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CRISPR/Cas9 REVITALIZES ADOPTIVE T-CELL THERAPY FOR CANCER IMMUNOTHERAPY

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Abstract:

Cancer immunotherapy, particularly Adoptive T-cell Therapy (ACT), has emerged as a promising approach for combating malignancies by harnessing tumor-specific T cells. However, the functional limitations, immune suppression, and exhaustion of T cells present significant therapeutic barriers. Recent advancements in CRISPR/Cas9 gene-editing technology have revolutionized ACT by enabling precise and efficient genetic modifications to enhance T-cell functionality and antitumor activity. This technology allows the creation of T cells equipped with chimeric antigen receptors (CARs) or engineered T-cell receptors (TCRs) that possess superior tumor antigen recognition, reduced exhaustion, and minimal treatment-related toxicities. Furthermore, CRISPR-mediated knockout of immune checkpoint regulators such as PD-1 and CTLA-4 has significantly improved T-cell persistence and cytotoxicity. Early-phase clinical trials have demonstrated the safety and feasibility of CRISPR-modified T cells for treating hematological and solid tumors. Despite challenges related to delivery, off-target effects, and immune responses, the continued optimization of CRISPR/Cas9 technology holds immense potential to advance personalized cancer immunotherapy and improve patient outcomes.

Keywords: CRISPR/Cas9, Cancer Immunotherapy, Adoptive T-cell Therapy, Gene Editing, CAR-T Cells, TCR-T Cells