

Neuromodulation

TECHNOLOGY AT THE NEURAL INTERFACE

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Clinical Science



Editor's Choice

551 Development of an Educational Curriculum for Implanting and Managing Vagus Nerve Stimulators for Epilepsy

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The North American Neuromodulation Society (NANS) education committee presents a curriculum defining level-dependent recommendations within the six-core competency rubric for the implantation and management of VNS devices. A multidisciplinary (anesthesiology, neurology, neurosurgery, and physiatrists) and diverse (advanced practice providers, physicians, and surgeons) subcommittee of the NANS education committee developed a curriculum following the Accreditation Council for Graduate Medical Education (ACGME) core competencies. The subcommittee used a consensus approach, evidence-based development strategy; once completed, the VNS curriculum was approved by the NANS board.

The subcommittee developed a VNS curriculum as a standard to be used for implanting surgeons, managing physicians and advanced practice providers. The vertical orientation of the curriculum utilizes the ACGME educational core competencies framework; within this paradigm is a horizontal progression of skills with distinct competency groups for implanting surgeons and/or managing physicians. The horizontal progression defines the expected competence for early learner, advanced learner, and independent practitioner.

558 A Clinical Care Pathway for Patients With Chronic Mechanical Low Back Pain Having Restorative Neurostimulation for Multifidus Muscle: Description, Patient Compliance, Clinical Outcomes, and Satisfaction in the First Two Years

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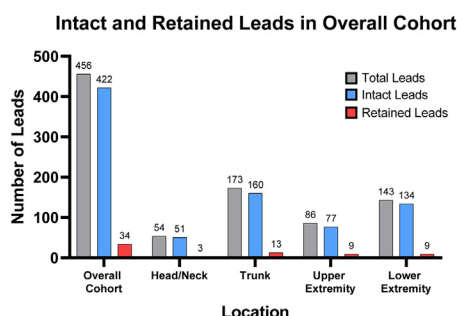
Romina Sangiacomo, MSc; Fermín Valera-Garrido, PhD; Francisco Minaya-Muñoz, PhD; Alberto Carcasona-Otal, PT, MSc; Pablo Herrero, PhD; Diego Lapuente-Hernández, PT, MSc



Editor's Choice

611 Incidence of Lead Tip Fracture and Retention After Percutaneous Lead Implantation for Peripheral Nerve Stimulation With an External Pulse Generator: A Multicenter Comparative Analysis of 456 Lead Implants Across Two Lead Hardware Generations

Chelsey Hoffmann, PA-C, MS, RD; Kalli J. Fautsch, MD; Ryan S. D'Souza, MD



We aim to quantify the current incidence of temporary PNS lead fracture/retention and compare this with rates prior to changes in lead hardware design of temporary peripheral nerve stimulators. A multi-center, retrospective observational study was conducted for patients implanted with a temporary PNS system between the dates of June 1, 2018, and August 1, 2024. Patients were included if they underwent temporary percutaneous PNS system implantation with planned lead removal at 60 days. The primary objectives of this study were to (1) quantify the incidence of lead retention with removal of temporary percutaneous PNS,

and (2) to compare the rates of lead retention between the original lead design (version 1.0) and the revised lead design (version 2.0). Secondary objectives included analysis of lead retention rates based on the following covariates: body mass index (BMI), patient age, location of lead placement, or duration of lead implant.

337 patients were implanted with a total of 456 leads within the studied timeframe. Of 337 patients, 40.4% (n=136) were implanted with lead version 1.0 and 59.6% (n=201) were implanted with lead version 2.0. Overall, 7.5% (34 of 456) of implanted leads were retained, impacting 10.1% of patients. Of 194 implanted version 1.0 leads, 13.4% (n=26) of leads were retained, whereas of 262 version 2.0 leads, 3.1% (n=8) were retained ($p<0.001$). These results showed a reduction in retained leads per patient from 19.1% with lead version 1.0 to 4.0% with revised lead version 2.0. Covariates including BMI, patient age, location of lead placement, or duration of lead implant did not predict lead retention rates.

