Gating of the expressed T-type Cav3.1 calcium channels is modulated by Ca2+.

Abstract:
AIM: We have investigated the influence of Ca2+ ions on the basic biophysical properties of T-type calcium channels. METHODS: The Cav3.1 calcium channel was transiently expressed in HEK 293 cells. Current was measured using the whole cell patch clamp technique. Ca2+ or Na+ ions were used as charge carriers. The intracellular Ca2+ was either decreased by the addition of 10 mm ethyleneglycoltetraacetic acid (EGTA) or increased by the addition of 200 microm Ca2+ into the non-buffered intracellular solution. Various combinations of extra- and intracellular solutions yielded high, intermediate or low intracellular Ca2+ levels. RESULTS: The amplitude of the calcium current was independent of intracellular Ca2+ concentrations. High levels of intracellular Ca2+ accelerated significantly both the inactivation and the activation time constants of the current. The replacement of extracellular Ca2+ by Na+ as charge carrier did not affect the absolute value of the activation and inactivation time constants, but significantly enhanced the slope factor of the voltage dependence of the inactivation time constant. Slope factors of voltage dependencies of channel activation and inactivation were significantly enhanced. The recovery from inactivation was faster when Ca2+ was a charge carrier. The number of available channels saturated for membrane voltages more negative than -100 mV for the Ca2+ current, but did not reach steady
state even at -150 mV for the Na+ current. CONCLUSIONS: Ca2+ ions facilitate transitions of Cav3.1 channel from open into closed and inactivated states as well as backwards transition from inactivated into closed state, possibly by interacting with its voltage sensor.