

REVIEW ARTICLE

Development of Liposomal Gel for Transdermal Delivery of Selegiline

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ABSTRACT

The aim of present study was to developed liposomal gel of Selegiline to deliver the active substance at targeted organ with maximum therapeutic effect. Liposomes are concentric bilayered vesicles in which an aqueous volume is entirely enclosed by a membranous lipid bilayer mainly composed of natural or synthetic phospholipids. Liposome gels were prepared by incorporation of liposomes into a structured vehicle. Liposome gels provided a prolonged drug release rate. The concentration of the gelling agent affected the release rate slightly. Selegiline is a drug used for the treatment of early-stage Parkinson's disease, depression and senile dementia. In normal clinical doses it is a selective irreversible Monoamine oxidase inhibitor-B inhibitor. Transdermal delivery of Selegiline by encapsulation into liposome in the form of gel in order to improve the bioavailability following oral administration by avoiding hepatic metabolism. This study achieve maximum therapeutic effect and to have sustained release of drug through enhancing circulations life time.

Key words: Liposomal gel, Selegiline, therapeutic effect, sustained release

INTRODUCTION

Liposomes are microscopic vesicles composed of a bilayer of phospholipids or any similar amphipathic lipids. They can encapsulate and effectively deliver both hydrophilic and lipophilic substances and may be used as a non-toxic vehicle for insoluble drugs. Liposome as a microstructure consists of one or more concentric spheres of lipid bilayer separated by water or aqueous buffer compartments. Liposomes have many of the requirements for good drug delivery systems as they are relatively non-toxic and bio-degradable. They have been found to be useful carriers for both hydrophilic and hydrophobic drugs. Liposomal encapsulation of a drug can dramatically alter the pharmacokinetic properties of a drug, targeting the drug to particular organs and/or enhance the efficacy of the encapsulated drug. The formulation of an appropriate liposomal system as a carrier for a given drug is dependent on the type of the lipid used and the method of preparation. According to their size they are known as small unilamellar vesicles (SUV) or large unilamellar vesicles (LUV). If more bilayers are present they are referred to as multilamellar vesicles (MLV). Drug candidates for liposomal encapsulation are those that have potent pharmacological activity and are either highly lipid or water soluble. If a drug is water soluble, it

will be encapsulated within the aqueous compartment and its concentration in the liposomal product will depend on the volume of the entrapped water and the solubility of that drug in the encapsulated water. The lipophilic drug is usually bound to the lipid bi-layer or 'dissolved' in the lipid phase. They are usually applied to the skin as liquids or gels. For transdermal application of liposomes in gel form, hydrophilic polymers are considered to be suitable thickening agents, but the type and concentration of the polymer, which forms the gel matrix, could influence the stability as well as the release rate of the incorporated drug. Considering the all above mentioned, liposome vesicles embedded into a suitable gel matrix, could be attractive candidates for the use as drug delivery vehicles for transdermal application of selegiline.

Selegiline is a selective, irreversible inhibitor of Type B monoamine oxidase is a drug used for the treatment of early-stage Parkinson's disease, depression and senile dementia. Presently selegiline is available only in the form of tablet with dose of 10mg twice a day. Following oral administration bioavailability of this drug is very low due to different path of metabolism. Because of prominent first pass effect and their tendency to inhibit monoamine oxidase in gut, alternative route of administration is developed. Also upon

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oral administration due to the primary metabolites of L-amphetamine and L-methamphetamine, Selegiline shares many side effects seen with these sympathomimetic stimulants. Minor side effects such as dizziness, dry mouth, and difficulty falling or staying asleep, muscle pain, rash, nausea and constipation have been seen. Thus bioavailability problems associated with oral administration generate interest of designing novel drug delivery system of selegiline with an alternative route of administration.

