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Next step in drug delivery: Getting inside cells and to individual organelles

Vladimir P Torchilin
Northeastern University, USA

There are already some means to deliver drugs inside cells by passing the lysosomal degradation. Thus, coupling of cell-penetrating peptides (CPP) to various molecules, including peptides and proteins, or even to nanoparticles, such as liposomes, dramatically facilitates their intracellular delivery. Similar effect could be achieved using phage coat fusion proteins purified from the phages selected for their specificity towards certain target cells as was shown with liposome-loaded anticancer drugs. The combination of targeted delivery of drug-loaded nano preparations to target cells and their subsequent delivery inside cells might still further improve the efficiency of therapy. Intracellular drug delivery with subsequent organelle targeting opens new opportunities in overcoming problems associated with multiple pathologies including lysosomal storage diseases and multidrug resistance (MDR) tumors. Delivery of deficient enzymes for the treatment of lysosomal diseases evidently requires specific targeting of lysosomes, while facilitating apoptotic cell death in MDR tumor would require targeting of mitochondria or lysosomes. Thus, next generation drug delivery systems should be able to target individual organelles inside cells. Clearly, this challenge will require some novel approaches in engineering multifunctional nanomedicine, capable of accumulating in the target tissue, penetrating inside cells, bypassing lysosomes, and bringing pharmaceuticals to individual organelles. Examples of specific targeting of pharmaceutical nanocarriers loaded with pharmaceutical agents to lysosomes and mitochondria in cells illustrate the benefits of this new approach.

Biography

Vladimir P Torchilin PhD, DSc is a University Distinguished Professor of Pharmaceutical Sciences and Director, Center for Pharmaceutical Biotechnology and Nanomedicine, Northeastern University, Boston. His interests include drug delivery and targeting, nanomedicine, multifunctional and stimuli-sensitive pharmaceutical nanocarriers, biomedical polymers, experimental cancer therapy. He has published more than 400 original papers, more than 150 reviews and book chapters, wrote and edited 12 books and holds more than 40 patents. Google Scholar shows more than 55,000 citations of his papers with H-index of 105. He is Editor-in-Chief of *Current Drug Discovery Technologies, Drug Delivery and Open Nano*, Co-Editor of *Current Pharmaceutical Biotechnology* and on the Editorial Boards of many other journals. He received more than $30 M from the governmental and industrial sources in research funding. He has multiple honors and awards and in 2011, Times Higher Education ranked him number 2 among top world scientists in pharmacology for the period of 2000-2010.

v.torchilin@neu.edu