MANTECH Publications

Journal of Pharmacovigilance and Quality Assurance
Volume 3, Issue 1, January-June, 2021

A Review on Niosomes and Vesicular Drug Delivery System

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Abstract

Various studies have carried over niosomes from ancient times. The niosomes article focuses on the many benefits of vesicular systems in terms of improving the effective drug delivery system and achieving maximal therapeutic concentration. Niosomes are made because the surfactant has a better chemical stability than phospholipids made from liposomes. Niosomes are utilised as a medication carrier as well as to decrease drug adverse effects and achieve maximal effective concentration in the body for a variety of effects. The formulation of niosomes is utilised in a variety of ways, including intravenous, oral, transdermal, inhalation, ocular, and nasal delivery. Niosomes are nonionic surfactant vesicles with a lamellar structure that must give additional benefits. According to this article, niosomes are fully utilised for medication transport and therapeutic usage in the treatment and management of a wide range of serious illnesses.

Keywords: *Niosomes, Vesicles, Vesicular system, Therapeutic Application, Entrapment*

INTRODUCTION

Niosomes are a nonionic surfactant-based vesicular system. The major rationale for producing noisome is that the surfactant is expected to have a greater chemical stability than phospholipids. Phospholipids are a kind of lipid that is utilised to make liposomes. Nonionic surfactants of several types are used to make niosomes. Niosomes are multilamellar vesicles made up of cholesterol and nonionic surfactants from the alkyl or dialkyl polyglycerol

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ether family. Polyglycerol alkyl ethers, glucosyl dialkyl ethers, crown ethers, and polyoxyethylene alkyl ethers and esters are only a few examples. 1 Controlling the release of medicines from the carrier system in order to achieve a regulated absorption in the body is one of the goals of creating a delivery system. Brij 96 and cholesterol in various molar ratios were used to make the noisy. The release was influenced by the vesicles' content, size, and number of baitlayers. This demonstrates the importance of these factors in the usage of vesicles in medicinal applications. (7, 8, 9, 10)

METHODS OF PREPARATION OF VESICLES

The vesicle preparation process is based on the usage of niosomes. As a result, the preparation techniques improve the number of bilayers, their size, size distribution, and entrapment effectiveness in the aqueous phase, as well as the vesicle membrane permeability. (1)

Ether Injection Method

At 60 degrees Celsius, the surfactant/cholesterol combination is dissolved in diethyl ether and injected slowly through a needle into the aqueous phase. Within the time it takes for the ether to evaporate, large unilamellar vesicles develop. However, this technique has certain drawbacks, such as the presence of a small quantity of ether in the vesicle suspension, which is typically difficult to remove. (1) Film Method (Hand Shaking)

With careful shaking, the surfactant/cholesterol combination is dissolved in diethyl. This has resulted in preparation of large multilamellar vesicles.

Sonication

The aqueous phase is introduced to the surfactant/cholesterol combination in a glass vial in this approach. The mixture was then placed in a sonicator for a set amount of time to be sonicated. As a result, vesicles become tiny, homogenous, and unilamellar. The generated vesicle size of niosomes is often greater than that of liposomes, with niosomes being no less than 100 nm in diameter.

Handjani-method Vila's is described here. To create a homogeneous lamellar phase, equal quantities of lipids (or a combination of lipids) and an aqueous solution of the active ingredient are combined and shaken. By using the shaking technique or ultracentrifugation, the produced mixture is homogenised at a regulated temperature.

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Method of Reverse Phase Evaporation

Lipids are dissolved in chloroform and 14% PBSether in a round bottom flask, and the organic solvent is then extracted at room temperature under decreased pressure. The surfactant film was then dried. At 50 to 60 degrees Celsius, this dry surfactant layer is hydrated with an aqueous phase (Phosphate buffer saline). Under lowered pressure, the mixture is sonicated and evaporated. The lipids form a gel, which is moistened thereafter. The evaporation process is repeated until the hydration process is complete.

