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Editorial Article

Gene Editing Revolution: CRISPR/Cas and the Future of Cancer Treatment

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Abstract

Cancer therapy is rapidly advancing, driven by the search for safer and more effective treatments. CRISPR/Cas systems are particularly suitable tools for the purpose due to their programmable Cas proteins, including Cas 9, Cas 12, and Cas 13. Such systems targeted gene editing in clinics to detect and treat disease, especially cancer. Via precise modifications at the genomic level, they can have an impact on changing cancer therapy. In this editorial, we examine the growing relevance of CRISPR/Cas-based technologies in oncology, including roles that extend from diagnostics to personalized immunotherapy. We also review key clinical trials and research milestones to emphasize the evolutionary impact on cancer therapy.

Key Words: car t cell; crispr-cas; cancer; therapy; diagnosis; genome editing

Introduction

Cancer therapy is rapidly advancing, driven by the search for safer and more effective treatments. CRISPR/Cas systems are particularly suitable tools for the purpose due to their programmable Cas proteins, including Cas9, Cas12, and Cas13. Such systems targeted gene editing in clinics to detect and treat disease, especially cancer. Via precise modifications at the genomic level, they can have an impact on changing cancer therapy. In this editorial, we examine the growing relevance of CRISPR/Cas-based technologies in oncology, including roles that extend from diagnostics to personalized immunotherapy. We also review key clinical trials and research milestones to emphasize the evolutionary impact on cancer therapy.

Precision cancer treatments are expected and demanded to be available. CRISPR systems are useful for clinical gene editing. These advances have broadened options in the detection and treatment of cancer; preemptive intervention on the genetic level may transform the cure of cancer [1]. CRISPR/Cas systems are, therefore, appealing for cancer therapy due to their straightforwardness and effectiveness. Tumor cells or immune cells receive the systems through several delivery methods, including physical methods, viral, and nonviral vectors. They are now indispensable in clinical applications, promising to transform treatment through targeting cancer development and immune evasion [2].

However, cancer is still a global challenge due to the absence of effective biomarkers for personalized therapies. Recent progress in genetic engineering, especially the CRISPR/Cas9 revolution, has enhanced the treatment of cancer. CRISPR/Cas9 can very effectively target DNA in cancer cells, editing genes that drive tumor growth or metastasis. Including nanoparticles in some CRISPR/Cas 9 treatments can enhance their effects because the particles deliver components directly to tumor cells, protect them from degradation, and improve their uptake by cells [3].

Cancer care has also advanced by leaps and bounds, with fewer deaths from the disease and longer life expectancy. But traditional treatments can cause nasty side effects. Now, CRISPR/Cas is taking over cancer care. CRISPR/Cas technology is transforming the treatment of cancers today. It can be used for both screening and the early diagnosis of cancer, as well as therapy and drug development. The real stars of CRISPR/Cas9, Cas12, and Cas13 are monstrous precision-guided missiles that target deadly cancer-causing genes to deliver the most precise and powerful molecular medicine. The same molecules also stimulate immunotherapy by activating CAR-T cells [4].

CRISPR/Cas has been a breakthrough in the field of cancer research, targeting issues such as early detection and effective treatment. It is anticancer and against resistance to chemotherapy [5, 6]. In a clinical trial, researchers used CRISPR-Cas9 to bolster the anti-tumor activity of human T cells. They focused on two genes that encode T cell receptor (TCR) chains in the hope of improving the T cells' ability to detect cancer cells. After the cells were edited, they were reinfused into patients, showing promising results for personalized cancer therapy (Figure 1).

