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Is our current understanding and management of nocturia allowing improved care? ICI-RS 2018

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Abstract

Aims: Nocturia, or waking at night to urinate, is a common cause of awakenings and may lead to sleep disturbance, impaired somatic health, impaired quality of life and increased mortality.

The aim of this report is to point out and discuss the aspects and issues that need to be addressed in order to improve care of nocturia.

Methods: This paper is a report of the presentations and subsequent discussion of a Think Tank session at the annual International Consultation on Incontinence Research Society (ICI-RS) in June 2018 in Bristol.

Results and conclusion:

Nocturia is a known risk factor for in-hospital falls. Unfortunately, its assessment in acutely hospitalised (older) people is not the current practice and ward- based care plans are not tailored to this symptom. A new care pathway for hospitalized patients who have nocturia should be considered.

More research into the relation of cardiovascular disorders and NP is warranted and management of NP patients may be improved by involving a cardiologist in their management. There is definitely a need for phenotyping nocturia in relation to bladder capacity, filling phase and emptying phase symptoms and how to treat the different phenotypes.

In the near future, smart automated monitoring devices and applications might help us to diagnose and treat nocturia with less efforts.

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KEYWORDS: Nocturia, Nocturnal Polyuria, Pathophysiology, Diagnostics, Treatments, Practice Guidelines.

INTRODUCTION

Nocturia has been defined by the International Continence Society (ICS) as “the complaint that the individual has to wake at night one or more times to void”(1).

Nocturia and nocturnal LUTS in general are mostly multifactorial and guidelines advise us to identify and treat the underlying cause first (2). These may include lower urinary tract (reduced bladder capacity due to OAB or post void residual), the kidneys (aging, reversed circadian rhythm, nephrogenic diabetes insipidus...), the endocrine system (estrogen or testosterone deficiency, diabetes mellitus and diabetes insipidus), sleep (sleep apnea, restless legs, insomnia), the cardiovascular system (leg edema, heart failure, hypertension, metabolic syndrome) and intake related disorders (polydipsia, high salt or protein diet).

The previous ICI-RS nocturia think tank (3) summarized the gaps in our knowledge in diagnosis and therapy of nocturia needed to develop algorithms.

It also promoted the need for a multidisciplinary approach in the management of nocturia with a promotion of partnership between specialties.

The aim of this work is to identify current problematic issues with the diagnosis and treatment of nocturia. It also provides recommendations to improve care based on the discussion during the ICI-RS meeting 2018.

NOCTURIA ON THE WARD: IMPROVE DIAGNOSIS AND THERAPY

Multifactorial health conditions increase a person's vulnerability to the situational challenge of being in hospital. When diuresis is upregulated in older unwell patients, polyuria can develop. This may be related to a disorder of solute or free water excretion, systemic illness, injury-related oedema or a cardio-vascular-metabolic condition (4,5). Deterioration of the sleep-wake cycle and sleep disruption (irrespective of the cause) can itself induce nocturnal polyuria (6). In older people this direct diuretic effect often coincides with reduced bladder capacity (largely due to structural changes in the detrusor muscle), exacerbating the mismatch between urinary production at night and bladder storage. Additional risk factors are conferred by acute and chronic illness interacting with medications and the physical environment of the hospital ward. **(Figure 1)**

Nocturia has far reaching health implications, with significant negative consequences associated with two or more episodes per night (Bower 2017). A short First Uninterrupted Sleep Period (FUSP) before needing to toilet is related to severity of nLUTS, quality of sleep and tiredness during the day. Waking to void is problematic when it occurs during the initial four hours that correspond to time spent in restorative slow wave sleep. Waking after insufficient sleep is associated with impaired standing balance and step length when walking; changes which are not corrected by adequate lighting (7). Nocturnal LUTS confer a twofold risk of falling and a threefold increase

in medical costs and hospitalization days (8). In-patients who fall are more likely to have a longer hospital stay and display reduced confidence and functional ability on discharge (9). Nearly half of all falls while in hospital are related to attempts to reach the toilet. In a third of cases this occurs during the night. Most night falls occurring in the early hours of the morning, coinciding with the period of peak diuresis (10). As might be expected, patients with nocturia have a markedly increased risk of injurious falls compared to people who sleep through the night (OR 2.2 for any fracture, 1.4 for hip fracture) (11). A common causal link between voiding at night and falling may be frailty, multimorbidity, polypharmacy or cognitive and gait changes seen on awaking unrefreshed or from insufficient sleep (12).

