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Review on Virosomes: As a Drug Delivery Carriers

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Abstract: *Since the last era, some revolutionary advances in drug delivery technologies have been observed in the realization of targeted drug delivery or targeted drug action at the site. The prospects for the use of biological molecules nanoparticles such as virosomes as drugs are motivating research and development areas that show the targeted fusion effects with the targeted fusion effects by target cells. Virosomes are biocompatible, biodegradable, non-toxic and non-autoimmunogeneous viral species and are new carriers and drug delivery systems for vaccines and cell delivery of active macromolecules. Virosomes are biomimetic nanoparticle drug delivery systems that contain active macromolecules in a virus coat made of lipoid membranes. The administration of virosomes takes place through various methods such as the intramuscular (IM), intravenous (IV), intravascular, subcutaneous (SC), oral and inhalation routes. The research paper focuses on the structure, components, types and formulations of virosomes, the mechanism of action and applications of viral genes, and available commercial formulations.*

Keywords: Virosomes, Drug delivery, Genes, Virus, Structure, mechanism of action, preparation etc

I. INTRODUCTION

The main objective of any drug is to deliver it to the target organ, tissue and cell. Many drugs with promising in vitro results fail to do so in vivo because they are not effective in targeting organs, tissues, and cells. [1] New treatments for cancer or neurodegenerative disorders require a delivery system that targets specific cell types and host tissue drugs by receptor-mediated absorption and controlled release. [2] Virosomes are a macromolecule delivery or transport system composed of phospholipid membranes, including viruses, and allow the fusion of viruses with targeted cells. It provides the delivery of cellular macromolecules to a target cell or tissue. It is mainly used to deliver proteins, nucleic acids, and genes. Antibiotics, cancer drugs and steroids are also delivered to the target cells. [3] Virosomal technology is developed to overcome the difficulties of incomplete delivery to targeted cell, tissue and body organs. [4]

DEFINITION

Virosomes are a carrier for the transportation of drug molecules, a semi-synthetic complex of viral particles derived from free nucleic acids. They have a specific receptor binding and membrane fusion to deliver drugs. Virosomes are essentially reconstructed viral skin in which infectious nucleic acids are replaced by macromolecules of non-infectious and powerful active drugs for targeted action. Compounds that contain antigens, genes or drug molecules that are also used mainly for vaccines. [10]

HISTORY

The term virosomes was first proposed by Kara in 1971 for oncogenic sub viral ribonucleoprotein particle of Rous sarcoma virus. However, virosomes were first prepared by Almeida (1975) by placing purified spike protein into preformed liposomes, using influenza A as a parental virus.[5].

TYPES OF VIROSOMES:

Depending on the viral envelope, there are several types of virosomes can be generated (Table 1). Some of them are as follows:

1. Influenza Virosomes[6]
2. Sendai Virosomes[7] [8]
3. HBV Virosomes

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4. HIV Virosomes
5. NDV Virosomes

Sr. no.	Virosomes	Parent virus	Family	Viral glycoprotein
1.	Influenza Virosomes	Influenza	Orthomyxoviridae	HA, NA
2.	Sendai Virosomes	Sendai or HVJ	Paramyxoviridae	HN, F
3.	HBV Virosomes	HBV	Orthohepadnaviridae	S, M, L
4.	HIV Virosomes	HIV	Retroviridae	Gp120, gp41, p17
5.	NDV Virosomes	NDV	Paramyxoviridae	HN, F

II. STRUCTURE OF VIROSOMES [9] [10] [11] [12]

Virosomes are a semi-synthetic complex in the form of a unilamellar or sphere. From nucleic acid-free viral particles, viral particles are obtained. These are bilateral vesicles with an average diameter of 120 nm to
180 nm, composed of lipid bilayers. Viral envelopes are dissolved by short-chain detergents and phospholipids and produce virosomes. In the preparation of virus molecules, influenza viruses are most widely used. In principle, virosomes represent a reconstituted envelope of the empty influenza virus without a nucleic capsid composed of the source virus genetic material. Normally occurring phospholipids (PL) and phosphatidyl choline (PC) are the main components of the immune-stimulating influenza virus.
HA1- Globular Head has a receptor site with a high affinity/similarity to sialic acid found on the surface of antigen-presenting cells (APCs), such as macrophages and lymphocytes.
HA2-The fusion of the immunostimulation of the reconstituted influenza virus (IRIV) and the endosome membrane is further mediated by HA2 polypeptide.

ADVANTAGES OF VIROSOMES :

1. Virosomal technology is applied to different forms of drugs, such as cancer drugs, antibiotics and fungicides.
2. It allows drugs to be supplied to the target cell cytoplasm. [13]
3. Biocompatible and non-lethal.
4. There is no danger of disease spreading.
5. No signs of self-immunity were found.
6. Use for adults and infants.
7. Virosomal technology is approved by the FDA and has high safety characteristics.

