

Editorial

Nomenclature for Synthetic Gene Delivery Systems

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TWENTY-FIVE YEARS AGO, in an article published in *Science* (T. Friedmann and R. Roblin, *Science* 175, 949-955, 1972), Ted Friedmann outlined prospects for human gene therapy. This forward-looking review anticipated the development of two alternative gene delivery systems—viral gene therapy vectors and synthetic gene delivery systems using purified gene sequences. As molecular biology techniques matured, the tools to package genes into nonreplicating, recombinant viral vectors became available, allowing the efficient introduction of recombinant genes into living cells *in vitro* (cultured cells) and *in vivo* (animals and humans). During the last several years, we have witnessed an exponential growth in preclinical research and clinical development of recombinant viral vectors for gene therapy applications.

Although the entry of synthetic delivery systems into the gene therapy repertoire has been somewhat delayed, today the clinical application of nonviral gene therapy products is steadily increasing. The direct injection of naked DNA is being aggressively pursued clinically as a method of inducing protective immunity in humans against influenza, human immunodeficiency virus (HIV), malaria, and a long and growing list of additional pathogenic organisms. The two classes of synthetic gene delivery systems that are being investigated most actively today involve the use of either cationic lipids or polycationic polymers. Cationic liposome-based delivery systems are being evaluated in phase I and phase II clinical trials for the treatment of a variety of different types of human cancer and for the treatment of cystic fibrosis. The cationic polymer-based systems have been most widely associated with the generation of receptor-mediated gene delivery systems, and advanced clinical trials using such systems are underway in Europe. An expanding interest in preclinical and basic research directed at improving and controlling the efficacy of synthetic nucleic acid delivery systems is evident from the growing number of publications on the topic, as well as from the participation at scientific conferences devoted to this area.

At a recent conference on the topic of synthetic gene delivery systems ("Self-assembling Systems for Gene Delivery," San Diego, November 1996), the participants raised a nomenclature problem that is becoming increasingly difficult as more investigators publish in the field. It is apparent that there are an unnecessarily large number of terms describing the same things. For example, cationic lipid-mediated transfection has been called li-

posome-mediated transfection, cationic liposome-mediated transfection, lipofection, cytofection, amphifection, and lipid-mediated transfection. Similarly, the complexes that are produced when cationic lipids are mixed with DNA have been referred to as cytosomes, amphisomes, liposomes, nucleolipidic particles, cationic lipid-DNA complexes, lipid-DNA complexes, DNA-lipid complexes, etc. Polycation condensed DNA has been referred to as interpolyelectrolyte complexes, molecular conjugates, polylysine-DNA complexes, DNA-polylysine complexes, etc. And finally, there are numerous different ways for describing the composition of the complexes including, DNA/cationic lipid (or cationic polymer), cationic lipid (or cationic polymer)/DNA, DNA/total lipid or total lipid/DNA, expressed either as wt/wt, mol/wt, wt/mol, or charge/charge. Any of us responsible for reviewing manuscripts must make conversions into familiar units before the data can be properly evaluated.

In order to resolve these issues, an *ad hoc* committee was convened over the internet, consisting of the authors of this editorial. The following nomenclature recommendation was agreed upon:

Complexes

Lipoplex = Cationic lipid-nucleic acid complex

Polyplex = Cationic polymer-nucleic acid complex

Transfection

Lipofection = Nucleic acid delivery mediated by cationic lipids

Polyfection = Nucleic acid delivery mediated by cationic polymers

Composition

$$\text{Charge ratio} = \frac{\text{Positive charge equivalents of the cationic component}}{\text{Negative charge equivalents of the nucleic acid component}}$$

"Lipoplex" replaces all of the terms for cationic lipid-nucleic acid complexes (including either DNA, RNA, or synthetic oligonucleotides) that were mentioned previously. For this

definition, cationic lipid refers to all cationic amphiphiles, including cationic cholesterol and bile salt derivatives as well as other micelle-forming cationic amphiphiles such as CTAB. "Polyplex" replaces the term "molecular conjugates" and any other terms that were used to describe complexes using polylysine or other polycationic peptides, dendrimers, polyethyleneimine, and the like. Complexes that contain both polycationic polymers and cationic lipids may be referred to as "Lipopolyplex." Although the general term "transfection" applies broadly to all methods for synthetic nucleic acid delivery, occasionally it may be convenient to have terms that substitute for phrases such as "cationic lipid-mediated transfection" or "transferrin-polysine-mediated transfection." For this purpose, lipid mediated transfection may be referred to as "Lipofection," and transfection mediated by systems condensed with polycations can be termed "Polyfection."

The composition of the complexes will be related to the net charge of the system as "positive charge equivalents/negative charge equivalents" and will be referred to as the "charge ratio." Thus, compositions containing an excess of the cationic component have a charge ratio greater than 1, formulations containing more negative than positive charge have a charge ratio less than 1, and systems containing an equal number of negative and positive charges have a charge ratio of 1. The DNA concentration can be determined empirically from the OD measurement at 260 nm, where $50 \mu\text{g/ml DNA} = 1 \text{ OD}$. Because each nucleotide monomer unit in DNA bears one negative charge, the negative charge equivalents can be calculated by using an average molecular weight per nucleotide monomer of 330. Alternatively, a phosphate assay can be used to determine negative charge equivalents. The positive charge equivalents in the cationic component must be determined differently for each cationic agent under investigation, accounting of course for such things as the presence of counterions in these agents. In those cases in which the positively charged moieties are derived from groups that are titratable within the useful pH range, and it is therefore difficult to ascertain the exact amount of positive charge contributed by the cationic component, then the maximum possible positive charge will be used.

We are hopeful that the investigators in this field will find this nomenclature convention reasonably acceptable, and that it will facilitate communication among the many laboratories engaged in this active area of scientific research.

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This article has been cited by:

