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Two-Staged Sacral Neuromodulation for the Treatment of Nonobstructive Urinary Retention: A Multicenter Study Assessing Predictors of Success

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ABSTRACT

Objectives: The aims of this study were to 1) determine the success rate of the tined lead test phase in patients with non-obstructive urinary retention (NOUR), 2) determine predictive factors of a successful test phase in patients with NOUR, and 3) determine long-term treatment efficacy and satisfaction in patients with NOUR.

Materials and Methods: The first part was a multicenter retrospective study at two centers in The Netherlands. Patients with NOUR received a four-week tined lead test phase. Success was defined as a ≥50% reduction of clean intermittent catheterization frequency or postvoid residual. We analyzed possible predictors of success with multivariable logistic regression. Second, all patients received a questionnaire to assess efficacy, perceived health (Patient Global Impression of Improvement), and treatment satisfaction.

Results: This study included 215 consecutive patients (82 men and 133 women) who underwent a tined lead test phase for the treatment of NOUR. The success rate in women was significantly higher than in men, respectively 62% (83/133) and 22% (18/82, $p < 0.001$). In women, age per ten years (odds ratio [OR] 0.74, 95% CI: 0.59–0.93) and a history of psychiatric illness (OR 3.92, 95% CI: 1.51–10.2), including posttraumatic stress disorder (PTSD), significantly predicted first stage sacral neuromodulation (SNM) success. In men, age per ten years (OR 0.43, 95% CI: 0.25–0.72) and previous transurethral resection of the prostate and/or bladder neck incision (OR 7.71, 95% CI: 1.43–41.5) were significant predictors of success. Conversely, inability to void during a urodynamic study (for women, OR 0.79, 95% CI: 0.35–1.78; for men, OR 3.06, 95% CI: 0.83–11.3) was not predictive of success. Of the patients with a successful first stage, 75% (76/101) responded to the questionnaire at a median follow-up of three years. Of these patients, 87% (66/76) continued to use their SNM system, and 92% (70/76) would recommend SNM to other patients.

Conclusions: A history of psychiatric illness, including PTSD, in women with NOUR increased the odds of first stage SNM success 3.92 times. A previous transurethral resection of the prostate and/or bladder neck incision in men increased the odds of success 7.71 times. In addition, a ten-year age increase was associated with an OR of 0.43 in men and 0.74 in women, indicating a 2.3- and 1.3-times decreased odds of success, respectively.

Keywords: Detrusor underactivity, posttraumatic stress disorder, sacral nerve stimulation, tined lead, underactive bladder

Conflict of Interest: The authors reported no conflict of interest.

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INTRODUCTION

Nonobstructive urinary retention (NOUR) is the inability to (completely) empty the urinary bladder without the presence of bladder outlet obstruction.[1] This voiding disorder affects millions of people worldwide, with estimations of its prevalence ranging from 9% to 48% among patients presenting with lower urinary tract symptoms.[2,3] NOUR can be idiopathic or neurogenic in origin. Neurogenic causes include spinal cord injury, Parkinson disease, multiple sclerosis, and spina bifida. Patients can present with the following symptoms: slow urinary stream, hesitancy, and straining to void with the feeling of incomplete bladder emptying. Furthermore, patients can present with recurrent urinary tract infections and renal failure or overflow incontinence, leading to skin problems in the genital area. A urodynamic study (UDS) may reveal absent or decreased contractility of the detrusor muscle. NOUR is especially clinically relevant in the case of significant postvoid residuals (PVRs), which may necessitate artificial drainage of the bladder. However, there is no consensus on the definition of significant PVR, and no validation of significant volumes has been done to date. An attempt was made by Stoffel et al,[1] describing a cutoff value of 300 mL and proposing a treatment strategy based on the risk of complications and symptoms. The preferred method for bladder drainage is clean intermittent catheterization (CIC) to ensure timely drainage of the bladder and prevent complications. When self-catheterization is not possible, a suprapubic or transurethral catheter can be offered. The possible long-term complications of urinary catheterization include bladder stones, urethral strictures, increased risk of urinary tract infections, urosepsis, renal failure, and bladder cancer.[4,5] Catheterization and its complications have a negative effect on quality of life.[6] Other treatments of NOUR include forms of neuromodulation. Transcutaneous electrical stimulation and percutaneous tibial nerve stimulation have limited evidence for their effectiveness in patients with NOUR and are therefore generally not advised for these patients.[7] These neuromodulation modalities are not incorporated in the Dutch (Nederlandse Vereniging voor Urologie), European (European Association of Urology), and American (American Urological Association) guidelines on the treatment of nonneurogenic urinary retention.[8–10] In contrast, sacral neuromodulation (SNM) has shown its effectiveness and can thus be offered to partially or completely restore voiding and improve quality of life.[11] A reduction of catheter use reduces complications, decreases health care expenditures, and decreases plastic waste.[12,13]

