

Poster presentation

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Differences in biophysical properties of nucleus accumbens medium spiny neurons emerging from inactivation of inward rectifying potassium currents

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Background

Nucleus accumbens medium spiny neurons display a two state membrane potential controlled by active channels and synaptic input. Inward rectifying potassium (K_{IR}) channels play a major role in maintaining one of the states, the hyperpolarized down state. The K_{IR} currents in 60% of these neurons are non-inactivating whereas in the remaining, they inactivate [1]. The significance of this difference is unknown. We describe a computational study

comparing the biophysical properties of medium spiny neurons possessing these two types of currents.

Methods

Two medium spiny neuron cells were modeled using NEURON, one equipped with non-inactivating K_{IR} currents (henceforth, "Cell A") and the other with inactivating K_{IR} currents (henceforth "Cell B") and their behaviors were compared in response to current injection inputs.

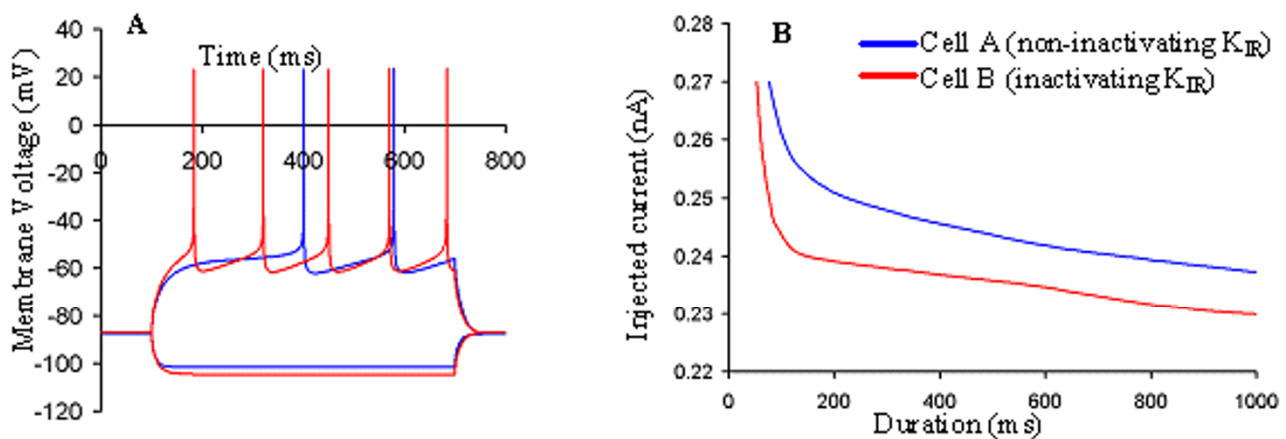


Figure 1

Comparison of Cell A with Cell B. (A) Membrane response to injected currents of 0.248 and -0.2 nA. **(B)** The strength-duration curves of the cells show a significant difference in trend.

Results

It was observed that these two kinds of cells were different in several notable ways. For instance, Cell B when compared with Cell A (i) had a resting potential higher by +0.6 mV; (ii) had a higher frequency of firing for the same injected current (Figure 1A); (iii) hyperpolarized more for the same injected negative current (Figure 1A); (iv) reached firing threshold with smaller injected currents; (v) had higher average inter-spike interval (by up to 15%) with the first spike occurring up to 32% earlier for injected currents matched for firing frequency; (vi) showed noticeable differences in strength-duration curves (Figure 1B), injected current *vs* spike frequency curves and voltage-current relationships.

Conclusion

These results show that clear biophysical differences in the properties of medium spiny neurons can emerge owing to the presence of inactivation in K_{IR} channels and indicate that these differences can influence state transitions driven by cortical and hippocampal excitatory inputs. They also suggest that the two types of neurons expressing the different types of K_{IR} channels may have computationally different functions.

References

1. Mermelstein PG, Song W, Tkatch T, Yan Z, Surmeier DJ: **Inwardly rectifying potassium (IRK) currents are correlated with IRK subunit expression in rat nucleus accumbens medium spiny neurons.** *J Neurosci* 1998, **18**:6650-6661.

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