Chapter 13
Advancements in Cancer Therapeutics:
Targeted Drug Delivery in Cancer Treatment

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ABSTRACT

Targeted drug delivery in cancer treatment is a very convenient method for increasing the effectiveness of drugs and reducing their toxic side effects. Nano drug delivery systems have unique physical, chemical, mechanical, and optical properties. Nanoparticles, which have large surface areas and functional groups for the binding of therapeutic agents, benefit the drug distribution with nanoparticle formulations and can provide new features. They also enable personal oncology for diagnosis and treatment, which is appropriate for the personal molecular profile structures of cancer patients. The tumor-targeted active substances are attached to nanoparticles and the active substance loaded nanoparticles are targeted to the tumor area; these nanoparticles can be used with a high tendency to bind and specificity, to target tumor antigens or vessels. This chapter, besides traditional chemotherapy and radiotherapy methods in the field of cancer treatment, is aimed to give information about targeted drug delivery systems for cancer cell targeting without damaging normal tissues.

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INTRODUCTION

Cancer, one of the deadliest diseases worldwide, is one of the serious health problems of the 21st century that can start and spread anywhere in the body with uncontrolled cell proliferation resulting from a significant decrease in apoptosis in cells. Cancer cells need to get the oxygen, glucose and amino acids necessary for survival (i.e. to divide and multiply), so they successfully compete with normal body cells. Tumors can grow to about 2 mm^3 without forming blood vessels. A significant proportion (more than 85%) of hundreds of cancer types is solid. Considering the location and behavior of tumor cells, it is divided into five main classes. These are carcinoma, sarcoma, lymphoma, leukemia and CNS cancers (Ferlay et al., 2017). This disease can show therapeutic resistance and leads to occur clinical diversity with complexity at the genetic and phenotypic levels (Zhao & Rodriguez, 2013). Various treatment methods are applied for cancer treatment. These are treatment methods such as surgical removal, chemotherapy, radiotherapy and hormone treatment (Jabir et al., 2012). It can be given good result to remove the tumor tissue formed in a certain and limited region by surgical intervention. However, it is not a suitable method for cancer types such as leukemia or cancers spread over more than one region. Chemotherapy, one of the most widely used methods, is the method in which controlled anticancer drugs are administered to the diseased person in order to prevent the spread of cancer cells that proliferate uncontrollably. There are many types of chemo used in this method. The treatment to be applied varies according to the type of cancer. However, in this method, medications and drug doses can cause serious side effects, and blood, mouth, digestive system and hair follicles cells can be damaged. The method called radiotherapy or radiation therapy is a treatment method applied to the tumor area with X-rays. Cancer cells can be prevented from division and proliferation and destroyed with high doses of radiation. This method, which is suitable for use in almost all types of cancer, is mostly used in cancer types such as skin cancer, head and neck cancers, brain tumor, breast, prostate, gynecological cancers. There are various side effects in this method. A large area is used to send a sufficient dose of beam to the cancerous area. This causes damage to healthy tissues. In this method in which radiation therapy is applied, the different radiation resistance of each organ applied can create different side effects. It is one of the treatment methods that can be used in cancer types that occur in hormone producing regions such as ovarian and prostate cancer. This method has various side effects due to hormone treatment (Hassanpour & Dehghani, 2017).

As it is understood from here, the absence of targeting or limited targeting in cancer treatment causes many side effects. The most difficult part for the therapeutics used in cancer treatment is to distinguish between cancerous and normal body cells. Therefore, the main purpose is to enable the drug to recognize cancer cells. Interaction with normal cells is inevitable as targeting to cancer cells cannot be achieved in chemotherapy methods (Mousa & Bharali, 2011). The insufficiency of drugs used in cancer treatment for drug delivery also bring about the development of new treatment methods and techniques. Drug delivery targeting can be classified as active, passive and physically in itself, and can target organs, tissues, organelles and cells (Yu et al., 2016). Targeted drug delivery systems are promising tools for the fewest side effects of diseases and high therapeutic effects. As an alternative to traditional methods, it is aimed to minimize negative side effects for effective drug transport in studies of cancer treatment systems with the nanomaterials having a size between 1-100 nm (Liyanage et al., 2019). The most important differences that distinguish nanomaterials from other materials are the increased surface area and quantum effects. Properties such as electrical properties, in vivo behavior, reactivity are related to properties that distinguish nanomaterials from other materials (BASHYAL, 2018).