Biomedical Application Approaches based on Nano-Drug Delivery

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Abstract

Nano-medicine and nano delivery systems are a relatively new but quickly emerging field in which tiny materials are used as diagnostic tools or to administer therapeutic medicines to specific targets in a controlled manner. Nanotechnology has a number of applications in the treatment of chronic human diseases, such as delivering precise medicines to specific locations. There have been a number of notable applications of nano-medicine in the treatment of various ailments in recent years. The short review summarises recent advances in the field of nano-medicines and nano-based drug delivery systems, including the discovery and application of nano-materials in improving the efficacy of both new and old drugs (e.g., natural products) as well as disease marker molecule-based selective diagnosis. From synthetic/natural sources to clinical applications, nano-medicines present both potential and obstacles in drug delivery.

Keywords

Biomedical; Nano-materials; Nanotechnology; Drug

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1. Introduction

Nanotechnology and the usage of nano-materials is a rapidly growing discipline that entails the creation of man-made materials on the nanoscales or molecular scale. Advances in communications, engineering, physics, chemistry, biology, robotics, and medicine have all contributed to the practical uses of nanotechnology. Nanomaterials have been used in medicine to deliver therapeutic drugs and to provide remedies for a wide range of diseases and disorders. These nanoparticles have emerged as a viable medication delivery option. The majority of researchers have been drawn to them because of their physiochemical features. The core substance of the nanoparticle, the therapeutic payload, and surface modifications are the three essential components of an efficient drug delivery nanoparticle [1].

Although a generalised structure does not accurately represent all nano-medicines, it can be useful in determining the purpose of each component of a nano-medicine carrier. The ability to load hydrophobic or hydrophilic treatments on nano-medicine carriers is common. As a result, appropriate carrier materials must be carefully chosen for each treatment. Some carrier materials, on the other hand, have both hydrophobic and hydrophilic areas [2]. These materials could be utilised to create nano-carriers that can deliver numerous medicines. To avoid harmful accumulation and adverse effects, the nanoparticle core material must also be non-toxic and non-immunogenic, as well as quickly cleared from the body. After the carrier has arrived at its destination, the therapeutic payload must be released from the core material. Surface modifiers contain both targeting moieties that help the carrier accumulate in a specific region and biocompatibility modifiers that help the carrier circulate in that location. The basic goal of a drug delivery system‘s design is to deliver the medicine to the appropriate location in a regulated manner. Drug release kinetics, pH and temperature sensitivity, polymers, nasal delivery, and oral drug delivery were among the first investigations in drug delivery systems [3]. The use of nano-materials in drug delivery systems is one of the subjects that many researchers have been considering in recent years since it can bring benefits such as accurate distribution to target cells, increased therapeutic qualities and safety, decreased toxicity, and biocompatibility. The system must have drug loading and release characteristics, a long shelf life, and biocompatibility when developing a nanofluid formulation for drug delivery. The charge of NPs in the fluid is one of the most significant aspects of nanofluidic medicines [4]. The inside walls of blood vessels are negatively charged, and the surface charge of fundamental biological particles in blood is almost negative. As a result, they repel one another, and blood cells do not clump together in the vessels. As a result, therapeutic particles are frequently negatively charged to prevent agglomeration. Oral administration, intravenous administration, injections, and per-rectum administration are among options for drug delivery. The sole disadvantage of these procedures is the length of time required and the drug‘s responsiveness. The use of nano-materials enhanced the circulation of the medication and maintained its needed reactivity, as well as reducing the treatment time. Carbon nano-materials, gold nano-materials, polymeric nano-materials, and biodegradable nano-materials are just a few of the nano-materials that can be employed as drug delivery vehicles and nano-carriers. These nano-carriers have a core material with a hydrophobic and hydrophilic region, as well as surface modifiers and a therapeutic payload. Due to their features, gold nanomaterial and biodegradable nanomaterial were found to be the most efficient nano-materials among these nano-materials. For instance, gold nanoparticles are utilised to cure cancer [5].

AuNps are biocompatible and less poisonous, with unique optical and electrical features. They can also be employed as a biosensor, a CT contrast agent, and an optical imaging agent. Polymeric and biodegradable nanoparticles are two more compounds that are gaining traction in the field of nano-medicine. The ability to modify the surface of polymeric nanoparticles, as well as their biodegradability and biocompatibility, make them ideal for drug administration. Among all nanoparticles, gold and biodegradable nanoparticles have a wide range of applications. Biodegradable nanoparticles have been used in one of the clinical trials for the treatment of wet macular degeneration.

2. Conclusion

Drug delivery through nano-materials leads to a solution for important medical issues, considerably improving people's quality of life. In this review, nanoparticles are used to discuss a medical trial. The study of these nano-carriers is on-going, and breakthroughs in material design, structural design, and cellular targeting are resulting in more effective therapeutic delivery. Current research focuses on numerous streams of science, material science, and engineering, all of which are heading to a new era of medicine, one in which medications will have significantly improved efficacy and administration convenience, as well as high bioavailability and lower toxicity.

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