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Exploring Novel Strategies for Lipid-Based Drug Delivery

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ABSTRACT

Currently, the concept of lipid-based drug delivery systems has gained much interest because of their capability to deliver drugs which dissolve sparingly in water or insoluble in nature. Several methods of lipid-based drug delivery exist, and each method has its own advantages as well as limitations. The primary objective of the formulation development is to improve the bioavailability of the drug. The nano-sized lipid-based drug delivery systems have enough potential to do so. This article addresses the various barriers to the transportation of drugs through certain routes and also the common excipients which used to develop the lipid-based drug delivery systems. It provides a thorough overview of the lipid formulation classification scheme (LFCS) and also deals with several formulation & evaluation aspects of lipid-based drug delivery system. Further, it focuses on the formulations which are already available in the market and their regulatory concerns, respectively.

KEYWORDS

Barriers, Bioavailability, Excipients, Lipid Formulation Classification Scheme (LFCS), Lipid-Based Drug Delivery

INTRODUCTION

During the past few decades, lipids become the popular drug delivery systems for the poor water-soluble drugs. Lipid-based pharmaceutical formulations have been developed in order to improve the oral bioavailability of the drug (Kalepu, varma Manthina, swamy Padavala, 2013). Site specific drug targeting with minimal side effects is not easy as specific carrier drug needs to be developed for better drug delivery. Different kind of formulations has been used depending upon how the drug is administered into the body. Mostly the drug is administered through oral route due to safe and convenient route of administration (Umeyor, Kenechukwu, Uronnachi, Osonnwa, &Nwakile, 2012). It is challenging to develop a drug which can be delivered orally because of its stability in the gastrointestinal tract (GIT) (Nnamani, Attama, Ibezim, &Adikwu, 2010). However, the absorption capacity of such drugs can be improved by using lipid systems such as structured lipid carriers, self-emulsifying lipid formulations, emulsions, drug-lipid conjugates, solid dispersions, dry emulsions, liposomes, lipid nanoparticles, solid-liquid compacts, and micellar solutions as drug carriers (Chime, Onyishi, Obito, Onunkwo & Odo, 2013). In order to decrease the risk of reaction with the carrying substance in emulsion system, Solid lipid microparticles (SLMs) have been created. The drug release rate can be altered by introducing variations in either one or both the inner solid vesicles of the

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SLMs (Jaspart, Bertholet, Piel, Dogné, Delattre &Evrard, 2007). Lipid-based formulations are able to stimulate the 'lipidsensing' mechanisms that promote the physiological variations that can help in drug absorption (Christopher J. H. Porter, Natalie L. Trevaskis and William N. Charman, 2007).

DIFFERENT TYPES OF ROUTES IN LIPID-BASED DRUG DELIVERY SYSTEM

Drug Delivery Through Liposomes

Liposomes are the most common and well-investigated nanocarriers for the targeted drug delivery. Liposomes have led to the advancement of therapies in the area of cancer research because they improve *in vivo* cellular and tissue uptake, and enhancing biodistribution of compounds to target sites (Koning & Storm, 2003; Ding, Dziubla, Shuvaev, Muro & Muzykantov, 2006; Hua & Wu, 2013). Liposomes are vesicles of phospholipid that have one or more concentric lipid bilayers enclosing aqueous spaces. A diverse range of drugs can be encapsulated by these vesicles because they are able to entrap both lipophilic and hydrophilic compounds. By employing organic solvents or solvent exchange methods, liposome can be formed in an aqueous solution saturated with soluble drug and drug can then be loaded inside the liposomes. They can be used for oral (Rogers & Anderson 1998), pulmonary, transdermal and ocular delivery of drugs. Hydrophilic molecules are insoluble in lipid and can be placed in the aqueous compartment, and hydrophobic molecules are soluble in lipid and can be incorporated into the bilayer membrane. The hydrophobic molecules get entangled into the aqueous centre of the liposome this will lead to the convenient diffusion of the DNA, proteins and imaging agents through the lipid bilayers of the liposomes (Monteiro, Martins, Reis, & Neves, 2014). In conventional liposomes there is a lipid bilayer that comprises of cationic, anionic, or neutral (phospho) lipids and cholesterol, which consist of an aqueous compartment. With the help of Liposomal based drug delivery the therapeutic index of encapsulated drugs has been successfully improved (Koning, & Storm, 2003). The liposomes can easily permeate into the nuclear membrane of the tumour cell (Zhao, Dai, Lu, Chen, Lin & Shen, 2013).

Advantages of Lipid-Based Drug Delivery

In order to reduce the toxicity of various drugs lipid-based drug delivery has been used because it prevents the drugs to interact with sensitive organs and it also improves the bioavailability of drugs which is the prime objective of this system. In vaccines, diagnostics, nutraceuticals, etc., lipid-based carriers can be safely used for drug delivery (Müller, Radtke & Wissing, 2002; Prajapati, Patel, Patel, Dalrymple & Serajuddin, 2011; Pouton, 2006).

There are various unique benefits of Lipid-based drug delivery systems such as control and target drug release, encapsulation of large amount of drug, increase the stability of pharmaceuticals, and have the capability to deliver both lipophilic and hydrophilic drugs etc. The synthesis of Lipid-based drug delivery system is also less expensive as compared to polymeric/surfactant-based carriers. Increased drug absorption, a smaller number of side effects, controlled drug release and site-specific targeting are various advantages of lipid-based drug delivery systems over polymer-based systems. Stability of most of the lipid formulations is high for both the hydrophilic and hydrophobic substances. Lipid based drug delivery systems also have, high carrier capacity, and feasibility of variable routes of administration, including oral, topical, parenteral and pulmonary. Bioavailability of some drugs can also be improved if they are administered with food (El Laithy & El-Shaboury, 2002; Amidon, Lennernas, Shah & Crison, 1995; Charman, Porter, Mithani & Dressman, 1997; Winstanley & Orme, 1989). In the absorption of lipophilic drugs and increasing their oral bioavailability, lipid components of food have a major role. Stimulation of biliary and pancreatic secretions is done by high-fat meals which in turn reduce the metabolism rate and efflux activity so as to increase the intestinal wall permeability and prolongation of gastrointestinal tract residence time (ElMaghraby, Barry, & Williams, 2008).