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The peripheral nerve evaluation: determining which symptoms lead to a successful test

Abstract

Objective: To identify the symptom or set of symptoms most improved in patients undergoing a successful peripheral nerve evaluation (PNE) for refractory overactive bladder syndrome (OAB).

Methods: An analysis was conducted on refractory OAB patients to determine which symptom (nocturia, daytime voids, urgency, leaks per day, pad use per day and time to reach the bathroom) most improved following a PNE. This was measured in two ways: 1) by patient responses to a questionnaire and 2) by determining changes in symptoms with use of a voiding diary. Patients completed a pre- and post-questionnaire by phone interview. Descriptive statistics were used to analyze demographic and baseline characteristics as well as responses to questionnaires. Changes in voiding patterns were analyzed using a paired-samples t-test.

Results: Overall, 28 patients were included. Prior to their evaluation patients indicated they were most bothered by urgency (n=26, 92.8%), followed by number of leaks per 24 hours (n = 24, 85.7%). After their evaluation, symptom improvement was highest for number of voids at night (n = 20, 71.4%) followed by sense of urgency (n = 18, 64.3%). Paired-samples t-tests on pre- and post-PNE voiding diaries revealed significant improvements in number of daytime voids ($p = 0.015$), number of leaks per 24 hours ($p = 0.001$), and number of urges per 24 hours ($p = 0.001$).

Conclusion: Voiding diaries alone cannot be used to accurately determine symptom improvement. Clinicians must take into account the degree to which their patients are bothered by their symptoms. In an elderly population, improvement in nocturia has important implications including decreased morbidity.

Keywords: sacral neuromodulation, peripheral nerve evaluation, overactive bladder, nocturia, interstim

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Introduction

Urinary incontinence is a significant health concern that impacts the lives of nearly 20 million women in the United States over the age of 18.[1,2] Worldwide, pelvic floor disorders affect between 9% and 50% of individuals.[2–5] Population-based studies indicate prevalence increases with age and is expected to substantially increase in the future.[1,3] Overactive bladder (OAB) accounts for a large portion of pelvic floor disorders. Affected women present to their physicians with varying symptoms and severity. Behavioral modification and pelvic floor physical therapy are first line treatments; however, anticholinergic medications are available as second line treatments if symptoms persist. Even then, there is a high rate of poor adherence, treatment failure, and permanent discontinuation by approximately 50% by the end of the two years.[6,7] In addition, there is evidence that anticholinergic medications can cause cognitive impairment and that the elderly are even more susceptible, given increased permeability of the blood brain barrier with age.[8] Women who fail first- and second-line therapy are now seeking alternative third line therapies such as sacral neuromodulation (SNM).

Sacral neuromodulation involves the placement of a tined lead that sends electrical pulses to the sacral nerve within the S3 foramen. OAB symptoms are believed to result from an abnormal interplay of afferent and efferent signaling between the bladder and the central nervous system. SNM therapy is thought to suppress intraneuronal transmission in the bladder reflex pathway via the ascending limb of the micturition reflex, thus blocking transfer of information to the pontine micturition center.[9] InterStim is an FDA-approved device that helps modulate these neural signals. Prior to undergoing placement of the full InterStim system, women undergo either a basic peripheral nerve evaluation (PNE) or a Stage 1 advanced evaluation to assess efficacy and predict outcomes of permanent treatment. A PNE is a procedure in which a monopolar lead is implanted adjacent to the S3 foramen and provides low amplitude stimulation to the sacral nerve. During a PNE, electrical pulses are delivered to the sacral neve via a programmable stimulator. Patients then complete a three-day bladder diary to determine treatment success or failure. Per the FDA, an overall symptom improvement of 50% represents a successful PNE evaluation. If desired, the InterStim system may then be placed permanently.

To date, the following have not been identified: specific OAB symptoms most bothersome to patients and the symptom that is most improved following SNM therapy. By identifying these factors, patients can be better counseled regarding outcomes and expectations of the SNM therapy. The objectives of this study were:

1) To determine differences in voiding patters pre- and post-PNE
2) To determine which symptoms were most bothersome at baseline
3) To determine improvement in symptoms following PNE.

Materials and methods

This retrospective IRB approved study included women treated by a single board-certified female pelvic medicine and reconstructive surgeon in a private practice setting. To meet inclusion criteria, women

must have failed first and second line treatments for OAB syndrome, must have been non-pregnant, and must have been counseled on additional treatment options including SNM by use of InterStim therapy. They provided written consent allowing us to use gathered data for analysis.

Prior to receiving a permanent neuromodulator, each patient completed a three-day voiding diary and then underwent a PNE. Patients were enrolled in a consecutive manner. The patient was provided a standard intake and voiding diary (developed by the American Urogynecologic Society) as well as a hat to measure void volume. She was instructed to record the following over three consecutive days:

1) Void time
2) Void volume
3) Leakage (measured using a scale from 1 to 3)
4) Activity during leak,
5) Urge (categories: yes, no)
6) Fluid intake volume.

