Novel Applications of Nanotechnology in Diagnosis and Treatment of Neurological Disorders.

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ABSTRACT:
The prevalence of neurological disorders with unknown causes is rising, includes well-researched conditions like Parkinson's, Alzheimer's, multiple sclerosis, Schizophrenia, cerebrovascular diseases and stroke. Consequently, focus has shifted to creating novel and efficient drug delivery devices that can transport drugs and have good brain bioavailability by Nano neurotechnology. Some of these issues have recently shown encouraging remedies due to use of nanoparticles in medicine delivery. In the diagnosis and treatment of various illnesses with drug and/or imaging agent efficacy, cellular uptake and selective transport to target organs frequently arise. Due to the BBB, a densely packed layer of endothelial cells that blocks foreign chemicals from entering the brain, neurodegenerative illnesses pose significant problems. Engineered nanomaterials, which are particles between 1 and 100 nm in size, are offering intriguing biomedical tools that may be able to overcome these issues because of their physico-chemical characteristics and the potential for multi-functionalization, which allows conferring variety of properties simultaneously, including the capacity to pass the blood-brain barrier. This study focuses on the most advanced nanomaterials for neuroprotection, neuronal tissue regeneration, and diagnostic imaging of the most prevalent neurodegenerative illnesses. The range of nanotechnologies that are readily available enables the nanoscale material with properties most suited to the therapeutic difficulties presented by a specific CNS illness. Clinical neuroscience's use of nanotechnology will depend on our capacity to combine it with our expanding knowledge of the molecular causes of CNS disorder. Finally, new nanotechnological methods are explored.

Keywords: Nano neurotechnology, BBB, diagnostic imaging, treatment, bioavailability

INTRODUCTION:
The term "neurological diseases" covers a broad range of wounds, infections, and tumors and disorders include declines in cognitive, motor and behavioral abilities brought on by neuronal activity impairment. The term refers to a group of illnesses that primarily affect the nerve system. The building blocks of the nervous system, nerve cells, are gradually damaged by ND. The degeneration may result in a persistent, progressive loss of neurons, which lowers brain function and impairs movement (ataxia) or mental capacity (dementia). As nerve cells control how our bodies react to stimuli or responses, their destruction is a core feature of "neurodegenerative disorder." The majority of degenerative nerve disorders are severe and essentially incurable. Treatments may aid in reducing discomfort, improving symptoms, and enhancing mobility. Additionally, there are approximately 46.8 million dementia patients globally, and 58% of them reside in medium- to high-income countries. In the past, prospective medications were dissolved in ethanol, polysorbate 80 (PS-80), and dimethyl sulfoxide in order to boost their

sensitivity and penetration through the blood-brain barrier (BBB). Recently, therapies based on nanotechnology. Due to their simple transportability across the BBB and special qualities including small size, selectivity, lower toxicity, biodegradability, and solubility, have become a possible therapeutic for brain diseases and disorders. Smallest particles are referred to as NPs, and they are typically between 1 and 100 nm in size, with the largest variety of NPs created at less than 1,000 nm.

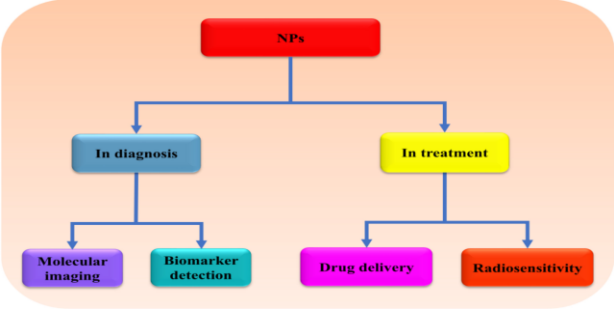

Figure1: The possible application of NPs in brain therapy. NPs can be used in diagnosis as well as treatment of brain diseases and disorders due to their high sensitivity, specificity, and ability to cross BBB. NPs, nanoparticles; BBB, blood–brain barrier.

NEED FOR THE STUDY:

Delivering therapeutic agents such as drugs, nucleic acids, proteins, imaging agents, and other macromolecules to the CNS is difficult due to the blood-brain barrier (BBB) and blood-cerebrospinal fluid barrier (BCSFB) in particular. Using nanotechnology as a delivery method for these neurotherapeutics across BBB is a novel idea. Effective medication administration to the brain is difficult with conventional drug delivery methods because of the protective architecture of the brain, or BBB. The difficulty of drug molecules that are hydrophilic and big lipophilic crossing the BBB's protective barrier causes an issue with a medicine's bioavailability. These significant barriers make a formulation that addresses the barrier for the treatment of neurological illnesses necessary. When creating a formulation, the physicochemical characteristics of the active ingredient and the best way to target brain delivery are taken into account.

