

Neuromodulation

TECHNOLOGY AT THE NEURAL INTERFACE

July 2025 ■ Volume 28 ■ Number 5 ■ Pages 713-874

TABLE OF CONTENTS

NEUROMODULATION FOR GASTROINTESTINAL AND GENITOURINARY DISORDERS

Obituary

713 Jeffrey Ardell, PhD (December 20, 1952–February 12, 2025)

Robert D. Foreman, PhD; Siamak Salavatian, MEng, PhD

Review Articles



Editor's Choice

715 Long-term Outcomes of Sacral Nerve Stimulation on the Treatment of Fecal Incontinence: A Systematic Review

Erica Eggers, MD; Tess Crouss, MD; Jasjit Beausang, MD; Devon Smith, DO; Sean Spector, MD; Benjamin Saracco, MLS, MAIT; Amanda Adams, MLS; Taylor Dickinson, MD; Lioudmila Lipetskaia, MD

A comprehensive search of the MEDLINE, Embase, and Cochrane Central databases was performed to find publications, excluding case reports, reporting outcomes of SNS treatment for fecal incontinence (FI) in adults with at least 36 months of follow-up. Bias was assessed using the Risk of Bias in Non-randomized Studies – of Interventions (ROBINS-I) tool. Data were summarized per reported FI-related outcomes for symptom severity and quality of life.

3,326 publications were identified, and 36 studies containing 3,770 subjects were included. All studies had a serious risk of bias. Success was variably defined by each publication and ranged from 59.4-87.5% for per-protocol analyses and 20.9-87.5% for intention-to-treat analyses. All studies reporting bowel diary data, St. Mark's scores, and Cleveland Clinic Incontinence Scores demonstrated significant improvement with SNS treatment in the long term. Studies which examined quality of life outcomes also all demonstrated improvements in quality of life as measured by the Fecal Incontinence Quality of Life scale. The aggregate revision rate was 35.2%, and the explantation rate was 19.7%.

Neuromodulation

TECHNOLOGY AT THE NEURAL INTERFACE

July 2025 ■ Volume 28 ■ Number 5 ■ Pages 713-874

Contents continued



Editor's Choice

727 A Meta-Analysis on the Efficacy and Safety of Sacral Neuromodulation for Neurogenic Bladder or Bowel Dysfunction

Penghao Sun, MD; Wei Song, PhD

To evaluate the efficacy and safety of sacral neuromodulation (SNM) in the treatment of neurogenic bladder (NB) and neurogenic bowel dysfunction (NBD), a systematic literature search was conducted using PubMed and Web of Science up to August 2024, focusing on studies related to SNM treatment for NB or NBD. After assessing the quality of the studies, data were extracted and analyzed using Review Manager 5.3.

A total of 15 studies involving 573 patients were included. Following SNM treatment, the patients showed significant improvements in key outcome measures, including voiding frequency/24h (WMD -4.08; 95%CI -6.80, -1.35; $p = 0.003$), single voiding volume (WMD 123.60; 95%CI 93.17, 154.03; $p < 0.001$), number of leakage episodes/24h (WMD -4.27; 95%CI -5.79, -2.74; $p < 0.001$), number of nocturia (WMD -2.48; 95%CI -2.62, -2.35; $p < 0.001$), clean intermittent self-catheterization/24h (WMD -2.35; 95%CI -2.98, -1.71; $p < 0.001$), bladder compliance (WMD 9.09; 95%CI 2.31, 15.87; $p = 0.009$), maximum detrusor pressure during storage phase (WMD -14.76; 95%CI -18.63, -10.88; $p < 0.001$), maximum urine flow rate (WMD 6.50; 95%CI 4.21, 8.80; $p < 0.001$), maximum bladder capacity (WMD 66.28; 95%CI 2.83, 129.73; $p = 0.04$), Wexner score (WMD -9.98; 95%CI -13.65, -6.31; $p < 0.001$), and NBD score (WMD -6.31; 95%CI -6.89, -5.73; $p < 0.001$).