A test phase precedes the implantation of an implantable pulse generator (IPG) to assess whether symptoms improve sufficiently. The success of the test phase is defined as a 50% or more improvement of PVR or CIC frequency. The test phase can be performed in two ways, either by percutaneous nerve evaluation (PNE) or with a tined lead.[14] Physicians counsel their patients with overactive bladder (OAB) to undergo either PNE or a tined lead test phase. In NOUR as opposed to OAB, physicians usually advise a tined lead test phase because this has been shown to be a more sensitive screening method than the PNE procedure.[15] After receiving the full implant, approximately 86% of patients with NOUR still have a >50% symptom improvement more than three years after implantation.[16] Two other studies reported a success rate of 71% and 87.5% after a follow-up of four years and five years, respectively.[17,18] These studies implicate that success is maintained in the long term. However, the preceding test phase with a tined lead has a success rate of 45%.[19] Attempts must be made to improve patient selection and thus the success rate of the tined lead test phase in patients with NOUR.

Multiple previous studies have focused on identifying patient characteristics that might predict tined lead test phase success. However, these studies have mainly focused on patients with OAB.[20] In one such study of OAB patients, female sex was associated with a successful first stage (women 41.6% vs men 27.7%).[21] A retrospective study of 21 male patients with NOUR identified a higher success rate in younger patients.[22] Urodynamic parameters might predict success as well, with a higher bladder contractility improving outcome.[23] Previous back surgery for bulging disc, trauma, spinal stenosis, or osteoarthritis did not affect SNM outcome.[24] In patients with OAB, there were no differences in SNM outcome between women who had previous surgical treatment of stress urinary incontinence or pelvic organ prolapse and women who did not have these procedures before SNM implantation.[25] However, the relevance of these factors in women with NOUR is unknown. Psychiatric illness might positively predict test phase outcome as well in patients with NOUR.[26] Altogether, there is limited evidence on which criteria can identify patients with NOUR who might benefit from SNM. Therefore, the aims of this study were to 1) determine the success rate of the tined lead test phase, 2) determine predictive factors of a successful test phase, and 3) determine long-term efficacy and patient satisfaction of SNM in patients with NOUR.

MATERIALS AND METHODS

The first part of this study was a multicenter retrospective study performed at two centers in The Netherlands. Approval was obtained from the local Medical Ethics Review Boards of the Erasmus Medical Center and Isala Clinics. All patients with NOUR received a four-week tined lead test phase between January 2009 and December 2020 (Fig. 1). The inclusion criteria for SNM testing were failed first- and second-line treatment, UDS performed before tined lead implantation, and significant PVR for which catheterization was being performed. The exclusion criteria were a previously failed tined lead procedure, cognitive impairment, bladder outlet obstruction confirmed by UDS, and pregnancy. Success was defined as a ≥50% reduction of CIC frequency or PVR. The first stage consisted of a tined lead with four electrodes placed to the S3 or S4 nerve root under x-ray guidance.[27] The ideal site for lead entry was determined by using bony landmarks. Optimal positioning was confirmed by the bellows response or urogenital sensation in sedated patients. The lead was connected to an external pulse generator for four weeks. Patients with a successful first stage subsequently received a subcutaneous IPG. The IPG was either nonrechargeable (Interstim, Medtronic, Dublin, Ireland) or rechargeable (Axonicsr-SNM System™, Axonics Modulation Technologies, Irvine, CA). Patients' data were extracted from their medical charts. The data extracted were sex, age at tined lead implantation, ability to void during UDS, PVR during UDS, CIC frequency, and the origin (neurogenic or idiopathic) of bladder dysfunction. Second, we determined in each patient whether they suffered a lead or wound infection during their tined lead test phase.