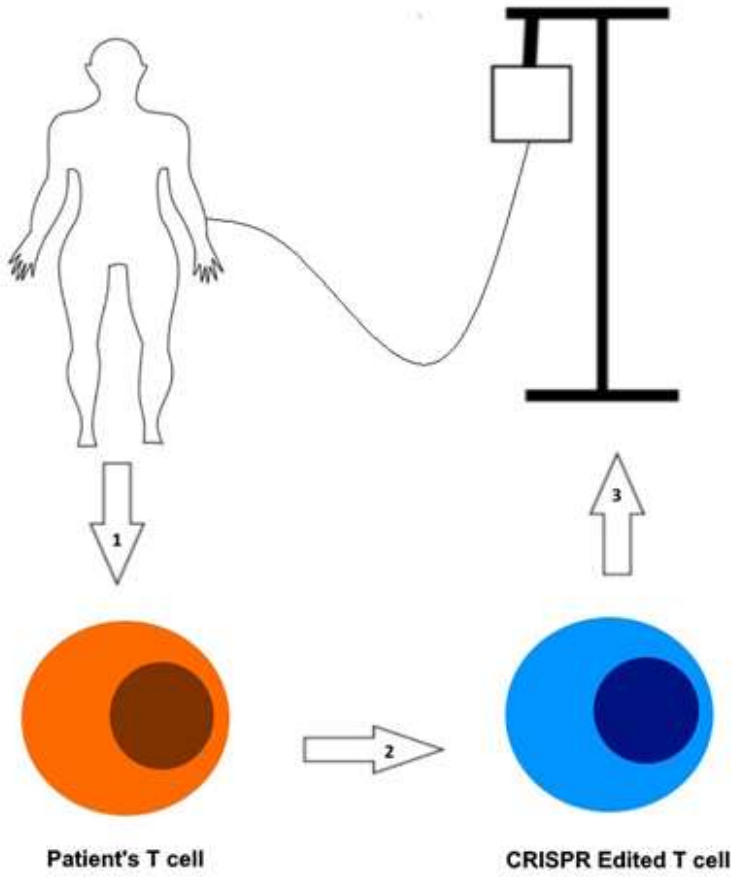

Figure 2: Application of CRISPR-Cas technology in cancer: (1) T cells are extracted from the patient (2) T cells were engineerred by CRISPR-Cas systems (3) After the T cells were edited, they were infused into the patient's body.

Cancer therapy CRISPR/Cas genome editing could have potential for cancer treatment as it may be used to target precisely the genetic mutations that make our cells cancerous. They can be used to edit treatment-resistant mutations, so you have a whole new way of getting around therapeutic resistance. CRISPR is used to edit immune cells and viruses for use in cancer immunotherapy, enhancing the body's own ability to fight tumors. Applications for techniques might include: engineering immune cells to recognize cancer and creating viruses that destroy tumors. Targeted therapies help such patients with fewer side effects [7].

CD8+ cytotoxic T lymphocytes (CTLs) mediate immunity against tumors. This population of CTL cells is constituted of precursor-exhausted T cells (Tpex) and terminally-exhausted T cells (Tex), two cellular targets of current immunotherapy. Scientists have identified and begun to deconstruct genetic networks that control CTL differentiation using a CRISPR approach, revealing important checkpoints. Tpex cell activation and Tex cell proliferation are required for effective antitumor response. These results shed new light on cancer immunity and pave the way for cellular function in cancer therapy. Inhibition of these pathways is an effort to refine immunotherapy in cancer treatment [8].

CRISPR systems, thanks to their range of Cas proteins, mark a major advance in the search for targeted treatments against cancer. This technology may revolutionize cancer treatment by targeting genes to stop the disease. CRISPR/Cas technology is adaptable and precise for cancer treatment, which will help patients live better and longer lives. Ongoing research and trials into CRISPR suggest a future with personalized treatments that change how cancer is handled [9-40].

Abbreviations

CAR T-cells: Chimeric antigen receptor T-cells

Cas protein: Cascade protein

CRISPR: Clustered regularly interspaced short palindromic repeats

CTLs: Cytotoxic T lymphocytes

Tpex: Precursor-exhausted T cells

Tex: Terminally-exhausted T cells

Conflicts of interest

The author confim that this article's content has no conflict of interest.

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