737 Meta-analysis of Randomized Controlled Trials on the Efficacy of Sacral Neuromodulation in Chronic Constipation

Sameh Hany Emile, MBBSCh, MSc, MD; Justin Dourado, MD; Anjelli Wignakumar, MBBS, BSc (Hons); Nir Horesh, MD; Zoe Garoufalia, MD; Rachel Gefen, MD; Marylise Boutros, MD; Steven D. Wexner, MD

Basic Science

746 Early Sacral Neuromodulation Prevented Detrusor Overactivity in Rats With Spinal Cord Injury

Linchen Lv, MD; Wenxian Li, MD; Dongyue Guo, MD; Benkang Shi, PhD; Yan Li, PhD

757 Transcutaneous Neuromodulation Promotes Functional Regeneration of the External Urethral Sphincter Neural Circuitry in Two Models of Nerve Lesion in Female Rats

Ricardo Juárez, PhD; José Luis Palacios, PhD; Yolanda Cruz, PhD

767 Effect and Mechanism of Vagal Nerve Stimulation on Gastric Motility: A Preliminary Rodent Study

Shiying Li, MBBS, MS; Feng Ye, MD, PhD; Sujuan Zhang, MD, PhD; Yi Liu, MD, PhD; Jiande D.Z. Chen, PhD

Neuromodulation

TECHNOLOGY AT THE NEURAL INTERFACE

July 2025 ■ Volume 28 ■ Number 5 ■ Pages 713-874

Contents continued

775 Frequency-Specific Effects of Noninvasive Median Nerve Stimulation on Gastric Slow Wave Activity in Humans

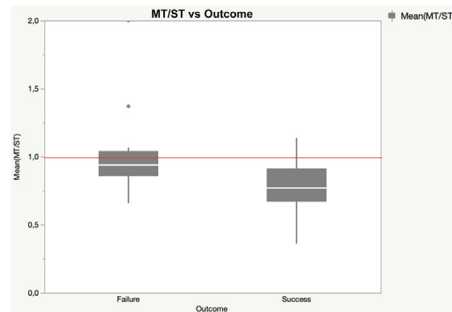
Elliot Thomas Hendry, BSc; Joseph Gonzales Balfe, BSc; Peng Du, PhD; Yusuf Ozgur Cakmak, MD, PhD



Editor's Choice

787 A Deep Analysis of the Pelvic Floor Motor Response in Sacral Neuromodulation Linking It to Outcome

Sam Tilborghs, MD; Sigrid Van de Borne, MD; Donald Vaganée, MD; Erik Fransen, PhD; Stefan De Wachter, MD, PhD



This prospective study (January 2018 - September 2021) included overactive bladder (OAB) or non-obstructive urinary retention (NOUR) patients undergoing unilateral SNM. An external pulse generator was connected for three weeks. Success was defined as $\geq 50\%$ improvement. Sensory threshold (ST), Motor threshold (MT) and their ratio (MT/ST) were analyzed. PFM electromyography was recorded using a multiple array probe. A linear regression model with ST, MT, MT/ST and mean LN(peak-to-peak-amplitude) versus outcome (% improvement) was carried out. Differences in electrical PFM motor response amplitude between different electrical stimulation levels (ST+/-0.5mA) and

different parts (4 sides, 3 depths) of the pelvic floor were modeled using linear mixed model analysis (LMM).

Sixty-four women constituted the study population (overall success 80%). Responders presented with significantly lower MT and MT/ST (resp. unpaired t-test: $p=0.0271$ and $p=0.0158$). MT and MT/ST proved a significant relationship with % improvement (respectively: lin. Regr. $p=0.0304$, $R^2=0.0745$ and lin. Regr. $p=0.0107$, $R^2=0.1020$). PFM amplitude showed a significant relationship with % improvement for all stimulation amplitudes (ST +/- 0.5 mA) (lin. Regr. $P<0.0001$, $R^2=0.2560$), and subsensory stimulation intensities (lin. Regr. $P=0.0008$, $R^2=0.1673$).

Responders presented with a different evolution in increase in overall peak-to-peak amplitude over increased stimulation intensities (LMM: $p=0.0160$), presenting with a significantly higher slope. This was significantly different dependent on the % improvement for all the different sides and depths, with contralateral superior being the only exception (LMM: $p=0.0071$, range: 0.0663 – <0.0001).

796 Ultra-High Frequency Spinal Nerve Neuromodulation for Improving Bladder Continence: Implications for Overactive Bladder Management

Bor-Shing Lin, PhD; Nurida Khasanah, MD; Chun-Ying Cai, BS; Chun-Wei Wu, PhD; Kuo-Hsiang Lu, MS; Wei-Tso Lin, PhD; Chih-Wei Peng, PhD