1. Bogdan Draghici, Marc A. Ilies. 2015. Synthetic nucleic acid delivery systems: present and perspectives. *Journal of Medicinal Chemistry* 150206115406002. [[CrossRef](#)]
2. Petra Kos, Ulrich Lächelt, Dongsheng He, Yu Nie, Zhongwei Gu, Ernst Wagner. 2015. Dual-Targeted Polyplexes Based on Sequence-Defined Peptide-PEG-Oligoamino Amides. *Journal of Pharmaceutical Sciences* **104**, 464-475. [[CrossRef](#)]
3. Dongsheng He, Ernst Wagner. 2015. Defined Polymeric Materials for Gene Delivery. *Macromolecular Bioscience* n/a-n/a. [[CrossRef](#)]
4. Yushin Yazaki, Ayako Oyane, Hideo Tsurushima, Hiroko Araki, Yu Sogo, Atsuo Ito, Atsushi Yamazaki. 2014. Improved gene transfer efficiency of a DNA-lipid-apatite composite layer by controlling the layer molecular composition. *Colloids and Surfaces B: Biointerfaces* **122**, 465-471. [[CrossRef](#)]
5. Klein Philipp M., Wagner Ernst. 2014. Bioreducible Polycations as Shuttles for Therapeutic Nucleic Acid and Protein Transfection. *Antioxidants & Redox Signaling* **21**:5, 804-817. [[Abstract](#)] [[Full Text HTML](#)] [[Full Text PDF](#)] [[Full Text PDF with Links](#)]
6. Julius A. Edson, Young Jik Kwon. 2014. RNAi for silencing drug resistance in microbes toward development of nanoantibiotics. *Journal of Controlled Release* . [[CrossRef](#)]
7. V Fehring, U Schaeper, K Ahrens, A Santel, O Keil, M Eisermann, K Giese, Jörg Kaufmann. 2014. Delivery of Therapeutic siRNA to the Lung Endothelium via Novel Lipoplex Formulation DACC. *Molecular Therapy* **22**, 811-820. [[CrossRef](#)]
8. Vishnu Dutt Sharma, Marc A. Ilies. 2014. Heterocyclic Cationic Gemini Surfactants: A Comparative Overview of Their Synthesis, Self-assembling, Physicochemical, and Biological Properties. *Medicinal Research Reviews* **34**:10.1002/med.2014.34.issue-1, 1-44. [[CrossRef](#)]
9. Ernst Wagner Polymers for Nucleic Acid Transfer—An Overview 231-261. [[CrossRef](#)]
10. Iwona Nierengarten, Marc Nothisen, David Sigwalt, Thomas Biellmann, Michel Holler, Jean-Serge Remy, Jean-François Nierengarten. 2013. Polycationic Pillar[5]arene Derivatives: Interaction with DNA and Biological Applications. *Chemistry - A European Journal* **19**:10.1002/chem.v19.51, 17552-17558. [[CrossRef](#)]
11. Sushma Savarala, Eugen Brailoiu, Stephanie L. Wunder, Marc A. Ilies. 2013. Tuning the Self-Assembling of Pyridinium Cationic Lipids for Efficient Gene Delivery into Neuronal Cells. *Biomacromolecules* 130724140257005. [[CrossRef](#)]
12. Carole Lavigne, Kathryn Slater, Niranjala Gajanayaka, Christian Duguay, Erika Arnau Peyrotte, Germaine Fortier, Martin Simard, Arnold J Kell, Michael L Barnes, Alain R Thierry. 2013. Influence of lipoplex surface charge on siRNA delivery: application to the in vitro downregulation of CXCR4 HIV-1 co-receptor. *Expert Opinion on Biological Therapy* **13**, 973-985. [[CrossRef](#)]
13. Ulrich Lächelt, Petra Kos, Frauke M. Mickler, Annika Herrmann, Eveline E. Salcher, Wolfgang Rödl, Naresh Badgular, Christoph Bräuchle, Ernst Wagner. 2013. Fine-tuning of proton sponges by precise diaminoethanes and histidines in pDNA polyplexes. *Nanomedicine: Nanotechnology, Biology and Medicine* . [[CrossRef](#)]
14. Nabil A. Alhakamy, Cory J. Berkland. 2013. Polyarginine Molecular Weight Determines Transfection Efficiency of Calcium Condensed Complexes. *Molecular Pharmaceutics* 130415153908002. [[CrossRef](#)]
15. Yu Nie, Ernst Wagner pH-Responsive Polymers for Delivery of Nucleic Acid Therapeutics 413-432. [[CrossRef](#)]
16. Chun-Bing Zhang, Hui-Lin Cao, Qian Li, Juan Tu, Xiasheng Guo, Zheng Liu, Dong Zhang. 2013. Enhancement Effect of Ultrasound-Induced Microbubble Cavitation on Branched Polyethylenimine-Mediated VEGF165 Transfection With Varied N/P Ratio. *Ultrasound in Medicine & Biology* **39**, 161-171. [[CrossRef](#)]
17. S. Aleandri, M.G. Bonicelli, L. Giansanti, C. Giuliani, M. Ierino, G. Mancini, A. Martino, A. Scipioni. 2012. A DSC investigation on the influence of gemini surfactant stereochemistry on the organization of lipoplexes and on their interaction with model membranes. *Chemistry and Physics of Lipids* **165**, 838-844. [[CrossRef](#)]
18. R.-E. Duval, I. Clarot, F. Dumarcay-Charbonnier, S. Fontanay, A. Marsura. 2012. Interest of designed cyclodextrin-tools in gene delivery. *Annales Pharmaceutiques Françaises* **70**, 360-369. [[CrossRef](#)]
19. Juan Sabín, Carmen Vázquez-Vázquez, Gerardo Prieto, Federico Bordi, Félix Sarmiento. 2012. Double Charge Inversion in Polyethylenimine-Decorated Liposomes. *Langmuir* **28**, 10534-10542. [[CrossRef](#)]

