Frog Sciatic Nerve Preparation

Compound Action Potentials
- Properties of CAPs
- Threshold
- Conduction Velocity
- Refractory Period
- Strength Duration Relationship

Electrophysiology Recording Methods

Extracellular Recording

Diphasic CAP

Extracellular Recording
Extracellular Recording

Di or Biphasic CAP

Extracellular Recording

Diphasic v. Monophasic CAPs

Can the Amplitude Change?

Threshold & Maximal Stimulation

Extracellular Recording
Monophasic CAP

Diphasic v. Monophasic CAP

Electrophysiology Recording Methods

Extracellular Recording

Recording Electrodes

Stimulating Electrodes

Latency

Compound Action Potentials

Action Potential vs. Compound Action Potential (CAP)

Neuron Fiber Types

Aα - largest diameter fibers
myelinated peripheral neurons
Aβ - second largest diameter
Aγ - smaller than α & β fibers
Aδ - smallest & slowest fibers
B - myelinated sympathetic neurons
(not in frog sciatic nerve)
C - unmyelinated fibers, pain receptor fibers

Largest Fibers are affected first by pressure

At end of Experiment try crushing the nerve bundle to see if you can eliminate its responses

Vertebrate Neuron Fiber Types

<table>
<thead>
<tr>
<th>Fiber class</th>
<th>Fiber diameter (μm)</th>
<th>Velocity (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aα</td>
<td>10.5</td>
<td>42</td>
</tr>
<tr>
<td>Aβ</td>
<td>14</td>
<td>25</td>
</tr>
<tr>
<td>C</td>
<td>2.5</td>
<td>8.5</td>
</tr>
</tbody>
</table>
Neuronal Conduction

- An Increase in $R_m$ means current spreads farther along the axon.

Neuronal Conduction Speeds

Passive spread of neuronal signal is inversely proportional to Longitudinal Resistance ($R_l$).

- An increase in $R_l$ means current spreads less.

Neuronal Conduction Speeds

Resistance Decreases as hose radius gets bigger.

$$R_m \propto \frac{1}{2\pi rl} \quad \text{(S.A. of a cylinder)}$$

$$R_l \propto \frac{1}{\pi r^2} \quad \text{(X section area)}$$

Squid Giant axon is 1 mm in diameter with conduction velocities 10x that of smaller axons.

Neuronal Insulation

- Unmyelinated
- Myelinated

Unmyelinated Myelinated

About the size of a dime

Squid Giant axon is 1 mm in diameter with conduction velocities 10x that of smaller axons.
Conduction Velocity - Method 1

Velocity (m/sec) = Distance traveled (mm) / travel time (msec)

Conduction Velocity – Method 2

Velocity (m/sec) = Distance traveled (mm) / travel time (msec)

Refractory Period

Strength Duration Relationship

Rheobase
- The minimal strength of an electrical stimulus of indefinite duration that is able to cause excitation of a tissue, e.g., muscle or nerve
- The voltage to which the Strength-Duration curve asymptotes.

Chronaxie
- A Measure of Excitability of neurons. This varies with axon size.
  - Calculate 2$x$ rheobase
  - Determine the Stimulus Duration at 2$x$ rheobase

Optional Manipulations

COLD
- Early studies on neuronal transmission and AP propagation used Temperature as a tool. What effect does temperature have on Conduction Velocities?

Nerve Block by Crushing
- Large diameter axons are affected more than small diameter axons by pressure.
- Partial crushing of the axon AT THE END of the lab may allow you to identify other classes of neurons in addition to the Aβ fibers.