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Dmytro S. Teslenko,
Orest I. Palamar,
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Oleksandr S. Usatov

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Invasive tumours of third ventricle. The possibilities of endoscopic transventricular surgery

Dmytro S. Teslenko, Orest I. Palamar, Andriy P. Huk, Dmytro I. Okonskyi, Oleksandr S. Usatov

Romodanov Neurosurgery Institute. Department of Endoscopic and Craniofacial Neurosurgery, Ukraine

Keywords
endoscopic transventricular,
invasive tumors,
secondary tumors,
thalamus,
third ventricle,
transforaminal,
ventriculocisternostomy

Abstract

Despite the rapid development of neurosurgery in the 21st century, the invasive (secondary) tumours of the third ventricle have always presented a highly sophisticated challenge in terms of surgical treatment. The question of radical resection of these tumours remains debatable, considering the high risk associated with the possibility of disability, the expected duration and the postoperative quality of life. We conducted a retrospective study of patients with invasive third ventricular tumours that have been treated in our department from 2015 to 2020 reviewing pre- and postoperative clinical and radiological data for 21 cases. The treatment options in all 21 cases included an endoscopic frontal transcortical transventricular transforaminal-transchoroidal tumour removal, achieving gross total and subtotal resection in 86% of the interventions, followed by adjuvant treatment (radiation therapy in all cases, and chemotherapy – for high-grade tumours). An endoscopic third ventriculocisternostomy was performed in cases with partial tumour removal in order to improve the CSF flow. Neurological deficits included permanent hemiplegia – in 3 patients (15%), permanent hemianopia – in 2 patients (10%), transient short-term memory impairment – in 3 patients (15%) with regression in 2-4 weeks after surgery. There was no postoperative lethality. Maximal postoperative survival in our patients with high-grade tumours was 16 months; patients with low-grade tumours are still under supervision. Endoscopic frontal transcortical transventricular transforaminal-transchoroidal approach to resection of third ventricular tumours is an effective surgical modality, that maximizes the possible resection volume with minimal occurrence of postoperative complications, therefore can be recommended for the routine treatment of the aforementioned pathology.

Introduction

Despite the rapid development of neurosurgery in the 21st century, surgery of invasive (secondary) tumors of the third ventricle, which are malignant in most cases, remains far from a solution [1-9]. Usually, the zone of primary growth of invasive third ventricular tumors is located in functionally important areas of the brain [2,3-9].

The questions of the radical removal of these tumors [4,7-9] remain debatable, taking into account the possible disability of patients [3-7,9], the expected duration and the postoperative quality of life [1,4,7,12].

Corresponding author:
Dmytro S. Teslenko

Romodanov Neurosurgery Institute. Department of Endoscopic and Craniofacial Neurosurgery, Ukraine

info@pituitary.com.ua

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Materials and methods

From 2015 to 2020, we have treated 43 patients with tumors of the third ventricle, 21 of which were invasive tumors with predominant growth from the thalamus. All patients underwent complete endoscopic resection using the frontal transcortical transventricular transforaminal approach. If the size of the interventricular foramen was inadequate for the endoscopic intervention, it was expanded by dissection of the anterior portions of the choroid plexus (Fig. 1).

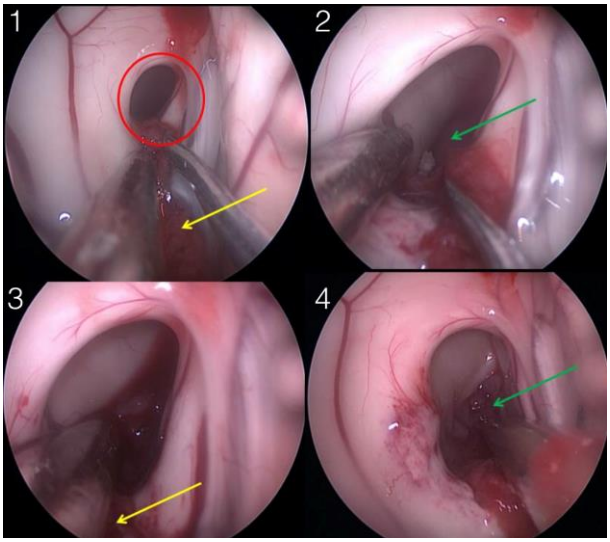


Figure 1. Step-like expansion of the interventricular foramen by dissecting the anterior portions of the choroid plexus: the interventricular foramen is circled in red; the yellow arrow indicates the choroid plexus; the green arrow indicates an invasive third ventricular tumour.

