RELATION BETWEEN MAXIMAL URINE CONCENTRATION, MAXIMAL WATER REABSORPTION CAPACITY, AND MANNITOL CLEARANCE IN PATIENTS WITH RENAL DISEASE

BY

E. J. DORHOUT MEES, M.D.

From the Medical Department, University Hospital,
Utrecht, The Netherlands

Despite the increase in our knowledge concerning renal physiology, there seems to be little need for more elaborate techniques in the evaluation of renal patients. Routine urine analysis, the "concentration test," and urea or creatinine clearance indeed give nearly maximal information about diagnosis and prognosis in most cases.

Recently the value of the "classical" concentration test has again been challenged. Not only has the determination of the freezing-point depression (which was abandoned some 50 years ago) been advocated instead of the specific gravity (Frank *et al.*, 1957), but the whole question of the value of measuring concentration ability at low flows has been a matter of dispute. Baldwin *et al.* (1955) stated that (concerning water conservation) "the basic physiological operation of the kidney can only be judged in terms of the quantity of water abstracted."

It is the purpose of this communication to determine whether measuring of the maximum water reabsorption (T^cH_2O) would give more useful information than the concentration power, measured as the maximum osmolar urine/plasma (U/P) ratio. We do not intend to comment on the correlation between osmolar concentration and specific gravity, which has been extensively investigated (Miles *et al.*, 1954; Dorhout Mees, 1957).

Materials and Methods

The normal persons and the patients investigated were the same as in the previous communication (Dorhout Mees, 1959); the methods of determining maximum U/P ratio and T^cH_2O are described there. The mannitol

clearance was determined in the same urine samples as was the T^cH_2O (usually the mean of four successive periods). The normal clearance values obtained in this way were lower than those found by most investigators, as was reported elsewhere (Dorhout Mees *et al.*, 1958). However, we assume that it reflects glomerular function with sufficient accuracy.

Results

Data Obtained from the Four Groups

Subject	Diagnosis	Sex	C Man	TcH ₂ O	TcH ₂ O C Man	85	U/P Osmolar Maximum
Group 1							
1	Normal	M	86	5.7	5.7		4.1
2	"	M	86	6.1	5.0		4.0
3	"	M	90	5.1	4.8		3.6
4	"	M	76	5.3	5.9		4.1
5a	"	F	75	4.9	5.5	}	3.6
5b			79	4.7	5.0		
6	"	M	81	5.7	6.0		3.4
7	"	M	89	5.2	5.0		3.5
8	"	M	87	6.0	6.1		4.1
9	"	M	78	6.0	6.5		3.7
10	"	M	95	5.4	4.8		3.8
Group 2							
A	Chron. nephritis	M	53	2.5	3.6		2.2
B1	" "	F	40	1.6	3.3		2.4
B2			41	1.4	2.9		2.5
C	" "	M	34	1.5	3.7		2.1
D	" "	F	24	0.16	0.7		1.4
E	" "	M	24	0.5	1.7		1.2
F	" "	M	12	0.4	2.9		1.3
G	" "	M	36	1.1	2.6		2.2
H	Acute nephr., recovering	M	57	3.2	4.9		2.5
I	Chron. nephr., dubious	M	71	2.9	3.7		2.6
Group 3							
J1	Hyperparathy- roidism	F	51	1.7	2.0	}	1.9
J2			58	1.1	1.6		
K	Vit. D intox.	F	29	1.1	3.15		1.55
L	Tubular necr.	F	62	1.9	2.6		1.45
M	Renal diab. insip.	M	50	1.5	2.5		1.5
N			56	0.65		1.8	
Group 4							
O	Renal vein thrombosis	F	21	1.1	4.8		1.8
P	Hypoplasia of one kidney.	M	56	3.1	4.5		3.3
Q	Hypertension	M	68	4.4	5.1		2.3
R	Nephrectomy	M	64	4.0	5.3		2.8
S	Unknown (neph- rolithiasis ?) (Hypertension)	M	68	2.7	3.4		2.2

The Table summarizes the patients and the data obtained. In the sixth column the ratio of T^cH_2O to mannitol clearance is given, multiplied by our normal mean of the latter. The letters and numerals in Figs. 1-3 relate to patients listed in the Table.

In Fig. 1 we have correlated U/P maximum (during "conventional" concentration test) and T^cH_2O values. There is a rough linear correlation.

In Fig. 2 $\frac{T^cH_2O}{C \text{ man}} \times 85$ is related to the mannitol clearance (C man). The shaded area includes those cases in which this value is in the normal range, although both T^cH_2O and mannitol clearance may be substantially reduced.

Finally, Fig. 3 gives the correlation of mannitol clearance and maximum U/P ratio.

Discussion

It is to be expected that maximal U/P concentration ratio and T^cH_2O are in some way related to each other,

FIG. 1.—Correlation of maximal U/P ratio and T^cH_2O values.