The Impact of Nocturia on Health Status and Quality of Life in Patients with Lower Urinary Tract Symptoms Suggestive of Benign Prostatic Hyperplasia (LUTS/BPH)

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Abstract

Nocturia (nocturnal voiding) is a common condition in the older population and its prevalence increases with age. Although the aetiology of nocturia may be multifactorial, a main cause in older men is benign prostatic hyperplasia/bladder outlet obstruction (BPH/BOO). Nocturia is experienced as one of the most bothersome symptoms of lower urinary tract symptoms (LUTS) suggestive of BPH/BOO by the patient and interferes considerably with the patient’s ability to perform daily activities and hence his quality of life (QoL). Nocturnal micturition in particular is associated with a considerable morbidity resulting from sleep disruption.

Contrary to earlier beliefs, recent studies indicate that lack of sleep may seriously impair health. Poor sleep is associated with daytime fatigue, decreased cognitive performance, loss of energy/vitality, depression, and increased susceptibility to disease. Not only the patient but also his spouse may suffer sleep disruption and associated morbidity. In nocturics with an active professional and social life impaired sleep leads to a decline in work performance, decreased levels of activity and increased rates of sick leave. In addition, waking up at night and finding one’s way to the bathroom for voiding represents an important risk factor for falls and fractures in the older population. Falls in the elderly contribute to a declined functional performance and the loss of independence. Nocturia is also a predisposing factor for nursing home admission and has been associated with increased mortality.

Current initial treatment for the relief of LUTS/BPH symptoms including nocturia consists mainly of $\alpha_1$-adrenoceptor (AR) antagonists, 5\textalpha-reductase inhibitors, or a combination of both. Although these agents relieve urinary symptoms, few studies have specifically addressed their impact on nocturia. However, it is well known that orthostatic hypotension, an adverse effect of the less selective $\alpha_1$-AR antagonists, contributes to imbalance. As such, the risk for falls and fractures may increase in LUTS/BPH patients who have to get up at night to void. Hence, LUTS/BPH treatment should aim to interfere as minimally as possible with blood pressure regulation.

Keywords: Review; Nocturia; Quality of life; Sleep disturbance; Partner morbidity; Falls and fractures; Loss of energy; Mortality

1. Introduction

Lower urinary tract symptoms (LUTS) and, more specifically, lower urinary tract symptoms suggestive of benign prostatic hyperplasia (LUTS/BPH) are a common condition in older men [1]. Despite the high prevalence of LUTS, the pathophysiology of the disorder is not completely understood [2]. Apparently, anatomical and physiological alterations in the aging lower urinary tract play a role [3,4]. LUTS/BPH probably also involves some deregulation of kidney function. The disease interferes strongly with daily activities as many patients avoid travelling long
distances, stay home, don’t go to places without immediate access to a toilet or restrict their fluid intake [5]. Therefore, LUTS/BPH has a considerably negative impact on the patient’s quality of life (QoL).

LUTS/BPH can be divided into either storage or voiding symptoms. According to the International Continence Society (ICS), voiding symptoms, in the past referred to as “obstructive” symptoms, are experienced during the voiding phase of the micturition cycle and include slow stream, intermittent stream, hesitancy, straining and terminal dribble [6]. Storage symptoms, previously referred to as “irritative/filling” symptoms, occur during the storage phase of the micturition cycle and include increased daytime frequency, nocturia, urgency and urinary incontinence [6]. Patients generally rate their storage symptoms as the most bothersome, although voiding symptoms are more prevalent (Fig. 1) [7–9]. Indeed, storage symptoms interfere more with daily activities, and hence may have the greatest negative impact on the patient’s QoL in LUTS/BPH patients [5]. The need for nocturnal micturition in particular is generally considered as one of the most bothersome symptoms associated with LUTS [10–13].

Although nocturia is associated with LUTS/BPH, it seems that BPH/decreased bladder capacity is not the only cause of nocturia. Rather, its aetiology is multifactorial. Indeed, polyuria at night, sleep apnoea and somatic disease can also induce nocturia [14,15]. Iatrogenic factors such as the use of diuretics for hypertension may also contribute to nocturia. Hence, nocturia is increasingly recognised as a urinary disorder in its own, rather than just a symptom of an underlying disease [16].

