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Combinatorial Delivery of Docetaxel

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Abstract

Docetaxel is a widely used taxane-based anticancer drug with established therapeutic activity against several solid tumors. However, its clinical application can be limited by poor aqueous solubility, nonspecific distribution, systemic toxicity, and formulation-related challenges. Combinatorial drug-delivery approaches have emerged as a promising strategy to improve the therapeutic performance of docetaxel by integrating multiple therapeutic agents or complementary delivery mechanisms within a single treatment platform. This paper explores the principles and potential applications of combinatorial delivery systems for docetaxel, with emphasis on improving drug solubility, stability, bioavailability, tumor targeting, and controlled release. Various nanocarrier-based approaches, including polymeric nanoparticles, liposomes, lipid-based systems, micelles, and multifunctional nanocarriers, are considered for the co-delivery of docetaxel with other anticancer agents or therapeutic molecules. Such systems may facilitate synchronized drug delivery, enhance intracellular drug accumulation, overcome multidrug resistance, and improve the therapeutic index of combination therapy. The study also highlights the potential role of surface modification and targeted delivery strategies in achieving selective accumulation of therapeutic agents at tumor sites while minimizing exposure to healthy tissues. Important formulation parameters, including particle size, drug-loading efficiency, release characteristics, stability, and cellular uptake, are discussed as critical factors influencing therapeutic effectiveness. Despite promising advances, challenges related to formulation complexity, scalability, toxicity, regulatory requirements, and reproducibility remain. Overall, combinatorial delivery represents a promising direction for developing more effective and targeted docetaxel-based therapies and may contribute to improved outcomes in cancer treatment.

Keywords: Docetaxel, Combinatorial Drug Delivery, Nanocarriers, Targeted Drug Delivery, Cancer Therapy, Nanoparticles, Liposomes, Controlled Release, Drug Synergism, Tumor Targeting.