Study of access resistance in bacterial channels

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Access resistance (AR) is a well known concept in the nanopore field that accounts for the resistance of the medium outside the pore and is related to the concentration polarization in the vicinity of a nanochannel. Here we show that it may be a crucial component of the measured conductance of ion channels under physiological concentrations. We present a new method of measuring AR. It is based on single channel measurements of conductance in electrolyte solutions containing varying concentrations of a high molecular weight neutral polymer (Polyethylene Glycol) sterically excluded from the pore. With the aid of a simplified theoretical model we have split the measurable conductance into two contributions: one coming from the pore itself and the contribution coming from the access resistance. Although AR is only a moderate contributor to the total resistance in concentrated solutions regardless the membrane charge, it is essential to account for it at low salt concentration in neutral membranes. In diluted solutions the channel charges could pass functionally unnoticed if AR is ignored. Furthermore, our measurements show that lipid charge decreases the AR, thus confirming earlier numerical predictions. Biological channels perform their physiological function in the cellular environment, which has two common features: low ionic strength and macromolecular crowding. Both factors make the AR contribution to channel conductance important. Therefore our findings are relevant to in vivo conductive properties of protein channels.