

# Blood-brain barrier opened noninvasively with focused ultrasound for the first time

10 November 2015

The blood-brain barrier has been non-invasively opened in a patient for the first time. A team at Sunnybrook Health Sciences Centre in Toronto used focused ultrasound to enable temporary and targeted opening of the blood-brain barrier (BBB), allowing the more effective delivery of chemotherapy into a patient's malignant brain tumor.

The team, led by neurosurgeon Todd Mainprize, MD, and physicist Kullervo Hynynen, PhD, infused the chemotherapy agent doxorubicin, along with tiny gas-filled bubbles, into the bloodstream of a patient with a [brain](#) tumor. They then applied focused ultrasound to areas in the tumor and surrounding brain, causing the bubbles to vibrate, loosening the tight junctions of the cells comprising the [blood-brain barrier](#) and allowing high concentrations of the chemotherapy to enter targeted tissues.

"The blood-brain [barrier](#) has been a persistent impediment to delivering valuable therapies to treat tumors," said Dr. Mainprize. "We are encouraged that we were able to open this barrier to deliver chemotherapy directly into the brain, and we look forward to more opportunities to apply this revolutionary approach."

This patient treatment is part of a [pilot study](#) of up to 10 patients to establish the feasibility, safety and preliminary efficacy of focused ultrasound to temporarily open the blood-brain barrier to deliver chemotherapy to brain tumors. The Focused Ultrasound Foundation is currently funding this trial through their Cornelia Flagg Keller Memorial Fund for Brain Research.

"Breaching this barrier opens up a new frontier in treating brain disorders," said Neal Kassell, MD, Chairman of the Focused Ultrasound Foundation. "We are encouraged by the momentum building for the use of focused ultrasound to non-invasively deliver therapies for a number of [brain disorders](#)."

Opening the blood-brain barrier in a localized region to deliver chemotherapy to a tumor is a predicate for utilizing focused ultrasound for the delivery of other drugs, DNA-loaded nanoparticles, viral vectors, and antibodies to the brain to treat a range of neurological conditions, including various types of [brain tumors](#), Parkinson's, Alzheimer's and some psychiatric diseases.

The procedure was conducted using Insightec's ExAblate Neuro system. "This first patient treatment is a technological breakthrough that may lead to many clinical applications," said Eyal Zadicario, Vice President for R&D and Director of Neuro Programs, Insightec.

While the current trial is a first-in-human achievement, Dr. Kullervo Hynynen, senior scientist at the Sunnybrook Research Institute, has been performing similar pre-clinical studies for about a decade. His research has shown that the combination of focused ultrasound and microbubbles may not only enable drug delivery, but might also stimulate the brain's natural responses to fight disease. For example, the temporary opening of the blood-brain barrier appears to facilitate the brain's clearance of a key pathologic protein related to Alzheimer's and improves cognitive function.

A [recent study](#) by Gerhard Leinenga and Jürgen Götze from the Queensland Brain Institute in Australia further corroborated Hynynen's research, demonstrating opening the blood-brain barrier with focused ultrasound reduced brain plaques and improved memory in a mouse model of Alzheimer's disease.

Based on these two pre-clinical studies, a pilot clinical trial using [focused ultrasound](#) to treat Alzheimer's is being organized.

**More information:** G. Leinenga et al. Scanning

ultrasound removes amyloid- and restores memory  
in an Alzheimer's disease mouse model, *Science  
Translational Medicine* (2015). DOI:  
[10.1126/scitranslmed.aaa2512](https://doi.org/10.1126/scitranslmed.aaa2512)

Provided by Focused Ultrasound Foundation

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