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# Sacral neuromodulation for refractory neurogenic underactive bladder in an adolescent dependent on clean intermittent catheterization: A case report

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**Abstract**
**Background:** Chronic urinary retention due to detrusor underactivity or acontractility can markedly impair quality of life and may necessitate long-term clean intermittent catheterization (CIC). Sacral neuromodulation (SNM) is an established treatment option for selected patients with refractory non-obstructive urinary retention, although evidence in adolescents and in neurologically mediated retention remains limited.
**Case presentation:** A 14-year-old girl with a diagnosis of neurogenic bladder had required CIC five to six times daily for two years. Assessment demonstrated a large-capacity bladder, post-void residual urine exceeding 250 mL, and no detrusor instability on urodynamic testing. Following a staged SNM trial, the patient reported improved bladder sensation and spontaneous voiding, with cessation of CIC during the trial. A permanent implant was subsequently placed.
**Outcome:** At three months the patient continued to void without CIC; at six months a near-normal voiding pattern without catheterization was reported. No complications were reported except occasional dysuria episodes during the documented follow-up.
**Conclusion:** This case illustrates a favorable short-term functional response to SNM in an adolescent with neurogenic bladdder.

**Keywords:** Sacral neuromodulation, adolescent, neurogenic bladder, detrusor acontractility, non-obstructive urinary retention, clean intermittent catheterization (CIC)

## Introduction

Underactive bladder describes a symptom complex characterized by prolonged urination, hesitancy, slow stream, and sometimes incomplete emptying; detrusor underactivity is a urodynamic diagnosis indicating a contraction of reduced strength and/or duration that results in prolonged or incomplete bladder emptying. An acontractile detrusor denotes absence of demonstrable detrusor contraction during urodynamic testing. In young patients, impaired emptying may arise from congenital, neurological, functional, or iatrogenic conditions, making etiological assessment essential.

Clean intermittent catheterization remains a cornerstone of management when bladder emptying is inadequate. Although effective in reducing retained urine, it imposes practical and psychosocial demands, particularly during adolescence. Sacral neuromodulation seeks to modify afferent and efferent neural signaling in lower urinary tract control. The present report describes an adolescent who regained spontaneous voiding after staged SNM.

## Case presentation

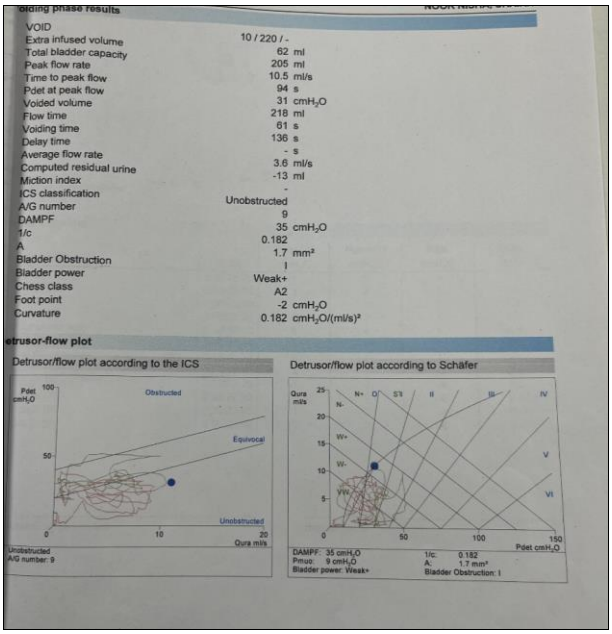
### Patient history:

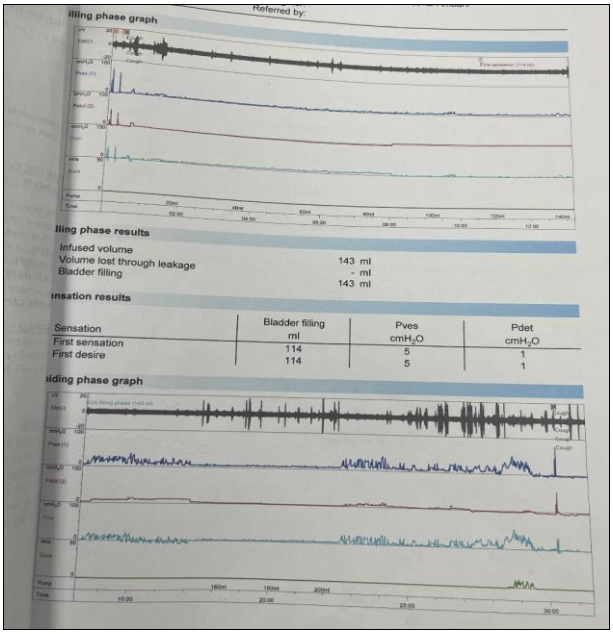
A 14-year-old female with a pre-existing diagnosis of neurogenic bladder presented with persistent chronic urinary retention. For the preceding two years she had performed clean intermittent catheterization approximately five to six times per day. She described minimal spontaneous voiding and substantial reliance on catheterization for bladder emptying.

