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ORIGINAL ARTICLE

Anatomical surgical approach to lateral vetricle masses and histopathological findings of the brain

İlker Ünlü et al., **Anatomıcal surgıcal approach to lateral vetrıcle masses**

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ABSTRACT

Background: The selection of surgical approach to the lateral ventricular masses includes difficulties due to their deep localizations, close proximity to the vascular and the eloquent brain structures. The most appropriate approach that should be chosen in surgical treatment of lateral ventricular masses is still controversial. In this study, the factors in the choice of surgical approach to the lateral ventricle masses and the results of them were investigated.

Materials and methods: In this study, 80 patients who underwent surgery in our clinic due to the lateral ventricular masses were retrospectively analyzed between the years 2002-2013. All of the cases were evaluated in terms of clinical and neuroradiological results pre and postoperatively. In 24 cases the anterior interhemispheric transcallosal, in 4 cases the posterior interhemispheric transcallosal, in 30 cases the posterior interhemispheric precuneal, in 14 cases the transcortical and in 8 cases the combined surgical approaches were performed.

Results: Gender distribution of the cases were 45 male/35 female and the mean age of them was 31.7 years (7 month - 73 years). In 64 patients the gross total resection was performed, whereas in 16 patients subtotal resection was performed due to the infiltration of eloquent brain areas. In the histopathological examination; 52 neuroepithelial, 8 mixed neuroglial, 3 meningeal, 2 lympho-hematopoietic system, 1 pine blastoma, 1 germ cell, 5 metastatic and 8 other benign masses were observed. After surgery, additional neurological deficits developed in 9 patients. The mortality was observed in 6 patients postoperatively. The average follow-up time was 13 (1-83) months.

Conclusions: The essential factors which affect the results of surgical treatment of lateral ventricular masses are; the size of the mass, histopathology, location, extension, and the relationship to the neurovascular structures. The goal of surgery is to provide the histopathological diagnosis, gross total resection, if it is possible, and to normalize the flow of cerebrospinal fluid by eliminating the mass effect of pressure.

Keywords: lateral ventricle, surgical approach, transcortical, transcallosal, transylvanian

INTRODUCTION

Lateral ventricles have an important place in neurosurgery practice due to their deep location in both hemispheres and their proximity to neurovascular structures. Lateral ventricle tumors may arise from the ependyma and subependymal region surrounding the ventricles, the choroid plexus epithelium, and ectopic tissue residues remaining in the ventricle or its walls [1]. Lateral ventricle tumors are rare lesions with an annual incidence of 0.81–1.6% [2]. Intraventricular tumors constitute 10% of CNS (Central nervous system) tumors, and lateral ventricle tumors constitute less than 1% of intracranial tumors [3].

Lateral ventricle pathologies include hydrocephalus, tumors, and developmental disorders. Approach to lateral ventricle pathologies is an important problem in neurosurgical practice, as they are deep-seated and difficult to reach parts of the brain due to their anatomical location. In choosing the approach to this area, the aim is to apply the surgical technique with the least harm possible to the patients. In addition to being deep-seated structures in the brain, lateral ventricles constitute an important passageway in the approach to the 3rd ventricle and some basal cisterns. Microsurgical anatomical knowledge and micro technical applications have expanded the limits of confidence in lateral ventricle approaches and facilitated radical surgery [4, 5].

The location of the lateral ventricles necessitates that all approaches to these lesions be made by passing cortical structures [6]. Thanks to advances in operating instruments, microscopes, neuroradiological and microsurgical techniques, surgical mortality, and morbidity in tumors of this region have decreased significantly [7, 8]. The transcortical–transventricular approach to intraventricular midline tumors was first described by Dandy in 1922, Bush used the midline approach in 1944, and this approach was later modified to transcallosal [9]. Various surgical corridors have been defined to reach space-occupying lesions in the lateral ventricles. These corridors aim to reach the pathology with the least incision, least traction and shortest distance, and provide adequate surgical working space, while not damaging the neurovascular structures. The main purpose of surgery for tumors located in the lateral ventricle is to establish histopathological diagnosis, remove the tumor as much as possible and ensure adequate CSF circulation[10–12].

This study aimed to retrospectively examine the factors affecting the choice of surgical approach and its results in patients who underwent surgery for lateral ventricle masses in our clinic.

MATERIALS AND METHODS

Patients

In this study, 80 patients who underwent surgery for lateral ventricle mass in our clinic between 2002 and 2013 were retrospectively examined. Tumors originating from the lateral ventricle walls and showing trans ependymal spread were included in primary lateral ventricle-derived tumors. All cases were evaluated retrospectively with their clinical, neuroradiological, surgical and pathological data.