20. Claudia Scholz, Ernst Wagner. 2012. Therapeutic plasmid DNA versus siRNA delivery: Common and different tasks for synthetic carriers. *Journal of Controlled Release* **161**, 554-565. [[CrossRef](#)]
21. Simcha Even-Chen, Rivka Cohen, Yechezkel Barenholz. 2012. Factors affecting DNA binding and stability of association to cationic liposomes. *Chemistry and Physics of Lipids* **165**, 414-423. [[CrossRef](#)]
22. Irene Martin, Christian Dohmen, Carlos Mas-Moruno, Christina Troiber, Petra Kos, David Schaffert, Ulrich Lächelt, Meritzell Teixidó, Michael Günther, Horst Kessler, Ernest Giralt, Ernst Wagner. 2012. Solid-phase-assisted synthesis of targeting peptide-PEG-oligo(ethane amino)amides for receptor-mediated gene delivery. *Organic & Biomolecular Chemistry* . [[CrossRef](#)]
23. R. Gref, D. Duchêne. 2012. Cyclodextrins as “smart” components of polymer nanoparticles. *Journal of Drug Delivery Science and Technology* **22**, 223-233. [[CrossRef](#)]
24. Takayuki Anno, Taishi Higashi, Keiichi Motoyama, Fumitoshi Hirayama, Kaneto Uekama, Hidetoshi Arima. 2011. Potential use of glucuronylglucosyl- β -cyclodextrin/dendrimer conjugate (G2) as a DNA carrier in vitro and in vivo. *Journal of Drug Targeting* **1-9**. [[CrossRef](#)]
25. Jo-Ann C. Leong, Kristine Romoren, Oystein Evensen DNA Vaccines for Viral Diseases of Farmed Fish and Shellfish 153-173. [[CrossRef](#)]
26. Catarina Madeira, Luís M.S. Loura, Maria R. Aires-Barros, Manuel Prieto. 2011. Fluorescence methods for lipoplex characterization. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1808**, 2694-2705. [[CrossRef](#)]
27. Thanigaivel Shanmugam, Rinti Banerjee. 2011. Nanostructured self assembled lipid materials for drug delivery and tissue engineering. *Therapeutic Delivery* **2**, 1485-1516. [[CrossRef](#)]
28. J.P. Neves Silva, A.C.N. Oliveira, M.P.P.A. Casal, A.C. Gomes, P.J.G. Coutinho, O.P. Coutinho, M.E.C.D. Real Oliveira. 2011. DODAB:monoolein-based lipoplexes as non-viral vectors for transfection of mammalian cells. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1808**, 2440-2449. [[CrossRef](#)]
29. David Schaffert, Melinda Kiss, Wolfgang Rödl, Alexei Shir, Alexander Levitzki, Manfred Ogris, Ernst Wagner. 2011. Poly(I:C)-Mediated Tumor Growth Suppression in EGF-Receptor Overexpressing Tumors Using EGF-Polyethylene Glycol-Linear Polyethylenimine as Carrier. *Pharmaceutical Research* **28**, 731-741. [[CrossRef](#)]
30. Souvik Biswas, Laura E. Gordon, Geoffrey J. Clark, Michael H. Nantz. 2011. Click assembly of magnetic nanovectors for gene delivery. *Biomaterials* **32**, 2683-2688. [[CrossRef](#)]
31. Dominique Ducheêne, Ruxandra Gref Cyclodextrins and Polymer Nanoparticles 371-391. [[CrossRef](#)]
32. O. Le Bihan, R. Chevre, S. Mornet, B. Garnier, B. Pitard, O. Lambert. 2011. Probing the in vitro mechanism of action of cationic lipid/DNA lipoplexes at a nanometric scale. *Nucleic Acids Research* **39**, 1595-1609. [[CrossRef](#)]
33. David Sigwalt, Michel Holler, Julien Iehl, Jean-François Nierengarten, Marc Nothisen, Emmanuelle Morin, Jean-Serge Remy. 2011. Gene delivery with polycationic fullerene hexakis-adducts. *Chemical Communications* **47**, 4640. [[CrossRef](#)]
34. Marc A. Ilies, Tiffany V. Sommers, Li Ching He, Adrian Kizewski, Vishnu Dutt Sharma Pyridinium Amphiphiles in Gene Delivery – Present and Perspectives 23-38. [[CrossRef](#)]
35. Manuel Alatorre-Meda, Pablo Taboada, Florian Hartl, Tobias Wagner, Michael Freis, Julio R. Rodríguez. 2011. The influence of chitosan valence on the complexation and transfection of DNA: The weaker the DNA-chitosan binding the higher the transfection efficiency. *Colloids and Surfaces B: Biointerfaces* **82**, 54-62. [[CrossRef](#)]
36. Kevin Maier, Ernst Wagner Intracellular Fate of Plasmid DNA Polyplexes 123-142. [[CrossRef](#)]
37. Sun Hwa Kim, Mei Ou, David A. Bull, Sung Wan Kim. 2010. Reductive Degradation Behavior of Bioreducible Poly(disulfide amine) for Enhancing SiRNA Efficiency. *Macromolecular Bioscience* **10**, 898-905. [[CrossRef](#)]
38. Romain Labas, Fanny Beilvert, Benoit Barteau, Stéphanie David, Raphaël Chèvre, Bruno Pitard. 2010. Nature as a source of inspiration for cationic lipid synthesis. *Genetica* **138**, 153-168. [[CrossRef](#)]
39. Soma Patnaik, Mohammed Arif, Atul Pathak, Naresh Singh, K.C. Gupta. 2010. PEI-alginate nanocomposites: Efficient non-viral vectors for nucleic acids. *International Journal of Pharmaceutics* **385**, 194-202. [[CrossRef](#)]
40. Hassan M. Ghonaim, Shi Li, Ian S. Blagbrough. 2010. N 1,N 12 -Diacyl Spermines: SAR Studies on Non-viral Lipopolyamine Vectors for Plasmid DNA and siRNA Formulation. *Pharmaceutical Research* **27**, 17-29. [[CrossRef](#)]
41. Dorian A. Canelas, Kevin P. Herlihy, Joseph M. DeSimone. 2009. Top-down particle fabrication: control of size and shape for diagnostic imaging and drug delivery. *Wiley Interdisciplinary Reviews: Nanomedicine and Nanobiotechnology* **1**, 391-404. [[CrossRef](#)]

42. Jerome M. Laurence, Richard D.M. Allen, Geoffrey W. McCaughan, Grant J. Logan, Ian E. Alexander, G. Alex Bishop, Alexandra F. Sharland. 2009. Gene therapy in transplantation. *Transplantation Reviews* **23**, 159-170. [[CrossRef](#)]
43. R.A.S. Randazzo, R. Bucki, P.A. Janmey, S.L. Diamond. 2009. A series of cationic sterol lipids with gene transfer and bactericidal activity. *Bioorganic & Medicinal Chemistry* **17**, 3257-3265. [[CrossRef](#)]
44. Geetha N. Goparaju, Michael F. Bruist, C. Satish Chandran, Pardeep K. Gupta. 2009. Influence of N-Terminal Hydrophobicity of Cationic Peptides on Thermodynamics of their Interaction with Plasmid DNA. *Chemical Biology & Drug Design* **73**:10.1111/jpp.2009.73.issue-5, 502-510. [[CrossRef](#)]
45. Alain R. Thierry, Vic Norris, Franck Molina, Marc Schmutz. 2009. Lipoplex nanostructures reveal a general self-organization of nucleic acids. *Biochimica et Biophysica Acta (BBA) - General Subjects* **1790**, 385-394. [[CrossRef](#)]
46. Jean-François Labbé, Francis Cronier, René C.-Gaudreault, Michèle Auger. 2009. Spectroscopic characterization of DMPC/DOTAP cationic liposomes and their interactions with DNA and drugs. *Chemistry and Physics of Lipids* **158**, 91-101. [[CrossRef](#)]
47. Moustafa K. Soltan, Hassan M. Ghonaim, Mohamed Sadek, M. Abou Kull, Lubna Abd El-aziz, Ian S. Blagbrough. 2009. Design and Synthesis of N 4,N 9-Disubstituted Spermines for Non-viral siRNA Delivery – Structure-Activity Relationship Studies of siFection Efficiency Versus Toxicity. *Pharmaceutical Research* **26**, 286-295. [[CrossRef](#)]
48. Hassan M. Ghonaim, Shi Li, Ian S. Blagbrough. 2009. Very Long Chain N 4 ,N 9 -Diacyl Spermines: Non-Viral Lipopolyamine Vectors for Efficient Plasmid DNA and siRNA Delivery. *Pharmaceutical Research* **26**, 19-31. [[CrossRef](#)]
49. Ernst Wagner. 2008. The Silent (R)evolution of Polymeric Nucleic Acid Therapeutics. *Pharmaceutical Research* **25**, 2920-2923. [[CrossRef](#)]
50. Felix IL Clanchy, Richard O Williams. 2008. Plasmid DNA as a safe gene delivery vehicle for treatment of chronic inflammatory disease. *Expert Opinion on Biological Therapy* **8**, 1507-1519. [[CrossRef](#)]
51. Ian MacLachlan. 2008. siRNAs with guts. *Nature Biotechnology* **26**, 403-405. [[CrossRef](#)]
52. Gaurang S Daftary, Hugh S Taylor In-utero gene transfer: promises and problems 623-636. [[CrossRef](#)]
53. N. A. Kas'yanenko, N. B. Zakharova, D. A. Mukhin, A. V. Slita, O. V. Nazarova, E. A. Leont'eva, E. F. Panarin. 2008. DNA complexes with polycations useful for delivery of DNA into cells. *Biophysics* **53**, 31-37. [[CrossRef](#)]
54. Lifen Zhang, Lingzhi Meng, Xiaoju Lu, Yunhai Liu. 2008. Novel Amphiphilic Poly(N-vinylpyrrolidone) Block Copolymer: Aggregative Behavior and Interaction with DNA. *Macromolecular Symposia* **261**:10.1002/masy.v261:1, 182-189. [[CrossRef](#)]
55. Baichao Ma, Shubiao Zhang, Huiming Jiang, Budiao Zhao, Hongtao Lv. 2007. Lipoplex morphologies and their influences on transfection efficiency in gene delivery. *Journal of Controlled Release* **123**, 184-194. [[CrossRef](#)]
56. Olga Mykhaylyk, Yolanda Sánchez Antequera, Dialekti Vlaskou, Christian Plank. 2007. Generation of magnetic nonviral gene transfer agents and magnetofection in vitro. *Nature Protocols* **2**, 2391-2411. [[CrossRef](#)]
57. Julia Boktov, Danielle Hirsch-Lerner, Yechezkel Barenholz. 2007. Characterization of the interplay between the main factors contributing to lipoplex-mediated transfection in cell cultures. *The Journal of Gene Medicine* **9**:10.1002/jgm.v9:10, 884-893. [[CrossRef](#)]
58. Ankit Agarwal, Rita Vilensky, Anne Stockdale, Yeshayahu Talmon, Robert C. Unfer, Surya K. Mallapragada. 2007. Colloidally stable novel copolymeric system for gene delivery in complete growth media. *Journal of Controlled Release* **121**, 28-37. [[CrossRef](#)]
59. Atul Pathak, Anita Aggarwal, Raj K. Kurupati, Soma Patnaik, Archana Swami, Yogendra Singh, Pradeep Kumar, Suresh P. Vyas, Kailash C. Gupta. 2007. Engineered Polyallylamine Nanoparticles for Efficient In Vitro Transfection. *Pharmaceutical Research* **24**, 1427-1440. [[CrossRef](#)]
60. Sarah Resina, Ryszard Kole, Adrian Travo, Bernard Lebleu, Alain R. Thierry. 2007. Switching on transgene expression by correcting aberrant splicing using multi-targeting steric-blocking oligonucleotides. *The Journal of Gene Medicine* **9**:10.1002/jgm.v9:6, 498-510. [[CrossRef](#)]
61. Verena Russ, Ernst Wagner. 2007. Cell and Tissue Targeting of Nucleic Acids for Cancer Gene Therapy. *Pharmaceutical Research* **24**, 1047-1057. [[CrossRef](#)]
62. Quande Wei, Hee Jung Jung, Dong Soo Hwang, Byeong Hee Hwang, Youngsoo Gim, Hyung Joon Cha. 2007. Escherichia coli-based expression of functional novel DNA-binding histone H1 from Carassius auratus. *Enzyme and Microbial Technology* **40**, 1484-1490. [[CrossRef](#)]

