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Recent Advances in Targeted Therapies

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Abstract

World-wide, cancer ranks second only to cardiovascular diseases in terms of deaths. Environmental or inherited factors damage or alter the genetic material of cells, causing cancer. Metastatic cancer is currently treated primarily with anti-cancer drugs, instead of surgery or radiotherapy, when it is localized and non-metastatic. The purpose of chemotherapy is to inhibit the division of rapidly growing cells, which are characteristic of cancerous cells, but unfortunately, it also affects normal cells with rapid proliferation rates, such as hair follicles, bone marrow, and gastrointestinal tract cells, which cause chemotherapy-like side effects. Chemotherapy utilizing targeted drug delivery can improve the therapeutic efficacy of drugs by delivering them specifically to tumor cells or tissues, and minimizing their unwanted side effects on normal cells. Through passive targeting by enhanced permeability and retention (EPR) as well as active targeting by various types of receptors, nanocarriers are effective drug delivery strategies. In this article, we review recent strategies and technologies to enhance chemotherapy delivery.

Keywords: Chemotherapy; Nanocarriers; Targeted Drug Delivery

Abbeviation: EPR: Enhanced Permeability and Retention.

Introduction

Human health is seriously threatened by cancer as a global public health issue [1]. Surgery, chemotherapy and radiotherapy are the widely used methods of cancer treatment. All these methods pose various side effects including damaging normal tissues. As a result, numerous therapeutic approaches are being investigated by researchers to lessen any unfavorable side effects on healthy cells or tissues. It should be noted that increasingly accurate and successful targeted drug delivery techniques are emerging as promising treatment approaches for a variety of illnesses, including cancers. Clinical practitioners want drugs to be released at the point of action. Drug Delivery Systems, however, face major challenges related to safe transportation of drugs to pathogenic sites as well as controlled release of drugs [2]. Targeted delivery techniques can accurately and successfully deliver most medications to tumor cells or tissues rather than normal cells or tissues [3]. Nanoparticles have gained popularity for drug delivery due to their ability to aggregate at tumor locations via the EPR effect [4]. Targeted drug delivery can dramatically increase the treatments' therapeutic effectiveness and lessen adverse effects by selectively delivering pharmaceuticals to tumor areas. Furthermore, the use of nanotechnology can increase the stability and bioavailability of medicine, thereby extending their therapeutic impact and lowering the frequency of administration and dose of pharmaceuticals.

Nanocarriers can boost the targeting impact on tumor cells by surface changes in order to accurately deliver medicine to tumor tissues. Such a targeted delivery technique can boost

the tumor accumulation of drugs, lowering their damaging side effects on normal cells or tissues. Recently, the numerous established nanocarrier-based targeted drug delivery techniques have mostly incorporated the introduction of targeting compounds like peptides, antibodies and small molecules etc. along with delivery vehicles like polymers, metal oxides and silica etc [5]. Drug delivery efficiency and specificity are increased, and a robust contact with tumor cells is made possible by the creation and optimization of these targeting compounds and delivery vehicles. In addition, nanocarrier-based targeted drug delivery can boost drug accumulation in tumor tissue while reducing drug dispersion in normal tissue [6]. Some of the drug delivery carriers with potential applications listed in Table 1.

S. No.	Nanocarriers	Drug	Application(s)	Reference
1	Magnetic poly(amido amine) (G2.5)-hydrazine hydrate NPs	Doxorubicin	Cancer treatment	[7]
2	Fe3O4@mSiO2-FA-CuS-PEG Nanocomposite	Doxorubicin	Chemotherapy & photothermal therapy	[8]
3	Trimethyl chitosan NPs	Paclitaxel	Gastroenteric Cancer treatment	[9]
4	Biotin–PEG- poly(curcumindithio dipropionic acid–MNPs-QDs	Paclitaxel	MCF-7/ADR cancer cells	[10]
5	Guanidine functionalized PEGylated MSNPs	Curcumin	Breast cancer cells.	[11]
6	Hydroxypropyl-betacyclodextrin AuMNPs	Curcumin	Tumor therapy	[12]
7	Au-3MPS NPs	Methotrexate sodium	Psoriasis treatment	[13]
8	Hydroxyl modified MNPs	Methotrexate sodium	MCF-7 cell line	[14]

Table 1: There are many more drugs and delivery agents under clinical trials.

Conclusion

The delivery of targeted drugs in cancer therapy has made significant progress, however many challenges and limitations remain, including the complexity of tumor structure, ambiguous biosafety from delivery systems, and rapid metabolism and clearance from the body. So it can be understood that for targeted drug delivery technologies to be applied efficiently to cancer treatment, further research is required [15].

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