Patient evaluation and surgical protocol

The clinical signs and symptoms of the cases before surgery, the location of the mass and its direction of expansion, the size and possible pathology of the mass, and the features that affect the choice of surgical approach, as well as complications, residual tumor size, the clinical course of the patient during follow-up, the need for additional treatment, and recurrence data were examined and interpreted.

Radiological evaluation

In all cases, preoperative MRI was used to determine the location, size, and expansion of the masses. CT and MRI with and without contrast were used to determine the morphological features of the masses. Vascular structures were evaluated with MRI Angio, especially in patients for whom an interhemispheric approach was planned. Additionally, DSA was performed in 2 patients in whom intraventricular hematoma and AVM were detected. The cases were followed up with MRI for postoperative residue and recurrence.

RESULTS

Gender and age of patients

45 of the cases were male, 35 were female, and the average age was 31.7 (7 months-73 years) and shown in Table 1.

Table 1. Gender and age of patients.

Patients	
Male (n, %)	45 (56.25%)
Female (n, %)	35 (43.75%)
Age (mean, min–max)	31.7 (7 months – 73 years old)

General symptoms

The main signs and symptoms were generally related to the mass location. In masses located in the anterior of the ventricles; While headache and nausea and vomiting were frequently observed, in addition to these findings, gait instability was observed in 1 patient and seizures were observed in 4 patients. In masses located in the middle of the ventricles; While increased intracranial pressure (ICP) findings were frequently observed, in addition to these findings, seizures were observed in 5 patients, confusion in 3 patients, motor loss in 3 patients, dizziness in 5 patients, and unilateral vision loss in 2 patients. In masses located posterior to the ventricles, vision-related problems and motor and sensory losses accompanied the increased ICP findings.

Tumor location and expansion

Masses according to their location in the ventricles; 14 were frontal horn, 19 were trunk, 21 were atrium, 17 were occipital horn, 5 were temporal horn, 2 were trunk and atrium, 1 was atrium, temporal and occipital horn, and 1 case was trunk. detected in the temporal and occipital horns. (Fig. 1). The masses were found in the left lateral ventricle in 40 cases, in the right lateral ventricle in 29 cases, and in both ventricles in 11 cases. A mass originating from the ventricle was observed in 48 of the cases, and a mass originating from the surrounding neural tissues and extending to the ventricle with transependymal spread was observed in 32 of the cases. 8 thalamic, 6 occipital, 6 temporal, 5 frontal, 2 paratrigonal, 1 frontoparietal, 1 hypothalamic, 1 pineal, 1 splenial, and 1 temporoparietal mass extending into the ventricle with transependymal spread were detected.

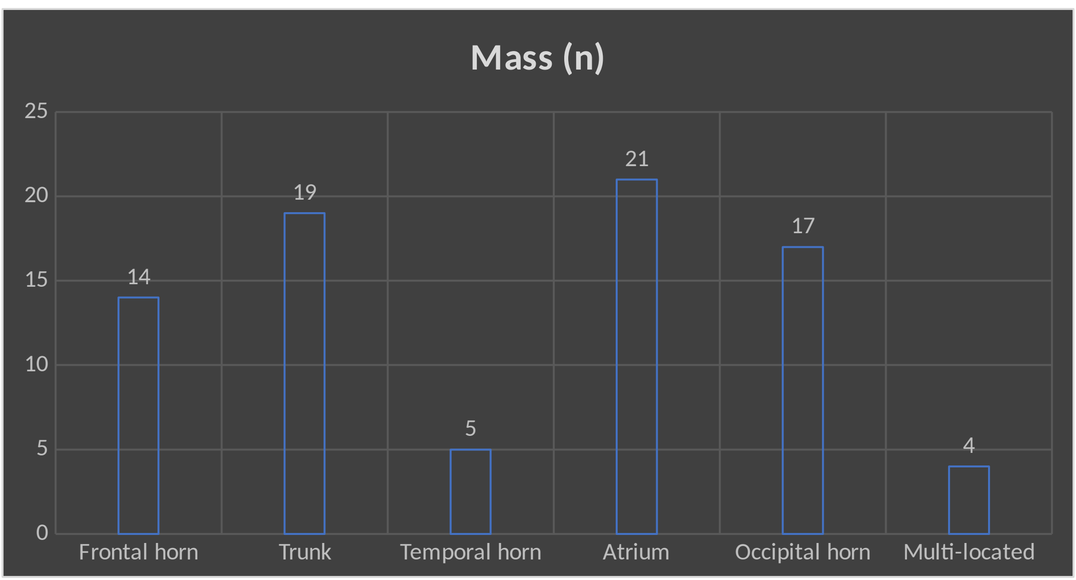

Figure 1. Distribution of masses in ventricular area

Pathological findings

High-grade glial tumors were most frequently found in the occipital horn (9/29), less frequently in the atrium (7/29) and trunk (6/29). All subependymal giant cell astrocytoma (SEGA) were in the frontal horn (5/5), 2 of the metastases were in the atrium, 1 was in the trunk, and 1 was in the temporal and occipital horns. Low-grade glial tumors were mostly located in the body (3/6).

