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Use of Nanoparticles for Brain and Lung Treatments

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Abstract

Nanotechnology is and will be the future of several fields and medicine is one of them. The use of nanoparticles in the treatment of psychotic and cancer problems is analyzed in this report. Psychotic treatment has been effective due to certain nanoparticles like haloperidol and RISP and these combinations are linked with other nanoparticles to treat other diseases. Nanoparticles have extended applications with a high degree of effectiveness to treat cancer cells due to the quick delivery and targeted process and the same is detailed in the review sheet. Oligonucleotides combined with nanoparticles have greater efficiencies.

Keywords: Nanoparticles, cancer, Oligonucleotides.

1. Introduction

Modern medicine uses nanoparticles for various drug delivery and treatment systems such as magnetic resonance imaging, cancer treatment, tumor treatment, and cell treatment [1-9]. Nanotechnology has allowed the researchers to experiment with different combinations of nanoparticles to apply the best to the biological devices and develop proper engineered materials to the patients. This review begins with an introduction on the need for nanoparticles followed by 2 different sections to explain the impact of nanoparticles in the treatment of tumor and lung cancer [10-16].

2. The need for nanoparticles

Nanotechnology has gained widespread usage in the field of medicine. Nanoparticles have been used as a drug delivery material to deliver light, heat and other substances to the affected cells [17-23]. It is observed that nanoparticles are efficient than other drug delivery methods for serious health problems such as cancer since nanoparticles can directly penetrate to cancer-causing cells and control its activity to a greater extent[24-27]. The targeted delivery is the reason for the widespread use of nanoparticles. Further, they dissolve within the cell leaving no side effect but a long-term impact on the body.

There are varied combinations of nanomaterials out of which solid-lipid and the polymeric nanoparticles tend to achieve higher success rate due to the biocompatibility and the safety associated with it. The treatment methodology used for the tumor can be repeated for lung cancer, too.

3. Impact of nanoparticles on brain problems

There are two types of problems addressed in this section - psychological and brain tumor. The modern society has shown a high prevalence of psychosis [28-32]. To control the psychological problems, antipsychotic medications have now been recommended involving nanoparticles that will develop building blocks and ensure a slow release process. Haloperidol (HP) loaded nanoparticle is used to treat schizophrenia and blocks the D2 dopamine receptors. Further, the dendrimers are altered to be induced as nanoparticles. A popular antipsychotic drug is risperidone (RISP) which is required to treat schizophrenia. The process of antipsychotic delivery is not researched in depth. However, nanoparticle-based administration to the treatment of psychotic problems tends to enhance the life of the affected individual and prove biocompatibility [33-38].

Table 1: Summary of Nanoparticles and Materials used for antipsychotics Delivery

Drug Name	Nanoparticle Type	Materials	Ref
Haloperodol	Solid Lipid	Glyceryl Monosterate + Tween 80	Yasir and Sara [2014]
	Polymer	Poly-ε-caprolactone + Polysorbate 80	Benvegnu *et al* [2011]
	Dendrimer	Polyamidoamine	Katare *et al* [2015]
Chlorpromazine	Supramolucule	Calixarene	Qin *et al* [2014]
	Polymer	PLGA	Halayqa and Domanska [2014]
Perphenazine	Polymer	PLGA	Halayqa and Domanska [2014]
Promazine	Polymer	PLGA	Domanska and Halayqa [2014]
Risperidone	Solid lipid	Compritol®888ATO	Silva *et al* [2012]
	Solid lipid/Polymeric Hydrogel	Glyceryl Monosterate + Carbomer 2001	Silva *et al* [2012]
	Solid lipid/Polymeric Inplant	Stearic acid/Glyceryl Monosterate + PLGA	Dong *et al* [2011]
Paliperidone	Solid lipid	Capmul®GMS-50K +sodium deoxycholate	Kumar and Randhawa [2013]
	Solid lipid	Capmul® GMS-50K +Gelucire® 50/13	Kumar and Randhawa [2014]
	Solid lipid	Steric acid + Gelucire® 50/13	Kumar and Randhawa [2015]
Quetispine	Solid lipid	Glyceryl Trimyristate + Poloxamer 188 & 407	Aboti *et al* [2014]
	Polymer	Chitosan + Tripolyphosphate	Shah *et al* [2016]
	Solid lipid/Polymeric Hydrogel	Glycerol monosterate + Poloxamer 188 & 407	Li *et al* [2015]
Clozapine	Polymer	Poly-L-glutamic acid + poly-L-lysine	Lukasiewicz *et al* [2016]
	Polymer	Poly-(ε-caprolactone)+Polysorbate 80/PEG/CS	Vieira *et al* [2016]
Olanzapine	Polymer	PLGA	Seju *et al* [2011]
	Polymer	Chitosan + Tripolyphosphate	Baltzley *et al* [2014]
Aripiprazole	Polymer	Poly(caprolactone)+Poloxamer 188 & 407	Sawant *et al* [2016]
Sulpiride	Solid lipid	Dynasan/Stearic acid + Tween 80	Ibrahim *et al* [2014]

