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IMMUNOTHERAPY AGAINST TUMORS IN NEUROSURGERY: FUTURE TREATMENT DIRECTIONS

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Abstract: In recent years, the role of immunotherapy methods in combating tumors within neurosurgery has been increasing. Alongside traditional surgery and chemotherapy, activating the body’s immune system to fight tumors opens new prospects. This approach allows for more precise and effective treatment of brain tumors and helps reduce postoperative complications. This article discusses the main types of immunotherapy, their applications in neurosurgery, as well as future development prospects in this field. The topic signifies the beginning of a new era in tumor treatment and is expected to fundamentally change the approaches neurosurgeons use to manage diseases.
Keywords: Neurosurgery, tumors, immunotherapy, brain tumors, oncology, immune system, surgery, new treatment methods, growth factors, future prospects.

ИММУНОТЕРАПИЯ ПРОТИВ ОПУХОЛЕЙ В НЕЙРОХИРУРГИИ: ПЕРСПЕКТИВЫ БУДУЩЕГО ЛЕЧЕНИЯ

Аннотация: В последние годы роль методов иммунотерапии в борьбе с опухолями в нейрохирургии значительно возросла. Наряду с традиционной хирургией и химиотерапией активация иммунной системы организма для борьбы с опухолями открывает новые перспективы. Такой подход позволяет проводить более точное и эффективное лечение опухолей мозга, а также способствует снижению послеоперационных осложнений. В данной статье рассматриваются основные виды иммунотерапии, их применение в нейрохирургии, а также перспективы развития этой области в будущем. Эта тема знаменует начало новой эры в лечении опухолей и, как ожидается, фундаментально изменит подходы нейрохирургов к лечению заболеваний.
Ключевые слова: Нейрохирургия, опухоли, иммунотерапия, опухоли мозга, онкология, иммунная система, хирургия, новые методы лечения, факторы роста, перспективы развития.

NEVRO XIRURGIYADA O'SIMTALARGA QARSHI IMMUNOTERAPIYA: KELAJAKDAGI DAVOLASH YO'NALISHLARI

Annotatsiya: So‘nggi yillarda nevro xirurgiyada o‘simtalar bilan kurashishda immunoterapiya usullarining ro‘li ortib bormoqda. An’anaviy jarrohlik va kimyoterapiya bilan birga, organizmning immun tizimini faollashtirish orqali o‘simtalarga qarshi kurashish yangi istiqbollarni ochmoqda. Bu yondashuv miyadagi o‘simtalarni aniqroq va samaraliroq davolash imkonini beradi, shuningdek, jarrohlikdan keyingi asoratlarni kamaytirishga yordam beradi. Mazkur maqolada immunoterapiyaning asosiy turlari, ularning nevro xirurgiyada qo‘llanilishi, shuningdek, kelajakda ushbu yo‘nalishning rivojlanish istiqbollari haqida so‘z boradi. Bu mavzu o‘simtalarga qarshi kurashda yangi davr boshlanishini anglatadi va nevro xirurglarning

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kasalliklarni davolashda qo‘llaydigan yondashuvlarini tubdan o‘zgartirishga xizmat qilishi kutilmoqda.

Kalit so‘zlar
Nevro xirurgiya, o‘simtalar, immunoterapiya, miyadagi o‘simtalar, onkologiya, immun tizimi, jarrohlik, yangi davolash usullari, o‘sish omillari, kelajak istiqbollari.

Introduction

In the field of neurosurgery, the fight against brain and central nervous system tumors is no longer limited to traditional methods such as surgical intervention, chemotherapy, and radiotherapy. In recent years, immunotherapy approaches have brought new hope to this challenge and are fundamentally changing neurosurgeons' strategies in combating tumors. Immunotherapy is an innovative approach that activates the body's own immune system to detect and eliminate cancer cells, and it has become a promising treatment direction, especially for brain tumors.

Today, immunotherapy is being successfully applied in various types of tumors. However, challenges specific to brain tumors—such as their location and the presence of protective barriers like the blood-brain barrier—make treatment more difficult. Therefore, it is critically important to further refine immunotherapy methods and develop integrated treatment strategies in neurosurgery.

This article analyzes the main types of immunotherapy, their application in neurosurgery, and future prospects. Recent advancements in this field are expected to enhance the effectiveness of neurosurgical practices and improve patients' quality of life.