Given the multifactorial association of bladder symptoms with systemic illness, ageing and multimorbidity in older hospital inpatients, there is a critical need to understand how nLUTS can be recognised, evaluated and addressed. Despite the considerable body of evidence that treating nLUTS within the community improves health outcomes, this knowledge has not been translated to older hospitalized patients. Trainee physicians, nurses at all levels and other healthcare practitioners are generally unaware of the new understanding about nLUTS aetiology, implications, evaluation, sub-classification and individualized intervention.

Incontinence (and other urinary symptoms) at night is a potentially treatable condition, even in older hospitalized patients. Modifiable factors that would reduce diuresis, improve bladder storage, support sleep duration and minimize falls risk can be identified and addressed. Consensus regarding community-based management of nLUTS can be translated into care of hospitalized patients. Development of such a paradigm to comprehensively evaluate and treat nLUTS aligns with the recommendation of the International Consultation on Incontinence that research into lower urinary tract symptoms in acutely hospitalized older people be made a high priority (13). The introduction of ward-based screening, assessment of underlying causes and first-line intervention for nLUTS will improve clinical outcomes of elderly people in hospital. High costs associated with containing bladder dysfunction at night may be reduced. The risk of morbidity and reduced functional ability at discharge may be modifiable with treatment of nocturnal bladder dysfunction during hospitalisation (14).

NOCTURIA, CARDIAC AND RENAL FUNCTIONS: IMPROVE CARE

Managing nocturia requires more than treating the symptoms and signs of the condition and requires investigating and treating the underlying cause.

Collaboration between urologists and cardiologists is of importance in managing NP taking into consideration the consequences of volume overload on both cardiac and renal function.

Sometimes the cardiac history of the patient with nocturia is overlooked notwithstanding the close relation between heart and kidneys function, in particular a close relationship exists between arterial hypertension (HT) and NP. **(Figure 2)**

Some epidemiological data suggest a significant association between N and HT (15) and Yoshimura et al reported that hypertension is an independent risk factor for nocturia (OR 1.64, 95% CI 1.5-1.9) and bothersome nocturnal voiding (OR 1.33, 95% CI 1.04-1.71) (16). However, the association between NP and HT has only been confirmed in 2017 by Yokoyama (17). Some older and smaller studies support this association too: in 1996, Matthiesent et al, showed that mean arterial pressure is higher in patients with NP than in controls (18) and higher night/day ratios of urinary sodium excretion are associated with raised blood pressure. Interestingly, two randomized controlled trials from 1988 showed that nocturia in the elderly patients with NP is alleviated by giving loop diuretics during the day (19).

Goessaert et al recently explored solute and water distribution in patients with and without NP. According to their results, based on the analysis of nighttime urine output, NP can be attributed to water or sodium diuresis or a combination of the two (20).

Another important aspect is to distinguish between dipping and non-dipping hypertension (arterial pressure is normally reduced during sleep but in some hypertensive patients, pressure values remain high overnight). NP is much more common in non-dippers however this is the only evidence available on NP and different types of HT. According to some cardiologists, non-dipping HT can be sometimes due to a wrong drug dosage with insufficient plasma levels of medication during the night. Calcium antagonists, particularly amlodipine, increase nocturnal urine volume by selectively dilating renal afferent arterioles. Similarly, some evidence, although scarce, suggests that olmesartan normalizes non-dipping blood pressure and that taking an α_1 receptor blocker at night significantly decreased nocturnal blood pressure in non-dippers and risers. Given the lack of high-quality data, we can only assume that proper selection of anti-hypertensive therapy is important for NP management.

Fujii and coworkers evaluated day and night sodium excretion in dippers vs non-dippers (21), according to their results sodium excretion is higher during the night in non-dippers when compared to dippers however the result is significant only in patients with high sodium intake. These results are completely in line with the theory that sodium restriction could help both HT and NP conditions.

