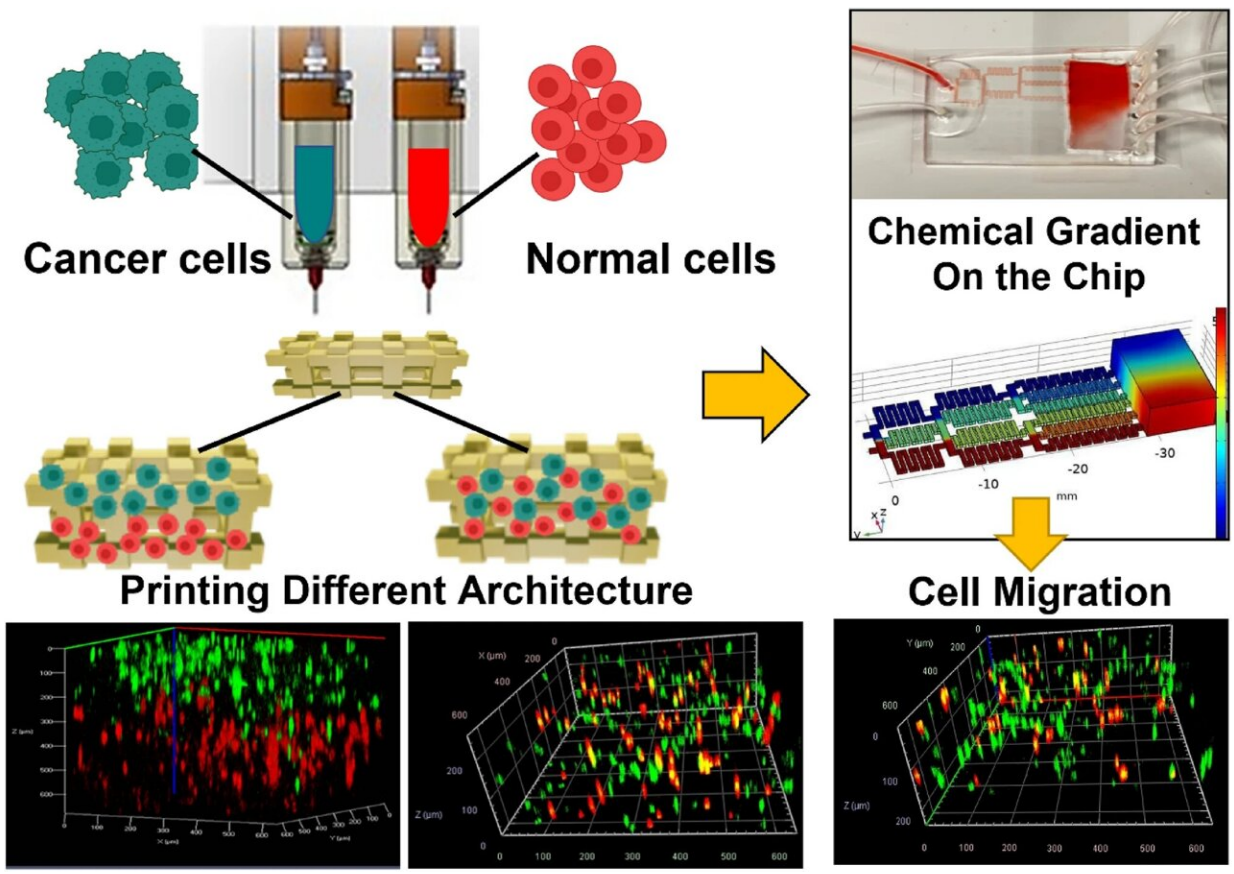
New 3D-printed tumor model enables faster, less expensive and less painful cancer treatment

October 21 2023



The summary of the proposed cancer-on-chip model. Credit: *Scientific Reports* (2023). DOI: 10.1038/s41598-023-40680-x

An international team of interdisciplinary researchers has successfully created a method for better 3D modeling of complex cancers. The University of Waterloo-based team combined cutting-edge bioprinting techniques with synthetic structures or microfluidic chips. The method will help lab researchers more accurately understand heterogeneous tumors: tumors with more than one kind of cancer cell, often dispersed in unpredictable patterns.

The research, "Controlled tumor heterogeneity in a co-culture system by 3D bio-printed tumor-on-chip model," appears in *Scientific Reports*.

Traditionally, medical practitioners would biopsy a patient's tumor, extract cells, and then grow them in flat petri dishes in a lab. "For 50 years, this was how biologists understood tumors," said Nafiseh Moghimi, an applied mathematics post-doctoral researcher and the lead author of the study. "But a decade ago, repeated treatment failures in human trials made scientists realize that a 2D model does not capture the real tumor structure inside the body."

The team's research addresses this problem by creating a 3D model that not only reflects the complexity of a tumor but also simulates its surrounding environment.

The research, which took place in the Mathematical Medicine Lab under the supervision of applied mathematics professor Mohammad Kohandel, united advancements from several disciplines. "We are creating something that is very, very new in Canada. Maybe just a couple of labs are doing something even close to this research," Moghimi said.

First, the team created polymer "microfluidic chips": tiny structures etched with channels that mimic blood flow and other fluids surrounding a patient's tumor.

Next, the team grew multiple types of cancer cells and suspended these cell cultures in their own customized bioink: a cocktail of gelatin, alginate, and other nutrients designed to keep the cells cultures alive.

Finally, they used an extrusion bioprinter—a device that resembles a 3D printer but for organic material—to layer the different types of cancer cells onto the prepared microfluidic chips.

The result is a living, three-dimensional model of complex cancers that scientists can then use to test different modes of treatment, such as various chemotherapy drugs.

Moghimi and her team are particularly interested in creating complex models of breast cancer. After skin cancer, breast cancer is the most common cancer diagnosed in women.

Breast cancer is especially challenging to treat because it appears as complex tumors containing multiple types of cells when it metastasizes. Relying on the cells from one or two biopsies to accurately represent an entire tumor can lead to ineffective treatment plans and poor outcomes.

The 3D-printed tumor models exemplify how new technology enables faster, less expensive and less painful treatments for serious conditions like late-stage breast cancer.

More information: Nafiseh Moghimi et al, Controlled tumor heterogeneity in a co-culture system by 3D bio-printed tumor-on-chip model, *Scientific Reports* (2023). DOI: 10.1038/s41598-023-40680-x

Provided by University of Waterloo