

BACKGROUND

Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by amyloid- β plaque deposition, tau neurofibrillary tangles, and cognitive decline. Although monoclonal antibodies have shown potential in targeting these pathological hallmarks, their therapeutic efficacy is limited by poor blood-brain barrier penetration and low brain bioavailability. Solid lipid nanocarriers (SLNs) offer a promising strategy to enhance antibody stability, brain targeting, and therapeutic effectiveness for the management of Alzheimer's disease.

METHODS

A comprehensive literature review was conducted using published studies focusing on solid lipid nanocarrier-mediated delivery of monoclonal antibodies in Alzheimer's disease. Recent advances in brain-targeted nanomedicine, blood-brain barrier transport mechanisms, and amyloid- β and tau-targeting therapies were systematically evaluated. Additionally, formulation strategies, therapeutic efficacy, nanoparticle characteristics, biodistribution profiles, and neuroprotective outcomes reported in preclinical and clinical studies were critically analyzed. Dynamic light scattering was employed to determine hydrodynamic diameter and particle size distribution, while scanning electron microscopy (SEM) or transmission electron microscopy (TEM) was used to examine particle morphology and surface characteristics. Fourier-transform infrared spectroscopy (FTIR) and differential scanning calorimetry (DSC) were performed.

METHODS

Physicochemical characteristics including particle size, polydispersity index, zeta potential, encapsulation efficiency, stability, and release kinetics were evaluated. Additionally, the ability of SLNs to enhance brain targeting, improve blood-brain barrier penetration, and facilitate effective monoclonal antibody delivery was assessed through reported preclinical studies. In vivo pharmacodynamic evaluation included assessment of cognitive performance using Morris water maze and Y-maze tests, followed by estimation of oxidative stress biomarkers, inflammatory cytokines, and histological examination of hippocampal and cortical tissues to determine the neuroprotective efficacy of the developed nanoparticle formulation against Alzheimer's disease pathology.

RESULTS AND CONCLUSION

Studies indicate that solid lipid nanocarriers (SLNs) significantly improve the delivery of monoclonal antibodies across the blood-brain barrier, enhancing their stability, bioavailability, and brain accumulation. SLN-mediated delivery promotes more effective clearance of amyloid- β plaques and tau aggregates, leading to reduced neuroinflammation and improved cognitive outcomes in preclinical models. These findings suggest that SLNs represent a promising nanocarrier system for targeted antibody delivery and may provide an effective disease-modifying approach for the treatment of Alzheimer's disease.

REFERENCES

Ntondini, T. L., Naki, T., & Alven, S. (2025). The therapeutic efficacy of nanoparticles in the treatment of alzheimer's disease. *Acta Neurologica Belgica*, 126(1), 35. <https://doi.org/10.1007/S13760-025-02905-W>

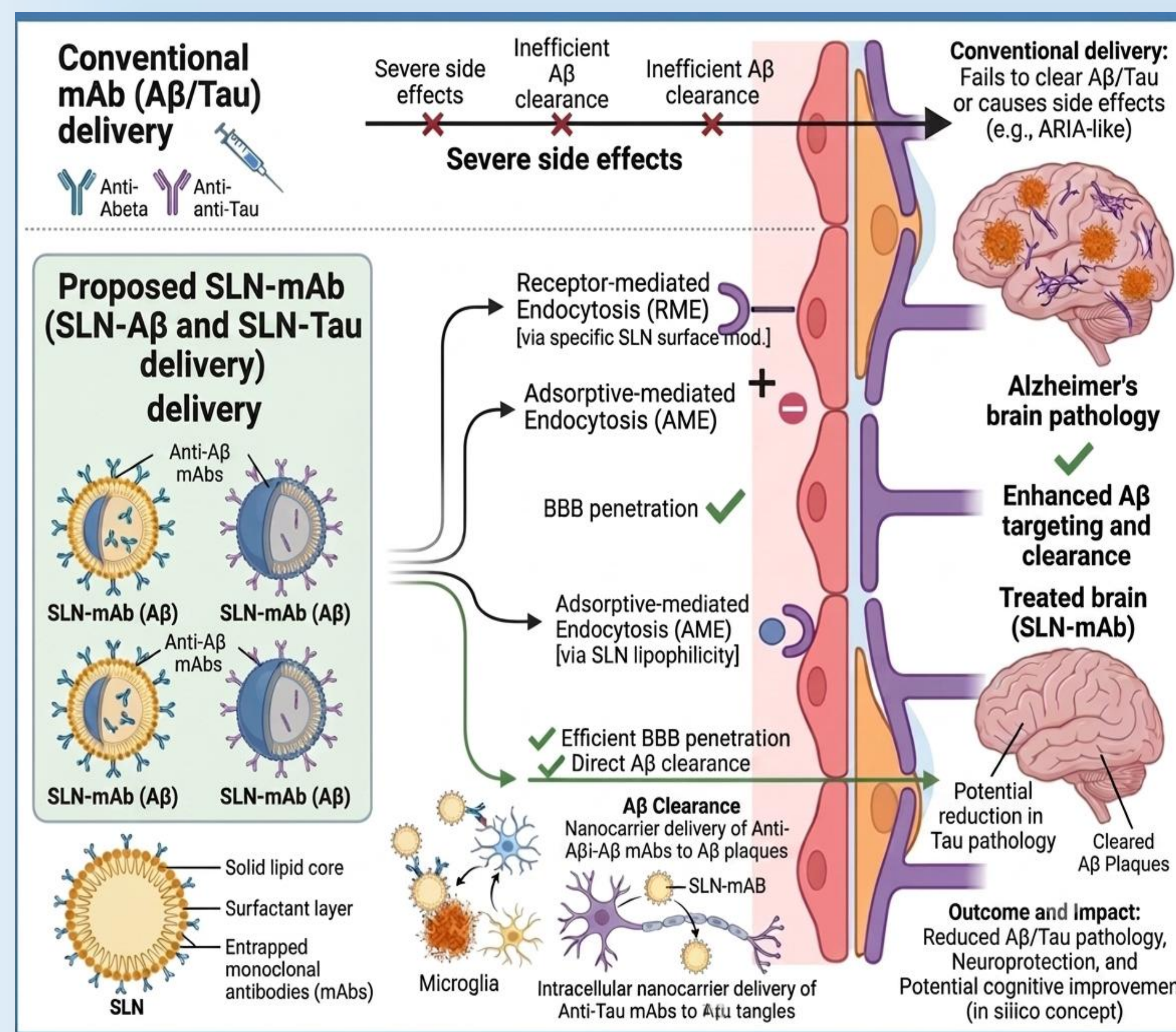


Figure 1. Proposed mechanism of solid lipid nanocarrier-mediated monoclonal antibody delivery for enhanced amyloid- β and tau targeting in Alzheimer's disease.