Review Article **CODEN: IJRPJK** **ISSN: 2319 – 9563**

International Journal of Research in Pharmaceutical and Nano Sciences

Journal homepage: www.ijrpns.com

https://doi.org/10.36673/IJRPNS.2021.v10.i01.A02

A REVIEW ON LIPOSOME AS NANOCARRIERS

Pathloth Sony*[1], A. V. S. Rajeswari[2], J. V. C. Sharma[3], A. V. S. S. S. Gupta[4]

[1*]Department of Pharmaceutics, Joginpally BR Pharmacy College, JNTUH, Bhaskar Nagar, Yenkapally(v), Moinabad, Telangana-500075, India.

[2]Department of Pharmaceutical Technology, Joginpally BR Pharmacy College, Faculty of Pharmacy, JNTUH, Bhaskar Nagar, Yenkapally(v), Moinabad, Telangana- 500075, India.

[3]Department of Pharmacognosy, Joginpally B.R Pharmacy College, Faculty of Pharmacy, JNTUH, Bhaskar Nagar, Yenkapally(v), Moinabad, Telangana- 500075, India.

[4]Department of Pharmacology, Joginpally B.R Pharmacy College, Faculty of Pharmacy, JNTUH, Bhaskar Nagar, Yenkapally(v), Moinabad, Telangana- 500075, India.

ABSTRACT

Liposomes are the biocompatible and stable can be crafted to carry both water and fat-soluble nutrients. If the formulate are correctly, and they can facilitate the absorption as soon as they land on the tongue, and they can help to protect the breakdown by the digestive acids and enzymes. Liposomes are the nanocarriers comprised of lipid bilayers encapsulating an aqueous core. Liposomes are the complex defence systems which protects itself, liposomes shows the predominant interaction of cells with either simple adsorption or subsequent endocytosis. The Liposomes containing drugs or a variety of elements and their utilisation as a form, tool, or reagent in the fundamental studies of cell interfaces. The ability of Liposomes to encapsulate a wide variety of diagnostic and therapeutic agents has led to significant interest in utilising Liposomes as nanocarriers for theranostic application. This review presents an overview of the various aspects of the Liposomes with special emphasis on nanocarriers based on strategies.

KEYWORDS

Nanocarries, Liposomes, Multimodal imaging, Targeted therapy thernostics and Clinical translation.

Author for Correspondence:
Pathloth Sony,
Department of Pharmaceutics,
Joginpally B.R Pharmacy College,
JNTUH, Bhaskar Nagar, Telangana- 500075, India.
Email: rajeswariavs9@gmail.com

INTRODUCTION

Nanocarriers is a nanomaterial begin used as a transport module for another substance, such as a drug. Commonly the nanocarriers are used as include micelles, polymers, carbon based materials, Liposomes and the other substances[1]. Nanocarriers range from sizes of 1-1000nm[1,2]. However due to

the width of the mocrocapillaries being 200nm, nanomedicine are often refers to devices less than the 200nm[3].

Because of their smaller size nanocarries can deliver drugs to otherwise inaccessible site around the body. Since nanocarriers are so smaller, it is the oftentimes difficult to provide larger drug doses using them. The emulsion techniques are also used to make nanocarriers also often results low drug loading and drug encapsulation, providing a difficulty for the clinical use[1]. Nanocarriers discovered thus far include polymers conjugated, polymeric Nanoparticles, lipid based carriers, dendrimers, carbon nanotubes and gold Nanoparticles, Lipid-based carriers includes both Liposomes and micelles. Examples of gold Nanoparticles gold nanoshells and gold nanocages[2]. Liposomes are the spherical vesicles formed from the lipid bilayers. Because of their unique stricture, Liposomes can also entrap the hydrophobic agents within the Lipid bilayers and the encapsulate hydrophilic agents inside of the aqueous compartments, which are protects the agents from the degradation. If the inherent advantage of Liposomes, they such as high agents loading efficiency[4].

The high stability in biological environments are controllable release kinetics and the biodistribution of the theranostics agents[4]. As a results of the Liposomes have becomes one of the most and greatable successful delivery system[5,6]. The earlier Liposomes first described in the year of 1965, this contain no surface modifications[7]. But they can be customised to have the varied sizes, rigidities and the biological properties by their altering the lipid composition[8-10]. The Liposomes conventional, which are loaded with the drug molecules such as an amphotericin B, are used as commercialized for the treatment of different types of fungal infections[11,12].

TYPES OF NANOCARRIES FOR DRUG DELIVERY

Dendrimers
Micelles
Nanoshell
Nanocapsules
Nanostructured lipid carriers (NLCs)
Solid lipid Nanoparticles (SLNs)
Lyotropic Lipid crystals
Lipid drug conjugates (LDC)
Niosomers
Liposomes

Dendrimers

Dendrimers are defined as highly ordered branched polymeric molecules[13,14]. Dendrimers are derived from the Greek word Dendron which translates to the tree. Synonymous terms of dendrimers include arborols and cascade molecules. The word dendron is also the encountered frequently. The dendron usually contain single chemically addressable group called as focal point or core but the dendrimers are symmetric about the core, adopt a spherical three dimensional morphology[15].

