Age-related changes of a calcium-sensitive potassium channel in the Cerebral Giant Cells of the common pond snail *Lymnaea stagnalis*: its role in learning and memory

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We aim to use the relatively simple neuronal feeding network of the pond snail *Lymnaea* to investigate the role of the small-conductance, Ca^{2+}-activated K^+ channel (SK) in learning and memory, and understand how the activity of this channel changes with age. Using an associative conditioning paradigm, snails injected *in vivo* with the SK channel activator 1-ethyl-2-benzylimidizolinone (1-EBIO, 50 microlitres of 500 microMolar solution) demonstrated impaired learning compared with vehicle-injected controls (mean bites per animal over 2 mins in response to conditioned stimulus: 1-EBIO 1.19 $\pm$ SEM 0.27 (n=12), control 16.08 $\pm$0.68 (n=11) $p<0.0001$). Intracellular recordings from spontaneously firing cerebral giant cells (CGCs, a pair of serotonergic cells that are integral to the neuronal feeding network and intimately involved in associative learning), showed that 1-EBIO delayed the recovery from individual action potentials (time to resting membrane potential following afterhyperpolarisation: 1micromolar 1-EBIO 0.528s $\pm$0.050s (n=5), control 0.320s $\pm$0.050s (n=5), $p<0.02$). Conversely, the SK inhibitor apamin, reduced recovery time from action potentials in spontaneously firing CGCs (time to resting membrane potential following afterhyperpolarisation: 1micromolar apamin 0.222s SEM+/- 0.014s (n=9), control 0.260s $\pm$0.008s (n=5), $p<0.05$). These results are coherent with the effect of ageing on the CGCs.[1] Initial studies using two-electrode voltage clamp on these cells have identified a Ca^{2+}-sensitive outward K^+ current that increases with age (total charge carried by $CdCl_2$ sensitive tail current: young 42.1 nC $\pm$30.9 nC (n=8), old 136.8 nC $\pm$ 29.9 nC (n=8), $p<0.03$). This is consistent with results from previous studies using vertebrate models.[2] Identifying a calcium-sensitive potassium channel that changes with age in an easily identifiable modulatory neurone crucial to the feeding network of *Lymnaea*, can help improve our understanding of how and why this channel undergoes age-related changes, and its corresponding role in learning and memory.

1. Arundell M *et al*. Neurobiol Aging 2006;27(12):1880-91

2. Hammond RS *et al*. J Neurosci 2006;26(6):1844-53