Microtubules in neuronal function:Building and maintaining the neuronal architecture.

Marij Kuijper*

Department of Molecular Neurobiology, Donders Institute for Brain, Cognition and Behaviour and Faculty of Science, Radboud University, 6525 AJ Nijmegen, the Netherlands

Introduction

Microtubules, dynamic structures composed of tubulin protein subunits, play a pivotal role in maintaining the intricate architecture of neurons, ensuring proper communication within the nervous system. These slender, cylindrical structures extend throughout the neuron, serving as essential components for various cellular processes, including cell shape maintenance, intracellular transport, and information transmission. This article delves into the significance of microtubules in neuronal function, highlighting their role in constructing and upholding the neuronal architecture [1].

Microtubules are constructed from tubulin, a protein dimer composed of α-tubulin and β-tubulin subunits. These subunits polymerize into protofilaments, which then align longitudinally to form the hollow cylindrical structure characteristic of microtubules. The polarity of microtubules arises from the distinct orientation of α-tubulin and β-tubulin within the protofilaments. This polarity is vital for various cellular processes, as motor proteins move directionally along microtubules during intracellular transport [2].

The architecture of neurons is characterized by their elongated, branched structures, which facilitate the transmission of information across the nervous system. Microtubules provide the structural framework necessary for maintaining this unique neuronal morphology. They extend from the cell body, also known as the soma, to the dendrites and axon, forming a complex network that enables efficient communication between neurons. Microtubules play a crucial role during neuronal development. As neurons migrate to their final positions in the brain, microtubules guide the movement of neuronal precursors. Additionally, they aid in axon formation and growth cone guidance, enabling the establishment of connections with target cells. The growth cone, located at the tip of developing axons, responds to guidance cues by dynamically rearranging microtubules, directing the axon's path [3].

Microtubules are instrumental in intracellular transport, a process essential for the distribution of cellular components, including organelles and vesicles. Motor proteins, such as kinesins and dyneins, utilize microtubules as tracks to move cargoes along the neuron. Kinesins move cargo toward the microtubule plus end, while dyneins transport cargo in the opposite direction. This bidirectional transport is fundamental for neuronal function, as it ensures that essential molecules reach their designated locations within the cell. Axonal transport relies heavily on microtubules to maintain the communication between the cell body and distant axon terminals. Defects in this process have been implicated in various neurodegenerative diseases. For example, in Alzheimer's disease, disruptions in axonal transport are believed to contribute to the accumulation of tau protein, leading to the formation of neurofibrillary tangles and subsequent neuronal dysfunction [4].

Microtubules also play a role in synaptic plasticity, the cellular mechanism underlying learning and memory. Dynamic changes in microtubule structure affect the morphology and function of dendritic spines, the tiny protrusions on dendrites where synapses form. This structural plasticity is essential for strengthening or weakening synaptic connections, which is crucial for memory formation and information storage. Microtubule-associated proteins (MAPs) are a diverse group of proteins that interact with microtubules, influencing their stability, organization, and function. Tau, a well-known MAP, is critical for microtubule stabilization in axons. Abnormal tau aggregation is associated with several neurodegenerative diseases, including Alzheimer's disease. Other MAPs, such as MAP2 and MAP6, play roles in dendritic microtubule organization and plasticity [5].

Conclusion

Microtubules serve as the architectural backbone of neurons, enabling their unique morphology and supporting essential cellular functions. From guiding neuronal migration during development to facilitating intracellular transport and contributing to synaptic plasticity, microtubules are integral to virtually every aspect of neuronal function. Understanding the intricate interplay between microtubules and neuronal architecture is crucial for unraveling the complexities of the nervous system and shedding light on the mechanisms underlying neurological disorders. Ongoing research in this field holds the promise of uncovering novel therapeutic avenues for neurodegenerative diseases and enhancing our comprehension of brain function as a whole.

***Correspondence to:** Marij Kuijper, Department of Molecular Neurobiology, Donders Institute for Brain, Cognition and Behaviour and Faculty of Science, Radboud University, 6525 AJ Nijmegen, the Netherlands. E-mail: marij.kuij@donders.ru.nl

***Received:** 28-Jul -2023, Manuscript No. AATR-23-111863; **Editor assigned:** 29- Jul -2023, PreQC No. AATR-23-111863 (PQ); **Reviewed:** 16- Aug-2023, QC No. AATR-23-111863; **Revised:** 18- Aug -2023, Manuscript No. AATR-23-111863 (R); **Published:** 25- Aug -2023, DOI: 10.35841/aatr-7.4.157*

***Citation:** : Kuijper M. Microtubules in Neuronal Function: Building and Maintaining the Neuronal Architecture. 2023;7(4):157*

References

1. Wirth T, Parker N, Ylä-Herttuala S. History of gene therapy. Gene. 2013;525(2):162-9.
2. Mulligan RC. The basic science of gene therapy. Science. 1993;260(5110):926-32.
3. Verma IM, Somia N. Gene therapy-promises, problems and prospects. Nature. 1997;389(6648):239-42.
4. Felgner PL. Nonviral strategies for gene therapy.**Sci Am**. 1997 ;276(6):102-6.
5. Cavazzana-Calvo M, Thrasher A, Mavilio F. The future of gene therapy. Nature. 2004 Feb;427(6977):779-81.

Citation: *: Kuijper M. Microtubules in Neuronal Function: Building and Maintaining the Neuronal Architecture. 2023;7(4):157*