CELLULAR ELECTROPHYSIOLOGY OF HOMOLOGOUS DILUTING SEGMENT FROM SQUALUS ACANTHIAS KIDNEY.

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In previous studies we identified a nephron segment from within the peritubular sheath that exhibited transport characteristics typical of diluting segments found in mammalian and amphibian species (Bull. MDIBL 25: 24, 128, 1985; 26: 61, 1986). The present studies used intracellular microelectrodes to assess further the electrophysiological properties of this segment. Single intermediate IV segments were perfused and bathed with shark Ringer's at 16-19°C. Microelectrodes were filled with 1M KCl and had tip resistances of 70-100 Mohm. Basolateral membrane voltage (V_{bl}, mV) and fractional resistance of apical membranes (f_a) were -64.0 ± 2.5 and 0.892 ± 0.011, respectively (n=17). Baseline transepithelial voltage (V_e, mV), conductance (G_e, mS/cm^2) and equivalent short-circuit current (I_{sc}, μA/cm^2) averaged 5.4 ± 0.8, 111.3 ± 14.5, and 486 ± 43, respectively. Luminal addition of 0.1 mM furosemide hyperpolarized V_{bl} by -16.1 ± 1.8 mV (n=15, P<0.001) and abolished V_e and I_{sc}. F_a decreased significantly from 0.889 ± 0.013 to 0.854 ± 0.018 (n=9, paired P<0.001). Replacement of luminal K with 1.0 mM Ba depolarized apical membranes by -10.4 ± 2.7 mV (n=7, paired P<0.01) and increased f_a from 0.862 ± 0.019 to 0.918 ± 0.016 (paired P< 0.03). Individual cellular (apical, R_a, and basolateral, R_{bl}) and paracellular resistances (R_s) were calculated from the linear relation between the temporal changes in G_e and f_a immediately following Ba addition ($G_e = 1/R_{bl}[1-f_a] + 1/R_p$). R_a, R_{bl} and R_s (ohm cm^2) were 40.6 ± 4.9, 6.0 ± 0.7 and 35.9 ± 5.5, respectively. Cellular conductance averaged 43.0 ± 4.9% of G_e. We conclude: 1) the hyperpolarization of V_{bl} and fall in f_a associated with abolition of transepithelial NaCl absorption by furosemide in intermediate segment IV is consistent with a reduction in conductive Cl efflux across basolateral membranes; 2) the depolarization of V_a and rise of f_a with Ba is consistent with the presence of potassium conductive pathways in apical membranes; and, 3) the electrical leakiness of this nephron segment, like that of other diluting segments, is due not only to the cation selective shunt pathway, but also to a large transcellular conductive pathway (Bull. MDIBL 25:128, 1985). (These studies were supported grant DCB 87-02159 from the National Science Foundation).