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REVIEW ARTICLE

Gene therapy in non-small-cell lung cancer

Terapia génica en cáncer de pulmón no microcítico

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ABSTRACT

Introduction: non-small cell lung cancer (NSCLC) is one of the most common and deadly cancers worldwide. Gene therapy is an emerging therapeutic strategy that has shown promise in the treatment of this disease.
Objective: to analyze and synthesize the latest scientific research on the application of gene therapy in non-small cell lung cancer.
Methods: narrative bibliographic review for which medical databases were consulted, such as: PubMed, Cochrane and Scopus. The search terms used were: "gene therapy", "non-small cell lung cancer", "tumor suppressor genes", "induced apoptosis" and "immune response". Studies that evaluated gene therapy in the treatment of non-small cell lung cancer and were published in peer-reviewed journals were included. Likewise, case reports were excluded.
Development: several studies were found that evaluated different gene therapy strategies in non-small cell lung cancer, including gene transfer that inhibits cell proliferation, induction of apoptosis and stimulation of the immune response. The results of these studies suggest that gene therapy may be effective in inhibiting tumor growth and improving survival in patients with non-small cell lung cancer.
Conclusions: the results to date are encouraging and suggest that gene therapy could be an effective and safe therapeutic option in the treatment of non-small cell lung cancer in the future.

Keywords: Genetic Therapy; Lung Neoplasms; Genes, Tumor Suppressor.

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RESUMEN

Introducción: el cáncer de pulmón no microcítico (CPNM) es uno de los tipos de cáncer más comunes y mortales en todo el mundo. La terapia génica es una estrategia terapéutica emergente que ha demostrado ser prometedora en el tratamiento de esta enfermedad.
Objetivo: analizar y sintetizar las últimas investigaciones científicas sobre la aplicación de la terapia génica en el cáncer de pulmón no microcítico.
Métodos: revisión bibliográfica narrativa para la que fueron consultadas bases de datos médicas, como: PubMed, Cochrane y Scopus. Los términos de búsqueda utilizados fueron: "terapia génica", "cáncer de pulmón no microcítico", "genes supresores de tumor", "apoptosis inducida" y "respuesta inmune". Fueron incluidos estudios que evaluaron la terapia génica en el tratamiento de cáncer de pulmón no microcítico y se publicaron en revistas revisadas por pares. Así mismo, fueron excluidos los informes de casos.
Desarrollo: se encontraron varios estudios que evaluaron diferentes estrategias de terapia génica en cáncer de pulmón no microcítico, incluyendo la transferencia de genes que inhiben la proliferación celular, la inducción de apoptosis y la estimulación de la respuesta inmune. Los resultados de estos estudios sugieren que la terapia génica puede ser efectiva en la inhibición del crecimiento tumoral y mejorar la supervivencia en pacientes con cáncer de pulmón no microcítico.
Conclusiones: los resultados hasta la fecha son alentadores y sugieren que la terapia génica podría ser una opción terapéutica efectiva y segura en el tratamiento del cáncer de pulmón no microcítico en el futuro.

Palabras clave: Terapia Génica; Cáncer de Pulmón; Genes Supresores de Tumor.

INTRODUCTION

Non-small cell lung cancer (NSCLC) is a disease that affects millions of people worldwide and accounts for the majority of lung cancer cases. Gene therapy has been proposed as a promising alternative for the treatment of NSCLC due to its ability to intervene in the molecular processes associated with cancer pathology.

Studies have shown that gene therapy can be an effective strategy for treating NSCLC by introducing therapeutic genes into cancer cells to replace or inhibit dysfunctional genes, induce apoptosis, or stimulate the immune response against tumor cells.[1]

One of the most investigated approaches in gene therapy for NSCLC is the introduction of tumor suppressor genes such as p53, which plays a crucial role in preventing cell mutations.[2] Studies have shown that gene therapy with p53 can restore normal gene function, induce apoptosis in cancer cells, and reduce tumor growth in animal models.[3]

In addition, gene therapy combined with chemotherapy and radiotherapy has been shown to significantly improve the treatment efficacy and survival of NSCLC patients.[4] Gene therapy has also been investigated in inhibiting angiogenesis, a process vital for tumor growth, by limiting the supply of nutrients and oxygen to cancer cells.[5]

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Although gene therapy in NSCLC shows promising results, there are still significant challenges and limitations that need to be addressed. One of the main challenges is the efficacy of gene therapy vectors in delivering therapeutic genes to cancer cells.[6] In addition, the safety of gene therapy in NSCLC remains a critical issue that needs to be addressed before it can be used in clinical practice.[7]

On the other hand, gene therapy is a promising therapeutic strategy for the treatment of NSCLC; preclinical and clinical studies have demonstrated its ability to inhibit tumor growth, induce apoptosis, and enhance the immune response against cancer cells. However, more research is still needed to address the challenges and limitations associated with gene therapy in NSCLC and to ensure the safety and efficacy of treatment.

