

PATHOPHYSIOLOGY OF NOCTURNAL POLYURIA: CIRCADIAN RHYTHMS OF RENAL FUNCTIONS

Hypothesis / aims of study

Nocturnal polyuria (NP) is a highly prevalent condition, affecting up to 75% of nocturic patients. It can result in nocturia, which has an important impact on quality of life, morbidity and mortality¹. NP can also lead to overnight dilatation of the bladder in patients with a spinal cord injury (SCI) and a neurogenic bladder, leading to several complications²⁻³. The objective of this study was to evaluate circadian rhythms of renal functions in an adult population.

Study design, materials and methods

A total of 97 adults <60 years were included: 26 cases with a SCI and NP, 30 able bodied controls with NP and 41 without NP. The ICS definition was used to define NP: nocturnal urine production/24h-urine production >33%. All participants performed a 24h-urinecollection (1sample/3h) to determine the voided volumes and the levels of creatinine, osmolality and sodium for each sample. The last 3 samples (12-2am, 3-5am, 6-8am) were considered as nighttime samples in the controls, while the last 4 samples were considered as nighttime samples in the cases. A blood sample was taken during the 24h-urinecollection.

Results

The median age in the 26 cases, 30 controls with NP and 41 controls without NP was respectively 46 [21-59], 51 [21-59] and 42 [18-59] years (table 1). Controls without NP showed a significant circadian rhythm with a lower diuresis rate ($p<0.001$), creatinine clearance ($p<0.05$) and osmotic clearance ($p<0.001$) during the night. They had no significant diurnal variation in free water clearance. In contrast, controls with NP showed a significant increase in nocturnal free water clearance ($p<0.001$). We observed no significant circadian rhythms in renal functions in the cases. However, an episode of high diuresis rate, creatinine clearance and osmotic clearance was observed early in the night (fig 1).

Interpretation of results

The increased nocturnal free water clearance in the controls with NP pleads for a disturbance in vasopressin secretion, which can be treated with desmopressin. NP in patients with a SCI can be explained by an absent circadian rhythm in both free water and osmotic clearance (e.g. sodium clearance). This suggests a role for desmopressin and diuretics in the treatment of NP. The peak in creatinine clearance in the beginning of the night can be the result of a glomerular hyperfiltration episode caused by the increased intravascular volume after lying down. This hypothesis can also explain the peak in osmotic clearance during the night, which can be caused by an increase in atrial natriuretic peptide and a decrease in aldosteron secretion.

Concluding message

Different pathophysiological mechanisms can contribute to the development of NP: disturbances in water diuresis, osmotic diuresis, and glomerular filtration. Consequently, specific treatment is necessary in order to avoid the symptoms and complications of NP.

