Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Mehdi Nikkhah
Roger Kamm
Danh Truong

Contact

Jovan Heusser
jovan.heusser@skysonginnovations.com

Tumor Microenvironments/Models on a Microfluidic Chip

The tumor microenvironment is a complex milieu consisting of numerous cell types, packed in an extracellular matrix, along with a dense network of capillaries. Research has shown that crosstalk between cancer cells and the microenvironment has great influence on the potential for metastasis and disease progression, however the lack of physiologically relevant tumor models to look at metastatic dispersion makes it difficult to study this crosstalk and identify efficient therapeutic strategies. Animal models are a great tool for studying the molecular basis of disease progression, however, they aren't as effective in studying the effects of microenvironmental cues on cancer metastasis, and they are prohibitively expensive. Thus, there is a need for physiologically relevant in vitro microenvironments for studying metastatic behavior of cancer cells in response to a wide range of stimuli.

Researchers at Arizona State University and collaborators have developed novel tumor microenvironments and models for studying cancer cells in a physiologically relevant manner. Hydrogel based biomaterials and microfabrication/microfluidic techniques are used to create a three dimensional biomimetic/in-vivo like human tumor microenvironment on a chip for studying the malignant behavior of cancer cells. This platform can be used to study multiple different solid cancer types as well as different stages of cancer cells including dissemination from the primary tumor, migration through the surrounding matrix and intravasation. The effects of various therapies on cancer metastasis can be investigated using this platform, and patient tumor cells can be used so that personalized treatment options can be developed.

This tumor microenvironment platform presents a major step toward producing a clinically translatable technique to study cancer cells as well as patient specific tumor metastasis. This platform may have an immense impact on the lives of cancer patients by helping in the development of personalized treatment regimens.

Potential Applications

- Breast and other solid tumor research
- Evaluating therapeutics for cancer metastases
- Development of personalized treatment regimens
- Development of therapeutic compounds targeting the tumor microenvironment

Benefits and Advantages

- Excellent scaffolding materials which provide an in-vivo like 3D microenvironment

- Patient specific primary cells and tumor biopsies can be used to develop more personalized, more effective and less toxic treatment regimens
- Cancer cells can be localized to precisely engineer a neoplastic lesion which is primarily isolated from the surrounding microenvironment
- Therapeutic compounds can be evaluated in a high throughput and combinatorial fashion
- Can be used to explore therapeutic compounds targeting the tumor microenvironment
- Samples can be recovered from different locations on the chip to assess the correlation between the heterogeneity of cancer cells to their migratory profile
- Highly organized patterns with high precision and consistency can be created for quantifiable assessment of cellular migration under rigorously controlled conditions

For more information about the inventor(s) and their research, please see Dr. Nikkhah's departmental webpageDr. Nikkhah's laboratory webpage