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Lipid nanoparticles in the treatment of lung cancer

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Introduction

Lipid Nanoparticles are used for efficient drug delivery in lung cancer. Just within the United States, it is estimated that lung cancer results in as many as 160,000 deaths[1-5]. Of this, non-small cell lung cancers NSLC accounts for an approximate 80 percent of a lung cancer situation. Compared to small cell lung cancer and other forms of cancer, the NSLC form is less responsive to surgery. This means that lung cancer can only be targeted using chemotherapeutic treatment and radiation. NSLC's mortality percentage and the lack of a surgical treatment means chemotherapeutical treatment must be efficient. It is in this context that lipid nanoparticles are identified as playing an influential role[6-12].

In human lung cancers, the miR-21 or the microRNA-21 is upregulated. It is an onco-miR. The antimiR-21 AM21, an Oligonucleotide is used complementary to miR-21 for inhibiting gene silencing of the miR-21. When used as a therapeutic agent, it is found that the antimiR is very sensitive to nucleases and is usually cleared faster from blood circulation necessitating more drug delivery. A therapeutic agent has to be present in the blood circulation for a particular time for it to be effective[13-19]. Additionally, it also suffers from its inability to penetrate the cell membrane for efficient drug delivery. When they are introduced with lipid nanoparticles LNPs, the new formulation is more efficient at drug delivery.

Cheng et al.[20] identified a new antisense oligonucleotide with chemical modifications and nanoparticle delivery that could target tumors and inhibit their growth compared to the use of traditional drug delivery of G319. The data suggested that the new modified G3139-GAPLNP promoted apoptosis better than other formulations. Cheng et al.[21] also present data on how the existing studies do show much benefit in using the lipid nanoparticles. Delivery with lipid nanoparticles supposedly increase the nuclease stability and hence the biological activity of the drug siRNA is reduced. When evaluated in in-vitro and in-vivo studies, it has been identified that there is an improvement in the efficacy of drug treatment. Similarly, Yung et al.[4] identified a novel lipid nanoparticle formulation, the QTsome. The QTsome made with a quaternary amine, and tertiary amine cationic lipids present with a unique pH-responsive profile called the QTsome, and this QTsome helped upregulate the miR21 in lung cancer[22-29].

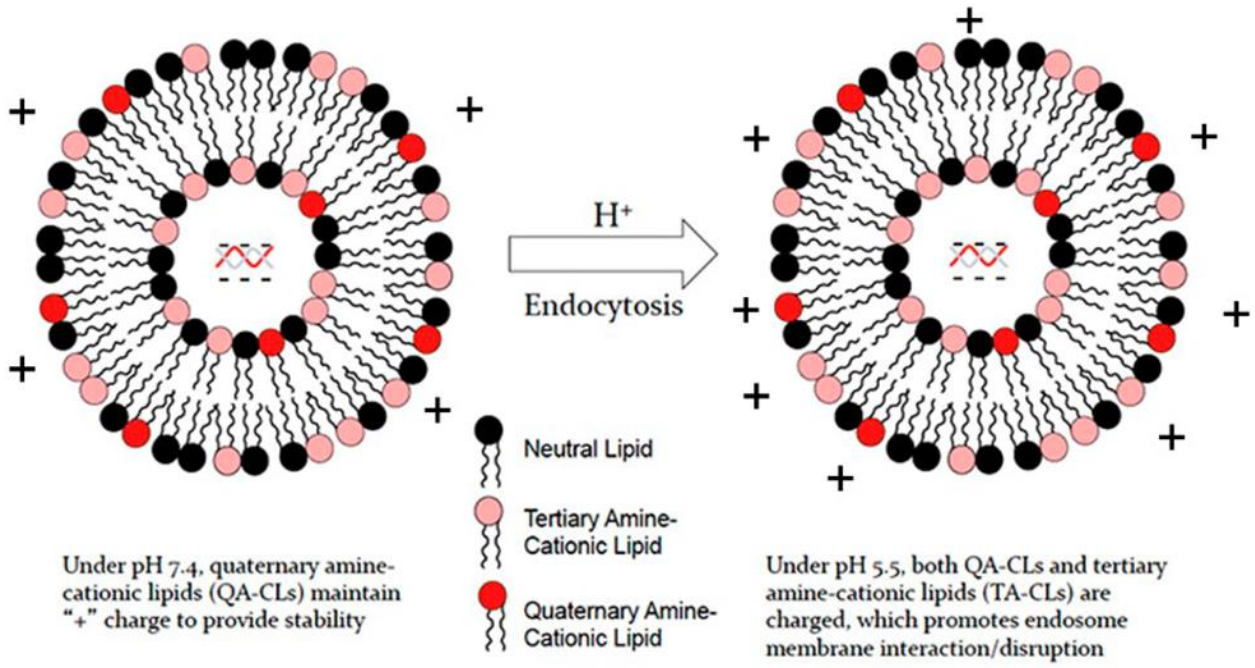

Figure 1: Unique pH profile, at pH value of 7.4 quaternary amine cationic lipids maintain charge for stability. After endocytosis, at pH 5.5, endosome membrane interaction/ disruption is promoted[4].

The QTsome used in the research work of Yung et al.[4] was prepared using a serial ethanol dilution method. The final concentration of the QTsome was stored at 4-degree Celsius, and for long term stability, a 10 percent sucrose solution was also added as a cryo-protectant. Mean particle diameter, and drug loading and stability aspects were also tested. Encapsulation efficiency was evaluated at -20, 4, and 25-degree Celsius for 30 days. Encapsulation efficiency and the colloidal stability of QTsomes were calculated. It was identified in-vitro analysis that better upregulation targeting of miR-21 happens[30-34]. The targeting activity is much better compared to other formulations that made use of quaternary or tertiary amine cationic lipids. Furthermore, the use of lipid nanoparticles also led to better stability in the system. A stable pH sensitive system is presented here. An additional benefit observed is that of the reduced migration and invasion of the drug. Cytotoxicity issues are identified in drug delivery because of drug leakage issues. Normal tissue cells also get affected in addition to the tumor cells. Drug dispersion can also result in reduced efficacy of the drug treatment as well[20,21,35,36]. Yung et al.[4] thus identified three different benefits in the use of lipid nanotechnology for drug delivery. In the context of discussing lipid nanoparticles for lung cancer, it is also necessary to explain how the use of nanoparticles could reduce multidrug resistance. Works on other forms of cancer such as brain tumors appear to show a multidrug resistance problem, and the use of nanotechnology for drug delivery helps control the problem. A similar case analysis can also be done concerning lung cancer to identify how MDR inhibition is aided in lung cancer.

This literature review attempted to analyze how lipid nanoparticles are used in the treatment of lung cancer. The research work of Yung et al.[4] and Cheng et al.[21] identified how lipid nanoparticles used for drug delivery help retain the drug in blood circulation for the needed time thus resulting in better health benefits.

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