The evidence suggests that correct treatment of hypertension may solve nocturnal polyuria in some patients. Proper knowledge of the different diuretics is important; a correct usage of these drugs could eliminate enough salt during the day and therefore reduce natriuresis during the night. From a pathophysiological point of view, regulation of sodium output depends on three factors: natriuretic peptide which has no circadian rhythm, urodilatin which increases renal vascular resistance and has a circadian rhythm, nitric oxide that lowers renal vascular resistance and the pathway of which is often impaired in the elderly.

Nevertheless, data regarding the effectiveness of drugs in managing NP are scarce. Desmopressin could be useful in those cases of NP associated with water diuresis. Some authors suggest to use L-arginine to increase nitric oxide production, however

very little data are available. The use of calcium antagonists has been associated with NP, although this effect is supposed to be reversible with alpha blockers.

Cardiologists suggest that using alpha blockers to reduce blood pressure should improve NP, however this effect is rarely seen. A possible explanation is that alpha blockers act on renal vascular resistance while they have no effect on the NO pathway which is frequently involved in the pathophysiology of NP in the elderly.

The only effective strategy to treat HT and NP is to lower sodium intake, this approach is simple and obviously cost-effective. However very little research is done on the subject considering that there is no interest from industry.

Some data linking the sympathetic system activity and NP is available in the literature. According to Yokoyama, the association between HT, heart rate and NP is of relevance only in women and not in men (17). These data suggest an association between an increased sympathetic tone and NP, however in men the presence of the prostate confounds this association. Similarly, Pontes et al showed how sympathetic overactivity increases renal sodium reabsorption by activation of renin-angiotensin and Na/H exchanger (22). More research is needed in this field to reach definitive conclusions.

Urologists managing patients with spinal cord injury should also be aware of the relation between autonomic dysreflexia and NP. Patients with autonomic dysreflexia have a decrease in vasopressin levels when they lay down resulting in a decrease in urine osmolarity and therefore suffer NP. Understanding the pathophysiology of renal function in patients with a high spinal cord injury or with Multiple System Atrophy is of importance to help the management of these patients.

STUDYING NOCTURNAL POLYURIA, AND BLADDER CAPACITY IN PATIENTS WITH NOCTURIA.

(Figure 2)

Nocturia is due to an imbalance in nighttime urine volume and nocturnal bladder capacity. Nocturnal polyuria is a commonplace cause of nocturia, especially in the elderly, but nocturia may also be caused due to a small bladder capacity. The issue of diminished bladder capacity itself has little, if any, clinically significant treatments for most patients, and poses a challenging task to the urologist when providing care for a patient complaining of nocturia caused by a small bladder capacity.

Weiss et al. retrospectively analyzed voiding diaries completed by men at a Veterans Affairs urology clinic between 2008-2017. Inclusion required patients aged at least 18 years, of male gender, undergoing treatment for nocturia, and having completed at least two 24-hour voiding diaries at least one month apart. Patients were divided into two cohorts: responders (any decline in nocturia over time) and non-responders (any increase in nocturia over time). Patients were further substratified as having low global voided volume (maximum voided volume [MVV] <200 mL) versus low nocturnal voided volume (nocturnal maximum voided volume [NMVV] <200 mL and

MVV ≥ 200 mL). Wilcoxon rank-sum was applied to test for significance with a Bonferroni correction applied for multiple comparisons.

Results: Forty pre- and post-treatment diaries from 27 patients were identified as having low global capacity bladder, and 19 pre- and post-treatment diaries from 17 patients were identified as having low nocturnal voided volume. Nocturia responders with low global capacity demonstrated significant decline compared to non-responders in nocturnal urine volume (NUV) (-140 vs +75), nocturia index (Ni, -1.1 vs +0.2), nocturnal urine production rate (NUP, ml/hour, -8.4 vs +10) and nocturnal bladder capacity index (NBCi) (-0.59 vs +0.23). Patients with low nocturnal voided volume similarly demonstrated decreased NUV (-30 vs +160), Ni (-0.24 vs +0.37), NUP (-8.5 vs +17) and NBCi (-1.4 vs +0.33). There was no significant change in MVV or NMVV for either group.

