

Neuromodulation

TECHNOLOGY AT THE NEURAL INTERFACE

January 2025 ■ Volume 28 ■ Number 1 ■ Pages 1-190

TABLE OF CONTENTS

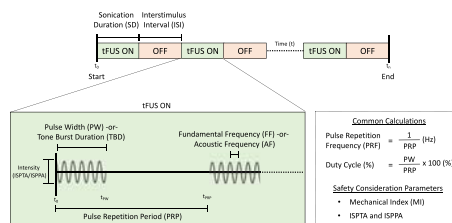
NON-INVASIVE NEUROMODULATION

Review Articles

★ Editor's Choice

1 A Comprehensive Review of Low-Intensity Focused Ultrasound Parameters and Applications in Neurologic and Psychiatric Disorders

Stewart S. Cox, MD, PhD; Dillon J. Connolly, BS; Xiaolong Peng, PhD; Bashar W. Badran, PhD



In this review, we provide a review of the most recent low intensity focused ultrasound (LIFU) literature covering three key domains: a) the history of focused ultrasound technology, comparing it to other forms of neuromodulation, b) the parameters and most up-to-date proposed mechanisms of LIFU, and finally c) a consolidation on the current literature to date surrounding the clinical research that has utilized LIFU for the modification or amelioration of several neuropsychiatric conditions. The impact of LIFU including post-stroke motor changes, pain, mood disorders, disorders of consciousness, dementia, and substance abuse is discussed.

16 Repetitive Transcranial Magnetic Stimulation for Motor Recovery After Stroke: A Systematic Review and Meta-Analysis of Randomized Controlled Trials With Low Risk of Bias

John J.Y. Zhang, MBBS; Jensen Ang, MBBS; Seyed Ehsan Saffari, PhD; Phern-Chern Tor, MBBS, MMed; Yew Long Lo, MBBS, MMed; Kai Rui Wan, MBBS

★ Editor's Choice

43 A Mechanistic Analysis of the Neural Modulation of the Inflammatory System Through Vagus Nerve Stimulation: A Systematic Review and Meta-analysis

Paulo S. de Melo, MD; Anna C. Gianlorenco, PT, PhD; Anna Marduy, MD; Chi K. Kim, MD, PhD; Hyuk Choi, MD, PhD; Jae-Jun Song, MD, PhD; Felipe Fregni, MD, PhD

We aimed to conduct a systematic review and meta-analysis assessing the anti-inflammatory effects of various VNS methods while exploring multiple anti-inflammatory pathways. We included clinical trials that used electrical stimulation of the vagus nerve and assessed inflammatory markers up to October 2022. We adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRIMA) guidelines and the Cochrane Handbook for Systematic Reviews. For each inflammatory marker, a random-effects meta-analysis using the inverse variance method was performed. This review included 15 studies, involving 597 patients. No statistically significant general VNS effect was observed on TNF- α , IL-6, and IL1 β . However, CRP, IL-10, and INF- γ were significantly modulated by VNS across all methods. Subgroup analysis revealed specific stimulation techniques producing significant results, such as taVNS effects in IL-1 β and IL-10, and iVNS in IL-6, whereas tcVNS and eaVNS did not convey significant pooled results individually. Cumulative exposure to VNS, higher risk of bias, study design, and pulse width were identified as effect size predictors in our meta-regression models. Pooling all VNS techniques demonstrated the ability of VNS to modulate inflammatory markers such as CRP, IL-10, and INF- γ .

Neuromodulation

TECHNOLOGY AT THE NEURAL INTERFACE

January 2025 ■ Volume 28 ■ Number 1 ■ Pages 1-190

Contents continued

54 Efficacy and Safety of Noninvasive Electrical Neuromodulation for Treatment of Functional Constipation: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