In a patient of this age, the evaluation should document prior spinal or neurological disease, congenital anomalies, pelvic surgery, constipation, medication exposures, and any symptoms suggesting dysfunctional voiding or outlet obstruction. Baseline renal function and upper-tract surveillance are particularly important in patients labeled as having neurogenic lower urinary tract dysfunction. However, this patient did not have any history of spinal injury or surgery

### Investigations

The initial assessment demonstrated a subnormal bladder capacity. USG KUB showed normal upper tract with thickened bladder wall. Urodynamic examination was reported to show a subnormal detrusor pressure, Small cystometric capacity, stable, compliant, no detrusor instability Study was repeated with slow fill rate similar findings were noted. UD study and cystoscopy is necessary to rule out all alternative causes of urinary retention.




| Parameter | Pre-SNM finding | Interpretation / reporting note |
|---|---|---|
| Age / sex | 14-year-old female | Adolescent patient |
| Duration of CIC | 2 years | Chronic catheter dependence |
| CIC frequency | 5–6 times/day | Reported baseline frequency |
| Spontaneous voiding | Minimal | Patient-reported |
| Bladder capacity | 205 ml | Infusion was stopped at 205 ml when patient had urgency and abdominal discomfort |
| Post-void residual | >150ml | High for bladder capacity |
| Detrusor function | subnormal detrusor pressure on urodynamics | Poor contractile bladder |

**Treatment rationale and consent**

Given persistent retention despite established catheter-based management, staged SNM was undertaken. In adolescent patients, treatment decisions usually follow multidisciplinary discussion and careful assessment of the expected benefits, limitations of pediatric evidence, device maintenance, potential need for revision, and the continued possibility of CIC. Patient and parent's consent were obtained and patient was posted for SNM.

Stage 1 procedure of temporary placement of lead was successful following which stage 2 where permanent lead with battery placement in subcutaneous pouch was done.

**Staged Sacral Neuromodulation**

A staged SNM approach was performed using Interstim technology, comprising a test phase followed by permanent implantation after a favorable response.

**Sacral Neuromodulation Stage-I**

Under LA, Pt in prone position parts painted & drapped.

7cm cranially from Coccyx tip & 2cm lateral to line markings made around.

Needle with Stiller inserted at the point 2cm left lateral to midpoint marked & Stiller Removed ,Guiderod inserted & Needle sheath removed ,port access sheath with cannula inserted & position checked with C-arm .Electrodes inserted via sheath & position checked /confirmed by C-Arm,Nerve Stimulation done & ankle twitching or jerks seen at 0.8 to 1 Joule current ,Electrode port deployed & position verified & through Submucosal tunneling brought out of skin to opposite side & connected to ENS stimulator.

Wound Incision closed using 2-0 vicryl subcutaneouly & Skin closed using 2-0 ETHILON, Sterile dressing applied. Post op vitals stable. Post operatively patient symptoms improved & Bladder voiding sensations gained & planned for Stage II Sacral NEUROMODULATION after 2 weeks






**Sacral Neuromodulation Stage-II**
Under SAP, Under LA, pt in prone position, Wound opened & submucosal tunnel opened, electrode attached with Stimulator is disconnected. Stimulator connected to the Battery &It is kept inside the Submucosal pocket & Wound closed using 2-0 Ethilon
Sterile dressing done & pt shifted to supine position

