Polymeric Nanocarriers as Robust Platforms for Cancer Therapy

The major challenges of conventional cancer therapeutic modalities encouraged the development of novel nanocarriers for more efficient cancer therapy “cancer nanomedicine” [1-3]. Most anti-cancer drugs suffer from poor aqueous solubility and non-selective tissue biodistribution leading to severe toxicity experienced by patients [4, 5]. Polymeric nanoparticulate carriers hold great promise for overcoming the delivery challenges of anti-cancer drugs [6].

The current issue embodies an in-depth discussion of polymeric nanocarriers as vehicles for anti-cancer drugs by global experts in drug delivery with respect to formulation aspects, types, and site-specific drug targeting. Sabra et al. [7] discussed the use of self-assembled nanocarriers based on amphiphilic natural co-polymers fabricated from proteins and polysaccharides for targeted anti-cancer drug delivery to the tumor sites. In addition, Keskin and Tezcaner [8] gave an overview of research on polymeric micelles as delivery system for cancer treatment. Different methods for drug loading into micelles were highlighted including dialysis, oil-in-water method, solid dispersion, freezing, spray-drying, etc. Various self-assembled polymeric nanogels as anticancer delivery systems was covered by Varshosaz et al. [9].

Several polymers were successfully used for fabrication of nanomedicines for cancer therapy, e.g., Abraxane®, paclitaxel-bound albumin nanoparticles. Among various polymers, naturally occurring proteins have been widely exploited as vehicles for delivery of anti-cancer drugs to tumor sites based on their excellent biodegradability and biocompatibility [10-12]. In this issue, protein nanocarriers fabricated from zein were thoroughly investigated by Elzoghby et al. [13] as vehicles for various bioactive therapeutics including anti-cancer drugs. Also, Siri et al. [14] reviewed the combined delivery of γ-irradiated albumin nanocarriers with therapeutic drugs for cancer therapy. In addition to proteins, a wide variety of polysaccharides were utilized for design of tumor-targeted nanocarriers as colloidal vehicles for anti-cancer drugs [15-17]. Freag [18] discussed the role of nano-hybrids fabricated from the polysaccharide hyaluronic acid with biocompatible lipids in cancer therapy. Another polysaccharide, cellulose, can be formulated in the form of various nanocarriers such as bacterial cellulose, cellulose acetate, microcrystalline cellulose, carboxymethyl cellulose, cellulose nanocrystals, cellulose nanofibrils, etc, reviewed by Meng et al. [19] as drug delivery platforms for cancer therapy.

Besides natural polymers, nanocarriers were also developed using synthetic polymers, e.g. poly(lactic-co-glycolic acid) PLGA, poly(caprolactone) PCL, and others [20] for targeted delivery of chemotherapeutics. Chou et al. [21] systematically introduced the concepts and amelioration mechanisms of the nanomedical techniques for melanoma treatment. On the other hand, Khan et al. [22] focused on recent developments regarding polymeric nanocarriers such as polymeric nanoparticles, micelles, dendrimers, liposomes, nanoshells, fullerene, carbon nanotubes and quantum dots in breast cancer therapy. In addition to chemotherapeutic drugs, gene therapy has become a novel therapeutic strategy for cancer treatment. In this regard, the potential of cationic nanocarriers as vesicular devices in cancer gene therapy was analyzed by Tavano et al. [23], giving an exhaustive collection of the most representative investigations.

One way to reduce the off-target effects of chemotherapy on healthy tissues is to alter the biodistribution of drug. This can be achieved in two ways: passive targeting utilizes shape, size, and surface chemistry to increase particle circulation and tumor accumulation. Active targeting employs either chemical moieties (e.g. peptides, sugars, aptamers, or antibodies) to selectively bind to cell membranes or responsive elements (e.g. ultrasound, magnetism, or light) to deliver its cargo within a local region. In this issue, Kouchakzadeh et al. [24] focused on the recent progress in the field of targeted biopolymeric nano-platforms decorated with mAbs, folate and transferrin as efficient tools for targeted cancer therapy. In this regard, Bayram et al. [25] overviewed recent developments of polymeric nanoparticles conjugated with peptides, saccharides, and small molecules in cancer therapy. Alshemery et al. [26] focused on the use of physicochemical attributes of the endogenous tumor microenvironment to provide the impetus for on-demand release of therapeutics from biopolymer-based nanocarriers that are sensitive to pH, enzymes, redox conditions and combinations thereof.

In recent years, nanomedicines with simultaneous capability of drug delivery and diagnostic imaging of tumor tissue attracted a great attention “Theranostics” [27]. Magnetic nanomedicines have received a great attention in cancer therapy and diagnosis. Muñoz-Bonilla and Herrasti [28] provided an overview of the recent advances in the development and applications of magnetic nanoparticles in cancer treatment and diagnosis including MRI, drug delivery, magnetic hyperthermia, photothermia and magnetolysis. Li et al. [29] reviewed the applications of ultrasound contrast agents which can provide simultaneous and co-localized enhancement on image contrast by highlighting tissue borders. Finally, the safety and quality control issues of nanocarriers used for cancer therapy were reviewed by Bianco et al. [30].

REFERENCES
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