

# Sacral Neuromodulation Treatment for Non-neurogenic Urological Disorders: Experience of a Single Center in Turkey

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## What's known on the subject? and What does the study add?

Sacral neuromodulation (SNM) has been proven by many studies to be an effective and safe minimal invasive therapy for the treatment of overactive bladder, bladder pain syndrome/interstitial cystitis, and idiopathic non-obstructive urinary retention. Efficacy and safety results of this study is similar with the literature. On the other hand, this study is presenting the experience of a center in Turkey with regard to SNM treatment in non-neurogenic urological disorders.

## Abstract

**Objective:** We evaluated the success rate and complications of sacral neuromodulation (SNM) in patients with non-neurogenic urological disorders.

**Materials and Methods:** We retrospectively evaluated patients with an overactive bladder (OAB), bladder pain syndrome/interstitial cystitis (BPS/IC), and idiopathic non-obstructive urinary retention (IUR), who underwent SNM between 2015 and 2020. SNM was recommended for patients with OAB and BPS/IC who previously had unsuccessful conservative and medical therapies and botulinum toxin injections. Success was defined as more than 50% improvement in clinical symptoms or voiding diary parameters in patients with OAB; more than 50% improvement in storage symptoms or subjective pain improvement or improvement after pain medications in patients with BPS/IC; more than 50% reduction in urethral catheterization rate in patients with IUR. We reviewed the success rates and complications.

**Results:** Twenty-four patients underwent the first stage of SNM and 16 patients (66.6%) received permanent implantation. Ten patients were female (62.5%) and six were male (37.5%). The mean age was 36.9 years. Seven patients (43.7%) had OAB, three patients (18.7%) had BPS/IC, and six patients (37.5%) had IUR. After a mean follow-up of 42.3 months, the overall success rate was 87.5% for all indications. The success rate was 100%, 100%, and 66.7% for OAB, BPS/IC, and IUR, respectively. Four patients underwent surgical reintervention: two had their devices removed due to failure (50%), one had their implantable pulse generator (IPG) repositioned due to serious pain (25%), and one changed IPG due to malfunction (25%).

**Conclusion:** SNM is a safe and effective minimally invasive therapy for patients with non-neurogenic urological disorders.

**Keywords:** Bladder pain syndrome, idiopathic urinary retention, interstitial cystitis, overactive bladder, sacral neuromodulation

## Introduction

Sacral neuromodulation (SNM) has proven to be an effective treatment option for refractory overactive bladder (OAB) and idiopathic nonobstructive urinary retention (IUR) (1). The Food and Drug Administration has approved SNM for treating OAB and IUR (2). Additionally, SNM has been widely used for treating bladder pain syndrome/interstitial cystitis (BPS/IC) and neurogenic bladder (3). Several SNM studies are present in the current literature, reporting long-term success and safety (1,4).

Currently, there are no articles on the success and complications of SNM in urological disorders in the English literature published from Turkey. This is the first study from Turkey, where we present our experience with SNM for treating OAB, IUR, and BPS/IC.

## Materials and Methods

Our institutional ethical board approved this study (University of Health Sciences Türkiye, Gülhane Training and Research Hospital, approval number: 19/80, date: 28.05.2019). Following

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**Received:** 05.02.2021

**Accepted:** 04.05.2021

**Cite this article as:** Coğuplugil AE, Yılmaz S, Topuz B, Zor M, Kaya E, Gürdal M. Sacral Neuromodulation Treatment for Non-neurogenic Urological Disorders: Experience of a Single Center in Turkey. *J Urol Surg* 2021;8(4):261-265.

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the ethical approval, we retrospectively reviewed the medical records of all patients who underwent implantable pulse generator (IPG) placement (Interstim™, Medtronic, Minneapolis, USA) in our center between January 2015 and May 2020. Patients' demographics, indications for SNM, treatment success, follow-up period, and complications (including revisions) were recorded.

