Medical Xpress

What causes MRI vertigo? Machine's magnetic field pushes fluid in the inner ear's balance organ

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A team of researchers says it has discovered why so many people undergoing magnetic resonance imaging (MRI), especially in newer high-strength machines, get vertigo, or the dizzy sensation of free-falling, while inside or when coming out of the tunnel-like machine.

In a new study published in Current Biology online on Sept. 22, a team led by Johns Hopkins scientists suggests that MRI's strong magnet pushes on fluid that circulates in the inner ear's balance center, leading to a feeling of unexpected or unsteady movement. The finding could also call into question results of so-called functional MRI studies designed to detect what the brain and mind are doing under various circumstances.

To determine the mechanism behind MRI-induced vertigo, Dale C. Roberts, M.S., senior research systems engineer in the laboratory of David Zee, M.D., within the Department of Neurology at the Johns Hopkins University School of Medicine, and his colleagues placed 10 volunteers with healthy labyrinths (inner tube-like structures in the ears that control balance) and two volunteers who lacked labyrinthine function into MRI scanners. They tracked vertigo not only by the volunteers' reports, but also by looking for nystagmus, a type of involuntary eye movement that reflects the brain's detection of motion—the kind of jerky eye tracking that a person on a merry-go-round might experience. Because visual clues can help suppress nystagmus, the researchers conducted their experiments in the dark.

Footage from night vision cameras showed that all the healthy volunteers had nystagmus in the MRI, but those without labyrinthine function didn't—a sure sign that the labyrinth plays a key role in MRI-related vertigo.

To figure out how MRI's magnetic field acts on the labyrinth, the researchers tested the healthy volunteers in MRIs of different strengths for various periods of time. They also tracked the volunteers' nystagmus as they were moved in and out of the machines' tunnels, called bores, both from the usual entryway and from behind—experiments designed to test the impact of motion or direction of magnetic field on the volunteers' balance centers.

Roberts' team found that higher magnetic field strengths caused significantly faster nystagmus. These eye movements persisted throughout the time volunteers spent in the machine, no matter how long the experiments lasted. In addition, the direction of the eye movements changed depending on which way the volunteers entered the bores, suggesting that the effect on the labyrinth was directionally sensitive.

Combining their results with what's known about the inner ear, the researchers surmised that MRI-related vertigo most likely relates to interplay between electrical currents flowing through the salty fluid in the canals of the labyrinth and MRI's magnetic field.

Through an effect well known to physicists called the Lorentz force, the magnetic field apparently pushes on the current of charged particles in the inner ear's fluid. This exerts a force on cells that use the fluid's flow as a way to sense motion.

Roberts notes the finding not only solves a decades-long scientific question, but also has implications for research that uses MRI. In one technique, known as functional MRI, researchers measure brain activity by tracking blood flow in the brain as subjects perform tasks. The new findings suggest that the scanner itself could be causing previously unnoticed brain activity related to movement and balance, potentially affecting results.

"We've shown that even when you think there's nothing happening in the brain while volunteers are in the scanner, there's actually a lot happening because MRI itself is causing some effect," Roberts says. "These effects must be taken into account in the way we interpret functional imaging."

The researchers add that doctors already use methods that stimulate the labyrinth to diagnose and treat inner ear and balance disorders, but these methods can be uncomfortable. They note that MRI's strong magnetic field could eventually be used for the same purpose, providing a novel method that's more comfortable and noninvasive.

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