In this paper we review recent literature data on the prevalence, aetiology and bothersomeness of nocturia related to LUTS/BPH, in particular its detrimental effect on sleep quality and hence the QoL of the patient (and his partner).

2. Prevalence and pathophysiology of adult male nocturia

Nocturia is a common urological symptom in older men. Prevalence estimates differ between studies because of various definitions used and age groups surveyed (Table 1). The ICS has defined nocturia as the complaint that the individual has to wake at night one or more times to void [6]. However, the most widely employed research definition of nocturia is “voiding at least twice per night” [17]. Based on this definition, prevalence rates of nocturia in the adult male population are estimated to be around 9%–14% [17–20]. The occurrence as well as the severity of nocturia increases linearly with age in the higher age groups [18,21–25] (Table 1, Fig. 2). When nocturia is defined as waking to urinate at least once per night, it appears that 30% of men 45 years old and 79% of men 80 years old report this symptom [26,27].

The most commonly cited pathophysiological causes for nocturia in the elderly comprise (1) overproduction of urine (polyuria), (2) the nocturnal overproduction of urine (nocturnal polyuria), (3) a low nocturnal bladder capacity and (4) a combination of these (mixed nocturia) [28,29,32]. Diabetes is the most common cause of polyuria. An increased night time urine production can be attributed to the age-specific
decrease in nocturnal vasopressine production [33]. In the aging person the 24-hour total amount of urine production often remains normal or is only slightly increased but the circadian diuresis rhythm changes, leading to increased nocturnal output, i.e. nocturnal polyuria. Whereas at the age of 30 years, the daytime urine output is twice as high as during the night, in elderly people equal amounts are produced during the day and night or much higher volumes may excreted at night than during daytime [30,31]. This may be caused by a wide array of factors such as congestive heart failure, stroke, sleep apnoea, renal disease, oestrogen deficiency or multiple sclerosis [32–34]. Behavioural factors such as the intake of alcohol, caffeine or excessive amounts of fluids shortly before bedtime also contribute to nocturnal polyuria.

The other main cause of nocturia, a low nocturnal bladder capacity, may be due to a reduced structural or functional bladder capacity (i.e. the single largest volume voided) [35]. A decrease of structural bladder capacity can be due to fibrosis, carcinoma or previous radiation therapy. LUTS/BPH often results in a reduced functional bladder capacity because of bladder outlet obstruction induced detrusor overactivity/ involuntary detrusor contractions, or high post-void residuals (PVR) [35]. This may manifest as several episodes of nocturia, with small volumes of urine that are passed [35].

3. Morbidity associated with nocturia

3.1. Health-related consequences of impaired sleep

Regardless of the underlying cause, nocturnal voiding is associated with sleep disorders such as insomnia and fragmented sleep [36]. Nocturia is even reported to be one of the most important causes of impaired sleep in older men [36,37]. Significantly less elderly people with nocturia claim to sleep well, compared to those without nocturnal micturition [36]. Impairment of sleep also increases with incremental increases in the number of voids/night [24]. Moreover, a treatment that reduces nocturia has been shown to improve sleep quality, confirming a cause and effect relationship between nocturia and poor sleep [31].

Sleep plays an important role in the physical and mental well-being and is necessary for restitution and rehabilitation, energy conservation/vitality and cognitive processing [28]. Poor sleep is associated with daytime sleepiness/tiredness, cognitive dysfunction resulting in poor concentration, mood changes and reduced performance, an increased risk of serious complications such as falls and fractures and even increased mortality [28,31] (Table 2). Sleep quality tends to deteriorate in the aging person [28]. However, aging itself is not synonymous with sleep complaints; for example, the prevalence of insomnia is lower in older patients with less comorbidities [38]. Hence, it is of utmost importance to relieve any other factor that might contribute further to poor sleep in the elderly.

