

Nanoparticle: Drug delivery system for cancer therapy

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Nanoparticle has emerged as a promising strategy for the efficient delivery of drugs used in the treatment of cancer by avoiding the reticuloendothelial system, utilizing the enhanced permeability and retention effect and tumor-specific targeting. Delivery methods using nanoparticle are highlighted including both degradable and non-degradable polymers. The preparation techniques include emulsion polymerization, micelle polymerization, desolvation of macromolecule, and emulsion-solvent evaporation methods. The particle size of the polymeric nanoparticle is in the nanometer range (10-1000 nm) and is dependent on the method of preparation employed.

Key word: Reticuloendothelial system, Paclitaxel, Doxorubicin, 5-Fluorouracil

INTRODUCTION

Nanoparticle exerts its site-specific drug delivery by avoiding the reticuloendothelial system, utilizing enhanced permeability and retention effect and tumor-specific targeting. These carriers are designed in such a way that they are independent in the environments and selective at the pharmacological site. The formation of nanoparticle and physiochemical parameters such as pH, monomer concentration, ionic strength as well as surface charge, particle size and molecular weight are important for drug delivery. Further, these nanoparticles have the capability to reverse multidrug resistance a major problem in chemotherapy.

MATERIALS AND METHODS

The challenge of modern drug therapy is the optimization of the pharmacological action of drug, coupled with the reduction of their toxic side effect *in vivo*.

Cancer as target for drug delivery

A single cancerous cell surrounded by other tissues will replicate at a higher rate the healing tissues will not be able to compete with the cancer cells for the inadequate supply of nutrients.

Tumor interstitium is characterized by a high interstitial pressure, leading an outward convective interstitial fluid flow as well as absence of an anatomically well-defined functioning lymphatic network. Hence, the

transport of an anticancer drug in interstitium will be governed by the physiological (i.e., pressure) and physiochemical properties of the molecule itself (i.e., size, composition, and structure), properties of investigation and by the physiochemical properties of the molecule itself (i.e., size configuration, charge, and hydrophobicity), poorly vascularized tumor regions, acidic environment high interstitial pressure, and low microvascular pressure.

Colloidal nanoparticle incorporating anticancer agents can overcome such resistance to drug circulation, therapy increasing selectivity of drug towards cancer cells, and reducing toxicity towards normal cells controlled release of drug can be achieved by controlling the nanoparticulate structure, polymer used and the way by which the drug is associated with the carriers.

Nanoparticle exhibits a significant capacity to accumulate in a number of tumor after intravenous administration. Some tumors have been shown to exhibit an increase in vascular permeability, which may favor the accessibility of nanoparticle to extra vascular tumoral cells.^[1-3] The binding of a variety of anticancer agents (e.g. doxorubicin, 5-fluorouracil, dactinomycin and methotrexate), immunomodulators mainly to albumin nanoparticle, enhanced their efficacy against experimental tumors in comparison to free compound.^[4] One of the most promising applications of anticancer drug-loaded nanoparticle may be their use in the treatment of hepatic metastases. Intravenously injected nanoparticles are mainly taken as a reservoir for the drug, allowing a different approach to achieve tumor-specific targeting, which was made using MAb-coated nanoparticle. These formulations recognize specific cell determinants

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belonging only to tumor cell. Numerous biological factors associated with the tumor influence the delivery of the drug to tumor. Drug delivery systems to solid tumors have been redesigned and subsequently injectable delivery systems (i.e.) to solid lipid nanoparticle have been developed as an alternative to polymeric nanoparticle for delivery to solid tumor.^[5,6]

Delivery of specific anticancer agents as nanoparticle

Paclitaxel

Biodegradable nanoparticle formulation using poly (lactic-co-glycolic) acid has shown comparable activity to traditional formulation and much faster administration.^[7,8] Paclitaxel could be incorporated at very high loading efficiencies nearing 100% using nanoprecipitation method, which leads to a very narrow therapeutic index.

Doxorubicin

Doxorubicin has a number of undesirable side effects, such as cardiotoxicity and myelosuppression, which leads to a very narrow therapeutic index. Conjugates of dextran and doxorubicin have been encapsulated in chitosan nanoparticles of approximately 100 nm diameter and it was found to cure tumor injected mice by 60%. Conjugated doxorubicin to PLGA nanoparticles showed an *in vitro* release for a period of 1 month.^[9]

5-Fluorouracil

The hydrophilicity of 5-fluorouracil (5-FU) allowed it to complex with dendrimers after simply incubating the polymer with the drug. The dendrimer formulation showed 5-FU clearance only after 7 h for non-PEG-ylated system and 13 h for PEG-ylated system, which shows ability to control the 5-FU release *in vivo* and the extension of that release by PEGylations of the polymers in the formulations.^[10]

Gene delivery

Other legends that show selective targeting to cancer cells

are transferring, epidermal growth factor.

CONCLUSION

Nanoparticle appears to be a unique viable approach for combating problems, such as poor bioavailability, to avoid reticuloendothelial system and to achieve site-specific delivery to the tumor site. The research has aimed towards achieving specific and targeted delivery of anticancer agent, directing drugs to tumors so as to improve the length and quality of life of cancer patients. This will require superior detection and targeting methods.

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