When tumor grades were examined, it was seen that benign (grade 1 and grade 2) and malignant (grade 3 and grade 4) lesions were equal, and grade 4 (32) lesions were the majority of malignant tumors (Figure 2).

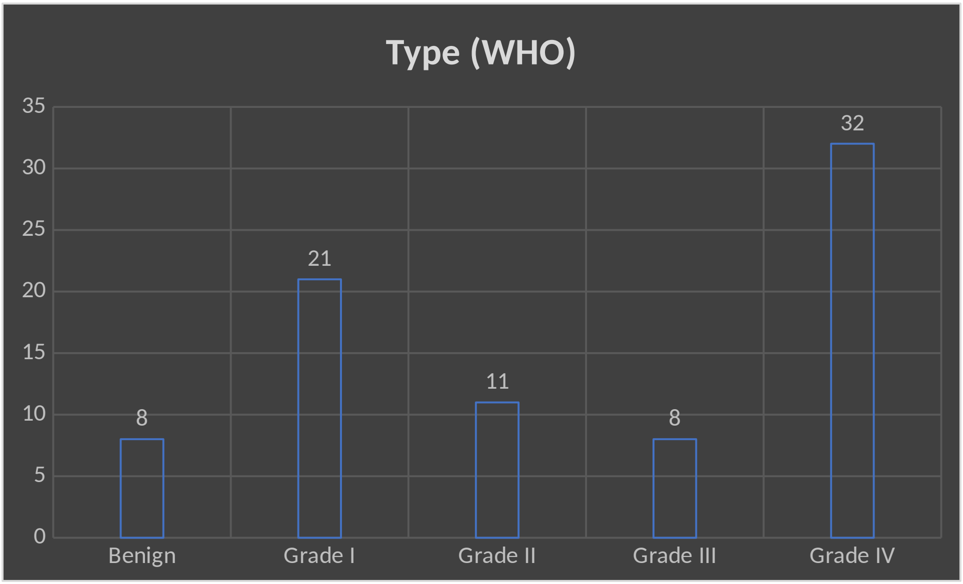

Figure 2. Type and number of tumors according to WHO criteria

Distribution of lateral ventricular pathology

The most common tumor types was SEGA (5/14) in frontal horn, GBM (4/19) and central neurocytoma (4/19) in trunk, malign glial mass (4/21) in atrium and GBM (7/18) in occipital regions. Type of tumors observed in different regions of lateral ventricles was presented in Table 2. The masses spread to more than one region of the ventricle in one case of metastasis, aspergilloma, astrocytoma grade 2 and high-grade glial tumor.

Table 2. Tumors and their location in lateral ventricles.

	Location of pathology				
Type of tumor	**Frontal horn**	**Trunk**	**Temporal horn**	**Atrium**	**Occipital**
SEGA (n)	5				

GBM (n)	3	4	1	2	7
Anaplastic astrocytoma (n)	1	2	1 (Grade I)		1 (Grade III)
Atypical meningioma (n)	1				1
Glial tumor (n)	1 (low grade)	3 (low grade)		1 (low grade)	1 (low grade) 1 (high grade)
Choroid plexus papilloma (n)	1				
Pilocytic astrocytoma (n)	1			1	1 (Grade I)
Central neurocytoma (n)	1	4			
Cyst (n)		2			
Astrocytoma (n)		1 (grade II)	1 (Grade II)		
Hematoma (n)		1			
Sub ependymoma (n)		1 (grade I)			
Metastasis (n)		1		2	
Atypical choroid plexus papilloma (n)			1		
Ganglioglioma (n)			1	2	
Anaplastic ependymoma (n)				2	
Lymphoma (n)				1 (B cell)	1
Epidermoid tumor (n)				1	1
Malign glial mass (n)				4	
Pleomorphic xanthoastrocytoma (n)				1 (malignant) 1 (Grade II)	
Meningioma (n)				1 (Grade I)	1
Yolk sac tumor (n)				1	
High level				1	

malignant epithelial tumor (n)					
Arteriovenous malformations (n)					1
Cyst hydatid (n)					1
Pine blastoma					1 (grade IV)

Pathological findings by genders

Although there was no significant difference in the distribution of pathologies according to gender, all metastases detected were in male cases. In addition, low grade glial mass were more common in men, and high grade glial mass were more common in women. The distribution of pathologies by gender is summarized Figure 3.