Sidan Long, MD; Shuangshuang Ji, MD; Borko Nojkov, MD; Jiande D.Z. Chen, PhD

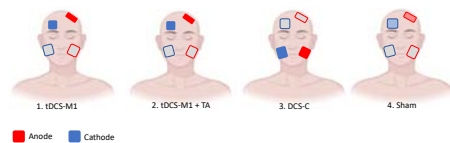
Basic Science



Editor's Choice

68 Investigating the Working Mechanism of Transcranial Direct Current Stimulation

Emma Lescauwaet, MSc; Mathieu Sprengers, MD, PhD; Evelien Carrette, PhD; Chloé Algoet, MD; Ann Mertens, MD, PhD; Debby Klooster, PhD; Steven Beumer, MSc; Rob Mestrom, PhD; Robrecht Raedt, PhD; Paul Boon, MD, PhD; Kristl Vonck, MD, PhD



In a randomized cross-over study, 4 experimental conditions with anodal direct current stimulation (tDCS) were compared in 19 healthy volunteers: (1) tDCS over the motor cortex (tDCS-M1), (2) tDCS over the motor cortex with a locally applied topical anesthetic (TA) on the scalp (tDCS-M1 + TA), (3) DCS over the

cheek region (DCS-C) and (4) sham tDCS over the motor cortex (sham). tDCS was applied for 20min at 1mA. Motor evoked potentials (MEPs) were measured before and immediately, 15, 30, 45, and 60min after tDCS. A questionnaire was used to assess the tolerability of tDCS.

A significant MEP amplitude increase compared to baseline was found 30min after tDCS-M1, an effect still observed 60min later; no time*condition interaction effect was detected. In the other three conditions (tDCS-M1 + TA, DCS-C, sham), no significant MEP modulation was found. The questionnaire demonstrated that side effects are significantly lower when the local anesthetic was applied before stimulation compared to the other 3 conditions.

76 The Effects of Transcranial Direct Current Stimulation and Exercise on Salivary S100B Protein Indicated Blood-Brain Barrier Permeability: A Pilot Study

Aidan Lewis, BS Hons; Constantino Toufexis, BS Hons; Chloe Goldsmith, PhD; Rebecca Robinson, BS; Grace Howie, BS Hons; Ben Rattray, PhD; Andrew Flood, PhD

86 Seeking Optimal Montage for Single-Pair Transcranial Direct Current Stimulation Using Bayesian Optimization and Hyperband—A Feasibility Study

Cheolki Im, PhD; Jongseung Lee, ME; Donghyeon Kim, PhD; Sung Chan Jun, PhD; Hyeon Seo, PhD

95 Low-Intensity Ultrasound Tibial Nerve Stimulation Suppresses Bladder Activity in Rats

Zitian He, MM; Qinggang Liu, MD; Ruiyao Yang, MM; Yongheng Zhou, MD; Xin Liu, MD; Han Deng, MD; Huiling Cong, MD; Yixi Liu, MD; Limin Liao, MD, PhD

Neuromodulation

TECHNOLOGY AT THE NEURAL INTERFACE

January 2025 ■ Volume 28 ■ Number 1 ■ Pages 1-190

Contents continued

103 Numerical Investigation of Layered Homogeneous Skull Model for Simulations of Transcranial Focused Ultrasound

Hyeon Seo, PhD; Mun Han, PhD; Jong-ryul Choi, PhD; Seungmin Kim, ME; Juyoung Park, PhD; Eun-Hee Lee, PhD

115 Effects of Transcutaneous Auricular Vagus Nerve Stimulation on Cortical Excitability in Healthy Adults

Yeo Joon Yun, MD; Youho Myong, MD; Byung-Mo Oh, MD, PhD; Jae-Jun Song, MD, PhD; Chi Kyung Kim, MD, PhD; Han Gil Seo, MD, PhD

Clinical Science

123 Exploration of Theta Burst-Induced Modulation of Transcranial Magnetic Stimulation-Evoked Potentials Over the Motor Cortex

Sofie Carrette, MD; Kristl Vonck, MD, PhD; Debby Klooster, IR, PhD; Robrecht Raedt, PhD; Evelien Carrette, PhD; Jean Delbeke, MD, PhD; Wytse Wadman, PhD; Silvia Casarotto, IR, PhD; Marcello Massimini, MD, PhD; Paul Boon, MD, PhD