We identified possible predictive factors of a successful first stage in the literature.[20] The included possible predictors for both

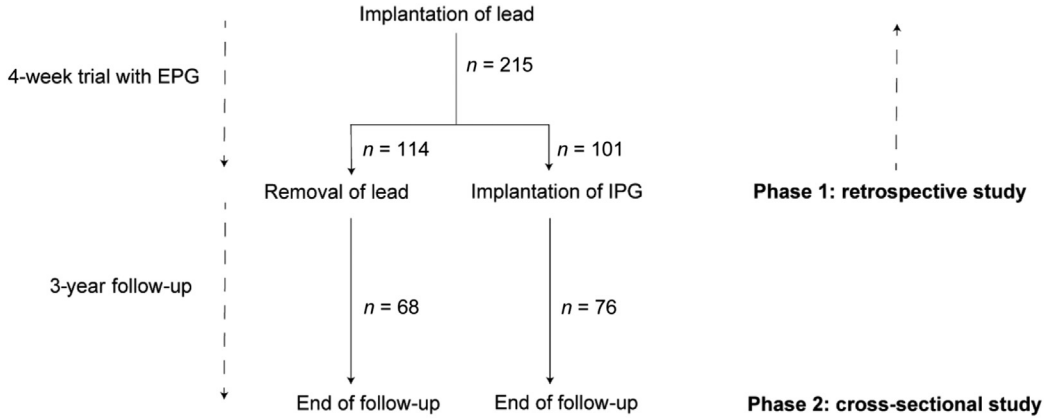

Figure 1. Flowchart of the study design. EPG, external pulse generator.

men and women were a history of orthopedic surgery and psychiatric illness. A history of psychiatric illness included the following diagnoses according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5): depression, posttraumatic stress disorder (PTSD), bipolar disorder, psychotic disorder, borderline personality disorder, autism/attention-deficit/hyperactivity disorder/attention deficit disorder, anxiety and panic disorder, somatoform disorder, and substance-related disorder. In women, we also included a history of pelvic surgery, and in men, we included a history of transurethral prostate resection and/or bladder neck incision in the respective prediction models. A history of pelvic surgery included the following: hysterectomy, a surgical procedure for stress urinary incontinence (tensionfree vaginal tape/Burch/Marshall-Marchetti-Krantz procedure), prolapse surgery, and/or a cesarean section.

In the second part of the study, all included patients received a questionnaire to assess efficacy, perceived health (Patient Global Impression of Improvement [PGI-I]), and treatment satisfaction between October 2020 and March 2021 (Fig. 1).[28] In patients with a failed test phase, we determined catheterization frequency, possible other treatments received, and their perceived health with this questionnaire. In patients with a successful test phase, we determined long-term success (measured as catheterization frequency) and satisfaction with the SNM therapy, and in the case of a rechargeable neuromodulator, the patients were asked about their experience regarding recharging.

We performed the statistical analysis with SPSS Statistics (version 25, IBM, Armonk, NY). The characteristics of the cohort as well as the outcome variables of the questionnaire are presented as descriptive statistics. The data were tested for normality using the Shapiro-Wilk test. The Mann-Whitney U test or independent *t*-test was used for the analysis of continuous data, depending on the distribution of the data. A χ^2 test was used to analyze categorical variables. Because we identified possible predictors of success in the literature that either solely apply to men or to women and their success rate significantly differs, separate prediction models for first stage success were made for men and women using binomial multivariable logistic regression. Only the most important possible predictors, based on previous studies, were incorporated in the prediction models. The variables incorporated in the two prediction models are presented as odds ratios (ORs), with their corresponding 95% CIs and p values. A p value < 0.05 was considered statistically significant.

RESULTS

Success Rate of Tined Lead Test Phase in Patients With NOUR

This study included 215 consecutive patients (82 men and 133 women) who received a tined lead test phase for the treatment of NOUR at two centers in The Netherlands (Table 1). Within this cohort, 47% (101/215) had a successful first stage and received the final implant. The success rate was 62% (83/133) in women (Table 1). This was significantly higher than in men, for whom the success rate was 22% (18/82) ($p < 0.001$; Table 1). The median age in patients with a successful first stage was 43 years (interquartile range [IQR] 28.5–61.5) and was 61 years (IQR 47.8–69.0) in those with a failed first stage ($p < 0.001$; Table 1). Of the patients who were unable to void during UDS, 53% (49/92) had a successful first stage, and 47% (43/92) had a failed first stage ($p = 0.094$).