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**Table 1**

Prevalence of nocturia across studies

<table>
<thead>
<tr>
<th>AG</th>
<th>N</th>
<th>&lt;30</th>
<th>18–34</th>
<th>30–59</th>
<th>35–54</th>
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<th>50–59</th>
<th>55–74</th>
<th>60–69</th>
<th>≥60</th>
<th>70–79</th>
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<th>≥80</th>
<th>80–84</th>
<th>Overall</th>
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<tbody>
<tr>
<td>Van Dijk et al. [17]</td>
<td>1,271</td>
<td>2</td>
<td>–</td>
<td>5</td>
<td>–</td>
<td>–</td>
<td>22</td>
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<td>–</td>
<td>–</td>
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</tr>
<tr>
<td>Fourcade et al. [18]</td>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>6.5</td>
<td>–</td>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>13.8</td>
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<tr>
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<td>1,221</td>
<td>3.4</td>
<td>–</td>
<td>5.7</td>
<td>–</td>
<td>–</td>
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<td>–</td>
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<td>–</td>
<td>–</td>
<td>10.8</td>
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<tr>
<td>McGrother et al. [20]</td>
<td>42,939</td>
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<td>4.3</td>
<td>–</td>
<td>8.3</td>
<td>–</td>
<td>16.8</td>
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<td>–</td>
<td>25.2</td>
<td>–</td>
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<td>–</td>
<td>28.5</td>
<td>–</td>
</tr>
<tr>
<td>Yoshimura et al. [21]</td>
<td>4,568</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>16.6</td>
<td>25.9</td>
<td>–</td>
<td>42.4</td>
<td>–</td>
<td>–</td>
<td>59.2</td>
<td>–</td>
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<tr>
<td>Chute et al. [22]</td>
<td>2,119</td>
<td>–</td>
<td>–</td>
<td>16</td>
<td>–</td>
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<td>–</td>
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<tr>
<td>Homma et al. [23]</td>
<td>168</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>5</td>
<td>–</td>
<td>13</td>
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<td>59</td>
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<td>–</td>
<td>–</td>
<td>62</td>
<td>Ref</td>
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</tbody>
</table>

Ref: reference; AG: age group.

* Voiding at least twice per night.

b Two voids per night.

c More than one void per night.

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Fig. 2. Prevalence and severity of adult male nocturia in the age groups 40–80 years vs. no nocturnal voiding [18].
Increased mortality
Increased risk of nursing home admission
Increased risk of falls and related fractures
Decreased physical functioning, increased risk of mood alterations and depression
Reduced creativity, activity, job performance
Memory impairment, and reduced concentration, fatigue

Fig. 3. Relationship between number of nocturnal voids and daytime voiding may have differences without nocturia against only one quarter of those who had to void at least three times a night reported [40]. Insomnia in older men is also a strong predictor for their nursing home placement [50]. A mutual link between insomnia and depression has been observed. Depression leads to poor sleep, while sleep disturbance constitutes a risk factor for depression; improvement of the sleep quality in depressed persons is often closely related to global improvement in depression [51,52]. An optimal management of sleep disorders may thus be instrumental in the prevention and treatment of depression [51,52]. Considering the relationship that also exists between nocturia and poor sleep, Asplund et al. assessed if any correlation between nocturia and poor sleep. They reported a significant association between major depression and nocturia, with the relationship becoming stronger in the men with more voids per night [53].

3.1.3. Effects of sleep disruption on physical health: increased risk for somatic disease and higher mortality rates

Recent evidence suggests that the sleep-wake cycle is of importance in the homeostatic regulation of the autonomic, neuroendocrine and immune system [54]. Spiegel et al. observed metabolic and endocrine alterations in sleep-deprived healthy volunteers that were similar to those seen in normal ageing [55]. Hence, it was suggested that chronic sleep loss may increase the severity of age-related pathologies such as diabetes and hypertension [55]. Sleep plays also a role in the regulation of the immune system [54,56]. Poor sleep quality and lack of sleep have been shown to have an immunosuppressive effect [57,58]. Loss of sleep has also been implicated in the onset of cardiovascular disease [56]. Nocturnal awakenings may constitute a risk factor for myocardial ischemia [59]. Evidence has been found that the inflammatory processes involved in

