Application of Bladder Diary in the Diagnosis and Treatment of Nocturia

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ABSTRACT

The causes of nocturia include global polyuria, nocturnal polyuria, reduced nighttime functional bladder capacity, and mixed type. Bladder diary provides important information about the frequency of urination, urine output, and maximal voided volume. Several valuable indexes can be calculated from the bladder diary. Careful interpretation of bladder diary can help clinicians find possible etiologies of nocturia between different individuals. Since the bladder diary is an invaluable first-line screening tool for the diagnosis of nocturia, treatment can be directly toward the underlying etiology. Accurate records can help physicians understand and analyze bladder diary.

Key word: bladder diary, nocturia, enuresis

INTRODUCTION

Nocturia is the most prevalent lower urinary tract symptom affecting both men and women in the general community [1]. According to the definition of the International Continence Society, an individual who wakes up at night to void one or more times is considered to have nocturia [2]. In addition, most people report that voiding more than two times per night is associated with impaired quality of life [3]. The prevalence of nocturia increases with age [4]. In younger men, the prevalence of one or more voids is 11% to 35.2%, and two or more voids is 2% to 16.6%. In younger women the prevalence is 20.4% to 43.9%, and 4.4% to 18%, respectively. In older men, the rates are 68.9% to 93%, and 29% to 59.3%, and in older women, 74.1% to 77.1%, and 28.3% to 61.5%, respectively [4]. Nocturia is the most bothersome lower urinary symptom and the most difficult symptom to improve with surgical or medical intervention [5-7]. Nocturia not only interrupts sleep but also negatively impacts health and quality of life [8]. In fact, nocturia has been associated with a higher mortality rate in elderly people with this symptom than in those without. The etiologies of nocturia include global polyuria, nocturnal polyuria, reduced nighttime bladder capacity or mixed type [9]. Through the bladder diary, one can get clues about the differential diagnosis of nocturia, which helps in further management. When comparing frequency volume chart with questionnaire [10] in one study, overestimation of nocturia episodes was more common than underestimation, especially in patients older than 60 years. Poor agreement between subjectively estimated and chart-determined nocturnal frequency was revealed [10]. Therefore, bladder diary should be included as an integral part of evaluating nocturia in both sexes. In addition to nighttime voiding frequency, bladder diary provides parameters, as listed below, which are of paramount importance in the differential diagnosis of nocturnal polyuria and reduced bladder capacity.

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Parameters generated from bladder diary [9]

A. 24-hour urine volume = the urine production in 24 hours, which reflexes the hydration status of the patient.
B. Maximal voided volume (MVV) = the maximal voided volume in the bladder diary which usually indicates the functional bladder capacity.
C. Nocturnal polyuria index (NPi) = nocturnal urine output/24-hour urine volume, which indicates the ratio of urine production during the nighttime.
D. Nocturia index (Ni) = nocturnal urine volume (NUV) divided by maximal bladder capacity. If Ni >1, nocturia may occur.
E. Predicted nightly void (PNV) = Ni-1.
F. Nocturnal bladder capacity index (NBCi) = actual number of nighttime voids-predicted nighttime voids. A NBCi >0 indicates a reduced nighttime bladder capacity. However, an NBCi >2 is reported to be associated with significant nocturia.

GLOBAL POLYURIA

Global polyuria is frequently observed in the clinic. When interpretating a bladder diary, one should first take a glance at the total daily urine output, daytime voiding frequency, nighttime voiding frequency and MVV. Global polyuria can be defined as >2.8 L/day [11] or 40 mL/kg of body weight/day [12]. In patients with global polyuria, the record of fluid intake can show that the patient's fluid intake is too high (Fig. 1, 2). However, some patients may deny overdrinking. One should ask the patient if the fluid intake record includes soup or other beverages and ask the patient to record fluid intake for another two days. The cause of global polyuria could be diabetes mellitus, diabetes insipidus, hypercalcemia, and thirst disorder [9]. Managing blood sugar should be the first line therapy for patients with diabetes mellitus. For pateints suspected of having diabetes insipidus, an overnight water deprivation test can be performed. Failure to concentrate urine after water deprivation could confirm a diagnoses of diabetes insipitus. Thereafter, desmopressin, a synthetic antidiuretic hormone, can be prescribed in patients with central diabetes insipidus. However, patients with nephrogenic diabetes insipidus should have regulation of fluid intake. In patient with polydipsia, the etiology, although uncommon, could be dipsogenic (trauma or radiation induced brain dysfunction) or more commonly, psychogenic (compulsive fluid intake) [9].