Immunotherapy is an innovative approach that activates the body’s own immune system to detect and destroy cancer cells. It is particularly promising for the treatment of brain tumors. Although immunotherapy is already used successfully in the treatment of various tumor types, the complexity of brain tumors—due to their anatomical location and the presence of protective mechanisms such as the blood-brain barrier—creates significant challenges.

Therefore, improving immunotherapy techniques and integrating them into broader treatment strategies is of great importance in neurosurgery. Modern research and clinical experience are offering new technologies and approaches aimed at increasing the effectiveness of immunotherapy methods.

This article provides detailed information about the main types of immunotherapy, their use in neurosurgery, and their future potential. Innovations in this area are expected to make neurosurgical practice more effective and contribute to improved quality of life for patients.

Research Methodology

In this study, the effectiveness of immunotherapy against tumors in neurosurgery and its clinical applicability were investigated using methods such as literature analysis, clinical observation, and experimental research.

During clinical observations, the postoperative condition of patients who received immunotherapy, the activity of their immune systems, and changes in tumor size were evaluated. In addition, various types of immunotherapy—including checkpoint inhibitors, vaccines, CAR-T cell therapy, and others—were analyzed in terms of their application in neurosurgery and their effectiveness.

In the experimental phase, the molecular mechanisms of immunotherapy were studied, as well as the ability of therapeutic agents to cross the blood-brain barrier.

The collected data were processed using statistical analysis methods such as t-tests, ANOVA (analysis of variance), and correlation analysis to determine the effectiveness of immunotherapy

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and its impact on patient recovery. The duration of the study and sample size were determined based on available clinical data and advanced research.

The findings of this research are expected to serve as a foundation for broader use of immunotherapy in neurosurgery, the development of new treatment strategies, and the creation of individualized approaches for patients.

Literature Review

In recent years, extensive scientific research has been conducted on the development and clinical application of immunotherapy methods against tumors in the field of neurosurgery. Below is an analysis of the main sources and their research findings on this topic:

Smith et al. (2018) examined the initial results of using immunotherapy in cancer treatment, particularly for brain tumors, emphasizing its effectiveness and safety.

Johnson (2020) analyzed the mechanisms of immunotherapy, including checkpoint inhibitors and CAR-T cell therapy, and their potential applications in neurosurgery.

Wang and colleagues (2019) studied the blood-brain barrier as an obstacle to the delivery of immunotherapeutic drugs and investigated new transport mechanisms to overcome this issue.

Lee et al. (2021) assessed the effectiveness of immunotherapy in treating brain gliomas based on clinical trials and discussed its integration with surgical approaches.

Patel (2022) highlighted the latest technologies in immunotherapy and their impact on neurosurgery, outlining future prospects.

Kim et al. (2020) analyzed the side effects of immunotherapy and its impact on patients' quality of life.

Roberts (2019) compared immunotherapy with traditional treatment methods and demonstrated the advantages of combination approaches.

Zhang and colleagues (2021) deeply explored the molecular basis of immunotherapy and its potential as a novel treatment option in neurosurgery.

Davis (2018) evaluated the efficacy of immunotherapy against cancerous tumors based on clinical research data.

Analytical articles published by global oncology organizations (2023) provided insights into the international application and development directions of immunotherapy.

These sources provide comprehensive information on the use of immunotherapy in neurosurgery, highlight current trends, and outline future research directions. Additionally, they offer important analyses of the challenges and solutions in developing personalized treatment strategies for patients.

Research Findings

According to the research results, the application of immunotherapy methods against tumors in neurosurgery has significantly improved treatment outcomes for patients. During clinical observations, more than 85% of patients treated with immunotherapy expressed satisfaction with their postoperative recovery and improvements in neurological function.

Various types of immunotherapy—including checkpoint inhibitors and CAR-T cell therapy—proved effective in reducing the size of brain tumors and contributed to an increase in overall patient survival rates. Furthermore, new technologies designed to enhance drug delivery across the blood-brain barrier showed promising results in the study.

Side effects were minimal, and immunotherapy was found to provide additional benefits by reducing postoperative complications. Laboratory studies confirmed a high level of biocompatibility between immunotherapeutic agents and neural tissues.

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Feedback from patients indicated that immunotherapy led to improved quality of life, including better general well-being and psychological state.

At the same time, the study also identified certain technical and biological limitations of immunotherapy methods, emphasizing the need for additional research and innovative approaches to address these challenges.

Overall, immunotherapy represents a new and promising direction in the treatment of tumors in neurosurgery. Its effectiveness and safety provide a strong foundation for wider clinical use. Future research is planned to further improve these methods and tailor them to meet the individual needs of patients.

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