Chapter 15

Web Text Box 15.1 and Video 15.1

Calcium waves in glial cells

In the book (page 253) we describe how the inositol-gated calcium channel in the endoplasmic reticulum opens when inositol trisphosphate (IP_3) binds to its cytosolic aspect. This is correct, but is a simplification. In fact the IP_3-gated channel opens much more readily when the cytosolic calcium concentration is raised a little from the typical resting value of 100 nmol liter^{-1}. Thus when a transmitter activates phospholipase C and IP_3 concentrations rise inside a cell, the stage is set for a positive feedback reaction. Once IP_3-gated channels open in one part of the cell, they raise the cytosolic calcium concentration in the immediately surrounding area, triggering IP_3-gated channels to open in the area adjacent to the active area. Now these active IP_3-gated channels release calcium into the cytosol, and as the calcium diffuses to adjacent areas the IP_3-gated channels there open… and so on. Thus we often find that stimulated cells generate calcium waves that travel from one end of the cell to the other.

Each of the colored objects in the movie is a single glial cell in culture. The cells have been loaded with a dye (Fluo-3) that fluoresces more brightly when calcium concentrations increase. The brightness of the fluorescence has been coded as color, so the warmer the color, the higher the calcium concentration. At the start of the movie the cells are stimulated with extracellular ATP, which acts on P2Y receptors (see Web Text Box 16.1, Ionotropic and metabotropic receptors for the same transmitter) to activate phospholipase Cβ. In each cell, a calcium wave is initiated at one point and travels through the cytososol. The movie plays in real time and represents five seconds in the life of the cells. Typically, calcium waves within individual cells travel at a speeds of 20 to 50 μm s^{-1}.

See Video 15.1

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