Short-Term Effects of Desmopressin on Water and Electrolyte Excretion in Adults With Nocturnal Polyuria

Yu-Lung Chang, Alex T. L. Lin* and Kuang-Kuo Chen

From the Division of Urology, Department of Surgery, Taipei Veterans General Hospital and Department of Urology, National Yang-Ming University, School of Medicine, Taipei, Taiwan

Purpose: Increased calcium excretion due to desmopressin has been reported in children with nocturnal enuresis. Desmopressin is often used to treat adult patients with nocturnal polyuria. However, data on the effect of desmopressin on water/electrolyte excretion in adults are scarce. We present the short-term effects of desmopressin on water and electrolyte excretion in adult patients with nocturnal polyuria.

Materials and Methods: A total of 16 male patients with nocturnal polyuria, mean age 76.3 years, received 0.1 or 0.2 mg desmopressin before sleep. Frequency volume chart was recorded, and daytime and nighttime urine samples were collected separately before and after desmopressin administration. Urinary excretions of sodium, potassium and calcium were determined, and compared before and after treatment with desmopressin.

Results: Desmopressin significantly increased urine osmolality, decreased nocturnal total urine volume, reduced the ratio of nocturnal urine volume-to-whole day urine volume and decreased nocturnal voiding frequency. Nocturnal urinary excretion of calcium (mean 0.137 vs 0.169 mg/kg body weight per hour, $p = 0.004$) and whole day excretion of calcium (mean 165.9 vs 200.0 mg per day, $p = 0.012$) were increased after desmopressin treatment. Nocturnal urinary potassium excretion (mean 0.030 vs 0.025 mEq/kg body weight per hour, $p = 0.030$) and whole day potassium excretion (mean 40.7 vs 36.1 mEq per day, $p = 0.017$) were decreased by desmopressin treatment. However, desmopressin treatment did not significantly change urinary secretion of sodium and chloride at nighttime or for the whole day.

Conclusions: Desmopressin reduces nocturnal urine volume and nocturnal voiding frequency in male patients with nocturnal polyuria. However, increased calcium and decreased potassium excretion following desmopressin treatment deserve attention particularly when it is used on a long-term basis.

Key Words: deamino arginine vasopressin, water-electrolyte balance, polyuria, nocturia

Nocturia significantly affects the elderly in terms of general health, quality of sleep and quality of life.[1] Nocturia is increasingly recognized as a multifactorial condition[2,3] with nocturnal polyuria as the cause in up to 70% of our reported cases.[3] Desmopressin, a synthetic antidiuretic hormone analogue, has been shown to effectively reduce nocturnal frequency secondary to nocturnal polyuria.[4] Desmopressin has also long been used for the treatment of nocturnal enuresis in children.[5] However, a report on treating enuretic children with desmopressin shows increased renal excretion of calcium,[6] demonstrating that desmopressin affects the renal absorption of water as well as other molecules. Data on the effect of desmopressin on water/electrolyte excretion in adult patients with nocturia are limited. We present the short-term effects of desmopressin on water and electrolyte excretion in adult patients with nocturnal polyuria.

MATERIALS AND METHODS

A total of 16 male patients with nocturnal polyuria, mean age 76.3 years (range 61 to 84), were enrolled in the study. All patients did not have a history of cerebral vascular accident, congestive heart failure, chronic renal insufficiency, liver disease with ascites, diabetes mellitus, chronic obstructive pulmonary disease, malignancy of the genitourinary system, polydipsia or psychogenic insomnia. Physical examination showed no edema of lower limbs. Frequency volume chart recording and urine sample collecting were done for at least 3 days before desmopressin treatment. We defined nocturnal polyuria as nighttime urine volume more than 35% of total daily urine amount.[7] The definitions of other parameters are based on the standardization of terminology in nocturia proposed by the International Continence Society.[7] All patients received 0.1 mg desmopressin before sleep initially. If nocturnal urine amount was not reduced the dose was increased to 0.2 mg the next night. The patients continued to record frequency volume chart and collect urine after desmopressin treatment. Serum levels of

Submitted for publication November 16, 2006.
Nothing to disclose.
* Correspondence and requests for reprints: Division of Urology, Department of Surgery, Taipei Veterans General Hospital, No. 201, Sec. 2, Shih-Pai Road, Taipei, Taiwan 11217 (telephone: 886-2-28757519; FAX: 886-2-28757540; e-mail: lintl@vghtpe.gov.tw).

***Editor's Note*: This article is the second of 5 published in this issue for which category 1 CME credits can be earned. Instructions for obtaining credits are given with the questions on pages 2404 and 2405.**

DOI:10.1016/j.juro.2007.01.145

Effects of desmopressin treatment on nocturnal polyuria

	Mean ± SD			
	Before	After	p Value	Normal Range*
Nocturnal voiding frequency (times/night)	6.0 ± 2.5	3.9 ± 2.0	<0.001	
Nocturnal total urine vol (ml)	1,102.4 ± 380.1	607.9 ± 224.1	<0.001	
Nocturnal urine vol (ml/hr)	129.5 ± 45.1	71.8 ± 26.3	<0.001	
Nocturnal urine vol: 24-hr urine vol (%)	51 ± 8	35 ± 11	<0.001	
Nocturnal urine osmolality (mOsmol/kg H_2O)	339.1 ± 92.2	552.4 ± 108.9	<0.001	
Nocturnal urine sodium (mEq/kg body wt/hr)	0.121 ± 0.062	0.108 ± 0.070	0.179	
Nocturnal urine potassium (mEq/kg body wt/hr)	0.030 ± 0.012	0.025 ± 0.010	0.030	
Nocturnal urine chloride (mEq/kg body wt/hr)	0.111 ± 0.055	0.100 ± 0.064	0.088	
Nocturnal urine calcium (mg/kg body wt/hr)	0.137 ± 0.070	0.169 ± 0.080	0.004	
Whole day urine sodium (mEq)	111.3 ± 44.5	101.8 ± 53.7	0.352	60–330
Whole day urine potassium (mEq)	40.7 ± 17.7	36.1 ± 16.7	0.017	37.5–180
Whole day urine chloride (mEq)	107.0 ± 41.3	99.8 ± 45.5	0.234	165–375
Whole day urine calcium (mg)	165.9 ± 86.5	200.0 ± 101.4	0.012	100–250

