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Nanomedicine-driven therapeutic interventions of autophagy and stem cells in the management of Alzheimer's disease

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Abstract
Drug-loaded, brain-targeted nanocarriers could be a promising tool in overcoming the challenges associated with Alzheimer's disease therapy. These nanocargoes are enormously flexible to functionalize and facilitate the delivery of drugs to brain cells by bridging the blood-brain barrier and into brain cells. To date, modifications have included nanoparticles (NPs) coating with tunable surfactants/phospholipids, covalently attaching polyethylene glycol chains (PEGylation), and tethering different targeting ligands to cell-penetrating peptides in a manner that facilitates their entry across the BBB and downregulates various pathological hallmarks as well as intra- and extracellular signaling pathways. This review provides a brief update on drug-loaded, multifunctional nanocarriers and the therapeutic intervention of autophagy and stem cells in the management of Alzheimer's disease. © 2023 Future Medicine Ltd.

Author Keywords
Alzheimer's disease; amyloid-ß; autophagy; brain targeting; gene therapy; nanoparticles; stem cell; theranostics

Index Keywords
aducanumab, carbamazepine, catechol derivative, curcumin, dendrimeric nanoparticle, dimebon, donepezil, galantamine, huperzine A, liposomal nanoparticle, memantine, metal nanoparticle, nanocarrier, nanocomposite, nanoparticle, phytochemical, placebo, poly(n butyl cyanoacrylate) nanoparticle, polyglactin nanoparticle, quercetin, resveratrol, rivastigmine, saponin, solid lipid nanoparticle, tacrine, terpene derivative, unclassified drug, drug, nanoparticle; active transport, Alzheimer disease, antiinflammatory activity, antioxidant activity, autophagy (cellular), blood brain barrier, drug approval, drug efficacy, drug mechanism, drug penetration, endocytosis, Food and Drug Administration, human, hypertension, membrane transport, nanomedicine, neurofibrillary tangle, neuroprotection, nonhuman, nose brain transport, pathophysiology, receptor mediated transcytosis, Review, risk factor, stem cell transplantation, theranostic nanomedicine, transcytosis, United States, Alzheimer disease, drug delivery system, nanomedicine, pathology, stem cell; Alzheimer Disease, Autophagy, Blood-Brain Barrier, Drug Delivery Systems, Humans, Nanomedicine, Nanoparticles, Pharmaceutical Preparations, Stem Cells

Chemicals/CAS
aducanumab, 1384260-65-4; carbamazepine, 298-46-4, 8047-84-5; curcumin, 458-37-7; dimebon, 3613-73-8, 12687-54-6, 20684-30-4, 97657-92-6; donepezil, 120011-70-3, 120014-06-4, 142057-77-0; galantamine, 1953-04-4, 357-70-0; huperzine A, 102518-79-6, 92138-20-0; memantine, 19982-08-2, 41100-52-1, 51052-62-1; quercetin, 117-39-5; resveratrol, 501-36-0; rivastigmine, 129101-54-8, 123441-03-2; saponin, 8047-15-2; tacrine, 1684-40-8, 3198-41-2, 321-64-2; Pharmaceutical Preparations

References

- Prince, M., Comas-Herrera, A., Knapp, M., Guerchet, M., Karagiannidou, M.
  World Alzheimer report 2016: improving healthcare for people living with dementia: coverage, quality and costs now and in the future: coverage, quality and costs now and in the future
  (2016) *Alzheimer's Dis. Int.*,
- Yiannopoulou, K.G., Papageorgiou, S.G.
  Current and future treatments in Alzheimer disease: an update
  (2020) *J. Cent. Nerv. Syst. Dis.*, 12, pp. 1-12.

- Klimova, B., Maresova, P., Valis, M.
  Alzheimer's disease and language impairments: social intervention and medical treatment
  (2015) *Clin. Interv. Aging*, 10, p. 1401.

- Maresova, P., Klimova, B., Novotny, M.
  Alzheimer's and Parkinson's diseases: expected economic impact on Europe – a call for a uniform European strategy
  (2016) *J. Alzheimers Dis.*, 54 (3), pp. 1123-1133.

- Morris, J.C.
  Classification of dementia and Alzheimer's disease
  (1996) *Acta Neurol. Scand.*, 94, pp. S41-S50.

- Klimova, B., Kuca, K.
  Speech and language impairments in dementia
  (2016) *J. Appl. Biomed.*, 14 (2), pp. 97-103.

- Nieoullon, A.
  Neurodegenerative diseases and neuroprotection: current views and prospects
  (2011) *J. Appl. Biomed.*, 9 (4), pp. 173-183.

- Von Schnehen, A., Hobeika, L., Huvent-Grelle, D.
  Sensorimotor synchronization in healthy aging and neurocognitive disorders
  (2022) *Front. Psychol.*, 13, p. 838511.

- **Alzheimer's disease facts and figures**
  (2022) *Alzheimers Dement.*, 18 (4), pp. 700-789.
  Association AS

- Cummings, J., Lee, G., Nahed, P.
  Alzheimer's disease drug development pipeline
  (2022) *Alzheimers Dement.*, 8, p. e12295.

- Plascencia-Villa, G., Perry, G.
  Neuropathologic changes provide insights into key mechanisms related to Alzheimer disease and related dementia
  (2022) *Am. J. Pathol.*, pp. 206-211.
  S0002-9440(22)

- De-Paula, V.J., Radanovic, M., Diniz, B.S.
  Alzheimer's disease
  (2012) *Subcell Biochem.*, 65, pp. 329-352.

- Tiwari, S., Atluri, V., Kaushik, A.
  Alzheimer's disease: pathogenesis, diagnostics, and therapeutics
  (2019) *Int. J. Nanomed.*, 14, p. 5541.

- Chen, Z.R., Huang, J.B., Yang, S.L.
  Role of cholinergic signaling in Alzheimer's disease
  (2022) *Molecules*, 27 (6), p. 1816.

- Hardingham, G.E., Fukunaga, Y., Bading, H.
  Extrasynaptic NMDARs oppose synaptic NMDARs by triggering CREB shut-off and cell death pathways
  (2002) *Nat. Neurosci.*, 5 (5), pp. 405-414.

- Ikonomidou, C., Bosch, F., Miksa, M.
  Blockade of NMDA receptors and apoptotic neurodegeneration in the developing brain
  (1999) *Science*, 283 (5398), pp. 70-74.

- Rothman, S.M., Olney, J.W.
Glutamate and the pathophysiology of hypoxic-ischemic brain damage
(1986) *Ann. Neurol.*, 19 (2), pp. 105-111.

- Brunholz, S., Sisodia, S., Lorenzo, A.
Axonal transport of APP and the spatial regulation of APP cleavage and function in neuronal cells
(2012) *Exp. Brain Res.*, 217 (3-4), pp. 353-364.

