An electrophysiological breakthrough for diabetic brain studies

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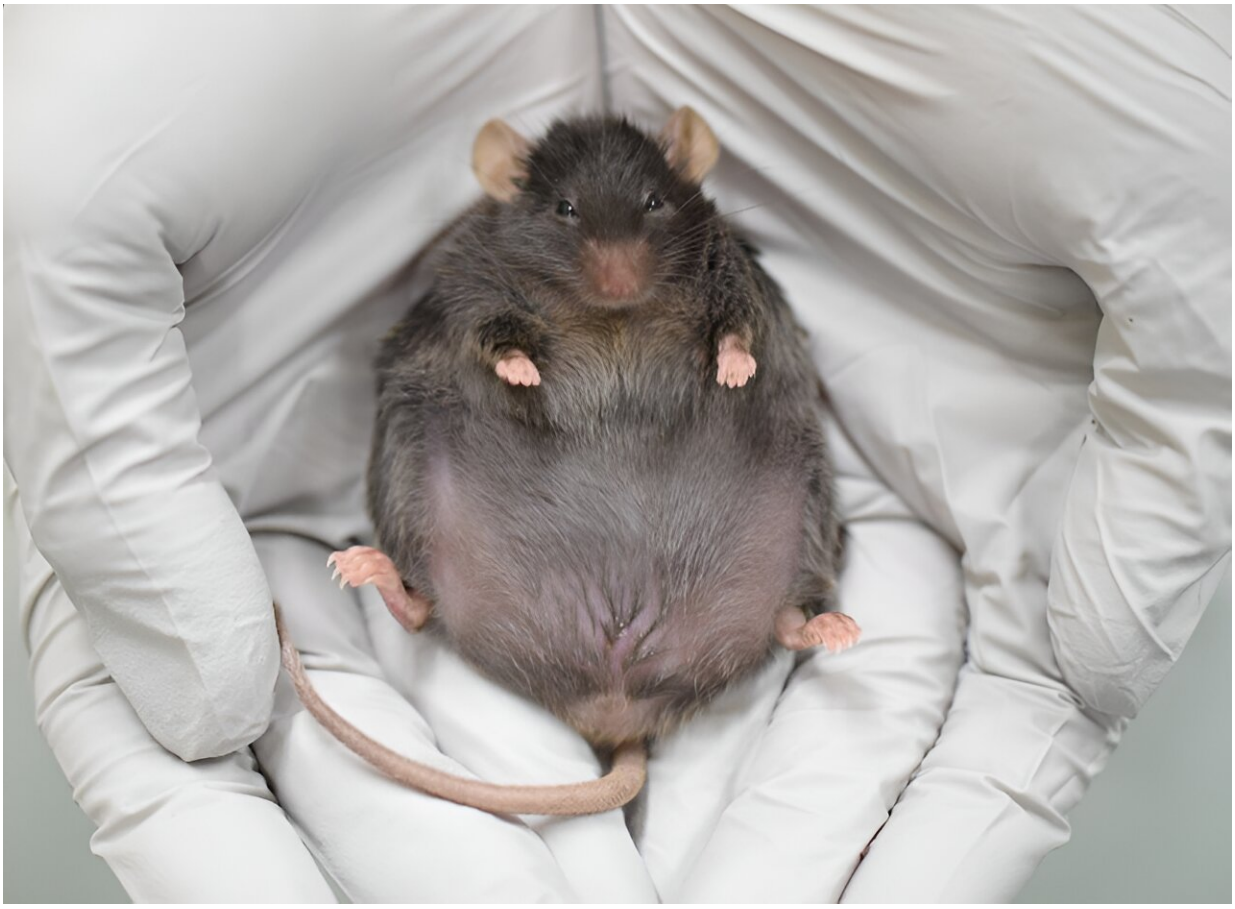

Mouse with diabetes. Credit: Toyohashi University of Technology.

A research team has successfully demonstrated low-invasive neural recording technology in the brain tissue of diabetic mice. This was

achieved using a small needle-electrode with a diameter of 4 μm.

Recording neuronal activity within the diabetic brain tissue is particularly challenging due to various complications, including the development of cerebrovascular disease. Because of the significant advantage of the miniaturized needle-electrode compared to conventional technologies, the needle electrode minimized tissue injury and enabled stable recording for an entire month.

The research team from the Institute for Research on Next-generation Semiconductor and Sensing Science at the Toyohashi University of Technology, National Institute of Technology, Ibaraki College, and TechnoPro R&D Company, published their findings in the journal *Biosensors and Bioelectronics*.

Diabetes is known to cause various complications, including the development of cerebrovascular disease, which is closely linked to Alzheimer's disease due to its contribution to neuronal reduction.

In the study of brain diseases, quantitative analysis through recording of neuronal activities with microelectrode holds great potential. However, recording from diabetic brains is expected to be more challenging than normal brains due to the complications associated with electrode penetration. The research team has successfully addressed this challenge by developing a low-invasive recording technology.

"Our challenge was to develop a technique to record neuronal activities from a mouse model of diabetes. We achieved this goal by demonstrating a neural recording technique using a microelectrode with a tip diameter of 4 μm. Our technique successfully recorded neuronal activity in diabetic mice while minimizing tissue responses. These findings suggest that our electrode can be applied to various damaged brain tissues, not only diabetes but also other diseases," explain the first

authors of the article, master student Rioki Sanda and Ph.D. Koji Yamashita.

Professor Takeshi Kawano, leader of the research team, explains the motivation behind their project, "Diabetes is a complex disease known to cause various complications, particularly vascular disorders. These disorders can lead to gangrene in the limbs, ultimately necessitating amputation."

"Brain-machine interface (BMI) technology holds immense promise in assisting patients who have lost limbs, enabling them to control artificial limbs through brain signals. However, the penetration of conventional electrodes into diabetic brain tissues induces damage, making the application of BMI technology in these patients considerably riskier than others. Recognizing this crucial need, we launched a project to develop a low-invasive recording technique specifically for patients suffering from diabetes-related vascular disorders."

The research team is confident that their recording technology, demonstrated successfully in diabetic mice, holds significant potential for broader applications. They envision its use in drug discovery studies using diverse model mice with various diseases.

Furthermore, the team aims to expand the technology's reach to other animal models, including rats and monkeys, to accelerate the development of next-generation BMIs with greater efficacy and wider applicability.

More information: Rioki Sanda et al, Low-invasive neural recording in mouse models with diabetes via an ultrasmall needle-electrode, *Biosensors and Bioelectronics* (2023). DOI: 10.1016/j.bios.2023.115605