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Dr. Kettner's review of *Differences in cortical response to acupressure and electroacupuncture stimuli*.

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Witzel T, Napadow V, Kettner NW, Vangel MG, Hämäläinen MS, Dhond RP. Differences in cortical response to acupressure and electroacupuncture stimuli. BMC Neurosci. 2011 Jul 27;12:73.

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The neural processing of somatosensory inputs including touch and nociception engages multiple interacting brain networks including those regulating emotional, autonomic, cognitive and motor behavior. A sensory experience may evolve into a perception and over time is modified by learning, memory and our individual experience. If we experience cervical spinal pain following an auto accident, nociceptor inflammation from damaged tissue activates somatosensory inputs that produce local and referred pain, accelerate our heart rate and blood pressure, activate abnormal postural tone that reduces range of motion and we may experience anxiety and depression. The integration of the somatosensory system across all the neural systems is a remarkable property of the brain that helps ensure our survival in a complex and potentially threatening environment.

Over the last 20 years, the connectivity and systems interaction of somatosensory processing has been examined by multiple functional neuroimaging tools. These have included positron emission tomography (PET) functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG). In the MEG, neuronal activity is localized by measuring the magnetic field oscillations arising from fluctuating extracellular neuronal currents. Moving electrical currents induce an extremely weak magnetic field measured in picotesla (10^{-12} T). The temporal resolution of MEG is in milliseconds in comparison to seconds with fMRI. Neural events are detected in high temporal resolution and display oscillations at different frequencies, representing sensory, motor and cognitive activity. High temporal resolution indicates precisely "when" a neural event has occurred.

Review continues on page 6.

Acupuncture

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Manipulation

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Cost

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Other

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Whiplash Injuries

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Neck Pain / Cervical Spine

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Sports Medicine

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Foot Orthoses

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Biomechanics

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Osteoarthritis

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Aging

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Transcutaneous Electrical Nerve Stimulation

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Pediatrics

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Fertility

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Cardiovascular Disease

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Health Care Reform

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Dr. Kettner's review continued from page 1.

There is a sizeable and growing body of in vivo neuroimaging evidence, (majority is fMRI) that has mapped the underlying cortical and sub-cortical neural responses to acupuncture stimuli. Acupuncture analgesia develops from the activation of the endogenous anti-nociception circuits including opioidergic, noradrenergic, dopamine and other neurotransmitters. Evidence for neuroplastic reorganization of S-1 in carpal tunnel syndrome and its favorable modulation by acupuncture has been published by Napadow et al. The somatosensory system is triggered by conditioning stimuli such as acupuncture, but little is known regarding its spatiotemporal profile within the somatosensory cortex.

The study design by Witzel et al employed the high temporal resolution of a 306-channel MEG Vectorview (Elekta Neuromag Oy, Helsinki, Finland) housed in a custom built six-layer magnetically shielded room to record two different forms of acupuncture stimuli, electroacupuncture and acupressure. Responses were recorded in the S-1 of 16 normal volunteers naive to acupuncture. MEG responses were recorded from tactile (acupressure) and electrical current (both delivered at 2 Hz) applied to needles (electroacupuncture) in the forearm at acupoint PC-6 for 15 minutes.

Data analysis yielded contralateral S-1 localization (BA 3b) for both electroacupuncture and acupressure stimuli. Acupressure stimuli mapped slightly dorsal to electroacupuncture and the latencies were similar to the evoked median nerve M20 and M30 components. The peaks of these components were delayed in acupressure compared with electroacupuncture. The MEG/EEG brain wave oscillatory frequency responses in S-1 early on included gamma (30-50 Hz) and theta (6-8 Hz). Late responses included a reduction in alpha (8-13 Hz) and beta (15-30 Hz). The acupressure stimulus evoked a stronger brain response than electroacupuncture. There were no significant differences in oscillatory frequency ranges between electroacupuncture and acupressure. There was a significant reduction in the relative power of beta 100-300 ms post-stimulus in the electroacupuncture group.

The results of this study are unique and inform important spatiotemporal mechanisms underlying acupuncture and acupressure stimuli in S-1. Although electroacupuncture and acupressure stimuli recruit afferent nerves (Aβ fibers), the acupressure stimulus was likely blunted and distributed over a wider area than electroacupuncture. The greater amplitude of cortical response by acupressure stimuli may have been reflective of the activation of more superficial fibers compared to electroacupuncture. The time frequency analysis for both stimuli types identified early onset gamma frequency activity. Although still under intense scientific investigation, this frequency band is thought to provide binding of attributes in a sensory stimulus. Gamma band activity is also known to occur during tactile and proprioceptive stimuli. Over the period of stimulation with electroacupuncture and acupressure, MEG activity attenuated consistent with habituation or conditioning response of the stimulus. This effect may be a mechanism underlying the beneficial effects of acupuncture in disorders where maladaptive neuroplasticity maintains the state of chronic pain.

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