Editorial

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2024.56.008898

Alzheimer's Disease: Nanotherapeutics

Rajiv Kumar*

University of Delhi, India

***Corresponding author:** Rajiv Kumar, University of Delhi, Delhi. 110007, India

ARTICLE INFO

Received: May 15, 2024

Published: May 23, 2024

Citation: Rajiv Kumar. Alzheimer's Disease: Nanotherapeutics. Biomed J Sci & Tech Res 56(4)-2024. BJSTR. MS.ID.008898.

Editorial

Nanotherapeutics is forefront of new strategies that is nanotechnology [1] due neurons size of nanotools and devices which fall in the range of a billionth of a meter, are being considered to treat and diagnose neurodegenerative diseases [2,3]. Irregularities in the natural functioning of neurons, initiate brain health disorders. Therefore, to treat these neurons is a very complicated task and even their locations are beyond the common approach. Nanotherapeutics [4] is quite capable to do the aforesaid chore and can be a good choice to be a therapy for neurodegenerative diseases, such as Parkinson's disease (PD) and Alzheimer's disease (AD) [5]. Various nanoparticles have been reported that can target brain in-vitro and in-vivo. Recently, the association of microglia, the brain-immune cells and uncontrolled inflammation has been discovered by the researchers of Rutgers University. Microglia tackled pathological changes within the brain to identify the undesired and foreign particles, so that it be cleared in a fast mode. The neurodegenerative disorders are very complex physiological, to resolve this issue, it is not a good approach to solely have a concern with searching therapy for neurons, but there are needs to search the mediators and those should be treated first, like in this case microglia, the mediator of neuron physiology and it be targeted first as this new strategy. This finding is considered as a breakthrough and could be a potential therapeutic target [6]. Such an approach may further reduce brain inflammation.

According to described literature, nanoparticles as a therapy and source of diagnosis of Alzheimer disease can cross the BBB and eliminate the Aß burden [7]. Finally, this therapy can slow the long-term progression of the disorder. The abnormal structure present in the brain of AD patients are senile plaques (deposits of the protein) and neurofibrillary tangles (neuron exposure) and both of them tied with Aß. By removing Aß, these disorders will be healed. It is very unfortunate that no researcher can get success in it. By applying nanotechnology, a few nanoparticles and nanomaterials have been designed that can simultaneously cross over BBB and hit the desired target [8]. Moreover, nanotechnologically developed tools and devices can perform diagnosis and imaging of brain diseases, including brain ischemia, stroke, and inflammation of the nervous system [9]. More interestingly, nano-biosensors have been developed that have a high grade of sensitivity for earlier detection of AD. The synthesis of biologically active HDL-based nanomaterials was reported through a microfluidic technology [10]. Lipid, protein, gold, quantum dot, and iron oxide, are the key components of aforesaid nanoparticles [11] These specifically designed nanoparticles can interact with microglia and this is what required. These interactions will explore new avenue for designing those nanomedicine platforms that can enable targeted delivery with zero toxicity. [12] Nanotherapeutics prescribed for curing Alzheimer's disease that explores various the applications of nanotechnology in clinical neuroscience for developing innovative therapeutic for treating AD [1].

Nanomedicine-based immunotherapy summarize to be considered for developing nanomedicine-based therapy to overcome the pathways of BBB and that can mimic the innate immune actions [13]. Nanorobotics are automatic molecular machines that can travel and monitor different compounds, and can store that information [14]. Nanotherapeutic that can combat excitotoxicity during stroke, TBI, and hypoxia–ischemia and deal with mitigating oxidative stress, was described [15]. Nanomedicines were reported that can replace or enrich diseased or injured cells and tissue and replenish the local environment or can halt further degeneration and hence capable in dissolve translational challenges for treating neurological disorders [16]. Generally, microglia protect neurons by removing pathological

agents, but if a long-term exposure of microglia stimulants initiate neuronal damage because of secretion of pro-inflammatory agents, resulting neuroinflammation and neurodegeneration [17] Designing microglia-targeting nanotherapeutics for the treatment of neurodegenerative disorders was presented [18]. Intranasal delivery of nanotherapeutics and nano biotherapeutics were designed as an engineered nanocarriers as a smart delivery system for treating AD and highlighted as a proficient approach [19]. In order to assess the potential applications of the medicinal plants, their derived components, and Phyto-Therapeutic, nano medicinal strategies have been developed that can transport aforesaid components for treating AD [20].

