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THE REVIEW:NOVEL DRUG DELIVERY SYSTEM

G. Usha Kiranmai[1*] and V. Vaishnavi[2]

[1,2] Department of Pharmaceutics, University College of Pharmaceutical Sciences, Kakatiya University, Warangal, Telangana, India-506009

Corresponding Author:

Dr. G. Usha Kiranmai

Assistant Professor(C)

Department of Pharmaceutics,

University College of Pharmaceutical Sciences, Kakatiya University, Warangal, Telangana, India-506009

ABSTRACT

The basic idea behind the evolution of controlled drug delivery concept is to alter the pharmacokinetics and pharmacodynamics of bio actives either by modifying the molecular structure or altering physiological patems. In Novel drug delivery, we modify the drug release pattern from the dosage form. The drug molecule modified to Novel drug delivery system can improve not only its performance but also patient compliance, safety and efficacy. Recent advances in the pharmacokinetic and pharmacodynamic drug behaviour gives a better approach in developing a Novel drug delivery system. The innovations of such newer drug delivery systems provided to the health professional in treating a disease with better efficacy, precision and the safety. Drug delivery research is a result of interdisciplinary approach and multidisciplinary approach to deliver the drugs to their targets. The Novel drug delivery system can be a major approach for the problems related to the release of the drugs at specific site with specific rate.

KEYWORDS: Novel drug delivery system, pharmacokinetic, pharmacodynamics, conventional drug delivery.

INTRODUCTION

The main objective of Novel drug delivery systems is to improve the safety and efficacy of drugs along with patient compliance. The drug delivered by these systems can also have its effect on efficacy (1). The drug delivery systems are under the development to reduce the degradation of drug, to decrease the side effects associated with it and to provide adequate bioavailability of the drug (2). Mainly Novel drug delivery systems enhances biotherapeutic agent performance when compared to conventional dosage forms.

SMART Nanocarrier drug delivery system is also another type of formulation which improves the cell selectivity of targeting. Here, we control the duration of action by utilising the novel techniques such as microfluidics (MF) (4).

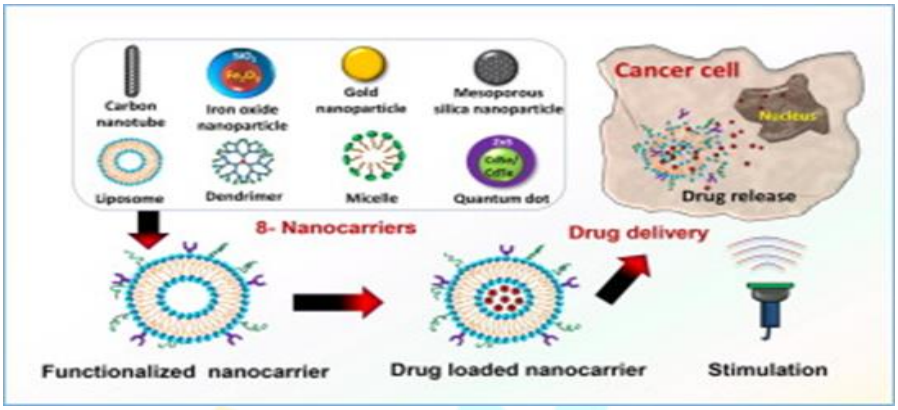


Figure 1: Smart Nanocarrier drug delivery systems

ADVANTAGES OF NOVEL DRUG DELIVERY SYSTEM OVER CONTROLLED DRUG DELIVERY SYSTEM

1.Controlled delivery achieved by maintaining required concentration of drug at controlled rate.

2.Accurate dosing may be possible.

3.Enhanced drug safety and efficacy.

4.Enhanced pharmacological activity of the drug.

5.Site specific delivery of drug is acquired with an optimum dose.

6.Decrease in toxicity and side effects.

7.Improved bioavailability.

8.Also, beneficial to patients with improved comfort.

DISADVANTAGES OF NOVEL DRUG DELIVERY SYSTEM

1.Dose dumping.

2.Dose adjustment may become difficult.

3.Patient education is required for successful therapy.

4.Poor in vitro- in vivo correlation.

5.High production cost.

6.Stability problems can be encountered.

7.other factors may also affect Novel drug delivery system such as physicochemical characteristics of drug, site of action, the route of administration and the disease level.