136 Perceptual and Cognitive Effects of Focal Transcranial Direct Current Stimulation of Auditory Cortex in Tinnitus

Amber M. Leaver, PhD

146 A Low-Intensity Transcranial Focused Ultrasound Parameter Exploration Study of the Ventral Capsule/Ventral Striatum

Tina Chou, PhD; Brian J. Kochanowski, MA; Ashley Hayden, BA; Benjamin M. Borron, BS; Miguel C. Barbeiro; Junqian Xu, PhD; Joo-Won Kim, PhD; Xuefeng Zhang, MD, PhD; Richard R. Bouchard, PhD; Kinh Luan Phan, MD; Wayne K. Goodman, MD; Darin D. Dougherty, MD

155 A Physiological Marker for Deep Brain Ultrasonic Neuromodulation

Taylor D. Webb, PhD; Carter Lybbert, MS; Matthew G. Wilson, PhD; Henrik Odéen, PhD; Jan Kubanek, PhD

Neuromodulation

TECHNOLOGY AT THE NEURAL INTERFACE

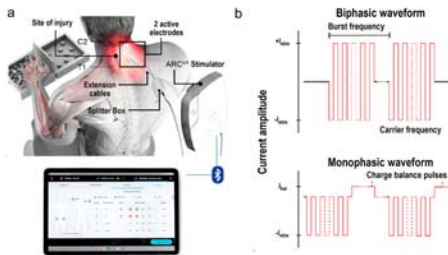
January 2025 ■ Volume 28 ■ Number 1 ■ Pages 1-190

Contents continued

★ Editor's Choice

162 Non-invasive Transcutaneous Spinal Cord Stimulation Programming Recommendations for the Treatment of Upper Extremity Impairment in Tetraplegia

Kristen Gelenitis, PhD; Andrea Santamaria, MD, MBA; Jared Pradarelli, DPT; Markus Rieger, PT, PhD; Fatma Inanici, MD, PhD; Candace Tefertiller, DPT, PhD; Edelle Field-Fote, PT, PhD; James Guest, MD, PhD; Jenny Suggitt, MSc, OT; Amanda Turner, BSc; Jessica M. D'Amico, PhD; Chet Moritz, PhD



This study analyzes the stimulation parameters implemented during two successful trials that utilized transcutaneous spinal cord stimulation (tSCS) to effectively improve upper extremity function after chronic SCI. It proposes a framework to guide stimulation programming decisions for the successful translation of these techniques into the clinic.

Programming data from sixty participants who completed the Up-LIFT Trial, and 17 participants who subsequently completed the

LIFT Home Trial were analyzed. All observations of stimulation amplitudes, frequencies, waveforms, and electrode configurations were examined. The incidence of adverse events and relatedness to stimulation parameters is reported. A comparison of parameter usage across ASIA impairment scale (AIS) subgroups was conducted to evaluate stimulation strategies across participants with varying degrees of sensorimotor preservation.

The suggested stimulation programming framework dictates the following hierarchical order of parameter adjustments: current amplitude, waveform type, active/return electrode positioning, and burst frequency, guided by clinical observations as required.

174 Integrative Effects of Transcutaneous Electrical Acustimulation and Autonomic-Endocrine Mechanisms on Postprocedural Recovery in Patients With Endoscopic Retrograde Cholangio-Pancreatography

Qin Shen, MMSc; Ying-wei Zhu, MD; Wen-hui Xu, MMSc; Ming-yu Tang, MMSc; Hong-jun Xie, MMSc; Jiande D.Z. Chen, PhD; Gao-jue Wu, MD

Clinical Letter

185 Optimizing Transcranial Focused Ultrasound Stimulation: An Open-source Tool for Precise Targeting

Cyril Atkinson-Clement, PhD; Marcus Kaiser, PhD

Neuromodulation

TECHNOLOGY AT THE NEURAL INTERFACE

January 2025 ■ Volume 28 ■ Number 1 ■ Pages 1-190

Contents continued

Letter to the Editor

188 Response to: Comparing the Efficacy of Dorsal Root Ganglion Stimulation With Conventional Medical Management in Patients With Chronic Postsurgical Inguinal Pain: Post Hoc Analyzed Results of the SMASHING Study

Yue-Yang Chen, MD; Hong-Tao Sun, MD

Professional Development

190 Calendar of Events

Online Content

S1-S309 Abstracts from the International Neuromodulation Society's 16th World Congress-Vancouver, Canada, 11-16 May 2024