HealthManagement
Promoting Management and Leadership

Ultrasound Potential in Pain Management

The dorsal anterior cingulate cortex (dACC) is a critical brain area for pain and autonomic processing, making it a promising non-invasive therapeutic target. In a recent study published in the Journal of Neuroscience, Andrew Strohman et al. investigated how to leverage low-intensity focused ultrasound (LIFU) on the dACC to reduce bodily pain. Application of soundwaves have an effect on behavioural and cardiac autonomic responses, and could prove to be a new way to alleviate chronic pain without using drugs.

Investigating the Effects of LIFU on Pain Perception

The Virginia Tech Carilion School of Medicine team conducted their study with 16 healthy volunteers, 6 men and 10 women. Brief pain was caused to the volunteers with a brief contact heat to their skin, and the researchers monitored their brain activity, heart rate and skin reaction using continuous electroencephalogram (EEG), electrocardiogram (ECG), and electrodermal response (EDR). LIFU was applied to the dACC in the intervention group, and outcomes were measured to see if it could impact humans' response to pain. Such measures included pain ratings, heart-rate variability, EDR response, blood pressure, and the amplitude of the contact heat-evoked potential (CHEP).

Pain Reduction and Physiological Changes

LIFU reduced pain ratings by 1.09 ± 0.20 points relative to Sham stimulation in the control group. LIFU focus on dACC was able to offer pain relief to the volunteers, pointing towards the use of ultrasound to non-invasively and effectively manage pain, and eliminate some risks associated with surgeries. CT scans and MRIs also revealed that changes occurred in the brain and heart: the response to pain was reduced in the heart, and associated brain autonomic responses were altered. LIFU increased heart rate variability indexed by the standard deviation of normal sinus beats (SDNN), low frequency (LF) power, and the low-frequency/high-frequency (LF/HF) ratio. There were no effects on blood pressure or EDR. Finally, LIFU resulted in a 38.1% reduction in the P2 CHEP amplitude.

Implications for Future Pain Management Strategies

As outlined by authors, "[LIFU] provides a potential new means to modulate the brain activity in response to pain that may serve to better understand the mechanisms of chronic pain to provide a new, innovative therapeutic option that could change how we approach and treat pain in the future." As dACC depth precludes direct access without invasive surgery, ultrasound holds potential for future therapeutic non-invasive options for pain relief and modulation of homeostatic signals and autonomic function. More research is needed to understand the physiological response, and how autonomic signals like heart rate variability (HRV) are aberrant in chronic pain and mental health disorders, which may contribute to their underlying aetiology. "Chronic pain patients often experience cardiovascular issues, which may either be at the root of their chronic pain or play a role in contributing to it," researchers noted. "Understanding this intricate relationship is crucial, because it enhances our comprehension of pain mechanisms and suggests the importance of addressing both pain perception and cardiovascular health."

In the recent years, progress has been made in the use of high intensity focused ultrasound for creating small lesions in patients' brain to treat disorders. Extending the exploration to the use of low intensity focused ultrasound to mildly modulate brain activity and affect pain perception and behavior is now in order. Emerging LIFU clinical applications in chronic pain and neuropsychological populations could offer patients therapies to manage pain, without surgical intervention, and without the use of potentially addictive drugs.

Source: JNeurosci

Image Credit: iStock

Published on : Thu, 22 Feb 2024