NOVEL DRUG DELIVERY SYSTEMS

Sustained release drug delivery: Sustained release drug delivery is characterised by slow releasing of a specific active substance with in certain time. There are certain agents such as physical sustained releasing agents (uniform, capsule and gel type agents) and chemical sustained release agents such as polymers.

Prolonged release drug delivery: A dosage form designed to release medication in a controlled manner during an extended period of time at predetermined rate.

Controlled release drug delivery: The objective of releasing the drug into the patient body at a predetermined rate, or at a specific time or with specific release profiles. Controlled release is classified into different types such as diffusion controlled (matrix and reservoir types), dissolution controlled (encapsulation and matrix types), water penetration controlled (osmotic and swelling systems) and chemically controlled (ion exchange resins) (5).

Targeted drug delivery: Targeted drug delivery by using carriers either meant for pre-programmed or self-programmed approach with suitable site-directing molecules which recognise their receptor or carbohydrate determinates at the target (6). This can be used for targeting of Anti neoplastic agents to their target site. There are different types of targeting, such as first order targeting, second order targeting, third order targeting.

Table 1: Marketed formulations

Type of drug delivery	Formulation	Dose	Active Pharmaceutical Ingredient	Uses
sustained drug delivery	S-Gest-300-SR	300mg	Progesterone	menstrualand pregnancy related issues.
prolonged drug delivery	Pantane-DSR	40mg	Pantoprazole and domperidone	Gastrointestinal reflux disease, Antacid.
controlled drug delivery	Epinote-Plus 300	300mg	Sodium valproate and valproic acid	Used in epilepsy, migraine headaches.
Targeteddrug delivery	Caelyx	2mg/ml	Pegylated liposomal doxorubicin hydrochloride	To treat breast and ovary cancer.

TYPES OF CARRIERBASED DRUG DELIVERY SYSTEMS

1.**Liposomes:**Liposomes are formulated from naturally occurring components of membrane and they are biocompatible and biodegradable. They incorporate both hydrophilic and hydrophobic drugs.

Potential applicationsin anti-malarial chemotherapy, cancer chemotherapy, enzyme therapy, immunomodulation, diagnosis and local therapy etc.(9)

2.**Niosomes:**Niosomes are made up of non-ionic surfactants. These are formed from self-assembly of hydrated surfactants monomers. These forms variety of aggregates from micelles to large vesicles.Niosomes are used in transdermal drug delivery.

3.**Microparticles:**Microparticles are sub-micron fragments derived from different cell types and are also referred as microbeads. Microparticles are generally used either intraperitonially, subcutaneously or intramuscularly to the target site. They provide sustained release due to their large size which ranges from 10 to 160 micrometre.

4.**Microspheres:**Microspheres or microcapsules are referred as spherical empty particles containing a core.These particles size range vary from 50nm to 2mm.

5.**Resealed erythrocytes:**Resealed erythrocytes are used as carriers for wide range of components. Components such as drugs, enzymes, DNA molecules and others etc. These carriers are used specially for lysosomal storage diseases.

6.**Monoclonal antibodies:**Monoclonal antibodies are used for concentrating drugs to the tumour to achieve therapeutic effect. Monoclonal antibodies to tumour associated cell surfaces are useful for targeting various agents which have anticancer activity. These are also used to define melanomas, carcinomas such as colon, ovarian, breast, lung carcinomas (10).

7.**Dendrimers:**Dendrimers are generally distinguished by three components a core' interior layers and an exterior. Due to high branching of dendrimers adopt globular size. Dendrimers are inert, non-cytotoxic and non-immunogenic (7).

8.**Transferosomes:**Transferosomes are any supramolecular entity that can pass spontaneously through a permeability barrier and there by transport material from the application to the destination site. These have newer approaches of efficient dermal and transcutaneous drug delivery of high and low molecular weight substances. It consists of a inner aqueous compartment surrounded by lipid bilayer (7).

9.**Nanosomes:** Nanosomes are nanoscale materials which are generated by natural, synthetic and mixed constituents. Liposomes are also a kind of nanosomes that are currently used. Non-ionic surfactants resulted from self-assembly of hydrated surfactant monomers.

10. **Aquasomes:**Aquasomes are like "bodies of water". Aquasomes properties helps to protect and preserve the biological molecules. These are composed of nanocrystalline core coated with oligomeric film to which drug molecules are attached.Aquasomes are three layered that are self-assembled by non-covalent or non-ionic bonds (7).

