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Circulating tumor cells as a real time liquid biopsy: Isolation and detection systems, molecular characterization and clinical applications

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Detection of Circulating Tumor Cells (CTC) in peripheral blood can serve as a "liquid biopsy" approach and has thus emerged lately as one of the hottest fields in cancer research. The clinical significance of CTC has been evaluated in many types of solid cancers, and the CTC enumeration test in metastatic breast, colorectal and prostate cancer has been cleared by the FDA almost a decade ago. CTC molecular characterization has a strong potential to be translated into individualized targeted treatments.

A variety of analytical systems are continuously been developed for CTC isolation, detection and molecular characterization. The main strategies are based on their separation from peripheral blood mononuclear cells based on CTC density, size and electric charges and protein expression on the cell surface of CTC. A variety of microfluidics and filtration devices has been developed and are currently under evaluation for selection and enumeration of CTCs. CTC detection and molecular characterization systems are mainly based on protein and image-based approaches like classical immunocytochemistry, the FDA cleared CellSearch system, and immunofluorescence, and molecular assays based on the nucleic acid analysis in CTCs like RT-qPCR, multiplex RT-qPCR, and next generation sequencing technologies. Quality control and standardization of CTC isolation, detection and molecular characterization methodologies is very important for the incorporation of CTCs into prospective clinical trials testing their clinical utility.

CTC molecular characterization at the single cell level holds considerable promise for the identification of therapeutic targets and resistance mechanisms in CTCs as well as for the stratification of patients and real-time monitoring of systemic therapies.

This lecture will be mainly focused on the analytical systems for CTC isolation, enumeration, and detection and the clinical applications of CTC in many types of solid cancer. We also discuss the potential of the molecular characterization of CTC as a liquid biopsy in individualized therapy.

Biography

Evi S. Lianidou is currently Professor of Analytical Chemistry and Clinical Chemistry at the Department of Chemistry, University of Athens, Greece. Dr. Lianidou is an elected member of the Committee for Clinical Molecular Biology Curriculum of the International Federation of Clinical Chemistry (IFCC) that offers training in Molecular Diagnostics all over the world. Dr. Lianidou is coordinating the M.Sc. program of Clinical Chemistry, at the Department of Chemistry, Her main research interests are especially on: a) study of micrometastasis through the development of singleplex and multiplex quantitative real time RT-qPCR assays for the detection of Circulating Tumor Cells (CTCs), b) development and clinical evaluation of DNA methylation assays in fresh tissues, paraffin-embedded breast carcinomas, in CTC and in cell-free circulating DNA, c) development and clinical evaluation of quantitative real time RT-qPCR assays for the detection of mature micro RNAs in fresh tissues, paraffin-embedded breast carcinomas and in cell-free circulating DNA, d) development and clinical evaluation of multiplex assays for gene expression in CTCs based on the Luminex bead array system. Dr. Lianidou has 80 publications.

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