

EVALUATION OF THE EFFECTIVENESS OF TREATMENT OF FOURTH VENTRICLE EPENDYMOMAS IN IMMEDIATE AND LONG-TERM PERIODS IN CHILDREN

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Abstract. Background: Ependymomas of the fourth ventricle are a significant clinical challenge in pediatric neurosurgery, representing a substantial portion of central nervous system tumors in children. Prognosis largely depends on the tumor's anaplasia grade, extent of surgical resection, and subsequent treatment strategies.

Methods: A retrospective analysis was conducted on 49 pediatric patients (aged 2–15 years) with fourth-ventricle ependymomas treated between 2022 and 2024. The degree of tumor resection was assessed using the "Tumor Volume Calculation" program, and postoperative outcomes, survival rates, and "quality of life" (QoL) were evaluated using established scales.

Results: Total tumor resection was achieved in 70.8% of patients, with postoperative mortality rates of 3.1% and 5.0% for total and subtotal resections, respectively. Five-year survival rates were 98.7% for Grade I–II tumors and 64.5% for Grade III tumors treated with adjuvant therapies. QoL assessments revealed that 41.0% of patients had good QoL, 54.2% satisfactory, and 4.8% poor. Extent of resection removal significantly impacted long-term QoL, with total resections yielding superior outcomes (53.6% improvement).

Conclusion: The effectiveness of treatment for pediatric fourth-ventricle ependymomas depends on the extent of tumor resection and subsequent therapy. Total resection, where feasible, significantly improves survival rates and long-term QoL.

Keywords: Ependymomas, fourth ventricle, pediatric neurosurgery, tumor resection, quality of life

Introduction

Tumors of the central nervous system (CNS) rank as the second most common malignant neoplasms in children, following leukemia [2, 5]. In pediatric patients, subtentorial brain tumors often exhibit a predominantly midline localization [5, 7]. Subtentorial hemispheric tumors are predominantly composed of neoplasms of the ependymal series.

Primary brain tumors, including ependymomas, represent a heterogeneous group of pathologies and are recognized as the most prevalent solid tumors in pediatric populations. Diagnostic and classification methodologies increasingly incorporate immunohistochemical profiling, cytogenetic and molecular genetic analyses, as well as evaluations of mitotic activity. While histological assessment remains the cornerstone of brain tumor classification, additional factors - such as anatomical location, extent of dissemination, molecular characteristics, and patient age - play pivotal roles in determining therapeutic strategies and prognostic outcomes. Ependymomas arise from ependymal cells that line the ventricles and

passageways in the brain and the center of the spinal cord. Ependymal cells produce cerebrospinal fluid (CSF). These tumors are classified as supratentorial, posterior fossa (infratentorial), or spinal. In children, 65% to 75% of ependymomas arise in the posterior fossa around the fourth ventricle.[4] Less commonly, ependymomas present in the supratentorial compartment. Spinal ependymomas are rare in childhood.

The success of surgical treatment for hemispheric ependymomas depends on tumor infiltration into subcortical structures, which affects the feasibility of radical resection, as well as the degree of tumor anaplasia. Total resection of Grade I–II anaplastic ependymomas yields a 10-year survival rate of 80%. Partial resections are often supplemented by radiotherapy and chemotherapy to prolong patients' lives. Tumor invasion into vital structures significantly limits the possibility of radical removal, which is achieved in only 3–10% of cases [1, 2, 7]. Despite these efforts, postoperative mortality rates remain high.

The use of combined therapy, including radiotherapy and chemotherapy during the postoperative period, results in a 5-year survival rate of no more than 30% [6, 10].

In recent years, the term "quality of life" has gained prominence in medical literature as an integral measure of physical, psychological, emotional, and social functioning, reflecting treatment outcomes. This concept is especially relevant in oncology, where it serves as both an effectiveness measure and an important prognostic criterion. Over 30 scales have been developed to assess patient quality of life. Thus, quality of life is a comprehensive indicator of an individual's perceived position in life [4].

