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Biophysics of cell membrane lipids in cancer drug resistance: Drug transport and drug delivery with nanoparticles

Recent advances in membrane lipid research show the varied roles of lipids in regulating membrane P-glycoprotein function, membrane trafficking, apoptotic pathways, drug transport, and endocytic functions, particularly endocytosis, the primary mechanism of cellular uptake of nanoparticle-based drug delivery systems. Since acquired drug resistance alters lipid biosynthesis, understanding the role of lipids in cell membrane biophysics and its effect on drug transport is critical for developing effective therapeutic and drug delivery approaches to overcoming drug resistance. We show that epigenetic changes are responsible for altered lipid biosynthesis in acquired drug resistance, making the membrane compact and rigid, thus hindering the drug transport process. Two different novel strategies are being investigated to overcome drug resistance: (a) modulating the biophysical properties of membrane lipid of resistant cells using epigenetic drugs to facilitate drug transport and regain endocytic function and (b) developing effective nanoparticles based on their biophysical interactions with membrane lipids to enhance drug delivery to overcome drug resistance.

Biography

Vinod Labhasetwar, PhD, is a Professor of Biomedical Engineering, Lerner Research Institute, Cleveland Clinic, both in Cleveland, Ohio, USA. The primary research focus of his laboratory over the past 25+ years has been on nanoparticle-mediated drug delivery in the context of translational and clinical medicine, particularly focusing on disease conditions where no effective treatments yet exist. His team's specific interests are in developing effective approaches to cancer therapy (against drug resistance and metastasis), cardiovascular diseases (particularly inhibition of restenosis), and facilitating neuromuscular repair mechanisms in stroke and spinal cord injury. Recently, his group's efforts have been expanding into two new areas: retinitis pigmentosa, with the goal of slowing the progression of photoreceptor degeneration; and transplantation research, with the objective of extending the critical window of time for organ preservation. He has published over 180 peer-reviewed articles and book chapters. He is listed among the 2014 and 2015 Highly Cited Researchers by Thomson Reuters, based on the top 1% of citations during the past 10 years. He has over 25 issued US and international patents and 4 provisional the US patents filed/pending. He is Editor-in-Chief of Drug Delivery and Translational Research, an official journal of the Controlled Release Society.

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