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Host-derived Extracellular Vesicles in Blood and Tissue: Implications for Human Protozoan Infections

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Introduction

Protozoan infections, caused by various parasites such as Plasmodium spp., Trypanosoma spp., Leishmania spp., and Toxoplasma gondii, continue to affect millions of people globally, particularly in tropical and subtropical regions. These infections pose substantial challenges due to their diverse clinical manifestations, resistance to treatment, and difficulties in diagnosis. Recent research has highlighted the intricate interplay between parasites and host cells, including the role of extracellular vesicles in modulating these interactions. EVs, which encompass exosomes, microvesicles, and apoptotic bodies, are membrane-bound vesicles released by cells that play crucial roles in intercellular communication, immune regulation, and disease pathogenesis [1].

Description

Protozoan infections can trigger a variety of immune responses in the human body. The immune system responds to these infections through both innate and adaptive mechanisms, aiming to eliminate the invading protozoa and prevent further spread of the infection. Macrophages, dendritic cells, and neutrophils are key players in the innate immune response against protozoan infections. They engulf and digest protozoa, presenting antigens to activate the adaptive immune response. B lymphocytes (B cells) produce antibodies specific to protozoan antigens. These antibodies can neutralize protozoa, opsonize them for phagocytosis, or activate the complement system. The effectiveness of the immune response against protozoan infections varies depending on factors such as the type of protozoa, the host's immune status, and the presence of co-infections or underlying health conditions. Understanding the intricacies of the immune response to protozoan infections is crucial for developing effective strategies for prevention, diagnosis, and treatment. Protozoan parasites have evolved sophisticated mechanisms to manipulate host cells and evade immune responses, facilitating their survival and proliferation within the host. Host-derived EVs have emerged as key players in these processes, serving as vehicles for the transfer of bioactive molecules between cells [2].

For instance, studies have demonstrated that Plasmodium-infected red blood cells release EVs containing parasite-derived proteins, nucleic acids, and virulence factors, which can modulate the immune response and contribute to disease pathogenesis. Similarly, EVs derived from Leishmania-infected macrophages have been shown to promote parasite survival and dissemination by modulating host cell signaling pathways. The host immune response plays a critical role in controlling protozoan infections, but parasites have developed various strategies to evade or subvert immune surveillance. Host-derived EVs participate in immune modulation during protozoan infections by influencing the function of immune cells and the production of cytokines and chemokines. For example, EVs released by infected cells can induce apoptosis or dysfunction of immune cells, impairing their ability to eliminate parasites. Additionally, EVs containing parasite antigens can promote antigen presentation and the activation of both innate and adaptive immune responses. Tissue, on the other hand, refers to a group of cells that perform a specific function. There are four primary types of human tissue: epithelial, connective, muscular, and nervous. Epithelial tissue covers the body's surfaces, lines cavities and organs, and forms glands. Connective tissue provides support and structure to the body and includes various types such as bone, cartilage, adipose tissue (fat), and blood. Muscular tissue is responsible for movement and includes skeletal, smooth, and cardiac muscle. Understanding the interplay between EVs and the immune system is essential for developing novel immunotherapeutic strategies against protozoan infections [3,4].

Nervous tissue consists of neurons and support cells called glial cells, transmitting electrical signals and coordinating bodily functions. Blood is a fluid connective tissue composed of plasma, red blood cells, white blood cells, and platelets. Plasma, the liquid portion of blood, carries nutrients, hormones, and waste products throughout the body. Red blood cells, or erythrocytes, transport oxygen from the lungs to tissues and organs and carry carbon dioxide back to the lungs for exhalation. White blood cells, or leukocytes, play a crucial role in the body's immune response, defending against infections and foreign invaders. Platelets aid in blood clotting, preventing excessive bleeding when tissues are damaged. The detection and diagnosis of protozoan infections often rely on invasive or time-consuming methods, highlighting the need for improved diagnostic approaches. Host-derived EVs present in biological fluids such as blood, urine, and saliva offer promising targets for non-invasive diagnostic assays. Studies have shown that EVs carry parasite-specific biomarkers, such as surface antigens, nucleic acids, and metabolites, which can be detected using sensitive techniques like nanoparticle-based assays and liquid biopsy platforms. Leveraging EVs as diagnostic biomarkers holds great potential for the development of rapid, point-of-care tests for protozoan infections, enabling early detection and timely intervention [5].

Conclusion

Host-derived extracellular vesicles play diverse roles in the pathogenesis, immune response, and diagnosis of human protozoan infections. Understanding the complex interactions between EVs and parasites, as well as their impact on host cells and the immune system, is crucial for developing effective strategies for disease control and management. Further research is needed to elucidate the mechanisms underlying EV-mediated host-parasite interactions and to translate these findings into clinically relevant applications, including novel diagnostic assays and immunotherapeutic interventions.

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Conflict of Interest

There are no conflicts of interest by author.

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