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Design of multifunctional polymeric carriers for cancer gene therapy

Primary objectives of gene therapy are to correct the genetic defects that underlie a disease process and to provide supplemental therapeutic modality through genetic engineering. Over 75% of current gene therapy is performed using viruses as gene delivery vehicles. However, with viruses, there are serious concerns over the issues of toxicity, immunogenicity, payload gene size limitations and difficulty in scale up for industrial production. Non-viral vectors therefore have attracted attention from academic and industrial point of view. Among the non-viral vectors, polymeric systems offer several important advantages. First, polymers are tremendously versatile and can provide physical, chemical and biological properties that are necessary for gene delivery applications. Second, polymers can be synthesized in parallel synthesis pathways for high-throughput screening of biocompatibility and transfection efficiency. Third, various formulations, designs and geometrics can be made from polymeric materials for specific types of gene delivery applications. Moreover, the surface chemistry of polymers can be easily modified with biological ligands for site specific targeting in the body. However, some non-degradable polymers accumulate in the body resulting in the cytotoxicity and thus the reduction in their gene transfer ability. Even though, low molecular weight polymers, which can be eliminated via kidney is an alternative, exhibits lower colloidal stability and DNA condensation due to their reduced number of electrostatic interactions thus reduced transfection efficiency. As biodegradable polymers are designed to contain a combination of various functional components, it is likely that engineered systems for non-viral gene delivery, especially with the application of biodegradable ester linkage will eventually be constructed. This biodegradable linkage approach to vector development is giving way to a safety profile where low molecular weight polyethylenimines are coupled with diacrylates and sugar alcohol linkers to yield high molecular weight poly (ester amine) (PEAs) with reduced cytotoxicity and high transfection efficiency. The need for a safety and biocompatibility approach extends to *in vitro* investigations, as modifications intended for *in vivo* applicability can significantly affect both *in vitro* and *in vivo* performance.

Biography

Arote Rohidas is an Associate Professor and the Director of Nanomedicine Laboratory in the Department of Molecular Genetics, School of Dentistry, Seoul National University, Republic of Korea. He is one of the leading scientists in the field of biomaterials development for gene delivery especially for cancer treatment. His research on DNA therapeutics, biodegradable polymeric carriers and nanoparticles has been published in over 50 international journals and produced various patents.

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