Table 2
Detrimental effects of sleep deprivation

<table>
<thead>
<tr>
<th>Impact of sleep disturbance</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daytime sleepiness and fatigue (also of partner)</td>
<td>[36,40–44,48,76]</td>
</tr>
<tr>
<td>Memory impairment, and reduced concentration, co-ordination and ability for problem solving</td>
<td>[38,48,49]</td>
</tr>
<tr>
<td>Reduced creativity, activity, job performance</td>
<td>[48,69,76]</td>
</tr>
<tr>
<td>Mood alterations and depression</td>
<td>[38,51,52]</td>
</tr>
<tr>
<td>Decreased physical functioning, increased risk of somatic diseases, immunosuppression</td>
<td>[54–56,58,77]</td>
</tr>
<tr>
<td>Increased risk of falls and related fractures</td>
<td>[38]</td>
</tr>
<tr>
<td>Increased risk of nursing home admission</td>
<td>[44,50]</td>
</tr>
<tr>
<td>Increased mortality</td>
<td>[50,77,78]</td>
</tr>
</tbody>
</table>

3.1.1. Daytime sleepiness/fatigue in nocturic men and their partners

Sleep disturbance due to nocturnal voiding often leads to increased daytime fatigue [36,39]. The number of nocturnal voidings is positively correlated with the degree of daytime fatigue [36] (Fig. 3). Apparently, waking up three or more times a night for voiding causes a sharp increase in the level of sleep disturbance [40]. Indeed, in one study more than half of the men who had to void at least three times a night reported daytime fatigue, against only one quarter of those without nocturia [36]. Patients waking at night for voiding may have difficulties to return to sleep and can be unable to fall asleep again for a long while (often more than half an hour) [36].

Besides inducing daytime fatigue and a general negative effect on the patient’s well-being, most partners of nocturics suffer at least some morbidity as a consequence of the patient’s urinary symptoms [41,42]. Their most common complaint is sleep disturbance due to the partner’s nocturnal voiding habits [42,43]. In one study, nearly half reported to be tired during daytime because of the nocturnal awakenings when their partner had to void (Fig. 4). This data suggests that the sleep fragmentation and its associated morbidity due to nocturia may be almost equally severe in the partner as in the patient. Moreover, sleep disruption of care givers caused by the patient’s nocturia is one of the most important reasons for the institutionalisation of elderly people [44].

3.1.2. Effects of sleep disruption on mental health status: decline in cognitive functioning and increased risk for depression

Sleep fragmentation may result in decreased cognitive performance, which is reflected by a decreased mental flexibility/health and attention, a decreased performance at work, memory impairment and depressed mood [45–48]. Lack of sleep has even been known to induce a dementia-like condition which is reversible upon regaining a normal sleep pattern [49].

Fig. 3. Relationship between number of nocturnal voids and daytime fatigue [36].
3.1.4. Increased risk of serious complications and mortality

Nocturia is considered as an independent risk factor for falls in the elderly, probably due to insufficient light and incomplete awakening [61,62]. A two-fold increase in falls is reported for the elderly getting up twice or more at night for voiding [61]. The daytime fatigue and sleepiness induced by the fragmented sleep may contribute to an impaired perception and balance which may be further compromised by orthostatic hypotension when standing up, especially in elderly people with cardiovascular disease.

People aged over 65 suffer an increased incidence rate of falls with 30% of community-dwelling people over 65 falling at least once a year [63]. This increases to 50% by the age of 80 [64]. Over two thirds of falls in the elderly result in some degree of physical injury, with about a quarter of the fallers needing health services [63]. Short-term as well as long-term survival is impaired in people suffering falls [65]. Indeed, falls are the leading cause of death from injuries in the older age groups [66]. Even if not lethal, falls may contribute to permanent disability and to nursing home admissions [64]. Stel et al. reported that more than one third of fallers reported a decline in functional status, while 17% and 15% experienced a decline in social, respectively physical activities as a direct consequence of the fall [63]. Even those who did not suffer major injury through falling might severely curtail their activities for fear of falling [66]. Hence, taking into account the increased risk for disability, along with the huge financial costs of hospital stays, care should be taken to avoid additional risk factors in a population that is already at augmented risk for falls and fractures.

Finally, it has been demonstrated that voiding at least three times per night is associated with excess mortality rates compared to less nocturnal voidings [67].

