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Control of anterior pituitary cell excitability by calcium-activated potassium channels

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Abstract

In anterior pituitary endocrine cells, large (BK), small (SK) and intermediate (IK) conductance calcium activated potassium channels are key determinants in shaping cellular excitability in a cell type- and context- specific manner. Indeed, these channels are targeted by multiple signaling pathways that stimulate or inhibit cellular excitability. BK channels can, paradoxically, both promote electrical bursting as well as terminate bursting and spiking dependent upon intrinsic BK channel properties and proximity to voltage gated calcium channels in somatotrophs, lactotrophs and corticotrophs. In contrast, SK channels are predominantly activated by calcium released from intracellular IP₃-sensitive calcium stores and mediate membrane hyperpolarization in cells including gonadotrophs and corticotrophs. IK channels are predominantly expressed in corticotrophs where they limit membrane excitability. A major challenge for the future is to determine the cell-type specific molecular composition of calcium-activated potassium channels and how they control anterior pituitary hormone secretion as well as other calcium-dependent processes.

Keywords: Kcna1, Kcnn1-4, ion channel, secretion, signalling

1. Introduction

Since the seminal work demonstrating that endocrine cells of the anterior pituitary gland generate calcium-dependent action potentials more than 40 years ago (Kidokoro, 1975) our understanding of how this electrical activity is shaped and the role of different patterns of excitability in coordinating hormone secretion in pituitary cells has undergone a dramatic transformation (Mason et al., 1988; Mollard and Schlegel, 1996; Ozawa and Sand, 1986; Stojilkovic, 2006; Stojilkovic et al., 2010). Important in this context is that endocrine pituitary cells exploit an eclectic array of ion channels, signaling pathways and mechanisms to control patterns of excitability in a cell specific manner dependent upon the ionic makeup of endocrine pituitary cell types. Moreover, while anterior pituitary cells exploit action potentials they are not simply neurons or skeletal muscles in disguise – the classical

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