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**Title:** BIOCHEMICAL ANALYSIS OF NOCTURIA IN THE ELDERLY

### Purpose

Nocturia is a common symptom in the elderly. Nocturia has been attributed to nocturnal polyuria and/or diminished nocturnal bladder capacity (1,2), but the etiology has been poorly studied. Therefore, we investigated the etiology of nocturia by biochemical and body composition analyses.

### Methods

This study was performed on 100 volunteers who were divided into 3 groups: a healthy young adult control group of 30 persons (17 men and 13 women aged 20 to 45 years) who had no nocturia, an elderly control group of 30 persons (17 men and 13 women over 60 years old) who usually had no nocturia, and an elderly nocturia group of 40 persons (27 men and 13 women over 60 years old) who had nocturia (over 2 times per night). All subjects had normal serum creatinine levels, normal urinalysis findings, and no edema. The elderly control and nocturia groups recorded frequency-volume charts for 24 hours.

In the 3 groups, a blood sample was taken at 1-3 p.m. and at 12-2 a.m. at least 2 hours after going to bed. Serum levels of glutamate, glycine, serotonin, dopamine, adrenaline, noradrenaline, melatonin, orexin, antidiuretic hormone, human atrial natriuretic peptide (HANP) and brain natriuretic peptide (BNP) were measured as well as the plasma osmotic pressure. Urinary osmotic pressure was also measured in urine voided at 1-3 p.m. and in early morning urine. Body weight, body mass index, the body water volume (intracellular water, extracellular water, and total body water), and the edema ratio (the ratio of extracellular water volume to total body water volume) were also measured in the early morning, at noon, and before sleeping using a body composition analyzer. Data were compared between the 3 groups by the unpaired t-test.

### Results

In the elderly nocturia group, there were 6 persons whose total 24-hour urine volume was over 2500 ml, 12 persons whose nocturnal urine volume was over 35% of the total 24-hour urine volume, and 3 persons who had nocturia before blood sampling at night. There was no significant difference of the single voided volume between daytime and nighttime. In the elderly nocturia group, there was a significant ( $p < 0.05$ ) decrease of melatonin at night, an increase of adrenaline and dopamine at night, an increase of HANP at night, a decrease of urinary osmotic pressure in the daytime and early morning, and an increase of the edema ratio before sleeping, in comparison with the other 2 groups (Table). There were no significant differences of the serum glutamate, serotonin, orexin, and antidiuretic hormone levels in the daytime and nighttime among the 3 groups.

### Conclusions

In elderly persons with nocturia, sleep disorder related to a decrease of melatonin may be considered, and sleep disorder may decrease the threshold for awakening by the desire for micturition. An increase of

catecholamines at night also suggested the existence of sleep disorder. The increased edema ratio before sleeping suggested the accumulation of water in the extracellular space, which might be induced by a decrease of renal blood flow and/or insufficient muscle pump function during the daytime. Water that pools in the extracellular space during the daytime may enter the intravascular compartment and increase the circulating blood volume, thus bringing about a rise of HANP that increases urine production. Therefore, sleep disorder related to a nocturnal decrease of melatonin, and accumulation of water in the extracellular space (possibly due to a decrease of renal blood flow and/or insufficient muscle pump function in the daytime) may be the causes of nocturia in elderly persons.

### **References**

- 1) J. Urol. 2000; 163: 5-12.
- 2) J. Urol. 2000; 163: 777-781.

Table. Biochemical and body composition analyses

Group	Adrenaline (pg/ml)		Dopamine (pg/ml)		Melatonin (pg/ml)	
	daytime	nighttime	daytime	nighttime	daytime	nighttime
Young control	36.3±19.1	18.1±10.7	14.2± 3.8	13.1±9.1	2.3±7.7	52.0±28.1
Elderly control	34.7±29.3	13.4± 7.1	16.1±10.5	12.6±4.3	0.8±1.3	29.2±20.6
Elderly nocturia	34.3±25.2	22.1±19.2*	21.9±13.2	18.3±11.5*	0.3±0.6	9.9±8.2*

Group	HANP (pg/ml)		BNP (pg/ml)		Edema Ratio	
	daytime	nighttime	daytime	nighttime	morning	before sleeping
Young control	11.4±5.5	16.2±13.0	5.6±5.3	4.7±4.9	0.325±0.015	0.334±0.012
Elderly control	17.3±10.3	16.7±11.6	17.2±17.7	13.6±14.7	0.359±0.019	0.361±0.019
Elderly nocturia	24.9±20.5	25.9±18.6*	42.8±84.1	40.0±91.0	0.366±0.015	0.373±0.004*

mean ± S.D., \*: p < 0.05, in comparison with elderly control group.