- Smith, D.G., Cappai, R., Barnham, K.J.
The redox chemistry of the Alzheimer's disease amyloid ß peptide
(2007) *Biochim. Biophys. Acta Biomembr.*, 1768 (8), pp. 1976-1990.

- Kim, J., Basak, J.M., Holtzman, D.M.
The role of apolipoprotein E in Alzheimer's disease
(2009) *Neuron*, 63 (3), pp. 287-303.

- Hernandez-Sapiens, M.A., Reza-Zaldívar, E.E., Márquez-Aguirre, A.L.
Presenilin mutations and their impact on neuronal differentiation in Alzheimer's disease
(2022) *Neural. Regen. Res.*, 17 (1), pp. 31-37.

- Meschia, J.F., Bushnell, C., Boden-Albala, B.
Guidelines for the primary prevention of stroke: a statement for healthcare professionals from the American Heart Association/American Stroke Association
(2014) *Stroke*, 45 (12), pp. 3754-3832.

- Sierra, C., Coca, A., Schiffrin, E.L.
Vascular mechanisms in the pathogenesis of stroke
(2011) *Curr. Hypertens. Rep.*, 13 (3), pp. 200-207.

- Joas, E., Bäckman, K., Gustafson, D.
Blood pressure trajectories from midlife to late life in relation to dementia in women followed for 37 years
(2012) *Hypertension*, 59 (4), pp. 796-801.

- Norton, S., Matthews, F.E., Barnes, D.E.
Potential for primary prevention of Alzheimer's disease: an analysis of population-based data
(2014) *Lancet Neurol.*, 13 (8), pp. 788-794.

- Cheng, G., Huang, C., Deng, H.
Diabetes as a risk factor for dementia and mild cognitive impairment: a meta-analysis of longitudinal studies
(2012) *Intern. Med. J.*, 42 (5), pp. 484-491.

- Barbagallo, M., Dominguez, L.J.
Type 2 diabetes mellitus and Alzheimer's disease
(2014) *World J. Diabetes*, 5 (6), p. 889.

- Fitzpatrick, A.L., Kuller, L.H., Lopez, O.L.
Midlife and late-life obesity and the risk of dementia: cardiovascular health study
(2009) *Arch. Neurol.*, 66 (3), pp. 336-342.

- Magalhaes, C., Carvalho, M., Sousa, L.
Leptin in Alzheimer's disease
(2015) *Clin. Chim. Acta*, 450, pp. 162-168.

- Irizarry, M.C.
Biomarkers of Alzheimer disease in plasma
(2004) *NeuroRx*, 1 (2), pp. 226-234.

- Mrak, R.E., Griffin, W.S.T.
Potential inflammatory biomarkers in Alzheimer's disease
(2005) *J. Alzheimers Dis.*, 8 (4), pp. 369-375.

- Pacheco-Quinto, J., De Turco, E.B.R., De Rosa, S.
Hyperhomocysteinemic Alzheimer's mouse model of amyloidosis shows increased brain amyloid ß peptide levels
(2006) *Neurobiol. Dis.*, 22 (3), pp. 651-656.

- Ballabh, P., Braun, A., Nedergaard, M.
The blood–brain barrier: an overview: structure, regulation, and clinical implications
(2004) *Neurobiol. Dis.*, 16 (1), pp. 1-13.

- Kniesel, U., Wolburg, H.
Tight junctions of the blood–brain barrier
(2000) *Cell. Mol. Neurobiol.*, 20 (1), pp. 57-76.

- Wolburg, H., Lippoldt, A.
Tight junctions of the blood–brain barrier: development, composition and regulation
(2002) *Vasc. Pharmacol.*, 38 (6), pp. 323-337.

- Abbott, N.J., Patabendige, A.A., Dolman, D.E.
Structure and function of the blood–brain barrier
(2010) *Neurobiol. Dis.*, 37 (1), pp. 13-25.

- Barnabas, W.
Drug targeting strategies into the brain for treating neurological diseases
(2019) *J. Neurosci. Methods*, 311, pp. 133-146.

- Praça, C., Rai, A., Santos, T.
A nanoformulation for the preferential accumulation in adult neurogenic niches
(2018) *J. Control. Rel.*, 284, pp. 57-72.

- Juillerat-Jeanneret, L.
The targeted delivery of cancer drugs across the blood–brain barrier: chemical modifications of drugs or drug-nanoparticles?
(2008) *Drug Discov. Today*, 13 (23-24), pp. 1099-1106.

- Gaillard, P.J., Visser, C.C., Appeldoorn, C.C.
Enhanced brain drug delivery: safely crossing the blood–brain barrier
(2012) *Drug Discov. Today Technol.*, 9 (2), pp. e155-e160.

- Jones, A.R., Shusta, E.V.
Blood–brain barrier transport of therapeutics via receptor-mediation
(2007) *Pharm. Res.*, 24 (9), pp. 1759-1771.

- Niu, X., Chen, J., Gao, J.
Nanocarriers as a powerful vehicle to overcome blood–brain barrier in treating neurodegenerative diseases: focus on recent advances
(2019) *Asian J. Pharm. Sci.*, 14 (5), pp. 480-496.

- Teixeira, M.I., Lopes, C., Amaral, M.H.
Current insights on lipid nanocarrier-assisted drug delivery in the treatment of neurodegenerative diseases
(2020) *Eur. J. Pharma. Biopharm.*, 149, pp. 192-217.

- Hanson, L.R., Frey, W.H.
Intranasal delivery bypasses the blood–brain barrier to target therapeutic agents to the central nervous system and treat neurodegenerative disease
(2008) *BMC Neurosci.*, 9 (3), pp. 1-4.

- Samaridou, E., Alonso, M.J.
Nose-to-brain peptide delivery – the potential of nanotechnology
(2018) *Bioorg. Med. Chem.*, 26 (10), pp. 2888-2905.

- Dhuria, S.V., Hanson, L.R., Frey, W.H.
Novel vasoconstrictor formulation to enhance intranasal targeting of neuropeptide therapeutics to the central nervous system
(2009) *J. Pharmacol. Exp. Ther.*, 328 (1), pp. 312-320.

- Liu, X.-F., Fawcett, J.R., Hanson, L.R.
The window of opportunity for treatment of focal cerebral ischemic damage with noninvasive intranasal insulin-like growth factor-I in rats
(2004) *J. Stroke Cerebrovasc. Dis.*, 13 (1), pp. 16-23.

- Binda, A., Murano, C., Rivolta, I.
Innovative therapies and nanomedicine applications for the treatment of Alzheimer's disease: a state-of-the-art (2017–2020)
(2020) *Int. J. Nanomed.*, 15, pp. 6113-6135.

