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Editorial

Polymeric Micelles for Drug Delivery

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Introduction

Suitable characteristics of the tumor microenvironment and particularly, angiogenesis render the design of optimally tailored polymeric micelles suitable for anti-cancer drug delivery. The conventional chemotherapeutic regimen of highly hydrophobic drugs, which is currently employed, often suffers from several limitations such as inadequate efficacy, poor pharmacokinetic profile, which ultimately results in higher dosage and subsequently causes dose-limiting toxicity [1,2]. Anti-cancer therapy is no longer limited to a single chemotherapeutic drug regime but requires a coordinated interplay amongst clinicians, toxicologists, practitioners, formulation scientists and even biomedical engineers to design systems that can harbor these potent chemotherapeutic drugs in suitable vehicles and deliver them to the intended target sites in optimal concentrations, without causing any toxicity issues [3,4]. During this process, the morphological characteristics or abnormalities that exist within the tumor core and periphery are often exploited to design appropriate polymeric delivery systems that can utilize these conditions adequately and deposit the drug at the intended site of action, preferably with sustained release. Taking this approach further, tumor targeting of these nanoparticulate delivery systems has emerged in the forefront to achieve successful drug delivery with maximum efficacy and minimal toxicity [5,6].

Polymeric micelles are core-shell structures synthesized form amphiphilic block copolymers [7,8]. Various conventional characteristics of these polymeric micelles such as increasing the solubilization of poorly hydrophobic drugs, exhibiting sustained release profile, more importantly, protecting the encapsulated cargo from degradation by various enzymes and even metabolism make them favorable candidates for drug delivery purposes. These micelles are formed when the concentration of the polymer in solution exceeds a certain threshold concentration known as the Critical Micellar Concentration (CMC) and above a certain threshold temperature known as the Critical Micellar temperature (CMT) [9,10]. They also exhibit other subsequent favorable characteristics such as alleviating toxicities, increasing the extent of delivery to the compromised leaky tumor vasculature sites and in effect, the therapeutic efficacy of these highly hydrophobic chemotherapeutic drugs [11].

Practically insoluble drugs can be incorporated into these micelles by various known techniques such as physical loading by solvent evaporation method or dialysis or by chemical conjugation or other emulsification techniques. Chemical conjugation will usually involve the formation of a stronger covalent bond such as an amide linkage between the end groups of the drug molecule and the polymeric chain. Loading achieved by this technique is pretty robust and with suitable combinatorial chemistry, higher percentage of loading can be tailored as per the surface chemistries of the drug molecule and the polymeric backbone [12]. The stable and robust bonding can pose some problems with the cleavage and the release of the drug moiety in the blood circulation, in presence of enzymes. For that reason, suitable groups that can undergo degradation easily, when in contact with the enzymes, should be inserted at specific sites between the drug molecule and the polymeric chain. Hence, physical loading of highly hydrophobic compounds is the preferred method to adopt in certain instances, as higher percentage of loading along with suitable release can be obtained with these kinds of nanodelivery systems [13,14].

Conclusion

Some distinct advantages of the polymeric micelles include achievement of sustained release of drugs, higher percentage of loading, increase in the solubility profile of highly hydrophobic drugs and optimal size ranges make them highly attractive candidates for drug delivery amongst other nanoparticulate systems. However, there might be some stability issues with this nanoparticulate delivery system as the micelles may undergo disintegration as the polymer concentration falls below the critical micellar concentration, when injected intravenously into the blood or these micelles may aggregate when they start interacting with the plasma proteins or other blood components *in vivo*.

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