Emerging biomarkers for predicting immunotherapy response in cancer patients.

Zhaoyang Guo*

Department of Immunology and Otolaryngology, University of Pittsburgh School of Medicine and The Hillman Cancer Center, Pittsburgh, PA, USA

Introduction

Immunotherapy has revolutionized cancer treatment by harnessing the power of the immune system to target and eliminate cancer cells. However, not all patients benefit equally from immunotherapy, highlighting the need for predictive biomarkers to identify individuals likely to respond. The emergence of novel biomarkers has shown promise in improving patient selection and treatment outcomes. This article explores the emerging biomarkers that hold potential for predicting response to immunotherapy in cancer patients. Immunotherapy has transformed the landscape of cancer treatment, offering new hope and improved outcomes for patients across various cancer types. However, not all patients respond equally to immunotherapy, highlighting the need for predictive biomarkers that can identify individuals who are most likely to benefit from these innovative therapies. The quest for such biomarkers has led to extensive research and the emergence of promising candidates that show potential in predicting immunotherapy response in cancer patients. The development of predictive biomarkers holds tremendous significance in personalized medicine [1].

By identifying patients who are more likely to respond to immunotherapy, these biomarkers can aid clinicians in making informed treatment decisions, optimizing therapeutic outcomes, and avoiding unnecessary treatments for patients who may not benefit from immunotherapy. While several established biomarkers, such as PD-L1 expression, have shown associations with immunotherapy response, they have limitations in terms of predictive accuracy and universal applicability. Therefore, there is a pressing need for the discovery and validation of novel biomarkers that can improve patient selection and treatment efficacy. This article aims to explore the emerging biomarkers that hold promise in predicting response to immunotherapy in cancer patients. We will delve into the current research surrounding these biomarkers and their potential implications for clinical practice. By highlighting these advancements, we aim to shed light on the on-going efforts to enhance the precision and effectiveness of immunotherapy, ultimately leading to better patient outcomes and improved cancer care [2].

Tumor Mutational Burden (TMB)

TMB refers to the number of mutations carried by tumor cells. High TMB is associated with increased neoantigen production, leading to enhanced recognition by the immune system. Several studies have demonstrated that patients with a high TMB exhibit improved response rates to immune checkpoint inhibitors (ICIs). TMB has been most extensively studied in solid tumors like melanoma and non-small cell lung cancer (NSCLC). However, standardization of TMB assessment and its clinical implementation remain on-going challenges [3].

PD-L1 expression

Programmed death-ligand 1 (PD-L1) expression on tumor cells and immune infiltrates is commonly used as a predictive biomarker for ICI therapy. High PD-L1 expression is associated with increased response rates to ICIs. However, the correlation between PD-L1 expression and response to immunotherapy is imperfect, with some patients lacking PD-L1 expression still experiencing positive outcomes. Additionally, dynamic changes in PD-L1 expression during treatment pose further challenges in its use as a predictive biomarker.

Tumor-Infiltrating Lymphocytes (TILs)

TILs are immune cells that infiltrate the tumor microenvironment. Higher levels of TILs, particularly CD8+ cytotoxic T cells, have been correlated with improved response to immunotherapy across multiple cancer types. TILs can be assessed by immunohistochemistry or gene expression profiling. However, standardized methods for TIL evaluation and defining clinically relevant thresholds are needed to facilitate their widespread use as predictive biomarkers [4].

Gut microbiota

The gut microbiota has emerged as a potential modulator of immune response and treatment outcomes in cancer patients. Studies have shown that specific bacterial species or microbial signatures can influence the efficacy of immunotherapy. For example, certain bacteria promote the maturation and activation of immune cells, enhancing the response to ICIs. Conversely, dysbiosis or an imbalance in the gut microbiota may lead to reduced treatment efficacy. Modulating the gut microbiota through probiotics, antibiotics, or fecal microbiota transplantation holds promise for optimizing immunotherapy responses. However, further research is needed to elucidate the complex interactions between the gut microbiota and the immune system.

***Correspondence to:** Zhaoyang Guol, Department of Immunology and Otolaryngology, University of Pittsburgh School of Medicine and The Hillman Cancer Center, Pittsburgh, PA, USA, E-mail: gua_zhoa56@edu.org.in

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Tumor-infiltrating immune cell subtypes

In addition to TILs, the characterization of specific immune cell subtypes within the tumor microenvironment is gaining attention as a predictive biomarker. Advanced techniques like multiparametric flow cytometry and single-cell RNA sequencing allow comprehensive profiling of immune cell populations. The presence of specific immune cell subsets, such as exhausted T cells, regulatory T cells, or myeloid-derived suppressor cells, can provide insights into treatment response and prognosis. Combining immune cell profiling with other biomarkers may enhance predictive accuracy and inform personalized treatment strategies [5].

Conclusion

The emergence of predictive biomarkers for immunotherapy is transforming cancer treatment by enabling patient stratification and personalized therapeutic approaches. Tumor mutational burden, PD-L1 expression, tumor-infiltrating lymphocytes, gut microbiota, and immune cell subtyping are among the promising biomarkers under investigation. However, their clinical utility and standardization require further validation and refinement. Combining multiple biomarkers and developing predictive algorithms may enhance accuracy in identifying patients likely to respond to immunotherapy. Ultimately, integrating these emerging biomarkers into routine clinical practice will facilitate optimal treatment selection and improve patient outcomes in the era of precision medicine. Continued research and collaborative efforts are crucial for harnessing the full potential of biomarkers in predicting response to immunotherapy and advancing the field of cancer immunotherapy

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