63. Ernst Wagner. 2007. Programmed drug delivery: nanosystems for tumor targeting. *Expert Opinion on Biological Therapy* 7, 587-593. [[CrossRef](#)]
64. Martin Meyer, Dr. Ernst Wagner. 2006. Recent Developments in the Application of Plasmid DNA-Based Vectors and Small Interfering RNA Therapeutics for Cancer. *Human Gene Therapy* 17:11, 1062-1076. [[Abstract](#)] [[Full Text PDF](#)] [[Full Text PDF with Links](#)]
65. N TOUB, C MALVY, E FAT TAL, P COUVREUR. 2006. Innovative nanotechnologies for the delivery of oligonucleotides and siRNA. *Biomedecine & Pharmacotherapy* 60, 607-620. [[CrossRef](#)]
66. Martin Meyer, Ernst Wagner. 2006. Recent Developments in the Application of Plasmid DNA-Based Vectors and Small Interfering RNA Therapeutics for Cancer. *Human Gene Therapy* 0:10.1089/hum.0.0.issue-0, 061010063524001. [[CrossRef](#)]
67. Soma Patnaik, Anita Aggarwal, Surendra Nimesh, Anita Goel, Munia Ganguli, Neeru Saini, Y. Singh, K.C. Gupta. 2006. PEI-alginate nanocomposites as efficient in vitro gene transfection agents. *Journal of Controlled Release* 114, 398-409. [[CrossRef](#)]
68. Mohamed M. Issa, Magnus Köping-Höggård, Kristoffer Tømmeraaas, Kjell M. Vårum, Bjørn E. Christensen, Sabina P. Strand, Per Artursson. 2006. Targeted gene delivery with trisaccharide-substituted chitosan oligomers in vitro and after lung administration in vivo. *Journal of Controlled Release* 115, 103-112. [[CrossRef](#)]
69. Mohammadi Kaouass, Raymond Beaulieu, Danuta Balicki. 2006. Histonefection: Novel and potent non-viral gene delivery. *Journal of Controlled Release* 113, 245-254. [[CrossRef](#)]
70. Noppadon Adjimatera, Teresa Kral, Martin Hof, Ian S. Blagbrough. 2006. Lipopolyamine-Mediated Single Nanoparticle Formation of Calf Thymus DNA Analyzed by Fluorescence Correlation Spectroscopy. *Pharmaceutical Research* 23, 1564-1573. [[CrossRef](#)]
71. M.E. Hayes, D.C. Drummond, K. Hong, J.W. Park, J.D. Marks, D.B. Kirpotin. 2006. Assembly of nucleic acid-lipid nanoparticles from aqueous-organic monophases. *Biochimica et Biophysica Acta (BBA) - Biomembranes* 1758, 429-442. [[CrossRef](#)]
72. Alain R. Thierry, Said Abes, Sarah Resina, Adrian Travo, Jean Philippe Richard, Paul Prevot, Bernard Lebleu. 2006. Comparison of basic peptides- and lipid-based strategies for the delivery of splice correcting oligonucleotides. *Biochimica et Biophysica Acta (BBA) - Biomembranes* 1758, 364-374. [[CrossRef](#)]
73. Moganavelli Singh, Mario Ariatti. 2006. A cationic cytofectin with long spacer mediates favourable transfection in transformed human epithelial cells. *International Journal of Pharmaceutics* 309, 189-198. [[CrossRef](#)]
74. Régis Cartier, Regina Reszka Biological and Cellular Barriers Limiting the Clinical Application of Nonviral Gene Delivery Systems 47-56. [[CrossRef](#)]
75. Osama A. A. Ahmed, Charareh Pourzand, Ian S. Blagbrough. 2006. Varying the Unsaturation in N4,N9-Dioctadecanoyl Spermines: Nonviral Lipopolyamine Vectors for More Efficient Plasmid DNA Formulation. *Pharmaceutical Research* 23, 31-40. [[CrossRef](#)]
76. Magnus Köping-Höggård, Mohamed M. Issa, Tamara Köhler, Ann Tronde, Kjell M. Vårum, Per Artursson. 2005. A miniaturized nebulization catheter for improved gene delivery to the mouse lung. *The Journal of Gene Medicine* 7:10.1002/jgm.v7:9, 1215-1222. [[CrossRef](#)]
77. U LUNGWITZ, M BREUNIG, T BLUNK, A GOPFERICH. 2005. Polyethylenimine-based non-viral gene delivery systems. *European Journal of Pharmaceutics and Biopharmaceutics* 60, 247-266. [[CrossRef](#)]
78. Osama A. A. Ahmed, Noppadon Adjimatera, Charareh Pourzand, Ian S. Blagbrough. 2005. N4,N9-Dioleoyl Spermine Is a Novel Nonviral Lipopolyamine Vector for Plasmid DNA Formulation. *Pharmaceutical Research* 22, 972-980. [[CrossRef](#)]
79. B CHRISTIAENS, P DUBRUEL, J GROOTEN, M GOETHALS, J VANDEKERCKHOVE, E SCHACHT, M ROSSENEU. 2005. Enhancement of polymethacrylate-mediated gene delivery by Penetratin. *European Journal of Pharmaceutical Sciences* 24, 525-537. [[CrossRef](#)]
80. Ankit Agarwal, Robert Unfer, Surya K. Mallapragada. 2005. Novel cationic pentablock copolymers as non-viral vectors for gene therapy. *Journal of Controlled Release* 103, 245-258. [[CrossRef](#)]
81. Marc A. Ilies, Betty H. Johnson, Fred Makori, Aaron Miller, William A. Seitz, E. Brad Thompson, Alexandru T. Balaban. 2005. Pyridinium cationic lipids in gene delivery: an in vitro and in vivo comparison of transfection efficiency versus a tetraalkylammonium congener. *Archives of Biochemistry and Biophysics* 435, 217-226. [[CrossRef](#)]

