Discussion

Graphical user interface, text, application

Description automatically generated

* Answer the Question asked
* Support your conclusion (your data, others’ data)
* Defend your conclusion (anticipated criticisms)
* Give the “big picture” take-home message
  + What do the results mean and why should anyone care
* Showcase good writing
  + Use active voice and tell like a story
* Start and end with the main finding
* Don’t travel too far from the data (what you actually found not hoped to find)
* Focus on the limitations that matter, not general limitations
* Make sure take-home message is clear and consistent

We found that local differences in the valence of impermeant anions along a dendrite result in a non-isopotential neuron. Although membrane potentials varied between compartments, transmembrane and axial driving forces were uniform throughout. We furthermore showed that impermeant anion valence change does not alter the cable properties or synaptic integration aspects of dendrites. This explains why electrical properties of neurons are relatively consistent despite heterogeneous spatial distributions in protein and other impermeant anions.

Consistent with Fraser and Huang1 impermeant anions concentration and charge set the membrane potential and cell volume, given a constant Na+-K+ ATPase density and a fixed extracellular bath. Impermeant anion valency also sets intracellular permeant ion concentrations. Hence regions with differences in impermeant anions will have ionic microdomains (regions with differing ion concentrations to its neighbouring regions).

(RESULT 1)

* Why does adding impermeants not affect other ion concentrations?
* Permanent changes to compartment volume
* Important to note that there are transient changes to all compartments which are similar

We found changes to impermeant anion concentration did not affect other ionic concentrations in dendrites. Compartments with increasing molar quantities of impermeant anions (e.g., where new protein synthesis is occurring) swelled. Volume increase offset the molar fluxes of ions resulting in the compartment having identical ion concentrations to its neighbours. Stable ion concentrations fix the membrane potential and ionic reversal potentials, therefore changing impermeant anion concentration did not change the electrical properties of the compartment.

(RESULT 2)

* Why does impermeant anion charge affect concentration?
* Why are none of the other compartment volumes affected like in result #1?
* Local impermeant anion charge sets local **permeant** anion concentration and influences volume
* The difference in voltage must mean there is different ion composition
* Why do ions move across the membrane in all compartments when z changes in just one

# Limitations

* Did not consider all aspects of electrodiffusion

Although our model displayed similar electrical properties to an equivalent circuit model used in NEURON, default electrodiffusion constants were halved.

* Electrodiffusion constants
* Normalization procedures
* Dendritic branching structures
* Gap in the research regarding the properties of the proteins and other impermeant anions.

# Importance

As impermeant anions underly neuronal growth though without affecting the signalling properties of the neuron.

# Future directions

* Branching models
* Experimental studies that can validate
* Different ideas of calculating electrodiffusion
* Role of changing extracellular concentrations and charge of impermeant anions

# Conclusion

Both impermeant anion concentration and charge are necessary components in setting neuronal volume. Heterogenous distributions of impermeant anions results in non-isopotential neurons with ionic microdomains. At steady state however, these discrepancies do not impact the passive or active electrical properties of neurons.