- Graham, W.V., Bonito-Oliva, A., Sakmar, T.P.
Update on Alzheimer's disease therapy and prevention strategies
(2017) *Annu. Rev. Med.*, 68, pp. 413-430.

- Harilal, S., Jose, J., Parambi, D.G.T.
Advancements in nanotherapeutics for Alzheimer's disease: current perspectives
(2019) *J. Pharm. Pharmacol.*, 71 (9), pp. 1370-1383.

- Cavazzoni, P.
(2021) *FDA's Decision to Approve New Treatment for Alzheimer's Disease*,

- *FDA grants accelerated approval for Alzheimer's drug*,
National Institute on Aging. Press release.

- Mudshinge, S.R., Deore, A.B., Patil, S.
Nanoparticles: emerging carriers for drug delivery
(2011) *Saudi Pharm. J.*, 19 (3), pp. 129-141.

- Ahmad, Z.M., Ahmad, J., Amin, S.
Role of nanomedicines in delivery of anti-acetylcholinesterase compounds to the brain in Alzheimer's disease
(2014) *CNS Neurol. Disord. Drug Targets*, 13 (8), pp. 1315-1324.

- Nazem, A., Mansoori, G.A.
Nanotechnology solutions for Alzheimer's disease: advances in research tools, diagnostic methods and therapeutic agents
(2008) *J. Alzheimer's Dis.*, 13 (2), pp. 199-223.

- Brambilla, D., Le Droumaguet, B., Nicolas, J.
Nanotechnologies for Alzheimer's disease: diagnosis, therapy, and safety issues
(2011) *Nanomedicine*, 7 (5), pp. 521-540.

- Saraiva, C., Praça, C., Ferreira, R.
Nanoparticle-mediated brain drug delivery: overcoming blood–brain barrier to treat neurodegenerative diseases
(2016) *J. Control. Rel.*, 235, pp. 34-47.

- Alyautdin, R., Khalin, I., Nafeeza, M.I.
Nanoscale drug delivery systems and the blood–brain barrier
(2014) *Int. J. Nanomed.*, 9, p. 795.

- Fernández, P.L., Britton, G.B., Rao, K.
Potential immunotargets for Alzheimer's disease treatment strategies

(2013) *J. Alzheimers Dis.*, 33 (2), pp. 297-312.

- Barone, E., Di Domenico, F., Butterfield, D.A.
  Statins more than cholesterol lowering agents in Alzheimer disease: their pleiotropic functions as potential therapeutic targets
  (2014) *Biochem. Pharmacol.*, 88 (4), pp. 605-616.

- Eskici, G.Z., Axelsen, P.H.
  Copper and oxidative stress in the pathogenesis of Alzheimer's disease
  (2012) *Biochem*, 51 (32), pp. 6289-6311.

- Lajoie, J.M., Shusta, E.V.
  Targeting receptor-mediated transport for delivery of biologics across the blood–brain barrier
  (2015) *Annu. Rev. Pharmacol. Toxicol.*, 55, pp. 613-631.

- Tenovuo, O.
  Central acetylcholinesterase inhibitors in the treatment of chronic traumatic brain injury – clinical experience in 111 patients
  (2005) *Prog. Neuropsychopharmacol. Biol. Psychiatry*, 29 (1), pp. 61-67.

- Venkatesh, K., Bullock, R., Akbas, A.
  Strategies to improve tolerability of rivastigmine: a case series
  (2007) *Curr. Med. Res. Opin.*, 23 (1), pp. 93-95.

- Yang, Z.-Z., Zhang, Y.-Q., Wang, Z.-Z.
  Enhanced brain distribution and pharmacodynamics of rivastigmine by liposomes following intranasal administration
  (2013) *Int. J. Pharm.*, 452 (1-2), pp. 344-354.

- Liu, X., Xu, K., Yan, M.
  Protective effects of galantamine against Aß-induced PC12 cell apoptosis by preventing mitochondrial dysfunction and endoplasmic reticulum stress
  (2010) *Neurochem. Intern.*, 57 (5), pp. 588-599.

- Mufamadi, M.S., Choonara, Y.E., Kumar, P.
  Ligand-functionalized nanoliposomes for targeted delivery of galantamine
  (2013) *Int. J. Pharm.*, 448 (1), pp. 267-281.

- Chen, H., Tang, L., Qin, Y.
  Lactoferrin-modified procationic liposomes as a novel drug carrier for brain delivery
  (2010) *Eur. J. Pharm. Sci.*, 40 (2), pp. 94-102.

- Kuo, Y.-C., Wang, C.-T.
  Protection of SK-N-MC cells against ß-amyloid peptide-induced degeneration using neuron growth factor-loaded liposomes with surface lactoferrin
  (2014) *Biomaterials*, 35 (22), pp. 5954-5964.

- Balducci, C., Mancini, S., Minniti, S.
  Multifunctional liposomes reduce brain ß-amyloid burden and ameliorate memory impairment in Alzheimer's disease mouse models
  (2014) *J. Neuro. Sci.*, 34 (42), pp. 14022-14031.

- Gobbi, M., Re, F., Canovi, M.
  Lipid-based nanoparticles with high binding affinity for amyloid-ß1-42 peptide
  (2010) *Biomaterials*, 31 (25), pp. 6519-6529.

- Matsuoka, Y., Saito, M., LaFrancois, J.
  Novel therapeutic approach for the treatment of Alzheimer's disease by peripheral administration of agents with an affinity to ß-amyloid
  (2003) *J. Neurosci.*, 23 (1), pp. 29-33.

- Wisniewski, T., Konietzko, U.
Amyloid-ß immunisation for Alzheimer's disease
(2008) *Lancet Neurol.*, 7 (9), pp. 805-811.

- Valera, E., Masliah, E.
Immunotherapy for neurodegenerative diseases: focus on a-synucleinopathies
(2013) *Pharmacol. Ther.*, 138 (3), pp. 311-322.

- Bard, F., Cannon, C., Barbour, R.
Peripherally administered antibodies against amyloid ß-peptide enter the central nervous system and reduce pathology in a mouse model of Alzheimer disease
(2000) *Nat. Med.*, 6 (8), pp. 916-919.

- Ordóñez-Gutiérrez, L., Posado-Fernández, A., Ahmadvand, D.
ImmunoPEGliposome-mediated reduction of blood and brain amyloid levels in a mouse model of Alzheimer's disease is restricted to aged animals
(2017) *Biomaterials*, 112, pp. 141-152.

- Danhier, F., Ansorena, E., Silva, J.M.
PLGA-based nanoparticles: an overview of biomedical applications
(2012) *J. Control. Rel.*, 161 (2), pp. 505-522.

