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*Review Article*

# Drug Delivery System in Cancer Treatment

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**Abstract**

Because of their sophisticated functions in vivo, biomacromolecular drugs have recently received a lot of attention, particularly in the drug development field, thanks to the development of biotherapy. For biomacromolecular drugs, a wide range of drug delivery strategies have been developed over the past few years to overcome druggability issues like instability and physiologic barriers' easy restriction. The efficacy and potential for clinical use of biomacromolecular drugs are greatly enhanced when novel delivery systems are utilized to deliver them. These systems typically have the ability to extend the half-life, increase the bioavailability, or enhance patient compliance. In this audit, late examinations with respect to the medication conveyance techniques for macromolecular medications in malignant growth treatment are summed up, predominantly drawing on the advancement throughout recent years.

**Keywords**: Macromolecular drugs, Delivery strategies, Cancer therapy

## INTRODUCTION

Over the past two decades, the field of macromolecular drug development-also known as biologics, biomacromolecules, and biotechnology drugs-have experienced rapid expansion. Diverse macromolecular drugs like DNA, RNA, peptides, and proteins have been discovered and manufactured in large quantities thanks to advancements in biotechnology **(Chang RL et al., 1975)**. They can be used as a targeting component, active pharmaceutical ingredients, or even carrier material in drug delivery applications. As indicated by U.S. Food and Medication Organization, macromolecules can be delegated antibodies, endlessly blood items, allergen separates for determination and treatment (like sensitivity immunization infusions), human cells and tissues for transplantation (like ligaments, tendons and bones), quality treatment arrangements, cell treatment arrangements, and reagents for recognizing irresistible specialists. Due to their singular affinity, satisfactory specificity, and sophisticated functions2 in the treatment of various diseases, macromolecules have received more attention as drug candidates **(Arreguin AMG et al., 2011)**. Particularly for malignant growth, this is a significant general medical condition all over the planet, while the overall rate of disease keeps on expanding.

However, the need for safe and efficient delivery methods impedes the development of macromolecule-based therapeutic delivery. Due to nucleases' (RNA and DNA) or proteolysis's (peptides and proteins') degradation, unmodified macromolecules are unstable in systemic circulation. Furthermore, due to their large particle diameter, macromolecules cannot easily cross cell membranes **(Ying JZ et al., 1987)**. To avoid adverse effects, it is therefore necessary to modify the chemical environment or safeguard the delivery material. In this paper, we focus on recent advancements in the field of drug delivery systems (DDS) for macromolecular drugs used in cancer therapy. First, macromolecular drugs will be divided into two generic groups based on how they affect the treatment of tumors: macromolecules, such as cytotoxic proteins or nucleic acids, that could be utilized directly for tumor suppression; and immunogenic macromolecules, such as antigens or antibodies, that indirectly activate the immune system and kill cancerous cells. Second, as depicted. A summary of some typical DDS examples for macromolecules will be provided **(Holden MG et al., 2013)**. Last but not least, we'll talk about the opportunities and obstacles that macromolecule delivery presents for cancer treatment **(Yoseph H et al., 2016)**.

In the treatment of cancer, macromolecular drugs that could directly stop the growth of tumors or kill cancer cells were frequently used. In the past few decades, a variety of different macromolecules have been created, such as oligonucleotides (like siRNA or miRNA), long-chain nucleic acids (like plasmid DNA), peptides, and proteins (like tumor necrosis factor related apoptosis-inducing ligand, TRAIL). Our goal is to keep these macromolecules stable in the circulatory system, break through physiologic barriers, and accumulate more at the tumor site as effectively as possible. Different delivery strategies have distinct characteristics that correspond to the various macromolecules' characteristics **(Deblonde T et al., 2011)**. Small hydrophilic oligonucleotides like siRNA and miRNA are anionic. Because of their hydrophilicity and electronegativity, they are unable to easily penetrate biological membranes. This suggests that they must be carried in carriers in order to cross cell membranes. Polycationic subordinates are the most greeting oligonucleotides transporters among non-viral frameworks since they can really gather oligonucleotides and convey them into cells. Thusly, cationic polymer-based conveyance frameworks have been examined for the non-viral conveyance of oligonucleotides explicitly. In cationic polymer-based conveyance frameworks, oligonucleotides are consolidated inside different sorts of polycationic subsidiaries, for example, polyethylenimine (PEI), cyclodextrin, and dendrimers to shape nanoparticles. Moreover, the outer layer of the nanoparticles is altered with polyethylene glycol (Stake) and focusing on ligands **(Lai MK et al., 2004) (Calandrelli L et al., 2004)**.

Cyclodextrin are a natural high-polymer material that can be used to create water-soluble inclusion complexes with macromolecules. They also played a role in the first systemic injection of nanoparticles that was used to deliver targeted siRNA to humans. By decreasing the expression of the M2 subunit of ribonucleotide reductase, this system was created to stop tumor growth. Human transferrin and a cyclodextrin-based polymer as well as PEG were used as targeting ligands in this system. PEI is a synthetic cationic polymer that is frequently used to deliver antitumor oligonucleotides. It is available in a variety of molecular weights in the commercial market as a branched or linear formation. Due to its high cationic charge density and capacity to form small and compact nanoparticles with oligonucleotides, it has been used as a "golden standard" polymer. It also has a high buffering capacity for oligonucleotide escape from endosomes. However, PEI with a high molecular weight has a number of flaws, including high cytotoxicity in vivo and non-degradability. As a result, the most important property is degradability because it can reduce cytotoxicity by breaking down polymers into small molecules that can easily be eliminated through the in vivo excretion pathway **(Takakura Y et al., 1990)**. Jiang and coworkers4,5 used tumor cell-degradable disulfide-bonded PEI to optimize nanoballs and protect the nanosphere, which was made by rolling circle transcription and contains a lot of RNAi sequences, from being destroyed by Dicer or another RNase in normal cells.