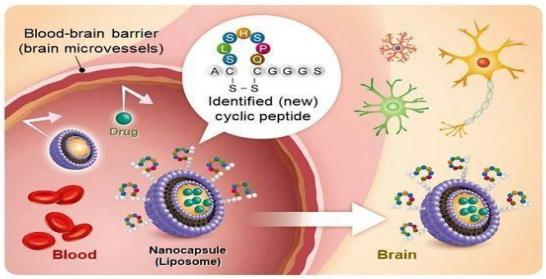

Figure 2: Nanoparticle Drug Delivery Technology Can cross the BBB

DIAGNOSTIC AND THERANOSTIC APPLICATIONS:

In recent years, the use of Nanotechnology in treatments and diagnostics has appeared to be a promising technology. Multifunctional nano-carriers used for targeted medication administration and in vivo imaging has brought numerous important treatments for neurodegenerative illnesses. Several new strategies for medication delivery to the CNS have been developed. However, the existence of BBB has hindered the transfer of the pharmacological substance. The advancement in the area of nanotechnology has promising application toward the treatment of CNS-related disorders such as AD, PD and epilepsy and many more by overcoming problems related to cross BBB. Nanotechnology has been utilized as imaging agents and have the potential to be theranostic agents in the future. They are mostly used in illness management to solve the shortcomings of traditional systems, such as patient compliance and safety. The term "theranostics" was coined to describe increasingly specialized and personalized medicines.

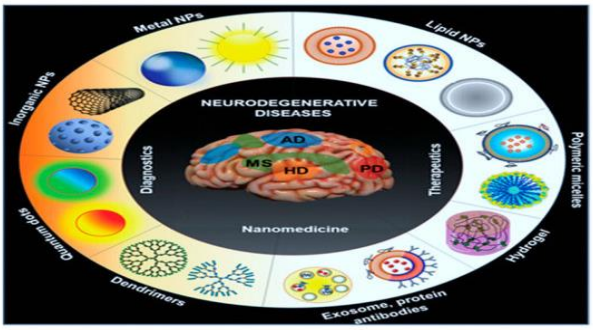

Figure 3.: Scheme identifies the emerging different kinds of nanomaterial formulations attempted for the improved drug delivery approaches in neurological diseases.

CLINICAL STATUS AND FUTURE PERSPECTIVES:

Nanoparticles, nano emulsion, nanosuspension, nanostructured lipid carrier, microemulsion, and solid lipid nanoparticles (SLNs) are some of the nano formulations that have been studied. According to reports on nano formulations, these formulations could be used as an effective carrier for therapeutic drug administration. Future CNS Nano medicine development should focus on improving drug-trafficking performance and specificity for brain tissue employing innovative targeting moieties, improving BBB permeability, and lowering neurotoxicity. Clinical experiments and preclinical trials must be prioritized in order to improve the delivery method.

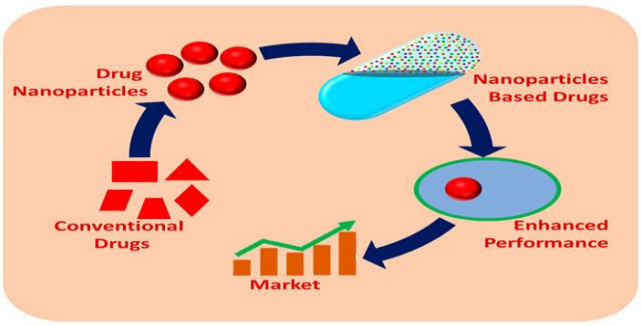

Figure 4: Nanoparticles-Based Drugs and Formulations: Current Status and Emerging Applications,

CONCLUSION:

Overall, nanocarriers hold great promise for treating neurodegenerative disorders. Liposomes, nanoparticles, nano micelles and exosomes improve brain targeting capabilities with Nanocarriers efficiently cross the BBB with the help of specific ligands (glucose, lactoferrin, transferrin, specific peptides) and can deliver drugs that ordinarily cannot cross the BBB at the specific spot. However, several challenges must be addressed before neurodegenerative disease nanomedicine can be used in clinical settings. Among these, the general and most significant impediment is low targeting efficiency, which may impair therapeutic impact and cause harm to other organs. Without a doubt, Nano medicine is progressing at an unavoidable rate, with the participation of global intelligence to conquer neurodegenerative illnesses and the abysmal repercussions associated with them.

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