- Sathya, S., Shanmuganathan, B., Saranya, S.
Phytol-loaded PLGA nanoparticle as a modulator of Alzheimer's toxic Aß peptide aggregation and fibrillation associated with impaired neuronal cell function
(2018) *Artif. Cells Nanomed. Biotechnol.*, 46 (8), pp. 1719-1730.

- Fornaguera, C., Feiner-Gracia, N., Calderó, G.
Galantamine-loaded PLGA nanoparticles, from nano-emulsion templating, as novel advanced drug delivery systems to treat neurodegenerative diseases
(2015) *Nanoscale*, 7 (28), pp. 12076-12084.

- Sánchez-López, E., Ettcheto, M., Egea, M.A.
New potential strategies for Alzheimer's disease prevention: PEGylated biodegradable dexibuprofen nanospheres administration to APPswe/PS1dE9
(2017) *Nanomedicine*, 13 (3), pp. 1171-1182.

- Sánchez-López, E., Ettcheto, M., Egea, M.A.
Memantine loaded PLGA PEGylated nanoparticles for Alzheimer's disease: in vitro and in vivo characterization
(2018) *J. Nanobiotechnol.*, 16 (1), pp. 1-16.

- Noetzli, M., Eap, C.B.
Pharmacodynamic, pharmacokinetic and pharmacogenetic aspects of drugs used in the treatment of Alzheimer's disease
(2013) *Clin. Pharmacokinet.*, 52 (4), pp. 225-241.

- Md, S., Ali, M., Baboota, S.
Preparation, characterization, in vivo biodistribution and pharmacokinetic studies of donepezil-loaded PLGA nanoparticles for brain targeting
(2014) *Drug Dev. Ind. Pharm.*, 40 (2), pp. 278-287.

- Baysal, I., Ucar, G., Gultekinoglu, M.
Donepezil loaded PLGA-b-PEG nanoparticles: their ability to induce destabilization of amyloid fibrils and to cross blood brain barrier in vitro
(2017) *J. Neural Transm.*, 124 (1), pp. 33-45.

- Wilson, B., Samanta, M.K., Santhi, K.
Poly(N-butylcyanoacrylate) nanoparticles coated with polysorbate 80 for the targeted delivery of rivastigmine into the brain to treat Alzheimer's disease
(2008) *Brain Res.*, 1200, pp. 159-168.

- Garrido-Maraver, J., Cordero, M.D., Oropesa-Ávila, M.
Coenzyme Q10 therapy
(2014) *Mol. Syndromol.*, 5 (3-4), pp. 187-197.

- Zh, W., Wang, Z.Y., Sun, C.S.
Trimethylated chitosan-conjugated PLGA nanoparticles for the delivery of drugs to the brain
(2010) *Biomaterials*, 31 (5), pp. 908-915.

- Toyn, J.
What lessons can be learned from failed Alzheimer's disease trials?
(2015) *Exp. Rev. Clin. Pharmacol.*, 8 (3), pp. 267-269.

- Carradori, D., Balducci, C., Re, F.
Antibody-functionalized polymer nanoparticle leading to memory recovery in Alzheimer's disease-like transgenic mouse model
(2018) *Nanomedicine*, 14 (2), pp. 609-618.

- Jose, J., Charyulu, R.N.
Prolonged drug delivery system of an antifungal drug by association with polyamidoamine dendrimers
(2016) *Int. J. Pharm. Invest.*, 6 (2), p. 123.

- Klajnert, B., Cortijo-Arellano, M., Cladera, J.
Influence of dendrimer's structure on its activity against amyloid fibril formation
(2006) *Biochem. Biophys. Res. Commun.*, 345 (1), pp. 21-28.

- Patel, D.A., Henry, J.E., Good, T.A.
Attenuation of ß-amyloid-induced toxicity by sialic-acid-conjugated dendrimers: role of sialic acid attachment
(2007) *Brain Res.*, 1161, pp. 95-105.

- Chafekar, S.M., Malda, H., Merkx, M.
Branched KLVFF tetramers strongly potentiate inhibition of beta-amyloid aggregation
(2007) *Chembiochem*, 8, pp. 1857-1864.

- Aso, E., Martinsson, I., Appelhans, D.
Poly(propylene imine) dendrimers with histidine-maltose shell as novel type of nanoparticles for synapse and memory protection
(2019) *Nanomedicine*, 17, pp. 198-209.

- Chen, Q., Du, Y., Zhang, K.
Tau-targeted multifunctional nanocomposite for combinational therapy of Alzheimer's disease
(2018) *ACS Nano*, 12 (2), pp. 1321-1338.

- Karaboga, M.N.S., Sezgintürk, M.K.
Analysis of tau-441 protein in clinical samples using rGO/AuNP nanocomposite-supported disposable impedimetric neuro-biosensing platform: towards Alzheimer's disease detection
(2020) *Talanta*, 219, p. 121257.

- Zhao, Y., Cai, J., Liu, Z.
Nanocomposites inhibit the formation, mitigate the neurotoxicity, and facilitate the removal of ß-amyloid aggregates in Alzheimer's disease mice
(2018) *Nano Lett.*, 19 (2), pp. 674-683.

- Sarin, H.
Overcoming the challenges in the effective delivery of chemotherapies to CNS solid

tumors
(2010) *Ther. Deliv.*, 1 (2), pp. 289-305.

- Chen, Y., Dalwadi, G., Benson, H.
Drug delivery across the blood–brain barrier
(2004) *Curr. Drug Deliv.*, 1 (4), pp. 361-376.

- Kang, X., Chen, H., Li, S.
Magnesium lithospermate B loaded PEGylated solid lipid nanoparticles for improved oral bioavailability
(2018) *Colloids Surf. B Biointerf.*, 161, pp. 597-605.

- Vakilinezhad, M.A., Amini, A., Javar, H.A.
Nicotinamide loaded functionalized solid lipid nanoparticles improves cognition in Alzheimer's disease animal model by reducing tau hyperphosphorylation
(2018) *DARU J. Pharm. Sci.*, 26 (2), pp. 165-177.

- Ghasemiyeh, P., Mohammadi-Samani, S.
Solid lipid nanoparticles and nanostructured lipid carriers as novel drug delivery systems: applications, advantages and disadvantages
(2018) *Res. Pharm. Sci.*, 13 (4), p. 288.

- Topal, G.R., Mészáros, M., Porkoláb, G.
ApoE-targeting increases the transfer of solid lipid nanoparticles with donepezil cargo across a culture model of the blood–brain barrier
(2021) *Pharmaceutics*, 13 (1), p. 38.

- Shankar, P.D., Shobana, S., Karuppusamy, I.
A review on the biosynthesis of metallic nanoparticles (gold and silver) using bio-components of microalgae: formation mechanism and applications
(2016) *Enzyme Microb. Technol.*, 95, pp. 28-44.

