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THE INCREASE IN 24-HR URINE PRODUCTION/WEIGHT CAUSES NOCTURNAL POLYURIA DUE TO IMPAIRED FUNCTION OF ANTIDIURETIC HORMONE IN ELDERLY MEN

Hypothesis / aims of study

Although an impaired response to arginine vasopressin (AVP) commonly occurs in the patients with polyuria due to increased fluid intake, it is not known whether the patients whose 24-hr production/weight is less than 40 have a different response to AVP. The aim of this study was to evaluate whether the endogenous AVP has a different function resulting in difference in 24-hr urine production/weight.

Study design, materials and methods

A total of 205 male patients, aged over 50 years, complaining of nocturia were enrolled in this study. Patients who had past or present history of heart disease, diabetes mellitus with fasting blood glucose of 200 mg/dl or more, serum creatinine (Cr) > 1.5 mg/dl, hydronephrosis, post-void residual (PVR) > 50 ml, or active urinary tract infection, and patients habitually receiving diuretics or lithium were excluded. The purpose and method of this study were approved by our Institutional Reviewer Board and fully explained to the patients, and informed consent was obtained from them. The frequency volume chart (FVC) and fluid intake (time and volume) were recorded. In this study, nocturnal urine volume (NUV) was defined as the total amount of urine voided between 22:00 and 6:00 including the first voided volume after rising from bed according to our previously reported method. Nocturnal polyuria (NP) was defined as NUV = 0.9 ml/min × sleeping time. The evening drinking volume was defined as the total amount of drinking volume between 17:00 and 6:00. All patients were requested to void urine at 22:00 and 6:00. A single urine sample voided at 6:00 was also obtained from the all patients. The details of measuring uAVP were described in our previous article [1, 2)]. The urine osmolarity, uNa, and uCr were also measured. Then, uAVP and uNa were adjusted as uAVP/uCr and uNa/uCr, respectively, by the uCr level to decrease the volumetric influence of urine production. The patients were divided into four groups according to their 24-hr urine production/weight as follows: group 1 (24-hr urine production/weigh)t: more than 40, group 2 (24-hr urine production/weight: more than 30 to 40), group 3 (24-hr urine production/weight: more than 20 to 30), group 4 (24-hr urine production/weight: 20 or less).

Results

After excluding 31 patients from this study because of incomplete FVC and fluid intake chart (28 patients) and blood glucose > 200 mg/dl (3 patients), 174 patients were examined. The numbers of patients divided according to 24-hr urine production/weight were as follows: 25 in group 1, 42 in group 2, 69 in group 3, and 38 in group 4. There were no significant differences in the blood pressure, electrolyte level (Na, K, Cl, Ca), uAVP/uCr and uNa/uCr among the 4 groups. On the other hand, there were significant differences in the 24-hr urine production and NUV. There were significant differences in the body weight, urine osmolarity, 24-hr drinking volume, and evening drinking volume between the higher and the lower groups considering that the cutoff value of 24-hr urine production/weight was 30 (Table 1).

The age, sex, body weight, Na, Cl, K, Ca, Cr, uAVP/uCr, uNa/uCr, 24-hr urine production/weight, 24-hr drinking volume, evening drinking volume, systolic and diastolic blood pressure were included in the predictive factors. The variables whose *p* values were less than 0.05 in the univariate analysis (age, Cr, uAVP/uCr, 24-hr urine production/weight: more than 20 to 30, and 24-hr urine production/weight: 20 or less) were used in the multivariate analysis. In the multivariate logistic model, the age, uAVP/uCr, 24-hr production/weight: more than 20 to 30, and 24-hr urine production/weight: 20 or less were independent predictive variables of NP (Table 2).

Interpretation of results

1. In this study, the 24-hr urine production/ body weight positively correlated with NUV. Although there were no significant differences in the levels of AVP and sodium at night among the groups, the lower groups (24-hr urine production/weight < 30) had lower NUV and higher urinary osmolarity than the higher groups. This phenomenon suggested that the increase in 24-hr urine production/weight resulted from an impaired response to AVP in the renal tubules. 2. The decrease in 24-hr production/weight in the lower groups potentially improved NP, because 24-hr urine production/weight of more than 20 to 30 and 24-hr production/weight of 20 or less were independent predictive variables of NP.

Concluding message

We recommend the patients complaining of nocturia due to NP to keep their 24-hr urine production/weight between 20 and 30.

References

1. Decrease in the nocturnal urinary levels of arginine vasopressin in patients with nocturnal polyuria
2. Cutoff Value of Urinary Arginine Vasopressin for Nocturnal Polyuria in Elderly Men

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HUMAN SUBJECTS: This study was approved by the This study was approved by the Nara medical university Human Participants Ethics

Commitee and followed the Declaration of Helsinki Informed consent was obtained from the patients. and followed the Declaration of Helsinki Informed consent was obtained from the patients.