Dendrimers are synthetic polymers that are highly branched and have a well-defined 3D nanoscale structure6. These one of a kind underlying properties, for example, adaptable size, modifiable terminal gatherings and great freight exemplify limit, make them alluring as transporters for oligonucleotides conveyance applications. Dendrimers like polyamidoamine (PAMAM), like PEI, also have a high positive charge density. The production of the dendrimers is largely responsible for the PAMAM transfection efficiency. In a nutshell, G3–G10 PAMAM dendrimers are more stable dendriplexes that contain oligonucleotides, and the transfection efficiency increases as generations pass. PAMAM and oligonucleotides typically form steady complexes like PAMAM–siRNA or PAMAM–miRNA through electrostatic attraction. In the fight against a variety of cancers, these "dendriplexes" demonstrated a favourable capacity to protect the miRNA or siRNA from degradation and high transfection efficiency.

Beyond oligonucleotides, numerous other macromolecular drugs have spawned novel strategies. It is important to note that the technology of cell membrane coating on nanoparticles has been used in numerous studies since it was first reported in 2011 to gain various advantages of natural cells (such as biocompatibility, biodegradability, and non-immunogenicity). For controlled drug retention, penetration, and releases36, this emerging delivery platform combines the advantages of natural cellular entities for long circulation and targeting capabilities. To disguise macromolecular delivery systems, a variety of strategies have been investigated, with erythrocytes leukocytes and sub-cellular platelets being among the sources of cell membranes used. The erythrocyte or red blood cell (RBC) membrane was a good first choice for coating the cell membrane of nanoparticles because it was a natural long-circulating delivery vehicle with limited immune cell clearance. It is currently the subject of the most research in the field. Due to the absence of intracellular organelles in mature erythrocytes47, membrane collection and purification of RBC has contributed to this platform's rapid development. RBCs are frequently used to coat the surfaces of synthetic nanoparticle-containing macromolecules39 in order to deliver macromolecules **(Abraham GA et al., 2003)**. The natural RBC membrane-coated nanoparticle easily accommodated macromolecules like aptamers, peptides, and proteins due to the thorough examination of the interfacial interactions between the two.

Immunotherapy has become the dominant focal point as an arising malignant growth treatment endeavor. There are numerous promising immunotherapies available that are made to elicit immune responses directed toward tumors. Various macromolecules like antigens, cytokines, chemokines, oligonucleotides, and Cost like receptor (TLR) agonists focusing on different resistant cells have been effectively shown in numerous preclinical settings55. For example, cytotoxic T lymphocyte antigen 4 (CTLA4) focusing

on the co-inhibitory receptors or modified cell demise protein 1 (PD1) on White blood cells which was known as resistant designated spot barricade both have prompted a wonderful durable endurance benefit in patients with different sort of growth through fundamental organization.

## CONCLUSION

The above-mentioned four interrelated obstacles must be overcome simultaneously for effective macromolecule delivery. It is difficult to overcome this multiple dilemma because the absence of any essentials will either result in the overall strategy's failure or a decrease in its effectiveness. Overall, the future research directions and challenges remain how to maintain the activity of biomacromolecules during delivery, allowing them to successfully penetrate various biological barriers in vivo and achieve precise targeted delivery into cells.

## CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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None

## REFERENCES

1. Chang RL, Deen WM, Robertson CR (1975). Permselectivity of the glomerular capillary wall: III. Restricted transport of polyanions. Kidney Int. 8(5): 212-218.
2. Arreguin AMG, Esquierdo JJ (2011). Overcoming difficulties. Science and Children. 48: 68–71.
3. Ying JZ, Mao XL, Ma QM (1987). Icons of Medicinal Fungi from China. Science Press. 43(4): 12-19.
4. Holden MG, Hsu LY, Kurt K, Weinert LA, Mather AE (2013).A genomic portrait of the emergence, evolution, and global spread of a methicillin-resistant Staphylococcus aureus pandemic. Genome Res. 23 (4): 653-664.
5. Yoseph H, Hussein K, Braun H, Paul M (2016).Natural history and decolonization strategies for ESBL/carbapenem-resistant Enterobacteriaceae carriage: systematic review and meta-analysis. J Antimicrob Chemother. 71 (10): 2729-2739.
6. Deblonde T, Cossu-Leguille C, Hartemann P (2011). Emerging pollutants in wastewater: A review of the literature. Int J Hyg Environ Heal. 214(4): 442-448.
7. Lai MK, McNaughton S, MacDonald S, Farry S (2004). Profiling reading comprehension in Mangere schools: A research and development collaboration. New Zealand Journal of Educational Studies. 39(2): 223-240.
8. Calandrelli L, De Rosa G, Errico ME (2002). Novel graft PLLA-based copolymers: potential of their application to particle technology. J Biomed Mater Res. 62(4): 244-253.
9. Takakura Y, Fujita T, Hashida M (1990). Disposition characteristics of macromolecules in tumor-bearing mice. Pharm Res. 7(2): 339-346.
10. Abraham GA, Gallardo A, San Roman J (2003). Polymeric matrices based on graft copolymers of PCL onto acrylic backbones for releasing antitumoral drugs. J Biomed Mater Res. 64(3): 638-647.