Neuromodulation

TECHNOLOGY AT THE NEURAL INTERFACE

July 2025 ■ Volume 28 ■ Number 5 ■ Pages 713-874

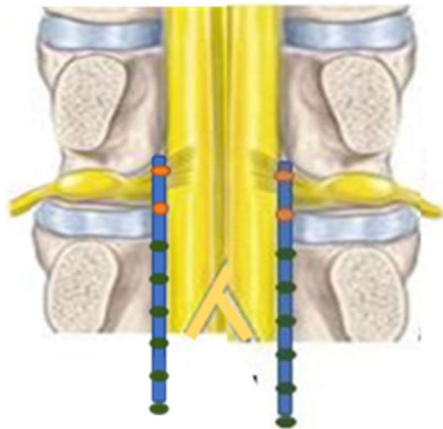
Contents continued



Editor's Choice

803 Electrical Diuretics: Lateral Epidural Stimulation of Dorsal Roots to Increase Diuresis

Pawel Chodakowski, MD; Adam Sokal, MD, PhD; Alicja Bogusz, MS; Agnieszka Manka, MS; Piotr Bogus, MS; Mike Eggen, PhD; Lilian Kornet, PhD



We investigated the feasibility and safety of lateral epidural stimulation (LES) to enhance diuresis by stimulating renal afferent sensory nerves. In 16 pigs, volume overload with elevated and stable pressures was induced. Diuresis was measured during cycles of up to 2 hours and GFR was assessed in 12/16 experiments. The most effective vertebrae stimulation level was established first. T11- T12 stimulation effectiveness was tested, using a high current (1.2 mA) in one animal and relatively low currents (0.1–0.3 mA) in 15 animals. In 3 animals LES effects were assessed during furosemide infusion.

T11-T12 was the most effective vertebrae level for LES. Diuresis increased from 18 ml/20 min (SD = 4 ml/20 min) to 47 ml/20 min (SD = 32 ml/20 min) ($n = 9$, $p < 0.0001$) and GFR increased on average 44 [ml/min] (SD = 26, $n = 6$) ($p < 0.001$) during T11-T12

LES compared to baseline, excluding 1 experiment with high current and 3 lead misplacements. Negative effects in these excluded cases were according to necroscopy related to ventral root stimulation, causing shivering, muscle contractions, and elevated heart rate. LES enhanced diuresis during a continuous infusion of furosemide by 54 and 156% and GFR increased 16 and 14 [ml/min] (2/3 correct lead placement).

812 Electroacupuncture at ST36 Relieves Visceral Hypersensitivity Based on the Vagus-Adrenal Axis in the Remission Stage of Ulcerative Colitis

Mingwei Fan, MBBS; Tan Chen, MBBS; Jinlan Tian, MBBS; Can Zhang, MA; Zijian Zhao, MBBS; Xinru Liu, MBBS; Shuhui Zhang, MA; Yan Chen, PhD

Clinical Science

825 Dorsal Root Ganglion Stimulation for Chronic Pelvic Pain Secondary to Endometriosis

Tiago da Silva Freitas, MD, PhD; Antonio Jorge Barbosa de Oliveira, MD; Stanley Golovac, MD; Bernardo Assumpcao de Monaco, MD, PhD

Neuromodulation

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July 2025 ■ Volume 28 ■ Number 5 ■ Pages 713-874

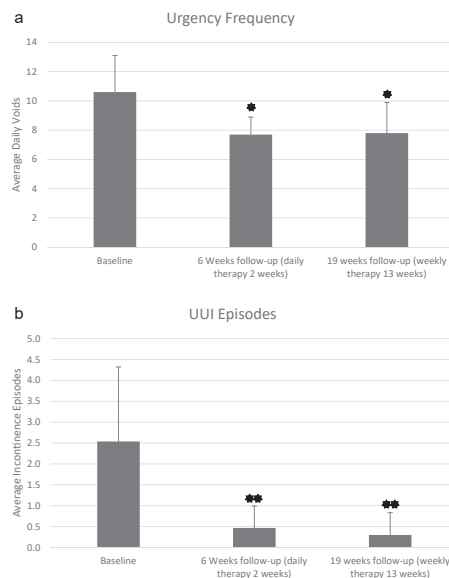
Contents continued



Editor's Choice

832 A First-In-Human Feasibility Study of a New Implantable Tibial Nerve Stimulator for Overactive Bladder Syndrome

Parminder S. Sethi, MD; Kenneth M. Peters, MD



Ten patients with OAB who had failed conservative treatments participated in the study. All patients received daily stimulation therapy for two weeks and weekly stimulation therapy for 13 weeks at the lowest electrical output amplitude at which paresthesia or motor response occurred. OAB symptoms (3-day bladder diary), quality of life scores (OAB-q SF) and patient-global response (GRA) were assessed at each follow-up visit. Amongst the enrolled patients (mean age 68 years), seven were OAB-wet and three OAB-dry.

