Application of CRISPR/Cas9 in CAR-T Cell Therapy: A Systematic Review Study

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ABSTRACT

Introduction: Currently, several attempts have been made to find effective treatments for cancer, with various options suggested, including chimeric antigen receptor-engineered T-cell (CAR-T) therapy. CAR-T cell therapy is a type of cell therapy that targets cancerous cells and is used in adoptive cell immunotherapy. Recent studies indicate that certain genetic therapeutic methods, such as clustered regularly interspaced short palindromic repeats (CRISPR)-Cas9-mediated genome editing technology, can enhance the efficacy of this treatment and have garnered significant attention.

Search Strategy: This article presents a review study that involved searching reputable databases, including Google Scholar, PubMed, Scopus, Cochrane Library, Web of Science, using keywords such as "CRISPR/Cas9", "CAR-T cell therapy", "Cancer", "Gene editing", and "immunotherapy" to ensure the comprehensive search results. The sources of the articles were thoroughly reviewed. After removing duplicate titles using EndNote software and examining the titles and abstracts, the articles relavant to the JBI tools were selected for further review. The appropriate checklist was then applied.

Results: Studies showed that despite significant success and promising result in CAR-T cell therapy, there were several challenges, including cell malfunction, toxicity, in adequate persistence of CAR-T cells, and T-cell exhaustion. These issues can adversely affect the efficacy and safety of this treatment. CRISPR/Cas9 technology has the potential to enhance CAR-T cell therapy by increasing resistance to immune cell-suppressive molecules. By enabling genome-targeted manipulation, this method can improve the effectiveness of CAR-T cell therapy through precise editing of these cells. CRISPR/Cas9 technology is notable for its remarkable efficacy in genome editing, flexibility, and ease of use. One of its most significant advantages is the utilization of a single nuclease combined with two short RNA molecules, which facilitates efficient genome editing.

Conclusion and Discussion: Despite the substantial advantages demonstrated by CRISPR/Cas9 technology, this method represents a novel approach to genome editing and offers rapid improvements in gene therapy. However, our understanding of all aspects of this technique, particularly its therapeutic application in cancer treatment, remains incomplete. Therefore, we recommend further studies to enhance our knowledge in this area.

Keywords: CRISPR-associated protein 9, Gene editing, Immunotherapy, Neoplasms

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