Following completion of the diary, it was reviewed by a physician and discussed with the patient. The patient then underwent a PNE and was instructed to complete an additional three-day voiding diary for assessing symptom improvement.

In addition to providing baseline demographic information and completing a Medical, Epidemiologic and Social aspects of Aging (MESA) questionnaire, each patient also completed a pretest and posttest survey to characterize and rate their symptoms (void volume, number of daytime voids, number of nighttime voids, sense of urgency, number of leaks, number of pads required, and time to reach the bathroom). On the pretest survey, patients rated the degree to which symptoms bothered them. On the posttest survey, they rated perceived improvement in symptoms. The posttest survey was completed by phone as close as possible to the PNE. For the purposes of this study, nocturnal urination was defined as a void occurring between 9:00 PM and 6:00 AM.

Statistical analysis

Descriptive statistics were used to summarize the following data: demographic and baseline characteristics, voiding patterns, and survey responses. Paired-samples t-tests were used to compare the following variables before and after PNE: number of voids per 24 hours, number of voids per 24 hours (from 9:00 PM to 6:00 AM), number of leaks per 24 hours, number of urges per 24 hours, and void volume. Significance levels were set to 0.05. Statistical analyses were performed using IBM SPSS (Version 24.0, Armonk, NY) software.

Results

A total of 28 women were evaluated following a PNE. All 28 moved on and received a full SNM implantation. Demographics and baseline characteristics are reported in Table 1. Mean age was 67.3 (standard deviation [SD] 11.1) years, and mean body mass index (BMI) was 34.7 (SD 8.6) kg/m^2. Mean gravidity was 2.7 (SD 1.5), and median parity was 2.0 (IQR 1.0 – 3.0). There were no current smokers, but 17 (60.7%) patients were former smokers. Baseline MESA questionnaires were completed by patients and average scores were 10.4 (SD 4.5) and 14.4 (SD 7.1), respectively, for the urge and stress components. Additionally, 23 (82.1%) patients had prior pelvic surgery and 11 (39.3%) patients reported sensation of a bulge or protrusion in the vagina. Prior surgeries included hysterectomies (n = 15, 53.6%), incontinence slings (n = 6, 21.4%), cesarean delivery (n = 4, 14.3%), tubal ligations (n = 3, 10.7%), oophorectomy (n = 1, 3.6%), appendectomy (n = 1, 3.6%), and cholecystectomy (n=1, 3.6%). One patient listed ovarian cancer treatment that was not further specified.

Table 1 Demographic and baseline characteristics

Variable	PNE n = 28
Age, y, mean (SD)	69.9 (11.4)
BMI, kg/m^2, mean (SD)	34.0 (8.8)[b]
Gravidity, mean (SD)	2.2 (1.4)
Parity, median (IQR)	2.0 (1.0-2.0)
Smoking, n (%)	
Never	11 (39.3)
Former	17 (60.7)
Current	0 (0)
HTN, n (%)	16 (57.1)
Prolapse, n (%)	
Prior pelvic surgery	23 (82.1)
Sensation of bulging/protrusion	11 (39.3)
Bulge or something falling out	10 (35.7)
MESA urge, mean (SD)	10.4 (4.5)
MESA stress, mean (SD)	14.4 (7.1)

PNE, peripheral nerve evaluation; SD, standard deviation; BMI, body mass index; IQR, interquartile range; HTN, hypertension; MESA, Medical, Epidemiologic and Social Aspects of Aging.

[a]n = 47 [b]n = 19 [c]n = 55 [d]n = 27

Bladder diary voiding measures pre- and post-PNE are presented in Table 2. Paired-samples t-tests revealed significant improvements in mean numbers of daytime voids (p = 0.015), leaks per 24 hours (p = 0.001), and urges per 24 hours (p = 0.001). No significant improvements were observed in number of nighttime voids or void volume.

Table 2 Voiding patterns (3-day Means)

Variable	PNE		p
	Pre	Post	
Total Number of voids per 24 h[a]	9.5 (3.8)	7.9 (2.9)	0.015
Number of nighttime voids (inside 9p-6a)[a]	2.5 (1.1)	2.0 (1.2)	0.076
Number of leaks per 24 h[b]	5.6 (3.0)	3.4 (2.7)	0.001
Number of urges per 24 h[c]	6.4 (3.0)	4.6 (2.8)	0.001
Void volume, ml[c]	181.5 (85.1)	179.5 (70.3)	0.822

Presented as mean (SD).

PNE, peripheral nerve evaluation; SD, standard deviation.

