Abstract View

# A MONTE CARLO MODEL OF EXTRACELLULAR CALCIUM DYNAMICS IN THE CEREBELLAR GLOMERULUS

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Cerebellar glomerulus (CG) is a complex structure comprised of a mossy fiber axon terminal (MFt) that synapses onto 20-50 granule cell (GrC) dendrites. CG is ensheathed by an astrocyte. Our past simulations under conditions of complete ensheathment showed that the concentration of extracellular calcium ([Ca++]o) is a function of the activity of GrC dendrites (GrCD) - a result that supported our original hypothesis that [Ca++]o dynamics may play a role in the information coding in the cerebellar glomerulus. However, when the ensheathment is incomplete, [Ca++]o does not show significant changes from baseline. We simulated virtual glia to quantify how changes in size of “holes” and glial wrapping of GrCD trunks influence the rate of re-equilibration of [Ca++]o. Preliminary results show that the rate of re-equilibration is proportional to the size of the “holes” and inversely proportional to the extent of GrCD wrapping. Further, our recent simulations with complete ensheathment show that [Ca++]o is related to the activity of both MFt and GrCDs, which suggests a need for a mechanism whereby the GrCs can compare the current [Ca++]o to the activity of the MFt. Finally, within the glomerulus, GrCDs form adhesion points with each other that have been recently shown to contain NMDARs. We speculate that these adhesion points may allow GrCs to sense each other's individual activity by detecting local changes in [Ca++]o. This may suggest a more complex situation, whereby GrCs may be sensing both the average activity of all GrCs as well as the more local activities of their immediate neighbors. We are performing simulations to measure the separability of such “global” and “local” signals. These hypotheses will also be explored in an accurately reconstructed glomerulus using EM tomography.

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