Flavonoid-based nanomedicines inhibit the accumulation of large aggregates state of amyloid-beta 42 (Aβ42), and hindered the formation of neurofibrillary tangles of hyper-phosphorylated forms of microtubule-associated tau protein, during AD [21]. The stem cell and nano-based therapies were applied as novel therapeutic strategies for treating AD, associated pathogenesis and pathogenic trajectories [22]. Nanomedicine [23] can offer impressive resolutions as a tiny machine for the healthcare that will cure a lot of life threatening diseases [24] Nanocarriers having polysaccharides as a component are remarkable as nanotherapeutics for curing Alzheimer disease and increase the transportation of the desired molecules [25]. Exploring recent advances in nanotherapeutics being tiny molecules of immunotherapeutic have many advantages over biological drugs regarding complexity, tissue penetration, manufacturing cost [26] Extracellular vesicles were also applied to treat neuroinflammation and are very helpful for pathogenesis, diagnosis, and therapy [27] Nanotherapeutics medicine of extracellular vesicles performed as theragnostic platform for biogenesis, membrane trafficking, and oxidative stress [28]. Highly bioactive zeolite imidazole framework-8–capped were applied as nanotherapeutics to suppresses inflammation- and the activation of astrocytes and secretion of proinflammatory cytokines, and notified as neuroprotective therapy. [29] Nanotools can detect the degeneration of amyloid-β peptide (Aβ) oligomers, and act as suppressor of oxidative stress of free radicals. [30].

Advances in personalized nanotherapeutics is a as state-of-the-art, that can be applied in various strategies and developed a novel nano-enabling therapeutic schemes to cure and monitor diseases. [31] The emergence of nanotherapeutics from laboratory to clinic comprehensively discussed and the persisted shortcomings for delivery of classical (small) drugs, macromolecular therapeutics, and recombinant vaccine were illustrated. [32,33] Nanomedicine overcome the obstacles and improve diagnostic and therapeutic outcomes in the healing neurodegenerative disorders. [34] Nano neuro medicines can be applied for neuroimaging as well as for therapeutic applications for degenerative, inflammatory and infectious disorders of the nervous system. [35] Small interfering RNAs, displayed remarkable promises and underlined as potential therapeutics option for curing AD. [36] Precision nanomedicine was reported as target-specific agents and are able to bypass the blood-brain barrier rapidly, and ultimately become a novel therapeutic modality to treat neurodegenerative diseases. [37] Potential use of nanomedicine for treating anti-inflammatory neurodegenerative diseases, (AD and PD) was underlined and that have ability of penetration of the BBB to achieve a therapeutic potential in the field of therapy that can be used for healing of neurodegenerative diseases. [38] Macrophage targeted theragnostic as personalized nanomedicine were discovered that can be successful as a theragnostic in macrophage ablation, phenotype modulation and inhibition of their inflammatory activity [39].

Selective targeting capabilities of nanomedicine have been reported that can deal with the pathological permeability of the blood–brain barrier during neurovascular inflammation [40]. Comparatively to conventional formulations, a number of nano formulations were recommended for improving the pharmacodynamics of the encapsulated drug for healing inflammatory diseases that can improve the quality of therapeutic treatment for curing diseases like AD and PDs. [41] Published article covered the promising aspects of ongoing developments in the diagnosis and management of Alzheimer's disease by applying nanotechnology. [42,43] Emerging role of nanotechnology and different nanoparticle (Gold, quantum dots, polymeric, liposomes, carbon nanotubes, and fullerenes) were highlighted for treating neurological disorders, including AD, PD and Huntington's disease and has shown great potential to overcome the problems. Phosphorus dendrimers that have potential to fight against cancers, neurodegenerative diseases, and inflammation, both in vitro and in vivo, were described. [44] A book, entitled "Nanomedicine for Inflammatory Diseases" covered different aspects of translational medicine for clinicians and disclosed various aspects for treating inflammatory disease and bridging the gap between the laboratory bench top and the clinical bedside [45].

Acknowledgements

One of the authors, Rajiv Kumar, gratefully acknowledges his younger brother, Bitto.

Consent for Publication

Not Applicable.

Funding

This research received no particular grant from any funding agency in the public, private, or not-for-profit sectors.

Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

Due to the nature of the research, [ethical, legal/commercial] supporting data is not applicable and thus not available.

