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OVERVIEW OF NANOCARRIERS AS AN ANTI-CANCER AND TREATMENT

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Abstract:

Nanotechnology has been laboriously integrated as medicine carriers over the last many times to treat colorful cancers. The main chain in the clinical operation of cancer is the development of multidrug resistance against chemotherapeutic agents. To overcome the limitations of chemotherapy, the experimenters have been developing technological advances for significant progress in the oncotherapy by enabling the delivery of chemotherapeutic agents at increased medicine content situations to the targeted spots. Several nano- medicine delivery systems designed for excrescence- targeting are estimated in preclinical and clinical trials and showed promising issues in cancerous excrescences' clinical operation. This review describes nanocarrier's significance in managing different types of cancers and emphasizing nanocarriers for medicine delivery and cancer nanotherapeutics. It also highlights the recent advances in nanocarriers- grounded delivery systems, including polymeric nanocarriers, micelles, nanotubes, dendrimers, glamorous nanoparticles, solid lipid nanoparticles, and amount blotches(QDs). The nanocarrier- grounded mixes are discussed in terms of their structure, characteristics, and therapeutic applications in oncology. To conclude, the challenges and future exploration opportunities of nanocarriers in chemotherapeutics are also presented. Cancer is a complicated disease for which finding a cure presents challenges. In recent decades, new ways to treat cancer are being sought; one being nanomedicine, which manipulates nanoparticles to target a cancer and release drugs directly to the cancer cells. A number of cancer treatments based on nanomedicine are under way and mostly are in preclinical trials owing to challenges in administration, safety, and effectiveness. One alternative method for drug delivery is the use of photovoltaic nanoparticles, which has the potential to deliver drugs via light activation. The concepts are based on standard photovoltaic cell that holds opposite charges on its surfaces and releases drugs when charge intensity or polarity changes upon photo-stimulation such as from a laser source or sunlight. This review will cover some recent progress in cancer treatment using nanoparticles, including photovoltaic nanoparticles.

Keywords: *nanomaterials, anticancer agents, recent advances,multidrug resistance, chemotherapy*

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INTRODUCTION:

Despite the complexities of modern medicine, cancer has reached epidemic proportions as researchers search for a cure. The most common type of cancer is lung cancer, with 1.61 million new cases diagnosed in 2008. Nearly half of the 12.4 million cancer cases diagnosed in 2008 and about two-thirds of the 7.6 million cancer deaths occurred in low- and medium-mortality countries. Income country. AIDS, tuberculosis and malaria kill fewer people each year than cancer. Moreover, the rapid increase in the number of deaths is the main motivation for this study. Currently available cancer treatments include surgery, chemotherapy, radiation therapy, and immunotherapy. These methods have side effects and limitations, so they are targeted at the elderly, and the risk increases with age as the functions of various organs and systems in the body deteriorate. To overcome the shortcomings of existing cancer treatments, nanomedicines (although most are still in preclinical testing) may lead the way. Nanotechnology has opened up new opportunities for controlled and targeted drug delivery. Nanoparticles (NPs) range in diameter from 10 to 200 nm. It has more promising pharmacokinetic properties compared to small molecule drugs. Drug-encapsulated NPs accumulate both passive and active mechanisms for long and full circulation periods, sustained drug release kinetics, and tissue recovery from tumors. Recently, NP drug carriers have received numerous reviews regarding their ability to co-encapsulate therapeutic vehicles and mediate their delivery to cancer cells. Drug nanocarriers generally serve two main purposes: targeted drug delivery to specific tissues, organs, or cells and controlled drug release. Drug delivery is based on biocompatible nanoparticles or nano capsules and targeting molecules. Select and include biocompatible materials to enhance the hydrophilic nature of the hydrophobic carrier system or drug. Targeting molecules are usually antibodies or avidin/biotin that directly target tissues, organs, or cells. The drug release properties of the nanocarrier system are ensured by the environmentally sensitive carrier structure. Controlled drug release provides primary therapeutic benefit by releasing the delivered high potency drug to the target site and preventing damage to healthy tissue that can occur with certain drugs, such as chemotherapy agents. Honey carriers made of polymer-based nanoparticles are solid colloidal particles. The size ranges from about 10 to 500 microns. Drug incorporation into nanocarriers is based on five methods: dissolution, capture adsorption, attachment, and encapsulation. A brief overview of the nanocarrier system is presented here. A brief review of the literature is provided, including popular easy-to-manipulate nanomaterials adopted as nanocarriers (Chinese (CS) nanohydrogel nanoparticles, GR/GO nanocarriers, and solid lipid nanoparticles). Nanohydrogels and CS nanoparticle derivatives are the most rotatable amphiphilic nanocarrier materials. GR/GO nanomaterials are preferred nanocarriers because they exist in a variety of carrier designs. Finally, solid lipid nanocarriers (SLNs) are currently the most promising new lipophilic drug carriers**.**

Types of Nanocarriers:

Nanocarriers can be divided into three major types:

1) Organic nanocarriers
2) Inorganic nanocarriers
3) Hybrid nanocarriers.

