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Brain imaging studies investigate pain reduction by hypnosis

Although hypnosis has been shown to reduce pain perception, it is not clear how the technique works. Identifying a sound, scientific explanation for hypnosis' effect might increase acceptance and use of this safe pain-reduction option in clinical settings.

Researchers at the University of Iowa Roy J. and Lucille A. Carver College of Medicine and the Technical University of Aachen, Germany, used functional magnetic resonance imaging (fMRI) to find out if hypnosis alters brain activity in a way that might explain pain reduction. The results are reported in the November-December 2004 issue of Regional Anesthesia and Pain Medicine.

The researchers found that volunteers under hypnosis experienced significant pain reduction in response to painful heat. They also had a distinctly different pattern of brain activity compared to when they were not hypnotized and experienced the painful heat. The changes in brain activity suggest that hypnosis somehow blocks the pain signal from getting to the parts of the brain that perceive pain.

"The major finding from our study, which used fMRI for the first time to investigate brain activity under hypnosis for pain suppression, is that we see reduced activity in areas of the pain network and increased activity in other areas of the brain under hypnosis," said Sebastian Schulz-Stubner, M.D., Ph.D., UI assistant professor (clinical) of anesthesia and first author of the study. "The increased activity might be specific for hypnosis or might be non-specific, but it definitely does something to reduce the pain signal input into the cortical structure."

The pain network functions like a relay system with an input pain signal from a peripheral nerve going to the spinal cord where the information is processed and passed on to the brain stem. From there the signal goes to the mid-brain region and finally into the cortical brain region that deals with conscious perception of external stimuli like pain.

Processing of the pain signal through the lower parts of the pain network looked the same in the brain images for both hypnotized and non-hypnotized trials, but activity in the top level of the network, which would be responsible for "feeling" the pain, was reduced under hypnosis.

Initially, 12 volunteers at the Technical University of Aachen had a heating device placed on their skin to determine the temperature that each volunteer considered painful (8 out of

10 on a 0 to 10 pain scale). The volunteers were then split into two groups. One group was hypnotized, placed in the fMRI machine and their brain activity scanned while the painful thermal stimuli was applied. Then the hypnotic state was broken and a second fMRI scan was performed without hypnosis while the same painful heat was again applied to the volunteer's skin. The second group underwent their first fMRI scan without hypnosis followed by a second scan under hypnosis.

Hypnosis was successful in reducing pain perception for all 12 participants. Hypnotized volunteers reported either no pain or significantly reduced pain (less than 3 on the 0-10 pain scale) in response to the painful heat.

Under hypnosis, fMRI showed that brain activity was reduced in areas of the pain network, including the primary sensory cortex, which is responsible for pain perception.

The imaging studies also showed increased activation in two other brain structures - the left anterior cingulate cortex and the basal ganglia. The researchers speculate that increased activity in these two regions may be part of an inhibition pathway that blocks the pain signal from reaching the higher cortical structures responsible for pain perception. However, Schulz-Stubner noted that more detailed fMRI images are needed to definitively identify the exact areas involved in hypnosis-induced pain reduction, and he hoped that the newer generation of fMRI machines would be capable of providing more answers.

"Imaging studies like this one improve our understanding of what might be going on and help researchers ask even more specific questions aimed at identifying the underlying mechanism," Schulz-Stubner said. "It is one piece of the puzzle that moves us a little closer to a final answer for how hypnosis really works.

"More practically, for clinical use, it helps to dispel prejudice about hypnosis as a technique to manage pain because we can show an objective, measurable change in brain activity linked to a reduced perception of pain," he added.

In addition to Schulz-Stubner, the research team included Timo Krings, M.D., Ingo Meister, M.D., Stefen Rex, M.D., Armin Thron, M.D., Ph.D. and Rolf Rossaint, M.D., Ph.D., from the Technical University of Aachen, Germany.

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