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Application of microfluidic platforms in gene therapy: Complexation of cationic liposome and small interfering RNA

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Gene therapy, as a promising technique which involves the delivery of correct copy of the defective gene, can be an approach in treatment of genetic diseases. The present study was aimed to technological development of microfluidic platforms in order to incorporate small interfering RNA (siRNA-silencer) in nano-scaled cationic liposomes (CLs) for further application of non-viral vectors in gene therapy. The production of CLs-siRNA complexes (lipoplexes) by using microfluidics technology, which processes fluids in small amounts, could provide the continuous operation as a single-phase system. For this purpose, CLs were produced in microfluidic device which was fabricated with PDMS (Polydimethylsiloxane) using soft lithography. The electrostatic complexation between CLs and siRNA was evaluated using both conventional and microfluidic processes. The physicochemical and biochemical properties of CLs and lipoplexes were evaluated and showed promising characteristics as delivery vector. The transfection study in HeLa cells was successfully carried out in ELISA plates using the most appropriate lipoplexes, which were previously produced. The result of cytotoxicity analysis of the lipoplexes was highly comparable with Lipofectamine, which is a commonly-used commercial carrier. Furthermore, as a part of optimization study, theoretical molar charge ratio between cationic liposome and siRNA were calculated and was compared with experimental value. Preliminary characterization of lipoplexes (size, polydispersity, zeta potential, siRNA accessibility, and morphology) prepared on microfluidic platform presented favorable characteristics. The results obtained in this study shed light on the benefits of utilizing microfluidics to optimize vectors for gene therapy.

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