

Inhibitory effect of melatonin on voltage-dependent potassium (Kv4.2) channels

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Melatonin is synthesized in and secreted from the pineal gland as a neurohormone. Secreted melatonin regulates the circadian rhythm. It has been reported that melatonin acts on ion channels directly, or indirectly via the melatonin receptors. The voltage-dependent potassium channel family is expressed in the most types of tissues and contributed to the physiological functions including the regulation of resting membrane potential and the formation of action potential. In this study, the effects of melatonin on voltage-dependent potassium (Kv4.2) channels were analyzed by whole-cell patch clamp techniques. In HEK293 cells stably expressed with Kv4.2 channels, outward currents with fast activation and inactivation were observed by membrane depolarization to +100 mV from the resting potential of -80 mV for 500 ms. The outward currents were clearly reduced by the application of 1 mM melatonin and partly recovered by wash-out. Quantitative real-time PCR data revealed that Kv4.2 channels were highly expressed in pineal glands from the rats. These results suggest that melatonin regulates the activity of Kv4.2 channels in pineal glands, potentially contributing to the regulation of circadian rhythm.