1)Organic nanocarriers :

Solid lipid nanocarriers, liposomes, dendrimers, polymeric nanocarriers, micelles, and viral nanocarriers are examples of organic nanocarriers. These organic nanocarriers are very flexible, have few adverse effects, and may be used with a wide range of medications and binders for drug delivery. Because of enhanced penetration and endurance, organic nanocarriers, such as micelles and liposomes, can aggregate at the appropriate location .

2)Inorganic Nanocarriers:

Gold, magnetic nanocarriers, quantum dots, and mesoporous silica are inorganic nanocarriers. Inorganic nanocarriers benefit from tradable characteristics. Inorganic nanocarriers can help with biosensing, cell tagging, retargeting, image processing, and detection. These inorganic nanocarriers are also therapeutically effective . Changing the composition or size of inorganic nanocarriers allows for extraordinary magnetic, plasmonic, and optical capabilities. However, using heavy metals as inorganic nanocarriers may have long-term health effects .

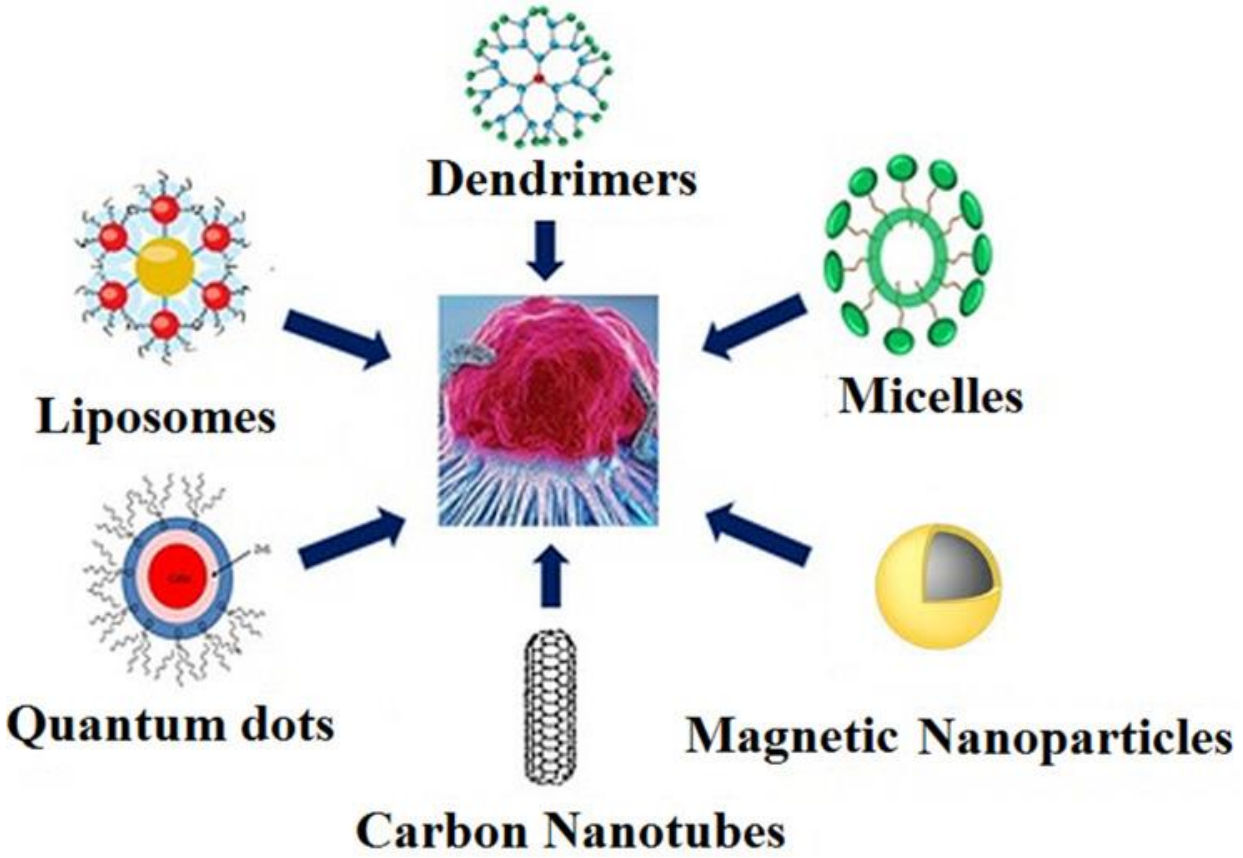
3)Hybrid Nanocarriers:

Hybrid nanocarriers are composed of two or more organic and inorganic nanocarriers that can be employed in combination or separately. Hybrid nanocarriers include lipids, ceramic–polymer hybrids, and other hybrid nanocarriers. When two nanoparticles combine, they have a dual nature of both, significantly improving their properties. Organic nanocarriers, such as liposomes, are less stable because of their internal solution permeability.