Of the 30 men with a previous transurethral prostate resection and/or bladder neck incision, 27% (8/30) had a successful first stage, and 73% (22/30) had a failed first stage ($p = 0.433$). Of the men with a successful first stage, 56% (10/18) did not have a previous transurethral prostate resection and/or bladder neck incision. In women with a history of pelvic surgery, 65% (46/71) had a successful test, and 35% (25/71) had a failed test ($p = 0.544$). A total of 47 patients had a history of orthopedic surgery, of whom 45% (21/47) had a successful test phase and 55% (26/47) a failed test phase ($p = 0.721$). Of the 51 patients with a history of psychiatric illness, 78% (40/51) had a successful first stage, and 22% (11/51) had a failed first stage ($p < 0.001$). Table 2 shows the underlying psychiatric illnesses according to the DSM-5 of the cohort. PTSD and depression were the two most common psychiatric illnesses.

During the test phase, 11 (5%) patients had a wound infection, which was effectively treated with antibiotics in all cases. One patient had an infected lead, which was removed before the end of the first stage. No other adverse events were reported.

Multivariable Logistic Regression

We included the following possible predictors in a logistic regression model for female patients: age, inability to void during UDS, a history of psychiatric illness, a history of orthopedic surgery, and a history of pelvic surgery (Table 3). In women, age and a history of psychiatric illness significantly predicted first stage SNM success. First, an increase in age of ten years decreased the odds of success 1.35 times (OR 0.74, 95% CI: 0.59–0.93, $p = 0.011$). Second, a

Table 1. Characteristics of Patients Who Had a First-Stage SNM for the Treatment of NOUR.

Parameter	Total	Successful first stage	Failed first stage	*p* Value
Median age	53 y (median, IQR 38–66)	43 y (median, IQR 28.5–61.5)	61 y (median, IQR 47.8–69.0)	<0.001
Sex				<0.001
All	215	101 (47%)	114 (53%)	
Male	82	18 (22%)	64 (78%)	
Female	133	83 (62%)	50 (38%)	
Cause of NOUR				0.246
Unknown	137	59 (43%)	78 (57%)	
After surgery	67	35 (52%)	32 (48%)	
Neurogenic	11	7 (64%)	4 (36%)	
CIC frequency				
Before tined lead	4.5 (median, IQR 3–5)	4.5 (median, IQR 3–5.5)	4 (median, IQR 3–5)	0.722
4 wk postoperative	2 (median, IQR 0–4.5)	0 (median, IQR 0–1)	4 (median, IQR 3–5)	<0.001
Preoperative UDS				
PVR	565 mL (mean, SD 232)	540 mL (mean, SD 224)	590 mL (mean, SD 239)	0.156
Inability to void	92	49 (53%)	43 (47%)	0.094
A history of				
Psychiatric illness	51	40 (78%)	11 (22%)	<0.001
Orthopedic surgery	47	21 (45%)	26 (55%)	0.721
TURP and/or BNI (men)	30	8 (27%)	22 (73%)	0.433
Pelvic surgery (women)	71	46 (65%)	25 (35%)	0.544

BNI, bladder neck incision; TURP, transurethral resection of the prostate.

history of psychiatric illness increased the odds of success 3.92 times (95% CI: 1.51–10.2, $p = 0.005$).

We included the following possible predictors in a logistic regression model for male patients: age, inability to void during UDS, a history of psychiatric illness, a history of orthopedic surgery, and a previous transurethral prostate resection and/or bladder neck incision (Table 4). Age and a previous transurethral prostate resection and/or bladder neck incision significantly predicted first stage SNM success in this cohort of patients with NOUR. A ten-year increase in age decreased the odds of success 2.33 times (OR 0.43, 95% CI: 0.25–0.72, $p = 0.002$), and a previous transurethral prostate resection and/or bladder neck incision increased the odds of success 7.71 times (95% CI: 1.43–41.5, $p = 0.017$).

