

# Pharmaceutical Nanocarriers (Liposomes and Micelles) in Cancer Therapy

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## Editorial

Fundamental progress in cancer biology has resulted in remarkable advances in diagnosis and cancer therapy. The need now is to transform this knowledge into effective therapies. The effectiveness of chemotherapeutic drugs is severely limited due to the dose-limiting toxicity and patient morbidity. In cancer therapy, effective delivery of the drug to the tumor site while avoiding off-site side effects is the primary challenge. This challenge can be overcome by targeting the tumor site selectively to avoid the undesired side-effects at non-target sites after the systemic delivery. A good drug delivery system fulfills several pharmaceutical requirements including increase in therapeutic effect, good biocompatibility, an ability to accumulate at a targeted site and controlled release of the drug at the target site [1]. Nanocarriers assisted delivery of drugs has become a successful strategy that enhances the delivery of small molecule and large molecules such as genes and peptides or proteins [2]. Different nanocarriers such as nanospheres, nanocapsules, liposomes, micelles, dendrimers, quantum dots, solid lipid nanoparticles, polymeric nanoparticles, gold nanoparticles, virus and virus-like nanoparticles have been explored for the delivery of small molecules and large molecules therapeutics.

Liposomes and micelles are the most extensively studied and understood pharmaceutical nanocarriers. Cholesterol and phospholipid molecules, that normally form cell membranes, generate liposomes which are vesicular nanostructures. Therapeutic liposomes are 50-200 nm in size and can be loaded with water soluble therapeutic agents in the aqueous core and water insoluble therapeutic agents in phospholipid (hydrophobic) bilayer. Micelles are colloidal dispersion with a particle size between 5-100 nm. For pharmaceuticals with poor solubility, Micelles can improve the bioavailability and solubility. Therapeutic agents in conjunction with nanocarriers such as liposomes and micelles result in better pharmacokinetic properties of the carrier-loaded drugs thereby improving therapeutic activity. These systems provide easier control, composition, size and in vivo stability in comparison with other drug delivery systems [3]. Furthermore, preparation is considerably simpler and also small amounts of a targeting component can be attached to these pharmaceutical nanocarriers. Thus, the fundamentals of liposomal and micellar nanocarrier and their biological interactions are well studied, and aids to design such nanocarriers with specific drug delivery, targeting and release characteristics. Lipid-or polymer-based delivery of therapeutic agent is the basic and simple nanotechnology platform which has found the most success in the clinics (Table 1).

Although an extensive number of scientific publications regarding these pharmaceutical nanocarriers exist, the translation of these pharmaceutical nanocarriers has been slow in comparison to that for small molecule drugs [4]. Lack of clear regulatory guidelines as well as technical issues are factors limiting the clinical application of nanomedicines [5].

As opposed to conventional drugs, the development of these technologies (nanomedicine/nanocarriers) combine expert knowledge from the fields of Chemistry, Biology and Physics. The products of these collaborations are wide ranging in concept and design. This conjunction of various academic disciplines in addition to a concerted effort by regulatory bodies and industry is required for advances in

such technologies. With these stakeholders working in harmony, it is possible to steer future research to obtain nanomedicine products that are both effective and safe.

Pharmaceutical nanocarriers such as liposomes and micelles have the potential to create new sources of revenue for the pharmaceutical and biotech industries and will improve the life cycle of proprietary drugs [6]. It will revolutionize the field of medicine by creating new therapies. So far, academic departments, new startups and small technology companies seem to have invested more effort in such technologies [6-14]. Drug delivery has already been revolutionized by nanotechnology. Pharmaceutical nanocarriers have made significant contributions to medicine and diagnostics and it will further continue to revolutionize these fields and further investigations are warranted in this area.

Pharmaceutical nanocarriers	Trade/Product Name	Drug	Company	Current Status	Ref
<i>Liposomes</i>	Onivyde	Irinotecan	Merrimack Pharmaceuticals	Approved in October 2015	14
	Maroqbio	Vincristine sulfate	Spectrum Pharmaceuticals	Approved in October 2012	12
	Doxil	Doxorubicin	Janssen Biotech	Approved in 1995	7
	Mepact	Mifamurtide	Takeda Pharmaceuticals	Phase III (USA) Approved in Europe	9
	ALN-VSP02	siRNA against VEGF and kinesin spindle protein	Alnylam Pharmaceuticals	Phase I	8
<i>Micelles</i>	Genexol-PM	Paclitaxel	Samyang Biopharma	Approved (South Korea) Phase II (USA)	7
	Paclical	Paclitaxel	Osamnia Pharmaceutical	Phase III	13
	NC 6004	Cisplatin	Nanocarrier	Phase II	10
	NK012	SN-38	Nippon Kayaku Co. Ltd	Phase II	11
	SP1049C	Doxorubicin	Supratek Pharmaceuticals	Phase II	7

Table 1: Selected list of nanomedicines in oncology.

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