Chapter 15
Cutting-Edge Nanotechnology in Oncology Therapy Advancements and Application: Targeted Drug Delivery System

P. Selvakumar
https://orcid.org/0000-0002-3650-4548
Department of Science and Humanities, Nehru Institute of Technology, Coimbatore, India

Varsha D. Satav
https://orcid.org/0000-0001-9477-6720
JSPM University, Pune, India

Akki Rajasekhar Reddy
Sai Rajeswari Institute of Technology, India

Shanmugarathinam Alagarsamy
https://orcid.org/0000-0002-2213-3045
University College of Engineering, BIT Campus, Anna University, Tiruchirappalli, India

Sumanta Bhattacharya
https://orcid.org/0000-0003-2563-2787
Maulana Abul Kalam Azad University of Technology, India

ABSTRACT

The study's goal was to discuss current research on nanoparticles and the different kinds of nanoparticles that can be used to deliver medications via parenteral infusion. The use of nanoparticles in fitness sciences and pharmacy, such as in targeted therapy and cancer therapy, is very beneficial for the advancement of the healthcare system. Along with reducing toxicity, enhancing release, and providing better formulation options, it helps to increase the solubility and bioavailability of medications. Several profitable oral medications have been developed using nanoparticles technology to enhance API absorption. Nano-milling progression is used to increase absorption of nano-parenteral. In oncology, dynamic target is beneficial because it can minimise side effects, especially when treating malignancies. By modifying

DOI: 10.4018/979-8-3693-6326-3.ch015

cancer immunotherapy, this system is expected to soon offer new therapeutic options.

INTRODUCTION

Nanoparticles are small, solid particle with size range 10 and 1000 nm. Using a nanoparticle matrix, the drug is captured or attached (Amreddy N., et al. 2018). Nano spheres are matrix system in which the medication is dispersed mentally and consistently within a hollow confinement, while nanocapsules are matrix systems in which the medication is contained within a hollow confinement, limited by a single polymer membrane. Due to their capacity to circulate for prolonged periods of time in the target organ and distribute proteins, peptides, and genes, biodegradable nanoparticles, particularly those encased in hydrophilic polymers like polyethylene glycol, have been investigated as prospective medicine delivery devices in recent years (Amreddy N., et al. 2015). Modern treatment methods are desperately needed because cancer is one of the most important causes of death worldwide. There has been a significant push to enhance medicine delivery in cancer thanks to the creation of innovative nanomaterials and nanocarriers (Xia S., et al. 2005). Most nanocarrier uses have as their primary goal preventing the drug from degrading too quickly after systemic distribution and enabling it to reach the tumor site at remedial concentrations while minimizing drug delivery to normal locations to minimize side effects. The purpose of these nanocarriers is to distribute medications through two different methods: passive targeting, which makes use of permeable tumor vasculature, or active target, which makes use of ligands that boost tumoral absorption and may lead to higher antitumor activity, thereby improving the therapeutic index net (Apte R. S., et al. 2019). Given that structural and physical properties including size, charge, shape, and surface features affect drug safety, internalization, pharmacokinetics, and biodistribution, it is imperative that nanoparticles be carefully designed. Our analysis focuses on a number of new and enhanced approaches to designing nanocarriers for cancer treatment.

Since they have more surface area per unit mass than other particles and have the ability to adsorb other substances, nanoparticles (NP) are attractive for these kinds of applications. However, their methods are constrained by innate problems like low encapsulation efficiency, rapid spillages of liquid drugs, and poor storage stability (Bahrami B., et al. 2017). Liposomes were use as prospective carriers with specific recompense like caring drugs from deprivation, targeting to the action site, and reducing toxicity or adverse reactions. In disparity to liposomes, polymeric nanoparticles have some special advantages. For instance, they support drug/protein stability and have crucial controlled release characteristics (Bai F., et al. 2013).

The following are some advantages of using nanoparticles to deliver drugs:

1. Nanoparticles range and exterior features can be simply distorted to achieve passive and dynamic medicine target after parenteral administration.
2. They control how medications are distributed throughout the body and then cleared in order to increase therapeutic effectiveness while minimising side effects during delivery and during transit (Torchilin V. P. 2005).
3. Prohibited discharge and particle dilapidation attributes are easily controllable by matrix elements. The ability of pharmaceuticals to enter tissues without undergoing any chemical changes is crucial for maintaining medication activity.
4. Site-specific target is made possible by the addition of target ligands to particle surfaces.