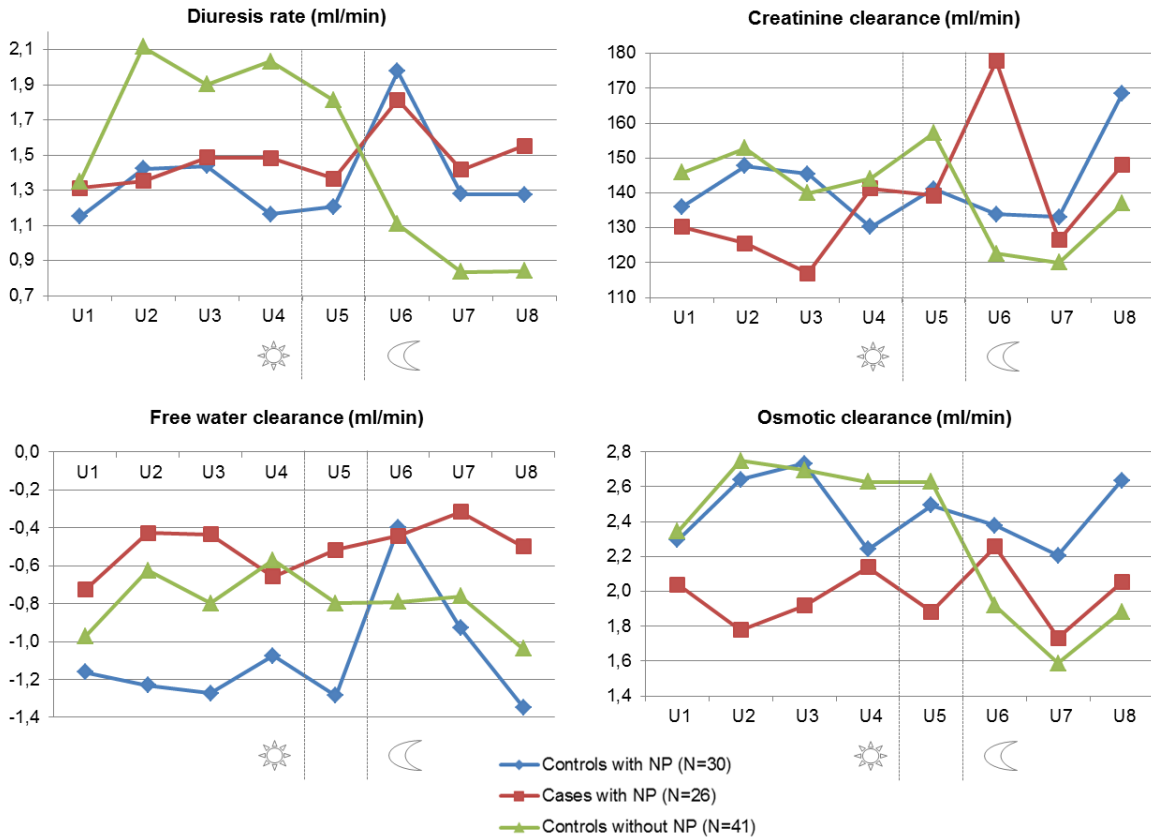
Table 1: Patient characteristics and circadian rhythms of renal functions

	Cases: SCI + NP (n=26)		Controls + NP (n=30)		Controls + no NP (n=41)		Cases vs. controls + NP (P-value)		Cases vs. controls + no NP (P-value)	
	Median [Min-Max]	Median [Min-Max]	Median [Min-Max]	Median [Min-Max]	Median [Min-Max]	Median [Min-Max]	(P-value)	(P-value)	(P-value)	(P-value)
Age (years)	46 [21-59]		51 [21-59]		42 [18-59]		NS		NS	
Gender (male/female)	16/10		17/13		10/31		NS		0,002	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Diuresis rate (ml/min)	1,3 [0,2-4,5]	1,4 [0,4-4,2]	1,2 [0,6-2,7]	1,3* [0,7-3,1]	1,8 [0,7-3,3]	0,8** [0,4-1,9]	NS	NS	NS	<0,001
	1,4 [0,3-4,3]		1,2 [0,6-2,5] ^o		1,4 [0,6-2,7] ^o		NS		NS	
Creatinine clearance (ml/min)	125 [32-276]	124 [56-398]	143 [51-216] ^o	130 [80-264] ^o	147 [70-275] ^o	118* [51-235] ^o	NS	NS	NS	NS
	125 [44-277]		136 [67-241] ^o		139 [71-260] ^o		NS		NS	
Free water clearance (ml/min)	-0,4 [-2,2-1,5]	-0,5 [-2,2-2,6]	-1,2 [-2,3-0,2] ^o	-0,7* [-2,4-1,2] ^o	-0,7 [-3,0-0,9] ^o	-0,8 [-2,6-0,1] ^o	0,002	NS	NS	0,016
	-0,5 [-2,1-2,1]		-1,0 [-2,2-0,6] ^o		-0,7 [-2,7-0,5] ^o		0,004		NS	

Osmotic clearance (ml/min)	1,9 [0,3-3,4]	1,8 [0,5-3,7]	2,4 [1,3-4,0] [°]	2,1 [1,5-4,5] [°]	2,5 [1,2-4,4] [°]	1,7** [0,9-4,0] [°]	0,013	0,036	0,001	NS
	2,0 [0,4-3,0]		2,4 [1,4-4,0] [°]		2,2 [1,1-4,1] [°]		0,010		0,046	

Paired P-test between day and night: *p<0,05; **p = <0,001. °1 missing value. NP = nocturnal polyuria = nocturnal urine production/24h-urineproduction>33%. NS = not significant. SCI = spinal cord injury

Fig 1: Circadian rhythms of renal functions



References

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Disclosures

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