Transdermal delivery of drugs provides advantages over conventional oral administration. The benefit of transdermal systems includes improved patient compliance, convenience and elimination of hepatic first pass effect. Nevertheless, most drugs are not applicable to this mode of administration due to the excellent barrier properties of the skin. Molecules must first penetrate the stratum corneum, the outer horny layer of the skin. The molecule then penetrates the viable epidermis before passing into the papillary dermis and through the capillary walls into systemic circulation. It is the stratum corneum, a complex structure of compact keratinized cell layers that presents the rate limiting step and the greatest barrier to absorption of transdermally administered drugs.

Method of preparation

1. Preparation of gel

As a vehicle for incorporation of liposomes for transdermal delivery, a carbopol gel was made. Carbopol 934 was dispersed in distilled water by stirring at 800 rpm for 60 minutes. Then, propylene glycol was added and the mixture was neutralized by drop wise addition of triethanolamine. Mixing was continued until a transparent gel appeared, while the amount of the base was adjusted to achieve a gel with pH 5.5.

2. Incorporation of liposomes of optimized batch into carbopol gel

Selegiline liposomes were prepared by thin film hydration technique using soya lecithin, cholesterol and drug in different weight ratios. Liposomes containing selegiline (separated from the untrapped drug) were mixed into the 1% (w/w) Carbopol gel with an electrical mixer (25 rpm, 2 min), the amount of liposomes of optimized batch (added into the gel, such that the prepared gel have 2% w/w liposomes concentration (20 mg drug per 1gm of gel).

CONCLUSION

It can be concluded that encapsulation of drug into multivesicular liposome offer a novel approach to sustained release of drug. Keeping in view all

associated problems of selegiline following oral delivery attempt is made to develop novel drug delivery system for transdermal delivery of the drug for the treatment of Parkinson's disease. Formulation is expected to provide better therapeutic effect and increased patient compliance.

REFERENCE

1. Fielding MR. Liposomal drug delivery: advantages and limitations from a clinical pharmacokinetics and therapeutic perspective. *Clin Pharmacokinetics* 1991; 21: 155-164.
2. Akbarieh M, Besner JG, Galal A and Tawashi R. Liposomal delivery system for the targeting and controlled release of praziquantel. *Drug DevInd Pharm* 1992; 18: 303-317.
3. Lidgate DM, Felgner PL, Fleitman JS, Whatley J and Fu RC. Invitro and in-vivo studies evaluating a liposome system for drug solubilisation. *Pharm Res* 1988; 5: 759-764.
4. Weiner N, Martin F and Riox M. Liposomes as drug delivery system. *Drug DevInd Pharm* 1989; 15(10): 1523-1554.
5. Lopez-Berestein, G. and Fidler, I.J. Liposomes in the Therapy of Infectious Diseases and Cancer. Alan R. Liss; New York: 1989.
6. YimeiJia, Helene Joly, AbdelwahabOmri. Liposomes as a carrier for gentamicin delivery: Development and evaluation of the physicochemical properties. *International Journal of Pharmaceutics* 2008; 359: 254-263.
7. Hwang, K.J. In *Liposomes: from Biophysics to Therapeutics*. Marcel Dekker Inc. New York: 1987; 109-110.
8. Taylor, K.M.G., Taylor, G., Kellaway, I.W. and Stevens, J. Drug entrapment and release from multilamellar and reverse-phase evaporation liposomes. *Int J Pharm* 1990; 58: 49-55.
9. Stebelska K. The Effect of PS Content on the Ability of Natural Membranes to Fuse with Positively Charged Liposomes and Lipoplexes. *J Membrane Biol* 2005; 206: 203-214.
10. R. Singh, S. P. Vyas, Topical liposomal system for localized and controlled drug

