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Unveiling the link between Blood-Brain Barrier Dysfunction and Alzheimer's. Disease: A Systematic Review on Aging, Oxidative stress and BDNF loss-related Mechanisms

Study Type: Systematic Review (Without Meta-Analysis)

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Key Points

Question:
How does blood-brain barrier (BBB) dysfunction contribute to Alzheimer's disease (AD) progression?
What role do aging, oxidative stress, and brain-derived neurotrophic factor (BDNF) loss play in BBB degeneration?

Findings:
BBB breakdown allows harmful substances and immune cells to enter the brain, triggering neuroinflammation and oxidative stress.
This contributes to amyloid-beta and tau accumulation, astrocyte loss, and reduced BDNF levels, all of which are linked to cognitive decline.
Studies consistently indicate a strong association between BBB dysfunction and AD pathology.
Identifying early BBB compromise may help in developing therapeutic interventions to delay AD onset.

Meaning:
BBB integrity is a crucial factor in neurodegeneration and could serve as a therapeutic target for AD.
Future research should focus on long-term studies exploring causal relationships between BBB breakdown, oxidative stress, inflammation, and neuronal health.
Understanding these mechanisms could lead to early intervention strategies for at-risk aging populations.

Abstract

Importance:
As the world's population ages, neurodegenerative diseases for example Alzheimer's disease (AD) poses a significant clinical and public challenge. it is critical to understand the alterable risk factors and mechanisms involved in its onset and progression and helping to develop preventive and therapeutic interventions. According to recent research studies indicates that Blood-Brain Barriers (BBB) degeneration may play a vital role in Alzheimer's disease pathogenesis, with growing evidence linking BBB breakdown leading to allowing harmful substances and immune cells to enter the brain furthermore, leading to neuroinflammation, oxidative stress and chromosomes inflammation. These contributes to amyloid-beta and tau accumulation, astrocyte loss and decrease in brain-derived neurotrophic factor (BDNF), all of which are associated with cognitive decline. Identifying and confirming the relationship between BBB dysfunction and these mentioned pathological changes could drive breakthroughs in early intervention and treatment for at-risk elderly populations.

Objective:
This systematic review aims to evaluate the relationship between Alzheimer's progression and BBB dysfunction in early adults. Specially, it examines whether BBB dysfunction due to earlier mentioned pathological conditions along with aging contributes to AD onset and progression, comparing finding between individuals with compromised versus intact BBB integrity.

Evidence Review:
A comprehensive search of databases, including Google scholar, PubMed, Cochrane Library along with textbooks like Guyton and Hall, Stuart Ira Fox and Sembuligum were referred. Focusing on studies published in recent and past few years. Search terms included combinations of "blood-brain barrier," "Alzheimer's disease," "aging," "cognitive decline," "oxidative stress," "chronic inflammation," "astrocyte loss," and "brain-derived neurotrophic factor." The review includes clinical studies, experimental research, and other literature review investigating BBB integrity in aging and its link to AD.

Findings:
Studies were screened and assess for quality based on sample size, methodology, and relevance to the research question, with findings to showcase consistent trends, potential mechanisms and remains gaps in the research.

Conclusion:
This review highlights the importance the further research into BBB degeneration as a potential therapeutic target. It recommends long-term studies to explore the casual relationship between BBB dysfunction due, oxidative stress, inflammation, astrocyte health and BDNF levels in Alzheimer's disease progression with aging population.

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