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Nanoparticle drug delivery for reducing cytotoxicity and MDR risks to cancer patients

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Introduction

Fast growing cancers such as malignant brain tumors, for instance, can attack the brain and the spinal cord in rapidly[1-4]. They attack the central nervous system and leave patients with inferior prognosis. A patient with glioblastoma, for instance, will have a six-percentage chance for a five-year survival rate. The options for most patients with a brain tumor or a localized tumor is debulking surgery, followed by radiation or chemotherapy. In this context, the use of chemotherapy is inevitable for most patients, and as research literature note, issues of multidrug resistance and cytotoxicity go hand in hand with the treatment. Cytotoxic drugs also called as cytostatic are drugs that target cancer cells. These drugs aim to inhibit cell division, and in this way, they lead to the death of cancer cells[5-10]. Their capability to destroy tumors results in better outcomes for patients after their debulking surgeries. The drugs are not only useful for a primary tumor but also can be rendered for destroying smaller tumors. The problem with the drugs is that they affect all other healthy cells as well, although they are particularly sensitive to cancer cells. Medications are often delivered as either high dosage drugs for some aggressive cancers or as a combinatorial therapy[11-15].

Sun et al.[16] discuss how the co-delivery of dual-drugs with nanoparticle can help prevent multidrug resistance MDR in cancer patients. Chemotherapy plays a very vital role when it comes to treating different types of cancer. However, many of the existing treatments are problematic in themselves because they are either cytotoxic and hence cause ill-health of the patient or in some situations could provoke multi-drug resistance[17-20]. The drugs that target the tumor cells will also affect the healthy tissues. In the case of MDR, the tolerance barrier has to be crossed by introducing more amount of the drug to treat the cancer patient, and this, in turn, contributes to increased cytotoxicity[21-24].

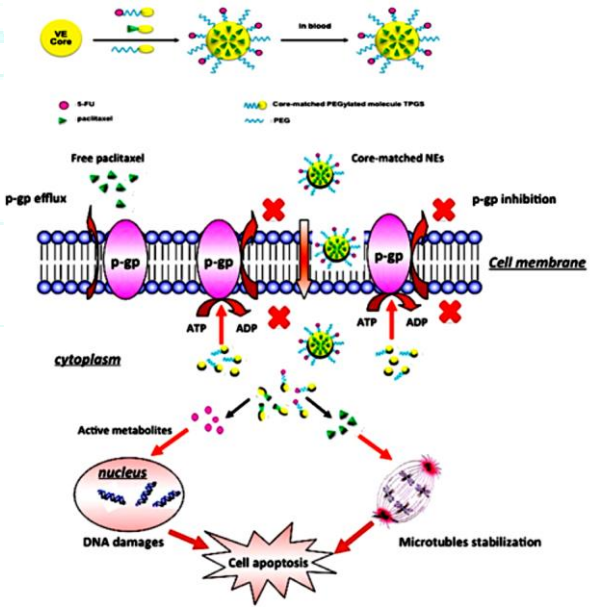

Figure 1: Co-delivery for achieving reversal of MDR, the core matched nano-emulsions are co-delivering PTX and 5-FU for achieving reversal of multidrug-resistance[16,25].

Kang et al.[15] presented a conjugate drug, and the camptothecin CPT loaded on a nanoparticle as the answer to selectively deliver the drug to the tumor cell. This way the healthy cells are not affected. Sun et al. on the other hand, present a targeted drug delivery system with dual drugs used to combat MDR. In some cases, it is even possible to reverse MDR through nano drug co-delivery mechanism as presented in the above diagram that highlights how Nano-

emulsions are co-delivering PTX and 5FU to achieve the reversal of MDR[16,26,27].

Sun et al.[16,25] in their review identified that the use of multiple drugs as chemotherapeutic agents did provide some efficacy in the context of treating cancer. It did reduce multidrug resistance as well because various medications have different pharmacokinetic properties. However, the efficacy observed was very nominal. It was identified that the use of different drugs, with nanotechnology, gene engineering, and associated significant data insights, shows much more promise. Improving the anticancer index is possible. Nanoparticle drug delivery system has the capability of selectivity in targeting tumor regions. An important adverse effect in radiation and chemotherapy was the loss of healthy cells[25,28-30]. Healthy cells also absorb the drug and are led to apoptosis. In the case of selective targeting, as is observed in the case of a nanoparticle drug delivery system, the healthy cells are spared, and hence the cytotoxicity effect is reduced. MDR problems are overcome as the nanotechnology carefully protects the payload[31-33]. The payload is usually a combination of chemotherapeutic drugs and an MDR sensitizer that reduces MDR effects. The nanotechnology capability is what helps encapsulate the drug and the inhibitor and helps deliver them in one shot[34-36].

The work aim was to review Nanoparticle drug delivery for reducing cytotoxicity and MDR risks to cancer patients. The work identified how in the context of cancer treatment, especially in the case of fast-growing cancer, and other malignant brain tumors, the use of chemotherapeutic agents are inevitable. Even with debulking surgeries, the patient has to undergo a regime of radiation or delivery of drugs. It is in this context that secondary health issues arise for the patient, such as cytotoxicity of drugs which harms their health or multidrug resistance that they develop which will stop the efficacy of their treatment drug action. Nanotechnology-based drug delivery systems were identified to hold much promise for preventing cytotoxicity and for MDR.

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