82. Kalle Kilk, Samir EL-Andaloussi, Peter Järver, Anne Meikas, Andres Valkna, Tamas Bartfai, Priit Kogerman, Madis Metsis, Ülo Langel. 2005. Evaluation of transportan 10 in PEI mediated plasmid delivery assay. *Journal of Controlled Release* **103**, 511-523. [[CrossRef](#)]
83. B. Lucas, K. Remaut, N.N. Sanders, K. Braeckmans, S.C. De Smedt, J. Demeester. 2005. Towards a better understanding of the dissociation behavior of liposome-oligonucleotide complexes in the cytosol of cells. *Journal of Controlled Release* **103**, 435-450. [[CrossRef](#)]
84. Zahra Hassani, Gregory F. Lemkine, Patrick Erbacher, Karima Palmier, Gladys Alfama, Carine Giovannangeli, Jean-Paul Behr, Barbara A. Demeneix. 2005. Lipid-mediated siRNA delivery down-regulates exogenous gene expression in the mouse brain at picomolar levels. *The Journal of Gene Medicine* **7**:10.1002/jgm.v7:2, 198-207. [[CrossRef](#)]
85. U.-R. Hengge, W. Bardenheuer, R. Doroudi, A. Mirmohammadsadegh. 2005. Thérapie génique et peau. *Annales de Dermatologie et de Vénérologie* **132**, 154-163. [[CrossRef](#)]
86. Alexander Kabanov, Jian Zhu, Valery Alakhov Pluronic Block Copolymers for Gene Delivery 231-261. [[CrossRef](#)]
87. Alexander V. Kabanov, Elena V. Batrakova, Srikanth Sriadibhatla, Zhihui Yang, David L. Kelly, Valery Yu. Alakov. 2005. Polymer genomics: shifting the gene and drug delivery paradigms. *Journal of Controlled Release* **101**, 259-271. [[CrossRef](#)]
88. Makiya Nishikawa, Yoshinobu Takakura, Mitsuru Hashida Pharmacokinetics of Plasmid DNA-Based Non-viral Gene Medicine 47-68. [[CrossRef](#)]
89. Ulrich R. Hengge. 2005. Progress and prospects of skin gene therapy: a ten year history. *Clinics in Dermatology* **23**, 107-114. [[CrossRef](#)]
90. Christophe Masson, Marie Garinot, Nathalie Mignet, Barbara Wetzter, Philippe Mailhe, Daniel Scherman, Michel Bessodes. 2004. pH-sensitive PEG lipids containing orthoester linkers: new potential tools for nonviral gene delivery. *Journal of Controlled Release* **99**, 423-434. [[CrossRef](#)]
91. Charles M. Roth, Sumati Sundaram. 2004. ENGINEERING SYNTHETIC VECTORS FOR IMPROVED DNA DELIVERY: Insights from Intracellular Pathways. *Annual Review of Biomedical Engineering* **6**, 397-426. [[CrossRef](#)]
92. Dagmar Fischer, Herbert Dautzenberg, Klaus Kunath, Thomas Kissel. 2004. Poly(diallyldimethylammonium chlorides) and their N-methyl-N-vinylacetamide copolymer-based DNA-polyplexes: role of molecular weight and charge density in complex formation, stability, and in vitro activity. *International Journal of Pharmaceutics* **280**, 253-269. [[CrossRef](#)]
93. Jie Wen, Hai-Quan Mao, Weiping Li, Kevin Y. Lin, Kam W. Leong. 2004. Biodegradable polyphosphoester micelles for gene delivery. *Journal of Pharmaceutical Sciences* **93**:10.1002/jps.v93:8, 2142-2157. [[CrossRef](#)]
94. E WAGNER, R KIRCHEIS, G WALKER. 2004. Targeted nucleic acid delivery into tumors: new avenues for cancer therapy. *Biomedicine & Pharmacotherapy* **58**, 152-161. [[CrossRef](#)]
95. Elisabete Gonçalves, Robert J. Debs, Timothy D. Heath. 2004. The Effect of Liposome Size on the Final Lipid/DNA Ratio of Cationic Lipoplexes. *Biophysical Journal* **86**, 1554-1563. [[CrossRef](#)]
96. K Romøren. 2004. Expression of luciferase in selected organs following delivery of naked and formulated DNA to rainbow trout (*Oncorhynchus mykiss*) by different routes of administration. *Fish & Shellfish Immunology* **16**, 251-264. [[CrossRef](#)]
97. Hidetoshi ARIMA. 2004. Polyfection as Nonviral Gene Transfer Method —Design of Novel Nonviral Vector Using α -Cyclodextrin—. *YAKUGAKU ZASSHI* **124**, 451-464. [[CrossRef](#)]
98. Carole Lavigne, Yanto Lunardi-Iskandar, Bernard Lebleu, Alain R Thierry Cationic Liposomes#Lipids for Oligonucleotide Delivery: Application to the Inhibition of Tumorigenicity of Kaposi's Sarcoma by Vascular Endothelial Growth Factor Antisense Oligodeoxynucleotides 189-210. [[CrossRef](#)]
99. Goldie Kaul, Mansoor Amiji Polymeric Gene Delivery Systems . [[CrossRef](#)]
100. K Romøren. 2003. The influence of formulation variables on in vitro transfection efficiency and physicochemical properties of chitosan-based polyplexes. *International Journal of Pharmaceutics* **261**, 115-127. [[CrossRef](#)]
101. J Kuo. 2003. Evaluation of the stability of polymer-based plasmid DNA delivery systems after ultrasound exposure. *International Journal of Pharmaceutics* **257**, 75-84. [[CrossRef](#)]
102. Francis Szoka, Lisa Uyechi-O'Brien Mechanisms for Cationic Lipids in Gene Transfer . [[CrossRef](#)]
103. Ernst Wagner, Lionel Wightman, Ralf Kircheis Polymer-Based Gene Delivery Systems . [[CrossRef](#)]

