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Effect of Variation of Membrane Thickness on the Activity of Ca^{2+}-activated K^+ Channel in Planar Lipid Bilayers

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Change of membrane property can affect the activity of membrane proteins. In this work, we investigated the single channel properties of large conductance Ca^{2+}-activated K^+ (BK) channels in planar lipid bilayers of different thickness. First, we recorded the activity of single BK channels from rat skeletal muscle incorporated into the control bilayer, then increased the bilayer thickness by perfusing the recording solution with the one saturated with *n*-pentane, or reduced the thickness by adding diheptanoylphosphatidylcholine ($diC_{7:0}PC$) to the recording solution. Bilayer thickness was estimated from measuring the membrane capacity.

Perfusion with the buffer saturated with *n*-pentane by 50 and 100 % increased membrane thickness by 8.5±3.30 (n=4), 22.6±3.64% (n=8), respectively, whereas addition of $diC_{7:0}PC$ (0.5mM) decreased bilayer thickness by 35.9±6.89% (n=9). BK channel activity was decreased when perfused with the solution saturated with *n*-pentane. The open state probability (P_o) at 20mV was decreased by 43% (from 0.49±0.11 to 0.28±0.08, n=5). The mean open time (τ_o) was decreased by 50%(from 4.96±0.94 to 2.49±0.54ms). But little change of channel activity was observed in case of 50% saturation. When $diC_{7:0}PC$ was added, BK channel activity was also decreased. Their P_o and τ_o were decreased by 38.7 and 40% (n=4), respectively. But, the single channel conductance was not affected in both cases.

Our results show that the decrease of BK channel activity by thickening or thinning of lipid membranes was due to the decrease of channel opening, but not due to the change in ion permeation, indicating that the conformational states of BK channel evoked by thickening or thinning stabilize BK channels at closed state rather than open state and require higher activation energy (or membrane voltage) to function.

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