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Research Article

Liposome: A Powerful Approach Festinates Drug Delivery System

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ABSTRACT

Drug delivery systems have become important tools for the specific delivery of a large Number of drug molecules. Liposomes are microparticulate lipoidal vesicles which are under extensive investigation as drug carriers for improving the delivery of therapeutic agents. Initially they were used to study biomembrane behavior but later on developed into a drug delivery system for targeting specific sites of action like the tumor targeting, gene and antisense therapy, genetic vaccination, immunomodulation, topical, cytosolic, and respiratory various infections etc.

Key Words: Liposome, Drug delivery system, Anticancer, Respiratory.

INTRODUCTION

Liposomes are structures of lipid molecules arranged in a bilayer configuration forming a spherical shell around an aqueous core [1]. Liposomes as a novel platform technology provide analternative to improve the drug delivery, which composed of a flexible bilayer and surrounded by an aqueous core domain. Liposome-based delivery systems play an important role owing to easy preparation, increasing the bioavailability, and also offer drug targeting and controlled release [2].

Liposome: Liposome is defined as "Liposome is simple microscopic vesicles in which an aqueous volume is entirely enclosed by a membrane composed of lipid molecule. Liposomes were first described by British haematologist Dr Alec D Bangham in 1961 (published 1964), at the Babraham Institute, in Cambridge. They were discovered when Bangham and R. W. Horne were testing the institute's new electron microscope by adding negative stain to dry phospholipids [3,8,12,20,21]. Liposomes are formed when thin lipid films or lipid cakes are hydrated and stacks of liquid crystalline bilayers become fluid and swell. During stirring, hydrated lipid sheets detach and self associate to form vesicles, which prevent interaction of water with the hydrocarbon core of the bilayer at the edges. Depending on the method of preparation, lipid vesicles can be multi-, oligo- or unilamellar, containing many, a few, or one bilayer shell(s) [5] figure1.

Types of Liposomes: There are a number of different types of liposomal vesicle:

Multilamellar vesicles: these range in size from 500 to 5,000 nm and consist of several

Concentric bilayers.

Small unilamellar vesicles: around 100 nm in size and formed by a single bilayer.

Large unilamellar vesicles: range in size from 200 to 800 nm.

Long-circulating liposomes: liposomes modified in such a way (usually surface-grafted with certain polymers) that they can stay in the blood much longer (for hours) than non-modified liposomes [6] table 1.

Drug Delivery System: Liposomes have been investigated for many years as parenteral drug carrier systems, particularly for the selective delivery of anticancer, antibiotic and antifungal agents, they have only for approximately one decade been considered for topical drug delivery, including ophthalmic, pulmonary and dermal/ transdermal delivery [18]. Biologically active materials encapsulated within liposomes are protected to varying extent from immediate dilution or degradation, suggesting drug carrier systems for the transport of drugs [19]. Natural lipids, particularly those, with aliphatic chains attached to the backboneby means of ester or amide bonds (phospholipids, sphingolipids and glycolipids) are often subject to the action of various hydrolytic (lipolytic) enzymes when injected into the animal or human body. These enzymes cleave off acyl chains and the resulting lysolipids have destabilising properties for the lipid layer and cause the release of the entrapped bioactive component(s). As a result new types of vesicles, that should merely bear the name of liposomes as their components are lipids only by similarity of their properties to natural (phospho) lipids, have been elaborated. These vesicles, still named liposomes, are made of various amphiphile molecules (the list of components is long) [8].

