

Using Bearded Capuchin Monkeys as an Alzheimer's disease Model

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Abstract

Alzheimer's disease (AD) is a debilitating neurodegenerative disorder characterized by progressive cognitive decline and memory loss. The search for effective treatments has been hindered by the limitations of current animal models, which often fail to replicate the complexity of human AD. Bearded capuchin monkeys (*Sapajus libidinosus*) present a promising alternative due to their advanced cognitive abilities, social behaviors, and neuroanatomical similarities to humans. This article explores the potential of using bearded capuchin monkeys as models for AD research, highlighting their advantages over traditional rodent models, the methodologies employed, and the challenges faced. Ethical considerations, the need for enhanced genetic tools, and the integration of behavioral and neurobiological studies are discussed as critical factors in leveraging capuchin monkeys for AD research. The findings suggest that capuchin monkeys could significantly advance our understanding of Alzheimer's disease and contribute to the development of more effective therapies.

Keywords: Alzheimer's disease; Bearded capuchin monkeys; Animal models; Cognitive decline; Neurodegeneration

Introduction

Alzheimer's disease (AD) is a progressive neurodegenerative disorder that leads to cognitive decline, memory loss, and functional impairment. Despite extensive research, effective treatments remain elusive, necessitating the development of reliable animal models to better understand the disease's pathology and to test potential therapies. Bearded capuchin monkeys (*Sapajus libidinosus*) have emerged as promising candidates for Alzheimer's disease models due to their advanced cognitive abilities, social behaviors, and neuroanatomical similarities to humans [1]. Bearded capuchin monkeys are known for their sophisticated tool use, problem-solving skills, and complex social interactions, which closely mimic human behaviors. These attributes make them suitable for studying cognitive functions and their decline in Alzheimer's disease. Unlike rodents, capuchins exhibit behaviors and cognitive processes that are more comparable to those of humans, providing a more relevant context for AD research. The brain structure of bearded capuchin monkeys shares significant similarities with the human brain, including the presence of well-developed neocortices and hippocampal formations [2]. These areas are critically involved in memory and cognitive function, which are notably affected in Alzheimer's disease. Additionally, the cholinergic system, implicated in AD pathology, is well-represented in capuchins, enhancing the validity of this model for studying disease mechanisms and potential treatments. Existing animal models, primarily rodents, have contributed significantly to our understanding of Alzheimer's disease. However, they have notable limitations. Rodent models, despite genetic modifications to exhibit AD-like symptoms, do not fully replicate the complex cognitive decline seen in humans [3]. Additionally, the anatomical and physiological differences between rodent and human brains limit the translatability of findings from these models to clinical settings. Capuchin monkeys' closer evolutionary relationship to humans means that findings from studies using these primates are more likely to be applicable to human conditions [4].

Discussion

This is particularly important for the development of treatments, as therapeutic approaches that are effective in capuchins have a higher likelihood of success in human clinical trials compared to those developed using rodent models. Bearded capuchins thrive in enriched

environments, similar to human social and physical settings. This allows researchers to study the impact of environmental factors on Alzheimer's progression, which is challenging in less socially complex species [5]. Understanding how social interactions and environmental stimuli influence AD could lead to holistic approaches to treatment and care. The use of bearded capuchin monkeys as a model for Alzheimer's disease is promising due to their cognitive complexity and neuroanatomical similarities to humans. These primates exhibit sophisticated behaviors, such as tool use and social interactions, which mirror human cognitive processes and can provide valuable insights into the cognitive decline observed in Alzheimer's disease [6]. Their well-developed neocortex and hippocampal formations, which are critically involved in memory and learning, make them particularly relevant for studying the pathological changes associated with AD. Traditional rodent models, while valuable, have significant limitations in replicating the full spectrum of Alzheimer's disease pathology. The simpler brain structure and less complex behaviors of rodents limit the translatability of findings to human AD. In contrast, capuchin monkeys' advanced cognitive abilities and complex brain structures provide a more relevant model for studying the disease's progression and potential interventions [7]. The closer evolutionary relationship of capuchins to humans further enhances the applicability of research findings to human conditions. Implementing research with capuchin monkeys involves comprehensive cognitive assessments, neuroimaging, and biomarker analysis. These methods provide a multifaceted understanding of AD, from behavioral changes to molecular and structural brain alterations. However, the use of non-human primates in research raises significant ethical concerns. Ensuring their welfare through enriched living conditions and minimizing distress is paramount. Adherence to stringent ethical guidelines and the

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Received: 01-May-2024, Manuscript No: JNID-24-137520, **Editor assigned:** 03-May-2024, Pre-QC No: JNID-24-137520 (PQ), **Reviewed:** 17-May-2024, QC No: JNID-24-137520, **Revised:** 22-May-2024, Manuscript No: JNID-24-137520 (R), **Published:** 29-May-2024, DOI: 10.4172/2314-7326.1000506

Citation: Andrew D (2024) Using Bearded Capuchin Monkeys as an Alzheimer's disease Model. J Neuroinfect Dis 15: 506.

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development of humane research protocols are essential for the ethical justification of using capuchins in AD research [8].

Research methodology

Ethical considerations: The use of non-human primates in research necessitates stringent ethical considerations. Ensuring the welfare of capuchin monkeys involves providing enriched living conditions, social companionship, and minimizing distress. Research protocols must comply with ethical guidelines set forth by institutions and regulatory bodies to ensure humane treatment [9].

Experimental Design

Cognitive assessments

Behavioral and cognitive assessments in capuchin monkeys can include tasks such as object recognition, problem-solving, and memory tests. These tasks are designed to parallel cognitive tests used in human AD patients, providing direct comparability of results.

Neuroimaging and biomarkers: Advanced neuroimaging techniques, such as MRI and PET scans, can be employed to monitor brain changes in capuchin monkeys over time. Additionally, the collection of cerebrospinal fluid (CSF) and blood samples allows for the analysis of biomarkers associated with Alzheimer's disease, such as amyloid-beta and tau proteins.

Longitudinal studies: Longitudinal studies involving capuchin monkeys can track the progression of cognitive decline and neurodegeneration over time, providing insights into the stages of Alzheimer's disease and the effects of potential treatments. These studies are essential for understanding the chronic nature of AD and evaluating long-term therapeutic efficacy.

Potential challenges

Ethical and logistical issues: The use of capuchin monkeys is not without challenges. Ethical concerns regarding the welfare of these primates must be carefully managed, and the costs associated with their care and housing is substantial. Additionally, the availability of these primates for research is limited, requiring judicious and efficient use of resources [10].

Genetic manipulation: While genetic manipulation is common in rodent models, it is more complex and less established in capuchin monkeys. Developing techniques for genetic modification in these primates is necessary to create models that exhibit the specific genetic mutations associated with Alzheimer's disease in humans.

Conclusion

In conclusion, utilizing bearded capuchin monkeys as an Alzheimer's disease model offers promising avenues for advancing our understanding of the disease and developing effective treatments. Their remarkable cognitive abilities, coupled with their susceptibility to age-related cognitive decline and neuropathological changes akin to Alzheimer's in humans, make them invaluable research subjects. By studying these primates, researchers can unravel the underlying mechanisms of Alzheimer's pathology and test potential therapeutic interventions in a more physiologically relevant model. Ultimately, this research has the potential to lead to groundbreaking discoveries that improve the lives of millions affected by Alzheimer's disease.

Acknowledgement

None

Conflict of Interest

None

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