THE 13th INTERNATIONAL CONGRESS ON MRI &
30th ANNUAL SCIENTIFIC MEETING OF KSMRM &
7th ANNUAL MEETING OF ASMRM

ICMRI & ASMRM 2025

Illuminating the Invisible: Advances in MRI
OCTOBER 31 - NOVEMBER 1, 2025
Grand Walkerhill Seoul, Seoul, Korea
https://icmri.ksmrm.org/2025m/

Meet the New Experts

SY18-2

MR-Guided Focused Ultrasound: Practice, Application

Kisoo Kim

Kyung Hee University, Korea

Magnetic resonance imaging (MRI)-guided focused ultrasound (FUS) is a non-invasive therapeutic platform that combines the spatial selectivity of ultrasound with the monitoring capabilities of MRI. This integration allows precise delivery of acoustic energy deep inside the brain, while continuously observing treatment effects and ensuring safety. The basic principle is to converge ultrasound waves at a focal point, generating localized thermal or mechanical effects without harming surrounding tissues. One of the most promising applications is blood–brain barrier (BBB) opening. When combined with microbubbles, FUS enables transient and localized modulation of the BBB, thereby facilitating targeted delivery of therapeutic agents to the central nervous system. In our preclinical studies with rodents, we observed reproducible and reversible BBB opening. These effects were confirmed through contrast-enhanced MRI and histological analysis, demonstrating both safety and feasibility for potential translational use. At the same time, MRI-guided FUS presents challenges. The integration of ultrasound hardware with MRI often introduces artifacts that degrade image quality and complicate real-time monitoring. To overcome this limitation, we developed a deep learning–based image restoration framework. Using paired datasets of artifact-contaminated and clean MR images, the model learns to suppress distortions while preserving structural integrity. The results show significant improvements in image clarity and reliability, enabling more accurate interpretation of BBB opening and therapeutic effects. By presenting both experimental data and methodological advances, this work highlights the dual development of therapeutic strategies and image processing solutions. The combination of FUS-induced BBB modulation with artifact-corrected MRI provides a more robust and precise platform for experimental neuroscience and therapeutic innovation. This integrated approach demonstrates the potential of MRI-guided FUS not only as a treatment tool but also as a reliable system for monitoring therapeutic outcomes.

Keywords: *MRI, Focused ultrasound, Drug delivery, Blood brain barrier opening, Deep learning*