jnm/ LETTERS TO THE EDITOR

APPLICATIONS OF HIPPURATE KINETIC MODELS

The authors (*1*) of "Clinical applications of a kinetic model of hippurate distribution and renal clearance" state that the urine OIH concentration is derived from the equation OIH $Conc_L$/OIH $Conc_R$ $= \tau_L/\tau_R$. This relationship can only hold true when $ERPF_L = ERPF_R$ for $ERPF = UV/P$ and $\tau \propto 1/V$ $\tau_L(ERPF_L)/\tau_R(ERPF_R) = [(1/V_L)(U_LV_L/P)]/[(1/V_R)(U_RV_R/P)]\tau_L(ERPF_L)\tau_R(ERPF_R) = U_L/U_R$ = OIH $Conc_L$/OIH $Conc_R$.

In addition, as a result of this relationship between OIH concentration, ERPF, and τ it is obvious that if they were able to show good correlation between urine concentration ratios obtained by RP/ED and constant infusion split-function tests as demonstrated in their Fig. 4, this was because in the seven normal patients the ratio of $ERPF_L/ERPF_R = 1$ and in the case of the two main renal artery stenosis patients because a fortuitous coincidence resulted in an incorrect τ_L/τ_R applied to a wrong formula giving a correct OIH $Conc_L$/OIH $Conc_R$.

In main renal artery stenosis (*2*) in the affected kidney, the ERPF is reduced by at least 40% and the minute volume is less than half and the PAH concentration more than twice that of the other kidney, e.g., $(ERPF_L/ERPF_R)(\tau_L/\tau_R)$ = OIH $Conc_L$/OIH $Conc_R$, $(0.6/1)(\tau_L/\tau_R) = 2$, $\tau_L/\tau_R = 3.33$, and $3.33 \neq 2$.

The ratio of "total renogram" (*3*) transit times does not give good ratios of minute volumes. By flagging an area of interest, "cortical transit time" ratios will give good approximations to ratios of minute volumes. The authors TTT includes time spent in calyces and renal pelvis which diminishes the τ_L/τ_R. If a correlation of RP/ED and constant infusion split functions were carried out on patients with unilateral disease, the apparent correlation would disappear.

The OIH volume of distribution is 28% of body weight and it takes from 20–40 min to reach this distribution depending on the cardiovascular status. The late λ of the blood disappearance curve is approx 0.04/min. Good OIH clearances can be approximated closely by using this late slope times a volume of distribution estimated at 28% of ideal body weight, or better still by analysis of the double exponential curve. Various workers, in the interest of economy of time, have used the early slope times an empirical volume of distribution equal to the plasma volume. This gives a good approximation in those with both normal renal function and normal cardiovascular status. The present authors have done likewise. In patients with poor cardiovascular status and poor renal function these calculated ERPFs can be out as much as 50%. This accounts for the impossible relationship in their patient shown in Fig. 6, who presumably had an ERPF of 500 ml/min and a creatinine clearance of only 26 ml/min. A creatinine clearance of 26 ml/min goes with an ERPF of about 130 ml/min and conversely an ERPF of 500 ml/min with a creatinine clearance of about 100 ml/min.

Until these errors in the RP/ED protocol are corrected, the values of the parameters produced are not valid.

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REFERENCES

1. DEGRAZIA JA, SCHEIBE PO, JACKSON PE, et al: Clinical applications of a kinetic model of hippurate distribution and renal clearance. *J Nucl Med* 15: 102, 1974

2. STAMEY TA, NUDELMAN IJ, GOOD PH, et al: Functional characteristics of renovascular hypertension. *Medicine* 40: 347–392, 1961

3. REESE L: Autofluoroscope in the study of split renal function—Province of Ontario Public Health Research Grant No. 8: unpublished data

THE AUTHORS' REPLY

We will treat the objections to our paper in order. First let us consider the comments relative to the estimation of transport time. Dr. Reese's statements are L/R OIH Conc Ratio $= \tau_L/\tau_R$ only if $ERPF_R'$ and $\tau \sim 1/V'$.

We believe the first statement to be incorrect and the second to be incomplete. In our work, estimates of urine flow rates are related to the mass of functioning tubular cells as well as to the transport time of hippuran in renal tubules. For this it is assumed that $V_L = k\beta_L/\tau_L$ and $V_R = k\beta_R/\tau_R$ as given on p. 105 of our paper (*1*). Direct substitution into the steady-state clearance equation, $ERPF = UV/P$, gives $ERPF_L = U_Lk\beta_L/P\tau_L$ and $ERPF_R = U_Rk\beta_R/$