Preoperative neurological status of patients: nonfocal symptoms were present in all patients, central hemiparesis (up to 2/5 points) - in 5 patients, impaired short-term memory - in 6 patients. Occlusive hydrocephalus was diagnosed in all cases.

All patients underwent an endoscopic removal by a frontal transcortical transventricular transforaminal approach, and in 11 cases an additional endoscopic third ventriculocisternostomy was performed.

Results

Radicality of surgical removal of invasive tumors (Fig. 2): Gross total resection (removal within healthy tissues) - 2 patients. Subtotal resection (removal of up to 90% of the tumor) - 16 patients. Partial removal - 3 patients. Partial removal was performed in the cases where an excessive bleeding from the tumor was observed. Endoscopic third ventriculocisternostomy was conducted in 11 cases with a bleeding tumor and limited removal radicality.

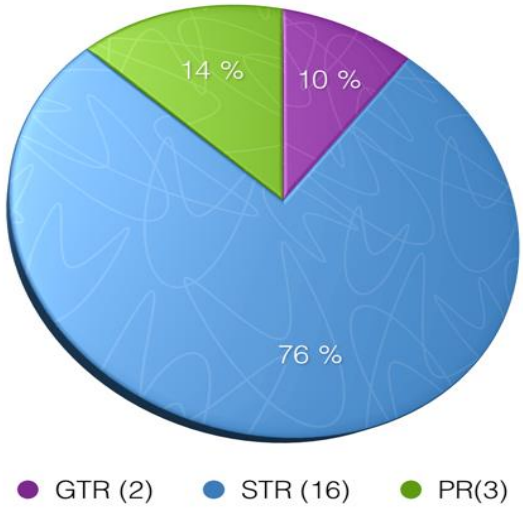
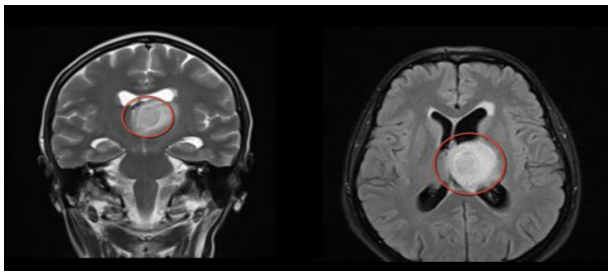


Figure 2. Radical removal of invasive third ventricular tumors: (GTR - Gross total resection - (total) removal of the tumor within healthy tissues; STR - Subtotal resection - subtotal (up to 90%) removal of the tumor; PR - Partial removal.

Histological distribution: low grade tumors (WHO grade 2 - fibrillar astrocytoma) - 3 cases; high grade tumors (WHO grade 3-4 - anaplastic astrocytoma (Fig. 3), anaplastic oligoastrocytoma (Fig. 4), glioblastoma) - 18 cases. The maximum size/diameter of the tumor reached 6.2 cm.



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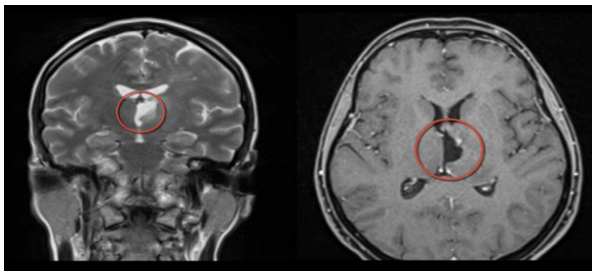
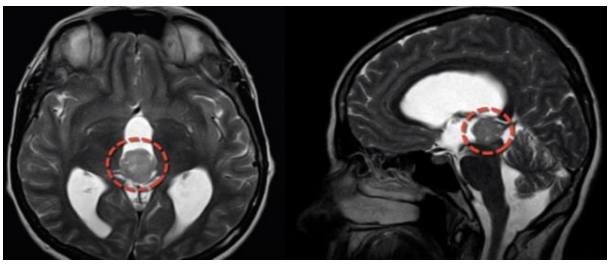


B.

