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Cancer Immunometabolism: A New Frontier in Cellular Oncology

Fusia Barbo*

Department of Oncology, University School of Technology, New York, USA

Description

Cancer immunometabolism is a field of research that explores the intricate relationship between the immune system and the metabolic processes within cancer cells. It has gained significant attention in recent years as scientists seek to better understand how the immune system interacts with and responds to cancerous cells, and how these interactions can be leveraged for more effective cancer therapies. The TME is the cellular environment in which a tumor exists. It consists of various immune cells, stromal cells, and blood vessels. The metabolism of both cancer cells and immune cells within the TME plays a critical role in determining the outcome of the immune response against the tumor. Immune cells, particularly T cells, need to undergo specific metabolic changes to carry out their functions effectively. For example, activated T cells shift from oxidative phosphorylation to glycolysis to support their rapid proliferation and cytokine production. Understanding these metabolic changes is crucial for optimizing immunotherapies. Cancer cells can exploit their altered metabolism to evade immune detection and destruction. They may produce metabolic byproducts that suppress immune responses, or they can create an immunosuppressive TME that inhibits the function of immune cells. Targeting the interactions between cancer cells and the various recruited healthy cells is another avenue for cancer therapy. Researchers are investigating ways to reprogram tumor-associated immune cells to have anti-tumor effects and to inhibit the activity of cancer-associated fibroblasts.

Understanding cancer immunometabolism has led to the development of novel cancer immunotherapies. For example, immune checkpoint inhibitors (e.g., PD-1 and CTLA-4 inhibitors) aim to restore the anti-tumor immune response by blocking inhibitory signals. Additionally, metabolic modulators are being investigated as potential adjuvants to enhance the effectiveness of immunotherapy. Immune cells and cancer cells may compete for essential nutrients within the TME, such as glucose and amino acids. Strategies to selectively target cancer cell metabolism while sparing immune cell metabolism are of interest in developing new therapies. Metabolic markers in tumors and immune cells can serve as biomarkers to predict treatment responses and patient outcomes. Measuring these markers can help tailor treatment strategies for individual patients. cancer immunometabolism is a complex and rapidly evolving field that examines the metabolic interplay between cancer cells and immune cells within the tumor microenvironment. Understanding these interactions is critical for developing innovative cancer therapies that harness the power of the immune system to target and eliminate cancer cells. Immunotherapy has emerged as a promising approach to overcome immune evasion in cancer. Checkpoint inhibitors, Chimeric Antigen Receptor (CAR) T-cell therapy, and other immunotherapies aim to enhance the immune system's ability to recognize and attack cancer cells. Combining immunotherapy with other treatments like targeted therapy or chemotherapy is an active area of research to improve cancer treatment outcomes.

***Address for Correspondence:** Fusia Barbo, Department of Oncology, University School of Technology, New York, USA, E-mail: barbo@yahoo.com*

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Cancer cells often undergo significant alterations in their energy metabolism to meet the demands of rapid growth and proliferation. The most well-known metabolic shift in cancer cells is the Warburg effect, where they preferentially use glycolysis for energy production even in the presence of oxygen. This metabolic shift not only provides energy but also generates intermediates needed for the synthesis of macromolecules required for cell division. This altered metabolism can make cancer cells more resistant to certain treatments, as they can adapt to low-oxygen environments within tumors. Targeting cancer cell metabolism is an active area of research. Potential strategies include inhibiting glycolysis or other metabolic pathways specific to cancer cells, as well as exploiting these metabolic differences for diagnostic purposes (e.g., using PET scans that detect increased glucose uptake). The immune system has mechanisms to identify and eliminate abnormal cells, including cancer cells. However, cancer cells can develop strategies to evade immune detection and destruction. This evasion can involve various mechanisms, such as downregulating surface antigens, activating immune checkpoint pathways (e.g., PD-1/PD-L1), and creating an immunosuppressive tumor microenvironment. cancer cells can recruit various healthy cells to support tumor growth and progression. For example, tumor-associated fibroblasts can create a supportive extracellular matrix, while immune cells like macrophages can have both pro-tumor (M2-like) and anti-tumor (M1-like) functions depending on their polarization [1-5].

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Conflict of Interest

The Author declares there is no conflict of interest associated with this manuscript.

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