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Perspective

THE ROLE OF IMMUNE AND TUMOR-SPECIFIC BIOMARKERS IN CANCER DIAGNOSIS AND PROGNOSIS

Olivia Bennett
Department of Bioscience, Aarhus University, Silkeborg, Denmark
Email: olivia.bennett@mail.ac

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DESCRIPTION

Cancer remains one of the most formidable challenges in modern medicine, both in terms of diagnosis and prognosis. Over the years, significant strides have been made in understanding the molecular and cellular mechanisms that underlie cancer, with biomarkers emerging as an important tool in enhancing early detection, guiding treatment strategies and predicting patient outcomes. Among these, immune and tumor-specific biomarkers have gained substantial attention for their role in cancer diagnosis and prognosis. This article explores how immune and tumor-specific biomarkers are reshaping cancer management and their potential for improving patient care.

Understanding immune and tumor-specific biomarkers

Immune biomarkers are molecules present in the blood, tissues, or other body fluids that reflect the body's immune response to cancer. They can originate from both tumor cells and the immune system. These biomarkers offer insights into how the body immune system interacts with cancer cells, either recognizing or attacking them or being suppressed by the tumor microenvironment. Key immune biomarkers include Tumor-Infiltrating Lymphocytes (TILs), Programmed Death-Ligand 1 (PD-L1), cytokines and immune checkpoint proteins. Tumor-specific biomarkers, on the other hand, are molecules directly produced by tumor cells and are unique to specific cancer types. These biomarkers can be genetic mutations, proteins, or metabolites that differentiate cancer cells from normal cells. Tumor-specific biomarkers, such as Human Epidermal Growth Factor Receptor 2 (HER2) in breast cancer, Estimated Glomerular Filtration Rate (EGFR) in lung cancer and in colorectal cancer, play an essential role in both diagnostic and prognostic assessments.

Tumor-infiltrating lymphocytes (TILs) are immune cells that migrate into tumors in response to cancer cells. The quantity and quality of TILs within a tumor microenvironment can provide insight into the likelihood of a successful immune response. High levels of TILs are often associated with better prognosis in cancers like melanoma, breast cancer and colorectal cancer. These immune cells include T-cells, B-cells and natural killer cells and their presence suggests that the immune system is actively engaging with the tumor. The assessment of TILs is becoming an increasingly important factor in cancer prognosis and therapy decisions. Cytokines, such as Interleukins (IL-2, IL-6), Tumor Necrosis Factor (TNF) and interferons, play significant roles in immune activation. Elevated cytokine levels can indicate an ongoing immune response, while dysregulation may suggest immune suppression or tumor-induced inflammation. In some cancers, such as lymphoma and multiple myeloma, cytokine profiles serve as potential biomarkers for disease progression and treatment response.

Combining immune and tumor-specific biomarkers

The integration of immune and tumor-specific biomarkers has the potential to significantly enhance cancer diagnosis, prognosis and treatment. Immune biomarkers, like PD-L1 and TILs, offer insights into the immune microenvironment of the tumor, while tumor-specific biomarkers provide direct information about the genetic and molecular characteristics of the cancer.

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Together, these biomarkers can offer a more comprehensive view of a patient's cancer and help guide personalized treatment approaches. For instance, in melanoma, combining tumor-specific markers with immune biomarkers can refine prognosis and treatment strategies, tailoring immunotherapies or targeted therapies based on the tumors unique profile.

CONCLUSION

The role of immune and tumor-specific biomarkers in cancer diagnosis and prognosis is rapidly advancing. These biomarkers provide invaluable insights into the molecular mechanisms of cancer, offering opportunities for earlier diagnosis, more precise prognostication and the development of personalized treatment strategies. As we continue to explore and refine these biomarkers, they hold the potential to revolutionize cancer care, improving outcomes for patients worldwide. The future of oncology lies in the integration of these biomarkers into routine clinical practice, offering a more targeted and effective approach to cancer treatment.

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