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Focused Ultrasound-induced Peripheral Nerve Blockade to Prevent and Treat Pain

Stanford researchers have developed an innovative, integrated diagnostic and therapeutic focused ultrasound (FUS) platform that non-invasively targets peripheral nerves to produce temporary, reversible nerve blockade for acute and chronic pain management.

Current pain management approaches rely on systemic medications, including opioids, or needle-based nerve blocks that require procedural expertise and carry risks such as infection and complications. There is a significant unmet need for a non-invasive, image-guided method that provides rapid, localized pain control without systemic exposure.

To address this gap, Stanford researchers developed a focused ultrasound-based peripheral nerve blockade system that enables precise, image-guided delivery of acoustic energy to a targeted nerve through intact skin. By integrating real-time ultrasound imaging with a therapeutic focused ultrasound transducer, the platform eliminates the need for needles, injectable anesthetics, or implanted devices. Preclinical studies demonstrate temporary blockade of nerve conduction with full functional recovery, supporting a controllable and repeatable modality.

By leveraging existing ultrasound infrastructure, the platform is positioned to simplify perioperative workflows, reduce infection risk, and decrease opioid reliance. It offers a scalable, non-addictive alternative for postoperative and chronic pain management.

Applications

- Acute postoperative and traumatic pain management

- Chronic pain treatment through targeted peripheral nerve modulation
- Outpatient and ambulatory pain procedures
- Platform technology for broader peripheral neuromodulation indications

Advantages

- Non-invasive, needle-free approach eliminating injection-related risks
- Temporary and reversible nerve blockade with controllable energy delivery
- Non-pharmacological modality that avoids systemic drug exposure
- Potential for longer-lasting analgesia compared to single-shot anesthetic blocks
- Compatible with existing ultrasound imaging systems to streamline clinical adoption

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