[a]n = 27 [b]n = 26 [c]n = 25

The baseline patient questionnaire provided a subjective measure of bother in OAB symptoms prior to undergoing a PNE. Patients reported the greatest degree of bother (moderately or quite bothered) in urgency (n = 26, 92.8%), followed by number of leaks (n = 24, 85.7%), number of voids at night (n = 23, 82.1%), daytime voids (n = 23, 82.1%), time to bathroom (n = 19, 67.9%) and number of pads used (n = 18, 64.2%) (Table 3). After their PNE, patients completed an improvement survey. Symptom improvement (moderately or quite improved) was highest for number of voids at night (n = 20, 71.4%) followed by sense of urgency (n = 18, 64.3%), daytime voids (n = 16, 57.1%), number of pads (n = 15, 53.6%), time to bathroom (n = 13, 54.5%) and leaks (n = 13, 26.4%) (Table 4).

Table 3 Pre survey responses to "How bothersome are the following to you?"

Variable	PNE n = 28
Number of voids at night	
Not at all	0 (0)
Somewhat	5 (17.9)
Moderately	9 (32.1)
Quite a lot	14 (50.0)
Number of voids during day	
Not at all	1 (3.6)
Somewhat	4 (14.3)
Moderately	14 (50.0)
Quite a lot	9 (32.1)
Sense of urgency	
Not at all	0 (0)
Somewhat	2 (7.1)
Moderately	9 (32.1)
Quite a lot	17 (60.7)
Number of leaks	
Not at all	0 (0)
Somewhat	4 (14.3)
Moderately	10 (35.7)
Quite a lot	14 (50.0)
Number of pads	
Not at all	7 (25.0)
Somewhat	3 (10.7)
Moderately	9 (32.1)
Quite a lot	9 (32.1)
Time to bathroom	
Not at all	1 (3.6)
Somewhat	8 (28.6)
Moderately	8 (28.6)
Quite a lot	11 (39.3)
Presented as n (%).	

PNE, peripheral nerve evaluation.

Table 4 Post survey responses to "How improved are the following to you?"

Variable	PNE n = 28
Number of voids at night	
Not at all	0 (0)
Somewhat	8 (28.6)
Moderately	13 (46.4)
Quite a lot	7 (25.0)
Number of voids during day	
Not at all	3 (10.7)
Somewhat	9 (32.1)
Moderately	9 (32.1)
Quite a lot	7 (25.0)
Sense of urgency	
Not at all	2 (7.1)
Somewhat	8 (28.6)
Moderately	10 (35.7)
Quite a lot	8 (28.6)
Number of leaks	
Not at all	5 (17.9)
Somewhat	10 (35.7)
Moderately	7 (25.0)
Quite a lot	6 (21.4)
Number of pads	
Not at all	8 (28.6)
Somewhat	5 (17.9)
Moderately	10 (35.7)
Quite a lot	5 (17.9)
Time to bathroom	
Not at all	2 (7.1)
Somewhat	11 (39.3)
Moderately	9 (32.1)
Quite a lot	6 (21.4)
Presented as n (%).	

PNE, peripheral nerve evaluation.

Discussion

Sacroneuromodulation is an effective treatment for refractory OAB. The PNE, though less frequently used than the staged implant, is a quicker and less expensive test and may be an appropriate office-based option in the non-obese population.[10] Knowledge on which symptoms are most bothersome to patients and which symptoms improve the most can help physicians counsel their patients and set expectations for the trial period. For this study, we report subjective data from a survey and objective data from voiding diaries following a PNE. To date, no study has included both as part of an evaluation to determine eligibility to progress to Stage II implantation following a PNE.

Questionnaire results indicated that OAB patients at baseline were most bothered by urgency and number of leaks. Surprisingly, the most improved symptom after a PNE was nocturia, followed by urgency. Information from voiding diaries indicated improvement in urgency, leakage, and total number of voids following a PNE.

The most commonly used assessment tool for OAB symptoms is the OAB symptoms score (OABSS). The tool incorporates measures of daytime frequency, nighttime frequency, urgency, and incontinence and gives a single weighed score.[11] As such, a pooled score may not reflect appropriate details. Other validated tools such as the Bristol Female Lower Urinary Tract capture frequency of events but do not assess degree of bother.[12] Patients included in this study were most bothered by urgency and leakage. They were least bothered by time to reach the bathroom and pad use. Many patients who have suffered from OAB for some time are accustomed to wearing pads at baseline and continue to do so even after successful treatment.

Physicians often focus on decreasing number of daytime voids, but we recognize that individuals in our patient population also suffer from nocturia. The post-PNE survey showed greatest improvement in nocturia, closely followed by urgency. For the elderly population, degree of bother associated with nocturia, with or without urgency, can be attributed to associated morbidity. A sense of urgency to void increases their risk of injury while attempting to reach the bathroom.[13] Additionally, nighttime voids disrupt restorative sleep and lead to daytime fatigue, depression, and adverse metabolic traits.[14]

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Addressing these components of OAB may help decrease associated morbidities and increase quality of life.