DISADVANTAGES OF VIROSOME:

1. Short lifetime.
2. Problems in production.
3. Poor raw materials quality.
4. The payload is too slow.
5. Disparities in data on chronic use of viruses.[14] [15]
6. Lack of data on the chronic use of virosomes.[16]
7. Modern technology can be used for quality control tests and batch variability can be measured[17].

CHARACTERIZATION OF VIROSOMES:

1. Protein detection: Electrophoresis of sodium dodecyl-sulfatepolyacrylamide gel (SDS-PAGE) can confirm the presence of HA protein in viruses[18]
2. Structure and size: Negative surface electron microscopy is generally used to determine the structure and size of viral cells. The dye solution is neutral pH, to avoid HA conformation changes caused by acid.

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PREPARATION OF VIROSOMES:

The process of formulation of virosomes goes through following steps:

- Selection of virus
- Selection of antigen
- Reconstitution of Virosomes

MECHANISM OF ACTION OF VIROSOMES

Virosomes work together as carriers and adjuvants with different functions to induce immune responses, the carrier functions include the integration of antigen stability into virosome particles, and the antigens on the surface of virosomes mimic the original pathogens and produce antibodies. The induction of antigens on surface immunity by the formation of complex B cells is the main focus for the targeted immune cells that are important for the induction of immunity. [19]

PHARMACOKINETICS OF VIROSOMES:

Pharmacokinetics data can be used to translate the differences in the pharmacological effects of medication and free drugs encapsulated by liposomal genes and can therefore be used for measurement planning. Pharmacokinetics manages the time-course of the retention, dissemination, and degradation of the in vivo virus transporters. The pharmacokinetics of viruses require information about possible location after intravenous organization, since this is the most recognized course for the different virosome details misused for clinical therapy with the exception of the current plans.

ROUTE OF ADMINISTRATION OF VIROSOMES:

virosome concentration as a vehicle is in the range of 20 and 200 mg mL−1 , although they can be enhanced depending on the characteristics of the virosome component and for a specific purpose.[36] Importantly, this formulation requires purification or sterilization before administration, through the classical process of liposomal sterilization, namely membrane filtration. Virosomes can be administered through a wide range of routes such as intravenous (IV), subcutaneous (SC), intramuscular (IM), intratrial , oral, topical or respiratory route and transdermal.[20]

VIROSOME UPTAKE BY CELLS:

Entry of virosomes into target cells divided into four types

- **Attachment:** This includes the official of virosomes by HA to cell receptors that are film glycoproteins or glycolipids with terminal sialic corrosion. If a specific virosome occurs, the Fab section is connected to the virosomal surface by a cross-linking arm and a space arm. Consequently, special virosomes apply selectiveness to the extraordinary types of cells. [22]
- **Penetration** : After penetration of virosomes, the endocytosis is initiated by the receptor. The viral molecules are captured in the endosome, an acidic combination of the virosomal film and the endosome layer. [21]
- **Carrier function:** The antigen re-regulates into the higher structures of the virosome molecule, balancing the antigen, ensuring the local status of the B cell epitope and protecting the antigen from decomposition.
- **Memory Support**: The proximity of the influenza-adjusted hemagglutinin (HA) causes memory reactions, as most people have a common level of initial infection against flu. Memory T-Partner cells quickly multiply in addition to cytokines to help and enhance the targeting-specific delivery of antigens and the amplification of immune reactions. [32]

APPLICATIONS OF VIROSOME TECHNOLOGY

- Cancer treatment :- Virosome have been also used in oncology field to carry peptide corresponding to tumour associated antigen as in case of peptide from parathyroid hormone related protein or from recombinant proteins such as her -2 neu Fab combined the anti Fab – doxovirosome combined the anti-proliferate properties of the monoclonal antibodies and cyototoxic effect of doxorubicin in vivo. [9]

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- RNA\DNA :- Small interfering RNA , encapsulated in virosomes, are able to down adequate the synthesis of newly induced and constitulevely expressed protein, overcoming the lack of suitable delivery methods for these molecules Intraperitoneal injection of SiRNA loaded virosome resulted in delivery of nucleotide to cell in peritoneal. [13] [22]
- Gene delivery :- Haemagglutinin the membrane fusion protein of influenza virus is known to mediate a low PH dependent fusion reaction between the viral envelope and the limiting membrane of endosomal cell compartment following cellular uptake of virus particle by receptor mediated endocytosis. [22]
- Malarial Therapy: Virosomes represent a revolutionary drug delivery system for various biologically active molecules like nucleic acids, genes and other numerous indications. The surface of virosomes can be adequately modified to allow targeted drug delivery.

III. CONCLUSION

Review of viruses is an innovative drug delivery system for various biologically active molecules, including nucleic acids and genes, which are safe, completely biocompatible, and biodegradable, and their surface can be modified to facilitate drug delivery. Virosomes can be used to supply antigens to the host through various channels such as intramuscular, intradermal and intramuscular, depending on the target of unintended side effects. It is an extremely useful method to deliver drugs to specific targets and to protect them from degradation and not be misdirected to other non-specific organs at any time, thus reducing drug side effects. The ability to target specific cell virosomes with specific binding Fab fragments of monoclonal antibodies is an attractive feature of virosomes. Virosomes can also provide new pathways to the modern pharmaceutical field, which may also help improve human life. In the future, there will be scope for development of virus-like drugs such as HIV, corona and ebola in the treatment of viruses.