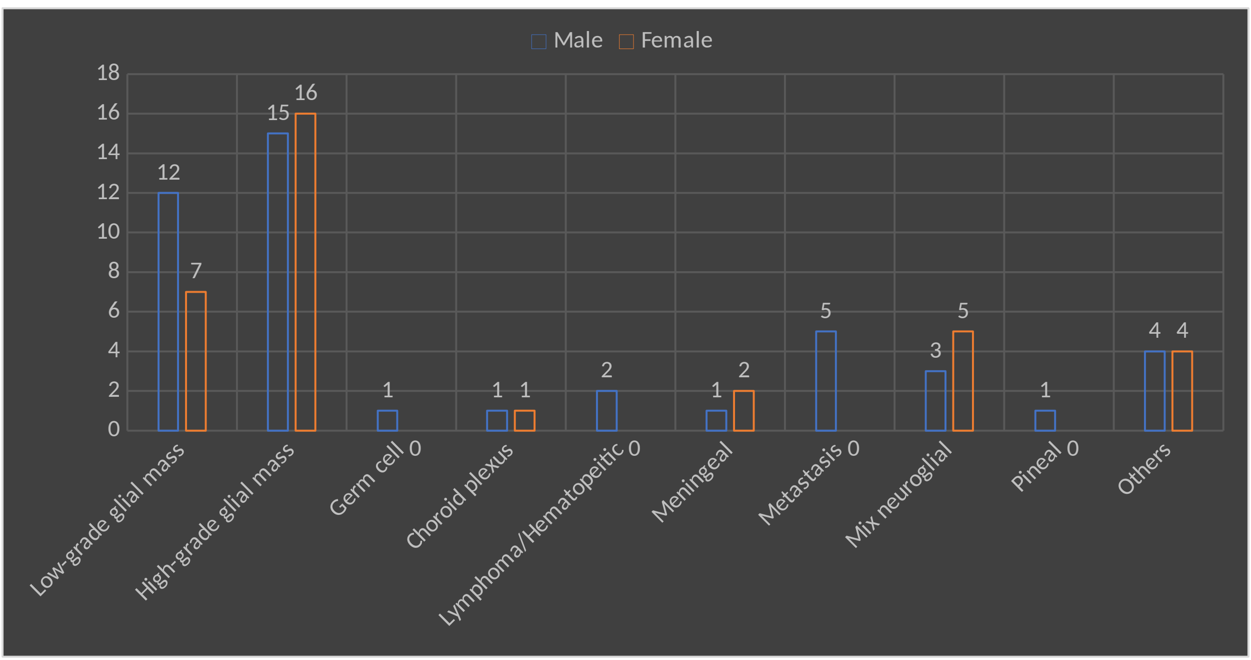

Figure 3. Distribution of pathologies by genders

Surgical interventions

The choice of approach was made according to the size of the mass, localization, expansion, vascularization, and its relationship with the sensitive area. For all these cases, 24 anterior interhemispheric transcallosal, 4 posterior interhemispheric transcallosal, 30 posterior interhemispheric precuneal, 14 transcortical and 8 combined approaches were applied. Gross total resection could be performed with a single surgery in 56 of the patients who underwent surgery, and subtotal resection could be performed in 24 cases (Table 3). Gross total resection could be achieved by adding combined approaches to 8 of the cases in which subtotal resection was performed. As a result, gross total resection was achieved in 64 cases, while residual tumor was left in 16 cases.

Table 3. Surgical interventions

Intervention	**Number (percentage)**
Anterior interhemispheric transcallosal	24 (30.00%)
Posterior interhemispheric transcallosal	4 (5.00%)
Transcortical	30 (37.50%)
Posterior interhemispheric precuneal	14 (17.50%)
Combined	8 (10.00%)

Other surgical interventions

4 cases were operated with the frontal transcortical approach. In 3 of them, the pathology was reported as high grade glial mass, and in 1 case, the pathology was reported as low grade glial mass. In 1 case, the mass originated from the left frontal lobe but extended to both lateral ventricle bodies, and in 1 case, the right frontoparietal mass filled the right lateral ventricle body. In both cases, the mass was evacuated by advancing anterior interhemispherically and making a transcortical incision at the level of the cingulate gyrus. The neurological loss of the patient, who presented with left hemiparesis and underwent anterior interhemispheric transcortical intervention, continued after surgery. The patient developed hydrocephalus during follow-up and a V-P shunt was installed 1 year later. In the other two cases, masses originating from the frontal lobe extended to the frontal horn of the ventricles. In 1 patient who did not have hydrocephalus before, a V-P shunt was placed due to hydrocephalus on the 50th day after surgery. There was no mortality or morbidity after surgery.

