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A REVIEW ON NANOSPEHERE FORMULATION

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ABSTRACT

Nanospheres are the particles having the size range between 10-200 nm in diameter. Nanospheres can be amorphous or crystalline in nature and also they have the ability to protect the drug from enzymatic and chemical degradation. It has been shown that the hydrophobic surfaces of these particles are highly susceptible to opsonization and clearance by the reticulo endothelial system. The tiny capsule of drug store house is called vesicles and the solid skeleton structure is called Nanospheres. Biodegradable Nanospheres include albumin Nanospheres, modified starch Nanospheres, gelatin Nanospheres, polypropylene dextran Nanospheres and polylactic acid Nanospheres. In addition there are two more types of Nanospheres, immune Nanospheres and magnetic Nanospheres. Immuno-magnetic nanospheres can be prepared by combining the above two kinds of nanospheres, which could significantly improve its targeting.

Key words: Nanospheres, Solvent Evaporation, Solvent displacement technique, Polymerization

1. INTRODUCTION:

Nanoparticles can be divided into two main families: nanospheres, which have a homogeneous structure in the whole particle, and nanocapsules, which exhibit a typical core-shell structure. Nanospheres are the particles having the size range between 10-200 nm in diameter. Nanospheres can be amorphous or crystalline in nature and also they have the ability to protect the drug from enzymatic and chemical degradation. It has been shown that the hydrophobic surfaces of these particles are highly susceptible to opsonization and clearance by the reticulo endothelial system. The tiny capsule of drug store house is called vesicles and the solid skeleton structure is called Nanospheres. Biodegradable Nanospheres include albumin Nanospheres, modified starch Nanospheres, gelatin Nanospheres, polypropylene dextran Nanospheres and polylactic acid Nanospheres. In addition there are two more types of Nanospheres, immune Nanospheres and magnetic Nanospheres. Immuno-magnetic nanospheres can be prepared by combining the above two kinds of nanospheres, which could significantly improve its targeting. There are various ways of targeting nanospheres on the tumor, as long circulation purpose and also for the drug delivery in the brain. Nanospheres can be prepared by various methods but the solvent displacement technique is the best method. Administration of medication via such systems is advantageous because nanospheres can be ingested or injected and they can be tailored for desired release profiles and used site-specific delivery of drugs and in some cases can even provide organ-targeted release. According to biodegradability, it can be divided into biodegradable nanospheres and nonbiodegradable nanospheres. Biodegradable nanospheres include albumin nanospheres, modified starch nanospheres, gelatine nanospheres, polypropylene dextran nanospheres and polylactic acid nanospheres, etc. According to the current literature reports on nonbiodegradable nanospheres, polylactic acid is the only polymer approved to be used by people and used as a controlled-release agent In addition; reports on immune nanospheres and magnetic nanospheres are also common in recent years. Immune nanospheres possess the immune competence as a result of the antibody and antigen was coated or adsorbed on the polymer nanospheres. Magnetic nanospheres possess a unique magnetic feature, namely their reaction to a magnetic force. These are generally coated with protective shells as magnetic polymer nanoparticles. Immuno magnetic nanospheres can be prepared by combining two kinds of nanospheres, which could significantly improve its targeting.[2]

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2. METHOD OF PREPARATION OF NANOSPHERES

There are various types of method by which Nanospheres are prepared.

- Polymerization (Emulsification polymerization)
- Solvent Evaporation.
- Solvent displacement technique.
- Phase inversion temperature methods.

Polymerization (Emulsification polymerization

In polymerization, polymeric compounds such as olymethylmethacrylate and polyethylcyanoacrylate are emulsified for emulsification polymerization and another polymerization is interfacial polymerization of polyalkylcyanoacrylate. In the polymerization monomers are polymerized to form the Nanospheres in an aqueous solution. Basically in this technique drug is incorporated by dissolving it in the polymerization medium or by adsorption onto the Nanospheres after that polymerization is completed. After that Nanospheres are purified for removal of stabilizers.