REFERENCES

[1]. Kalra, N., et al. 2013. Virosomes : As a Drug Delivery Carrier. American Journal of Advanced Drug Delivery, 1(1):29–35.
[2]. Almeida JD, Brand CM, Edwards DC, Heath TD. Formation of virosomes from influenza subunits and liposomes. Lancet. 1975;2:899–901.
[3]. Bhattacharya Sanjib, Muzumder Bhaskar. Virosomes A Novel Strategy for Drug Delivery and Targeting. Biopharm International, 2011; volume 2011 Supplement (issue1).
[4]. Idris N, Chilkawar R, Nanjwade B, Srichana T, Shafioul A. Nanotechnology Based Virosomal Drug Delivery Systems. Journal of Nanotechnology and Materials Science 2014; 1(1):27- 35.
[5]. Morein, B., et al. 1978. Effective subunit vaccines against an enveloped animal virus. Nature, 276(5689):715–718.
[6]. Zurbriggen, R. 2003. Immunostimulating reconstituted influenza virosomes. Vaccine, 21(9):921– 924.
[7]. Uchida, T. 1979. Reconstitution of lipid vesicles associated with HVJ (Sendai virus) spikes. Purification and some properties of vesicles containing nontoxic fragment A of diphtheria toxin. Journal of Cell Biology, 80(1):10–20.
[8]. Kaneda, Y. 2002. Hemagglutinating virus of Japan (HVJ) envelope vector as a versatile gene delivery system. Molecular Therapy, 6(2):219–226.
[9]. Dr. Shaikh Siraj N, Shahid Raza, Mohd. Aslam Ansari, Dr. G.J. Khan, Siddiqi Hifzurrahman MD Athar. Overview on virosomes as a novel carrier for drug delivery. Journal of Drug Delivery & Therapeutics, 2018; 8(6-s):429-434.
[10]. Kalra Naresh, Dhanya V, Saini Vineeta, Dr.Jeyabalan G. Virosomes: As a Drug Delivery Carrier. American Journal of Advanced Drug Delivery, 2013; ISSN-2321-547X: 029-035.
[11]. Sarkar D.P, Ramani K, Tyagi S.K. Targeted Gene Delivery by Virosomes. Methods in Molecular Biology, 2002; 199: 163.
[12]. Kumar V.V, Singh R.S, Chaudhari A.Catoinic Transfection Lipids in Gene Therapy: Successes, set- backs, challenges and promises. Current Medicinal Chemistry, 2003; 10: 1297-1306.

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[13]. Naresh Kalra et al, Virosomes: As a Drug Delivery Carrier, American Journal of Advanced Drug Delivery, Date of Acceptance- 02/05/2013.

[14]. Kumari A, Singla R, Guliani A, Yadav SK. Nanoencapsulation for Drug Delivery. EXCLI Journal 2014; 13:265-286.

[15]. Kapoor D, Vyas RB, Lad C, Patel M. Amultipurpose and novel carrier for drug delivery and targeting virosomes. Journal of Drug Delivery & Therapeutics 2013; 3(5):143-147

[16]. Priyanka Rathore et al, VIROSOMES: A NOVEL VACCINATION TECHNOLOGy, INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND REASEARCH, 2012; Vol. 3(10): 3591-3597

[17]. Bungener L, Huckriede A, Wilschut J, Daemen T. Virosomes as a vaccine delivery system. In: 14th European Immunology Meeting (EFIS 2000). Medimond Publishing Company. 2000:845-50

[18]. Huckriede A, Bungener L, Stegmann T, Daemen T, Medema J, Palache AM, Wilschut J. The virosome concept for influenza vaccines. Vaccine 2005; 23(S1):S26–38.

[19]. Felnerova D, Viret JF, Glück R, Moser C: Liposomes and virosomes as delivery systems for antigens, nucleic acids and drugs. Curr Opin Biotechnol 2004; 15:518–29

[20]. Harandi, A., Medaglini, D. 2010. Mucosal Adjuvants. Current HIV research, 8(4):330–335.

[21]. Shaikh SN, Raza S, Ansari MA, Khan GJ, Athar SH. Overview on virosomes as a novel carrier for drug delivery. J Drug Deliv Ther. 2018;8(6-s):429-34.

[22]. Mufeeda P et al, VIROSOMES; A NOVAL APPROACH IN NOVAL DRUG DELIVERY SYSTEM:

[23]. A REVIEW, International Journal of Modern, 2020, 4(1), 132-137

[24]. Nagi F. et al, Nanotechnology Based Virosomal Drug Delivery Systems, Journal of Nanotechnology and Materials Science, Accepted date: Dec 11, 2014.