Micelles

Micelles are defined as the collection of amphiphilic surfactant molecules that are spontaneously aggregate in water into a spherical vesicles. The center of the micelle are hydrophobic and therefore can sequester hydrophobic drugs until they released by some drugs delivery mechanism. The conventional micelles are formed from small molecules that they have a hydrophilic or polar or charged head group and a hydrophobic tail, often composed of the hydrocarbon portion of long fatty acids, the molecular size and other geometrical features of the surfactant determine the sizes of the micelles[16].

Nanoshells

Nanoshells are the type of spherical Nanoparticles which are consisting of a dielectric core which are covered by a thin metallic shell usually gold[17].

This type of Nanoshells involve a Nanoparticle called as the plastic, which are collective excitation or quantum plasma oscillation where the electrons simultaneously oscillate with respect to all the ions. Simultaneously oscillates can be called as plasmon hybridisation[18].

Nanocapsules

Nanocapsules also known as nanocages. This nanocages are the gold nanocages which are hollow, porous gold Nanoparticles ranging in size from the 10 to over 150nm[19]. They are created by reacting silver Nanoparticles with chloroauric acid in boiling water. Whereas gold Nanoparticles absorb light in the visible spectrum of the light at about 550nm, gold nanocages absorb light in the near infrared[20]. Nanocages have been functionalized with cancer specific antibodies[21,22].

Nanostructured lipid carries (NLCs)

Nanostructured lipid carriers are the spring up as the second generation of the lipid Nanoparticles to overcome the shortcoming of the first generation that is SLNs. The liquids lipids (oil) incorporation caused structural imperfections of solids lipids leading to less ordered crystalline arrangement which are avert the drugs leakage and furnish a high drugs load[23,24].

Solid lipid Nanoparticles (SLNs)

Nanoparticles are composed of lipids. That they are a novel pharmaceutical drug delivery system (A part of Nanoparticle drug delivery and a novel pharmaceutical formulation)[25,22]. LNPs as a drug delivery vehicles were first approved in the year of 2018 for siRNA drug, Imparted[23]. Imparted. Lnps came to wider prominence in 2020, as some COVID-19 vaccines that are used in RNA vaccine technology coated with the fragile mRNA strands with PEGylated lipid Nanoparticles as their delivery vehicles[26].

Niosomers

Niosomers are the one of the best among the carriers. They can self assembly of non-ionic surfactant into the vesicles was the first reported in the 70s by the researcher in the cosmetic industry's these are the non ionic surfactant vesicles which are obtained on the hydration are microscopic lamellar structures formed upon combining non ionic surfactant of the album or dialkyl polyglycerol ether class with cholesterol[27].

Liposomes

Liposome is the spherical vesicles having at least one lipid bilayers. These can be used as a drug delivery vehicles for the administration of nutrients and pharmaceutical drugs[28], such lipid Nanoparticles in mRNA vaccines, and DNA vaccines. Liposomes can also be prepared by disrupting biological membranes such as by sonication.

Types of Liposomes

According to the Liposomes and depending upon their specific structure, they are two different types of Liposomes they are:

Unilamellar Liposomes

Unilamellar vesicles

Which are` have a single phospholipid bilayer sphere enclosing an aqueous solution or multiple layers Liposomes, and which are multilamellar structure. In the multilayer Liposomes and the multilayer vesicles will form the one inside the other in diminished sizes, creating a multilamellar structure of concentric phospholipid sphere like a matroyoshka doll separated by layers of the water. The structural components of Liposomes could be:

- Phospholipid such as phosphatidycholine, phosphatidylglycerol, phosphatidylinositol, etc. For stable Liposomes, saturated fatty acids are used.
- Sphingolipids like sphingomyelin.
- Sterol, such as cholesterol, with the potential to decrease the fluidity or microviscosity of the bilayers. It can reduce the permeability of the membrane to water -soluble molecules and stabilize the membrane in the presence of biological fluids such as plasma.
- Sphingolipids like sphingomyelin.
- Polymeric materials. Polymerized Liposomes have the significantly higher permeability barriers to entrance of aqueous drugs.
- Polymers -bearing lipids. Coating liposome surface with charged polymers results in repulsion interaction with macromolecules.
- Cationic lipids such as dioctadecyldimethylammonium bromide or chloride.

General Preparation Methods of Liposomes

They are many types of methods are there but the Liposomes are involved in four basic stages,

A. Drying down lipids from organic solvent.
B. Dispersing the lipid in aqueous media.
C. Purifying the resultant liposome.
D. Analysis the final product.

Method of Liposomes preparation and drug loading: Following methods are used for the preparation

A. Passive loading techniques.
B. Active loading techniques.

Passive loading techniques including three different methods are

A. Mechanical dispersion method.
B. Solvent dispersion method.
C. Detergent removal method. (removal of non-encapsulated material[29].