Solvent evaporation

This method is used in the formulations of nanospheres, in which the macromolecules are dissolved in the phase to be dispersed (mainly organic solvent). This process involves the removal of the organic (and volatile) solvent from the formulation and therefore polymer precipitation within the organic phase template. Removing the solvent can be performed by evaporation or diffusion shock. The main difference from the previous process appears to be the fact that not only are synthetic polymers used, but also natural macromolecules, such as chitosan, polysaccharides, alginate, gelatine etc, hence increasing their biocompatibility with the potential therapeutic objectives.

Solvent Displacement Technique

In solvent displacement technique polymer is dissolved in an organic, water miscible solvent. After that, adding it into the aqueous phase in the presence or absence of a surfactant. Addition of organic solvent from the oil phase to aqueous phase can diffuse immediately by which precipitation of polymer occurs and Nanospheres are formed.

Phase inversion temperature method

In this process, desolubilization of the polymer occurs with the help of nano-emulsion droplets to formulate nanospheres. The main advantage of PIT methods,that of being organic solvent is lost.[6]

3. NANOSPHERES AS TARGETED DRUG DELIVERY:

There are various ways to using of Nanospheres as targeted drug delivery system.

Targeting on the tumor:

Basically Nanospheres are able to deliver the concentrate dose of the drug to the tumor targets through permeability enhancing and retention effect or active targeting by ligands on the surface of Nanospheres. Its can reduce the toxicity by reducing the drug exposure of health tissue by limiting drug distribution to the target organ. Nanospheres have higher concentration manifested in liver, spleen, lungs than in other parts of body. By this study Bibby, we can say that there is no doubt that Nanospheres have an effective role in the treatment of cancer. But they have a drawback which was reported that during biodistribution of drug which is incorporated into the Nanospheres mainly accumulated in liver. 56% of drug accumulated in the liver and only 1.6% of drug reaches to the tumour. Thus we can say that Nanospheres have a great tendency to be captured by liver. So it is a great challenge to avoid particles uptake by mononuclear Phagocytic system (MPS) in spleen and liver for using Nanospheres for tumour targeting. It has been proved that using doxorubicin with Nanospheres have a great effect against hepatic metastasis than free drug used.

Long circulation of Nanospheres:

Basically Nanospheres are able to target tumors which are localized outside MPS (Mononuclear Phagocytic system). For long circulation of Nanospheres a major break came in the field when hydrophilic polymer (PEG, Poloxamine) is coated to the surface of Nanospheres by which opposite effect is produced to the uptake by the MPS. The coating provides a cloud of hydrophilic and neutral chain at the particle surface which repels plasma proteins. As a result coated Nanospheres become invisible to MPS and remain for a longer duration during circulation.

Nanospheres for oral delivery:

It is very difficult to use the bioactive molecules (peptides and proteins) with suitable carriers. These suitable carriers remain a challenge due to the fact that bioavailability of these molecules is limited and they get degraded by enzymatic action. So the polymeric Nanospheres allow encapsulation of

bioactive molecules and protecting them against enzymatic degradation.

Nanospheres for drug delivery in the brain:

In central nervous system the most important factor is Blood brain barrier (BBB) for the development of new drugs and it is characterized by impermeable endothelial cells with tight junction, enzyme activity and active transport systems. Basically the BBB only permits selective transport of molecules. So if we use Nanospheres as targeted drug delivery it will interact with specific receptor-mediated transport system in BBB. E.g. Polysorbate 80/LDL is capable for delivery. So the drugs which cannot easily cross the BBB, can pass easily with the help of nanospheres.

There are also other drug delivery systems present for this purpose.

- Nanospheres for gene delivery
- Nanospheres targeting to epithelial cells etc.

Future prospects Presently Nanospheres have been widely used for drug delivery, polypeptides, proteins, nucleic acid, genes etc. And now researchers focused on various parameters for the development of Nanospheres drug delivery system: Selection and combination of carrier materials to obtain a suitable Drug release speed.

4. CONCLUSION:

By this study we can conclude that Nanospheres have great potential and they have the ability to convert poorly soluble, poorly absorbed drugs into the better deliverable drugs. Nanospheres are site specific and also protect the drug from various body fluids (enzyme action) which can degrade the drug during targeting.

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