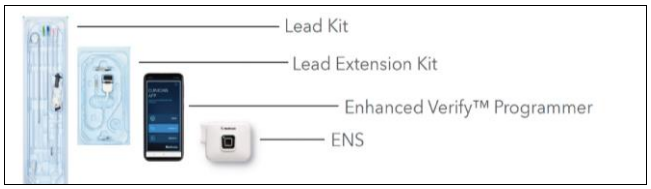
**Results and follow-up**

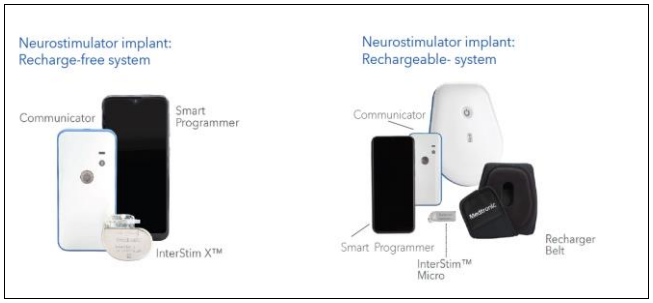
| Outcome | Baseline | Trial phase | 3 months | 6 months |
|---|---|---|---|---|
| CIC requirement | 5–6/day | None reported | None reported | None reported |
| Spontaneous voiding | Minimal | Improved | Improved | Near-normal pattern |
| Bladder sensation | Poor | Improved | Improved | Improved |
| PVR | >150mL | Not documented | Not documented | Not documented |
| Complications | - | Nil | Nil | Nil |

At three months after implantation, the patient was reported to have improved spontaneous voiding and no need for CIC. By six months, a near-normal voiding pattern without catheterization was described. No major complications were reported during this interval except for few episodes of dysuria with urine culture negative for organisms which was managed conservatively. The strongest supported endpoint is sustained patient-reported catheter independence through six months.

**Discussion**
**Components of SNM device**
The mechanisms of SNM are complex. Electrical stimulation of sacral neural pathways influence afferent signaling, spinal reflex networks, and supraspinal control of storage and voiding.




Clinical benefit in non-obstructive urinary retention may reflect improved coordination or restoration of functional voiding pathways rather than direct replacement of detrusor contractility.

**Mechanics of SNM**
Sacral neuromodulation electrically stimulates somatic afferent nerves in a sacral spinal root and sends signals to the CNS.The action potentials induced by electrical stimulation are thought to alter abnormal sensory input from the bladder. Efferent pathways are uninhibited so as not to suppress voluntary voiding. No direct influence of the bladder or sphincter muscles.

- The sacral nerve, in particular influences pelvic floor behavior and is believed to modulate neural reflexes.

**Relationship to existing evidence**
Evidence supporting SNM is strongest in carefully selected adults with refractory non-obstructive urinary retention and certain other lower urinary tract dysfunctions. The prospective study by Jonas and colleagues demonstrated clinically meaningful benefit in chronic urinary retention, while long-term multicenter follow-up reported sustained efficacy for several indications. Systematic reviews also emphasize that study populations, definitions of response, and outcome measures are heterogeneous. These adult data cannot be assumed to provide an adolescent-specific success probability.
Pediatric and adolescent use is comparatively less established, and published reports frequently involve small, heterogeneous cohorts with differing underlying conditions and endpoints.

**Clinical significance**
For a teenager, avoiding catheterization several times daily may improve independence, school participation, privacy, and treatment burden. Safety assessment is considered like urinary retention recurrence, urinary tract infections, pain, lead migration, loss of efficacy, device revision, and future device replacement.

**Strengths and limitations**
The central strength of this report is the clear temporal sequence of refractory catheter-dependent retention, a positive SNM test response, permanent implantation, and continued reported catheter independence at three and six months along with patient relief and satisfaction.
The principal limitations are the unspecified cause of neurogenic bladder; absence of detailed Postop pressure-

flow and cystometric data, lack of numerical postoperative residual volumes and a six-month follow-up horizon.

**Practical implications**

This case supports consideration of specialist evaluation for SNM in selected adolescents with refractory non-obstructive retention, but should not be taken as an argument for routine use in all patients with subnormal detrusor pressure. Appropriate selection requires confirmation that mechanical obstruction and reversible causes have been addressed, review of neurological status, discussion of alternative treatments, and a defined trial-response criterion. Continued objective surveillance is important even after the patient reports normal voiding.

**Conclusion**

Staged sacral neuromodulation was associated with improved spontaneous voiding and reported freedom from clean intermittent catheterization through six months in a 14-year-old girl with refractory urinary retention and subnormal detrusor functioning on baseline urodynamics. The case highlights a potential role for SNM in carefully selected adolescent patients

**Declarations**

**Patient consent:** Obtained.

**Financial support and sponsorship:** Nil

**Conflicts of interest:** None

**Data availability:** Clinical information is summarized in this report; further access is subject to patient confidentiality and institutional requirements.

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