4. Impact of nocturia and associated sleep disruption on the patient’s QoL

Considering the negative impact of nocturia on the patients’ mental and physical health status due to decreased sleep quality, it is very likely that nocturia may severely impair their QoL [17,24]. About two thirds of the men with at least two voids per night claimed that their nocturia had a negative impact on their QoL [9,19]. Increased severity of nocturia is positively correlated with a higher level of impairment...
of QoL [19] (Fig. 5). An increased frequency of nocturnal voids also correlates negatively with good sleep and feeling in good health [14,68]. The sleep deprivation associated with nocturnal voiding induces a decreased vitality and activity in otherwise healthy people with an active professional and social life and leads to an impaired productivity at work [69]. People with nocturia are more likely to frequently consult a physician and show increased rates of sick leave [40] (Fig. 6). Women with three nocturnal micturitions were also treated 2.5 times as often with drugs than women with less nocturnal voidings [40].

5. Impact of LUTS/BPH treatment on nocturia

Despite the negative impact of nocturia on QoL, surprisingly many LUTS/BPH patients do not seek treatment for their nocturia and instead adapt their lifestyle and daily activities [5]. For example, in an attempt to avoid nocturnal micturition many patients restrict their daytime fluid intake, which may lead to increased thirst, especially at night [36]. Besides being ineffective, this carries the risk for dehydration [31]. A similar lack of help seeking behaviour has been described in other urological disorders such as urinary incontinence [70]. It may reflect embarrassment or the belief that nocturnal voiding is a normal consequence of aging [18].

Those seeking help for their urinary problems are usually initially prescribed α1-adrenoceptor (AR) antagonists, 5α-reductase inhibitors or a combination of these. Although their effect on relief of LUTS/BPH symptoms as measured by symptom scoring systems such as the International Prostate Symptom Score (I-PSS) has been very well studied, less information is available on how these therapies affect nocturia [71]. It has been shown that terazosin reduced nocturia, and to a greater extent than finasteride [71]. However, it should be noted that α1-AR antagonists such as terazosin also block α1-ARs in the blood vessels. Hence, they interfere with blood pressure regulation and have a greater potential to induce orthostatic hypotension and associated symptoms of dizziness than for instance the more selective α1-AR antagonist tamsulosin modified release capsules [72,73]. However, it is clear that there is an urgent need for studies which more specifically address the effect of LUTS/BPH treatment on nocturia, potential improvement in the hours of undisturbed sleep and sleep-related QoL [74].

Until recently, no specific instrument was available for objectively measuring the impact of nocturia on the patient’s QoL [75]. Nocturia has been included in various QoL questionnaires as one of the symptoms of LUTS/BPH, but the impact of nocturia alone on the patient’s QoL has rarely been assessed [74,75]. This has changed with the recent development of the Nocturia Quality-of-Life questionnaire (N-QOL) [74]. The N-QOL measurement tool consists of 13 items including queries about productivity, level of activity impairment, energy, fatigue and worry. The N-QOL overall score and subscores are able to discriminate between men experiencing one, two or three or more episodes of nocturia. It has been proven to be internally consistent and reproducible [74]. Hence, the N-QOL may offer a useful tool for an adequate assessment of the perceived effect of nocturia on life quality and hence optimise treatment.

6. Conclusions

Nocturia is a highly prevalent disorder in elderly men and can lead to more serious health complications than previously thought. Impaired sleep quality associated with nocturnal micturitions may lead to daytime fatigue, a decline in cognitive performance, enhanced susceptibility for disease and depression. Hence, nocturia may lead to a severely decreased QoL for the patient as well as his partner. Waking up at night for voiding is also associated with a highly increased risk for falls and fractures in the elderly. Men with severe nocturia (≥3 voids per night) suffer even increased mortality rates. Nocturia is also an important reason for the institutionalisation of older people.

Although the origin of nocturia may be multifactorial, BPH plays an important role in its aetiology. LUTS/BPH patients perceive nocturia as one of the most bothersome consequences of LUTS/BPH and hence impaired QoL. Consequently, an adequate treatment of
LUTS/BPH which alleviates these bothersome symptoms is warranted. Indeed, improvements in sleep quality through the relief of nocturia are likely to contribute to a better overall QoL for the patient and his partner. In addition, a reduced incidence of the falls and fractures associated with nocturnal voiding may avoid temporary or permanent disability. The recent development of the N-QOL, a tool for assessing the impact of nocturia on the patient’s QoL, may allow including the patient’s perception of his condition and optimise the treatment of nocturia accordingly. In addition, future research in the treatment of patients with LUTS/BPH should not only address whether the treatment reduces the nocturia but also whether this is associated with an increase in the hours of undisturbed sleep.