Patients with low voided volume improved as a result of decreased nocturnal urine production (NUV, NUP), and increased tendency for nocturia voids to occur at volumes close to their bladder capacity (*reflected in decreased NBCi*). No increase was seen in voided volume (MVV, NMVV), the surrogate measure for bladder capacity. Lowering nocturnal urine production, and treatment designed for patients to consistently void at capacity during sleep time is a rational strategy to treat nocturia in patients with low bladder capacity.

We also discussed how treating nocturia due to OAB and NP or pure OAB. There is paucity in publications on this topic, searching mesh words (OAB, nocturia, desmopressine) gives only 10 hits in Pubmed of whom 3 are RCT's ((23–25). There is definitely need for research on this topic.

Medications for OAB (ie antimuscarinics) show a small statistical improvement in nocturia in some series, none in others (26). In a retrospective data query, Rackley et al. (27) pointed out that only those with severe OAB awakenings due to urgency benefitted from tolterodine given at bedtime. Brubakers group (28) showed that, using solifenacin, only patients without NP benefitted in terms of nocturnal frequency. The problem with trying to draw conclusions from the OAB literature regarding the effects on nocturia of either antimuscarinics or a beta 3 agonist is that the baseline number of nocturic episodes rarely exceeds 2 or slightly above, making it very difficult to show statistical significance over placebo with either conscious or unconscious behavioral modification. Trials with a nasally administered emulsified microdose of desmopressin in patients with NP seem to show a similar reduction in nocturic episodes whether or not OAB is present (29).

In men, small micturitions and difficulties to pass urine during the night may also be related to nocturnal erections. The “Piss proud” phenomenon may explain increased residual urine at night, or male patients voiding less well at night, as it is difficult to pass urine with an erected penis, which may take a prolonged time to detumescere. There is definitely a need for phenotyping nocturia in relation to bladder capacity, filling phase and emptying phase symptoms.

FUTURE AND AVAILABLE SMART DEVICES AND E-HEALTH APPLICATIONS: IMPROVE MANAGEMENT OF NOCTURIA

The diagnosis of nocturnal polyuria relies on the accurate documentation and interpretation of bladder diaries. Since the causes of nocturia are multifactorial patients should be managed both in primary and secondary care within a multidisciplinary team.

If the diagnosis cannot be facilitated by the use of a bladder diary then screening questions to identify patients with nocturia and underlying nocturnal polyuria may be useful as part of the diagnostic algorithm. After a consultation with experts in primary care, general medicine, urology and urogynaecology the following questions have been devised and now require further validation (**Table 1**).

The use of these screening questions may replace the reliance on bladder diaries in terms of diagnosis and also may be more applicable in special groups such as the elderly where the use diaries may not be possible.

Diagnosis and management of patients with nocturia is labour intensive and time-consuming for patients and physicians.

Indeed, it requires classification of the aetiology the etiologies of the condition to target the underlying cause and to monitor the degree of success based on subjective and objective parameters explaining what, if anything, gets better along the course of treatment.

For example, it would appear to be beneficial for patient to directly record data into a computerised smartphone app which can then be uploaded to a secure website allowing for automated nocturia parameter calculations and graphical display of serial diary/questionnaire comparisons.

Smart automated monitoring devices (voiding, urine production, residual, diet, blood pressure, pulse, sleep...) and applications (bladder diaries, intake diaries, ...) (**Figure 3**) might help us in the (near) future to diagnose the different causes of nocturia and target the correct patients with greater benefit to both patients and carers.

Applications for the future include individual patient management, clinical research and quality improvement measures.

Technology is available; and applications are available or easy to make. The problems to solve are mainly validation of the applications and devices for the purpose of exploring nocturnal LUTS and the financial incentive for companies to this low-volume work. Community driven sponsoring might be a solution for this.

Ideally all devices and applications would be integrated, so that data are automatically gathered into a database, ready for big data analysis. Such coupling devices exist on the market (<https://www.byteflies.com/>).