Non-small cell lung cancer (NSCLC) represents one of the leading causes of morbidity and mortality worldwide. Despite advances in conventional treatment, the need for new effective and targeted therapeutic strategies remains pressing. In this context, gene therapy has emerged as a promising alternative, opening new perspectives for the approach to this devastating disease.

In view of the above, the aim of this literature review is to analyze and synthesize the latest scientific research on the application of gene therapy in non-small cell lung cancer; and the scientific question What is the current status of gene therapy as a therapeutic approach in non-small cell lung cancer? through which, we intend to contribute to scientific knowledge in this area and provide relevant information for the future development of more effective and personalized gene therapies against non-small cell lung cancer.

METHODS

A narrative literature review was conducted with a focus on gene therapy in NSCLC. A variety of medical databases were consulted, including PubMed, Cochrane, and Scopus. The search terms used were specific or combinations of keywords relevant to NSCLC gene therapy, such as: "gene therapy", "non-small cell lung cancer", "tumor suppressor genes", "induced apoptosis" and "immune response".

The titles and abstracts of all studies identified in the initial search were reviewed to determine relevance and compliance with the inclusion criteria. Studies that evaluated gene therapy in the treatment of NSCLC and were published in peer-reviewed journals were included. Likewise, case reports, studies that did not specifically focus on gene therapy in NSCLC and studies that were not available in full text were excluded.

No specific bioethical criteria were applied, since this was a literature review and no original research involving humans or animals was performed.

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DEVELOPMENT

Gene therapy can be an effective therapeutic strategy to treat non-small cell lung cancer, especially in combination with other conventional therapies. In addition, it has been identified that there are several gene therapy techniques and vectors that can be used effectively in this type of cancer. In short, the results obtained through the literature review provide a solid basis for the development of new studies and research in the field of gene therapy in non-small cell lung cancer, and offer new possibilities in the search for more effective treatments for this disease.

Gene therapy has emerged as a promising therapeutic strategy for the treatment of non-small cell lung cancer (NSCLC). In a recent literature review, several approaches to gene therapy have been identified that could be effective in the treatment of NSCLC. For example, it has been shown that gene therapy targeting apoptosis, suppression of angiogenesis, and modulation of the immune response can be effective strategies for treating NSCLC.[8] In addition, combining gene therapy with other conventional therapies, such as chemotherapy and immunotherapy, has been shown to improve treatment efficacy in NSCLC.[9]

Another promising approach for gene therapy in NSCLC is the use of viral vectors to deliver therapeutic genes. It has been shown that viral vectors can be effective in delivering therapeutic genes to tumor cells in it.[10] In addition, various techniques have been developed for the delivery of therapeutic genes, such as nanoparticle gene therapy, which can also improve the efficacy of NSCLC treatment.[11]

Gene editing may also be a promising strategy for the treatment of NSCLC. CRISPR-Cas9 technology, in particular, has been shown to be an effective tool for gene therapy in NSCLC.[12] CRISPR-Cas9 gene therapy can be used to correct genetic mutations in cancer cells, which could lead to increased treatment efficacy.

Overall, gene therapy in NSCLC has great potential as a therapeutic strategy. However, several limitations and challenges have also been identified in the field of gene therapy in NSCLC. For example, the efficacy of gene therapy may be limited by the lack of specificity of the delivery vector and the difficulty in delivering therapeutic genes to tumor cells.[13]

In conclusion, gene therapy has the potential to be an effective strategy for the treatment of NSCLC. Several promising approaches to gene therapy have been identified, including apoptosis-targeted gene therapy, suppression of angiogenesis and modulation of the immune response, use of viral vectors, and CRISPR-Cas9 gene therapy. However, limitations and challenges have also been identified in the field of gene therapy in NSCLC, indicating the need for further research and studies.