References

1. Fazil M, Shadab, Baboota S, Sahni JK, Ali J (2012) Nanotherapeutics for Alzheimer's disease (AD): Past, present and future. J Drug Target 20(2): 97-113.
2. Faouzi A, Roullin VG (2021) Think big, start small: How nanomedicine could alleviate the burden of rare cns diseases. Pharmaceuticals 14(2).
3. Kumar N, Kumar R (2013) Nanotechnology and Nanomaterials in the Treatment of Life-Threatening Diseases.
4. Siddiqi KS, Husen A, Sohrab SS, Yassin MO (2018) Recent Status of Nanomaterial Fabrication and Their Potential Applications in Neurological Disease Management. Nanoscale Res Lett 13.
5. Zhang W, Wang W, Yu DX, Xiao Z, He Z (2018) Application of nanodiagnostics and nanotherapy to CNS diseases. Nanomedicine 13(18): 2341-2371.
6. Kumar R, Chhikara BS, Gulia K, Chhillar M (2021) Review of nanotheranostics for molecular mechanisms underlying psychiatric disorders and commensurate nanotherapeutics for neuropsychiatry: The mind knockout. Nanotheranostics 5: 288-308.
7. Harilal S, Jose J, Parambi DGT, Rajesh Kumar, Githa Elizabeth Mathew, et al. (2019) Advancements in nanotherapeutics for Alzheimer's disease: current perspectives. J Pharm Pharmacol 71(9).
8. Gu X, Chen H, Gao X (2015) Nanotherapeutic strategies for the treatment of Alzheimer's disease. Ther Deliv 6(2).
9. Chowdhury A, Kunjiappan S, Panneerselvam T, Somasundaram B, Bhattacharjee C (2017) Nanotechnology and nanocarrier-based approaches on treatment of degenerative diseases. Int Nano Lett 7(91-122).
10. Rajiv Kumar, Sandeep Mittan JS (2015) Nanobiomaterials, nanobiomechanics and tissue bioengineering for advanced regenerative therapeutics: present and future perspectives. J Mater Nanosci 2(1): 15-26.
11. Dogra A, Narang RS, Narang JK (2020) Recent Advances in Nanotherapeutic Interventions for the Treatment of Alzheimer's Disease. Curr Pharm Des 26(19).
12. Kumar R, Chhikara BS, Er Zeybekler S, Dhruv Sanjay Gupta, Ginpreet Kaur, et al. (2023) Nanotoxicity of multifunctional stoichiometric cobalt oxide nanoparticles (SCoONPs) with repercussions toward apoptosis, necrosis, and cancer necrosis factor (TNF-α) at nano-biointerfaces. Toxicol Res (Camb) 12(5): 716-740.
13. Hanif S, Muhammad P, Chesworth R, Fawad Ur Rehman, Rong jun Qian, et al. (2020) Nanomedicine-based immunotherapy for central nervous system disorders. Acta Pharmacol Sin 41.
14. Ion RM, Munteanu D (2009) Nanotechnology - Nanorobotics - Nanomedicine. Metal Int 14: 43-46.
15. Liao R, Wood TR, Nance E (2020) Nanotherapeutic modulation of excitotoxicity and oxidative stress in acute brain injury. Nanobiomedicine 7.
16. Nemeth CL, Fine AS, Fatemi A (2019) Translational challenges in advancing regenerative therapy for treating neurological disorders using nanotechnology. Adv Drug Deliv Rev 148: 60-67.
17. Binda A, Murano C, Rivolta I (2020) Innovative therapies and nanomedicine applications for the treatment of alzheimer's disease: A state-of-the-art (2017–2020). Int J Nanomedicine 15.
18. Zhao N, Francis NL, Calvelli HR, Moghe PV (2020) Microglia-targeting nanotherapeutics for neurodegenerative diseases. APL Bioeng 4(3).
19. Dhas NL, Kudarha RR, Mehta TA (2019) Intranasal delivery of nanotherapeutics/ nanobiotherapeutics for the treatment of Alzheimer's disease: A proficient approach. Crit Rev Ther Drug Carrier Syst 36(5): 373-447.
20. Ovais M, Zia N, Ahmad I, Ali Talha Khalil, Abida Raza, et al. (2018) Phyto-Therapeutic and Nanomedicinal Approaches to Cure Alzheimer's Disease: Present Status and Future Opportunities. Front Aging Neurosci 10.
21. Prasanna P, Upadhyay A (2021) Flavonoid-Based Nanomedicines in Alzheimer's Disease Therapeutics: Promises Made, a Long Way to Go. ACS Pharmacol. Transl Sci 4(1): 74-95.
22. Derakhshankhah H, Sajadimajd S, Jafari S, Zhila Izadi, Sajad Sarvari, et al. (2020) Novel therapeutic strategies for Alzheimer's disease: Implications from cell-based therapy and nanotherapy. Nanomedicine Nanotechnology Biol Med 24.
23. Ruozi B, Belletti D, Pederzoli F, Forni F, Vandelli MA, et al. (2016) Potential use of nanomedicines for drug delivery across the BBB in health and diseased brain. CNS Neurol Disord Drug Targets.
24. Saha (2009) Nanomedicine: Promising Tiny Machine for the Healthcare in Future-A Review. Oman Med J 24: 242-247.
25. Gao H, Pang Z, Jiang X (2013) Targeted delivery of nano-therapeutics for major disorders of the central nervous system. Pharm Res 30(10).
26. Rao MR, Sonawane A, Sapate S, Abhang K (2020) Exploring Recent Advances in Nanotherapeutics. J Drug Deliv Ther 10.
27. Ruan J, Miao X, Schlüter D, Lin L, Wang X (2021) Extracellular vesicles in neuroinflammation: Pathogenesis, diagnosis, and therapy. Mol Ther 29(6): 1946-1957.
28. Gurunathan S, Kang MH, Qasim M, Khan K, Kim JH (2021) Biogenesis, membrane trafficking, functions, and next generation nanotherapeutics medicine of extracellular vesicles. Int J Nanomedicine 16.
29. He L, Huang G, Liu H, Sang C, Liu X, et al. (2020) Highly bioactive zeolitic imidazolate framework-8-capped nanotherapeutics for efficient reversal of reperfusion-induced injury in ischemic stroke. Sci Adv 6(12).
30. Nazem A, Mansoori GA (2011) Nanotechnology for Alzheimer's disease detection and treatment. Insciences J 1(4): 169-193.
31. Kaushik A, Jayant RD, Nair M (2017) Advances in personalized nanotherapeutics.
32. Chowdhury EH (2016) Nanotherapeutics: From laboratory to clinic.
33. Chhikara BS, Kumar R, Rathi B, Krishnamoorthy S, Kumar A (2016) Prospects of Applied Nanomedicine: potential clinical and (bio)medical interventions via nanoscale research advances. J Mater Nanosci 3: 50-56.
34. Kabanov AV, Gendelman HE (2007) Nanomedicine in the diagnosis and therapy of neurodegenerative disorders. Prog Polym Sci 32(8-9).
35. Gendelman HE, Anantharam V, Bronich T, Shivani Ghaisas, Huajun Jin, et al. (2015) Nanoneuromedicines for degenerative, inflammatory, and infectious nervous system diseases. Nanomedicine Nanotechnology Biol Med11(3): 751-767.
36. Zhou Y, Zhu F, Liu Y, Meng Zheng, Yibin Wang, et al. (2020) Blood-brain barrier-penetrating siRNA nanomedicine for Alzheimer's disease therapy. Sci Adv 6(41): eabc7031.
37. Goldsmith M, Abramovitz L, Peer D (2014) Precision nanomedicine in neurodegenerative diseases. ACS Nano 8(3): 1958-1965.
38. Cayero Otero MD, Espinosa Oliva AM, Herrera AJ, Irene Garcia Dominguez, Mercedes Fernandez Arevalo, et al. (2018) Potential Use of Nanomedicine

