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Research Paper

IMPORTANCE OF NANOTECHNOLOGY IN DRUG DELIVERY SYSTEMS: A CONSOLIDATED

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Drug Delivery systems are carriers of therapeutics agents to their desired effectors'. Drug delivery systems are designed to overcome the hurdles that the drug faces in the body, to make drug successfully reach the desired site and spare the undesired site which may leads to undesired side effects. Drug delivery by nanoparticles has potential to play a vital class of drug delivery systems. Nanoparticles are colloidal carriers of submicron size (< 1 micrometer) that are useful in drug delivery carriers, they works not only to improve the delivering of greater fractions of drug load to the target site, or by delivering a combination of drugs simultaneously to the target site, but also they allow the possibility to delivering drugs to target site where free drug cannot made to reach, or via routes of administration that free drug cannot bare. Nanoparticles are thereby useful drug delivery systems in a variety of applications such as improvement in targeting of chemotherapy specifically in brain, increase in solubility of poorly soluble drugs, targeting with resealed erythrocytes tagging with nanoparticles, delivery of genes therapies, delivery of vaccines, and crossing drug through varies biological barriers like blood-brain barrier, placental barrier.

The preset work was undertaken with aim of collecting and summarizing the information available on applications of nanotechnology in drug delivery system from reliable sources like Indian and International journals, Internet, authentic literature from books in the field of nanotechnology, so that it can contribute as ready reference for formulation scientist and researchers.

Key words: Nanoparticles, Methanol, Chloroform

INTRODUCTION

Nanotechnology derives name from the nanometer (10^{-9} meter or billionth of a meter) and refers to the manipulation of matter at the molecular level (on a nanoscale). Nanotechnology builds on the interface of multiple basic sciences and applied disciplines; it engages physical sciences, chemistry, elemental sciences and engineering. It also engages life sciences such as biology, genetics, bio-medicine, medicine (including several specialties such as oncology, radiology and orthopedics).

Nanotechnology involves Nanoparticles, Nanocapsules Nanospheres Nanoemulsions Nanorobots, Nanomedicines etc. which is applicable to biomedical therapeutic and diagnostic systems. Every physical property has a critical size and if the particle size is smaller than the critical size, the property becomes the function of the size. Controlling the particle size surface chemistry and assembly it is possible to engineer properties and function in unprecedented ways.

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Nanotechnology represents an important technological advancement in 21st century, Current economical projection gives estimates that nanotechnology enabled drug delivery systems will generate over $ 1.7 billion ($ U.S.) in 2009 and over $ 4.8 billion in 2012.

Broad applications of nanotechnology

1. Drug delivery
2. Sensors
3. Porous membranes and sieves
4. Tailor made catalyst
5. Chemical and electrical storage devices
6. Thermal and optical barriers

Classification of nanotechnology used in biomedical applications:

Currently nanotechnology is focused in following drug carriers.

1. Liposomes
2. Neosomes
3. Resealed erythrocytes
4. Nanoparticles

Advantages for using Nano size particles in drug delivery

Particle size reduction of drugs has the potential in following criteria:

1 Increased surface area
2 Enhanced solubility
3 Increased dissolution rate
4 Increased oral bioavailability
5 More rapid onset of action
6 Decreased in dose required
7 Decreased fed/ faster availability
8 Decreased patient to patient availability

Some Specific applications of Nanoparticles

1. In target drug delivery to Brain tissue.
2. In dissolution enhancement of poorly soluble drug.
3. In Medical Diagnosis and therapy.
4. In preparing nanoerthrosomes

Nanotechnology for target drug delivery and medical diagnosis.

In current knowledge it's presumed that without targeted drug delivery of the drug, drug therapy is very limited, leaving most of the drug dose to accumulate at specific site, and/or fail to reach the intended target entirely.