RESEARCH NEEDS TO ANSWER THE RESEARCH QUESTION

Nocturia on the ward:

Improve care of nocturia on the ward: focus on improvement of in-hospital care by a better screening for nocturia patients and prevention of fall incidents.

This will not only reduce the number of falls but also decrease the costs related to this problem. Nurses and physicians will be able to detect and treat nocturia more efficiently so that, as a result, patients will recover better and faster.

Cardio-vascular:

The pathophysiology of NP in the individual patients is often elusive. More research into the relation of cardiovascular disorders and NP is warranted and management of NP patients may be improved by involving a cardiologist in their path of care. Reducing water diuresis is not necessarily the optimal therapeutic approach in all patients.

Questionnaires and smart devices:

We need more detailed terminology on nocturnal LUTS and need to validate available technology and applications for the purpose of screening nocturnal LUTS.

It is of paramount importance to gather the multicausal information in a larger group of patients from different disciplines and use this to develop diagnostic and therapeutic algorithms for nocturia, nocturnal LUTS and nocturnal falls.

Lower Urinary Tract Dysfunction:

Investigate patients with nocturia, low voided volume and no NP.

Design clinical strategies to increase voided volume.

Perform studies to explore the link between diuresis rate and voided volume.

Phenotyping nocturia in relation to the micturition cycle and evaluate therapies.

CONCLUSION

Nocturia is a frequent and bothersome condition and an important issue of public health.

Further work is needed to diagnose nocturia correctly and easily, and to improve treatments.

When people are hospitalised or stay at a residential care centre, they have a high risk for falling on the way to the toilet when they have to void at night. A new care pathway for hospitalized patients who have nocturia have to be embed.

In the future, it would appear to be beneficial for patients and caregivers to directly record data into a computerized smartphone app which can then be uploaded to a secure website allowing for automated nocturia parameter calculations and graphical display of serial diary/questionnaire comparisons.

More research into the relation of cardiovascular disorders and NP is warranted and management of NP patients may be improved by involving a cardiologist in their path of care.

The International Consultation on Incontinence-Research Society (ICI-RS) Nocturia Think Tank therefore stresses the importance of improving the diagnosis and treatment of nocturia.