104. Emmanuel Dauty, Jean-Paul Behr. 2003. Monomolecular condensation of DNA by cationic detergents. *Polymer International* **52**:10.1002/pi.v52:4, 459-464. [[CrossRef](#)]
105. Gabriele D Schmidt-Wolf, Ingo G.H Schmidt-Wolf. 2003. Non-viral and hybrid vectors in human gene therapy: an update. *Trends in Molecular Medicine* **9**, 67-72. [[CrossRef](#)]
106. M. K^oping-H^ogg^ord, Y. S. Mel'nikova, K. M. V^orum, B. Lindman, P. Artursson. 2003. Relationship between the physical shape and the efficiency of oligomeric chitosan as a gene delivery system in vitro and in vivo. *The Journal of Gene Medicine* **5**:10.1002/jgm.v5:2, 130-141. [[CrossRef](#)]
107. Takeshi Nagasaki, Katsutoshi Wada, Seizo Tamagaki. 2003. Photo-enhancement of Transfection Efficiency with a Novel Azobenzene-based Cationic Lipid. *Chemistry Letters* **32**, 88-89. [[CrossRef](#)]
108. Christophe Masson, Virginie Escriou, Michel Bessodes, Daniel Scherman Lipid reagents for DNA transfer into mammalian cells 279-289. [[CrossRef](#)]
109. Pamela A. Norton, Catherine J. Pachuk Methods for DNA introduction into mammalian cells 265-277. [[CrossRef](#)]
110. F Bordi. 2002. Salt-induced aggregation in cationic liposome aqueous suspensions resulting in multi-step self-assembling complexes. *Colloids and Surfaces B: Biointerfaces* **26**, 341-350. [[CrossRef](#)]
111. Jérôme Gaucheron, Catherine Santaella, Pierre Vierling. 2002. Transfection with fluorinated lipoplexes based on fluorinated analogues of DOTMA, DMR1E and DPPES. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1564**, 349-358. [[CrossRef](#)]
112. D. Balicki, C. D. Putnam, P. V. Scaria, E. Beutler. 2002. Structure and function correlation in histone H2A peptide-mediated gene transfer. *Proceedings of the National Academy of Sciences* **99**, 7467-7471. [[CrossRef](#)]
113. Christine Gon^oalves, Chantal Pichon, Brigitte Gu^orin, Patrick Midoux. 2002. Intracellular processing and stability of DNA complexed with histidylated polylysine conjugates. *The Journal of Gene Medicine* **4**:10.1002/jgm.v4:3, 271-281. [[CrossRef](#)]
114. Alexander V Kabanov, Pierre Lemieux, Sergey Vinogradov, Valery Alakhov. 2002. Pluronic[®] block copolymers: novel functional molecules for gene therapy. *Advanced Drug Delivery Reviews* **54**, 223-233. [[CrossRef](#)]
115. DANUTA BALICKI, ERNEST BEUTLER. 2002. Gene Therapy of Human Disease. *Medicine* **81**, 69-86. [[CrossRef](#)]
116. Lars J. Branden, C.I.Edvard Smith[6] Bioplex technology: Novel synthetic gene delivery system based on peptides anchored to nucleic acids 106-124. [[CrossRef](#)]
117. Chantal Pichon, Christine Gon^oalves, Patrick Midoux. 2001. Histidine-rich peptides and polymers for nucleic acids delivery. *Advanced Drug Delivery Reviews* **53**, 75-94. [[CrossRef](#)]
118. Alexandru T Balaban, Marc Antoniu Ilies. 2001. Recent developments in cationic lipid-mediated gene delivery and gene therapy. *Expert Opinion on Therapeutic Patents* **11**:10.1517/etp.2001.11.issue-11, 1729-1752. [[CrossRef](#)]
119. Marion d.C. Molina, S. Dean Allison, Thomas J. Anchordoquy. 2001. Maintenance of nonviral vector particle size during the freezing step of the lyophilization process is insufficient for preservation of activity: Insight from other structural indicators. *Journal of Pharmaceutical Sciences* **90**:10.1002/jps.v90:10, 1445-1455. [[CrossRef](#)]
120. Haeshin Lee, Ji Hoon Jeong, Je Hoon Lee, Tae Gwan Park. 2001. Enhancing transfection efficiency using polyethylene glycol grafted polyethylenimine and fusogenic peptide. *Biotechnology and Bioprocess Engineering* **6**, 269-273. [[CrossRef](#)]
121. Jérôme Gaucheron, Catherine Santaella, Pierre Vierling. 2001. Improved in vitro gene transfer mediated by fluorinated lipoplexes in the presence of a bile salt surfactant. *The Journal of Gene Medicine* **3**:10.1002/1521-2254(200107/08)3:4<1.0.CO;2-H, 338-344. [[CrossRef](#)]
122. Lionel Wightman, Ralf Kircheis, Vanessa R^ossler, Sebastian Carotta, Regina Ruzicka, Malgorzata Kurska, Ernst Wagner. 2001. Different behavior of branched and linear polyethylenimine for gene delivery in vitro and in vivo. *The Journal of Gene Medicine* **3**:10.1002/1521-2254(200107/08)3:4<1.0.CO;2-H, 362-372. [[CrossRef](#)]
123. Catherine L. Gebhart, Alexander V. Kabanov. 2001. Evaluation of polyplexes as gene transfer agents. *Journal of Controlled Release* **73**, 401-416. [[CrossRef](#)]
124. M González Ferreiro, L Tillman, G Hardee, R Bodmeier. 2001. Characterization of complexes of an antisense oligonucleotide with protamine and poly-l-lysine salts. *Journal of Controlled Release* **73**, 381-390. [[CrossRef](#)]
125. M Kerner. 2001. Interplay in lipoplexes between type of pDNA promoter and lipid composition determines transfection efficiency of human growth hormone in NIH3T3 cells in culture. *Biochimica et Biophysica Acta (BBA) - Molecular and Cell Biology of Lipids* **1532**, 128-136. [[CrossRef](#)]

