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A REVIEW PAPER ON DRUG DELIVERY SYSTEMS FOR THE SYNERGISTIC CANCER CURE

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Abstract

Cancer remains difficult to treat, despite being a leading cause of death worldwide, due to the emergence of drug resistance and serious adverse effects associated with traditional chemotherapy. Thus, due to the synergistic effects of drugs and suppression of drug resistance, combination chemotherapy is potentially beneficial. A promising method for the successful treatment of different cancers is nanoparticle-mediated chemotherapeutic delivery because it can simultaneously improve therapeutic effects and decrease side effects. In addition, the loading of various chemotherapeutic agents into these systems could enhance antineoplastic efficacy. Recent developments in combination chemotherapy using small-molecule chemotherapy agents by nano-carrier systems such as liposomes, polymeric micelles, dendrimers, polymer-drug conjugates, and mesoporous silica nanoparticles are highlighted in this study. In particular, it highlights the specific properties of these systems that make them ideal for optimized effectiveness and safety treatments and clarifies areas in which existing therapeutic strategies can be improved.

Keywords: *Cancer, Chemotherapy, Liposomes, Nanoparticles, Nano.*

I. INTRODUCTION

In both the developing and developed world, cancer is a leading cause of death linked to disease and a significant public health issue. In its growth, structural and regulatory molecular alterations that affect different aspects of cell behavior result. A significant mechanism underlying cancer growth and progression is these genetic alterations. Valuable efforts have therefore been made to identify common genomic alterations and the key target genes associated with cancer forms[1].

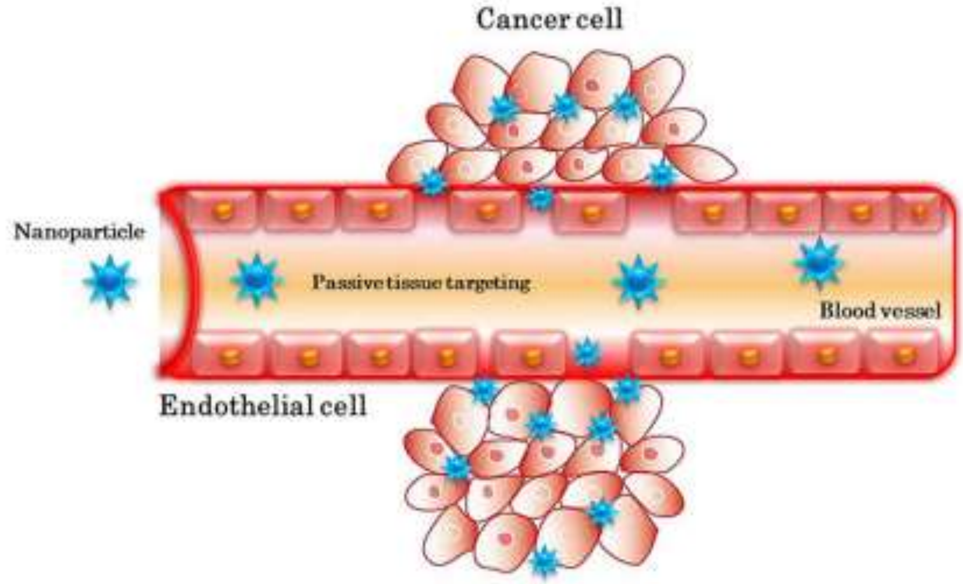

Fig. 1 Shows nanoparticle-mediated chemotherapeutic delivery to a tumor site[2].

Cancers may be intermittent or inherited, i.e. caused by different carcinogenic agents. Several changes in cell physiology are associated with neoplastic development, including growth signal enhancement, non-responsiveness to anti-growth signals, infinite replicative capacity, metastasis, angiogenesis, and apoptosis escape[1].

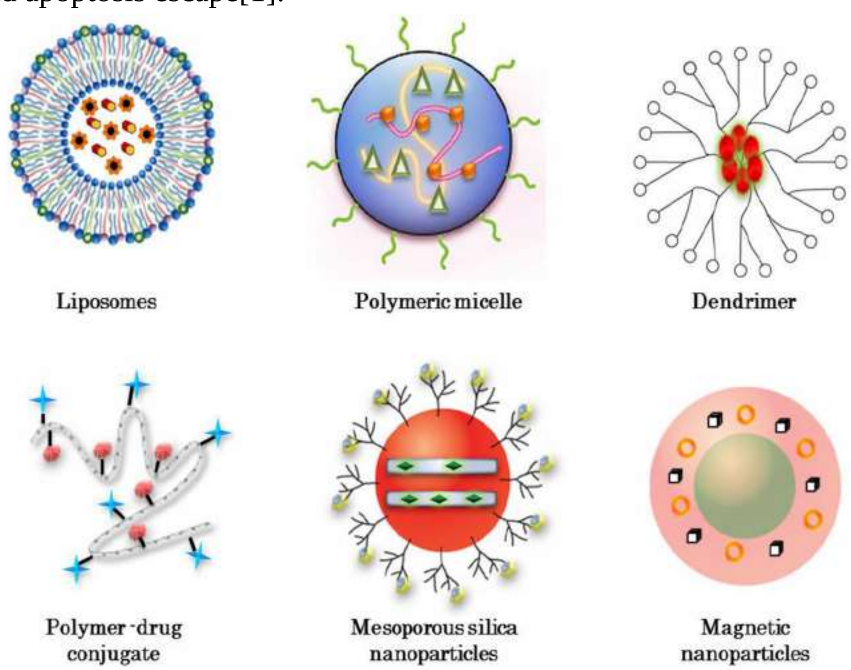

Fig. 2 Illustrates diverse nano carrier systems used for combination chemotherapeutic delivery to cancer cells[3].