for the Anti-inflammatory Treatment of Neurodegenerative Diseases. Curr Pharm Des 24(14).

39. Patel SK, Janjic JM (2015) Macrophage targeted theranostics as personalized nanomedicine strategies for inflammatory diseases. Theranostics 5(2): 150-72.
40. Marcos Contreras OA, Greineder CF, Kiseleva RY, Vladimir R Muzykantov (2020) Selective targeting of nanomedicine to inflamed cerebral vasculature to enhance the blood–brain barrier. Proc Natl Acad Sci 117(7): 3405-3414.
41. Al Lawati H, Binkhathlan Z, Lavasanifar A (2019) Nanomedicine for the effective and safe delivery of non-steroidal anti-inflammatory drugs: A review of preclinical research. Eur J Pharm Biopharm 142: 179-194.
42. Arun K, Navas A, Joseph Francis P (2018) Novel trends in the management of Alzheimer's disease by using Nano based Materials. Madridge J Nanotechnol Nanosci 3(1): 96-97.
43. Kumar R, Gulia K (2021) The convergence of nanotechnology-stem cell, nanotopography-mechanobiology, and biotic-abiotic interfaces: Nanoscale tools for tackling the top killer, arteriosclerosis, strokes, and heart attacks. Nano Sel 2: 655-687.
44. Ghosh R, Pradip Bhattacharjee, Anish Pal (2021) Emerging Applications of Nanotechnology in Neurological Disorders: Recent Meta Review. Biosci Biotechnol Res Commun 14.
45. Milane LS, Amiji MM (2017) Nanomedicine for inflammatory diseases.

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2024.56.008898

Rajiv Kumar. Biomed J Sci & Tech Res

Submission Link: https://biomedres.us/submit-manuscript.php