Various Types of Nanocarrier-Based Drug Delivery Systems

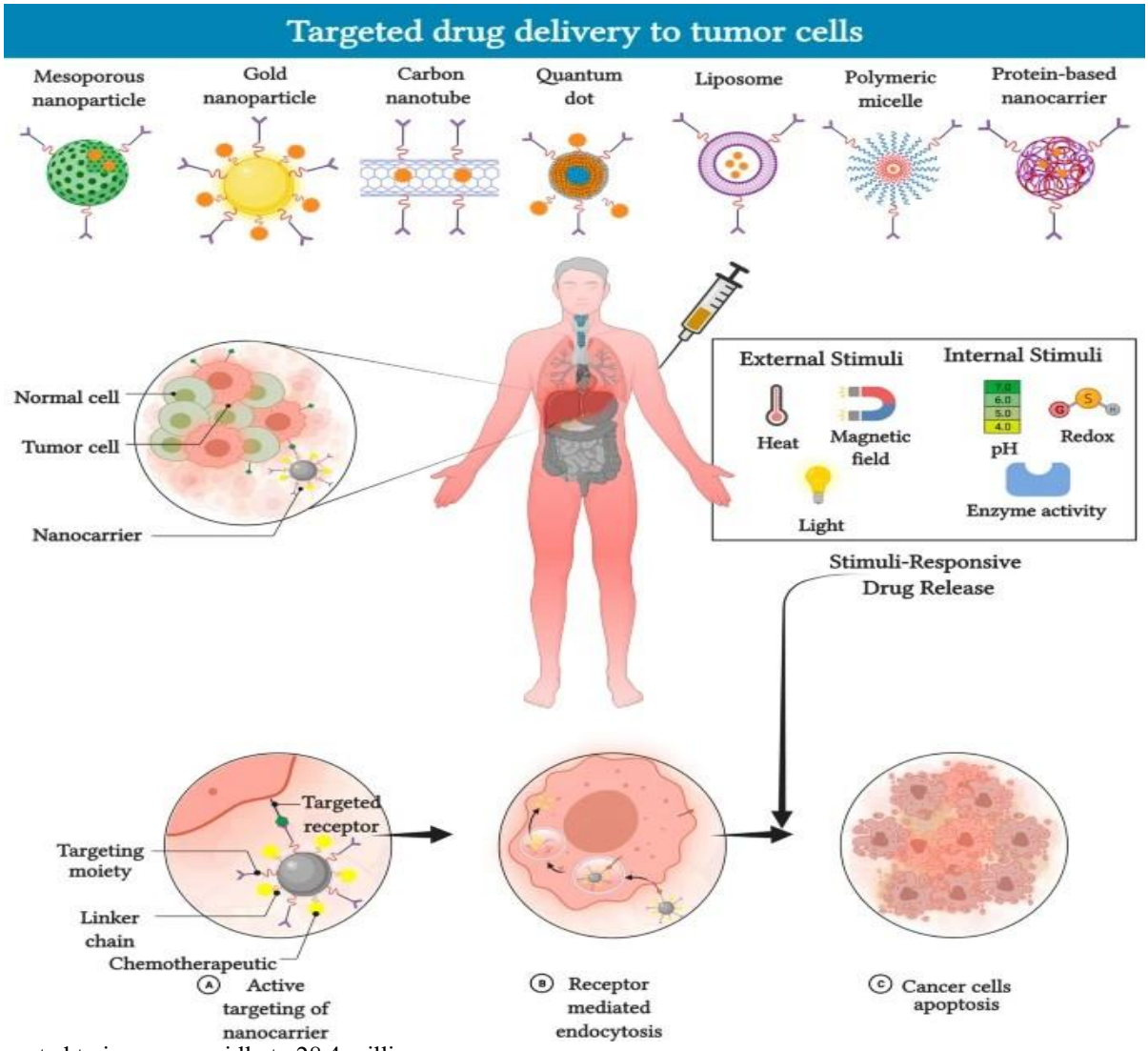
If at all possible, for anticancer drugs to be significantly effective, they should initially, be capable of breaching over the obstructions in the body and targeting the anticipated tumor tissues with insignificant forfeiture of their volume or activity in the blood circulation. Subsequently, after attaining the target site, chemotherapeutic agents should have the capacity to eradicate the tumor cells without distressing healthy cells. These two rudimentary tactics are also connected with enhancements in patient endurance by increasing the accumulation of chemotherapeutic agents inside the tumor microenvironment and dropping dose-limiting toxicities all together. Progressively, nanocarriers give the impression to have the prospective to propitiate both of these necessities for effective drug carrier systems.