126. A G Schatzlein. 2001. Non-viral vectors in cancer gene therapy: principles and progress. *Anti-Cancer Drugs* **12**, 275-304. [[CrossRef](#)]
127. Wolfgang Zauner, Neil A Farrow, Adrian M.R Haines. 2001. In vitro uptake of polystyrene microspheres: effect of particle size, cell line and cell density. *Journal of Controlled Release* **71**, 39-51. [[CrossRef](#)]
128. M.Teresa Girão da Cruz, Sérgio Simões, Pedro P.C. Pires, Shlomo Nir, Maria C. Pedroso de Lima. 2001. Kinetic analysis of the initial steps involved in lipoplex–cell interactions: effect of various factors that influence transfection activity. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1510**, 136-151. [[CrossRef](#)]
129. Yechezkel Barenholz. 2001. Liposome application: problems and prospects. *Current Opinion in Colloid & Interface Science* **6**, 66-77. [[CrossRef](#)]
130. Chong-Kook Kim, Kh. H Haider, Soo-Jeong Lim. 2001. Gene medicine: A new field of molecular medicine. *Archives of Pharmacal Research* **24**, 1-15. [[CrossRef](#)]
131. D. Putnam, C. A. Gentry, D. W. Pack, R. Langer. 2001. Polymer-based gene delivery with low cytotoxicity by a unique balance of side-chain termini. *Proceedings of the National Academy of Sciences* **98**, 1200-1205. [[CrossRef](#)]
132. Louise A. Wangerek, Hans-Henrik M. Dahl, Tim J. Senden, John B. Carlin, David A. Jans, Dave E. Dunstan, Panayiotis A. Ioannou, Robert Williamson, Susan M. Forrest. 2001. Atomic force microscopy imaging of DNA-cationic liposome complexes optimised for gene transfection into neuronal cells. *The Journal of Gene Medicine* **3**:10.1002/1521-2254(2000)9999:9999<1.0.CO;2-O, 72-81. [[CrossRef](#)]
133. S Aliño. 2000. Pharmacodynamic approach to study the gene transfer process employing non-viral vectors. *Biochemical Pharmacology* **60**, 1845-1853. [[CrossRef](#)]
134. Simcha Even-Chen, Yechezkel Barenholz. 2000. DOTAP cationic liposomes prefer relaxed over supercoiled plasmids. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1509**, 176-188. [[CrossRef](#)]
135. Daniel Martinez-Fong, Ivan Navarro-Quiroga. 2000. Synthesis of a non-viral vector for gene transfer via the high-affinity neurotensin receptor. *Brain Research Protocols* **6**, 13-24. [[CrossRef](#)]
136. NIEK N. SANDERS, STEFAAN C. DE SMEDT, ELSA VAN ROMPAEY, PAUL SIMOENS, FRANS DE BAETS, JOSEPH DEMEESTER. 2000. Cystic Fibrosis Sputum. *American Journal of Respiratory and Critical Care Medicine* **162**, 1905-1911. [[CrossRef](#)]
137. Jeffrey Bonadio. 2000. Tissue engineering via local gene delivery:. *Advanced Drug Delivery Reviews* **44**, 185-194. [[CrossRef](#)]
138. Christoph Uherek, Winfried Wels. 2000. DNA-carrier proteins for targeted gene delivery. *Advanced Drug Delivery Reviews* **44**, 153-166. [[CrossRef](#)]
139. Jesús Fominaya, María Gasset, Rosana García, Fernando Roncal, Juan Pablo Albar, Antonio Bernad. 2000. An optimized amphiphilic cationic peptide as an efficient non-viral gene delivery vector. *The Journal of Gene Medicine* **2**:10.1002/1521-2254(200011/12)2:6<1.0.CO;2-2, 455-464. [[CrossRef](#)]
140. Edmund J. Niedzinski, Michael J. Bennett, David C. Olson, Michael H. Nantz. 2000. Gastroprotection of DNA with a synthetic cholic acid analog. *Lipids* **35**, 721-727. [[CrossRef](#)]
141. A Geall. 2000. Rapid and sensitive ethidium bromide fluorescence quenching assay of polyamine conjugate–DNA interactions for the analysis of lipoplex formation in gene therapy. *Journal of Pharmaceutical and Biomedical Analysis* **22**, 849-859. [[CrossRef](#)]
142. Ian S Blagbrough, Dima Al-Hadithi, Andrew J Geall. 2000. Cheno-, Urso- and Deoxycholic Acid Spermine Conjugates: Relative Binding Affinities for Calf Thymus DNA. *Tetrahedron* **56**, 3439-3447. [[CrossRef](#)]
143. P. Delpine, C. Guillaume, V. Floch, S. Loisel, J.-J. Yaouanc, J.-C. Clément, H. Des Abbayes, C. Frec. 2000. Cationic phosphonolipids as nonviral vectors: In vitro and in vivo applications. *Journal of Pharmaceutical Sciences* **89**:10.1002/(SICI)1520-6017(200005)89:5<1.0.CO;2-2, 629-638. [[CrossRef](#)]
144. A Geall. 2000. Homologation of Polyamines in the Rapid Synthesis of Lipospermine Conjugates and Related Lipoplexes. *Tetrahedron* **56**, 2449-2460. [[CrossRef](#)]
145. Victor M. Meidan, Jack S. Cohen, Ninette Amariglio, Danielle Hirsch-Lerner, Yechezkel Barenholz. 2000. Interaction of oligonucleotides with cationic lipids: the relationship between electrostatics, hydration and state of aggregation. A preliminary report of this study was presented by V.M. Meidan et al. at the Monte Verita Workshop on Gene and Oligonucleotide Delivery of Therapeutics and Vaccines, organized by the Department of Pharmacy, ETH Zurich,

- Ascona, Switzerland, April 23–24, 1999.1. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1464**, 251-261. [[CrossRef](#)]
146. Anne E. Regelin, Stefan Fankhaenel, Laura Grtesch, Claudia Prinz, Gnter von Kiedrowski, Ulrich Massing. 2000. Biophysical and lipofection studies of DOTAP analogs. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1464**, 151-164. [[CrossRef](#)]
147. S Simes. 2000. Human serum albumin enhances DNA transfection by lipoplexes and confers resistance to inhibition by serum. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1463**, 459-469. [[CrossRef](#)]
148. Stephen L Hart. 2000. Synthetic vectors for gene therapy. *Expert Opinion on Therapeutic Patents* **10**:10.1517/etp.2000.10.issue-2, 199-208. [[CrossRef](#)]
149. P. van de Wetering, N.M.E. Schuurmans-Nieuwenbroek, M.J. van Steenbergen, D.J.A. Crommelin, W.E. Hennink. 2000. Copolymers of 2-(dimethylamino)ethyl methacrylate with ethoxytriethylene glycol methacrylate or N-vinylpyrrolidone as gene transfer agents. *Journal of Controlled Release* **64**, 193-203. [[CrossRef](#)]
150. Arthur A. P. Meekel, Anno Wagenaar, Jarmila Šmisterov, Jessica E. Kroeze, Peter Haadisma, Bouke Bosgraaf, Marc C. A. Stuart, Alain Brisson, Marcel H. J. Ruiters, Dick Hoekstra, Jan B. F. N. Engberts. 2000. Synthesis of Pyridinium Amphiphiles Used for Transfection and Some Characteristics of Amphiphile/DNA Complex Formation. *European Journal of Organic Chemistry* **2000**:10.1002/(SICI)1099-0690(200002)2000:4<&t;&t;1.0.CO;2-F, 665-673. [[CrossRef](#)]
151. Joseph Turek, Catherine Dubertret, Gabrielle Jaslin, Kostas Antonakis, Daniel Scherman, Bruno Pitard. 2000. Formulations which increase the size of lipoplexes prevent serum-associated inhibition of transfection. *The Journal of Gene Medicine* **2**:10.1002/(SICI)1521-2254(200001/02)2:1<&t;&t;1.0.CO;2-B, 32-40. [[CrossRef](#)]
152. Edward Chaum, Mark P. Hatton, Gary Stein. 2000. Polyplex-mediated gene transfer into human retinal pigment epithelial cells in vitro. *Journal of Cellular Biochemistry* **76**:10.1002/(SICI)1097-4644(20000101)76:1<&t;&t;1.0.CO;2-2, 153-160. [[CrossRef](#)]
153. M. Schmutz, D. Durand, A. Debin, Y. Palvadeau, A. Etienne, A. R. Thierry. 1999. DNA packing in stable lipid complexes designed for gene transfer imitates DNA compaction in bacteriophage. *Proceedings of the National Academy of Sciences* **96**, 12293-12298. [[CrossRef](#)]
154. P Ross. 1999. Polyethylene glycol enhances lipoplex-cell association and lipofection. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1421**, 273-283. [[CrossRef](#)]
155. Andrew J Geall, Michael A.W Eaton, Terry Baker, Catherine Catterall, Ian S Blagbrough. 1999. The regiochemical distribution of positive charges along cholesterol polyamine carbamates plays significant roles in modulating DNA binding affinity and lipofection. *FEBS Letters* **459**, 337-342. [[CrossRef](#)]
156. Robert C. MacDonald, Vera A. Rakhmanova, Kenneth L. Choi, Howard S. Rosenzweig, Marc K. Lahiri. 1999. O-ethylphosphatidylcholine: A metabolizable cationic phospholipid which is a serum-compatible DNA transfection agent. *Journal of Pharmaceutical Sciences* **88**:10.1002/jps.v88:9, 896-904. [[CrossRef](#)]
157. Marcel B Bally, Pierrot Harvie, Frances M.P Wong, Spencer Kong, Ellen K Wasan, Dorothy L Reimer. 1999. Biological barriers to cellular delivery of lipid-based DNA carriers. *Advanced Drug Delivery Reviews* **38**, 291-315. [[CrossRef](#)]
158. Lee G. Barron, Lucie Gagne, Francis C. Szoka. 1999. Lipoplex-Mediated Gene Delivery to the Lung Occurs within 60 Minutes of Intravenous Administration. *Human Gene Therapy* **10**:10, 1683-1694. [[Abstract](#)] [[Full Text PDF](#)] [[Full Text PDF with Links](#)]
159. Yuhong Xu, Sek-Wen Hui, Peter Frederik, Francis C. Szoka. 1999. Physicochemical Characterization and Purification of Cationic Lipoplexes. *Biophysical Journal* **77**, 341-353. [[CrossRef](#)]
160. W Zauner. 1999. Differential behaviour of lipid based and polycation based gene transfer systems in transfecting primary human fibroblasts: a potential role of polylysine in nuclear transport. *Biochimica et Biophysica Acta (BBA) - General Subjects* **1428**, 57-67. [[CrossRef](#)]
161. Patrick Erbacher, Thierry Bettinger, Pascale Belguise-Valladier, Shaomin Zou, Jean-Luc Coll, Jean-Paul Behr, Jean-Serge Remy. 1999. Transfection and physical properties of various saccharide, poly(ethylene glycol), and antibody-derivatized polyethylenimines (PEI). *The Journal of Gene Medicine* **1**:10.1002/(SICI)1521-2254(199905/06)1:3<&t;&t;1.0.CO;2-6, 210-222. [[CrossRef](#)]
162. J Cherng. 1999. The effect of formulation parameters on the size of poly((2-dimethylamino)ethyl methacrylate)-plasmid complexes. *European Journal of Pharmaceutics and Biopharmaceutics* **47**, 215-224. [[CrossRef](#)]

