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A DNA Nanodevice Simultaneously Activating the EGFR and Integrin for Enhancing Cytoskeletal Activity and Cancer Cell Treatment

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Cell-surface receptors (e.g., EGFR and integ-rin) and their interactions play determining roles in signal transduction and cytoskeletal activation, which affect cell attachment/detachment, invasion, motility, metastasis (intra-cellular), and cell-cell signaling. For instance, the interactions between the EGFR and integrin (a6b4) may cause increased mechanical force and shear stress via enhanced cytoskeleton activation. Here, we design a DNA nanodevice (DNA ND) that can simultaneously target the EGFR and integrin receptors on the caveolae. The piconewton (pN) forces in response to the EGFR-integrin coactivation can be sensed upon the unfolding of the DNA hairpin structure on the side arm of the device via changes of the fluorescence and plasmonic signals. We find that simultaneous activation of EGFR-integrin receptors causes enhanced signal transduction, contractions of the cells, and initiation of the biochemical pathways, thus resulting in a change of the cell division and endocytosis/exocytosis processes that affect the cell proliferation/apoptosis. The DNA-ND further enables us to visualize the co internalization and degradation of the receptors by lysosomes, providing a novel approach toward bioimaging and mechano-pharmacology.

Keywords— Cell surface receptors, EGFR and integrin, caveolae, cytoskeleton, pN forces

Biography

Dr. Baig, MMFA is a registered pharmacist, and currently a post-doctoral fellow (PDF) at the Faculty of Dentistry, The University of Hong Kong, under the supervision of Professor Dr. Chengfei Zhang. He received his Doctor of Pharmacy (PharmD), and MPhil (Pharmaceutical Chemistry) degrees from the Faculty of Pharmacy, Bahauddin Zakariya University (BZU), Pakistan, and a Ph.D. degree from the School of Chemistry and Chemical Engineering, Nanjing University (NJU), China under the supervision of Prof. Dr. Xing-Hua Xia. During his PharmD research, he worked on a clinical trial in the Cardiology Ward of Nishtar Hospital, Multan, Pakistan (2009-2011). Later, he worked as a "Research Assistant" on a breast cancer project in the Department of Molecular Biology & Biotechnology, BZU, Pakistan (2011-2012). His task was to analyze genetic polymorphism in the DNA extracted from the WBCs of the freshly collected blood samples. Then, he joined "Novartis Pharma, Pakistan" as a "Medical Information Officer" in the cardiovascular group (2012-2015) and won the "National Performance Award" in 2015.

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