REVIEW ARTICLE

Liposomes with Ligand Carrier Vesicles Called Nanospheres Mimic Exosomes in the Cell

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ABSTRACT

Gene therapy is one of the most popular methods today. Recent advances in molecular biology have shown that cancer is actually a genetically based disease and the identification of genes that play a role in the development of cancer is continuing, as well as research and clinical studies related to gene therapy in cancer disease. In this sense, nanotechnology has created many profound effects among various disciplines of science and one of the most important application areas is the field of health.Nanotechnology also has the potential to generate entirely novel and highly effective therapeutic agents. Cancer nanotechnology is a branch of nanotechnology concerned with the application of both nanomaterials (such as nanoparticles for tumor imaging or drug delivery) and nanotechnology approaches (such as nanoparticle-based theranostics) to the diagnosis and treatment of cancer. In this context, liposomes can be used to improve current cancer treatment regimens due to their capacity to increase the solubility of poorly water-soluble antitumor drugs.

Key words: Nanotechnology, cancer therapy, gene therapy, biomolecules, liposomes

INTRODUCTION

Gene therapy is one of the most popular methods today. Recent advances in molecular biology have shown that cancer is actually a genetically based disease and the identification of genes that play a role in the development of cancer is continuing, as well as research and clinical studies related to gene therapy in cancer disease. In this sense, nanotechnology has created many profound effects among various disciplines of science and one of the most important application areas is the field of health. Nanomedicine includes organic or synthesized nanoscale materials for medical purposes, such as early detection of pathological processes; prevention and targeted therapies; and chemical, physical, electrical, optical, and biological properties. The most important application of nanotechnology in medicine is cancer diagnosis and treatment applications. Nanoparticles can overcome biological barriers and facilitate diagnosis, treatment, follow-up of disease, and treatment response. Some vectors are used in this.

Lipid-derived vectors are one of the most widely used non-viral vectors in drug and nucleic acid loading/release studies. Lipid-derived vectors have important properties such as high biocompatibility, controlled release, low cytotoxicity, and ease of ingestion due to their similarity to the cell membrane. Lipid-derived vectors have important properties such as high biocompatibility, controlled release, low cytotoxicity and ease of ingestion due to their similarity to cell membrane.[1]

Among the different delivery systems, liposomes have the most remarkable and optimal properties for both diagnostic imaging and treatment. Liposomes are non-toxic and biologically inert materials. Therapeutic liposomes have found extensive research in cancer, enzyme and gene therapy, infection, vaccines, and eye and skin diseases.

Liposomes are mainly phospholipid-like, cell membrane-like, polar and apolar headed, bendable vesicle-forming, double lipid layer structure, non-toxic, and biologically inert

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materials. Physical, chemical, and pharmacological stability is important in liposomes. The most important problem encountered in the use of liposomes in medicine has been the clearance of immunoliposomes by the phagocytic system. To solve this problem, scientists have solved the liposome surface by covering it with molecules that do not activate the immune system. Despite this development, the desired results could not be obtained with the liposomes given to the bloodstream for therapeutic purposes. The reason for this problem is insufficient blood circulation in solid tumors.[2]

By attaching immune components to the liposomes (such as immunoliposomes and cancer drugs ending with -mab), the third-generation liposomes were obtained. With the immunoliposomes, the drug is safely delivered until the target is reached and treatment success is increased. As a result of altering, improving, and improving the properties of liposomes, imaging and treatment efficiencies are increased by prolonged vascular circulation after intravenous administration. It is anticipated that liposomes mimicking exosomes will be widely used in drug therapy as a drug carrier in the near future.

Exosomes are formed when the endosomes mature during the maturation of the endosomes [Figure 1]. This formation, which contains many nanoparticles, is called multivesicular structures multivesicular bodies. Exosomes spread to body fluids as this multicapsular endosome merges with the cell membrane and releases the cargo therein. Due to this formation path, it forms a more homogeneous society in terms of its cargo and structure although it is separated from other cell-derived vesicles. Exosomes have natural liposome properties and, therefore, have importance in therapeutic research. Exosomes are nanosized and can move freely in the blood due to their protein and lipid contents in their membranes and also have the ability to cross the blood–brain barrier. In some studies, it has been observed that when granulocyte-macrophage colony-stimulating factor is grafted into dendritic cell-derived exosomes (dexosomes), it increases T-cell proliferation and promotes antitumor response. In the light of the developing technology, exosomes are thought to be a nano-biological structure that deserves to be investigated not only for the formation, progression, diagnosis, and treatment of cancer but also for the formation mechanism and diagnosis of many diseases [Figure 2].

