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3P53 - Magnetic field effects on efficiency of non-viral gene delivery using magnetic nanoparticles

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While several non-viral gene delivery methods (e.g., electroporation and optoporation) have been developed with various degrees of success, no uniform solution with low cost, high transfection efficiency, low toxicity, simplified workflow and ease of use has been achieved. One approach to deliver genetic material into eukaryotic cells uses magnetic nanoparticles and magnetic fields [1]. While the mechanism of action is incompletely understood, it is hypothesized that the magnetic force brings the magnetic nanoparticle/DNA complexes in the cell growth medium sufficiently close to the cell membrane so that the genetic material will be rapidly taken into the cell by endocytosis [2].

The relationship between magnetic field intensity/magnetic force on cell transfection has not been characterized. This work examines the effect of magnetic field on transfection efficiency for various cell lines using commercially available magnetic particles and magnetic particles synthesized in-house. A commercial permanent magnet and an in-house electromagnet with varying magnetic field capabilities were utilized in experiments. For various cell lines, combining the magnetic field with magnetic particles did not improve siRNA transfection efficiency. For others, magnetic fields improved transfection 5 to 10-fold; however, increasing the magnetic field did not reproducibly increase transfection efficiency. This suggests that the mechanism is more complicated than previously thought, and requires research to determine the impact of particle size, charge, magnetic properties, aggregation and magnetic forces on gene delivery.

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