- Kim, Y., Park, J.-H., Lee, H.
How do the size, charge and shape of nanoparticles affect amyloid ß aggregation on brain lipid bilayer?
(2016) *Sci. Rep.*, 6 (1), pp. 1-14.

- Gao, N., Sun, H., Dong, K.
Gold-nanoparticle-based multifunctional amyloid-ß inhibitor against Alzheimer's disease
(2015) *Chem. A Eur. J.*, 21 (2), pp. 829-835.

- Sonawane, S.K., Ahmad, A., Chinnathambi, S.
Protein-capped metal nanoparticles inhibit tau aggregation in Alzheimer's disease
(2019) *ACS Omega*, 4 (7), pp. 12833-12840.

- Javdani, N., Rahpeyma, S.S., Ghasemi, Y.
Effect of superparamagnetic nanoparticles coated with various electric charges on a-synuclein and ß-amyloid proteins fibrillation process
(2019) *Int. J. Nanomed.*, 14, p. 799.

- Ahmed, M.E., Khan, M.M., Javed, H.
Amelioration of cognitive impairment and neurodegeneration by catechin hydrate in rat model of streptozotocin-induced experimental dementia of Alzheimer's type
(2013) *Neurochem. Int.*, 62 (4), pp. 492-501.

- Prakash, D., Sudhandiran, G.
Dietary flavonoid fisetin regulates aluminium chloride-induced neuronal apoptosis in cortex and hippocampus of mice brain
(2015) *J. Nut. Biochem.*, 26 (12), pp. 1527-1539.

- Khan, H., Amin, S., Kamal, M.A.
  Flavonoids as acetylcholinesterase inhibitors: current therapeutic standing and future prospects
  (2018) *Biomed. Pharmacother.*, 101, pp. 860-870.

- Nabavi, S.F., Braidy, N., Habtemariam, S.
  Neuroprotective effects of chrysin: from chemistry to medicine
  (2015) *Neurochem. Int.*, 90, pp. 224-231.

- Kim, D.H., Kim, S., Jeon, S.J.
  Tanshinone I enhances learning and memory, and ameliorates memory impairment in mice via the extracellular signal-regulated kinase signalling pathway
  (2009) *British J. Pharmacol.*, 158 (4), pp. 1131-1142.

- Uddin, M., Kabir, M., Niaz, K.
  Molecular insight into the therapeutic promise of flavonoids against Alzheimer's disease
  (2020) *Molecules*, 25 (6), p. 1267.

- Kanubaddi, K.R., Yang, S.-H., Wu, L.-W.
  Nanoparticle-conjugated nutraceuticals exert prospectively palliative of amyloid aggregation
  (2018) *Int. J. Nanomed.*, 13, p. 8473.

- Neves, A.R., Queiroz, J.F., Reis, S.
  Brain-targeted delivery of resveratrol using solid lipid nanoparticles functionalized with apolipoprotein E
  (2016) *J. Nanobiotechnol.*, 14 (1), pp. 1-11.

- Qi, Y., Guo, L., Jiang, Y.
  Brain delivery of quercetin-loaded exosomes improved cognitive function in AD mice by inhibiting phosphorylated tau-mediated neurofibrillary tangles
  (2020) *Drug Deliv.*, 27 (1), pp. 745-755.

- Pinheiro, R., Granja, A., Loureiro, J.
  RVG29-functionalized lipid nanoparticles for quercetin brain delivery and Alzheimer's disease
  (2020) *Pharm. Res.*, 37 (7), pp. 1-12.

- Pinheiro, R., Granja, A., Loureiro, J.
  Quercetin lipid nanoparticles functionalized with transferrin for Alzheimer's disease
  (2020) *Eur. J. Pharm. Sci.*, 148, p. 105314.

- Ovais, M., Zia, N., Ahmad, I.
  Phyto-therapeutic and nanomedicinal approaches to cure Alzheimer's disease: present status and future opportunities
  (2018) *Front. Aging Neurosci.*, 10, p. 284.

- Meng, Q., Wang, A., Hua, H.
  Intranasal delivery of huperzine A to the brain using lactoferrin-conjugated N-trimethylated chitosan surface-modified PLGA nanoparticles for treatment of Alzheimer's disease
  (2018) *Int. J. Nanomed.*, 13, p. 705.

- Li, C., Tu, G., Luo, C.
  Effects of rhynchophylline on the hippocampal miRNA expression profile in ketamine-addicted rats
  (2018) *Prog. Neuropsychopharmacol. Biol. Psychiatry.*, 86, pp. 379-389.

- Shao, H., Mi, Z., Ji, W.G.
  Rhynchophylline protects against the amyloid ß-induced increase of spontaneous

discharges in the hippocampal CA1 region of rats
(2015) *Neurochem. Res.*, 40 (11), pp. 2365-2373.

- Fu, A.K., Hung, K.W., Huang, H.
Blockade of EphA4 signaling ameliorates hippocampal synaptic dysfunctions in mouse models of Alzheimer's disease
(2014) *Proc. Natl Acad. Sci. USA*, 111 (27), pp. 9959-9964.

- Xu, R., Wang, J., Xu, J.
Rhynchophylline loaded-mPEG-PLGA nanoparticles coated with Tween-80 for preliminary study in Alzheimer's disease
(2020) *Int. J. Nanomed.*, 15, p. 1149.

- Lohan, S., Raza, K., Mehta, S.
Anti-Alzheimer's potential of berberine using surface decorated multi-walled carbon nanotubes: a preclinical evidence
(2017) *Int. J. Pharm.*, 530 (1-2), pp. 263-278.

- Mishra, S., Palanivelu, K.
The effect of curcumin (turmeric) on Alzheimer's disease: an overview
(2008) *Ann. Indian Acad. Neurol.*, 11 (1), p. 13.

- Yang, F., Lim, G.P., Begum, A.N.
Curcumin inhibits formation of amyloid ß oligomers and fibrils, binds plaques, and reduces amyloid in vivo
(2005) *J. Biol. Chem.*, 280 (7), pp. 5892-5901.

- Baum, L., Lam, C.W.K., Sk-K, C.
Six-month randomized, placebo-controlled, double-blind, pilot clinical trial of curcumin in patients with Alzheimer disease
(2008) *J. Clin. Psychopharmacol.*, 28 (1), pp. 110-113.

- Collins, A.E., Saleh, T.M., Kalisch, B.E.
Naturally occurring antioxidant therapy in Alzheimer's disease
(2022) *Antioxidants (Basel)*, 11 (2), p. 213.

- Sathya, S., Shanmuganathan, B., Devi, K.P.
Deciphering the anti-apoptotic potential of a-bisabolol loaded solid lipid nanoparticles against Aß induced neurotoxicity in neuro-2a cells
(2020) *Colloids Surf. B Biointerf.*, 190, p. 110948.