Alternative Techniques

The alternate method can vary the size and quantity of bilayers of vesicles made of polyoxyetylene alkyl ether and cholesterol. When temperatures rise over 60 degrees Celsius, tiny unilamellar vesicles transform into big multilamellar vesicles (>1um), but strong agitation at normal temperature has the reverse effect, transforming multilamellar vesicles into unilamellar vesicles. The ability of polyoxyethylene alkyl ether (ester) surfactant to convert unilamellar vesicles into multilamellar vesicles at higher temperatures might be one of its features. As a result of the breakdown of hydrogen bondings between water and PEG moieties, polyethylene glycol (PEG) and water combine again at higher temperatures. The free drug is replaced by the encapsulated drug using a gel permeation chromatography dialysis technique or a centrifugation method in this approach. Furthermore, the weight density variations between niosomes and the exterior phase are less than those between liposomes and the external phase, making centrifugation separation problematic. To affect separation during centrifugation, protamine might be added to the vesicle suspension.

EFFICACIES OF ENTRAPMENT

The entrapment efficiency of the hydrophilic and lipophilic chemical is reliant on the formulation technique, just as liposomes. According to Baillie et al., the entrapment effect of carboxyfluorescein in niosomes generated by ether injection was substantially larger than that of vesicles prepared by the handshaking approach. Both Baille et al. and Hunter et al. employed glycerol surfactant and found that as the amount of cholesterol in the nonionic surfactant increased, the entrapment efficiency dropped. When an octapeptide, DGAVP, was incorporated into a noisome made from polyoxyethylene alkyl ether surfactant, high entrapment efficacies were reported. The freezing/thawing process

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was utilised to achieve entrapment effectiveness of up to 40% while only utilising a modest surfactant concentration (90mM). (1)

THERAPEUTIC APPLICATION

Naftifine HCl (Naf.HCl)

NaftifineHCl (Naf.HCl) is a synthetic, broad-spectrum antifungal that is one of the first-line treatments for dermatophytosis. The issue with producing Naf.HCl is that the concentration necessary in topical applications affects its aqueous solubility. Attempts have been undertaken to manufacture the medication as creams, in which the drug base is liberated by the formulation pH and emulsified as an o/w cream— alternatively, Naf.HCl has been solubilized with alcohol and Tween 80 and formed as a hydroalcoholic gel containing 52 percent (vol/vol) alcohol (Merz Pharmaceuticals, 2004). The clinical implications and consequences of recurrent skin contact to high alcohol concentrations are a key relationship with such hydroalcoholic compounds. The skin-irritating potential of alcohol has been thoroughly researched and recorded in this formulation (Bacchi-Modena, Bolis, Campagnoli, & De Cicco, 1997; Baumanna, Rath, Fischer, & Iffland, 2000; Tornier, Rosdy, & Maibach, 2000). Ethanol has the potential to permeate normal skin through the sweat and sebaceous gland ducts, as well as transepidermal through the stratum corneum, in just a few minutes. The permeability constant for ethanol in human abdominal skin is around (1.2 103 cm/h), which is comparable to water (1.0 103 cm/h) (Scheuplein & Ross, 1970). Dryness, desquamation, brown maculae, decline or halt of hair development, erythema, urticaria, papules, vesicles, and erosions have all been clinically reported as a result of repeated alcohol application. Hyperkeratosis, acanthosis, epithelialatypism, and mast cell degranulation were all verified histologically. Alcohol's negative effects are linked to its carbon atoms (C–OH), which produce free radicals that cause fast and severe responses, especially on sensitive skin (Baumanna et al., 2000; Hess, Molinari, Gleason, & Radecki, 1991). The treatment of fungal infections on the skin might take a long time. Furthermore, the skin's integrity is harmed, particularly in diseases such as athletes' foot, which is marked by maceration and fissuring of the interdigital skin. It will be painful to apply a strong alcoholic formulation. That is why it is critical to formulate Naf.HCl in an alcohol-free delivery method with improved pharmacological properties. Niosomes are