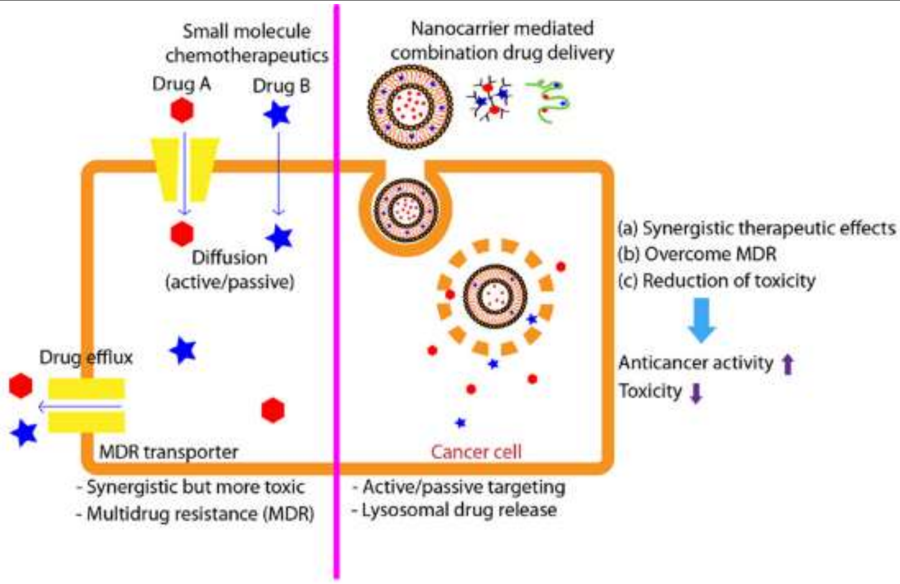

Fig. 3 Illustrates small-molecule chemotherapeutics and nano carrier-mediated combination drug delivery approaches[4].

II. DISCUSSION

Over the past three decades, several nano carrier structures, including liposomes, polymeric micelles, and polymer-drug conjugates, have formed the basis of many clinically approved therapeutic products[5]. Here, we illustrate nano particulate systems that have been tested to hold two or more forms of chemotherapeutic agents with small molecules for cancer treatment. The popular goal of these systems is to facilitate synergism through the regulated delivery of combination drugs; however, different advantages arise from the specific characteristics of each system[6]. Therefore, detailed information, with an emphasis on the resulting anticancer effects, on the nano carrier systems along with the loaded chemotherapeutic combinations is discussed. Figure 1 shows nanoparticle-mediated chemotherapeutic delivery to a tumor site[7]. Figure 2 illustrates small-molecule chemotherapeutics and nano carrier-mediated combination drug delivery approaches. Figure 3 illustrates small-molecule chemotherapeutics and nano carrier-mediated combination drug delivery approaches. Table 1 illustrates Liposomes for combination chemotherapeutics delivery.

Formulation	Drugs	Indication	Status	Targeting
Liposome	Cytarabine and daunorubicin (5:1 ratio)	Acute myeloid lukemia	Phase II	Passive
Liposome	Irinotecan and floxuridine (1:1 ratio)	Colorectal cancer	Phase II	Passive
Liposome	6-mercaptopurine and daunorubicin	Acute lymphoctic leukemia	In vitro	Passive
Two liposomal mixture	Irinotecan and cisplatin (7:1 ratio)	Small-cell lung cancer	In vivo	Passive
PEG-Liposome	Quercetin and vincristine (1:2 ratio)	Breast cancer	In vitro	Passive
Polymer caged nanobin	Cisplatin and doxorubicin	Breast and ovarian cancer	In vitro	Passive
PEG-liposome	Vincristine and topotecan	Brain and colon cancer	In vivo	Passive
Liposome	Omacetaxine mepesuccinate and doxorubicin	Cervical cancer	In vivo	Passive
PEG-liposomes	Paclitaxel and artemether	Invasive brain glioma	In vivo	Active (mediated by glucose receptor for mannose-vitamin E derivative)
Layer-by-layer (LbL)-engineered liposomes	Doxorubicin and mitoxantrone	Breast cancer	In vitro	Passive
Liposomes	Paclitaxel and chloroquine	Paclitaxel-resistant lung cancer	In vivo	Passive

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Table 1 Illustrates Liposomes for combination chemotherapeutics delivery[8].

Avenues for the managed and targeted delivery of combination chemotherapeutics have been established by recent advances in the nanotechnology sector. In contrast to small-molecule drugs only, nanoparticles of\200 nm in size provided more desirable treatment modules. Passive drug targeting mediated by the enhanced permeability and retention (EPR) effect is the gain of nano carrier-mediated combination chemotherapy (Fig. 1)[9].

III. CONCLUSION

This analysis summarizes recent advances in the delivery of combination chemotherapy agents using different nanocarriers, such as liposomes, polymeric micelles, dendrimers, poly-drug conjugates, and nanoparticles of mesoporous silica. Unprecedented regulation of therapeutic delivery has been made possible by versatility in the synthesis of nanoparticle platforms. By minimizing drug resistance and adverse effects, combination drug-loaded nanocarriers give new therapeutic possibilities for the successful treatment of cancers, but their implementation also raises many challenges. A detailed biological assessment based on a comprehensive understanding of their molecular mechanisms can optimize the drug ratio. In addition, in order to establish an effective drug loading ratio, the release kinetics of each drug in a multidrug-loaded nano carrier device should be evaluated, since one drug may influence the release kinetics of the other, thus altering the behavior. The creation of newer multidrug-loaded nanoparticles with accurate drug loading and release profiles to treat different types of cancer can be facilitated by a near collaboration between oncologists and engineers.

IV. REFERENCES

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