Lipopolyplexes: A Next Generation Lipid and Polymer Based Gene Delivery Systems

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Editorial

Nucleic acids and Oligonucleotides like DNA, siRNA, miRNA and miRNA inhibitors have overriding attention as payloads of gene delivery systems for cancer treatment. The advancement of nanotechnology in last few decades has rapidly transformed the chemistry and functionality of the gene delivery nanocarriers. Lipoplexes (Lipid based delivery vehicles) [1] and Polyplexes (Cationic polymer based delivery vehicles) [2,3] are widely explored for their surface modification, complexation efficiency, endosomal escape and release of nucleic acids from carriers in the cytoplasm, the ideal characteristics of a gene delivery nanocarrier. Despite these advantages, Lipoplexes and polyplexes succumb to cytotoxicity, immunogenicity and premature dissociation of nucleic acid material [4-6]. Hence, these delivery vehicles aren't fruitful in clinical trials. Cytotoxicity is a foremost limitation impeding the therapeutic use of gene knockdown and gene delivery vehicles. Apart from immunogenicity and cytotoxicity, low cellular uptake and rapid degradation are additional important factors manipulating therapeutic use of gene delivery vehicles. However, recent research showed that the gene delivery nanocarriers with neutral or negatively charged Lipoplexes have squashed issues likes cytotoxicity and immunogenicity generated by cationic carriers. Investigation also yielded encouraging out comes in in vitro and in vivo than cationic lipids as being used currently [7]. However, negatively charge lipids lack the positive charge, which is essential to promote interaction with nucleic acids for efficiently encapsulating. This understanding leads to the possibility of development of new type of gene nanocarrier blend called Lipopolyplexes with the combined affirmative characteristics of Lipoplexes and polyplexes. The combination of a cationic polymer and negative or neutral lipid with genetic material is principally a fascinating concept of developing these possibly next generation gene nanocarriers. Lipopolyplexes showed improved encapsulation efficiency by condensation of the nucleic acid payload by cationic polymers. This also showed enhanced colloidal stability and also lowers the cytotoxicity and immunogenicity compared to cationic Lipoplexes and polyplexes. In addition, they can be stored at room temperature or can be nebulized without altering their physicochemical integrity and biological activity thus appear suitable for gene therapy [8]. The effectiveness of Lipopolyplex mediated gene delivery system mainly depends on the lipid and polymer chemical structure, lipid/Nucleic acid and Polymer/nucleic acid molar ratios. Lipoplexes formulated using cationic lipids such as DOTAP, DPPC-DSPE, DPPC: DPPG, DOPE: Cholesteryl Hemisuccinate: Folate-Polyethlene Glycol-DOPE, DOCSPER, DOSPER, DOTMA [9-14], have shown improved transfection efficiency in cancer cell lines. The relationship between cationic polymers (PEI, chitosan, PAA and PLL, etc.) [15-18] and lipids can be selected rationally to make an effective gene delivery. The polyplex part of the Lipopolyplexes improves the intracellular trafficking of nucleic acid material while the lipids encourage cellular uptake of the lipopolyplexes [19,20]. Lipopolyplexes formulated with negatively charged lipid in different combinations such as DPPC: DSPE-PEG, DOPE: DPPC: Cholesterol, have been playing an imperative role in gene therapy and offer preclinical proof of concept. Lipopolyplex a novel technology is going to be explored widely for cancer treatment in the coming days. The Lipopolyplexes will support the cause of gene therapy, resulting in advances in the medical industry and, more vitally, to the patients.

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