We assessed all patients using a thorough medical history, physical examination, cystoscopy, urodynamic testing, neurological and psychiatric examination, and seven-day voiding diary (frequency, urgency, incontinence episodes, voided volume, and self-catheterization episodes and volume). Inclusion criteria were as follows: patients in the age range of 18 to 55 years, urinary urgency, frequency, urgency incontinence, pain related to the urinary bladder, dysuria, and urinary retention. Exclusion criteria were as follows: patients older than 55 years bladder outlet obstruction, urethral stricture, urinary tract cancer, urinary tract infection, pregnancy, and neurological or psychiatric pathology. SNM treatment indications included refractory OAB, refractory BPS/IC, and IUR.

OAB was diagnosed according to the definition of the International Continence Society (5). BPS/IC was diagnosed according to the definition of the European Society for the Study of Interstitial Cystitis (ESSIC) (6). IUR was defined as "neurologically healthy patients who are unable to urinate or had difficulty urinating with a significant residual urine volume, greater than 300 mL, without urethral stricture or bladder outlet obstruction." Patients defined as "refractory OAB" were those who experienced no improvement using one antimuscarinic drug or more for three months or those who were unable to tolerate the side effects of antimuscarinics (7). All patients with OAB and BPS/IC had botulinum toxin injections before SNM treatment. In patients with OAB, failure of intradetrusor botulinum toxin injections was defined as less than 50% improvement or worsening of symptoms following the injections. Refractory BPS/IC was defined as less than 50% improvement or worsening of symptoms following oral and intravesical treatments, hydrodistension, fulguration, or intradetrusor botulinum toxin injections.

All patients underwent two-stage SNM implantation. The first stage was performed in the operating room under local anesthesia and sedation. A 22-G spinal needle was placed percutaneously into each S3 foramen under fluoroscopic guidance, and stimulation was then performed. Proper needle location was assessed using sensorial (vaginal or perineal sensation) and motor (bellow-like contraction of the anal sphincter or plantar flexion of the great toe) responses during stimulation. The needle with the best stimulation responses was retained and the other one removed. Then, a small incision was made and the tined permanent lead was placed through

the needle tract. Proper tined lead placement was confirmed using fluoroscopy and repeat stimulation. The tined lead was then connected to an extension wire, which was tunneled subcutaneously to the contralateral upper lateral side of the hip and connected to an external temporary generator. Patients were taught how to work the external generator. During the test stimulation period (7-30 days), patients were seen daily for the first five days to assess the sensorial response and symptom improvement. Patients completed a seven-day voiding diary (frequency, urgency, incontinence episodes, voided volume, and self-catheterization episodes and volume). After seven days, the patients were contacted by phone. If a patient reported a decreased vaginal or perineal sensation, reprogramming was done. Reprogramming was also done for patients who experienced no clinical improvement after the first week and repeated if necessary. Success was defined as more than 50% improvement in clinical symptoms or voiding diary parameters in patients with OAB; more than 50% improvement in storage symptoms or subjective pain improvement or improvement after pain medications in patients with BPS/IC; less than 50% reduction in urethral catheterization rate in patients with IUR. If successful results were achieved during the test stimulation period, then the patients underwent permanent IPG placement under local anesthesia. Improvement of less than 50% or worsening of the symptoms was defined as failure for all indications.

All patients were followed up at three, six, and twelve months postoperatively and yearly thereafter, or if clinically indicated. Overall symptom improvement was reported using a voiding diary and direct interview on each visit. Symptom scores were not used. Also, PVR measurement was performed for patients with IUR. During the follow-up, SNM was considered successful if there was an initial improvement of more than 50% in clinical symptoms or voiding diary parameters persisted compared with baseline. Due to the small number of patients and retrospective design, descriptive statistical data (percentage, mean, and range) were used.

