

**Drugs at the neuromuscular junction.**

succinylcholine, flaxidil, curare, cobra toxin,  $\alpha$ -bungarotoxin: ACh antagonists

eserine, neostigmine, physostigmine, sarin, VX, tabun, Raid: AChE antagonists

botulinum toxin, tetanus toxin: diable snare proteins

nicotine: potentiator of ACh at nicotinic receptors

muscarine: potentiator of ACh at muscarinic receptors (from a mushroom)

norepinephrine: presynaptic modulator [clonidine is antagonist]

epinephrine, isoproterenol: postsynaptic modulator [ $\beta$ -propranolol is antagonist]

ACh itself

ouabain, digitalis, digitoxin: sodium/potassium pump blocker

tetrodotoxin: sodium pump blocker

TEA: potassium pump blocker

**Important equations.**

*Capacitance*

$$I = C \frac{dV}{dt}$$

*Nernst equation*

$$V_m = 58 \cdot \log_{10} \frac{[K^+]_o}{[K^+]_i}$$

*Goldman equation*

$$V_m = 58 \cdot \log_{10} \frac{[K^+]_o + \frac{P_{Na}}{P_K} [Na^+]_o + \frac{P_{Cl}}{P_K} [Cl^-]_o}{[K^+]_i + \frac{P_{Na}}{P_K} [Na^+]_i + \frac{P_{Cl}}{P_K} [Cl^-]_i}$$

where  $P_x$  is permeability of membrane to relevant ion

*Weighted average equation*

$$V_m = \frac{g_K E_K + g_{Na} E_{Na}}{g_K + g_{Na}}$$

, where  $V_m$  is the inside potential minus the outside potential (or threshold),  $E_K$  essentially equals resting, and  $E_{Na}$  essentially equals the overshoot.

*Ohm's Law for membranes*

$$I_m = g_K (V_m - E_K) + g_{Na} (V_m - E_{Na}),$$

where  $I_m$  is current through the membrane

*Passive spread of current*

$$V(x) = V(0) \cdot e^{-x/\lambda},$$

where  $x$  is the distance from the current source

*Space constant*

$$\lambda = \sqrt{\frac{r_m}{r_i + r_o}}, \text{ where } r_x \text{ is the resistance of the relevant part of the cell per unit length}$$

*Probability of synaptic failure*

$P(0) = e^{-m}$ , where  $m$  is mean quantal content

**Quantal analysis.**

A presynaptic change is a change in  $m$ , which is measured by changes in  $P(0)$ .

A postsynaptic change is a change in  $v_1$ , which is measured by changes in peak voltage for spontaneous EPSPs.

mean quantal content =  $m = E(m)$ , or quanta per release

**Units.**

Capacitance: farads

Voltage: volts

Current: amperes

Conductance: siemens

Resistance: ohms