Various novel nanocarrier-mediated drug delivery systems to deliver the chemotherapeutic agents at targeted sites are currently in practice. The structural representation of different nanocarriers-based delivery systems is



illustrated in Figure Some important nanocarriers include polymeric nanoparticles, liposomes, polymeric micelles, carbon nanotubes, Dendrimers,solid lipid nanoparticles, magnetic nanoparticles, and quantum dots. These nanocarriers are discussed in the following sub-sections.

Where are we today with cancer therapeutics?
Cancers are a group of diseases that are caused by the uncontrolled development of malignant cells, which can infiltrate tissues and spread to other regions of the body. According to the World Health Organization, cancer-related fatalities accounted for nearly 10 million deaths in 2020, and the incidence of cancer is expected to increase rapidly to 28.4 million new cases in 2040 [1]. The most common cancer-related death includes breast, lung, colon and rectum, prostate, skin (non-melanoma), and stomach cancers. Fortunately, the death rate has been reduced drastically by advances in our understanding of tumor biology and the development of improved diagnostic equipment and therapies.



Current oncological treatments and new therapies: an overview Several core strategies exist for treating cancer, including surgical intervention, chemotherapy, and radiation therapy, as well as a combination of these techniques. Conventional chemotherapy works primarily by interfering with the genetic material and cell division of cancer cells; however, this approach is non-selective and damages even the healthy cells, thereby resulting in severe side effects and a high mortality rate. In addition, hydrophobic drugs have poor accessibility that reduces the final drug dosage delivered to the tumor tissues, meaning that higher doses must be administered systematically. However, this can lead to severe toxicity in normal tissues and increase the chances of multiple drug resistance (MDR) where cancer cells can evade chemotherapies

by developing resistance against cytotoxic drugs immediately after therapy. Therefore, novel drug delivery systems that can enhance specific targeting and reduce adverse side effects in cancer tissues are urgently required. These shortcomings of conventional chemotherapy have prompted the development of smart monitored nanocarrier (NCs)-based drug delivery systems that allow targeted drug release at specific sites and reduce toxicity [2,3,4,5] with enhanced penetration [6].

The correlation between dru" delivery and nanoparticles (NPs) was first described by Paul Ehrlich [7] using the magic bullet concept, while Speiser et al. [8] were the first to report the regulated sustained release of drugs using a bead polymerization technique. Also, some engineered bioinspired synthetic and cellular systems towards design of nanomedicine platforms for the treatment of cancer [9]. In recent years, an increasing number of studies have investigated tumor biology and reported the construction of NCs using versatile materials, such as inorganic carriers, lipids [10], proteins [11], and polymeric micelles [12, 13]. This has led to the development of NC-based drug delivery systems that can deliver chemotherapeutics into the tumor microenvironment

On demand. Compared to conventional chemotherapeutics, NCs like liposomes, micelles, and nanoparticles have a variety of advantageous features for use in clinical cancer therapy. For instance, NCs can have a high selective accumulation rate in the tumor microenvironment via the enhanced permeability and retention (EPR) effect [14], which improves treatment efficiency by reducing toxicity in normal tissues. Moreover, active targeteddelivery can be achieved using NCs loaded with chemotherapeutic agents and conjugated to molecules that bind to receptors that are overexpressed on cancer cells.

In this review, we highlight various NCs-based drug delivery systems and discuss the targeted mechanisms via which they improve the therapeutic index of chemotherapeutic drugs. In addition, we discuss several endogenous and exogenous stimuli-responsive drug release studies in the context of present-day NCs development, in addition, the metabolic pathways and mechanisms induced by drug-loaded NCs.

CONCLUSION:

In this paper, we have critically reviewed the current cancer treatment in using nanocarriers as drug delivery vehicles and suggested that photovoltaic (PV) nanomaterials could in future be potentially used as a new and effective targeted drug delivery system. Although, nanomaterials are already recognized as vehicles in the targeted drug delivery in chemotherapy processes, these methods possess some side effects which can be detrimental to human health.

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