Table 1. Characteristics of patients divided according to 24-hour urine production / weight

		24-hour production/weight											
		a			b			c			d		
		≧20(n=38)			<20-≧30(n=69)			<30-≧40(n=40)			<40 (n=25)		
		average	±	S.D.	average	±	S.D.	average	±	S.D.	average	±	S.D.
Age(y.o.)	*	70.0	±	8.7	69.9	±	7.9	73.8	±	5.7	73.6	±	7.1
Weight(kg)	§	65.0	±	12.4	63.4	±	8.0	59.6	±	9.5	56.5	±	8.1
Systolic BP (mmHg)		135	±	17.3	130	±	15.2	130	±	14.2	129	±	14.3
Diastolic BP (mmHg)		74	±	9.4	74	±	11.5	72	±	11.3	74	±	11.3
Na(meq/l)		141	±	2.4	141	±	2.0	141	±	2.6	141	±	2.6
K(meq/l)		4.1	±	0.3	4.2	±	0.3	4.2	±	0.4	4.2	±	0.4
Cl(meq/l)		104	±	3.0	104	±	2.7	104	±	3.1	103	±	2.7
Ca(mg/dl)		9.2	±	0.4	9.2	±	0.4	9.2	±	0.4	9.3	±	0.4
BNP(pg/ml)		24.0	±	21.0	26.8	±	25.1	38.6	±	28.4	40.1	±	32.0
Cr(mg/dl)	#	0.8	±	0.2	0.9	±	0.2	0.8	±	0.1	0.9	±	0.1
uAVP/uCr(pg/ml/Cr)		33.2	±	29.3	27.1	±	21.3	23.5	±	28.3	22.4	±	27.1
uNa/uCr(meq/l/Cr)		4.0	±	3.2	7.2	±	11.5	7.8	±	12.6	8.6	±	14.8
Urine osmolarity	§	593	±	183	568	±	147	456	±	183	429	±	126
24-hour production(ml)	†	1101	±	272	1575	±	261	2032	±	342	2636	±	581
nocturia	‡	1.8	±	1.2	1.9	±	1.2	2.3	±	1.1	2.9	±	1.8
Nocturnal urine volume(ml)	†	383	±	182	497	±	198	724	±	300	902	±	369
Nocturnal polyuria index		0.35	±	0.14	0.32	±	0.13	0.36	±	0.14	0.36	±	0.16
24-hour drinking volume(ml)	§	1344	±	509	1390	±	500	1618	±	514	1730	±	728
Evening drinking volume(ml)	§	468	±	258	478	±	285	614	±	334	650	±	452

*: a vs. c, b vs. c, b vs.d; $p<0.05$

§ : a vs. c, a vs.d, b vs. c, b vs.d; $p<0.05$

: a vs b; $p<0.05$

†: a vs. b, a vs.c, a vs.d, b vs.c, b vs.c, c vs.d : $p<0.05$

‡: a vs. d, b vs.d, c vs.d : $p<0.05$

Table 2. Multivariate analysis on associated variables correlating with nocturnal polyuria

	Univariate analysis				Multivariate analysis		
	Odds ratio	95%CI	*p*-value		Odds ratio	95%CI	*p*-value
Age(y.o.)	1.07	1.03-1.12	0.0009		1.07	1.01-1.12	0.02
Weight(kg)	0.99	0.96-1.03	0.72				
Na(meq/l)	0.9	0.98-1.001	0.13				
Cl(meq/l)	0.99	0.98-1.001	0.28				
K(meq/l)	1.001	099-1.02	0.98				
Ca(mg/dl)	1.95	0.84-4.53	0.12				
BNP	1.009	0.99-1.03	0.29				
Cr(mg/dl)	8.7	1.24-60.4	0.03		3.34	038-30.1	0.29
uAVP/uCr(pg/ml/Cr)	0.97	0.95-0.98	<0.0001		0.97	0.95-0.98	0.0001
uNa/uCr(meq/l/Cr)	1.07	0.99-1.14	0.06				
24-hour production/weight							
vs. <40							
≦40, 30>	0.58	0.14-2.43	0.45				
≦30, 20>	0.18	0.05-0.65	0.009		0.19	0.04-0.88	0.03
≦20	0.07	0.02-0.25	<0.0001		0.07	0.01-0.34	0.001
24-hour drinking volume(ml)	1	1.00-1.001	0.19				
Evening drinking volume(ml)	1.001	1.00-1.002	0.09				
Systolic BP (mmHg)	0.98	0.96-1.03	0.14				
Diastolic BP (mmHg)	0.98	0.94-1.01	0.17				