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Editorial

Biodegradable polymeric nanoparticles: An overview

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Polymeric nanoparticles evolved as a result of tailored drug administration, improved bioavailability, controlled drug release from a single dosage, and the capacity to preserve the medication until delivery to the target place.[1] Biodegradable polymeric nanoparticles (NPs) have demonstrated tremendous therapeutic promise in regulated drug delivery. Concurrently, tailored delivery methods are becoming more relevant as a scientific topic of study. For example, targeted polymeric NPs can be utilized to deliver chemotherapies to tumor cells with increased effectiveness and less harm to periphery healthy tissues in cancer. Biodegradable polymers are widely used in medication delivery because they may be reduced to harmless monomers inside the body. Synthetic polymers (PLA), poly (lactic-coglycolic acids) (PLGA), poly(-caprolactone) (PCL), poly (methyl methacrylates), and poly (alkyl cyanoacrylates) or natural polymers (albumin, gelatin, alginate, collagen, or chitosan) are utilised in the formation of nanoparticles.[2] Polyesters are the most often utilized polymers in the creation of nanoparticles, both alone and in combination with other polymers. Both PLGA and PLA are biocompatible and biodegradable. Some of the recent developments in the field of polymeric nanoparticles are discussed below:

Caldorera-Moore et al.[3] investigated the pH influence on interferon alfa (IFN-a) release via photo-emulsified poly (methacrylic acid-grafted-ethylene glycol) hydrogel nanoparticles. By immersing the nanoparticles in an IFN-a solution, the medication was loaded. A Caco-2/HT29-MTX coculture was used as a gastrointestinal tract model to study the processes of IFN-a transfer. Lee et al.[4] created pluronic/poly(ethylenimine) nanocapsules as siRNA nanocarriers and as an efficient endosome-breaking agent for delivery to the cytoplasm. These nanocapsules were capable of reacting to a heat stimulus. Ge et al. (2012)[5] used a temperature-sensitive hydrogel to deliver fluorescein (negatively charged) or daunorubicin (positively charged) charged polypyrrole (conductive polymer) nanoparticles subcutaneously in vivo (PLGA-PEG PLGA). The release mechanisms were induced by an electrochemical process of reduction/oxidation caused by the application of a weak external electric field of direct current. Paris et al.[6] suggested an ultrasound-responsive system based on mesoporous silica nanoparticle carriers and polymers acting as ultrasound-sensitive nanogates. Because the polymer has an open conformation, the device is based on p(MEO2MA-co-THPMA)-SiO2 nanoparticles (Hybrid-MSNs): APTES conjugation and was charged at a low temperature (4 °C). Gu et al. (2018) examined the manufacture of enzyme-responsive nanoparticles, creating self-assembled polythyrosine nanoparticles (PTNs)

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from doxorubicin-loaded poly (ethylene glycol)-bpoly(L-tyrosine) block copolymers. In RAW 264.7 cells or the presence of proteinase K, the method displayed fast drug release, resulting in an improved antiproliferative impact compared to LP-DOX clinically employed in both RAW 264.7 cells and HCT-116 human colorectal cancer cells.[7] Qiu et al.[8] showed that using these micelles reduced retinal dysfunctions, prevented retinal leukostasis, decreased retinal vascular leakage, and controlled VEGF overexpression eight weeks after application. Similarly, Lui et al.[9] proposed a PLGA/PVA-based micelle-based treatment for choroidal neovascularization. The polymer system in this example also comprised polyethyleneimine (PEI) to include positive charges in the NP, and the drug was a mixture of dexamethasone and bevacizumab, which can interact with the positive charges of PEI.

Zorzi et al.[10] created a PEGylated PV that encapsulates siRNA sequences to treat Acanthamoeba-caused ocular keratitis. In a mouse model, combining siRNA-loaded PV with chlorhexidine led to a 60% decrease in corneal damage induced by this illness. Wang et al.[11] developed photoacoustic imaging biodegradable polymeric NPs based on silica-coated AuNPs (PAI). This technology enables researchers to get pictures of various shapes and types of biological structures, including organelles. It forms wideband ultrasonic waves (called PA waves) owing to thermoelastic expansion when tissue is exposed to near-infrared (NIR) light, which is absorbed by the target.

The key advantage of employing polymeric nanoparticles over traditional pharmaceuticals is better therapeutic and diagnostic effects. The nanotherapeutic impact relies entirely on altering the physical-chemical properties and surface functionalization, which can boost specificity. Despite the numerous advantages of nanomedicine, drug availability remains a challenge. Understanding cytotoxicity and in vivo behavior presents challenges that must be overcome. Developing multicomponent and complex materials has the potential to provide novel therapeutic categories and genes. Improvements in nanoparticle research and design capable of providing even more complicated alternatives and large-scale production capacity are expected in the next generation.

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2. Conflict of Interest

None.

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