References


Roth T, Roehrs T. Insomnia: epidemiology, characteristics and con-


Pollak CP, Perlick D. Sleep problems and institutionalization of the


Van Dijk L, Kooij DG, Schellevis FG, Kapteijn AA, Boon TA, Wooning M. Nocturia: impact on quality of life in a Dutch adult


Roth T, Roehrs T. Insomnia: epidemiology, characteristics and con-


effects of sleep loss and fatigue on resident-physicians: a multi-


Kelly J, Feigenbaum LZ. Another cause of reversible dementia: sleep


Pollak CP, Perlick D, Linsner JP, Wenston J, Hsieh F. Sleep problems in the community elderly as predictors of death and nursing home


Jindal RD, Thase ME. Treatment of insomnia associated with clinical

Buysse DJ. Insomnia, depression and aging. Geriatrics 2004;59:

47–52.

Asplund R, Henriksen S, Johannson S, Isaacsson G. Nocturia and

Redwine L, Hauger RL, Gillin C, Irwin M. Effects of sleep and sleep
deprivation on interleukin-6, growth hormone, cortisol and melanotin


Spiegel K, Leproult R, Van Cauter E. Impact of sleep debt on


Irwin M, Thomspn J, Miller C, Gillin C, Ziegler M. Effects of sleep and sleep deprivation on catecholamine and interleukin-2 levels in

humans: clinical implications. J Clin Endocrinol Metab 1999;84:

1979–85.

Irwin M, McClintick J, Costlow C, Fortner M, White J, Gillin JC.

Partial night sleep deprivation reduces natural killer and cellular


Barry J, Campbell S, Yeung AC, Raby KE, Selwyn AP. Waking and


Meier-Ewert HK, Ridker PM, Rifai N, Regan MM, Price NJ, Dinges

DF, et al. Effect of sleep loss on C-reactive protein, an inflammatory


Stewart RE, Moore MT, May FE, Marks RG, Hale WE. Nocturia: a


Brown JS, Vittinghoff E, Wyman JF, Stone KL, Nevitt MC, Ensrud

KE, et al. Urinary incontinence: does it increase risk for falls and

fractures? Study of Osteoporotic Fractures Research Group J Am


Stel V, Smit JH, Pluijim SMF, Lips P. Consequences of falling in older

men and women and risk factors for health services use and functional

Timetti ME, Williams CS. Falls, injuries due to falls, and the risk of


Nurmi IS, Lüthje PMJ, Kataja JM. Long-term survival after falls among the elderly in institutional care. Arch Geront Geriatr 2004;

38:1–10.

Binder S. Injuries among older adults: the challenge of optimizing

safety and minimizing unintended consequences. Inj Prev 2002;


Asplund R. Mortality in the elderly in relation to nocturnal micturition.

BJU Int 1999;84:297–301.

Rembracht A, Norgaard JP, Andersson KE. Nocturia and associated

morbidities in a community-dwelling elderly population. BJU Int 2003;


Hunskaar S, Lose G, Sykes D, Voss S. The prevalence of urinary

incontinence in women in four European countries. BJU Int 2004;


Changes in nocturia from medical treatment of benign prostate hyperplasia: secondary analysis of the Department of Veterans Affairs


Djavan B, Marberger M. A meta-analysis on the efficacy and tolerability of α1-adrenoceptor antagonists in patients with lower urinary


De Mey C, Michel MC, McEwen J, Moreland T. A double-blind

comparison of terazosin and tamsulosin on their differential effects on


with nocturia: secondary analysis of the Department of Veterans Affairs


Ulberg J, Carter N, Talbäck M, Edling C. Excessive daytime sleepi-

ness at work and subjective work performance in the general popula-

tion and among heave snorers and patients with obstructive sleep


Asplund R. Sleep disorders in the elderly. Drugs Aging 1999;14:91–

103.

Kripke DF, Garfinkel L, Wingard DL, Klauber MR, Marler MR.

Mortality associated with sleep duration and insomnia. Arch Gen