Liposome for anticancer drug delivery: Liposomes have been used as carriers for anticancer drugs to increase their aqueous solubility, minimize their toxicity, increase their plasma residence time, and provide a controlled-release profile. They rely on passive targeting of tumor tissue, where the liposomes diffuse from the systemic circulation across the tumor's leaky vasculature into the cancer tissue. DOXIL (Centocor Ortho Biotech, Horsham, PA) is a clinically approved liposomal formulation of doxorubicin

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Table 1 Vesicle Types with their Size and Number of Lipid Layers [7]

Vesicle Type	Abbreviation	Diameter Size	No of Lipid Bilayer
Unilamellar vesicle	UV	All size range	one
Small Unilamellar Vesicle	SUV	20-100 nm	one
Medium Unilamellar Vesicle	MUV	More than 100nm	One
Large Unilamellar Vesicle	LUV	More than 100nm	One
Giant Unilamellar Vesicle	GUV	More than 1 micro	One
Oligolamellar vesicle	OV	0.1-1 micro meter	Approx. 5
Multilamellar Vesicle	MLV	More than 0.5	5-25
Multivesicular Vesicle	MV	More than 1 micro Meter	Multi compartmental Structure

Table 2 Liposomal Formulation for the Respiratory Disorder [7].

Active constituent	Effect
Insulin	Facilitated pulmonary adsorption and enhanced hypoglycemic Effect
Catalase	Conferred resistance to pulmonary oxygen toxicity
Super oxide dismutase	Minimize toxicity to subsequent hyperoxia and improved Survival
Cyclosporins	Preferentially adsorbed by lung and shows sustained Release
Ricin vaccine	Improved safety profile for intra pulmonary vaccination
Interleukin-2	The lungs Facilitated bioactivity and reduce toxicity
Isoniazid and rifampicin	Improved the effect of drugs for the tuberculosis

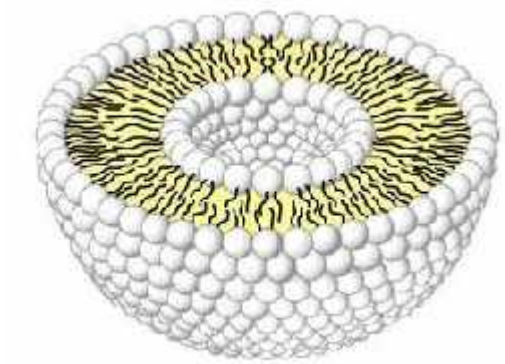

Fig.1.Structure of liposome [3]

that is used in treatment of breast cancer and Kaposi sarcoma [9,16]. Another interesting property of liposomes is their natural ability to target cancer. The endothelial wall of all healthy human blood vessels is encapsulated by endothelial cells that are bound together by tight junctions. These tight junctions stop any large particle in the blood from leaking out of the vessel. Tumour vessels do not contain the same level of seal between cells and are diagnostically leaky [6]. The effectiveness of the anticancer drugs currently adopted, in fact, is largely limited by their toxicity, so that novel therapeutic strategies, including novel drugs and/or a better 'targeted' delivery to cancer cells, are under investigation [13]

Liposome for respiratory drug delivery system: The recent use of liposome for the delivery of DNA to the lung means that a greater understanding of their use in macromolecular delivery via inhalational is now emerging. Much of this new knowledge, including new lipids and analytical techniques, can be used in the development of liposome based protein formulations. For inhalation of liposome the liquid or dry form is taken and the drug release occurs during nebulization. Drug powder liposome has been produced by milling or by spry drying. Drugs which are formulated in the form of liposome are presented [7] table 2.

Liposomes for cytosolic drug delivery: Cytosolic access is problematic with many new biotherapeutic molecules (e.g. proteins, (poly) peptides and nucleic acids). Although ligand-mediated binding of liposomes to cell surface receptors can increase the cellular uptake of liposome-encapsulated drugs, the internalization process itself is not sufficient to yield an enhanced therapeutic effect as long as the entrapped drug is not delivered to the (sub) cellular intervention site. In most cases, the drug needs to be delivered into the cytosol in order to become effective. Some of the delivery strategies leading to cytosolic drug delivery are depicted in figure 2.

