Editorial

CANCER IMMUNOTHERAPY: ADVANCES AND CHALLENGES

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ABSTRACT
Cancer immunotherapy has emerged as a transformative approach in cancer therapeutics, offering new hope to patients by harnessing the power of the immune system to target and eliminate cancer cells. It falls under the category of targeted therapy where an immune target i.e. molecule is identified and then immunotherapy i.e. antibodies are given to target it. Recent advances have brought a number of novel therapeutic options but they are also tagged with various challenges. These challenges include but not limited to the identification of appropriate target, later resistance to the therapy and most importantly the cost of the treatment.

Key Words: Cancer Immunotherapy, Targeted therapy of cancer, Cancer antibodies

INTRODUCTION

Cancer immunotherapy has emerged as a transformative approach in cancer therapeutics, offering new hope to patients by harnessing the power of the immune system to target and eliminate cancer cells. It falls under the category of targeted therapy where an immune target i.e. molecule is identified and then immunotherapy i.e. antibodies are given to target it. Over the past few decades, significant advancements in immunotherapy have revolutionized cancer treatment, leading to remarkable improvements in patient outcomes and survival rates in many cancer types including those which were considered having no treatment. However, as with any therapeutic option there are challenges related to side effects, cost, selectivity and many others, that necessitate ongoing research, innovation, and collaboration to explore the full potential of immunotherapy in oncology.

ADVANCES IN CANCER IMMUNOTHERAPY:

Immunotherapy encompasses a diverse range of strategies designed to enhance the body's natural immune response against cancer molecules mainly proteins expressed in cancer cells. The first monoclonal antibody introduced in the clinical practice was trastuzumab i.e. Herceptin for breast cancer where human epitheial growth factor receptor -2 (HER2) was positive. The HER2 positive breast cancer used to be considered as poor prognostic type before the use of transtuzumab. Following the success of immunotherapy many other targets have been identified and immunotherapy is introduced in many cancer types. Such as the advent of cancer immunotherapy, particularly immune checkpoint inhibitors and chimeric antigen receptor (CAR) T-cell therapy, has transformed the landscape of cancer treatment. Immune checkpoint inhibitors, including PD-1 and CTLA-4 inhibitors, have demonstrated unprecedented clinical responses in patients with advanced melanoma, lung cancer, and other malignancies. These therapies unleash the immune system's ability to recognize and attack cancer cells, leading to durable responses and prolonged survival. Key advances in cancer immunotherapy include:

Immune Checkpoint Inhibitors: Drugs targeting immune checkpoint molecules such as PD-1, PD-L1, and CTLA-4 have demonstrated unprecedented efficacy in various cancers, including melanoma, lung cancer, and renal cell carcinoma. These agents enhance the immune system's ability to recognize and attack tumor cells, leading to durable responses and long-term survival in some patients.

CAR-T Cell Therapy: Chimeric antigen receptor (CAR) T cell therapy involves genetically modifying a patient's T cells to recognize and kill cancer cells expressing specific surface antigens. CAR-T cell therapies have shown remarkable efficacy in hematological malignancies, leading to complete remissions in patients with refractory or relapsed disease including refractory acute lymphoblastic leukemia and non-Hodgkin lymphoma, offering a lifeline to patients with limited treatment options.

Cancer Vaccines: Therapeutic cancer vaccines stimulate the immune system to recognize and target tumor-specific antigens, triggering an immune response against cancer cells. Advances in vaccine technology and personalized neoantigen vaccines hold promise for improving treatment outcomes and overcoming tumor heterogeneity.

Adoptive Cell Transfer: Adoptive cell transfer (ACT) involves isolating and expanding tumor-infiltrating lymphocytes (TILs) or genetically engineered T cells ex vivo before reinfusion into patients. ACT has shown promising results in melanoma and other solid tumors, offering a personalized and targeted approach to cancer treatment.

Furthermore, ongoing research in cancer immunotherapy continues to uncover novel targets, biomarkers, and combination therapies that hold promise for improving treatment outcomes and expanding the reach of immunotherapy to a broader spectrum of cancer types and patient populations.

CHALLENGES IN CANCER IMMUNOTHERAPY:

Despite the remarkable progress in cancer immunotherapy, significant challenges remain on the path to widespread adoption and optimization of these therapies. One of the foremost challenges is identifying predictive biomarkers to stratify patients who are most likely to benefit from immunotherapy. While PD-L1 expression and tumor mutational burden have shown utility as biomarkers, they are not universally predictive, highlighting the need for more robust predictive markers to guide treatment decisions. Understanding the factors influencing treatment response and resistance is essential for optimizing patient selection and treatment strategies. The definition of the targets is also essential aspect to be explored. Related to that, these cancer molecules are also expressed on normal non cancer cells, thus there is higher risk of immune-related adverse events (irAEs) affecting various organs, including skin, gastrointestinal tract, liver, and endocrine glands. Thus it is fundamental to define the target to the level where it is only expressed in cancer cells. While immune checkpoint inhibitors have revolutionized cancer treatment, they can also unleash the immune system's attack on healthy tissues, leading to a spectrum of autoimmune-like toxicities. Effective management of irAEs requires close monitoring, timely intervention, and multidisciplinary collaboration to mitigate treatment-related complications. Tumors employ various mechanisms to evade immune surveillance, including downregulation of antigen presentation, induction of immune checkpoint expression, and recruitment of immunosuppressive cells. Overcoming tumor immune evasion mechanisms is critical for enhancing the efficacy of immunotherapy and overcoming treatment resistance.

Another important issue is the cost of the treatment. Immunotherapy drugs are often expensive, limiting access for many patients, particularly in low- and middle-income countries. Addressing cost barriers and ensuring equitable access to immunotherapy remains a significant challenge in cancer care. Additionally, resistance to immunotherapy remains a challenging barrier to achieving durable responses in patients. Tumor immune evasion mechanisms, including upregulation of alternative immune checkpoints, tumor heterogeneity, and immune-suppressive tumor microenvironments, can limit the effectiveness of immunotherapy and lead to treatment resistance. Overcoming resistance mechanisms requires innovative strategies, such as combination therapies targeting multiple checkpoints or enhancing T-cell functionality within the tumor microenvironment.

CONCLUSION:

Cancer immunotherapy represents a paradigm shift in cancer treatment, offering unprecedented opportunities to transform patient care and outcomes. Despite the remarkable progress achieved, significant challenges remain that require collective efforts from researchers, clinicians, policymakers, and industry stakeholders to overcome. By addressing the challenges of response heterogeneity, immune-related adverse events, tumor immune evasion, and access barriers, we can unlock the full potential of immunotherapy and comprehend its promise as a cornerstone of modern cancer treatment. Continued investment in research, innovation, and collaboration is essential to advance the field of cancer immunotherapy and improve outcomes for patients worldwide.