Long-Term Efficacy and Patient Satisfaction

The questionnaire was filled out by 60% (68/114) of patients with a failed first phase, at a median of three years (IQR 1–5) after the patient's tined lead test phase (Table 5). The response rate of patients with a successful first stage was 75% (76/101) at a median duration of three years (IQR 1–6) after the tined lead test phase (Table 5). Of those patients, 87% (66/76) continued to use their SNM system, and 92% (70/76) would recommend SNM to other patients. Among the patients with a failed first stage, 72% (49/68) reported no change in their health on the PGI-I scale. The reported health on the PGI-I scale was significantly different from those with a successful first stage ($p < 0.001$). Of those patients, 84% (64/76) reported to have an "improvement of health" since receiving the SNM system. The CIC frequency per day was significantly different between the patients with a failed and a successful first stage ($p < 0.001$). Most patients with a failed first stage (88%, 60/68) still applied CIC once or more times per day. In the group of patients with a successful first stage, 61% (46/76) of the patients applied no CIC, and 88% (67/76) did not receive another treatment for NOUR after IPG implantation; the latter rate was 94% (64/68) in patients with a failed first stage ($p = 0.119$). Five patients received a urinary diversion, three patients who had a failed first stage and two patients who had a successful first stage (Table 5). The most frequent complication that occurred was pain around the lead or

Table 2. Diagnoses of Psychiatric Illness, According to the DSM-5, in Patients Who Received a First Stage.

Diagnosis	Total	Successful first stage	Failed first stage
PTSD	23	18	5
Depression	17	11	6
Somatoform disorder	8	6	2
Anxiety and panic disorder	5	5	0
Autism/ADHD/ADD	4	4	0
Psychotic disorder	3	3	0
Borderline personality disorder	3	2	1
Bipolar disorder	2	2	0
Substance-related disorder	1	1	0

ADD, attention deficit disorder; ADHD, attention-deficit/hyperactivity disorder.

Table 3. Multivariable Logistic Regression Model to Predict First-Stage SNM Success in Women.

Parameter	OR	95% CI	*p* Value
Age (10 y)	0.74	0.59–0.93	0.011
Inability to void during UDS			
No	Ref		
Yes	0.79	0.35–1.78	0.573
Psychiatric illness			
No	Ref		
Yes	3.92	1.51–10.2	0.005
Orthopedic surgery			
No	Ref		
Yes	0.73	0.29–1.85	0.509
Pelvic surgery			
No	Ref		
Yes	1.95	0.86–4.42	0.107

Ref, reference.

IPG (20%, 15/76). Furthermore, 42% (32/76) of patients had one or more parameter adjustments during follow-up.

Of all patients with a successful first stage who responded to the questionnaire, 37% (28/76) received a rechargeable Axonicsr-SNM System™ (Table 6). Of those patients, 82% (23/28) found the recharging procedure easy or feasible. Most patients (61%, 17/28) recharged their device once every seven to 14 days; 93% (26/28) of the patients were content with the frequency of recharging. For most patients, the duration of recharging was between 30 minutes and one hour (61%, 17/28), and 93% (26/28) were content with the recharging duration.

DISCUSSION

Patients with NOUR with significant PVRs use CIC or indwelling catheterization to ensure timely drainage of the bladder. Therapeutic options to restore bladder function and abolish the necessity for catheterization are limited. Pharmacologic treatment, such as distigmine or tamsulosin, provides a noninvasive option but has a limited success.[29] In certain cases, bladder outlet surgery in men or pelvic floor relaxation education are possible treatment options. These management strategies do not alter the contractile power of the bladder but might improve bladder emptying and decrease PVR by lowering urethral resistance. A possible curative option is latissimus dorsi detrusor myoplasty. However, this is a complex, invasive procedure that can only be offered to selected cases, and its efficacy has to be validated in larger series.[30] Alternatively, SNM provides a minimally invasive, surgical intervention. It is important for clinical practice to optimize patient selection for SNM.

Table 4. Multivariable Logistic Regression Model to Predict First Stage SNM Success in Men.

Parameter	OR	95% CI	*p* Value
Age (10 y)	0.43	0.25–0.72	0.002
Inability to void during UDS			
No	Ref		
Yes	3.06	0.83–11.3	0.093
Psychiatric illness			
No	Ref		
Yes	4.39	0.74–26.1	0.104
Orthopedic surgery			
No	Ref		
Yes	0.81	0.19–3.53	0.778
TURP and/or BNI			
No	Ref		
Yes	7.71	1.43–41.5	0.017

BNI, bladder neck incision; Ref, reference; TURP, transurethral resection of the prostate.