Liposomes for topical drug delivery: Topical drug applications and delivery of other compounds are less stringent than the ones for parenteral administration and several hundred cosmetic products. The same properties of

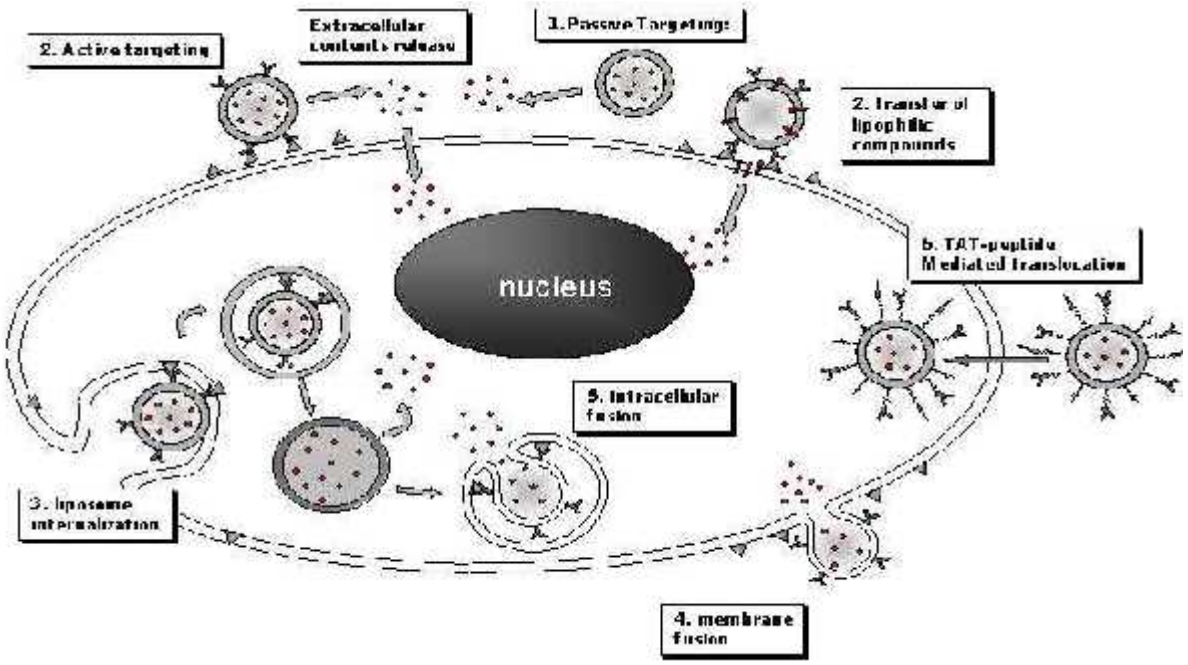

Fig.2. Potential ways of cytosolic drug delivery with passively and actively targeted liposomes [10]

liposomes can be utilized also in the delivery of ingredient in cosmetic. Liposomes as a carrier itself offers advantages because lipids are well hydrated and can reduce the dryness of the skin which is a primary lipid and importantly, linolenic acid, and natural lipids, either phospholipids or skin lipids, which contain mistly sphingolipids, ceramides and cholesterol sulphate, liposomes made from synthetic lipid also being used [11]. The application of liposomes on the skin surface has been proven to be effective in drug delivery into the skin. Liposomes increase the permeability of skin for various entrapped drugs and at the same time diminishes the side effect of these drugs because lower doses are now required [14].

Liposome for blood brain barrier drug delivery: Liposomes were also investigated to deliver drugs to the brain. An alternative approach is the employment of the nanoparticles. They consist of macromolecule materials in which the active principle is dissolved, entrapped, encapsulated or to which the active principle is absorbed or attached. Nanoparticles can be used therapeutically, as drug carriers or as adjuvant in vaccines [15].

CONCLUTION

Liposome can play a vital role of drug delivery system and unique characteristics such as capability to incorporate hydrophilic and hydrophobic drugs, good biocompatibility, low toxicity, lack of immune system activation, and targeted delivery of bioactive compounds to the site of action [22]. So liposomes are one of the exclusive drug delivery carrier system provide options and opportunities for designing bio-stable and/ or site specific drug therapy which can be of potential use in controlling and targeting drug delivery [17].

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