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PART II. NON-INVASIVE PERIPHERAL NERVE STIMULATION

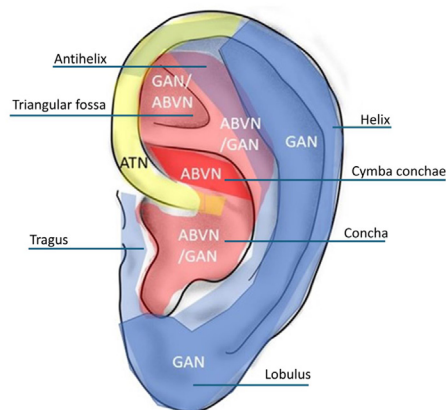
Review Articles



Editor's Choice

627 Effects of Auricular Stimulation on Inflammatory Parameters: Results of a Systematic Review and Meta-Analysis of Randomized Controlled Trials

Kevin Hua, MD; Mike Cummings, MD; Miriam Bernatik, MD; Benno Brinkhaus, MD, PhD; Taras Usichenko, MD, PhD; Stefan N. Willich, MD, PhD; Carmen Scheibenbogen, MD, PhD; Joanna Dietzel, MD



This systematic review evaluated the effects of auricular stimulation (AS) on biomarkers of inflammation and the stress response. MEDLINE (PubMed), EMBASE, Cochrane Central Register of Controlled Trials (CENTRAL), ISI Web of Science, and Scopus Database were searched. Quality and risk assessment of included studies was performed and the meta-analysis of the effect of the most frequently assessed biomarkers was conducted using the statistical software RevMan.

A total of 1122 patients and healthy volunteers of 27 RCTs were included in this systematic review. 81% of the population was female with a median age of 51 years. Pooled data of 18 studies showed a significant effect of AS regarding a reduction of serum C-reactive protein (CRP), tumor necrosis factor-alpha (TNF-alpha),

interleukin-6 (IL-6) and IL-10. Although IL-4, IL-1beta, cortisol, substance P and calcitonin gene-related peptide, and adrenocorticotrophic hormone did not show any changes, salivary amylase increased under AS.

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641 Noninvasive Vagus Nerve Stimulation in Parkinson's Disease: A Systematic Review

Negin Eissazade, MD; Shayan Eghdami, MD, MPH; Mohammad Rohani, MD; Atra Ajdari, MD; Seyed-Mohammad Fereshtehnejad, MD, PhD; Alfonso Fasano, MD; Tara Khoeini, MD

Basic Science

652 Tonic and Event-Related Phasic Transcutaneous Auricular Vagus Nerve Stimulation Alters Pupil Responses in the Change-Detection Task

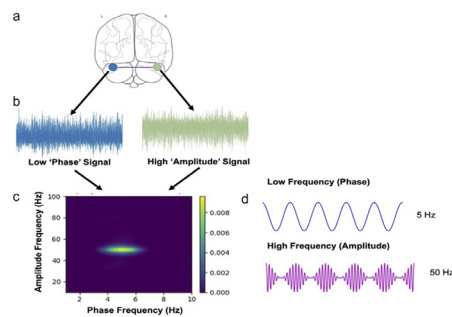
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Editor's Choice

663 Phase-Amplitude Coupling in Response to Transcutaneous Vagus Nerve Stimulation: Focus on Regions Implicated in Mood and Memory

Charlotte Keatch, PhD; Elisabeth Lambert, PhD; Will Woods, PhD; Tatiana Kameneva, PhD



To investigate whether transcutaneous vagus nerve stimulation (tVNS) at different frequencies can affect phase-amplitude coupling between regions of the brain linked to mood and memory disorders, we used simultaneous magnetoencephalography (MEG). Phase-amplitude coupling was measured between areas of the brain in response to different stimulation frequencies of tVNS using concurrent MEG and tVNS in 17 healthy participants. Four stimulation protocols were tested; 24 Hz, 1 Hz and pulse-frequency modulation, all delivered to the cymba concha, and 24 Hz delivered to the ear lobe as a sham. A driven auto-regressive

method was used to estimate coupling between brain areas in different physiological frequency bands in response to these protocols.

