Nanoparticles for Drug Delivery

Mini Review

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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.

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).

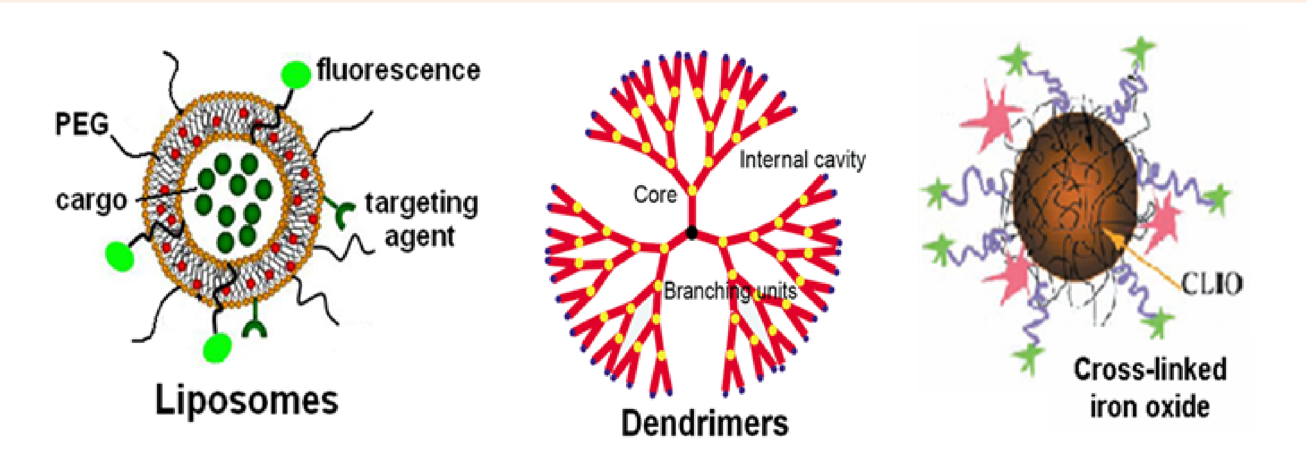

Figure 1: Liposomes, Dendimers, Cross-Linked iron oxide.

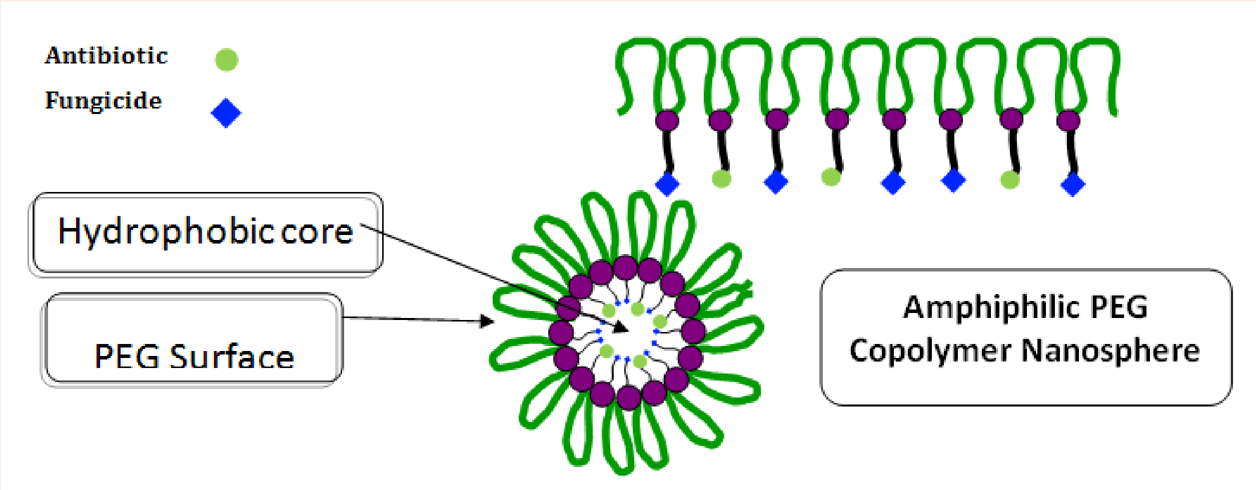

Figure 2: Amphiphilic PEG Copolymer w/ Functional Groups.

Table 1: Comparison of different delivery systems.

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

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