Through these biomolecules, they are involved in many biological functions such as immune regulation, cell differentiation, intercellular communication, and cell migration by regulating gene expression in host cells. Tumor-derived exosomes, on the other hand, regulate the local and systemic environment to assist the development and spread of cancer through the biomolecules they carry. Studies investigating the potential use of exosome contents as biomarkers in the diagnosis of cancer and monitoring of the disease course are rapidly increasing. In recent years, there are also approaches, in which exosomes are targeted or used in cancer treatment.[3,4]

There are many ways in which cells communicate with each other. As an important way, binding to receptors on the cell surface after the release of signaling molecules in another cell to initiate a specific response in one cell can be illustrated. In another case, small vesicles formed by the packaging of one or more types of signal molecules are released from the cells, either by merging or incorporating with other cells [Figure 3]. Exosomes are small vesicles produced by almost all cells (also called microvesicles). After the cells are released into the extracellular environment, such as the space between blood and other body fluids, the exosomes can fuse to the adjacent or distant cells by transporting the cargo of functional molecules they carry. Remarkably, in addition to conventional signaling molecules such as exosomes, proteins, and peptides, they can also carry RNAs and DNA fragments that mutually transfer genetic information from one cell to another.[5]

Exosomes released from cells to the external environment not only carry mRNA and miRNA molecules but also change the transcriptome of the recipient cell [Figure 4]. The best example of this function has been shown that exosomes released by glioblastoma cells convert into protein in brain endothelial cells from which RNA cargos are taken and play a role in the regulation of tumor microenvironment.

Although nanoparticles have important physiological tasks, the release of exosomes into the environment in different types and effects depending on the cell and the state of origin allows the biomedical use of exosomes in both therapeutic and diagnostic applications. However, there are some barriers to the clinical use of exosomes today, such as the heterogeneous population of body fluids, the lack of understanding of the exact mechanisms of protein and RNA classification into exosomes, and the lack of adequate sensitivity techniques. A better understanding of exosome