NOCTURNAL POLYURIA

Nocturnal polyuria means urine overproduction during sleep hours. There is a consensus that a NPi >1/3 or 0.35 can be defined as nocturnal polyuria. Primary nocturnal polyuria means NPi >1/3 or 0.35 in cases without global polyuria (Fig. 3). The NUV should include the first morning micturition. The etiologies of nocturnal polyuria include psychological polydipsia, diabetes mellitus, diabetes insipidus, congestive

第 1 天					第 2 天				
日　　期	3 月 19 日	起床時間			日　　期	3 月 20 日	起床時間		
時間	喝水量	尿量	急尿感	漏尿感	時間	喝水量	尿量	急尿感	漏尿感
06:00		220			07:30		230	V	
07:00	500				07:50	500			
08:30		280	V		10:00	300			
10:00	250				10:15		200		
12:00	500				12:20		250		
12:10		200			14:30		220		
14:00		200			16:10		300	V	
14:20		380			16:20	300			
14:30	500				17:00		210	V	
17:30		280	V		18:00	30	200		
17:35	300				21:35		340		
19:20		230			22:15		150		
21:10	30	320	V						
22:30	30	280							
就寢時間	22:40				就寢時間	22:40			
01:10		310			01:25		350	V	
02:40		300	V		03:15		300	V	
05:00		380	V		06:00		350	V	
05:50		210	V		07:35		220	V	
06:00		220							
總　　計	2110	3810			總　　計	1130	3320		

Fig. 1. The frequency of urination in the daytime and nighttime was 9 +5 and 9 + 4. Urgency occurred 6 and 7 times per day. The nocturnal/ total urine output was 1420/3810 and 1220/3320. The maximal voided volume (MVV) for the daytime/ nighttime was 380/380.

第 1 天					第 2 天				
日　　期		起床時間			日　　期		起床時間		
時間	喝水量	尿量	急尿感	漏尿感	時間	喝水量	尿量	急尿感	漏尿感
07:30	250	340			08:50		240		
09:00		250			09:00	250			
09:30	250				09:30	250			
10:00	250				13:00	250			
10:10	100				13:00	200			
11:30		130			16:00		300		
13:30		200			17:40		270		
14:00	250				18:40				
17:00	200				19:00		210		
18:30		190			21:00		180		
22:20		100							
就寢時間					就寢時間				
06:00		270	眠		23:15		300	眠	
					01:00		300	眠	
					06:40	250	380	眠	
總　　計	1300	1480			總　　計	1200	2190		
睡眠時間 270 佔 18%					睡眠時間 980 佔 45%				

Fig. 2. The frequency of urination in the daytime + nighttime was 6 + 1 and 5 + 3. The nocturnal/ total urine output was 270/1480 and 980/2180. The maximal voided volume (MVV) for the daytime/ nighttime was 340/380.

第 1 天					第 2 天				
日　　期	3 月 27 日	起床時間			日　　期	3 月 28 日	起床時間		
時間	喝水量	尿量	急尿感	漏尿感	時間	喝水量	尿量	急尿感	漏尿感
08:00		120			08:00		20		
09:00	120				09:00	100			
09:10		40			09:30		60		
10:00	120				10:30	100			
11:50		210			12:00		100		
13:00	100				12:30	120			
13:30		120			13:30		120		
15:25		125			14:10		170		
17:10		100			14:50		200		
18:00		100			15:15		40		
18:35		45			16:00		110		
18:45	120				16:50		50		
20:20	70				18:40	100			
20:25		50			19:00		50		
21:05		90			20:40	100			
					21:40	200			
					22:00		50		
就寢時間					就寢時間				
23:00		330			02:30		390		
03:25		325			07:40		200		
06:40		260							
總　　計	530	1915			總　　計	720	1560		

Fig. 3. The frequency of urination in the daytime + nighttime was 10 + 3 and 11 + 2. The nocturnal/ total urine output was 915/1915 and 590/1560. The maximal voided volume (MVV) for the daytime/ nighttime was 210/390.

