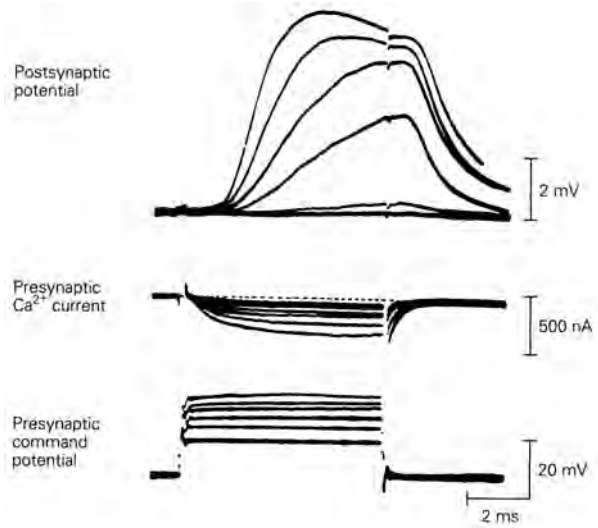

Figure 14-3 A simple experiment demonstrates that transmitter release is a function of Ca^{2+} influx into the presynaptic terminal. The voltage-sensitive Na^+ and K^+ channels in a squid giant synapse are blocked by tetrodotoxin and tetraethyl-ammonium. The presynaptic terminal is voltage-clamped and the membrane potential is stepped to six different command levels of depolarization (bottom traces). The amount of presynaptic inward Ca^{2+} current (middle traces) that accompanies the depolarization correlates with the amplitude of the resulting postsynaptic potential (top traces). This is because the amount of Ca^{2+} current through voltage-gated channels determines the amount of transmitter released, which in turn determines the size of the postsynaptic potential. The notch in the postsynaptic potential trace is an artifact that results from turning off the presynaptic command potential. (Adapted from Llinas and Heuser 1977.)