Drug delivery system is carriers for therapeutics' to overcome many hurdles that the drug faces in the body to successfully reach the target site. Nanoparticle comprises one class of such drug delivery system. Nanoparticle are colloidal carriers of submicronic (<1 micrometer)size that are useful drug delivery vehicle to not only improve therapy by delivering a greater fraction of the drug load to the target site or by delivering a combination of drug simultaneously to the target site, but they also allow for the possibility to delivery drug to the target river that free drug cannot reach or via routes of administration that free drug cannot bear. Nanoparticle are therapy useful drug delivery system in a variety of application such as improvement of cancer therapy, delivery of gene therapies delivery of vaccines and delivery of drug across the alone brain barrier. Nanoparticle have the advantage that they can an formulated from a wide variety of chemical composition to optimize

their use in encapsulation and delivery of a wide variety of small molecule drug and biotherapeutices, while they can also be formulated to contain contrast imaging agents for medical diagnostics. Surface modification of there nanoparticle allows for the inclusion of targeting antibiotics or ligands, which ages in localization of the drug ford primarily at the site of action there by reducing side effect of potent therapeutics. And recent advances in the field have aimed towards multifunctionalization of these nanoparticle to produce therapeutics system that combine targeted drug therapy with diagnostic for a more real time therapeutic system, Current research at our focus on the design development and testing of such Nanoparticle drug delivery system to improve therapy across a wide range of disorder.

Targeting potential of nanotechnology:

De loach et al (1992) and Jain and Jain et al (1996A) selectively targeted drug loaded erythrocytes renders them to both osmotic shock's and turbulence induced lyses. Another novel approach is to magnetize the carrier so that the carrier cells can be retained at or guided to the target site by the application of an external magnetic field of an appropriate strength (sprandel et al .76, 1987). Retention of magnetic carrier at target site will delay Renticuloendothelial clearance and prolong the action of drug

Nanotechnology in brain targeting drug delivery systems.

Drug delivery to brain

Delivery of poorly lipid soluble compounds require some strategic way to deliver in brain tissue, its needs to design ways for getting passed the blood brain barrier(BBB),, there are possible ways such as transient osmotic opening of BBB, natural and chemical transporters, high dose chemotherapy and even biodegradable implants, but all of these methods have some specific limitations besides they are invasive procedures, have toxic side effect and low efficiency and are not sufficiently safe.

There is immense need for the brain targeting despite aggressive research in drug delivery to patient suffering from fatal/depilating nervous system (CNS) disorders such as brain tumors, HIV, encephalopathy, epilepsy cerbrovascular diseases and neuron degenerative disorder.

Strategies of enhancing brain drug delivery:

Some theoretical strategies for enhancing poorly lipid

soluble drug to brain tissue:

A. Drug manipulation

(i) Lipophillic analogs

(ii)Prodrugs

(iii)Chemical drug deliver

(iv) Carrier mediated drug delivery

(v) Receptor/ vector mediated drug delivery

B. Disturbing the BBB

(i) Osmotic BBB destruction

(ii) Biochemical BBB destruction

C. Alternative routes for brain deliver

Intraventricular/ thoracic route

Alfactory/trigennitial pathway

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D. Interstitial delivery

(i) Injections catheters and pumps

(ii) Biodegradable implants

Brain targeting by Nanoparticles

Drug loaded Nanoparticles are used as carriers for delivery of drug in specific site in the brain.

Mechanisms of Nanoparticles transport through BBB

Endocytosis: Endocytosis by blood capillary endothelium followed by adsorption of blood, plasma component –apolipoprotein-E polysorbate especially by polysorbate 80 of Nanoparticles, polysorbates seem to be able to inhibit efflux pump. this inhibition could combine to brain transport properties of BBB, this coating facilitate adsorption of apolipoprotein, by this nanoparticle mimic the LDL and interact with LDL receptor leading to drug release in the cells by adsorption or degradation of nanoparticles and drug diffuses inside the brain tissue.

Transcytosis: Transport may occur by transcytosis of nanoparticle with drug across the endothelial cells.

Advantages of Nanoparticles in the brain targeted drug delivery

a) Simple method of preparation and easy to scale up.

b) Freeze-dried or spray- dried improve stability.

c) Site specific targeting of the drugs.(antibiotic , ,peptides ,and proteins, nucleic acid etc)

d) Protection against chemical and enzymatic degradation.

e) Ability to entrap high molecular weight /hydrophilic.

f) Reduction of toxicity.

g) Improved bio availability, controlled release patterns, adhesion to tissues due to nanosizing .

h) Mucosal delivery of high molecular weight substance. peptides , proteins, oligonucleotides and plasmids.

i) Nanoparticles were found to be able to reverse P-glycoprotein mediated resistance by a specific mechanism.