163. Pedro Pires, Sérgio Simões, Shlomo Nir, Rogério Gaspar, Nejat Düzgünes, Maria C. Pedroso de Lima. 1999. Interaction of cationic liposomes and their DNA complexes with monocytic leukemia cells. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1418**, 71-84. [[CrossRef](#)]
164. Antoine Kichler, Isabelle Freulon, Valérie Boutin, Roger Mayer, Michel Monsigny, Patrick Midoux. 1999. GlycofectionTM in the presence of anionic fusogenic peptides: a study of the parameters affecting the peptide-mediated enhancement of the transfection efficiency. *The Journal of Gene Medicine* **1**:10.1002/(SICI)1521-2254(199903/04)1:2<1.0.CO;2-F, 134-143. [[CrossRef](#)]
165. Philip L. Felgner *Progress in Gene Delivery Research and Development* 25-38. [[CrossRef](#)]
166. Lee G. Barron, Francis C. Szoka *The Perplexing Delivery Mechanism of Lipoplexes* 229-266. [[CrossRef](#)]
167. John Marshall, Nelson S. Yew, Simon J. Eastman, Canwen Jiang, Ronald K. Scheule, Seng H. Cheng *Cationic Lipid-Mediated Gene Delivery to the Airways* 39-68. [[CrossRef](#)]
168. MARIUSZ G. BANASZCZYK, CHARLES P. LOLLO, DEBORAH Y. KWON, ALISON T. PHILLIPS, ARJANG AMINI, DUNCAN P. WU, PATRICIA M. MULLEN, CHRISTOPHER C. COFFIN, STEVEN W. BROSTOFF, DENNIS J. CARLO. 1999. POLY-L-LYSINE- GRAFT -PEG COMB-TYPE POLYCATION COPOLYMERS FOR GENE DELIVERY. *Journal of Macromolecular Science, Part A* **36**, 1061-1084. [[CrossRef](#)]
169. Raponi Mitch, Geoff Symonds *Gene Deliver Technology* 293-322. [[CrossRef](#)]
170. Leaf Huang, Ekapo Viroonchatapan *Introduction* 3-22. [[CrossRef](#)]
171. Christine Guillaume-Gable, Virginie Floch, Bernard Mercier, Marie-Pierre Audrézet, Eric Gobin, Gwenaëlle Le Bolc'H, Jean-Jacques Yaouanc, Jean-Claude Clément, Hervé Des Abbayes, Jean-Paul Leroy, Vincent Morin, Claude Férec. 1998. Cationic Phosphonolipids as Nonviral Gene Transfer Agents in the Lungs of Mice. *Human Gene Therapy* **9**:16, 2309-2319. [[Abstract](#)] [[Full Text PDF](#)] [[Full Text PDF with Links](#)]
172. V Floch, M.P Audrezet, C Guillaume, E Gobin, G Le Bolch, J.C Clement, J.J Yaouanc, H Des Abbayes, B Mercier, J.P Leroy, J.F Abgrall, C Férec. 1998. Transgene expression kinetics after transfection with cationic phosphonolipids in hematopoietic non adherent cells. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1371**, 53-70. [[CrossRef](#)]
173. Katalin Karikó, Alice Kuo, Elliot S Barnathan, David J Langer. 1998. Phosphate-enhanced transfection of cationic lipid-complexed mRNA and plasmid DNA. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1369**, 320-334. [[CrossRef](#)]
174. Marilyn E. Ferrari, Cuong M. Nguyen, Olivier Zelphati, Yali Tsai, Philip L. Felgner. 1998. Analytical Methods for the Characterization of Cationic Lipid-Nucleic Acid Complexes. *Human Gene Therapy* **9**:3, 341-351. [[Abstract](#)] [[Full Text PDF](#)] [[Full Text PDF with Links](#)]
175. Soumendu Bhattacharya, Leaf Huang *Cationic liposome-DNA complexes in gene therapy* 371-394. [[CrossRef](#)]
176. Virginie Escriou, Carole Ciolina, Florence Lacroix, Gerardo Byk, Daniel Scherman, Pierre Wils. 1998. Cationic lipid-mediated gene transfer: effect of serum on cellular uptake and intracellular fate of lipopolyamine/DNA complexes. *Biochimica et Biophysica Acta (BBA) - Biomembranes* **1368**, 276-288. [[CrossRef](#)]
177. Mahendra P Deonarain. 1998. Ligand-targeted receptor-mediated vectors for gene delivery. *Expert Opinion on Therapeutic Patents* **8**:10.1517/etp.1998.8.issue-1, 53-69. [[CrossRef](#)]
178. Carole Lavigne, Alain R. Thierry. 1997. Enhanced Antisense Inhibition of Human Immunodeficiency Virus Type 1 in Cell Cultures by DLS Delivery System#. *Biochemical and Biophysical Research Communications* **237**, 566-571. [[CrossRef](#)]