- Brenza, T.M., Ghaisas, S., Ramirez, J.E.V.
Neuronal protection against oxidative insult by polyanhydride nanoparticle-based mitochondria-targeted antioxidant therapy
(2017) *Nanomedicine*, 13 (3), pp. 809-820.

- Jose, S., Sowmya, S., Cinu, T.
Surface modified PLGA nanoparticles for brain targeting of bacoside-A
(2014) *Eur. J. Pharm. Sci.*, 63, pp. 29-35.

- Aalinkeel, R., Kutscher, H.L., Singh, A.
Neuroprotective effects of a biodegradable poly(lactic-co-glycolic acid)-ginsenoside Rg3 nanoformulation: a potential nanotherapy for Alzheimer's disease?
(2018) *J. Drug Target.*, 26 (2), pp. 182-193.

- Cano, A., Ettcheto, M., Chang, J.-H.
Dual-drug loaded nanoparticles of epigallocatechin-3-gallate (EGCG)/ascorbic acid enhance therapeutic efficacy of EGCG in a APPswe/PS1dE9 Alzheimer's disease mice model
(2019) *J. Control. Rel.*, 301, pp. 62-75.

- Doggui, S., Sahni, J.K., Arseneault, M.
Neuronal uptake and neuroprotective effect of curcumin-loaded PLGA nanoparticles on the human SK-N-SH cell line
(2012) *J. Alzheimers Dis.*, 30 (2), pp. 377-392.

- Mathew, A., Fukuda, T., Nagaoka, Y.
Curcumin loaded-PLGA nanoparticles conjugated with Tet-1 peptide for potential use in Alzheimer's disease
(2012) *PLOS ONE*, 7 (3).

- Hu, B., Dai, F., Fan, Z.
Nanotheranostics: congo red/rutin-MNPs with enhanced magnetic resonance imaging and H#inf#2#/inf#O#inf#2#/inf#-responsive therapy of Alzheimer's disease in APPswe/PS1dE9 transgenic mice
(2015) *Adv. Mater.*, 27 (37), pp. 5499-5505.

- Jaruszewski, K.M., Curran, G.L., Swaminathan, S.K.
Multimodal nanoprobes to target cerebrovascular amyloid in Alzheimer's disease brain
(2014) *Biomaterials*, 35 (6), pp. 1967-1976.

- Zhang, C., Wan, X., Zheng, X.
Dual-functional nanoparticles targeting amyloid plaques in the brains of Alzheimer's disease mice
(2014) *Biomaterials*, 35 (1), pp. 456-465.

- Poplawski, S.G., Garbett, K.A., McMahan, R.L.
An antisense oligonucleotide leads to suppressed transcription of Hdac2 and long-term memory enhancement
(2020) *Mol. Ther. Nucleic Acids*, 19, pp. 1399-1412.

- Mourtas, S., Lazar, A.N., Markoutsa, E.
Multifunctional nanoliposomes with curcumin-lipid derivative and brain targeting functionality with potential applications for Alzheimer disease
(2014) *European J. Med. Chem.*, 80, pp. 175-183.

- Papadia, K., Markoutsa, E., Mourtas, S.
Multifunctional LUV liposomes decorated for BBB and amyloid targeting. in vitro proof-of-concept
(2017) *Eur. J. Pharm. Sci.*, 101, pp. 140-148.

- Mourtas, S., Christodoulou, P., Klepetsanis, P.
Preparation of benzothiazolyl-decorated nanoliposomes
(2019) *Molecules*, 24 (8), p. 1540.

- Siegemund, T., Paulke, B.-R., Schmiedel, H.
Thioflavins released from nanoparticles target fibrillar amyloid ß in the hippocampus of APP/PS1 transgenic mice
(2006) *Int. J. Dev. Neurosci.*, 24 (2-3), pp. 195-201.

- Glick, D., Barth, S., MacLeod, K.F.
Autophagy: cellular and molecular mechanisms
(2010) *J. Pathol.*, 221 (1), pp. 3-12.

- Bateman, R.J., Munsell, L.Y., Morris, J.C.
Human amyloid-ß synthesis and clearance rates as measured in cerebrospinal fluid in vivo
(2006) *Nat. Med.*, 12 (7), pp. 856-861.

- Nilsson, P., Saido, T.C.
Dual roles for autophagy: degradation and secretion of Alzheimer's disease Aß

peptide
(2014) *BioEssays*, 36 (6), pp. 570-578.

- Nixon, R.A.
Autophagy, amyloidogenesis and Alzheimer disease
(2007) *J. Cell Sci.*, 120 (23), pp. 4081-4091.

- Lee, J.-A., Beigneux, A., Ahmad, S.T.
ESCRT-III dysfunction causes autophagosome accumulation and neurodegeneration
(2007) *Curr. Biol.*, 17 (18), pp. 1561-1567.

- Yamazaki, Y., Takahashi, T., Hiji, M.
Immunopositivity for ESCRT-III subunit CHMP2B in granulovacuolar degeneration of neurons in the Alzheimer's disease hippocampus
(2010) *Neurosci. Lett.*, 477 (2), pp. 86-90.

- Saido, T., Leissring, M.A.
Proteolytic degradation of amyloid ß-protein
(2012) *Harb. Perspect.*, 2 (6), p. a006379.

- Nixon, R.A., Wegiel, J., Kumar, A.
Extensive involvement of autophagy in Alzheimer disease: an immuno-electron microscopy study
(2005) *J. Neuropathol. Exp. Neurol.*, 64 (2), pp. 113-122.

- Yu, W.H., Cuervo, A.M., Kumar, A.
Macroautophagy – a novel ß-amyloid peptide-generating pathway activated in Alzheimer's disease
(2005) *J. Cell Biol.*, 171 (1), pp. 87-98.

- Nilsson, P., Loganathan, K., Sekiguchi, M.
Aß secretion and plaque formation depend on autophagy
(2013) *Cell Rep.*, 5 (1), pp. 61-69.

- Nixon, R.A.
The role of autophagy in neurodegenerative disease
(2013) *Nat. Med.*, 19 (8), pp. 983-997.

- Sarkar, S.
Role of autophagy in neurodegenerative diseases
(2011) *Curr. Sci.*, 101 (4), pp. 514-519.

- Zhang, L., Wang, L., Wang, R.
Evaluating the effectiveness of GTM-1, rapamycin, and carbamazepine on autophagy and Alzheimer disease
(2017) *Med. Sci. Monit.*, 23, p. 801.

- Steele, J.W., Gandy, S.
Latrepirdine (Dimebon#sup#®#/sup#), a potential Alzheimer therapeutic, regulates autophagy and neuropathology in an Alzheimer mouse model
(2013) *Autophagy*, 9 (4), pp. 617-618.