Nanotechnology for dissolution enhancement of poorly soluble drug

Many different approaches have been developed to overcome the solubility problem of poorly soluble drug, for example solubilization , inclusion compound, complexation; a basic disadvantage is that these formulation approaches can only be applied to a certain number of drug exhibiting special features required to employ the formulation principle(e.g. molecule fits into the cavity of the cyclodextrin ring .

The use of solvent mixtures is also limited due to toxicological consideration. In adition more & more newly developed drug are poorly soluble in aqueous media & simultaniously in organic media, thus excluding the use of solvent mixtures ideally the formulation principle should be able to be applied to all or at least most of the poorly soluble drug.

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An alternative to other method developed was the production of drug nanoparticles by high pressure homogenization, in contrast to pearl milling, high pressure homogenization is a continuous production process. Contamination from the production equipment is within the regulatory limits, for examples contamination with iron was found to be less then 1ppm.

Nanotechnology in the form nanoerthrosomes

Nanoerthrosomes is novel approach of preparing targeting resealed erythrocytes, the concept of designing specific delivery system is to achieve drug targeting, has oriented from the perception of Paul Ehrlich who imagine drugs as magic bullet, describing targeted drug delivery system as event where a drug carrier complex delivers drug exclusively to the preselected tissue, that are preselective to the ions in manner similar to biomemebrane led to discovery of artificial somatic system based on phospholipids amphiphiles, Gregorides described targeting with a help of novel drug delivery system as old drugs in new cloth. Amongst various carrier used for carrier targeting of drugs to various body tissue, the cellular biocompatibility of carrier and its degradation products. Leucocytes, platelets, erythrocytes and nanoerthrosomes (NEs) extra have been proposed as cellular carrier system.

Amongst these erythrocytes have been most investigated and have been found to posses great potential in drug delivery, it is infancy erythrocytes encapsulation attracted many scientist.

Nanoerthrosomes may be synthesize by following methods

1. Extrution Method
2. Sonication method
3. Electrical breakdown method

Advantages of nanoerthrosomes as drug targeting carriers.

a) They are natural product of the body which are biodegradable.

b) Isolation of nanoerythrosomes (NEs) are easy and large amount of drug can be loaded in small volume.

c) The loading of drug does not require chemical modification,s this is in contrast with others system which involves covalent coupling of the drug and carrier that effects inherent biological activity of parent drugs.

d) They are nonimmunogenic in action and can be targetted to diseased tissue.

e) They prolong the systemic activity of drug by residing in the body for long time.

f) They protect the premature degradation, inactivation and excretion of protein and act as carrier.

g) They can be targeted to Reticuloendothelial system as well

h) Decrease in side effect.

CONCLUSION

Drug Delivery systems are carriers of therapeutics agents to their desired effectors'

Drug delivery systems are designed to overcome the hurdles that the drug faces in the body, to make drug successfully reach the desired site and spare the undesired site which may leads to undesired side effects. Drug delivery by nanoparticles has

potential to play a vital class of drug delivery systems. Nanoparticles are colloidal carriers of submicron size (< 1 micrometer) that are useful in drug delivery carriers, they works not only to improve the delivering of greater fractions of drug load to the target site, or by delivering a combination of drugs simultaneously to the target site, but also they allow the possibility to delivering drugs to target site where free drug cannot made to reach, or via routes of administration that free drug cannot bare. Nanoparticles are thereby useful drug delivery systems in a variety of applications such as improvement in targeting of chemotherapy specifically in brain, increase in solubility of poorly soluble drugs, targeting with resealed erythrocytes tagging with nanoparticles, delivery of genes therapies, delivery of vaccines, and crossing drug through varies biological barriers like blood-brain barrier, placental barrier.

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REFERENCE

1. Labhasetwar V, song C , levy R.j. Nanoparticle drug delivery systems.Adv.Drug del. Rev 1997;24:63-85

2. Vandorpe J,Schacht E.[Poly (organophospha zene)] nanoparticles Surface modified with polyethylene oxide : Biotechnol.bioeng 1996.:52:89-95.