Source: Sun Y. *et al* [28]

With respect to the brain tumor, it is a serious case though nanoparticles are available in abundance in the market. The problem is the absence of a substance that can control brain tumor-like glioblastoma at an earlier stage. Nanoparticle plays a role in such situations. Further, the brain tumor is treated with chemotherapy that has high cytotoxicity and nanoparticles tend to eliminate the blood-brain barriers[29]. *In vivo* and *in vitro* are the nanomaterials where nanoparticles have the abilities to link and bond with macromolecules and ease the circulation[29].

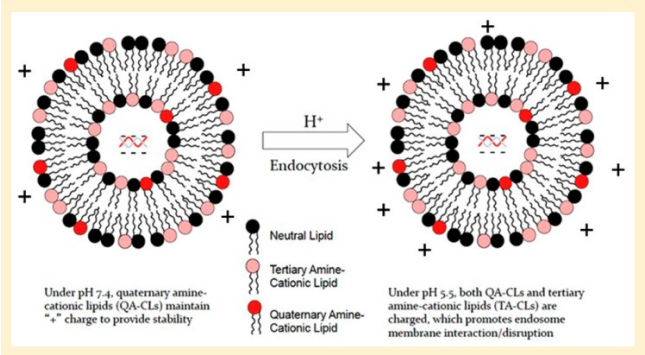
Gold nanoparticles have been very useful to perform brain targeting followed by drug delivery. The electrons are conducted on the metal surface and there is an excitation by light. Serine-arginine-leucine (SRL) modified dendrimers are found to have higher rates of transfusion and the toxicity level is extremely less. The problem faced in the treatment of brain tumor is the specificity and targeting[39,40]. Glioblastoma multiforme, a form of brain tumor, is aggressive and makes it difficult for the treatment to turn effective. Fibrin binding peptide can be induced to treat this case[29].

Polymeric, lipid and magnetic and microbubble nanoparticles have been useful in the treatment of brain tumor. They have addressed the neoplasm groups and reduced the toxicity with the application of nanoparticles. These generate proteins needed to control the impact of tumor and enhance the success rate of treatment.

4. Impact of nanoparticles on lung cancer

Human cancer is developed due to the excessive expression of Bcl-2 which is an anti-apoptotic gene. This expression has been controlled with the help of antisense oligonucleotides (ASOs) therapy [21,22]. However, there have been problems in the binding affinity and immunity of oligonucleotide. This has led to the demand of lipid nanoparticles which can increase the overall nuclease stability and the circulation time of such oligonucleotides [8,21,22].

Figure 1: A novel lipid nanoparticle formulation -- QTsome



Source: Yung, B.C. *et al* [21]

It is true that gapmer design can downregulate the presence of cancer and improve the binding affinity. So far, the treatment of lung cancer has shown positive results with LNP formulation as the *in vitro* and *in vivo* activities are high and there is a considerable stability which can improve the usefulness of the therapy [21,22]. While antisense oligonucleotide combined with lipid nanoparticles is called an effective therapy, quaternary amine-tertiary amine cationic lipid combination ensures an efficient and cost-effective therapy, too.

The latter works in both *in vitro* and *in vivo* gene regulation. The nanoparticles slowly invade the affected region and alter the surface and charge it to enhance the quality delivery of the oligonucleotides. miR-21 plays an important role in regulating the propagation of tumor and cancer. QTsome nanoparticles are ideal to induce strong dosage of the therapy without affecting the sensitivity and increasing the invasion pace [10,11,21-23].

5. Conclusion

The nanoparticle powered treatment for tumor and cancer in addition to the psychotic analysis is the most effective and sustainable therapy which can change the way other diseases are treated. Though varied combinations of nanoparticles are chosen, this still serves as a suitable therapy mode due to its suitability and biocompatibility and there is no side effect, unlike conventional chemotherapy. As a result, it is possible to expect faster results with the targeted delivery of therapy.

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