## Results

Twenty-four patients underwent the first stage of SNM from January 2015 to May 2020 in our urology department. Eight patients (33.3%) failed the test period, and 16 patients (66.6%) received permanent IPG implantation. During implantation, motor responses were achieved in 15/16 patients (93.7%) and sensory responses were achieved in 12/16 patients (75%). Our implantation rate was 66.6%. Of these 16 patients, 10 were female (62.5%) and six were male (37.5%). The mean age was 36.9 (range: 20-55) years. Seven patients (43.7%) had OAB, three patients (18.7%) had BPS/IC, and six patients (37.5%) had

IUR. After a mean follow-up of 42.3 months (range: 5-80), our overall success rate was 87.5% for all indications. The success rate was 100%, 100%, and 66.7% for OAB, BPS/IC, and IUR, respectively (Table 1).

No local wound complication (hematoma, infection, etc.) occurred in the early postoperative period. Also, no serious complications occurred. Four patients (25%) experienced complications during the follow-up period: Two patients experienced device failure, one patient had IPG site pain, and one patient experienced IPG malfunction. Four patients underwent surgical reintervention: Two had their devices removed due to failure (50%), one had their IPG repositioned due to serious pain (25%), and one changed IPG due to malfunction (25%) (Table 1). Failure occurred in two patients with IUR at three and 47 months after implantation. Follow-up with clean intermittent catheterization was recommended for these patients.

	All	OAB	BPS/IC	IUR
Number of patients, n (%)	16	7 (43.7)	3 (18.7)	6 (37.5)
Mean age (range), years	36.9 (20-55)	31.1	49	37
Gender: female/male, n	10:6	3:4	3:0	4:2
Mean follow-up, months	42.3	37.8	37.6	42.5
Success, %	87.5	100	100	66.7
Complications, n	4	0	0	4
• Failure	2	0	0	2
• IPG site pain	1	0	0	1
• IPG malfunction	1	0	0	1

OAB: Overactive bladder, BPS/IC: Bladder pain syndrome/interstitial cystitis, IUR: Idiopathic non-obstructive urinary retention, IPG: Implantable pulse generator

## Discussion

SNM is a safe and long-term effective therapy for patients with nonneurogenic lower urinary tract dysfunction (LUTD) (2). The precise mode of action of SNM still remains largely unknown (4). It is thought that SNM works by modulating reflexes at the cord level; however, supraspinal pathways also have a role (8).

Our overall success rate was 87.5% at a mean follow-up 42.3 months, and the success rates for OAB, BPS/IC, and IUR were 100%, 100%, and 66.7%, respectively. These results are similar to those of other SNM studies. In a retrospective study by Sutherland et al. (4), a 69% success rate was reported after SNM implantation in patients with voiding dysfunction with a mean follow-up of 22 months. Peeters et al. (8) reported a 70% success rate in patients with urgency incontinence and a 73% success

rate in patients with IUR at a mean follow-up of 47 months. In another retrospective study with a median follow-up of 9.7 years, Ismail et al. (9) reported a 63% success rate in patients with OAB. Siegel et al. (10) reported an 83% success rate of SNM in patients with OAB (10). Zhang et al. (3) reported that the success rates in patients with OAB, BPS/IC, and IUR were 42.5%, 72.4%, and 51.6%, respectively. Gajewski and Al-Zahrani (11) reported that the rate of permanent IPG implantation was 59%, and the success rate in patients with BPS/IC was 72%, at a mean-follow-up of 61.5 months.

The most common adverse event reported in the literature was pain at the implant site (15%-42%) (2). No serious complications were reported (2,4). van Kerrebroeck et al. (1) reported that 20% of the patients experienced adverse events resulting in surgical intervention at the one-year follow-up. This rate increased to 42.1% at five-year follow-up. The most common surgical complications requiring surgical intervention were IPG site pain, suspected lead migration, and new pain or undesirable change in stimulation. Other complications reported in the literature were loss of efficacy, device problem, adverse change in bowel function, infection, and suspected neuropraxia (12). The surgical revision rate was between 13-47% (9,13). The most common reason for surgical revision was pain at the site of implantation (2,13). The reintervention rate is high in long-term follow-up and tends to be within the first two years after the implantation (2). Our complication rate was 25%. Four patients underwent surgical intervention: Two had their devices removed due to failure (50%), one had their IPG repositioned due to serious pain (25%), and one changed IPG due to malfunction (25%). All complications occurred in patients with IUR. Additionally, none of our patients experienced serious complications.