- delivery, *J. Dermatol. Sci.*, 1996;13, 107–111.
11. M. Glavas-Dodov, E. Fredro-Kumbaradzi, K. Goracinova, S. Calis, M. Simonoska, A. A. Hincal, 5-Fluorouracil in topical liposome gels for anticancer treatment – Formulation and evaluation, *Acta Pharm.*, 2003;53, 241–250
 12. Robinson DS. Monoamine oxidase inhibitors: a new generation. *Psychopharmacol Bull.* 2002; 36(3):124-138.
 13. Blackwell B, Marley E, Price J, Taylor D. Hypertensive interactions between monoamine inhibitors and foodstuffs. *Br J Psychiatry.* 1967;113(497):349-365. Azzaro AJ, VanDenBerg CM, Blob LF, et al. Tyraminepressor sensitivity during treatment with the selegiline transdermal system 6 mg/ 24 hr in healthy subjects. *J ClinPharmacol.* In press.
 14. Shulman KI, Walker SE, MacKenzie S, Knowles S. Dietary restriction, tyramine, and the use of monoamine oxidase inhibitors. *J Clin Psychopharmacology.* 1989;9(6):397-402.
 15. Bodkin JA, Amsterdam JD. Transdermal selegiline in major depression: a double-blind placebo-controlled parallel-group study in outpatients. *Am J Psychiatry.* 2002;159(11):1869-1875.
 16. Amsterdam JD. A double-blind, placebo-controlled trial of the safety and efficacy of selegiline transdermal system without dietary restrictions in patients with major depressive disorder. *J Clin Psychiatry.* 2003;64(2):208-214.
 17. Robinson DS, Moonsammy G, Azzaro AJ. Relapse prevention study shows the long-term safety and efficacy of transdermal selegiline, a new generation MAOI. Poster presented at: the 41st Annual Meeting of the American College of Neuropsychopharmacology; December 11, 2002; San Juan, Puerto Rico.
 18. Aulton, M E, editor. Transdermal drug delivery. In: *Pharmaceutics the Science of Dosage Form Design.* Second ed. London: Cherrchill Livingston, 2002:505- 508.
 19. Hadgraft J, Guy R H, editors. Penetration enhancers and their use in transdermal therapeutic systems. In: *Transdermal Drug Delivery.* New York: Marcel Dekker, 1989:197–246.
 20. Agarwal R. and Katare O.P. Preparation and in vitro evaluation of miconazole nitrate loaded topical liposome, *Pharmaceutical Technology* November 2002:123-126.
 21. Rakesh and Patel P. Formulation and evaluation of liposome of ketoconazole, *International Journal of Drug Delivery Technology* 2009; 1 (1): 16-23.
 22. Vyas S.P., Khar R.K. “Targeted and Controlled drug delivery”, Novel carrier system ,CBS publishers and Distributors ,New Delhi,122
 23. Chien, Y. W., “Logics of transdermal controlled drug administration”, *Drug Dev. Ind. Pharm.*, 1983, 9, 497.
 24. Patel, R. P., Patel, H., Baria A.H. Formulation and evaluation of Liposomes of ketoconazole. *International Journal of Drug Delivery & Technology.* 2009; 1(1): 17-23.
 25. Siewert, M., Dresssmen, J., Brown, C. K., & Shah, V.P. FIP/AAPS Guideline to dissolution/in vitro release testing of novel/special dosage form. *AAPS PharmSci Tech.*, 2003;4 (1), 1-10.
 26. Mendlewicz J, Youdim MBH. L-Deprenil, a selectivemonoamine oxidase type B inhibitor, in the treatment of depression: A double blind evaluation. *Br J Psychiatry* 1983; 142:508–11.
 27. Berry M D, Juorio A V, Paterson I A, Possible mechanisms of action of (-) deprenyl and other MAO-B inhibitors in some neurologic and psychiatric disorders. *ProgNeurobiol* 1994; 44:141–61.
 28. Gordon MN, Muller CD, Sherman KA, Morgan DG, Azzaro AJ , Wecker L. Oral versus transdermal selegiline: Antidepressant - like activity in rats. *Pharmacol. Biochem. Behav* 1999; 63(3): 501-06.
 29. Fang JY, Hung CF, Chi CH and Chen CC. Transdermal permeation of selegiline from hydrogel-membrane drug delivery systems. *Int J Pharma* 2009; 380:33–39.
 30. Wecker L, James S, Copeland N and Pacheco M A. Transdermal selegiline: Targeted effects on monoamine oxidases in the brain. *Biol psychiatry* 2003; 54:1099–1104.