* Normal range of whole day urinary electrolyte excretion provided by laboratory at our institution.

sodium, potassium and calcium were checked before and after desmopressin treatment. We compared several items before and after desmopressin treatment including daytime and nighttime urine volume per hour, the ratio of nocturnal urine volume-to-whole day urine volume, voiding frequency, urine osmolality, and urine excretion of sodium, potassium, chloride and calcium. Data were analyzed with SPSS® version 11.0 using the Wilcoxon signed rank test with $p < 0.05$ as statistically significantly different.

RESULTS

All patients received desmopressin for a mean of 2.13 days (range 1 to 5). A dose of 0.1 mg desmopressin was effective to reduce nocturnal urine volume in 14 patients while 2 patients needed 0.2 mg. Desmopressin significantly reduced total nocturnal urine volume (1,102.4 ± 380.1 vs 607.9 ± 224.1 ml, $p < 0.001$), nocturnal urine volume per hour (129.5 ± 45.1 vs 71.8 ± 26.3 ml per hour, $p < 0.001$) and the ratio of nocturnal urine volume-to-whole day urine volume (51% ± 8% vs 35% ± 11%, $p < 0.001$) with a decrease in nocturnal voiding frequency (6.0 ± 2.5 vs 3.9 ± 2.0 times per night, $p < 0.001$) (see table). Nocturnal urine osmolality was increased by desmopressin treatment (339.1 ± 92.2 vs 552.4 ± 108.9 mOsmol/kg H_2O, $p < 0.001$). Nocturnal urinary excretion of calcium (0.137 ± 0.070 vs 0.169 ± 0.080 mg/kg body weight per hour, $p = 0.004$) was increased following desmopressin treatment. Whole day excretion of calcium (165.9 ± 86.5 vs 200.0 ± 101.4 mg per day, $p = 0.012$) was also increased by desmopressin treatment. Nocturnal urinary excretion of potassium was significantly decreased (0.030 ± 0.012 vs 0.025 ± 0.010 mEq/kg body weight per hour, $p = 0.030$) following desmopressin treatment. Whole day excretion of potassium was also significantly decreased (40.7 ± 17.7 vs 36.1 ± 16.7 mEq per day, $p = 0.017$) by desmopressin treatment. However, treatment with desmopressin did not significantly change urinary secretion of sodium and chloride at nighttime or for the whole day. The levels of sodium, potassium and calcium in serum were normal before treatment, and were not significantly changed by short-term desmopressin treatment.

DISCUSSION

Nocturnal polyuria could be due to age associated decreased renal concentrating capacity, decreased sodium conserving ability, loss of the circadian rhythm of antidiuretic hormone secretion, decreased secretion of rennin-angiotensin-aldosterone and increased secretion of atrial natriuretic hormone.[1,3,8] A number of studies have shown the effectiveness of desmopressin in reducing nocturnal frequency following the decrease in nocturnal urine volume.[8] The most notable adverse effect of desmopressin in adults with nocturia is hyponatremia, which occurs in 4.9% of patients.[9] Previous studies usually focused on the change in serum sodium whereas the urinary excretion of other electrolytes following desmopressin was rarely explored.

This study shows that in males with nocturnal polyuria, desmopressin increases nocturnal urine osmolality, reduces nocturnal urine volume, and decreases the ratio of nocturnal urine volume with a result of decreasing nocturnal voiding frequency. The onset of oral desmopressin occurs within 15 to 30 minutes[10] and lasts for 6 to 24 hours.[11] In the present study the mean duration of desmopressin treatment was only 2.13 days (range 1 to 5), but the effects of decreasing nocturnal urine volume, nocturnal voiding frequency, ratio of nocturnal urine volume-to-whole day urine volume and increasing urine osmolality were comparable with other studies.[2,12]

In the present study we found that in addition to increasing water reabsorption, desmopressin also had effects on the renal handling of potassium and calcium. However, investigators have found conflicting results on the effect of desmopressin on potassium excretion. One human study revealed that a single dose of desmopressin increased urinary potassium excretion with the most pronounced changes observed in younger individuals.[13] The authors suspect that desmopressin may increase tubular secretion of potassium. However, in another animal study it was found that in pregnant and lactating goats renal potassium excretion decreased in response to desmopressin.[14] In the present study we found that desmopressin decreases urinary potassium excretion in male adults with nocturnal polyuria. It is likely that the renal handling of potassium and the response to desmopressin might be different from normal instances in our elderly patients. Further studies are required to address these unknowns.

Vasopressin may have a role in regulating potassium excretion by modulating ion transporters/channels. The literature has shown that vasopressin increased Na-K-2Cl cotransporter expression in the thick ascending limb of Henle's loop[15] and the abundance of aquaporin 2 in the collecting duct.[16] In addition, desmopressin increased potas-