The number of our patients is small because we cannot provide SNM to every patient with refractory OAB and BPS/IC. SNM and botulinum toxin injections are both effective and recommended for treating patients with OAB and BPS/IC who failed conservative and initial therapies. No hierarchy has been implied between botulinum toxin and SNM (14,15). In our country, the social security institution allows implantation of SNM in neurologically and psychologically healthy patients with OAB and BPS/IC, who failed conservative and initial medical therapies and intradetrusor botulinum toxin injection. Therefore, it is mandatory to use intradetrusor botulinum toxin injections in patients with OAB and BPS/IC before SNM implantation. In fact, this clinical practice is performed to reduce the treatment costs of patients with OAB and BPS/IC since SNM is an expensive treatment option. In randomized studies conducted on patients with OAB, it has been shown that SNM treatment is more expensive than botulinum toxin injections (16,17).

In our study, a previous history of psychiatric disease was an exclusion criterion since, in some studies, psychiatric disorders

were associated with poor results and adverse events. In a study by Weil et al. (18) that reported SNM treatment results in 36 patients with chronic voiding dysfunction, all patients with a previous history of psychological disorder or sexual abuse had a good response to temporary stimulation. However, the median duration of the therapeutic effect was only 12 months in patients with a previous psychiatric history, and 82% of these patients showed poor results compared with 28% of the patients without a history of psychiatric disorders (18). White et al. (19) reported a high rate of implant removal in patients with a psychiatric disease history but could not show a significant relationship between psychiatric history and adverse events (19). Marcelissen et al. (20) reported that a history of psychiatric disease was unrelated to the outcome of the test stimulation. However, patients with a history of psychiatric disease more likely encounter adverse events with permanent SNM treatment.

Age was associated with the success rate of SNM. Peters et al. (21) reported that advanced age was negatively associated with SNM success. Amundsen et al. (22) reported in a prospective study that, in patients with refractory urge incontinence who were treated with SNM, age older than 55 years and more than three chronic conditions were independent factors associated with a lower cure rate. Sherman et al. (23) reported that an age less than 55 years was positively associated with SNM treatment. Therefore, we included patients younger than 55 years old in our study.

When placing the quadripolar electrode, it is important to obtain sensory and motor responses. Cohen et al. (24) investigated whether intraoperative motor or sensory response is more predictive of a successful SNM treatment. The authors concluded that a positive test stimulation is more likely when intraoperative lead placement causes a positive motor response compared with sensory response (24). Peters et al. (21) evaluated the impact of assessing sensory responses during quadripolar lead placement in patients with refractory voiding symptoms. They found that, during permanent lead placement, routinely assessing the sensory response insignificantly impacts the success rate of IPG implant and the clinical outcomes of SNM (22). We tried obtaining motor and sensory responses in each patient, and we achieved motor responses in 93.7% of patients and sensory responses in 75% of patients.

### Study Limitations

The main limitations of this study were its retrospective design and a small number of patients. However, this is the first study from Turkey reporting on SNM treatment outcomes in urological disorders.

## Conclusion

SNM is a safe and effective minimally invasive therapy in patients with OAB, BPS/IC, and IUR and should be considered before any invasive surgical intervention is planned. Several studies are published in English literature, but this is the first study from Turkey reporting on SNM treatment outcomes in urological disorders.

## Ethics

**Ethics Committee Approval:** Our institutional ethical board approved this study (University of Health Sciences Turkey, Gülhane Training and Research Hospital, approval number: 19/80, date: 28.05.2019).

**Informed Consent:** Retrospective study.

**Peer-review:** Externally peer-reviewed.

## Authorship Contributions

Surgical and Medical Practices: A.E.C., S.Y., M.G., Concept: A.E.C., M.G., Design: A.E.C., M.G., Data Collection or Processing: A.E.C., Analysis or Interpretation: A.E.C., Literature Search: A.E.C., S.Y., B.T., M.Z., E.K., Writing: A.E.C., M.G.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declare that they have no relevant financial.

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