



Czech Annual Cancer Research Meeting November 18–20 2024 | Olomouc, CZ

**19th Czech Annual
Cancer Research
Meeting**

former Diagnostic, Predictive
and Experimental Oncology
Days

**19th Molecular
Pathology Days**

**3rd Conference of the
National Institute for
Cancer Research**

ABSTRACT BOOK

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CZECH
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Electrochemical biochip technologies for clinical sample analysis in molecular oncology

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Electrochemical (EC) detection of nucleic acids presents a promising approach for identifying these biomolecules as important cancer biomarkers. Primary benefits include affordability, rapidity, simplicity, minimal sample requirements, and potential for miniaturization, making it ideal for personalized, decentralized medicine at point-of-care or in limited resource settings. By integrating the EC detection with novel, PCR-free isothermal amplification techniques (IAT) like loop-mediated amplification (LAMP), rolling circle amplification (RCA), or recombinase polymerase amplification (RPA), high sensitivity and selectivity can be achieved.

Application of these technologies in analyzing clinical samples from cancer patients, targeting a variety of DNA/RNA biomarkers, is demonstrated. Examples include the development of bioassays for detecting HPV oncoviruses in cervical cancer, long non-coding RNAs in prostate cancer, and DNA point mutations in BRAF or KRAS oncogenes in colorectal cancer. Consequently, EC methods coupled with IATs could serve as a valuable alternative in contemporary molecular cancer diagnostics. This work was supported by grant projects AZV NU21-08-00078, AZV NU21-08-00057, National Institute for Cancer Research (Programme EXCELES, ID Project No. LX22NPO5102) - Funded by the European Union - Next Generation EU, Large research infrastructure BBMRI.cz (Project

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Spatiotemporal organization of biomolecules in cancer cells by phase separation

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Our research investigates the spatiotemporal organization of biomolecular material within cells, emphasizing its critical role in the efficacy and kinetics of cellular processes, particularly in the context of cancer transformation. We are investigating the molecular mechanisms that drive pathophysiological changes in cellular architecture during oncogenesis, with a particular interest in the principles of biomolecular condensation by phase separation driven by phosphoinositides and RNA molecules. We use a

combination of *in vitro* and *in vivo* methods, integrating biochemistry, molecular cell biology, microscopy, proteomics and bioinformatics. These approaches are applied to a range of cancer cell culture models, from glioblastoma to human papillomavirus-infected cell lines, and our findings are corroborated with patient-derived material in translational projects. An important aspect of our study is the role of RNA and phosphatidylinositol 4,5-bisphosphate (PIP2) in the formation of nuclear compartments such as nuclear speckles and nucleoli. PIP2 found in these compartments is involved in RNA polymerase I/II transcription and exhibits RNA-dependent nuclear localization. We investigated the cooperative interaction between PIP2 and RNA in the establishment of nuclear architecture and determined the RNA-dependent PIP2-associated (RDPA) nuclear proteome in human cells using mass spectrometry. Our results show that intrinsically disordered regions (IDRs) with polybasic PIP2-binding K/R motifs are important features of RDPA proteins. We found that the RDPA protein BRD4 associates with PIP2 in an RNA-dependent manner via electrostatic interactions. Elevated PIP2 levels were found to increase the number of BRD4 nuclear foci, suggesting that PIP2 spatiotemporally orchestrates nuclear processes by associating with RNA and RDPA proteins, thereby influencing their phase separation ability. These findings highlight the critical role of PIP2 in establishing a functional nuclear architecture competent for gene expression, advancing our molecular understanding of cancer and offering new avenues for early diagnosis and treatment strategies.

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