

CLINICAL RESEARCH

## Neuroendoscopic Intervention for Deep Midline Brain Tumors with Secondary Occlusive Hydrocephalus

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### Abstract

This article analyzes the results of a clinical examination of 102 patients (78/76.47% men and 24/23.53% women) with a brain tumor (BT) complicated with a secondary obstructive hydrocephalus (SOH). All the patients were divided into 3 groups according to the type of surgery. Group 1 included 38(37.2%) patients who underwent Torkildsen's ventriculocisternostomy. Group 2 consisted of 34(33.3%) patients who underwent endoscopic third ventriculocisternostomy (ETV) with simultaneous endoscopic tumor removal. Group 3 included 30 (29.4%) patients who underwent a two-stage intervention: ETV in the first stage, and the endoscopic tumor removal in the second stage. The distinct advantages of EVT with tumor removal in the second stage of the operation were revealed.

**Keywords:** brain tumor; secondary obstructive hydrocephalus; endoscopic third ventriculocisternostomy (ETV).

### Introduction

Surgeries of deep midline brain tumors (BTs) remain one of the most difficult sections of clinical neurosurgery [1,2]. Characteristic features of BT with secondary obstructive hydrocephalus (SOH) and the bright manifestation of hydrocephalus, so-called brain dropsy, require the solution of two important issues. First of all, elimination of a progressive manifestation of the hypertension-hydrocephalic syndrome (HHS) and SOH; second, microsurgical BT removal [2-4]. Traditional methods of surgical correction of HHS caused by occlusion of the cerebrospinal fluid (CSF) pathways (Torkildsen's ventriculocisternostomy (VCS), ventriculoperitoneostomy, ventriculoatriostomy) have a number of contraindications and are quite traumatic. Marked interventions often contribute to the development of severe complications, such as infection and occlusion of shunts, particularly in decompensated patients [1,3]. An alternative to these interventions for SON elimination in BT patients is endoscopic third ventriculocisternostomy (ETV), which contributes to the creation of new the CSF pathway, that provide drainage of excess CSF to subarachnoidal space via

cisterns [5-8]. The bypass surgery is mainly performed by leading neurosurgeons, as is ETV with simultaneous tumor removal. It should be noted that tumor removal at the second stage after SOH elimination, on the background of absence of the cerebral symptoms and relatively satisfactory patient's condition, is performed significantly less frequently, which is not always justified.

**The purpose** of this study was to compare the results of one- and two-stage surgical procedures after EVT and Torkildsen's ventriculocisternostomy (VCS) in patients with midline brain tumors complicated with SOH.

### Material and Methods

The study included 102 patients (78/76.47% men and 24/23.53% women) with BT complicated with SOH treated in the Republican Research Centre of Neurosurgery (RRCN). All the patients were admitted with severe clinical symptoms of secondary hydrocephalus. Age of the patients ranged from 1.5 to 50 years: from 1.5 to 5 years in 4 (3.9%) cases, from 6 to 15 years in 44(43.1%) cases, from 16 to 25 years in 25(24.5%) cases, from 26 to 35 years in 19(18.6%) cases, and from 36 to 50 years in 10(9.8%) cases.

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tumor removal. Group 3 included 30 (29.4%) patients who underwent a two-stage intervention: ETV in the first stage, and the endoscopic tumor removal in the second stage; the second step was performed 5–35 days after elimination of SOH symptoms and stabilization of the patient’s condition.

ETV was performed using video endosurgical complex “Aesculap” (Germany) and a set of standard microinstruments. Indication for ETV was the presence of open access to inferior part of the third ventricle. At the occlusion of the foramen of Monroe by BT in the anterior and middle regions of the third ventricle, the performance of EVT in most cases was impossible, and we performed VCS of Torkildsen. The length of the catamnestic observation time was from 3 to 12 months.

The clinical condition of the patients was assessed according to standard physical examination to determine neurological status. The severity of cerebral symptoms was determined by the complaints related to obstructive hydrocephalus: headaches, dizziness, nausea, uncontrollable vomiting, bradycardia, etc., as well as the results of a neuro-ophthalmic examination and MRI. The ophthalmological exam included in-depth study of the structures of the eye fundus. The severity of papilledema was assessed according to accepted standards of the Frisen grading scale. Severity of hydrocephalus was assessed in view of the state and sizes of the ventricles, the state of the subarachnoid space, and the degree of the periventricular edema according to MRI data. The results of surgery were assessed by the dynamics of clinical symptoms associated with regression of hydrocephalus, papilledema, and MRI signs of lesion. Before surgery, the condition of the ventricular system was assessed by neuroimaging techniques; all cerebral cisterns (interpeduncular, prepontine) were evaluated. The study was approved by the RRCN. Written informed consent was obtained from each patient. Statistical analysis was performed using the statistical software «Statistica». The difference was considered reliable when  $P < 0.05$ .