REFERENCES

1. Van Kerrebroeck P, Abrams P, Chaikin D, Donovan J, Fonda D, Jackson S, et al. The standardization of terminology in nocturia: report from the standardization subcommittee of the International Continence Society. *BJU Int* [Internet]. 2002 Dec [cited 2016 Mar 6];90 Suppl 3:11–5. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/12445092>
2. Gratzke C, Bachmann A, Descazeaud A, Drake MJ, Madersbacher S, Mamoulakis C, et al. EAU Guidelines on the Assessment of Non-neurogenic Male Lower Urinary Tract Symptoms including Benign Prostatic Obstruction. *Eur Urol* [Internet]. 2015 [cited 2017 Jun 6];67(6):1099–109. Available from: <http://www.sciencedirect.com/science/article/pii/S0302283814013943>
3. Everaert K, Hervé F, Bower W, Djurhuus JC, Dmochowski R, Fine N, et al. How can we develop a more clinically useful and robust algorithm for diagnosing and treating nocturia? ICI-RS 2017. *Neurourol Urodyn* [Internet]. 2018 Jun [cited 2018 Oct 31];37(S4):S46–59. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/30133785>
4. Nakagawa H, Niu K, Hozawa A, Ikeda Y, Kaiho Y, Ohmori-Matsuda K, et al. Impact of nocturia on bone fracture and mortality in older individuals: a Japanese longitudinal cohort study. *J Urol* [Internet]. 2010 Oct [cited 2018 Dec 12];184(4):1413–8. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0022534710037481>
5. Bing MH, Moller LA, Jennum P, Mortensen S, Lose G. Nocturia and associated morbidity in a Danish population of men and women aged 60–80 years. *BJU Int* [Internet]. 2008 Sep [cited 2018 Dec 12];102(7):808–14; discussion 814–5. Available from: <http://doi.wiley.com/10.1111/j.1464-410X.2008.07813.x>
6. Kamperis K, Hagstroem S, Radvanska E, Rittig S, Djurhuus JC. Excess diuresis and natriuresis during acute sleep deprivation in healthy adults. *AJP Ren Physiol* [Internet]. 2010 Aug 1 [cited 2017 Dec 20];299(2):F404–11. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/20519376>
7. McBean AL, Najjar RP, Schuchard RA, Hall CD, Wang C-A, Ku B, et al. Standing Balance and Spatiotemporal Aspects of Gait Are Impaired Upon Nocturnal Awakening in Healthy Late Middle-Aged and Older Adults. *J Clin Sleep Med* [Internet]. 2016 Nov 15 [cited 2018 Dec 15];12(11):1477–86. Available from: <http://jcsn.aasm.org/ViewAbstract.aspx?pid=30854>
8. Nakagawa H, Ikeda Y, ... YK-, 2009 undefined. Impact of nocturia on medical care use and its costs in an elderly population: 30 month prospective observation of national health insurance beneficiaries. *Proc Int Cont Soc* [Internet]. 2009 [cited 2018 Dec 15];280. Available from: https://scholar.google.be/scholar?hl=fr&as_sdt=0%2C5&q=Nakagawa+H+et+al.+Impact+of+nocturia+on+medical+care+use+and+its+costs+in+an+elderly+population%3A+30-month+prospective+observation+of+national+health+insurance+beneficiaries+in+Japan.+Proc+Int+Cont+S
9. von Renteln-Kruse W, Krause T. Fall events in geriatric hospital in-patients. Results of prospective recording over a 3 year period. *Z Gerontol Geriatr* [Internet]. 2004 Feb [cited 2018 Dec 15];37(1):9–14. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/14991290>
10. Al. RS et. In-hospital fall injuries: Where, when and how do they occur? *Proc 6th Bienn Aust New Zeal Falls Prev Conf*. 2014;109.
11. Damián J, Pastor-Barriuso R, Valderrama-Gama E, de Pedro-Cuesta J. Factors associated with falls among older adults living in institutions. *BMC Geriatr* [Internet]. 2013 Dec 15 [cited 2018 Dec 15];13(1):6. Available from:

<http://bmcgeriatr.biomedcentral.com/articles/10.1186/1471-2318-13-6>

12. Gibson W, Hunter KF, Camicioli R, Booth J, Skelton DA, Dumoulin C, et al. The association between lower urinary tract symptoms and falls: Forming a theoretical model for a research agenda. *Neurourol Urodyn* [Internet]. 2018 Jan [cited 2018 Dec 15];37(1):501–9. Available from: <http://doi.wiley.com/10.1002/nau.23295>
13. Wagg A, Abrams P, Cardozo L, Wein A WA (Eds). Chapter 11: INCONTINENCE IN FRAIL OLDER PERSONS. In: 6th International Consultation on Incontinence. 2017.
14. Bower WF, Whishaw DM, Khan F. Nocturia as a marker of poor health: Causal associations to inform care. *Neurourol Urodyn* [Internet]. 2017 Mar [cited 2019 Jan 16];36(3):697–705. Available from: <http://doi.wiley.com/10.1002/nau.23000>
15. Sugaya K, Kadekawa K, Ikehara A, Nakayama T, Gakiya M, Nashiro F, et al. Influence of hypertension on lower urinary tract symptoms in benign prostatic hyperplasia. *Int J Urol*. 2003;10:569–574; discussion 575.
16. Yoshimura K, Terada N, Matsui Y, Terai A, Kinukawa N, Arai Y. Prevalence of and risk factors for nocturia: Analysis of a health screening program. *Int J Urol*. 2004;11(5):282–7.
17. Yokoyama O, Nishizawa O, Homma Y, Takeda M, Gotoh M, Kakizaki H, et al. Nocturnal Polyuria and Hypertension in Patients with Lifestyle Related Diseases and Overactive Bladder. *J Urol*. 2017;197(2):423–31.
18. Matthiesen TB, Rittig S, Nørgaard JP, Pedersen EB, Djurhuus JC. Nocturnal polyuria and natriuresis in male patients with nocturia and lower urinary tract symptoms. *J Urol*. 1996 Oct;156(4):1292–9.
19. Pedersen PA, Johansen PB. Prophylactic treatment of adult nocturia with bumetanide. *Br J Urol*. 1988 Aug;62(2):145–7.
20. Goessaert AS, Krott L, Hoebeke P, Vande Walle J, Everaert K. Diagnosing the pathophysiologic mechanisms of nocturnal polyuria. *Eur Urol* [Internet]. 2015;67(2):283–8. Available from: <http://dx.doi.org/10.1016/j.eururo.2014.09.003>
21. Fujii T, Uzu T, Nishimura M, Takeji M, Kuroda S, Nakamura S, et al. Circadian rhythm of natriuresis is disturbed in nondipper type of essential hypertension. *Am J Kidney Dis*. 1999;33(1):29–35.
22. Pontes RB, Girardi ACC, Nishi EE, Campos RR, Bergamaschi CT. Crosstalk between the renal sympathetic nerve and intrarenal angiotensin II modulates proximal tubular sodium reabsorption. *Exp Physiol*. 2015;100(5):502–6.
23. ROVNER ES, RAYMOND K, ANDRUCZYK E, JUUL K V. Low-dose Desmopressin and Tolterodine Combination Therapy for Treating Nocturia in Women with Overactive Bladder: A Double-blind, Randomized, Controlled Study. *LUTS Low Urin Tract Symptoms* [Internet]. 2018 Sep [cited 2019 Jan 7];10(3):221–30. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28560762>
24. Jeong JY, Kim SJ, Cho HJ, Hong SH, Lee JY, Hwang TK, et al. Influence of Type of Nocturia and Lower Urinary Tract Symptoms on Therapeutic Outcome in Women Treated With Desmopressin. *Korean J Urol* [Internet]. 2013 Feb [cited 2019 Jan 7];54(2):95. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/23549374>
25. Sand PK, Dmochowski RR, Reddy J, van der Meulen EA. Efficacy and Safety of Low Dose Desmopressin Orally Disintegrating Tablet in Women with Nocturia: Results of a Multicenter, Randomized, Double-Blind, Placebo Controlled, Parallel Group Study. *J Urol* [Internet]. 2013 Sep [cited 2019 Jan 7];190(3):958–64. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/23454404>
26. Smith AL, Wein AJ. Outcomes of pharmacological management of nocturia with non-antidiuretic agents: does statistically significant equal clinically significant? *BJU Int* [Internet]. 2011 May [cited 2019 Jan 5];107(10):1550–4. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/21518417>
27. Rackley R, Weiss JP, Rovner ES, Wang JT, Guan Z. Nighttime dosing with tolterodine reduces overactive bladder-related nocturnal micturitions in patients with overactive bladder and nocturia. *Urology* [Internet]. 2006 Apr 1 [cited 2019 Jan 5];67(4):731–6. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0090429505017140>
28. Brubaker L, FitzGerald MP. Nocturnal polyuria and nocturia relief in patients treated with solifenacin for overactive bladder symptoms. *Int Urogynecol J Pelvic Floor Dysfunct* [Internet]. 2007 Jul 18 [cited 2017 May 31];18(7):737–41. Available from: <http://link.springer.com/10.1007/s00192-006-0239-y>
29. Kaminetsky J, Fein S, Dmochowski R, MacDiarmid S, Abrams S, Cheng M, et al. Efficacy and Safety of SER120

Figures

Figure 1:Nocturia on the ward

Figure 2: Nocturia gaps

Figure 3: Smart devices and applications to improve management of nocturia.

Table 1: Screening Questions

Screening questions	Aim
1. Do you get up at night to void? How many times?	Identifying nocturia
2. Does it bother you?	Identifying bothersomeness
3. Do you pass large volumes of urine at night?	
When you urinate at night, is the volume you urinate the same as it is during the day?	Identifying nocturnal polyuria
4. Do you have to rush to the toilet day or night?	Excluding urgency
5. Do you void frequently during the day?	Excluding diurnal frequency
6. First void; dark/concentrated or pale/dilute?	Identifying nocturnal polyuria

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