Rare Cancer Screening (RCS): Sarcoma-on-a-Chip

What if ex vivo simulations of rare cancer diseases would be possible?

On the basis of organ-on-a-chip technologies, sarcoma and tumor related microenvironments are focussed in this joint endeavour. Through rapid ‘on-site’ screening of individual tumor cells and tissue in the operating room, the necessity for multifaceted untargeted medication could be improved and potentially be reduced as well. Establishing a unique microfluidics-based organoid in-vitro system for rare cancers, which enables medical research to develop safer therapy strategies avoiding risky trial-and-error medicine by identifying sarcoma-specific biomarkers respecting the patient’s unique genetic makeup. Herewith, holistically collected individual data opens the way to individual ‘avatars’ on the basis of miniaturized tumor simulation devices that apply this information to treating medical ailments in the not-too-distant future.

TUMOR-ON-A-CHIP TECHNOLOGY

The simulation platform is based on state-of-the-art chip technology, including several complex biological components such as diverse organ and tumor cells as well as a simulated blood stream containing immune cells to mimic the complexity of tumor microenvironments. The sarcoma-on-a-chip is composed of a multi-layered, membrane-based sensor-integrated biochip. Patient-isolated co-cultured cancer associated fibroblasts (CAF), lipocytes, somatic cells as well as interacting cytokines are embedded in 3D biocompatible gel matrices resulting in organoid-like structures closest to in vivo conditions as possible. Chip adaptations are focused on the optimization of versatile multi-sensor monitoring for relevant microfluidic culture conditions (pH, O₂, CO₂, etc.), including cell vitality tests on the basis of transepithelial electrical resistance (TEER) measurements. Test set-up shown to the left (Figure A,B).

CORE STRATEGY – NETWORK STRENGTH

The formation of an excellent network of leading research groups from interdependent research areas via joint infrastructures combines Austrian/EU research efforts, presently involving:

- TU Vienna - Microfluidics (Cell-Chip-Technologies)
- Biomedical Research BMF Graz (Tumor-Cell-Culture)
- CCC-Subcenter: ‘Sarcoma’ Graz (Clinical Validation)
- OMICs-Analyses ZMF Graz

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Acib fellows (1st and 2nd author) have gathered a bilateral network, a ‘think tank’, open for input from scientific and industrial partners to develop a future simulation system that addresses the following cancer research aspects in full detail:

- Novel Biomarker Detection
- Precision Diagnosis & Therapy
- On-Site OR/OP Screening
- Unique Organoid-Replication
- Individual Health Care: Personalized Treatment
- Drug Testing/Development
- Database-integrated & expanded Big-Data-Mgmt

Illustrations by Julie McMurry