Medical Xpress

Bioengineers combine lab-on-a-chip technology with AI to improve cancer immunotherapy

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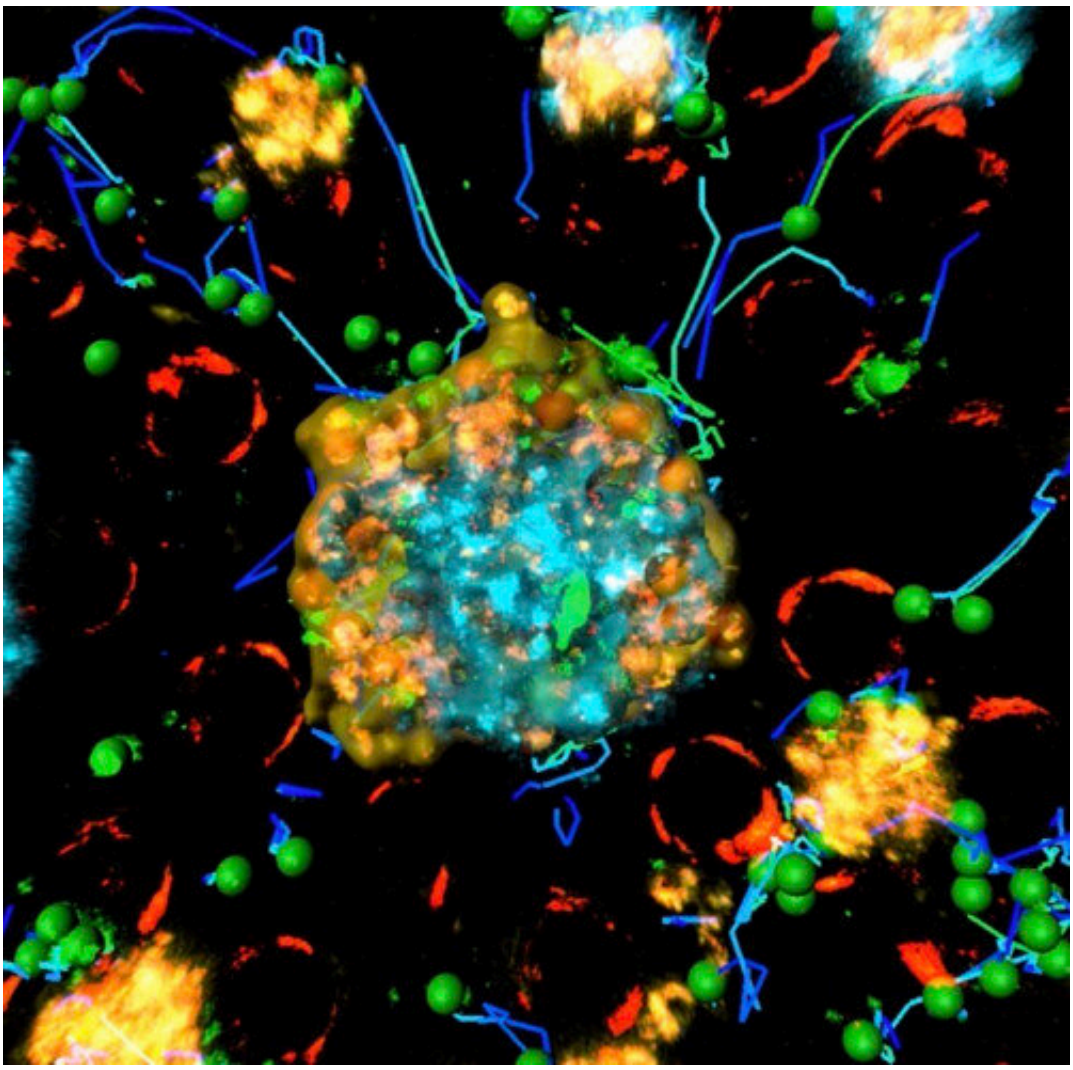

The platform tracks T cell infiltration of tumor spheroids, which are 3D structures made of cancer cells. Credit: Feng Guo

An interdisciplinary team of researchers led by Indiana University bioengineer Feng Guo has developed a tool that could lead to improved cancer immunotherapy. The prototype platform facilitates automated drug screening and real-time, 3D imaging and analysis of interactions between immune cells and cancer cells. The team's findings were recently published in *Proceedings of the National Academy of Sciences*.

"We can use our platform to see how different therapies impact the killing of target cancer cells—even tumor infiltration, which is very unique," said Guo, senior author of the paper and an assistant professor of intelligent systems engineering at the IU Luddy School of Informatics, Computing and Engineering.

Guo said the platform uses microfluidics—often referred to as lab-on-a-chip technology—combined with a type of artificial intelligence called deep learning. Microfluidics is the technology of fluid manipulation in microscopic channels, essentially scaling down different laboratory functions onto one microchip. Deep learning is machine learning based on computing systems inspired by biological neural networks. Together, these technologies allow the platform to quickly and autonomously identify potential cancer immunotherapy drugs and test how they will perform on a cellular level.

According to the researchers, solid tumors represent the vast majority of human cancers. However, current cancer immunotherapy screening methods overlook the capacity of the immune cells, which are called T cells, to penetrate the solid tumor tissue.

"Cancer immunotherapy has been really successful, but we are still facing formidable challenges to conquering cancer," said Ming Dao, co-senior author of the paper and director of MIT's Nanomechanics Lab.

"For most solid tumors, it's still hard to develop an effective therapy that can both infiltrate and kill diseased cells. We aimed to develop a new tumor immunotherapy screening platform that can dynamically track both T cell tumor penetration and tumor cell killing, and is capable of scanning through many potential drugs in a high-throughput and automated manner."

The researchers trained a deep-learning algorithm using clinical data, including digitized images of solid tumors and patient survival data. Then, they integrated the algorithm with the microfluidic platform, which can model tumor immunity and screen new immunotherapeutics that promote T cell tumor infiltration and the killing of cancer cells.

"We call it 'intelligent microfluidics,'" said Hongwei Cai, an IU graduate student in the Guo lab and co-first author of the paper. "I'm super excited about this platform and its potential to address immunotherapy for solid tumors."

Zheng Ao, a former postdoctoral researcher in the Guo lab and first author of the paper, said the platform also could be used in health fields beyond oncology, such as immunology, neurology, tissue engineering and more.

"Our findings represent powerful science and technology with the potential to transform medical research," Ao said.

More information: Zheng Ao et al, Microfluidics guided by deep learning for cancer immunotherapy screening, *Proceedings of the National Academy of Sciences* (2022). DOI: 10.1073/pnas.2214569119

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