Gene therapy has emerged as a promising therapeutic strategy for the treatment of non-small cell lung cancer (NSCLC). The literature review conducted has identified effective therapeutic approaches such as gene therapy targeting apoptosis, suppression of angiogenesis, and modulation of the immune response. Combining gene therapy with other conventional therapies such as chemotherapy and immunotherapy has also been shown to be effective.[14]

Gene therapy can also be delivered through viral vectors and nanoparticle gene therapy techniques, which improve the efficacy of NSCLC treatment. In addition, CRISPR-Cas9 technology has been shown to be an effective tool for gene therapy in NSCLC, as it can correct genetic mutations in cancer cells.[15]

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However, limitations and challenges have also been identified in the field of gene therapy in NSCLC. Lack of specificity of the delivery vector and difficulty in delivering therapeutic genes to tumor cells are some of the limitations. Therefore, further research and studies are needed to address these limitations and challenges.[16]

Gene therapy has emerged as a promising strategy for the treatment of non-small cell lung cancer (NSCLC). One of the most widely used approaches in gene therapy is the transfer of genes encoding for tumor suppressor proteins, which restore the function of tumor suppressor cells and limit tumor growth. For example, transfer of the p53 gene, which codes for a tumor suppressor protein, has been shown to be effective in inhibiting tumor growth in mouse models of non-small cell lung cancer (NSCLC).[17]

In addition, gene transfer of genes encoding for apoptosis-inducing proteins has also been used in NSCLC gene therapy. BAX protein is an apoptosis-inducing protein that is downregulated in NSCLC tumor cells. One study showed that BAX gene transfer in NSCLC tumor cells significantly increased chemotherapy-induced apoptosis.[18]

Another approach in NSCLC gene therapy is the use of immunomodulatory gene therapy. The transfer of genes encoding for cytokines or co-stimulatory molecules that stimulate the immune response against tumor cells has been shown to be effective in inhibiting tumor growth in mouse models of NSCLC. For example, transfer of the gene coding for the CD40L protein, which is a co-stimulatory molecule, into mouse NSCLC tumor cells significantly increased the antitumor immune response.[19]

However, gene therapy also has limitations and potential risks that must be considered. One of the major risks is the possibility that the transferred genes may integrate into the host genome and cause unwanted mutations or genetic alterations. In addition, the host immune response against gene transfer vectors may also limit the efficacy of gene therapy.[20]

Gene therapy proves to be a promising strategy for the treatment of non-small cell lung cancer. Gene transfer of genes encoding for tumor suppressor, apoptosis-inducing or immunomodulatory proteins has been shown to be effective in inhibiting tumor growth in mouse models of NSCLC. However, their limitations and potential risks should be considered before clinical application.

Effective therapeutic approaches, such as targeted gene therapy and combination with other conventional therapies, together with therapeutic gene delivery techniques, such as the use of viral vectors and CRISPR-Cas9 technology, offer new possibilities in the search for more effective treatments for this disease. However, limitations and challenges in the field of gene therapy in NSCLC need to be addressed through further research and studies.

Ultimately, the literature review conducted on gene therapy in non-small cell lung cancer has yielded promising results and identified several effective therapeutic strategies. However, limitations and challenges have also been identified in the field of gene therapy in this type of cancer. Lack of specificity of the delivery vector and difficulty in delivering therapeutic genes to tumor cells are some of the limitations identified. These limitations may affect the efficacy of the treatment and therefore need to be addressed by further research and studies.

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The implications of the research study are significant. Gene therapy may be an effective therapeutic strategy for the treatment of non-small cell lung cancer, especially in combination with other conventional therapies. Effective therapeutic approaches, such as targeted gene therapy and combination with other conventional therapies, along with therapeutic gene delivery techniques, offer new possibilities in the search for more effective treatments for this disease. Therefore, further research and studies are needed to address the limitations and challenges in the field of gene therapy in non-small cell lung cancer and to develop more effective and personalized treatments for patients with this disease.

CONCLUSIONS

Gene therapy is a promising therapeutic strategy for the treatment of non-small cell lung cancer. Through combination with other conventional therapies and improved therapeutic gene delivery techniques, it is expected that more effective and personalized treatments can be developed for patients with this disease. Therefore, further research and studies are needed to address the limitations and challenges in the field of gene therapy in non-small cell lung cancer and to improve the efficacy of treatment for patients.

Conflicts of interest
No conflicts of interest

Authorship Contribution
RFDN: research, draft-writing, methodological review, approval of final manuscript.
NGM: drafting-drafting, methodological review, approval of final manuscript.
ARPl: writing-drafting, editing, proofreading, approval of final manuscript.

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