J Neurol Neurosci ©
15 (3) 2024 : 001-002 • SHORT COMMUNICATION

Marine mammal central nervous system disorders: Human disease models

Gucep Ittalio*
Department of Neurology, University of Teramo, Teramo, Italy

INTRODUCTION

Marine mammals, including whales, dolphins, seals, and manatees, are fascinating creatures that have adapted to life in aquatic environments. Their unique physiology and behaviours provide valuable insights into the evolutionary adaptations of mammals as a whole. One particularly interesting area of study is the Central Nervous System (CNS) disorders that can affect these animals. Understanding these disorders not only aids in marine mammal conservation efforts but also has significant implications for human medicine, especially in developing models for human CNS diseases [1]. Marine mammals face a range of threats, including pollution, climate change, habitat loss, and human interaction, all of which can impact their health and well-being. Among the various health issues, CNS disorders are particularly concerning as they can affect an animal's ability to navigate, hunt, socialize, and reproduce. Research into these disorders can help scientists and veterinarians develop better treatment strategies for marine mammals and create more effective models for human neurological diseases, such as Alzheimer's, Parkinson's, and multiple sclerosis. The central nervous system of marine mammals is similar to that of terrestrial mammals, comprising the brain and spinal cord. However, it exhibits some unique adaptations that facilitate life in water. For instance, the larger brain-to-body size ratio in marine mammals, particularly cetaceans suggests advanced cognitive abilities, including complex social interactions and problem-solving skills.

The brain of marine mammals shows particular specialization in regions responsible for echolocation, social communication, and navigation. The neocortex in dolphins, for example, is highly developed, which correlates with their sophisticated social behaviours and communication skills. Accidents involving boats, entanglement in fishing gear and other forms of human interaction can lead to traumatic brain injuries. Pathogens, including viruses and bacteria, can invade the CNS, leading to conditions such as meningoencephalitis. Similar to humans, marine mammals can experience neurodegenerative diseases. Evidence suggests that conditions akin to Alzheimer's disease may occur in certain species. Exposure to environmental toxins, such as heavy metals and persistent organic pollutants, can cause neurological damage. Stressors from captivity or environmental changes can lead to changes in behaviour, which may be linked to CNS dysfunction. Their complex brains and sophisticated behaviour provide a comparative framework for understanding CNS diseases across species [2].

Address for correspondence:

Gucep Ittalio
Department of Neurology, University of Teramo, Teramo, Italy
E-mail: gucepittalioo2@gmail.com

Word count: 948 **Tables:** 00 **Figures:** 00 **References:** 05

Received: 01.06.2024, Manuscript No. ipjnn-24-15250; **Editor assigned:** 03.06.2024, PreQC No. P-15250; **Reviewed:** 15.06.2024, QC No. Q-15250; **Revised:** 22.06.2024, Manuscript No. R-15250; **Published:** 29.06.2024

Many CNS disorders manifest similarly in marine mammals and humans, making them suitable models for studying disease mechanisms. Marine mammals are at the top of the food chain in their ecosystems, making them excellent indicators of environmental health and the effects of toxins on CNS function. Research has indicated that dolphins exhibit signs of neurodegenerative diseases similar to Alzheimer's in humans. Studies of stranded dolphins have revealed the presence of neurofibrillary tangles and amyloid plaques in the brain, which are hallmark features of Alzheimer's disease. These findings suggest that dolphins can be used as models to study the progression and potential treatment of neurodegenerative diseases. Understanding the environmental and genetic factors that contribute to these disorders in dolphins could shed light on similar processes in humans.

California sea lions have been observed with various infectious diseases, including leptospirosis and domoic acid poisoning, which affects the CNS. Domoic acid, produced by harmful algal blooms, leads to neurological symptoms in both sea lions and humans. Research on these cases has provided insights into the mechanisms of excitotoxicity and inflammation in the brain. Understanding how sea lions respond to such infections can inform treatment strategies for similar conditions in humans, such as seizure disorders and neuroinflammatory diseases [3].

DESCRIPTION

Whales frequently face traumatic injuries from ship strikes or entanglement. Studies examining the recovery processes and rehabilitation strategies for injured whales can inform human medical practices related to traumatic brain injuries. Insights gained from whale recovery efforts, including physical therapy techniques and the use of technology to monitor brain activity, can be translated into human medicine, improving rehabilitation approaches for brain injury patients. Advanced imaging techniques, such as MRI and CT scans, allow researchers to visualize brain structures and identify pathological changes. Examination of brain tissues from stranded or deceased marine mammals provides crucial information about disease processes. Observing changes in behaviour can help identify CNS disorders and their impacts on social interactions and survival. Genetic analysis can reveal predispositions to certain CNS disorders and aid in understanding disease mechanisms. Monitoring environmental pollutants and their effects on marine mammal health contributes to understanding the links between environmental health and CNS disorders. Research on marine mammals raises ethical questions, particularly regarding their treatment in captivity and during studies. Ensuring that research practices minimize harm and stress to the animals is paramount. Additionally [4,5], conservation efforts must be integrated with research activities to ensure that the welfare of marine mammal populations is prioritized. Insights into the pathology of CNS disorders in marine mammals can enhance our understanding of similar conditions in humans. The study of how environmental factors affect marine mammals can inform public health policies regarding pollution and its impacts on human health. Research into treatments and recovery strategies for marine mammals can inspire innovative therapeutic approaches for humans.

CONCLUSION

Increased awareness of marine mammal health issues can foster a greater understanding of the interconnectedness of human and environmental health. Marine mammals present a unique opportunity to explore the complexities of central nervous system disorders and their implications for human health. By studying these creatures, researchers can uncover valuable insights into the mechanisms of neurological diseases, the effects of environmental pollutants, and potential therapeutic strategies. The ongoing collaboration between marine biologists, veterinarians, and medical researchers is essential in developing effective models for understanding and treating CNS disorders in both marine mammals and humans. As research continues to advance, the potential for marine mammals to contribute to human medicine becomes increasingly evident, highlighting the importance of conserving these remarkable animals and their habitats.

ACKNOWLEDGEMENT

None.

CONFLICT OF INTEREST

None.

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