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Drug and Gene Delivery Using Nanotechnology

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Editorial

Despite recent breakthroughs in clinical research, clinics confront a tremendous challenge in finding appropriate therapeutic options to address a variety of ailments. The majority of today's therapeutic drugs are water-insoluble, resulting in low bioavailability, minimal action at the illness site, and severe therapy-related adverse effects. Scientists from all around the world are working around the clock to fix these challenges and improve the treatment's therapeutic benefits. In recent years, there has been an unanticipated increase in nanotechnology research. Nanotechnology's use in medication and gene delivery has grown in popularity in health care and other industries during the last several decades. Nanotechnology's application in medicine is gaining traction as a promising tool for cancer detection, treatment, and prevention. Growing interest in nanotechnology's potential medical uses has spawned a new discipline known as nanomedicine, which aims to maximise therapeutic index, dramatically extend human longevity, and reduce unpleasant side effects. Countless nanomedicines have been developed to treat diseases such as cancer, diabetes, and neurodegenerative disorders using diverse organic and inorganic materials like as lipids, polymers, metals, or their mixtures with the appropriate physicochemical properties and biological functionalities. To circumvent biological barriers via the increased permeability and retention (EPR) effect, physicochemical factors such as particle size, shape, surface charge, and surface ligand distribution must be tuned utilising improved chemical procedures. Nano formed medications have better pharmacokinetics than free pharmaceuticals, such as a longer half-life in the circulation and enhanced, increased drug concentration at the disease site, and decreased normal tissue toxicity. Only a few nano-formulated medications have been approved by the FDA since the mid-nineties, such as Doxil (a liposomal formulation of doxorubicin), the first nanomedicine licenced for cancer treatment in 1995. Abraxane (albumin-bound paclitaxel formulation) was approved in 2005 for the treatment of solid tumours, mostly due to its reduced adverse effects. The FDA recently approved ONIVYDETM (Irinotecan liposome injection) for the treatment of metastatic pancreatic cancer after gemcitabine treatment. Despite substantial advancements in nanotechnology, few authorised nano-formulated medications are available. In-depth characterization is frequently portrayed as a translational bridge that every candidate must cross. A complete and well-documented classification of each substance is the most dangerous phase in nanomedicine evaluation. Its biological inquiry can be readily misunderstood without a thorough grasp of the nanoformulations. To avoid delays in clinical testing, each preparation's physical, chemical, and biological characteristics must be thoroughly evaluated. According to our observations, there is a gap in our understanding of the complexities of developing nanotechnology-based medicines. For each application, a variety of physical and chemical features, such as nanoparticle size, charge, surface chemistry, and hydrophobicity, must be fine-tuned, and this process necessitates a set of skills and technologies that must often be developed iteratively. In the field of nanomedicine, for example, the formula "one size does not fit all" must be considered. As a result, when applying nanotechnology to drug delivery, the pharmacology of the delivered drugs must be considered in the nanocarrier design, i.e., delivering the drugs to the correct site at the right time at the proper doses. The ultimate goal of clinical drug delivery systems is to improve treatment efficacy while lowering undesirable side effects. We can only hope that nanotechnology-based nanomedicine will attain its full potential for improving healthcare when it can replace all existing medicines and become a part of newly devised therapies in the future if these difficulties are resolved.

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