MedCrave
Step into the World of Research

Journal of Nanomedicine Research

Mini Review

Open Access

CrossMark

Nanoparticles for drug delivery

Volume 3 Issue 4 - 2016

Syed K Hasan,[1] Bhavna Gupta,[1] Ted Germond,[1] Arthur Watterson[1]

[1]Department of Research and Development, Immunotrex Biologics Inc, USA

[2]University of Massachusetts, USA

Correspondence: Syed K Hasan, Department of Research and Development, Immunotrex Biologics Inc, 100 Business Park Dive, Suite #4, Tyngsborough MA 01879, USA
Email shasan@immunotrex.com

Received: January 28, 2016 | **Published:** April 23, 2016

Introduction

Nanotechnology as a discipline has opened a new approach within the fieldof drug delivery. There remain hurdles to overcome to create cost effective, non-toxic and highly stable viable drug carriers with the capacity to target specific tissues. In this mini review we will discuss the strengths and weaknesses of the current art in the field of "nano" drug delivery systems. The three major systems as shown in the illustration beloware the most favored in industrial development but each one has characteristic weaknesses that outweigh its strengths as an effective carrier (Figure 1) (Table 1). As shown in the chart above - Liposomes are biocompatible and very cost effective to produce but they are often too large, often unstable and offer poor encapsulation of the desired therapeutic .[1-4] Dendrimers are a unique system but are difficult to synthesize and pose a potential immune system reactivity concern (e.g. hapten reaction) due to its conformational structure .[5-6] Quantum dots (e.g. cross-linked iron oxide) are not suitable for drug carriers due to their metallic nature but have been hotly pursued as potential imaging reagents. Research to date on QDots show them to be toxic to body tissues.[7-8] Thus far it seems there is no good nano-carrier for therapeutic delivery but one that has been introduced a few years back does seem to have great potential. PEG-based nanoparticle formulations have been used in the past but until recently none were stable enough for therapeutic delivery.

Table 1 Comparison of different delivery systems

Delivery System	Strengths	Drawbacks
Liposomes	Biocompatible Clinical success in cancer (breast, ovarian, lymphoma), antifungals	Often too large stability & sterility isues Poor encapsulation
Dendimer	High surface unites per area Adaptable interior	Difficult synthesis-time consuming, expensive Scalability issues
Imaging Agent (Megnetic, Qdots)	Easily modifiable Powerful MR, fluorescence contrast agents	Less suitable for drug delivery applications Potential toxicity (Qdots)

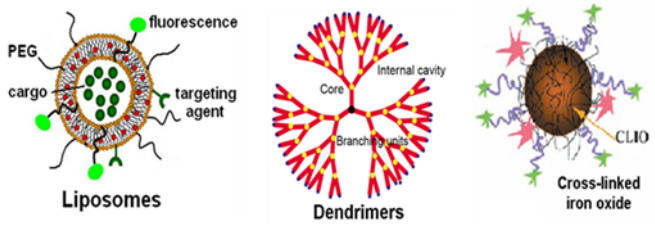

Figure 1 Liposomes, Dendimers, Cross-Linked iron oxide.

A new more robust and nontoxic drug delivery nanoparticle has been achieved by Immunotrex Biologics, Inc. in conjunction with the University of Massachusetts-Lowell. This new method of producing water based copolymer PEG nanoparticles allows for formation of nano-micelles with highly adaptable surface chemistry thus allowing for a wide range of applications- from a basic carrier of imaging agents to a vast range therapeutics. The flexibility of this water-based nanosphere allows for not only single payload delivery but also multiple, diverse payloads to be delivered with time release precision.[9]

We have a process to make water soluble nanospheres (80-100nm) with the capacity to encapsulate both hydrophobic and hydrophilic drugs, along with the ability to selectively target cells in tissue via ligands attached to the outer surface. Currently, research is focused on drug delivery to selective targets via ligand attachments. This should pave the way for more complex nanoparticle delivery systems.[9,10] (Figure 2).

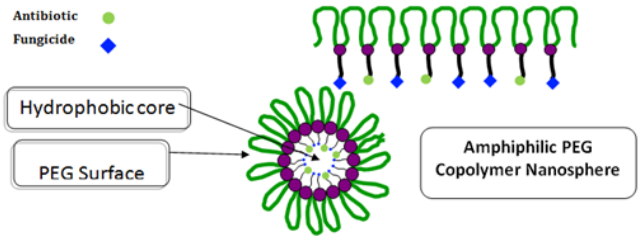

Figure 2 Amphiphilic PEG Copolymer w/ Functional Groups.

Acknowledgments

None.

Conflicts of interest

None.

References

1. Paliwal SR, Paliwal R, Agrawal GP et al. Hyaluronic acid modified pH–sensitive liposomes for targeted intracellular delivery of doxorubicin. *J Liposome Res.* 2016;19:1–12.
2. López–Dávila V, Magdeldin T, Welch H et al. Efficacy of DOPE/DC–cholesterol liposomes and GCPQ micelles as AZD6244 nanocarriers in a 3D colorectal cancer in vitro model. *Nanomedicine.* 2016;11(4):331–344.
3. Mikhaylov G, Mikac U, Magaeva AA et al. Ferri–liposomes as an MRI–visible drug–delivery system for targeting tumours and their microenvironment. *Nat Nanotechnol.* 2011;6(9):594–602.

4. Lokerse WJ, Kneepkens EC, Ten Hagen TL et al. In depth study on thermosensitive liposomes: Optimizing formulations for tumor specific therapy and in vitro to in vivo relations. *Biomaterials.* 2015;82:138–150.
5. Singh J, Jain K, Mehra NK, Jain NK Dendrimers in anticancer drug delivery: mechanism of interaction of drug and dendrimers. *Artif Cells Nanomed Biotechnol.* 2016;8:1–9.
6. Wais U, Jackson AW, He T et al. Nanoformulation and encapsulation approaches for poorly water–soluble drug nanoparticles. *Nanoscale.* 2016;8:1746–1769.
7. Maity AR, Stepensky D Efficient Subcellular Targeting to the Cell Nucleus of Quantum Dots Densely Decorated with a Nuclear Localization Sequence Peptide. *ACS Appl Mater Interfaces.* 2016;8(3):2001–2009.
8. TS Hauck, RE Anderson, HC Fischer et al. In vivo quantum-dot toxicity assessment. *Small.* 2010;6(1):138–144.
9. Kumar R, Chen MH, Parmar VS et al. Supramolecular Assemblies Based on Copolymers of PEG600 and Functionalized Aromatic Diesters for Drug Delivery Applications. *J Am Chem Soc.* 2004;126(34):10640–10644.
10. Kumar V, Gupta B, Kumar G et al. Novel PEGylated Amphiphilic Copolymers as Nanocarriers for Drug Delivery: Synthesis, Characterization and Curcumin Encapsulation. Journal of Macromolecular Science, Part A: *Pure and Applied Chemistry.* 2010;47(12):1154–1160.