E-POSTER VIEWING
NEUROPROSTHETICS AND NEURAL ENGINEERING

EV118
SPATIOTEMPORAL ACTIVATION OF VAGUS NERVE FIBERS VIA INTERMITTENT INTERFERENTIAL CURRENT STIMULATION

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Introduction: Vagus nerve stimulation (VNS) is emerging as a potential treatment for several chronic diseases. However, the inability to control fiber activation to achieve a desired therapeutic effect while minimizing side effects limits its clinical application.

Materials / Methods: Here we present a novel VNS method that utilizes intermittent, interferential sinusoidal current stimulation (i^2CS) via implanted, multi-contact epineural cuff electrodes.

Results: In experiments conducted on a cohort of anesthetized swine, i^2CS elicited specific nerve potentials and end organ responses distinct from those produced by equivalent non-interferential sinusoidal stimulation and showed improvements in selectivity for achieving a desired over a side effect.

Discussion: We demonstrated that i^2CS selectively reduces fiber activation at the interference focus, by combining detailed anatomical tracing of the fascicles and nerve fibers from the stimulation electrode to the end-organ with the experimental data to create a realistic, physiologically validated computational model of the vagus nerve.

Conclusions: Finally, we propose that the spatiotemporal pattern of vagal fiber activation by i^2CS, which is determined by current steering and repetition frequency, can improve the precision of controlling neural and end-organ responses.

E-POSTER VIEWING
NEURO-REGENERATION

EV119
PERIPHERAL NERVE STIMULATOR FOR LONG NERVE GAP USING BIODEGRADABLE AND CONDUCTIVE CONDUITS

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Introduction: Peripheral nerve injuries often require surgical intervention, particularly for long gaps where direct repair is ineffective. Autografts are the clinical gold standard but have limitations such as donor site morbidity. Conductive biomaterials and electrical stimulation have emerged as promising strategies for nerve regeneration. This study presents a biodegradable conductive nerve conduit integrated with a wireless stimulator to enhance nerve repair while avoiding secondary surgery.

Materials / Methods: A molybdenum (Mo)/polycaprolactone (PCL) composite conduit was developed for conductivity and biodegradability. Wireless electrical stimulation was applied via an implanted RF-powered stimulator. A rat sciatic nerve injury model with a 10 mm gap was used to assess functional recovery through behavioral and histological analyses.

Results: The Mo/PCL composite exhibited optimized conductivity and mechanical properties, maintaining structural integrity while allowing gradual degradation. In vivo experiments demonstrated that the combination of the conductive conduit and wireless stimulation significantly enhanced nerve regeneration compared to non-stimulated controls. Functional recovery, as assessed by the sciatic functional index and muscle weight measurements, was notably improved in the stimulated group. Histological analyses confirmed increased axonal growth and myelination in the stimulated nerves, with higher densities of regenerated nerve fibers observed in the distal segments of the conduit. These findings suggest that the synergistic effects of a biodegradable conductive scaffold and targeted electrical stimulation can accelerate nerve repair in long-gap injuries.

Discussion: The findings of this study highlight the synergistic effects of biodegradable conductive conduits and wireless electrical stimulation in promoting nerve regeneration. Electrical stimulation has been shown to enhance neurite outgrowth and Schwann cell activity, which aligns with our observations of improved axonal regeneration and functional recovery. The biodegradable Mo/PCL composite eliminates the risks associated with non-degradable implants, reducing the need for secondary surgical removal. While the results are promising, further studies are required to refine stimulation parameters and assess long-term biodegradation effects. Future efforts should also explore fully biodegradable wireless components to improve clinical applicability.

Conclusions: A biodegradable electroceutical platform integrating a conductive nerve conduit with wireless stimulation significantly improves nerve regeneration. This approach offers a promising alternative to existing treatments, with the potential for clinical translation.