Microtubules: changing capabilities and important cellular interactions.

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Introduction

Extracellular matrix components called microtubules are responsible for mitosis, vesicle and organelle trafficking, and guided cell migration. In this review, we describe recent advances in the lens that have revealed novel functions for stable microtubules throughout morphogenesis and development. Several functions for dynamic microtubules and stable populations are being revealed in the lens and other systems. A growing area of research is the mechanisms of microtubule stability and the related post-translational alterations. Not just one cytoskeletal component, but rather an interaction between cytoskeletal proteins and other physiological regulators, is necessary for proper cellular homeostasis. Microtubules play a crucial role in the integration of actin, intermediate filaments, cell-cell functional proteins, and other cellular components regulators including myosin and RhoGTPases to maintain this balance. Microtubules play an ever-expanding role in cellular activity. In this review, we emphasise the many functions that stable versus dynamic subpopulations play in morphogenesis and evaluate fresh and intriguing areas of research to expand our understanding of microtubules as a cellular integrator [1].

The cytoskeleton is a component of the cell that aids in maintaining cell form, arranges and transports organelles, offers mechanical support, and permits cell movement and division. Microtubules in particular are recognized regulators of directional cell motility, vesicle and organelle trafficking, and mitosis among these cytoskeletal components. The minus ends of these polarised hollow cylinders, which are made of -tubulin and -tubulin heterodimers and nucleated at the microtubule organising centre, expand outward. Kinesins and dyneins are molecular motor proteins that control movement along microtubules to enable trafficking and positioning of cellular contents, with kinesins moving towards the microtubule plus end and dyneins moving towards the microtubule minus end [2].

The dynamic instability that characterizes microtubules is a continuous cycle of swelling and contracting. Microtubule subpopulations can be sustained through interactions with proteins associated with microtubules, post-translational changes such acetylation or detyrosination, and other mechanisms (MAPs). Acetylated microtubules, which are present at the leading edge of actively moving cells, aid in directed migration and are crucial for various cell activities. The primary cilia, also known as the cell's antennae, are built on acetylated microtubules and are responsible for various sensory organ activities, including odour, sound, and vision, as well as cell signaling, liquid flow, and cell polarity. The capacity of microtubules to coordinate the actions of other cellular elements, including other cytoskeletal components, is crucial to their function in a cell. This has been demonstrated to be particularly true in the context of cellular migration, where it has been demonstrated that microtubules influence the motile cells' actomyosin machinery in both direct and indirect ways, in part through regulating their stability. Moreover, more recent studies have shown that cell-cell junctional proteins interact with microtubules in addition to cytoskeletal components and cytoplasmic organelles. Here, we examine the growing significance of microtubules in cellular processes and how they could be a lynchpin for cytoskeletal coordination [3].

It is a translucent tissue free of nerves and blood vessels that directs light onto the retina to enable vision. Contrary to popular perception, the lens is really determined by a particular cellular arrangement inside the lens epithelium, among the differentiated fiber cells, and between these two main cell types of the lens. The development and maintenance of a three-dimensional structure that can adjust and accommodate to enable adequate vision depends on the interaction between and among these two separate cell types. Cell-cell junctions and cytoskeletal signaling networks work together to build and maintain this exact cytoarchitecture. The lens is an excellent system since it depends so heavily on cell-cell communication studying the processes of development, morphogenesis, and regeneration [4].

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