Mechanical dispersion method

1. Sonication.
2. French pressure cellextrusion
3. Freeze -thawed Liposomes.
4. Lipid film hydration by hand shaking, non-hand. Shaking or freeze drying.
5. Micro-emulsification.
6. Membrane extrusion.
7. Dried reconstituted vesicles[29].

LIPOSOMES AS NANOCARRIES FOR DIAGNOSTIC APPLICATION

Early detection of the diseases such as cancer is the major determinant of the different clinical outcome. As a result, the development of a new diagnostic agents or the analytical assays for the detection of the disease has been a subjects of various significant interest. Control over the composition of Liposomes and on the surface functionalisation of the many types of recognition agents has allowed a greatful deal of progress towards the detection of biomarkers and disease in vivo. Liposomes as a diagnostic tools, highlight the uses of different imaging modalities as well as the detection of various types of molecular targets[30].

LIPOSOMES AS NANOCARRIES OF IMAGING AGENTS

The Liposomes have been used as nanocarriers for many existing and widely used the medical imaging techniques, including fluorescence, magnetic resonance, ultrasound and nuclear imaging application. For the all of these techniques, Liposomes have been developed to increase the bioavailability, stability and performance of the existing contrast agents. The manner of this Liposomes manner to enhance the existing the capabilities of these medical imaging modalities[30].

TYPES OF THE LIPOSOMES IMAGING AGENTS

Fluorescence imaging
Magnetic Resonance Imaging (MRI)
Ultrasound imaging

Liposomes as nanocarriers for detection of biomolecular targets

Liposomes vehicles which have proven to be effective nanocarriers, the able to encapsulate and the protect a variety of the payloads for various applications. Meanwhile, the lipid formulation of Liposomes have also been engineered with the specific ligands to recognise chemical and biological target with high specificity[31,32]. The platform for various biomolecular targets, including proteins, DNA and smaller organic molecules.

Liposomes as nanocarriers for theranostic application

Major subject of recent interest has been development of the theranostics which both combines imaging modalities or imaging and therapeutic function in one complex[33]. Due to the flexibility encapsulation capabilities of Liposomes, they can be further engineered to be able to co-deliver of the different imaging agents and the therapeutic drugs, allowing multimodal imaging as well as evaluation of the effects of therapy.

TARGETED STEALTH LIPOSOMES

PEGylation fails to lead to more than the 5% of the administered formulation accumulation in the tumor. Although radio labeled liposomes were

shown to accumulate in solid tumors in patient, they are also distributed to normal organs, revealing the also distributed to normal organs, revealing the need for tumor targeting[34].

Moreover mostly macromolecules, free drugs and Liposomes without an internalisation moiety have an accumulation limited to the periphery of a tumor due to the poor vascular density in tumor and the high tumor interstitial fluid pressure impeding transport of macromolecules[35,36].

ADVANTAGES AND DISADVANTAGES OF LIPOSOMES

Advantages[1,37]

1. Liposomes increased efficacy and therapeutic index of drug (actinomycin).
2. Liposomes increased stability via encapsulation.
3. Liposomes are non-toxic flexible, biocompatible, completely biodegradable, and non-immunogenic for systemic administration.
4. Liposomes reduce the toxicity of the encapsulated agents (amphotericin B, taxi).
5. Liposomes help reduce the exposure of sensitive tissue to toxic drugs.
6. Flexibility to couple with site -specific ligands to achieve targeting.

Disadvantages of liposomes[1,37]

1. It has low solubility.
2. Liposomes has the short half life time.
3. Sometimes phospholipid undergoes oxidation and hydrolysis like reaction.
4. Leakage and fusion of encapsulated drugs /molecules.
5. Production cost is high.

Approved liposome products on the market and associated indication

S.No	Year Approved	Brand Name	Drug	Approved Indication
1	2000	Myocet	Doxorubicin	Metastatic breast cancer (with cyclophosphamide)
2	2003	Estrasorb	Estrogen	Menopause
3	2003	DepoDur	Morphine sulfate	Pain management

CONCLUSION

From the above content mentioned, it is clear that Liposomes have drawn a lot of attention in the filed of sensing and therapy in the few years due to their intriguing physical properties which in the broad range of pharmaceutical applications. Liposomes are showing particular promise as promote targeting of particular diseased cells within the disease site finally Liposomal drugs exhibit reduced toxicity and retain enhanced efficacy compared with free complements only time will tell which of the above applications and which of the above applications and speculation. However based on the pharmaceutical applications and their available products, we can say that Liposomes have definitely established their position in modern delivery system.

ACKNOWLEDGEMENT

The authors wish to express their sincere gratitude to Department of Pharmaceutics, Joginpally BR Pharmacy College, JNTUH, Bhaskar Nagar, Yenkapally(v), Moinabad, Telangana-500075, India for providing necessary facilities to carry out this review work.

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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Please cite this article in press as: Pathloth Sony *et al.* A review on liposome as nanocarriers, *International Journal of Research in Pharmaceutical and Nano Sciences,* 10(1), 2021, 13-19.