

Applying nanoparticles in nanotherapeutics: Some challenges

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In the field of nanotechnology, the applications of nanoparticles have evolved considerably over time. Nanoparticles (NPs) are small particles with a few hundred atoms with a size that is measured in nano-units. These polymeric particles might be either naturally occurring or man-made. NPs are used in a variety of industries including engineering, medicine, biotechnology and pharmacology. The surface, intermediate and core layers are the three layers that make up these particles. Silver, gold, quantum dots, organic nanoparticles, such as natural medicinal compounds (curcumin, piperine, etc.), liposomes, dendrimers and polymers are a few of the most prevalent and commonly used nanoparticles.

The main focus in nanotechnology research is nanotherapeutics and nanomedicine which aims to provide new advancements in drug delivery and administration through nanoparticles. Nanotherapeutics can overcome biological barriers which have been noted as a downside of conventional medications. The mechanism, size, chemical formulation and assembly of nanoparticles as nanotherapeutics are already being researched. Although nanotherapeutic formulations in medicine have already been accepted and are in clinical use to treat a variety of diseases, they face multiple obstacles due to unnecessary toxicity and barriers at various stages of nano-drug growth.

There are several challenges associated with evaluating nanotherapeutics risks, namely biological barriers and target site due to the nanoparticle composition as a medicine, the classification and study of nanoformulations for drug delivery systems, pharmaceutical development and manufacturing of nanomedicines to achieve batch production stability of physicochemical properties and nanoparticle safety and regulation profile to solve nanotoxicity and pharmacology. As a result, several studies are being conducted to solve the problems of nanotoxicity by using nanotoxicity assessment tools that include both in vitro and in vivo analysis of nano-based therapeutics.

The major demand in the research is to consider the positive and negative control in nanotoxicology studies, to promote progress in new nanotherapeutic characteristics and the materials in the fields of life science and nanotechnology. Despite this, nanoparticles have made significant advancements in clinical medicine, treatment and diagnostics.

Newer technologies have begun to evolve based on the same design principles. However, from a therapeutic standpoint, nanomedicine is still in its infancy and must overcome several roadblocks before being licensed for commercialisation. Nanomedicine will advance to a new level and deliver realistic and meaningful benefits to human medicine and healthcare. Therefore, the use of nanoparticles in nanotherapeutics must be rationally planned and systematic techniques must be used to address the aforementioned challenges.

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