3. Hrkach JS, Peracchia MT,Domb A, lotan N, Langer R.Nanotechnology for biomaterials engineering ; structural characterization of amphphilic polymeric nanoparticle by 1H NMR Spectroscopy. Biomaterial 1997; 18; 27-30.

4. Kreuter J. Recent advance in nanoparticle. In: hincle AA, KAS HS. Editors. Biomedical science and technology. NEW YORK; Plenum press : 1998.p. 31-39.

5. Crone C, Thompson AM. Permeability of brain capillaries.In: Crone C,lassen AS,editors. Capillary permeability; the transfer of molecule and ion's between Capillary blood and tissue munksgaard.:copenhagen; 1970. P 447- 53.

6. Oldendorf WH . Lipid solubility and drug penetration of the blood brain barrier , proc. Soc. Exp. Bio. Med. 147(1974)813-16.

7. Rapoport IS.Blood brain barrier in physiology and medicine . New york ; raven press; 1976.p.134-37 .

8. Bratbury M. Physiology and pharmacology of blood brian barrier. The concept of a blood brain barrier . Wiley: New york ; 1979.

9. Bodor N, brewster BE. Problem of delivery of drug to the brain , pharmacol . Ther. 1983; 337-386.

10. Fenstermacher JD, Rapoport SI. Blood brain barrier . Renkin EM, Michel CC. Editors handbook of physiology, section 2; the cardiovascular system vol 4, micro-circulation , part 2 am physiology. Soc Bethesda; 1984.p.969-1000.

11. Bradbury MW. Physiology and pharmacology of the blood brain barrier .springer: berlin : 1992 ; 47 ; 987-991.

12. Begley DJ. The blood brain barrier: principles for targetting peptide and drug to the central nervous system .J. Pharm. Pharmacol 1996;48;136-146.

13. Crone C. The blood brain barrier ,a modified tight epithelium. In; sucking AJ, Rumsby MJ, BRADBURY MW. Editor . The blood brain barrier in health and diseases ellis horwood; chicester; 1986.p.17-40.

14. Pardridges WM. Peptide Drug delivery to the brian. New york.raven press ; 1991. p.235-238.

15. Abbott NJ, bundgaard M, Cserr HF. Comparative physiology of the blood brain barriers . In ; suckling AJ. Rumsby MG, bradbury MW editors. The blood brain barrier in health and diseases. Ellis horwood; chicester 1986.p. 52-72 16.

16. Smith QR. Quantitation of blood brain barrier permeability. In: Netwelt EA editors. Implication of the Blood-Brain Barrier and its Manipulation. Plenum: New York; 1989.p. 85-113.

17. Stewart PA,Tuor UI.Blood-eye barrier in the rat: correlation of ultrastructure with function.J.Comp. Neurol.1994; 340: 566-76.

18. Regier DA, Boyd JH, Burke JD , Rae DE,Myers JE, Kramer M, Robins LN,George M,Karno BZ,Locke M. One month prevalence of mental disorder in the United States.Arch. Gen. Psychiatry 1988; 45:977-986.

19 Ehrlich P. Das Sauerstoff beetsenis des organismts . Eine farbenanalytische studies Hirschwald .berlin 1885.

20. Pratz H. Die Bedeutung der vitalen farbung fur die lehre vom stoffaustsasch zwischen

21. Reese TS , karnovsky MJ . FIne structal location of a blood_brain barrier to exogenous peroxidase.J. Cell biol.1967;34:207-217- 23

22.Ghersi-Egea JF , Leninger-Muller B ,Suleman G, Siest G,Minn A.Localization of drug metabolizing enzyme activities to blood-brain interface and circumventricular organs.J.Neurochem. 1994;69:1089-1096.

23. Brownlese J,Williams CH.Peptidases, peptides, and the mammalian blood-brain barrier.J.Neurochem.1993; 60:793-803.

24. Krogh A.The active and passive exchange of inorganic ions through the surfaces of living cells and through living membranes. Proc R. Sos. B1946; 133:140-200.

25. Crone C.Facilitated transport of glucose from blood into B .J.Physiol.1965;181:103-13