Following 13 weeks of therapy delivery, reduction in the number of daily voids during waking hours (8.5 ± 2.5 to 6.3 ± 1.9 ; $p=0.016$), the number of incontinence episodes (2.5 ± 1.8 to 0.3 ± 0.5 ; $p<0.001$) and the daily voids associated with urgency (7.6 ± 3.1 to 3.0 ± 3.1 ; $p<0.001$) were reported. Eight of the 10 subjects were classified as responders for at least one OAB component with one patient reporting worsened symptoms of urgency (+6%). All 10 patients reported global improvement in symptoms on the GRA with a median of 6. Improvements in OAB severity and health-related quality of life scores were noted from pre- to post-treatment

across participants ($p<0.001$). No serious adverse effects were noted.

840 Auricular Allodynia is Associated With Worse Outcomes in Children With Functional Abdominal Pain Disorders Using Neurostimulation

Neha R. Santucci, MD, MBBS; Umber Waheed, MD; Jesse Li, BS; Sherief Mansi, MD; Kahleb Graham, MD; Jennifer Hardy, MSc; Megan M. Miller, PhD; Rashmi Sahay, MD, MS; Khalil El-Chammas, MD

847 Symptom Assessment of Candidates for Sacral Neuromodulation Therapy With Urologic and Colorectal Conditions: Time for a Holistic Approach? Results and Findings From a Prospective Single-Center Study

Lynn Ghijselings, MD; Irina Verbakel, MD; George Bou Kheir, MD; Dirk Van de Putte, MD; François Hervé, MD, PhD; An-Sofie Goessaert, MD, PhD; Kim Pauwaert, MD; Dimitri Beeckman, PhD; Melissa Ooms, MD; Karel Everaert, MD, PhD

858 Burst Stimulation Evokes Increased Bladder and Urethral Pressure in Patients With Sacral Neuromodulation, Indicating Potential Activation of the Autonomic Nervous System: A Pilot Study

Perla Douven, PhD; Sam Tilborghs, MD; Sigrid van de Borne, MPT; Gommert A. van Koeveeringe, MD, PhD; Stefan de Wachter, MD, PhD

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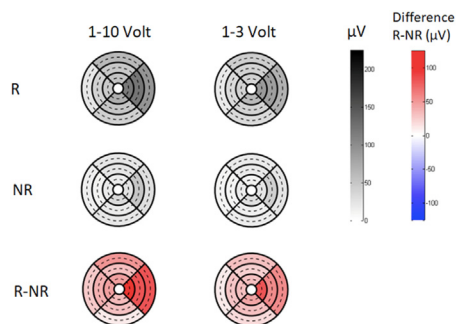
Contents continued



Editor's Choice

865 Motor Response Matters: Lead Placement and Urologic Efficacy Linked in Sacral Neuromodulation

Sam Tilborghs, MD; Tim Brits, MD; Sigrid van de Borne, MSc; Donald Vaganée, MD; Stefan de Wachter, MD, PhD



A prospective pilot study (January 2018 - September 2021) including overactive bladder (OAB) or non-obstructive urinary retention (NOUR) patients – a very homogeneous group without any medical history interfering with bladder function - undergoing SNM. An external pulse generator was connected for three weeks. Success was defined as $\geq 50\%$ improvement. PFM electromyography was recorded using a multiple array probe. Differences in electrical PFM motor response (peak-to-peak amplitude, AUC or latency) between different electrical stimulation levels up to 10V (and the clinically relevant intensities up to 3V) and different parts (4 sides, 3 depths) of the pelvic

floor were modeled using linear mixed model analysis (LMM).

Twenty-six women constituted the study population (overall success 81%). With increasing improvement in voiding diary data higher peak-to-peak amplitudes and AUC were seen for up to 10V stimulation intensities (LMM: p-value resp. 0.0046 and 0.0043) and up to 3V stimulation intensities (LMM: p-value resp. 0.0261 and 0.0416). Sub-analysis of the different parts of the PFM showed all different sides (first corrected p-value < 0.0125) and depths (first corrected p-value < 0.0167) presented with statistically significant differences in favour of those with higher % improvement for the 10- and 3-V analyses, with only two exceptions: peak-to-peak amplitude at the posterior layer at the clinically relevant stimulation intensities (LMM: p-value: 0.0752) and AUC at the posterior layer for the stimulation intensities upon 10V (LMM: p-value: 0.0557). No statistically significant differences were found for the overall mean peak-to-peak amplitude and AUC based upon dichotomous outcome (R vs NR).

Professional Development

873 Calendar of Events