

EARLY INDICATORS OF DETERIORATING RENAL EFFICIENCY IN ELDERLY SUBJECTS

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Abstract : Renal functions decline with age. Only after considerable renal reserves are lost, the traditional clinical tests of urine, blood or clearance levels reveal the defect. The urine quantity & contents passed in 24 hrs both by young and elderly, show little differences between the two groups. Their creatinine clearances are also comparable.

Earlier Studies on water dilution test had shown significant differences between the performance of the young and elderly subjects, indicating decrease in renal efficiency on ageing.

In the present study 4 hourly collections of urine showed that the night collections in elderly subjects were comparatively larger in volume, electrolytes and other components as compared with younger subjects. The kidneys of the elderly seem to compensate by labouring at night, while the young have their restful phase.

Thus in addition to water dilution test, comparison of day/night outputs of urine can be taken as an early indicator of renal deterioration in elderly.

Key words : renal functions young and elderly 4 hrly (D/N) urine output water dilution test

INTRODUCTION

With ageing all physiological functions decline. This applies to renal functions also (1,2,3).

Nature has endowed upon man large reserves of nephrons. It is estimated that a child at birth has about 2 million nephrons and for carrying out renal functions satisfactorily only 1/6 of the renal tissue is adequate (4). Until 2/3 or 3/4 of renal tissue has been rendered functionless, the ordinary kidney efficiency tests yield "normal" results (5).

For testing renal functional efficiency, the usual tests (5, 6, 11) employed are:

a) routine urine examination, particularly for proteinuria, and casts; b) blood chemistry for nitrogenous substances-urea, creatinine; c) creatinine clearance; and d) water dilution test.

Although these investigations are of great help

in clinical states, they elude evidence of early decline of efficiency (5). Hence, further investigations were undertaken in two groups of subjects, young and elderly, to elucidate any changes in renal function.

METHODS

15 young (average age 26.5 ± 3.56 yrs) and 40 elderly (average age 71.33 ± 5.44 yrs.) men were taken up as subjects for this study after their clinical and routine pathological examination showed no abnormality. In all of them blood was collected at 10 am for urea and creatinine estimations.

Further, in all the subjects, the following procedures were followed:-

- (a) The subject collected his urine in plastic bottles at each four hourly interval;
 - (i) Day collection =
(I) 8 a.m. - 12 noon (II) 12 noon - 4 p.m.
(III) 4 p.m. - 8 p.m.

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(ii) Night collection =

(IV) 8 p.m. - 12 night (V) 12 night - 4 a.m.

(VI) 4 a.m.- 8 a.m.

Volume and specific gravity for each sample were noted, and then urea, creatinine, Na, K, Cl, PO₄ contents were estimated.

(b) Creatinine clearance values were calculated from the above data employing the standard formula =

$$\frac{UV}{P} \quad U = \text{mg\% concentration of creatinine in urine}$$

$$V = \text{urine vol. in ml per minute.}$$

$$P = \text{mg\% plasma concentration of creatinine mg.}$$

(c) After emptying the bladder in the morning the subject drank 1 litre water in about 3 mts and urine was collected hourly for 4 hrs thereafter. Each sample was estimated for volume, specific gravity, and its urea and creatinine contents.

RESULTS AND DISCUSSION

Thus the total volume, urea and creatinine passed in 24 hours were almost similar in both groups of subjects and were within accepted physiological norms.

The average blood urea in young subjects was 18.8 ± 4.23 mg% and serum creatinine 0.91 ± 0.17 mg%. The values of urea for elderly subjects were

27.2 ± 2.6 mg% and creatinine 1.00 ± 0.3 mg%, which did not indicate any gross differences.