11. **Micelles:**Micelles are spherical structured particles which encapsulates hydrophilic drugs in their hydrophobic core. These are amphiphilic in nature and are self-assembled.

12. **Nanoparticles:**Nanoparticles are in solid from they can be amorphous or crystalline. Nanoparticles are characterised as the nanosized colloidal structures which are composed of polymers (such as synthetic or semisynthetic) ranging from 10nm to 1000nm in size. Nanoparticles are of different types such as:

- Solid lipid nanoparticles
- Nanocrystals or nanosuspension
- Hydrogel nanoparticles

Groups of nanoparticles:

1.Nanowires

2.Nano shells

3.Quantum dots

4.Nanopores

5.Gold nanoparticles

6.Nano tubes (Carbon nanotubes)

1.Nanowires: Nanowires are glowing silica nanowire. These are generally wrapped around strands of human hair which are delicate. These nanowires are 5 times small than a virus application. Nanowires are used in early stage of breast and ovarian malignancies.

2.Nanoshells: Hallow silica spheres which are gold coated are known as nanoshells. Nanoshells are used to target shells to cancer cells. These shells may be coated with antibodies on surface.

3.Quantum dots: These are tiny semiconductor particles, which acts as markers for specific types of cells or substances. There is a type of cadmium in their cores which may affect the radiation wavelength. Such as Cadmium telluride used in Far IR and Near IR, Cadmium sulphide in UV, Cadmium selenide in visible spectrum.

4.Nanopores: Nanopores are mainly used in cancer research and treatment of cancer. Nanopores are holes made to the particles which are so small that a DNA molecule can enter through them. This cause effective DNA sequencing we can also control the drug diffusion in the body by these nanopores.

5.Gold nanoparticles: The transmission electron microscopy represents it has a solid core. These are used to create detection method for DNA, proteins and also to detect cancer types by gold nanoparticles.

6.Nanotubes: Nanotubes are generally hollow cylinders which are arranged by carbon atoms. These tubes can be liquid filled and then sealed and then used as delivery systems.Carbon nanotubes can be easily modified to circulate in body. The length can be shortened if required during circulation. Carbon nanotubes are soluble in body fluids with minimal toxicity. Carbon nanotubes are used to deliver prodrugs and other active pharmaceutical ingredients.

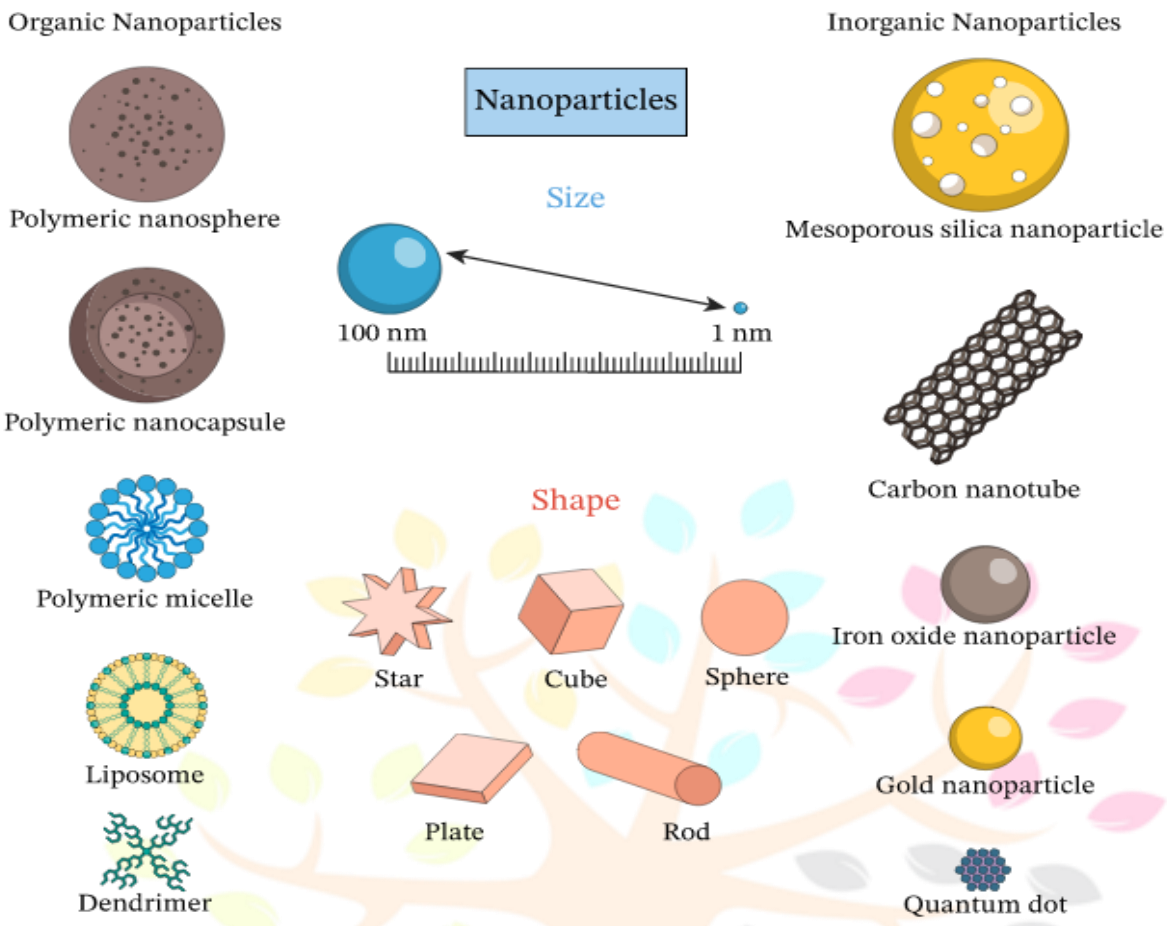
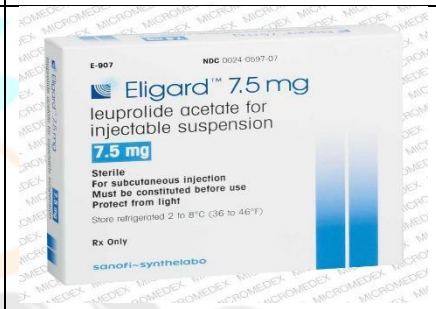


