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Peptide-based therapeutic strategies for glioma: Current state and prospects

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Highlights

- Peptide-based therapeutic strategies represent a novel class of pharmaceutical agents for the treatment of glioma.
- Therapeutic peptides have 4 anti-tumor types: tumor-homing, inhibitor/antagonist, interference peptides, and peptide vaccines.
- Clinical trials have demonstrated that peptide-based treatment strategies are promising for glioma therapy.

Abstract

Glioma is a prevalent form of primary malignant central nervous system tumor, characterized by its cellular invasiveness, rapid growth, and the presence of the blood-brain barrier (BBB)/blood-brain tumor barrier (BBTB). Current therapeutic approaches, such as chemotherapy and radiotherapy, have shown limited efficacy in achieving significant antitumor effects. Therefore, there is an urgent demand for new treatments. Therapeutic peptides represent an innovative class of pharmaceutical agents with lower immunogenicity and toxicity. They are easily modifiable via chemical means and possess deep tissue penetration capabilities which reduce side effects and drug resistance. These unique pharmacokinetic characteristics make peptides a rapidly growing class of new therapeutics that have demonstrated significant progress in glioma

treatment. This review outlines the efforts and accomplishments in peptide-based therapeutic strategies for glioma. These therapeutic peptides can be classified into four types based on their anti-tumor function: tumor-homing peptides, inhibitor/antagonist peptides targeting cell surface receptors, interference peptides, and peptide vaccines. Furthermore, we briefly summarize the results from clinical trials of therapeutic peptides in glioma, which shows that peptide-based therapeutic strategies exhibit great potential as multifunctional players in glioma therapy.

Section snippets

Background

Gliomas are the most common central nervous system (CNS) tumors in adults, originating from the glial cells of the brain or spinal cord [1], [2]. This category encompasses several different types of tumors and can be classified into four grades (I, II, III, and IV) according to the World Health Organization (WHO) system[3]. Grade I or II tumors are known as low-grade gliomas and typically exhibit slow growth. The term malignant or high-grade glioma is used for Grade III and Grade IV tumors; …

Therapeutic peptides

Therapeutic peptides are a novel class of pharmaceutical agents composed of well-ordered amino acids (AA), typically consisting of 5–50 AA stabilized by disulfide bonds[8]. Research into therapeutic peptides started with the first medical use of purified insulins obtained from animals in 1922 [9]. Since then, over 80 peptide drugs have been introduced to the global market for a wide range of disease treatments, including cancer, diabetes, multiple sclerosis, HIV infection, chronic pain, and more …

Types of peptides and their function in cancer

Peptides can be classified in various ways based on different criteria: they can be categorized as natural peptides, engineered peptides created using recombinant or genetic libraries, or from chemical libraries according to their source[13]. In terms of length, peptides can be divided into oligopeptides with short amino acid chains containing up to 20 amino acids and polypeptides with longer amino acid chains[14]. Peptides are further categorized based on their anti-tumor function[14], …

Interfering peptides

Interference peptides are gaining increasing attention as a promising strategy for cancer drug development due to their ability to target intracellular protein-protein interactions and disrupt normal signaling pathways[217]. Considering their physicochemical characteristics, interfering peptides are better suited than small molecules to interfere with the large surfaces involved in

PPIs [217] and all the interfering peptides for glioma treatment are summarized in Table 3.

c-Myc, an oncogene that …

Peptide vaccines

Cancer immunotherapy utilizes the body's immune system to target and eliminate cancer cells; this approach has become central to cancer treatment strategies [290]. Among different types of immunotherapy such as immune checkpoint inhibitors(ICIs), oncolytic viruses,chimeric antigen receptor-T cell therapies,and therapeutic cancer vaccines [291], therapeutic cancer vaccines have shown promise for activating anti-tumor immune responses, resulting in tumour regression, minimal residual disease …

Clinical trials of therapeutic peptides in glioma

Currently, therapeutic peptides are being investigated as a pharmacological tool for glioma therapy in various clinical trials. A total of 77 registered clinical trials related to peptide and glioma were identified on ClinicalTrials.gov (http://www.clinicaltrials.gov ↗) (Table 5) as of May 10, 2024. Among these trials, 15 were excluded for not being relevant to therapeutic peptides, while 2 were withdrawn, 8 terminated, 1 suspended, and 2 unknown. Additionally, there were 24 completed trials, 11 …

Conclusion and perspectives

In recent years, peptides have emerged as a distinct class of therapeutic agents due to their unique biochemical characteristics and potential for treatment. The use of peptides in cancer treatment has become an increasingly popular area of research[10]. However, when it comes to treating glioma, a type of brain tumor, there are certain barriers such as the blood-brain barrier (BBB) and blood-brain tumor barrier (BBTB) that need to be overcome. Despite significant progress in tumor treatment …

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Gao xingchun: Writing – review & editing, Writing – original draft, Validation, Investigation. **Zhang Dian:** Writing – review & editing, Writing – original draft. **Feng Lin:** Writing – review & editing, Writing – original draft. **Luan Jing:** Writing – review & editing, Writing – original draft. **Jiang Pengtao:** Writing – review & editing, Writing – original draft. **Mi Yajing:** Writing – review & editing, Writing – original draft. …

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. …

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