Excitable Cells: Electrophysiological and Fluorimetrical Approaches

潘建源
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Stimulus-secretion Coupling
Embryonic Cortical & Dopaminergic Neurons

E14.5 midbrain

TH: tyrosine hydroxylase, dopaminergic neuron marker
GFAP: glial fibrilar associated protein, glia marker
Expressing GFP in cultured neurons
**Adrenal gland**

**Mineralocorticoids**

**Adrenal medulla**

**SHORT-TERM STRESS RESPONSE**

1. Glycogen broken down to glucose; increased blood glucose
2. Increased blood pressure
3. Increased breathing rate
4. Increased metabolic rate
5. Change in blood-flow patterns, leading to increased alertness and decreased digestive and kidney activity

**STRESS**

**Glucocorticoids**

**ACTH**

**Adrenal medulla**

**ACTH**

**Adrenal cortex**

**LONG-TERM STRESS RESPONSE**

1. Retention of sodium ions and water by kidneys
2. Increased blood volume and blood pressure

**Hypothalamus**

**Releasing hormone**

**Anterior pituitary**

**Blood vessel**

**Nerve cell**

**Spinal cord (cross section)**

**Sympathetic postganglionic neurons**

**Bovine chromaffin cells**

**Nerve signals**

**Splanchnic nerve**

**Epinephrine and norepinephrine**

**Mineralocorticoids**

**Glucocorticoids**

**Biology, Campbell et al.**
Electrophysiology and Electrochemistry

Whole-Cell Patch

Voltammetry

Carbon Fiber

Electrochemistry

INa

ICa

Oxidation Current

30 pA

1 s

High K+

Oxidation

[Ca^{2+}]_i

Capacitance Trace

400 pA

100 fF

10 depolarizations

40 mV

0.2 s

1 s

30 pA

150 ms

+20 mV

-80 mV
Simultaneously monitor ionic current and $[\text{Ca}^{2+}]_i$ fluorescence response
Double Patch to study synaptic connection
Synaptic connection

Post EPSC

Pre AP

30 mV

50 ms

150 pA

50 ms

30 mV
Stimulus-secretion Coupling

1. What molecules are involved in: calcium binding proteins, vesicle recycling-related proteins, Na\(^+\)/Ca\(^{2+}\) exchanger, Ca\(^{2+}\) channels

2. How coupling is modulated: proteins, polyphenols, lysophospholipids, toxins

3. Tracking vesicle movement