## Results and Discussion

For the development of SOH, BT location and proximity to the CSF pathway had a paramount importance in comparison with the size and histological structure of BT. Among the 102 patients, severe hydrocephalic symptoms were observed in 81(79.4%) patients. An extremely critical condition, diffuse headaches, dizziness, nausea, vomiting, Bruns syndrome, bradycardia, and severe papilledema with retinal hemorrhage were observed in 21(20.58%) patients. According to fundoscopy, Stage 1 of papilledema was detected in 38(37.2%) patients, stage 2 in 43(42.25%) patients, and stages 3–4 with signs of optic atrophy in 21(20.6%) patients. Moderate and severe bradycardia was detected in 36(76.6%) patients. Ventriculomegaly with symptoms of periventricular edema on CT and/or MRI brain imaging was determined in all patients.

The choice of surgical investigation was determined according to the level of the occlusion. Table 1 shows the distribution of patients according to the level of occlusion and surgery method. Comparative analysis of the clinical results of

different methods of surgical interventions based on mortality, clinical deterioration, and clinical improvement is shown in Table 2. The distinct advantages of EVT according to all aspects should be noted; in addition, Group 3 patients who underwent tumor removal in the second stage of the operation were characterized by a significant advantage in comparison with the Group 1 patients. Patients of Group 3, after the endoscopic intervention, were in satisfactory condition and quickly recovered from anesthesia. Symptomatic relief of hydrocephalus was achieved in all patients. Furthermore, after surgery we observed in all patients a clear tendency to reduction of cerebral symptoms, a statistically significant decrease of diffuse headaches in 22(73.3%) patients, and the presence of local pain in the occipital region in 8(26.6%). After EVT, moderate dizziness persisted, but nausea and vomiting completely stopped. On the second and third days after the first stage of the intervention, a regression of disorders in the CSF circulation, according to CT and MRI data, was observed in most patients. Periventricular edema disappeared in all patients of Group 3 and a significant change in the size of the subarachnoid space was observed in 25(83.3%); reduction in the size of the ventricular system (“Flow void” phenomenon) in the area the anterior regions of the third ventricle and the stoma occurred in 14(46.76%) patients.

**Table 1.**  
*Distribution of patients according to the cause and the level of occlusion*

The causes of SOD	The posterior third ventricle region and aqueduct of Sylvius		Posterior fossa region (fourth ventricle, worm, cerebellar hemisphere)		Amount	
	Abs	%	Abs	%	Abs	%
Tumors of the pineal region and quadrigemina	6	28.6	15	71.4	21	20.6
Posterior fossa tumor	10	12.3	71	87.6	81	79.4
Total	16	15.7	86	84.3	102	100

**Table 2.**  
*Outcomes of surgical treatment in the postoperative period in accordance with the method of surgical treatment*

Method of surgery	Clinical improvement		Clinical deterioration		Mortality		Amount	
	Abs	%	Abs	%	Abs	%	Abs	%
VCS of Torkildsen	15	39.5	14	36.8	9	23.8	38	37.2
ETV with simultaneous endoscopic tumor removal	21	61.8	8	23.5	5	14.7	34	33.3
ETV with endoscopic tumor removal in the second stage	22	73.3*	5	16.7*	3	10.0*	30	29.4
Total	58	56.9	27	26.5	17	16.7	102	100

\*-  $P < 0.05$  versus VCS of Torkildsen

## Conclusion

ETV is the best neurosurgical technique and should be considered as the initial treatment for BT complicated with SOH. ETV excludes mechanical complications and lowers the risk of biological complications, which are characteristic for drainage operations. EVT leads to successful outcomes by ensuring an adequate internal drainage of the cerebrospinal fluid and maximum recovery of the CSF circulation. EVT with endoscopic tumor removal in the second stage of the operation, compared with the VCS of Torkildsen, which is accompanied by significant damage to the brain structure, provides additional benefits to normalize the clinical status on the background of the absence of cerebral symptoms.

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