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Molecular Mechanisms of Exosome Biogenesis and their Roles in Intercellular Communication

Xiaofang Wei*

Department of Physiology, National University of Singapore, Singapore 117593, Singapore

Abstract

Exosomes are small extracellular vesicles (30-150 nm) that play a crucial role in intercellular communication by transporting proteins, lipids, and RNA between cells. This review explores the molecular mechanisms underlying exosome biogenesis, focusing on the Endosomal Sorting Complex Required for Transport (ESCRT)-dependent and ESCRT-independent pathways. Additionally, we examine the roles exosomes play in physiological and pathological processes, including immune response, tumour progression, and neurodegenerative diseases. Understanding the biogenesis and function of exosomes could lead to novel therapeutic strategies for various diseases.

Keywords: Exosomes • Biogenesis • Intercellular communication • ESCRT • Tumor progression • Immune response • Neurodegenerative diseases

Introduction

Exosomes are nanosized vesicles secreted by various cell types and found in biological fluids such as blood, urine, and cerebrospinal fluid. Initially considered cellular waste products, exosomes are now recognized for their role in facilitating intercellular communication. They carry a diverse array of biomolecules, including proteins, lipids, and nucleic acids, which can influence the behavior of recipient cells. The biogenesis of exosomes involves complex intracellular processes, primarily associated with the endosomal pathway. This review aims to elucidate the molecular mechanisms of exosome biogenesis and highlight their significance in intercellular communication and disease [1].

Literature Review

Exosome biogenesis involves a complex series of intracellular events that start with the formation of early endosomes from the invagination of the plasma membrane. These early endosomes mature into late endosomes or Multivesicular Bodies (MVBs), which contain Intraluminal Vesicles (ILVs) formed through the inward budding of the endosomal membrane. The biogenesis of ILVs can follow two primary pathways: the ESCRT-dependent and ESCRT-independent mechanisms [2]. The ESCRT-dependent pathway relies on the Endosomal Sorting Complex Required for Transport (ESCRT) machinery, composed of four complexes (ESCRT-0, -I, -II, and -III) and associated proteins. These complexes work sequentially to recognize ubiquitinated cargo, deform the membrane, and facilitate vesicle scission. Conversely, the ESCRT-independent pathway does not rely on the ESCRT machinery but instead involves tetraspanins, specific lipids like ceramide, and proteins such as ALIX and syndecans to mediate ILV formation. After the MVBs are formed, they can either fuse with lysosomes for degradation or with the plasma membrane to release ILVs as exosomes into the extracellular space [3].

***Address for Correspondence:** Xiaofang Wei, Department of Physiology, National University of Singapore, Singapore 117593, Singapore; E-mail: Xiaofang@wei.sg*

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Exosomes serve as crucial mediators of intercellular communication by transferring a diverse array of biomolecules, including proteins, lipids, and nucleic acids, between cells. This transfer can significantly influence the physiological state of recipient cells. For example, in the immune system, exosomes derived from Antigen-Presenting Cells (APCs) can stimulate immune responses by presenting antigens to T cells [4]. In cancer, tumor-derived exosomes modulate the tumor microenvironment, aiding in processes such as angiogenesis, immune evasion, and metastasis. Additionally, in neurodegenerative diseases, exosomes play a role in the propagation of pathogenic proteins, contributing to the spread and progression of diseases like Alzheimer's and Parkinson's. Understanding these mechanisms not only provides insights into fundamental biological processes but also offers potential avenues for developing diagnostic and therapeutic strategies based on exosome biology [5].

Discussion

Understanding exosome biogenesis and function opens new avenues for clinical applications. Exosomes can serve as biomarkers for disease diagnosis due to their presence in various body fluids and the specific molecular signatures they carry. Moreover, their ability to transfer functional biomolecules between cells makes them attractive candidates for therapeutic delivery systems. However, challenges remain, including the need for standardized methods for exosome isolation and characterization, and a deeper understanding of the mechanisms governing their cargo selection and release [6].

Conclusion

Exosomes are integral to intercellular communication, influencing numerous physiological and pathological processes. Advances in our understanding of the molecular mechanisms of their biogenesis and function could lead to innovative therapeutic approaches for diseases ranging from cancer to neurodegenerative disorders. Further research is essential to fully exploit the potential of exosomes in clinical applications, paving the way for novel diagnostic and therapeutic strategies.

Acknowledgement

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Conflict of Interest

None.

References

1. Gurunathan, Sangiliyandi, Min-Hee Kang, Muniyandi Jeyaraj and Muhammad Qasim, et al. "Review of the isolation, characterization, biological function, and multifarious therapeutic approaches of exosomes." *Cells* 8 (2019): 307.

2. An, Qianli, Aart JE van Bel and Ralph Hückelhoven. "Do plant cells secrete exosomes derived from multivesicular bodies?." *Plant Signal Behav* 2 (2007): 4-7.

3. Orefice, Nicola Salvatore, Rossella Di Raimo, Davide Mizzoni and Mariantonia Logozzi, et al. "Purposing plant-derived exosomes-like nanovesicles for drug delivery: Patents and literature review." *Expert Opin Ther Pat* (2023): 89-100.

4. Hou, Yingnan, Y. I. Zhai, L. I. Feng and Hana Z. Karimi, et al. "A Phytophthora effector suppresses trans-kingdom RNAi to promote disease susceptibility." *Cell Host Microbe* (2019): 153-165.

5. Rezaie, Jafar, Maryam Feghhi and Tahereh Etemadi. "A review on exosomes application in clinical trials: Perspective, questions, and challenges." *Cell Commun Signal* (2022): 145.

6. Cai, Ying, Luoxin Zhang, Youjian Zhang and Rong Lu. "Plant-derived exosomes as a drug-delivery approach for the treatment of inflammatory bowel disease and colitis-associated cancer." *Pharmaceutics* (2022): 822.

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