Different stimulation protocols of tVNS led to alterations in phase-amplitude coupling between multiple brain regions that are linked to mood and memory, notably the prefrontal cortex, hippocampus and the temporal pole. Stimulation delivered at 24 Hz was observed to decrease delta-gamma coupling within the temporal pole and cingulate cortex when contrasted with 24 Hz sham stimulation.

Increased alpha-gamma coupling was observed between the hippocampus and the prefrontal cortex when contrasting 24 Hz with pulse-frequency modulated stimulation. Finally, comparing 24 Hz with low frequency 1 Hz stimulation showed an increase in theta-gamma coupling within the prefrontal cortex.

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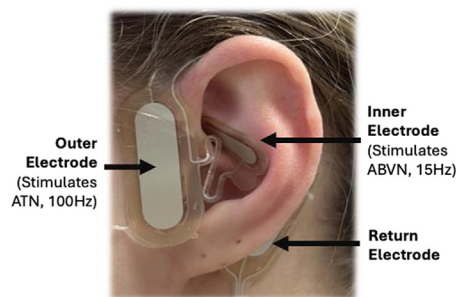
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Clinical Science

★ Editor's Choice

672 Accelerated Transcutaneous Auricular Vagus Nerve Stimulation for Inpatient Depression and Anxiety: The iWAVE Open Label Pilot Trial

Christopher W. Austelle, MD; Stewart S. Cox, MD, PhD; Dillon J. Connolly, BS; Brenna Baker Vogel, BS; Xiaolong Peng, PhD; Kristin Wills, BS; Falon Sutton, BS; Katherine B. Tucker, BS; Ethan Ashley, MD; Andrew Manett, MD; Bernadette Cortese, PhD; Edward Baron Short, MD; Bashar W. Badran, PhD



This study evaluates the safety and feasibility of transcutaneous auricular vagus nerve stimulation (taVNS) on the inpatient psychiatric unit and preliminarily explores efficacy for comorbid depression and anxiety. Ten adult patients (5 females, mean age $\pm$ SD, 35.60 $\pm$ 19.14) admitted to the inpatient psychiatric unit with comorbid depression and anxiety participated in this open-label safety and feasibility trial. Patients were randomized to receive one of two taVNS dosing approaches, A) three taVNS sessions on three consecutive days (nine sessions total) (N=5) or B) nine taVNS sessions in one day (N=5). Each day, we assessed

depression, using the Patient Health Questionnaire (PHQ-9) and Beck's Depression Inventory (BDI), and anxiety, using the Generalized Anxiety Disorder-7 (GAD-7), and Beck Anxiety Inventory (BAI).

Both taVNS dosing approaches were safe and feasible in this novel setting. Regardless of condition, stimulation significantly reduced GAD-7 (Mean Reduction $\pm$ SD, -5.90 ± 6.87 , $p<0.05$), BAI (-9.40 ± 10.52 , $p<0.05$), PHQ-9 (-6.00 ± 7.57 , $p<0.05$) and BDI (-11.00 ± 11.59 , $p<0.05$) final scores compared to baseline. There was not a significant difference in clinical response between treatment conditions.

682 Pulsed Shortwave (Radiofrequency) Therapy With a Noninvasive, Wearable, Disposable Device: A Randomized, Participant- and Assessor-Masked, Sham-Controlled Pilot Study

Brian M. Ilfeld, MD, MS (Clinical Investigation); John J. Finneran IV, MD; Engy T. Said, MD; Scott T. Ball, MD; Bryan J. Sandler, MD; Ryan C. Broderick, MD; Francis B. Gonzales, MD; Nathan J. Lau, BS; Adam Schaar, MD; Baharin Abdullah, MD

690 Accelerative Effects of Transcutaneous Electrical Acustimulation on Postoperative Recovery After Thoracolumbar Vertebral Fracture Associated With Suppressed Sympathetic Activity and Interleukin-6

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707 Response to: Letter to the Editor Regarding: "Anesthetic Effect on the Subthalamic Nucleus in Microelectrode Recording and Local Field Potential of Parkinson's Disease"

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S1-S32 Abstracts from the Joint Annual Scientific Meeting of the Neuromodulation Society of the UK and Ireland (NSUKI) and Canadian Neuromodulation Society: 3-5 October, 2024 in Dublin, Ireland