The decline of renal functions on ageing are well reported in literature (1,2,3). The kidneys decrease in size, more on account of atrophy of their cortical areas where glomeruli abound, while the medullary regions, where tubules are located, are not so affected (7). Roessle and Roulet (7) emphasised the loss in number and size of nephrons on ageing. Oliver (8) reported progressive loss of average weight of kidneys, as follows: Age 60, av. wt. 250 g.; Age 70, av. wt. 230 g.; Age 80, av. wt. 190 g. Brocklehurst (9) in 100 consecutive postmortems on geriatric patients could find only 3% of the kidneys which were normal. Tauchi et al (10) reported progressive loss of renal mass on ageing, being 250-270 g in young adults, and only 180-200 g in the eighth decade.

Total 24 hours urinary composition failed to demonstrate any gross differences in young and elderly subjects in this series (Table I). It is presumed, therefore, that in the elderly subjects the remaining nephrons are competent to carry out their daily assignment and maintain thereby homeostasis of the body. In spite of reduction in nephrons, the elderly subjects excrete more water and components at night than during the day, which appears to be an adaptation on ageing.

Amongst the various laboratory investigations

TABLE I : 4 hrly urine - vol ml, urea g, creatinine g.

4 hrly samples	I	II	III	IV	V	VI	Total vol. urine 24 hrs
	(day)			(night)			
Volume (ml)							
Subjects (n)							
Young (15)	325	252	392	289	297	185	1740
Elderly (40)	220	240	275	250	295	290	1570
Urea (g)							
Young	1.87	1.63	3.10	1.95	2.00	1.70	12.25
Elderly	1.60	1.69	1.86	1.80	1.78	1.66	10.39
Creatinine (g)							
Young	0.36	0.25	0.27	0.26	0.25	0.18	1.57
Elderly	0.28	0.23	0.23	0.24	0.28	0.23	1.51

for renal function, the creatinine clearance is considered to be the most sensitive one in clinical practice (5). Shock (11) had obtained in 20-29 years old subjects, creatinine clearance values of 123 ± 16 and in elderly subjects of 50-51 years, clearance values were 99 ± 15 ml/mt.

The following creatinine clearance values were obtained for different age groups, in our study.

TABLE II : Creatinine clearance ml/mt in different age groups.

Young av. age	(n)	ml/mt
26.5 yrs	15	99.46
Elderly		
60-64 yrs	5	93.94
65-69 ,,	11	89.88
70-74 ,,	14	99.30
75-79 ,,	7	98.05
80 + ,,	3	77.69
Total elderly	40	93.86

Dilution Test: Pathak and Joshi (3), while reporting on the volumes of urine passed every hour upto 4 hrs after drinking 1 litre of water in the morning, observed renal functional deterioration on ageing. The younger subjects eliminated 92% of this water intake in 3 hrs, while the elderly subjects passed out only 49% of the water intake in 3 hrs, and 56% in 4 hours.

Day and Night outputs: According to Mossenthal (12) increase in nocturnal output of urine, alongwith lowering of sp gr and N_2 output, is an

early sign of renal inadequacy. Brod (13) recommended comparison of day and night urine outputs as early indicators of renal efficiency.

TABLE III : Ratio of day and night (D:N) outputs of urine volume & electrolyte contents in young and elderly subjects.

(n)	Volume	Na	K	Cl	PO ₄
	D:N	D:N	D:N	D:N	D:N
Elderly (40)	1:1.27	1:1.13	1:0.83	1:1.05	1:1.24
Young (15)	1:0.72	1:0.80	1:0.60	1:0.66	1:1.40

Davidson, Talner and Downs (14) found more rigid renal vessels at higher age. The elastic vessels in young possibly adapt easily to vascular variations in diverse circumstances, while the rigid elderly vessels fail to do so. Such vascular changes on ageing may account for larger volumes at night. (Table III).

In elderly subjects all the electrolytes were found to be higher in the night samples, except that of potassium. In the young D:N ratio for all electrolytes, except PO₄, are less in the night samples. De Wardener (15) had reported increased PO₄ output in urine at night, possibly a result of diurnal variation.

Our study established that in the elderly subjects the nocturnal output of urine and its electrolyte contents exceed the day output. This observation may be profitably used as an early indicator of determining renal functional deterioration in elderly subjects.

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