Figure 3. Preoperative brain MRI (A) and 3 months after surgery (B). Total removal of the tumor of the left thalamus (Histological diagnosis – anaplastic astrocytoma, WHO grade 3). Hydrocephalus regressed in the postoperative period.



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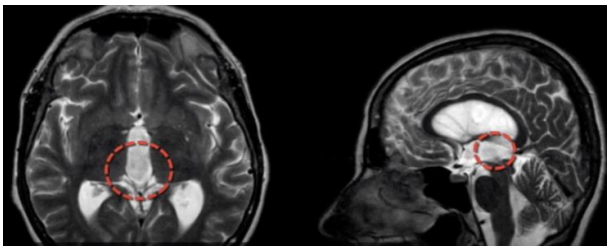

B.

Figure 4. Preoperative brain MRI (A) and 3 months after surgery (B). Total removal of an invasive tumor in the posterior portions of the third ventricle (Histological diagnosis – anaplastic oligoastrocytoma, WHO grade 3). Hydrocephalus regressed in the postoperative period.

Postoperative condition: the postoperative Karnofsky Performance Status in all patients was 70 points or more. Postoperative neurological deficit: permanent hemiplegia – in 3 patients (15%), permanent hemianopia – in 2 patients (10%), transient short-term memory impairment – in 3 patients (15%) with a regression in 2-4 weeks after surgery.

In all patients, nonfocal symptoms regressed. After surgical treatment all patients received adjuvant treatment (radiation therapy in all cases, chemotherapy – for high-grade tumors).

Maximal postoperative survival in our patients with high-grade tumors was 16 months, patients with low-grade tumors are still under supervision. There was no postoperative lethality.

Discussion

The problem of radical gross total resection of invasive tumors of third ventricle is deeply connected to their site of origin, as they predominantly arise from the thalamus. A greater resection volume may jeopardize the integrity of this critical neurostructure, thus leading to a postoperative neurological deficit and disability. Previously, microsurgical technique for resection of third ventricular tumors has been performed with the use of operative microscope. The rapid development of neuroendoscopy in the last 20 years has provided new minimally invasive options for treatment of ventricular pathology, therefore opening new prospects for surgical resection of invasive tumors of third ventricle. Shorter operative time period, minimal invasiveness and better visualization of deep-seated ventricular structures are considered to be the main advantages of neuroendoscopy over microsurgery, although the traditional microsurgery retains its edge in bleeding control [1, 3, 4, 5, 8].

The endoscopic frontal transcortical transventricular transforaminal approach has been used in surgical resection of third ventricular tumors in many institutions worldwide [3, 4, 5, 8]. This approach provides the possibility to utilize a natural pathway such as the foramen of Monro in order to reach third ventricle through established anatomical landmarks, especially in the setting of hydrocephalus, which is habitually present in patients with invasive third ventricular tumors [8]. Achieving gross total and subtotal resection was possible in 86% of the interventions, with minor postoperative complications. Other authors, such as Tawk RG et al. [8] have reported similar results, achieving complete and near complete resection in 84% of the cases. Various endoscopic modalities could be used, when approaching the third ventricular invasive tumors [11]. The endoscopic endonasal approach has similar radical resection success and an ETV procedure could be performed, but it is believed to be associated with higher risk of infectious complications, such as meningoencephalitis, and hormonal disorders (diabetes insipidus, obesity etc.) [10, 12].

The authors believe, that the use of endoscopic frontal transcortical transventricular transforaminal approach in patients with invasive third ventricle tumors and obstructive hydrocephalus may appear to be an effective alternative to microsurgical resection using an operative microscope, although more clinical studies have to be conducted in order to confirm the clinical efficacy of the endoscopic frontal transcortical transventricular transforaminal approach. [1-12].

Conclusions

1. Minor functional disorders and high life expectancy in invasive high-grade tumors make it possible to recommend frontal endoscopic transcortical transventricular transforaminal-transchoroidal approach as an effective method of surgical treatment of these tumors.

2. To prevent the development of a postoperative obstructive hydrocephalus by a blood clot, intraventricular hemorrhages, obstruction of cerebral aqueduct, in patients with invasive third ventricular tumors, it is advisable to perform intraoperative third ventriculocisternostomy.

Disclosures

The authors declare no funding sources or conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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