The overall success rate of the first stage SNM in patients with NOUR was 47% in this study. This success rate reflects the number of patients who were able to empty their bladder without significant PVR or had a >50% reduction of CIC frequency (most patients performed zero catheterizations per day after the first stage), implicating significant improvement of bladder emptying. The success rate is comparable to the success rate reported by Jairam et al,[19] which was 45%. A previous study compared the efficacy of PNE with that of the tined lead test phase.[31] All included patients received PNE first and thereafter a tined lead test phase. More patients with NOUR had a successful tined lead test phase than those who had a successful PNE (61% vs 45%). These results indicate that the PNE procedure to test a patient's responsiveness to SNM in the case of NOUR is less sensitive. This may at least partly be explained by the higher migration rate of the PNE wire electrode than that of the tined lead.[15] However, PNE has the advantage of having one less surgery in the case of success.

Female sex was associated with a more favorable tined lead test phase outcome. In this study, there was a success rate of 62% in women and 22% in men. In a previous study that included a mixed population of patients with OAB, NOUR, neurogenic bladder, and interstitial cystitis, who received a PNE or first stage, male sex was significantly associated with a lower likelihood of test phase success.[32] In another cohort, including 84 patients with NOUR, female sex was significantly associated with a successful tined lead test phase.[19] In the respective study, 18% of men and 68% of women had a successful test phase. This is comparable to the success rates in this study. In contrast, other studies reported comparable success rates in men and women. A retrospective study in 21 male patients with chronic urinary retention showed that the tined lead test phase was successful in 66.7% of the included patients, which is different from the success rate in the present cohort.[22] However, this was a relatively small cohort. A possible explanation for the difference between men and women might be the contribution of the prostate to the lower urinary tract symptoms. It is hypothesized that lowering bladder outlet resistance in men by removing the prostate or part of the prostate facilitates bladder emptying in the case of NOUR.[33] Therefore, initially resecting the prostate in men with detrusor underactivity might be favorable, after which SNM can be offered to men with persistent significant PVR after deobstruction.[34] This is supported by the multivariable logistic regression analysis in this study, which showed that a previous transurethral prostate resection and/or bladder neck incision increased the odds of success 7.71 times. It is noteworthy to state that the term 'non-obstructive urinary retention' or NOUR is not fully correct since obstruction cannot be observed in urinary retention in the absence of a voiding phase during urodynamics. The contribution of bladder outlet resistance, and thus obstruction, to the retention observed in these patients remains unclear.

Furthermore, we identified age as a predictor of tined lead test phase outcome. A ten-year increase in age decreased the odds of success 1.35 times in women and 2.33 times in men. These results

Table 5. Follow-up of Patients With a Successful First Stage and a Failed First Stage.

Parameter	Total	Successful first stage	Failed first stage	*p* Value
Response rate	144 (67%)	76 (75%)	68 (60%)	
Duration of follow-up	3 y (median, IQR 1–5)	3 y (median, IQR 1–6)	3 y (median, IQR 1–5)	
% of patients using SNM at follow-up		66 (87%)	na	
Would recommend SNM to other patients		70 (92%)	na	
PGI-I				<0.001
Very much better	26	25 (33%)	1 (1%)	
Much better	36	31 (41%)	5 (7%)	
A little better	12	8 (11%)	4 (6%)	
No change	54	5 (7%)	49 (72%)	
A little worse	11	4 (5%)	7 (10%)	
Much worse	4	2 (3%)	2 (3%)	
Very much worse	0	0	0	
CIC frequency per day				<0.001
0	54	46 (61%)	8 (12%)	
1	5	4 (5%)	1 (1%)	
2	12	8 (11%)	4 (6%)	
3	13	6 (8%)	7 (10%)	
4 or more	56	8 (11%)	48 (71%)	
Other intervention				0.119
No other intervention	131	67 (88%)	64 (94%)	
Urinary diversion	5	2 (3%)	3 (4%)	
Transurethral or suprapubic catheter	8	7 (9%)	1 (1%)	
Complications				
Device malfunction		2 (3%)	na	
Box/lead site infection		4 (5%)	na	
Replacement		6 (8%)	na	
Box/lead site pain		15 (20%)	na	
Box/lead repositioning		10 (13%)	na	
Explantation		3 (4%)	na	
Adjustment of stimulation parameters		32 (42%)	na	

na, not applicable.