Figure 2: Types of carriers based delivery systems.

Table 2: Marketed formulations of different types of carriers

Carrier type	Formulation	Dose	Active Pharmaceutical Ingredient	Marketed Product
liposomes	EPAXAL	0.5ml	Hepatitis A virus antigen	
nanoparticles	ELIGARD	7.5mg	Leuprolide acetate	
microspheres	RISPERIDAL	1mg/ml	Risperidone	
niosomes	LANCOME	–	–	
monoclonal antibodies	BAMLANIVIMAB Injection	700mg/20 ml	Bamlanivimab	

dendrimers	VIVAGEL	1% w/w	Astodrimer sodium	

ADMINISTRATION ROUTES OF NDDS

The delivery rate is considered according to patient acceptability, depending upon drug properties, location of the disease site and on drugs effectiveness. Mostly, they prefer effective therapeutics. The protein drugs are administered by injection but this route may cause problems in blood drug concentrations. So, d ue to these problems per-oral routes are preferred.

Pulmonary route is an important and effective in different ways such as administration by aerosols, Metered dose inhalers, Dry powder inhalers and solutions etc. All these formulations contain liposomes, micelles, nanoparticles and dendrimers. Pulmonary drug delivery is also used for local targeting in respiratory diseases.Proteinswhen administered by this route may suffer by proteases in lungs which may reduce the bioavailability.

Transdermal route has an advantage which avoids problems such as GI irritation, metabolism and others. This type of delivery route is very useful in unconscious patients and also for local drug delivery. There are certain limitations by this route such as slow penetration, lack of dosage flexibility etc.

Parenteral routes which are important such as intravenous, intramuscular, subcutaneous. Liposomes are currently used nanosystems for intravenous administration in market. Nanocarriers have greater ability to improve drug delivery. These routes may avoid first pass metabolism. And also improves the bioavailability of drugs when administered in colloidal drug carriers.

Trans-tissue and local drug delivery systems aim is to produce pharmacological effect along with minimizing toxicity. Examples of trans-tissue systems Drug loaded gelatinous gels, antibody fixed gelatinous gels and Device directed delivery.

CONCLUSION

The creation of innovative drug delivery systems such as Novel drug delivery systems for the formulation of active pharmaceutical ingredients has received lot of interest now-a-days. And these novel drug delivery systems have been studied to overcome the limitations encountered by conventional delivery systems. This type of innovation is very useful to the patients who are sensitive to drug toxicity by minimal level of drug in blood stream and avoid toxicity problems. Targeted drug delivery is a major part of interest in present scenario.

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