

Customising Cancer Immunotherapy: Adapting Therapy to the Patient and the Tumor

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ABOUT THE STUDY

Immunotherapy has revolutionized cancer treatment, providing optimism for patients with advanced and previously untreatable malignancies. However, not all patients respond equally to these therapies, highlighting the importance of personalized approaches to enhance efficacy and minimize adverse effects. Customising cancer immunotherapy involves customized treatment strategies to the unique characteristics of both the patient and their tumor.

Cancer immunotherapy

Cancer immunotherapy harnesses the body's immune system to recognize and destroy cancer cells. Key modalities include immune checkpoint inhibitors (e.g., PD-1/PD-L1 and CTLA-4 inhibitors), adoptive cell therapies such as CAR-T cells, cancer vaccines, and cytokine-based therapies. While these treatments have shown significant success, variability in response necessitates an individualized approach.

Genetic and epigenetic profiles

Genetic and epigenetic profiles play pivotal roles in advancing cancer immunotherapy. Genetic alterations, such as mutations in tumor suppressor genes or oncogenes, influence tumor immunogenicity and response to immune checkpoint inhibitors. Epigenetic modifications, including DNA methylation, histone modifications, and non-coding RNAs, regulate the expression of immune-related genes, shaping the tumor microenvironment. Epigenetic reprogramming can enhance antigen presentation, overcome immune evasion, and restore immune surveillance. Integrating genomic and epigenetic profiling helps identify predictive biomarkers for therapy response and resistance mechanisms. This approach enables personalized immunotherapy, improving efficacy while reducing adverse effects, thus leads for transformative cancer treatment strategies.

Tumor-specific factors

Tumor-specific factors significantly influence the success of cancer immunotherapy. These factors include tumor antigens, such as neoantigens and oncofetal proteins, which serve as targets for immune recognition. The tumor microenvironment (TME) also plays a critical role, with immunosuppressive components like regulatory T cells, myeloid-derived suppressor cells, and cytokines hindering immune responses. Tumor Mutational Burden (TMB) and genetic alterations affect antigen presentation and immune evasion. Additionally, the expression of immune checkpoint molecules, like PD-L1, modulates the efficacy of therapies targeting checkpoint pathways. Understanding these tumor-specific factors enables personalized approaches, improving the precision and effectiveness of cancer immunotherapy strategies.

Strategies for personalization

Personalized cancer immunotherapy is an Adjusting treatment based on an individual's unique genetic, molecular, and immunological profile. Strategies include genetic profiling of tumor cells to identify specific mutations and neoantigens that can be targeted by personalized vaccines or engineered T-cells. Biomarker analysis helps predict patient responsiveness to immune checkpoint inhibitors, allowing clinicians to choose the most effective drugs. Combining therapies, such as immune checkpoint blockers with targeted agents or radiation, can enhance immune activation and tumor response. Additionally, monitoring the patient's immune system throughout treatment ensures adjustments are made to optimize efficacy and manage potential resistance, improving the overall therapeutic outcome.

Challenges and future directions

Personalized immunotherapy faces challenges, including high costs, limited access to advanced diagnostic tools, and the complexity of interpreting multi-dimensional data.

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Efforts to streamline biomarker discovery, enhance clinical trial designs, and improve accessibility are essential.

The cancer immunotherapy lies in integrating precision medicine with advanced computational tools, such as artificial intelligence and machine learning, to analyses vast datasets and predict optimal therapeutic strategies. Additionally, fostering collaborations between researchers, clinicians, and patients will accelerate the translation of personalized approaches into routine clinical practice. Customising cancer immunotherapy represents a paradigm shift in oncology, focusing on the unique needs of each patient and their tumor. By leveraging advancements in genomics, immunology, and technology, personalized strategies hold the potential to maximize therapeutic efficacy, minimize toxicity, and ultimately improve patient outcomes. As research and innovation continue to evolve, the dream of truly tailored cancer care comes closer to reality.