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Commentary

Magnetic Nanocarriers: A Comprehensive Approach for Cancer Therapy

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DESCRIPTION

Magnetic nanocarriers are nano-platforms with various moieties based on magnetic nanoparticles that are used for medicinal and diagnostic applications. They have recently developed into a cutting-edge platform for tumor treatment as a result of their extensive use in biocatalysis, magneto-thermal therapy, Magnetic Resonance Imaging (MRI), and photoresponsive therapy. By precisely altering their structural characteristics, drugs placed inside magnetic nanocarriers can be effectively delivered to specific locations and continuously monitor the therapy process, follow the location of the therapeutic substance, and evaluate the treatment's effectiveness due to magnetic nanocarriers. To treat tumors precisely and successfully, they are generally employed in synergistic therapeutic applications. Here, some of their most recent uses in the treatment of tumors, such as stimuli-responsive drug delivery, Menopausal Hormone Therapy (MHT), photoresponsive therapy, immunotherapy, gene therapy, and synergistic therapy. Magnetic nanocarriers' reduced toxicity, enhanced anticancer effectiveness, and precise targeting. Also, the difficulties of their clinical translation and their potential for cancer therapy are explored.

Tumor cells in cancer create nefarious signals that drive their unchecked proliferation. Despite the enormous advancements made over the past few decades, cancer still poses a serious threat to global health. Several nanoparticle-based nanocarriers that combine molecular biology and nanotechnology to effectively treat tumors have been developed. In order to deliver comprehensive therapeutic effects, the ideal nanocarrier therapy devices should possess the distinct physical, chemical, and biological characteristics of nanoparticles. They should also intelligently distribute anticancer medications. Moreover, different nanostructures and surface modifications should enable nanocarriers to target tumors through Enhanced Permeability and Retention effects or other interactions with the characteristics of tumor tissue.

Recent years have seen a rise in the use of magnetic nanocarriers based on Magnetic Iron Oxide Nanoparticles (MIONs) for the treatment of tumors. Many biological sectors, including tissue repair, magnetic thermotherapy, magnetic targeting, and photoresponsive therapy, have shown interest in them. It has been demonstrated that the biological and magnetic properties of MIONs enhance the therapeutic effectiveness of anticancer drugs. Also, by minimising degradation in circulation, magnetic nanocarriers can enhance medication pharmacokinetics and boost their solubility and stability. Using "active targeting" and "passive targeting," magnetic nanocarriers improve medicine uptake in tumor tissue. The "Enhanced Permeability and Retention (EPR)" effect, which has been shown for a variety of nanoparticles, is referred to as passive targeting. Magnetic nanocarriers can be actively targeted using external magnetic fields or by adding ligands to their surfaces that can interact with particular biomarkers. Furthermore, adding functional shells to MIONs' surfaces enhances bonding at particular areas and improves their biocompatibility and nontoxicity qualities.

An ideal drug-targeted delivery system would keep the treatments in the bloodstream and only release them in response to internal or environmental signals like pH and enzymes, magnetic fields, temperature changes, and light. Therefore, it is crucial to choose a coating that guarantees the nanoparticles' durability and covertness in biological media.

Conventional cancer therapy delivery is frequently constrained by a wide range of problems. According to studies, chemical systems created to release medications when needed greatly enhance cancer treatment. The development of combinatorial methods based on magnetic nanocarriers to improve drug release has also been common. Examples include Photothermal/ Photodynamic Therapy (PTT/PDT) and magneto-thermal therapy, which can be used in combination with chemotherapy to treat tumors as effectively as possible. To lessen toxicity and enhance the therapeutic effect of tumors, concentrate on stimulus-responsive drug delivery, magneto-thermal therapy, PTT, PDT, immunotherapy, gene therapy, and synergistic approaches.

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