Three-dimensional cell culture and Light Sheet-based Fluorescence Microscopy advances cancer diagnosis and drug development

Nariman Ansari, Francesco Pampaloni, Ernst H.K. Stelzer
Physical Biology, Buchmann Institute for Molecular Life Sciences (BMLS)
Goethe Universität, Frankfurt am Main, Germany

Nariman.Ansari@PhysikalischeBiologie.de, Francesco.Pampaloni@PhysikalischeBiologie.de, Ernst.Stelzer@PhysikalischeBiologie.de

The demand for three-dimensional (3D) cell cultures is booming. During the period 2004-2010, the total number of publications with a focus on 3D cell cultures rose from 2550 to 9479 (i.e. almost by a factor of four, Google Scholar). The three main reasons are: 1) assays based on culturing cells on hard and flat surfaces seem to fail in clinical, i.e. in physiological relevant, research, 2) 3D cell cultures are much more likely to resemble the situation found in tissue and 3) the ethical and financial pressure to reduce the number of animal experiments.

Several technical innovations of the last few years have simplified the manipulation of 3D cell cultures. Assays based on cellular spheroids are performed more easily and seem to become more suitable for high-throughput and high-content screenings. Novel 3D imaging techniques such as light sheet-based fluorescence microscopy allow studies of live 3D cell cultures in real-time and with a high spatial and temporal resolution. Thus, conducting even sophisticated cell-based assays in 3D cell cultures is now feasible.

The fastest growing applications of 3D cell cultures are found in cancer diagnosis, cancer therapy, and in drug screening. We develop three-dimensional cultures of tumor cell spheroids for drug screening. The cultivated tumor spheroids serve as a model for tumors in the living organism. In this talk we present the evaluation process of different 3D tumor models for drug screening and the therapeutic benefits as well as the toxicity of drug candidates in the spheroids by means of automated epifluorescence microscopy, confocal laser scanning microscopy and light sheet-based fluorescence microscopy (LSFM).

References

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