The Effectiveness of Combined Drug Delivery Systems

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ABSTRACT

Treatment of tumors with nanoparticles and combined drugs tend to turn effective as it can sustain for a longer time in the recipient’s body and also improve the impact. The conjugates that have proven to have high cytotoxicity are suggested in this report. Pegylation is an advanced drug delivery system that maximizes the immunity of the patient and helps in the correct targeting of the affected cells.

Keywords: Tumors, Nanoparticles, Drug targeting

Introduction

Drug delivery system is effective since long to treat patients with different disorders. The drug delivery methods have changed with the introduction of new technologies like nanotechnology\textsuperscript{1-3}. Single and combined drug methodologies are used to overcome multidrug resistance and make the nanomedicine infusion process effective. This co-delivery is observed to offer the clinical advantage and improved efficiency thereby adding ease to the treatment of cancer patients\textsuperscript{4-8}. This review paper begins with the conjugates that are used for single and combined drug delivery followed by the effectiveness of co-delivery therapy technique. The last section of the report discusses the applications of the co-delivery method in the field of biomedicine.

Conjugates for single and combined drug delivery

The modern society has reported a high number of cases affected by cancer. Chemotherapy is a commonly used treatment for cancer. However, there are issues with the dosage and targeting. Camptothecin is one conjugate that can be used with the inhibitor and diluted with dimethyl sulfoxide. To build a self-assembly structure, camptothecin is conjugated with short oligo ethylene glycol. This can enable the patient to overcome drug resistance\textsuperscript{9-13}.

Similar to these conjugates, the nanoparticles that originate from the polymer self-assembly are highly effective. The end conjugate develops a spherical nanoparticle that has up to 8 active drugs. In addition to camptothecin, disulfide bonding is used to crosslink with the nanoparticles and this act as a nano drug delivery system\textsuperscript{14-17}. In some instances, paclitaxel and camptothecin are conjugated to develop a beta sheet forming multiple compounds and peptides. The advantage with this bond is that it self-assembles into nanostructures\textsuperscript{18-21}. This conjugate can release the cancer cause agents and eliminate cervical cancer cell from the body. This conjugation can also help overcome drug resistance.

Not just restricted to the tumor, co-delivery can be a better option for treating breast cancer. Multiple polymers are combined and infused via the nanosized drug delivery system. Mitoxantrone is one anticancer agent that is already in use in the clinic since the past. Now, this is combined with covalent to improve efficiency\textsuperscript{22-25}. Redox-triggered MTO prodrug performs a controlled drug release and improves the therapeutic effect. This amphiphilic MTO prodrug is a combination of MTO and TPGS where the micelles are self-assembled\textsuperscript{26-29}.
This combination has brought better apoptosis promoting action. Further, the drug efflux rate is decreased, and drug resistance is controlled for the patient. When a single drug is induced, the patient does not see significant development. However, a co-therapy has multiple advantages with no accumulation of additional cancer or tumor-causing cells.10-33, 30-33

The effectiveness of co-delivery therapy

Chemotherapy is often hindered due to the multidrug resistance problems faced by cancer patients. The cancer cells cannot tolerate the injuries induced by the drug. Therefore, there is a need for co-administration of various chemotherapeutic agents to be applied in the clinic.4 It is observed that the co-delivery therapy for cancer is a promising mechanism as the undesirable toxicity is eliminated. Administration of the two drugs - fluorouracil and paclitaxel can improve efficiency in the treatment of MDR cancer.34-38

There are multiple ways to enable co-delivery - inducing dual chemotherapeutic drugs, with MDR inhibitor and with a sensitizer. The MDR inhibitor is a combination of cytotoxic drugs and many efflux pump inhibitors. This combination can maintain cytotoxicity and improve pharmacokinetic properties. The most promising inhibitor is tariquidar as this can sensitize those resistant cell lines and control the overexpression of P-gp.22,24,39,40

On the other hand, sensitizer compounds can fix the dysfunctional apoptotic signaling with chemotherapeutic drugs. Curcumin is yet another polyphenol that engages in anticancer activity and also down regulates the pathways from functioning and progressing the cancer cells further to other parts. It is observed that the co-delivery has a higher potential to control MDR and this only requires the proper selection of the nanotherapeutic delivery system to choose inhibitor/ sensitizer/ modulator.9-11,37,

Figure 1: Schematic diagram of self-assembly, tumor targeting, redox-sensitive MTO release responding to the intracellular high level and inhibition of P-gp efflux of TPGS-based prodrug micelles.
Pegylated drug delivery applications

Drug delivery has now got different methods to reach the targeted cells and use inhibitors to control the activity of attacking molecule. Pegylation is a procedure where polyethylene glycol (PEG) (hydrophilic) is attached to the therapeutic molecule. This attachment improves hydrophilicity and also keeps up the activity of enzymes. Pegylation typically includes hydroxyl groups and PEG is attached to liposome/protein/peptide/polymersome. The application of PEG does not show high toxicity level. It has so far proved to be safe to the humans.

The only drawback with this delivery system is the choice of molecules to influence the pharmacokinetics. Pegylation is a favorite technique to deliver drugs to the end body. It is a model that is used in genetic engineering as well as several in vivo and in vitro applications. The other advantage with pegylation is that it can increase the half-life of vectors. As a result, the circulation times increases and the impact is longer. The concerned health problem is reduced.

Conclusion

The types of drug deliveries are numerous in the market. Nanomedicine is a field that encourages a play with nanoparticles to treat multiple health disorders. From the observation in this review sheet, it is known that co-delivery of therapeutic drugs can increase the effectiveness and the targeted delivery is feasible. The conjugate has to be chosen carefully. This drug delivery requires expert knowledge. Otherwise, it has a widespread application in the treatment of cancer and tumors and can be the future of medical field.

References