The inconsistent and often unsatisfactory outcomes of treatment for children with fourth-ventricle brain tumors highlight the continuing importance of addressing this issue.

Objective

To analyze and predict treatment outcomes for fourth-ventricle ependymomas in pediatric patients.

Materials and Methods

A retrospective analysis of 49 pediatric patients treated at the Republican Specialized Scientific and Practical Medical Center of Neurosurgery (RSSPMCN) between 2022 and 2024 was conducted. The patients were aged 2 to 15 years, comprising 26 boys and 23 girls. Diagnosis was established based on clinical-neurological, instrumental, and histopathological investigations. The degree of radicality of tumor removal was assessed using the program "Tumor Volume Calculation."

Results and Discussion

In terms of anaplasia, 61.8% of ependymal tumors were classified as benign, while 38.2% were classified as malignant. Tumor location in functionally critical brain zones and spread into subcortical structures limited the possibility of radical removal, which was achieved in 70.8% of patients. Postoperative mortality overall was 4.6%, with 3.1% for total resections and 5.0% for subtotal resections.

Five-year survival rates varied based on the degree of tumor removal and anaplasia grade. Total resection of Grade I–II anaplastic gliomas resulted in a five-year survival rate of 98.7%. For Grade III tumors treated with radiotherapy (RT) and chemotherapy (CT), the

survival rate was 64.5%. Subtotal tumor removal yielded five-year survival rates of 94.7% and 39.0% for benign and malignant tumors, respectively.

Quality of life assessments revealed that 41.0% of children with fourth-ventricle ependymomas had a good quality of life, 54.2% had a satisfactory quality of life, and 4.8% had a poor quality of life, often due to pronounced hemiparesis. It was found that neither tumor anaplasia grade nor the type of adjuvant therapy had a statistically significant effect on quality of life. However, quality of life deterioration correlated with tumor spread into subcortical structures and, consequently, with the extent of surgical intervention.

To evaluate the relationship between quality of life in the postoperative period and the radicality of tumor removal, patients were divided into three groups based on the totality of resection. Quality of life was assessed in the immediate and long-term postoperative periods using a scale for evaluating the quality of life in patients with supratentorial neoplasms. Results were categorized into excellent, satisfactory, and unsatisfactory quality of life. The comparison was based on the baseline quality of life in the early postoperative period.

Table 1.

Dynamic relationship between resection totality and quality of life in immediate and long-term postoperative periods

Quality of life		Extent of resection						TOTAL	
		up to 75 %		75-95%		95-100%			
		partial		subtotal		total		n.	%
		N	%	n.	%	n.	%		
Good	Immediate postoperative period	3	27,3	8	47,1	8	38,1	19	38,8
	Long-term postoperative period	3	30	6	37,5	12	52,2	21	42,8
Satisfactory	Immediate postoperative period	5	45,4	7	41,1	11	52,4	23	46,9
	Long-term postoperative period	3	30	7	43,75	9	39,1	19	38,8
Poor	Immediate postoperative period	3	27,3	2	11,8	2	9,5	7	14,3
	Long-term postoperative period	4	40	3	18,75	2	8,7	9	18,4

From Table 1, it is evident that the best neurological outcomes were observed in patients with subtotal resections during the immediate postoperative period, a trend that persisted in the long-term period for 37.5% of patients. Poorer outcomes in patients with partial resections were associated with their initially poor condition, as these surgeries were generally emergent and life-saving.

In our study, total resection had unfavorable outcomes in 9.7% of cases in the immediate postoperative period. However, in the long term, it was associated with improved quality of life and a stable favorable outcome in 53.6% of patients.

Conclusion

1. The effectiveness of treatment for pediatric patients with fourth-ventricle ependymomas largely depends on the degree of tumor resection and adjuvant therapy.
2. The program "Tumor Volume Calculation" was successfully utilized to accurately determine the radicality of surgical intervention.
3. Long-term outcomes in the group with total resections were superior to those in the subtotal resection group due to the complete elimination of the pathological factor.

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