We used the AUGS intake and voiding diary to track voiding patterns over three days. On an individual level, information in the voiding dairies only occasionally reflected perceived bothersome symptoms included within surveys. For example, some patients indicated in their diaries they had many daytime voids with urgency and fewer than three nighttime voids. However, their survey responses indicated they were most bothered by nighttime voids. This finding suggests that a voiding diary alone does not accurately determine symptom improvement and that perceived improvement, which may not be reflected in the diary, may be the better measure. We chose to study three-day voiding diaries based on the nature of the PNE test and lead migration risks. In future studies, inclusion of seven-day diaries may provide more robust data. However, prior studies have shown that use of seven-day diaries places a significantly higher burden on patients without improving accuracy.[15]

Our analysis is limited by a small number of patients treated by a single provider. Also, accuracy of information provided in voiding diaries cannot be guaranteed. We defined nighttime voids as those occurring between 9:00 PM and 6:00 AM, but we recognize sleep time varies among patients.

Conclusion

SNM is proving to be an effective form of treatment for OAB syndrome, but it requires a prerequisite of a PNE or Stage 1 implant. In most urogynecology practices, a voiding diary is the sole method used to determine improvement following these tests. However, determining symptoms which are bothersome to patients may inform on placement of a permanent stimulator.

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Conflicts of interest

There is no competing interests between the authors.

References

1. Wu Jennifer M, Hundley AF, Fulton RG, et al. Forecasting the prevalence of pelvic floor disorders in U.S. Women. *Obstet Gynecol*. 2009;114(6):1278–1283.
2. Stewart WF, Van Rooyen JB, Cundiff GW, et al. Prevalence and burden of overactive bladder in the United States. *World J Urol*. 2003;20(6):327–336.
3. Coyne Karin S, Sexton CC, Vats V, et al. National community prevalence of overactive bladder in the United States stratified by sex and age. *Urology*. 2011;77(5):1081–1087.
4. Coyne KS, Sexton CC, Bell JA, et al. The prevalence of lower urinary tract symptoms (LUTS) and overactive bladder (OAB) by racial/ethnic group and age: Results from OAB–POLL. *Neurourol Urodyn*. 2012;32(3):230–237.
5. Irwin Debra E, Kopp ZS, Agatep B, et al. Worldwide prevalence estimates of lower urinary tract symptoms, overactive bladder, urinary incontinence and bladder outlet obstruction. *BJU Int*. 2011;108(7):1132–1138.
6. Chancellor Michael B, Migliaccio–Walle K, Bramley TJ, et al. Long–term patterns of use and treatment failure with anticholinergic agents for overactive bladder. *Clin Ther*. 2013;35(11):1744–1751.
7. D'Souza Anna O, Smith MJ, Miller LA, et al. Persistence, Adherence, and Switch Rates among Extended–Release and Immediate–Release Overactive Bladder Medications in a Regional Managed Care Plan. *J Manag Care Pharm*. 2008;14(3):291–301.
8. Araklitis George, Robinson D, Cardozo L. Cognitive effects of anticholinergic load in women with overactive bladder. *Clin Interv Aging*. 2020;15:1493–1503.
9. Gill Bradley C, Pizarro–Berdichevsky J, Bhattacharyya PK, et al. Real–time changes in brain activity during sacral neuromodulation for overactive bladder. *J Urol*. 2017;198(6):1379–1385.
10. Latini Jerilyn M, Alipour M, Kreder KJ. Efficacy of sacral neuromodulation for symptomatic treatment of refractory urinary urge incontinence. *Urology*. 2006;67(3):550–553.
11. Homma Y, Yoshida M, Seki N, et al. Symptom assessment tool for overactive bladder syndrome—overactive bladder symptom score." *Urology*. 2006;68(2):318–323.
12. Brookes Sara T, Donovan JL, Wright M, et al. A scored form of the bristol female lower urinary tract symptoms questionnaire: data from a randomized controlled trial of surgery for women with stress incontinence. *Am J Obstet Gynecol*. 2004;191(1):73–82.
13. Asplund R. Nocturia, nocturnal polyuria, and sleep quality in the elderly. *J Psychosom Res*. 2004;56(5):517–525.
14. Oelke M, De Wachter S, Drake MJ, et al. A practical approach to the management of nocturia. *Int J Clin Pract*. 2017;71(11):e13027.
15. Ku JH, Jeong IG, Lim DJ, et al. Voiding diary for the evaluation of urinary incontinence and lower urinary tract symptoms: prospective assessment of patient compliance and burden. *Neurourol Urodyn*. 2004;23(4):331–335.