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closed bilayer structures formed when nonionic amphiphiles, primarily surfactants, self-assemble in aqueous environments. Micelles, which are another form of surfactant aggregation, entrap lipophilic molecules in an aqueous media, are considerably smaller than niosomes, and do not include bilayers (Van Hal et al., 1996a; Narang, Delmarre, &Gaoc, 2007). Because of their capacity to alter medication release and function as solubility and penetration enhancers, niosomes are regarded effective drug carriers for a wide range of cutaneous applications (Manosroi et al., 2003). The use of niosomes for transdermal medication administration, particularly for hydrophobic and amphiphilic medicines, looks to be promising. When compared to more hydrophilic medicines, they are more likely to bind with these loosely bound surfactant vesicles (Uchegbu & Vyas, 1998). (5)

Insulin

The difficulties associated with insulin treatment, which are common in the administration of polypeptide and protein medicines. When given orally, rapid enzymatic breakdown leads in a short biological half–life. Furthermore, due to the large molecular weight and lack of lipophilicity of these medicines, membrane permeability is frequently low. Insulin can be given via a variety of routes, including oral, ophthalmic, nasal, rectal, transdermal, and buccal. However, the creation of alternative effective drug delivery systems of insulin in the form of niosomal formulation has been committed to the success in terms of repeatability and bioavailability. (6)

Amarogentin

Niosomes were made using a non-ionic surfactant from the Span class, such as Span 20. The reagent Span-20 is used to make niosomal amarogentin. In a chloroform methanol combination, cholesterol and phosphatidic acid were dissolved as previously, then amarogentin (500 g in methanol) was added. To eliminate excess amarogentin, the dry film was inflated, sonicated, and centrifuged. Amarogentin synthesised in niosomal form was shown to be more effective. (3)

System for Vaccine Delivery

BALB/c mice were used to test the possibility of developing a peroral vaccination delivery method based on nonionic surfactant a vesicle (niosomes). Ovalbumin was encapsulated in a lyophilized noisome formulation containing sucrose, ester, cholesterol, and dicetylphosphate, among other ingredients.

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In this investigation, two distinct formulations were compared. On days 7, 14, 21, and 28, after intragastric injection, ELISA measured specific antibody titers in serum, saliva, and intestinal washings. Only when ovalbumin was encapsulated in 70 percent stearate sucrose ester, 30 percent palmitate sucrose ester (40 percent mono, 60 percent di/triester) niosomes did antibody titers change significantly. The delivery of ovalbumin and empty niosomes, as well as the administration of any control formulation, had no impact. (4)

Cisplatin

The use of cisplatin is restricted because to its negative side effects. Noisome of cisplatin was synthesised utilising Span-60 and Cholesterol and tested for antimetastatic efficacy in the experimental metastasis model of B16 F 10 melanoma. A similar model was used to test theophylline and its combination effect, which is linked to free and niosomal cisplatin. When compared to the untreated control and free cisplatin, treatment with niosomal cisplatin and its combination with theophylline resulted in a substantial reduction in the number of lung nodules. The use of activated macrophages reduces the tumor's secondary growth in the lungs. When compared to free cisplatin, niosomal cisplatin provided substantial protection against weight loss and bone marrow damage. These findings show that cisplatin encapsulated in niosomes has potent anticancer properties.

Product has lower toxicity and antimetastatic efficacy than free cisplatin. Theophylline, on the other hand, had no antimetastatic impact when used alone, in conjunction with cisplatin, or with active macrophages. (2)

CONCLUSION

The Vesicular System has proven to be a promising medication carrier, with the potential to minimise drug side effects and improve treatment efficacy in a variety of illnesses. Intravenous, oral, transdermal, inhalation, ocular, and nasal modes of delivery are also possible. As a result, properly developing a vesicular drug delivery system will improve patient compliance, maximise medication delivery to the target location, and reduce undesirable or toxic consequences.

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