- Forlenza, O.V., De Paula, V.J., MacHado-Vieira, R.
Does lithium prevent Alzheimer's disease?
(2012) *Drugs Aging*, 29 (5), pp. 335-342.

- Matsunaga, S., Kishi, T., Annas, P.
Lithium as a treatment for Alzheimer's disease: a systematic review and meta-analysis
(2015) *J. Alzheimers Dis.*, 48 (2), pp. 403-410.

- Matsunaga, S., Kishi, T., Iwata, N.
Memantine monotherapy for Alzheimer's disease: a systematic review and meta-analysis
(2015) *PLOS ONE*, 10 (4).

- Song, G., Li, Y., Lin, L.
Anti-autophagic and anti-apoptotic effects of memantine in a SH-SY5Y cell model of Alzheimer's disease via mammalian target of rapamycin-dependent and-independent pathways
(2015) *Mol. Med. Rep.*, 12 (5), pp. 7615-7622.

- Liu, D., Pitta, M., Jiang, H.
Nicotinamide forestalls pathology and cognitive decline in Alzheimer mice: evidence for improved neuronal bioenergetics and autophagy procession
(2013) *Neurobiol. Aging*, 34 (6), pp. 1564-1580.

- Gong, B., Pan, Y., Vempati, P.
Nicotinamide riboside restores cognition through an upregulation of proliferator-activated receptor-? coactivator 1a regulated ß-secretase 1 degradation and mitochondrial gene expression in Alzheimer's mouse models
(2013) *Neurobiol. Aging*, 34 (6), pp. 1581-1588.

- Kickstein, E., Krauss, S., Thornhill, P.
Biguanide metformin acts on tau phosphorylation via mTOR/protein phosphatase 2A (PP2A) signaling
(2010) *Proc. Natl Acad Sci. USA*, 107 (50), pp. 21830-21835.

- Spilman, P., Podlutskaya, N., Hart, M.J.
Correction: inhibition of mTOR by rapamycin abolishes cognitive deficits and reduces amyloid-ß levels in a mouse model of Alzheimer's disease
(2011) *PLOS ONE*, 6 (11).

- Vingtdeux, V., Giliberto, L., Zhao, H.
AMP-activated protein kinase signaling activation by resveratrol modulates amyloid-ß peptide metabolism
(2010) *J. Biol. Chem.*, 285 (12), pp. 9100-9113.

- Porquet, D., Griñán-Ferré, C., Ferrer, I.
Neuroprotective role of trans-resveratrol in a murine model of familial Alzheimer's disease
(2014) *J. Alzheimers Dis.*, 42 (4), pp. 1209-1220.

- Zhu, Z., Yan, J., Jiang, W.
Arctigenin effectively ameliorates memory impairment in Alzheimer's disease model mice targeting both ß-amyloid production and clearance
(2013) *J. Neurosci.*, 33 (32), pp. 13138-13149.

- Deng, M., Huang, L., Ning, B.
ß-asarone improves learning and memory and reduces acetyl cholinesterase and beta-amyloid 42 levels in APP/PS1 transgenic mice by regulating Beclin-1-dependent autophagy
(2016) *Brain Res.*, 1652, pp. 188-194.

- Grossi, C., Rigacci, S., Ambrosini, S.
The polyphenol oleuropein aglycone protects TgCRND8 mice against Aß plaque pathology
(2013) *PLOS ONE*, 8 (8).

- Martorell, M., Forman, K., Castro, N.
Potential therapeutic effects of oleuropein aglycone in Alzheimer's disease
(2016) *Curr. Pharm. Biotechnol.*, 17 (11), pp. 994-1001.

- Inestrosa, N., Tapia-Rojas, C., Griffith, T.
Tetrahydrohyperforin prevents cognitive deficit, Aß deposition, tau phosphorylation and synaptotoxicity in the APPswe/PSEN1?E9 model of Alzheimer's disease: a possible effect on APP processing
(2011) *Trans. Psychiatry*, 1 (7), p. e20.

- Cavieres, V.A., González, A., Muñoz, V.C.
Tetrahydrohyperforin inhibits the proteolytic processing of amyloid precursor protein and enhances its degradation by Atg5-dependent autophagy
(2015) *PLOS ONE*, 10 (8).

- Sarkar, S., Davies, J.E., Huang, Z.
Trehalose, a novel mTOR-independent autophagy enhancer, accelerates the clearance of mutant huntingtin and a-synuclein
(2007) *J. Biol. Chem.*, 282 (8), pp. 5641-5652.

- Krüger, U., Wang, Y., Kumar, S.
Autophagic degradation of tau in primary neurons and its enhancement by trehalose
(2012) *Neurobiol. Aging*, 33 (10), pp. 2291-2305.

- Luo, Q., Lin, Y.-X., Yang, P.-P.
A self-destructive nanosweeper that captures and clears amyloid ß-peptides
(2018) *Nat. Commun.*, 9 (1), pp. 1-12.

- Mytych, J., Solek, P., Bedzinska, A.
Klotho-mediated changes in the expression of Atg13 alter formation of ULK1 complex and thus initiation of ER- and Golgi-stress response mediated autophagy
(2020) *Apoptosis*, 25, pp. 57-72.

- Mytych, J., Solek, P., Koziorowski, M.
Klotho modulates ER-mediated signaling crosstalk between prosurvival autophagy and apoptotic cell death during LPS challenge
(2019) *Apoptosis*, 24, pp. 95-107.

- Chen, K., Sun, Z.
Autophagy plays a critical role in Klotho gene deficiency-induced arterial stiffening and hypertension
(2019) *J. Mol. Med.*, 97, pp. 1615-1625.

- Li, D., Jing, D., Liu, Z.
Enhanced expression of secreted alpha-Klotho in the hippocampus alters nesting behavior and memory formation in mice
(2019) *Front. Cell. Neurosci.*, 13, p. 133.

- Fung, T.Y., Iyaswamy, A., Sreenivasmurthy, S.G.
Klotho an autophagy stimulator as a potential therapeutic target for Alzheimer's disease: a review
(2022) *Biomedicines*, 10 (3), p. 705.

- Nixon, R.A.
The aging lysosome: an essential catalyst for late-onset neurodegenerative diseases
(2020) *Biochim. Biophys. Acta Proteins Proteom.*, 1868, p. 140443.

- Fernandez, A.F., Sebti, S., Wei, Y.
Disruption of the beclin 1-BCL2 autophagy regulatory complex promotes longevity in mice
(2018) *Nature*, 558, pp. 136-140.

- Abraham, C.R., Mullen, P.C., Tucker-Zhou, T.
  Klotho is a neuroprotective and cognition-enhancing protein
  (2016) *Vitam. Horm.*, 101, pp. 215-238.

