62

INFLUENCE OF ION TRANSPORT AND CORTICO-MEDULLARY CYTOARCHITECTURE ON SOLUTE CONCENTRATIONS IN THE DIFFERENTIATING KIDNEY: PREDICTIONS FROM A MODEL SIMULATION ANALYSIS.

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The capacity of the medullary countercurrent system for osmotic concentration of final urine increases with ontogeny. The relative contributions of different morphological and transport parameters to this process can not be evaluated experimentally. The present model incorporates,in particular, changes of ion transport in the differentiating nephron (1), ontogenetic alterations of the microarchitecture of outer (OM) and inner (IM) medulla (2), and re-entry of urea from the pelvis into medullary interstitium (3,4). Three developmental phases were computed:(i) low ion transport rate in TAL,most loops turning in cortex;(ii) intermediate ion transport rate in TAL, entry of most loops into outer medulla; (iii) final state of function.
Results.(i) Central core (CC) NaCl ($mmol \cdot l^{-1}$) is almost constant, CC urea rises slightly at transition OM/IM. (ii) CC NaCl increases by a factor of 2 in OM and CC urea by a factor of 5 in OM. (iii) CC NaCl rises by a factor of more than 3 in OM, total osmotic activity by a factor of almost 4 in OM, to reach 1200 $mosm \cdot l^{-1}$ in IM. The data agree with measured values.
Conclusions. Ontogeny of renal osmotic work depends on two primary factors: the increasing ion transport capacity of the thick ascending loop of Henle (TAL) and the descend of cortical loops of Henle into the medulla to provide for the sequestration of previously concentrated urea. The model will be applied to predict the effect of variations of individual components, such as induced ion transport or osmotic water permeability in the distal nephron,upon the efficacy of medullary osmotic work.

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