第 1 天					第 2 天				
日　　期	4 月 7 日	起床時間			日　　期	4 月 8 日	起床時間		
時間	喝水量	尿量	急尿感	漏尿感	時間	喝水量	尿量	急尿感	漏尿感
06:40		200			06:20		120		
08:00	250				07:30	250			
08:20		120			08:10		100		
10:30		100			11:20		50		
11:00	200				12:00	300			
12:10		120			12:20		150		
12:20	250				15:00	100			
13:30		200			17:10		80		
16:20	200				18:30	150			
16:30		150			19:00	100			
17:30		50			20:00		200		
19:00	200				20:30		100		
19:10		200			20:40	200			
20:30	250				22:10		120		
22:30	100	50			23:00	120			
就寢時間					就寢時間				
24:00		50			01:00		70		
03:00		100			03:50		100		
06:20		120			07:00				
總　　計	1450	1460			總　　計	1220	1090		

Fig. 4. The frequency of urination in the daytime + nighttime was 9 + 3 and 8 + 2. The nocturnal/ total urine output was 270/1460 and 170/1090. The maximal voided volume (MVV) for the daytime/ nighttime was 200/120.

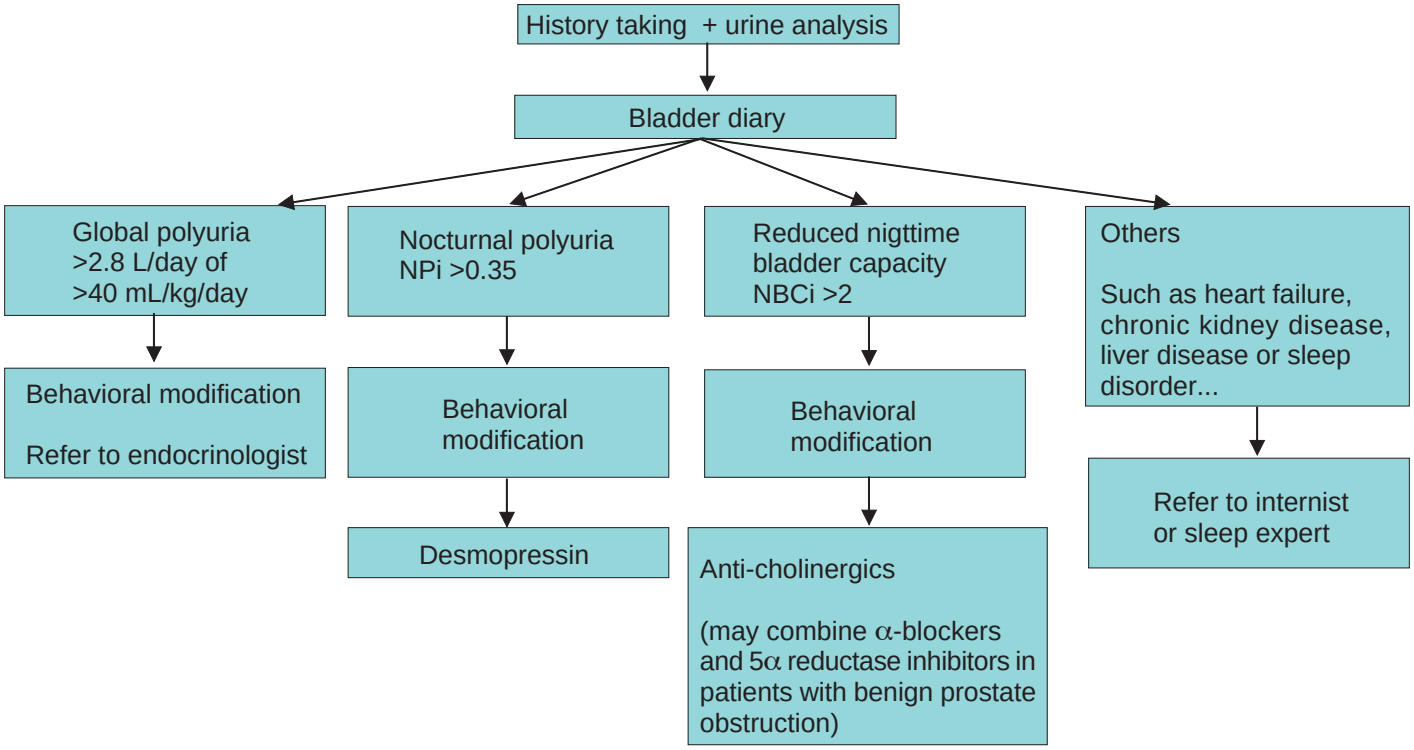

Fig. 5. The algorithm for diagnosis of the underlying pathophysiology of nocturia and related treatments. (modified from the algorithm proposed by Van Kerrebroeck) [8]

heart failure, sleep apnea, and peripheral edema [9]. Using bioelectric impedance analysis, a study of patients with nocturnal polyuria [13] found overproduction of urine per fat-free mass leads to nocturnal polyuria. Extracellular fluid accumulating as edema in the legs during the day may occur in patients with nocturnal polyuria. Research had also shown that deficient production of arginine vasopressin (antidiuretic hormone) [14] in elderly people is due to redistribution of extracellular fluid into the circulation. In addition, a number of medical conditions can inhibit the antidiuretic effect of arginine vasopressin, including stroke, hypercalcemia, hypokalemia, and use of lithium and tetracycline [9]. Therefore, a thorough history is important. Another special cause of nocturnal polyuria is sleep apnea which is cessation of respiration during sleep due to airway obstruction [15]. The mechanism of sleep apnea- induced nocturnal polyuria may be increased airway resistance and pulmonary artery constriction, resulting in increased right atrial pressure [15]. As the pressure increases in the right atrium, atrial natriuretic peptide (diuretic hormone) increases and diuresis occurs.