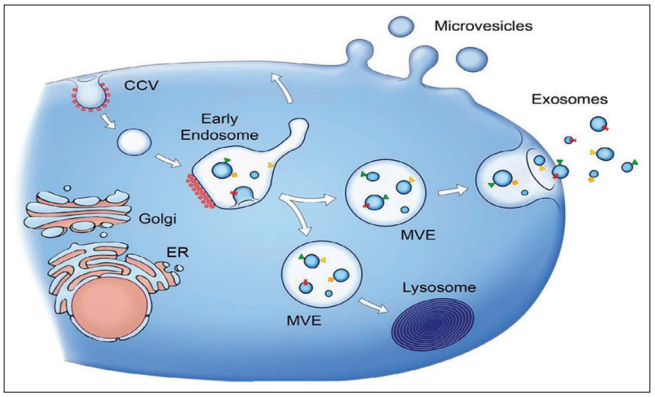

Figure 1: Exosome formation

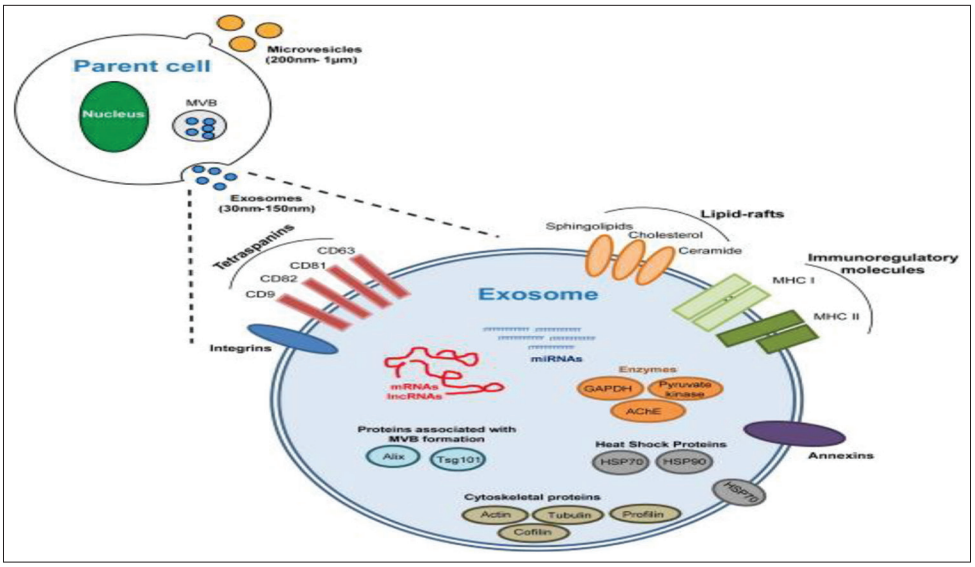

Figure 2: Physiological tasks of exosomes in the body

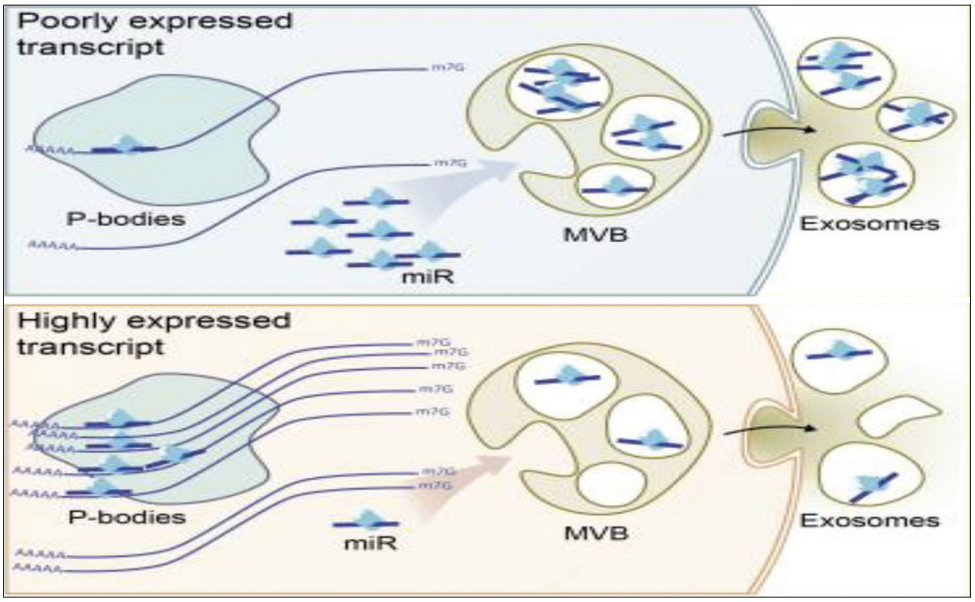

Figure 3: Exosomes in cell-cell interaction

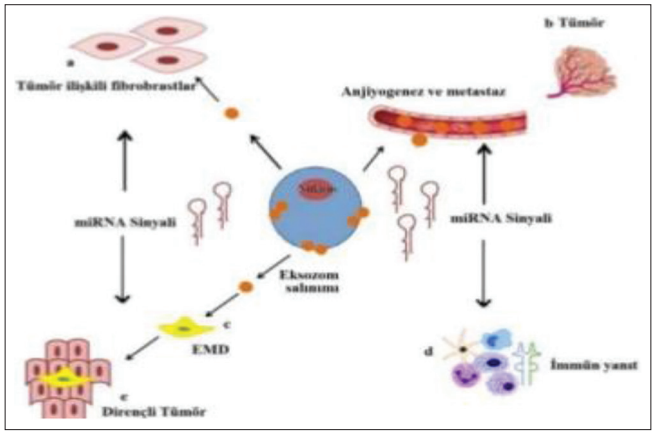

Figure 4: The role of exosomes in cancer

biology will help overcome these problems and develop new therapeutic approaches. At the same time, especially with the development of techniques that will enable more sensitive detection of miRNA, exosomal miRNAs may increase their potential in the diagnosis of the disease and it is considered to be more effective and widely used in the clinic.[6,7]

They characteristically carry the membrane and cytoplasmic properties of the cells they release.

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