- Mytych, J.
  Klotho and neurons: mutual crosstalk between autophagy, endoplasmic reticulum, and inflammatory response
  (2021) *Neural Regen. Res.*, 16, pp. 1542-1543.

- Zhang, F.-Q., Jiang, J.-L., Zhang, J.-T.
  Current status and future prospects of stem cell therapy in Alzheimer's disease
  (2020) *Neural Regen. Res.*, 15 (2), p. 242.

- Reddy, P.H.
  Current status of stem cell research: an editorial
  (2020) *Biochim Biophys Acta Mol Basis Dis.*, 1866 (4), p. 165635.

- Zhang, L., Dong, Z.-F., Zhang, J.-Y.
  Immunomodulatory role of mesenchymal stem cells in Alzheimer's disease
  (2020) *Life Sci.*, 246, p. 117405.

- Farzamfar, S., Nazeri, N., Salehi, M.
  Will nanotechnology bring new hope for stem cell therapy?
  (2018) *Cells Tissues Organs*, 206 (4-5), pp. 229-241.

- Ramalingam, M., Haj, A.E., Webster, T.J.
  A special section on the role of nanotechnology in stem cell research
  (2016) *J. Nanosci. Nanotechnol.*, 16 (9), pp. 8859-8861.

- Santos, T., Maia, J., Agasse, F.
  Nanomedicine boosts neurogenesis: new strategies for brain repair
  (2012) *Integr. Biol.*, 4 (9), pp. 973-981.

- Teleanu, D.M., Chircov, C., Grumezescu, A.M.
  Neurotoxicity of nanomaterials: an up-to-date overview
  (2019) *Nanomaterials*, 9 (1), p. 96.

- Bhabra, G., Sood, A., Fisher, B.
  Nanoparticles can cause DNA damage across a cellular barrier
  (2009) *Nat. Nanotechnol.*, 4 (12), pp. 876-883.

- Formicola, B., Cox, A., Dal Magro, R.
  Nanomedicine for the treatment of Alzheimer's disease
  (2019) *J. Biomed. Nanotechnol.*, 15 (10), pp. 1997-2024.

- Teleanu, D.M., Chircov, C., Grumezescu, A.M.
  Impact of nanoparticles on brain health: an up to date overview
  (2018) *J. Clin. Med.*, 7 (12), p. 490.

- Carro, C.E., Pilozzi, A.R., Huang, X.
  Nanoneurotoxicity and potential nanotheranostics for Alzheimer's disease
  (2019) *EC Pharmacol. Toxicol.*, 7 (12), pp. 1-7.

- Kononenko, V., Narat, M., Drobne, D.
  Nanoparticle interaction with the immune system
  (2015) *Arh. Hig. Rada Toksikol.*, 66 (2), pp. 97-108.

- Amor, S., Peferoen, L.A., Vogel, D.Y.
  Inflammation in neurodegenerative diseases – an update
  (2014) *Immunology*, 142 (2), pp. 151-166.

- Yang, X., He, C., Li, J.
Uptake of silica nanoparticles: neurotoxicity and Alzheimer-like pathology in human SK-N-SH and mouse neuro2a neuroblastoma cells
(2014) *Toxicol. Lett.*, 229 (1), pp. 240-249.

- Sikorska, K., Gradzka, I., Sochanowicz, B.
Diminished amyloid-ß uptake by mouse microglia upon treatment with quantum dots, silver or cerium oxide nanoparticles: nanoparticles and amyloid-ß uptake by microglia
(2020) *Hum. Exp. Toxicol.*, 39 (2), pp. 147-158.

- St. George-Hyslop, P.H., Morris, J.C.
Will anti-amyloid therapies work for Alzheimer's disease?
(2008) *Lancet*, 372 (9634), pp. 180-182.

- Mangialasche, F., Solomon, A., Winblad, B.
Alzheimer's disease: clinical trials and drug development
(2010) *Lancet Neurol.*, 9 (7), pp. 702-716.

- Marciani, D.J.
Alzheimer's disease vaccine development: a new strategy focusing on immune modulation
(2015) *J. Neuroimmunol.*, 287, pp. 54-63.

- Ballard, C., Lang, I.
Alcohol and dementia: a complex relationship with potential for dementia prevention
(2018) *Lancet Public Health*, 3 (3), pp. e103-e104.

- Fazil, M., Md, S., Haque, S.
Development and evaluation of rivastigmine loaded chitosan nanoparticles for brain targeting
(2012) *Eur. J. Pharm. Sci.*, 47 (1), pp. 6-15.

- Joshi, S.A., Chavhan, S.S., Sawant, K.K.
Rivastigmine-loaded PLGA and PBCA nanoparticles: preparation, optimization, characterization, in vitro and pharmacodynamic studies
(2010) *Eur. J. Pharm. Biopharm.*, 76 (2), pp. 189-199.

- Hanafy, A.S., Farid, R.M., ElGamal, S.S.
Complexation as an approach to entrap cationic drugs into cationic nanoparticles administered intranasally for Alzheimer's disease management: preparation and detection in rat brain
(2015) *Drug Dev. Ind. Pharm.*, 41 (12), pp. 2055-2068.

- Misra, S., Chopra, K., Sinha, V.
Galantamine-loaded solid-lipid nanoparticles for enhanced brain delivery: preparation, characterization, in vitro and in vivo evaluations
(2016) *Drug Deliv.*, 23 (4), pp. 1434-1443.

- Li, W., Zhou, Y., Zhao, N.
Pharmacokinetic behavior and efficiency of acetylcholinesterase inhibition in rat brain after intranasal administration of galanthamine hydrobromide loaded flexible liposomes
(2012) *Env. Toxicol. Pharmacol.*, 34 (2), pp. 272-279.

- Wilson, B., Samanta, M.K., Santhi, K.
Targeted delivery of tacrine into the brain with polysorbate 80-coated poly(n-butylcyanoacrylate) nanoparticles
(2008) *Eur. J. Pharm. Biopharm.*, 70 (1), pp. 75-84.

- Luppi, B., Bigucci, F., Corace, G.
  Albumin nanoparticles carrying cyclodextrins for nasal delivery of the anti-Alzheimer drug tacrine
  (2011) *Eur. J. Pharm. Sci.*, 44 (4), pp. 559-565.

- Md, S., Ali, M., Ali, R.
  Donepezil nanosuspension intended for nose to brain targeting: in vitro and in vivo safety evaluation
  (2014) *Int. J. Biol. Macromol.*, 67, pp. 418-425.

- Shi, M., Chu, F., Zhu, F., Zhu, J.
  Impact of anti-amyloid-ß monoclonal antibodies on the pathology and clinical profile of Alzheimer's disease: a focus on aducanumab and lecanemab
  (2022) *Front. Aging Neurosci.*, 14, p. 870517.

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