REDUCED BLADDER CAPACITY

There is no clear definition of reduced bladder capacity. In adults, a MVV <250 mL can be considered reduced bladder capacity (Fig. 4). The median voided volume or the frequently voided volume can have higher clinical significance. The daytime and nighttime MVV can be quite different and some patients may have reduced bladder capacity only at night. Nocturia may occur because of decreased MVV or decreased nighttime bladder capacity [16]. The possible causes of reduced bladder capacity are idiopathic detrusor overactivity, benign prostatic obstruction, hypersensitivity of the bladder, anxiety, certain pharmacological agents and urolithiasis [16].

TREATMENT ALGORITHM

Based on the results of the bladder diary, specific treatment can be initiated. Examples include behavioral modification for polydipsia, antimuscarinics for reduced bladder capacity, and antidiuretic hormone for nocturnal polyuria (Fig. 5). Desmopressin is more effective in patients with nocturnal polyuria [8,17]. In patients over 65 years old, desmopressin should be used with caution since water intoxication may occur, although it is rare [8]. Antimuscarinics are more effective in patients with a reduced bladder capacity(i.e. NBCi >2) [18]. In patients with benign prostatic obstruction, alpha-blockers may be prescribed. A combination of alpha-blockers and 5-alpha reductase inhibitors can prevent progression of benign prostatic obstruction. In patients with mixed type nocturia, combination therapy with both desmopressin and nocturia may help, but needs further study to prove the efficacy [8].

CONCLUSION

Nocturia increases with age and is bothersome in the community dwelling population. It also has a negative impact on health and quality of life. Because of multiple factors in the etiology of nocturia, bladder diary is crucial in the differential diagnosis and treatment.

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