Research & Reviews: Journal of Pharmaceutics and Nanotechnology e-ISSN: 2347-7857
P-ISSN: 2347-7849

Neurological Disorders: The Significance of Pharmaceutical Nanotechnology

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Short Communication

Received: 28-Nov-2022, Manuscript No. JPN-23-84596; **Editor assigned:** 01-Dec-2022, Pre QC No. JPN-23-84596 (PQ); **Reviewed:** 14-Dec-2022, QC No. JPN-23-84596; **Revised:** 21-Dec-2022, Manuscript No. JPN-22- 84596 (A); **Published:** 30-Dec-2022
DOI:10.4172/23477857.10.1.005

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ABOUT THE STUDY

Pharmaceutical nanotechnology comprises of the molecular fabrication at the nanoscale level (10 nm–1000 nm) for rendering various functions including diagnostics and therapeutics. Nano drugs have several properties including physically, chemical, optical and electrical attributions. Nano medicines are the important contributions from the field of nanotechnology research. Nanotechnology is used for targeted drug delivery, accurate detection of diseases, their prevention and precise treatment. Over the past several decades there have been significant progress in nanomedicine research. The translation of nanomedicine research has yielded several of the commercially viable and effective medications. Nano medicines mostly comprise of efficient drug delivery systems. The active pharmaceutical ingredient is entrapped, dissolved, encapsulated or linked at the molecular level to the nanoparticles to form a complex of medicine delivery system for accurate and precise drug delivery. Nano medicines are being increasingly used as a medium of gene therapy for the treatment of cancer, AIDS. Nanoparticles are also used for the transportation of antibiotics, therapeutic proteins and vaccines and they can even function as a vesicle to cross the blood brain barrier.

Nano medicines are designed by factoring in several attributes that control their particle size, surface properties the drug release, site directed drug delivery and their activity with predefined dosage regimen [1].

The biodegradable nature of nanoparticles ensures that these vehicles of drugs are safe and effective while their activity is determined by the size of the nanoparticle. These particles display better solubility and superior bioavailability going by extremely small particle size and relatively greater surface area. Nano particles have

exceptional properties of crossing the blood brain barrier or entering the pulmonary system or the endothelium of the tumors. They are also suitable for absorption through skin endothelial cells.

Nano medicines could be administered *via* intravenous mode when compared to other macro or micro drugs that need to be given conventionally through oral route. Some of the smallest blood vessel capillaries have a diameter up to five to six microns and these nanoparticles being extremely small enough are able to disperse in the circulation and reach the target tissue or cells. Nanotechnology provides unique advantage of delivering both natural and synthetic medicines with targeted drug delivery and greater bioavailability and also for sustained release of medications at the target site throughout the treatment time and they are efficient enough to prevent the catalysis of the drugs by endogenous enzymes. Nano technology has been effectively used in the development of COVID-19 vaccines based upon the lipid nanoparticles with a greater efficiency over the other conventional vaccines.

One of the most significant neurological disorders is the Parkinson's disease that affects the patient's quality of life while giving rise to high economic burden on the health systems. So far there have been no safe and effective drugs for the treatment of Parkinson's disease. When compared to conventional drug development strategies the repositioning of the current approved drugs in the market reduces the time and cost involved. There are also several of the drugs that can be reformulated into nanostructures for targeted drug delivery. A recent survey identified nearly 28 potential drugs that can be used for repositioning clinical trials for the treatment of Parkinson's disease. There are also several other drug compounds that have the potential to treat but they have limitations that they cannot cross the blood brain barrier like for example nilotnib that has shown promising results in the clinical trials. The study suggested that the identified drugs can be used to construct biodegradable nanoparticles that are based on the lipid and other polymer compounds for further clinical trials. Such formulations could help in crossing the blood brain barrier and deliver the drug in the certain regions of the brain. The functional parameters that influence the delivery of the drug to the nervous system includes the size of the nanoparticle, the drug load, poly dispersity index and z-potential. The currently available drugs are not effective in improving the prognosis or restricting the disease progression. Additionally, there could be side effects such as dyskinesis. One of the most effective drugs is levodopa but it has several side effects including extensive peripheral metabolism leading to motor fluctuations [2].

Neurodegenerative diseases are highly prevalent among the aged populations. Parkinson's disease is one of them. The current level of prevalence of Parkinson's disease is high among aged individuals. The incidence of Parkinson's disease is expected to rise by fifty percent Parkinson's disease is characterized by dyskinesis, cognitive dysfunction and non-motor impairment. Some of the main pathologies include decrease in the dopaminergic neurons, aggregation of alpha synuclein proteins, nerve inflammation and oxidative stress. The current anti-Parkinson drugs include dopaminergic drugs, anti-muscarinic drugs, anti-glutamatergic medication that provide only symptomatic relief for dyskinesis but does not cure the disease altogether. The latest drug development strategies must focus on redox regulation, alpha synuclein misfolding, aggregation attenuation and neuronal degeneration [3].

Epilepsy is the abnormal electrical activity of the hippocampus and cortex region. Among all the neurological diseases epilepsy is the most dangerous disorder as it may lead to neuronal degeneration in the brain. This disease could be acquired or genetic in nature or infectious in origin. Commonly meningitis, encephalitis, autoimmunity, biochemical changes such as porphyria, uremia, aminoacidopathies or pyridoxine related seizures are observed. The currently available antiepileptic medications are not effective in the treatment or alleviation of the symptoms. Here pharmaceutical nanotechnology plays a greater role in delivering the antiepileptic drugs to the nervous system

thus increasing their bioavailability and efficacy. Particularly the polymeric and lipid based nano carrier drugs will be more effective in crossing the blood brain barrier [4]. Recent technologies often make use of the optical and electrical properties of the nano sensors for increasing the efficacy of nano-drug complexes [5-7].

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