are in line with previous studies. In a retrospective study of 21 male patients with chronic urinary retention, men with an age lower than a median of 43 years were more likely to have a successful tined lead test phase.[22] The median age of responders in this study was 43 years (median, IQR 28.5–61.5) and 61 years (median, IQR 47.8–69.0) in nonresponders. In another retrospective study of patients with NOUR receiving a first stage tined lead, age was also significantly lower in responders than in nonresponders.[19] The mean age in responders was 44.3 (range: 40.1–48.6) years and 53 (range: 49.1–56.8) years in nonresponders. These studies and this study implicate that tined lead test phase success decreases with an increasing age.

We also included the factor "inability to void during UDS" in the prediction models. This is often incorrectly referred to as an acontractile detrusor in the context of UDS, probably because of sympathetic activation during UDS. The absence of a contraction of the detrusor muscle during UDS does not necessarily mean that the detrusor muscle is acontractile. Our analysis implies that the inability to void during UDS does not predict a successful first stage. Previous reports have only investigated the relationship between bladder contractility and tined lead outcome, implicating a higher success rate when contractility is preserved.[23,35]

We found that women with NOUR and a history of psychiatric illness were more likely to benefit from a tined lead test phase than women who did not have such a history. It has been shown that PTSD because of sexual abuse increases the risk of bladder dysfunction, including urinary retention.[36] In a previous study in 54 patients with OAB or NOUR, no association was detected between a history of psychiatric illness and PNE outcome.[26] The difference with the results of this study might be caused by the lower sensitivity of PNE as well as the different types of patients, that is, the inclusion of OAB patients. On the contrary, a history of pelvic surgery (in women) and a history of orthopedic surgery were not predictive of first stage SNM success. This can be because of the heterogeneity of the included procedures for both pelvic and orthopedic surgery.

The cohort described in this study is relatively large compared with similar studies and includes a multivariable analysis. A limitation, however, is its retrospective nature. Most patients were from a tertiary center. Therefore, it is unclear to what extent the results of this study are generalizable to all patients with NOUR.

In conclusion, this study identified age and psychiatric illness, such as PTSD and depression in women, and age and transurethral resection of the prostate and/or bladder neck incision in men to be predictors of first stage SNM success. Psychiatric illness in women increased the odds of success 3.92 times, and a previous transurethral resection of the prostate and/or bladder neck incision in men increased their odds of success 7.71 times. A ten-year increase in age decreased the risk of success in both sexes. Altogether, the identified predictors can be used by clinicians when counseling their patients to undergo a tined lead test phase in an attempt to treat NOUR. Also, this study showed that those patients who

Table 6. Follow-up of Patients Who Received a Rechargeable SNM Device After a Successful First Stage.

Parameter	No. of patients (%)
No. of patients with rechargeable IPG	28
Difficulty of recharging	
Easy	8 (29%)
Feasible	12 (43%)
Neutral	3 (11%)
Difficult	4 (14%)
Very difficult	1 (4%)
Frequency of recharging	
Every day	0
Every 2 to 4 d	1 (4%)
Every 5 to 7 d	9 (32%)
Every 7 to 14 d	17 (61%)
Less than once every 14 d	1 (4%)
Content with frequency of recharging	
Yes	26 (93%)
No	2 (7%)
Duration of recharging	
<15 min	0
<30 min	1 (4%)
<1 h	17 (61%)
<2 h	9 (32%)
>2 h	0
Content with duration of recharging	
Yes	26 (93%)
No	1 (4%)

receive an implant are generally satisfied with their therapy, and those who receive a rechargeable system are content with the frequency and duration of recharging their device.

Authorship Statements

Bertil F.M. Blok, Jeroen R. Scheepe, and Lambertus P.W. Witte contributed to the conception and design of the study. Rosa L. Coolen, Jan Groen, Alexander B. Stillebroer, Lambertus P.W. Witte, and Bertil F.M. Blok contributed to the acquisition of data. All authors contributed to the analysis and interpretation of the data and editing of the manuscript. All authors approved the final manuscript. All authors had complete access to the study data.

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