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to provide insights into the intricate interplay between exosomes and the immu
of this cellular orchestra in orchestrating immune responses.

Keywords: Exosomes; Immune regulation; Intercellular communication; Immunomodulation; Biomarkers; Therapeutics

Introduction

The immune system is a complex network of cells, tissues, and molecules that collectively defend the body against pathogens and maintain tissue homeostasis. Central to this defense mechanism is the ability of immune cells to communicate with each other, coordinating their responses to various stimuli [1]. In recent years, exosomes have emerged as key players in intercellular communication, facilitating the transfer of bioactive molecules between cells and modulating diverse physiological and pathological processes. Exosomes, small extracellular vesicles ranging from 30 to 150 nm in diameter, are generated through the endocytic pathway and released into the extracellular environment

inflammatory cytokines, chemokines, and matrix metalloproteinases (MMPs) to target cells. Collectively, these findings underscore the diverse roles of exosomes in immune regulation and highlight their potential as therapeutic targets for immune-related disorders.

Exosome-Mediated Crosstalk in Inflammatory Diseases

Dysregulation of exosome-mediated immune regulation has been implicated in various inflammatory diseases, including autoimmune disorders, infectious diseases, and cancer. In autoimmune diseases such as rheumatoid arthritis, systemic lupus erythematosus, and multiple sclerosis, aberrant secretion of exosomes by immune cells contributes to the breakdown of immune tolerance and the perpetuation of chronic inflammation. Similarly, in infectious diseases caused by viruses, bacteria, or parasites, pathogen-derived exosomes can modulate host immune responses and promote immune evasion and disease progression. Moreover, tumor-derived exosomes play a crucial role in cancer immune evasion by suppressing anti-tumor immune responses and promoting tumor growth, metastasis, and drug resistance [8]. Understanding the molecular mechanisms underlying exosome-mediated crosstalk in inflammatory diseases is essential for the development of novel diagnostic and therapeutic strategies targeting exosome biogenesis, secretion, and function.

Clinical Implications and Future Perspectives

Exosomes hold great promise as diagnostic biomarkers and therapeutic targets for a wide range of immune-related disorders. Their presence in various biological fluids, including blood, urine, and saliva, makes them attractive candidates for non-invasive biomarker discovery and disease monitoring. Indeed, alterations in exosome cargo composition have been observed in numerous diseases, suggesting their potential utility as disease-specific biomarkers. Furthermore, exosomes can be engineered to deliver therapeutic payloads, such as drugs, small interfering RNAs (siRNAs), and CRISPR/Cas9 gene editing tools, to target cells with high specificity. Several preclinical and clinical studies have demonstrated the feasibility and efficacy of exosome-based therapeutics for the treatment of cancer, infectious