
The regulation of cell, tissue and organ development in health and disease

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The research is concentrated on cell biology of both plant and animal, including human cells. Basic cell biological processes and structures are analyzed. Important achievement in plant cell biology was the discovery and subsequent functional characterization of plant multiprotein complex exocyst, which has crucial role in vesicle transport, exocytosis, cell growth and motility. In addition, the influence of evolutionary conserved actin nucleators – FH2 proteins – on structure and dynamics of microtubule cytoskeleton in plants was described. In animal and human cell biology, the attention was concentrated on cancer cell transformation and malignant progression, with emphasis on cell signaling, subcellular structures and mechanisms of cell motility. Important achievement was the elucidation of structure of invasive protrusions of cancer cells – invadopodia – in a complex 3D environment. Other important discoveries were related to amoeboid invasiveness of cancer cells (the discovery of primarily amoeboid invasiveness in cells of mesenchymal origin, demonstration of the importance of amoeboid invasiveness in metastasis of sarcomas, identification of key signaling proteins). In relation to analysis of signalling in malignant progression the role of CAS protein in invasiveness, metastasis and mechanoreception was shown and elucidated. In addition, the tyrosine phosphorylation within SH3 domains was identified as a novel general negative regulatory mechanism of cell signalling.

The research in the field of developmental biology is mainly concentrated on genetics and cytogenetics of *Xenopus tropicalis* and *Xenopus laevis*. Among most important achievements within this field was the construction of linkage and physical map of *Xenopus Tropicalis*, which subsequently enabled the identification of many genes, responsible for mutant phenotypes of interest for biomedical research. Another important achievement was the evolutionary analysis of human X chromosome origin based on sequential and cytogenetic data from *X. tropicalis*. Very important results came from evo?devo analysis of morphogenesis of head tissue/structures, which form the body plan of vertebrates and their developmental plasticity is responsible for the origin of crucial evolutionary innovations and adaptive changes.

Selected outputs

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