4 cases were operated with the temporal transcortical approach. The pathology of 2 of them was high grade glial mass, 1 was atypical choroid plexus papilloma, and the pathology of 1 was ganglioglioma. While there were masses originating from the temporal lobe and extending

to the temporal horn in 3 cases, there was a pure intraventricular mass in 1 case. In 3 cases, 1 cm of the limen insula was removed with the transsylvian-transinsular approach. An incision was made from the posterior aspect to reach the temporal horn and excise the mass. With this approach, gross total excision was achieved in 2 cases and subtotal excision was achieved in 1 case. Gross total tumor resection was achieved in 1 case with a transcortical incision from the posterior part of the middle temporal gyrus due to the tumor completely filling the temporal horn, infiltrating the temporal lobe and reaching the subpial area. In this case, who presented with dysphasia, motor aphasia developed after surgery. Subtotal resection could be performed in 1 case with high grade glial mass, which was operated via transsylvian-transinsular approach, due to advanced neurovascular adhesions. The patient, who had right upper monoparalysis and central facial paralysis after surgery, developed loss of consciousness after a seizure on the 3rd day and died due to cardiac arrest on the 6th day.

With this approach, 5 cases with masses originating from the occipital lobe and extending to the occipital horn were operated on. The pathology of 3 of these cases was reported as high grade glial mass, 1 as hydatid cyst and 1 as metastasis. One patient, who was operated on at an external center due to an occipital mass and who applied to our clinic due to cerebrospinal fluid (CSF) fistula and confusion, was operated on with a posterior interhemispheric transcortical approach. External ventricular drainage (EVD) was applied to the case, whose pathology was reported as a high-grade malignant epithelial tumor, due to continuing hydrocephalus after surgery. The patient died due to sepsis on the 25th postoperative day. The case, who had right hemiparesis, aphasia and confusion at the time of admission, and who was operated on via the occipital transcortical approach due to multiple hydatid cysts in the temporal and occipital horns of the lateral ventricle, died on the first day after surgery. Right temporal hemianopsia developed after surgery in 1 case, which was operated on due to a mass extending to the left occipital horn and whose pathology was reported as GBM.

Four cases with masses located in the atrium, body and occipital horn were operated on. 2 of these cases were glial masses, 1 was diffuse large B-cell lymphoma, and 1 was an arteriovenous malformation (AVM) whose nidus was in the occipital horn. While gross total resection could be achieved in 2 of the operated cases, subtotal resection could be performed in 2 cases due to difficulty in transportation. There was no postoperative mortality or additional neurological loss in the cases.

Thirty cases with masses located in the atrium, occipital horn and trunk were operated on. The pathology of the majority of these cases was reported as high grade glial mass, 40 (53.3%). While gross total resection was achieved in 24 of the cases, subtotal resection could be achieved in 6 cases due to difficulty in access or sensitive area infiltration. He applied with the complaint of difficulty in swallowing and was diagnosed with a mass in the atrium while being examined for vocal cord paralysis. The pathology of the patient, who was operated via the posterior interhemispheric precuneal approach in our clinic, was reported as high grade glial mass. A tracheostomy was performed after surgery due to vocal cord paralysis. The patient developed lung infection and failure and died on the 21st day. It was observed that vision loss continued after surgery in 2 patients who complained of narrowing of the visual field. The masses of these patients were reported as high grade glial mass and pilocytic astrocytoma. Right temporal hemianopsia developed after surgery in 1 patient with a metastatic (malignant mesenchymal tumor) mass located in the right atrium, who presented with headache and seizure complaints. The patient, who was operated on due to a mass located in the left atrium and whose pathology was reported as high grade glial mass, developed right hemiparesis and facial paresis on the right after surgery. The patient, whose neurological loss improved in the long term, presented with hydrocephalus clinic 2 years later and a V-P shunt was installed. Postoperative right hemiparesis developed in 1 patient, who was operated on due to a mass originating from the left thalamus and extending to the body of the ventricle, and whose pathology was reported as GBM.

Combined approaches

Gross total resection was aimed with second surgeries performed with different approaches within the same week in 8 cases where adequate resection could not be achieved in the first surgery due to sensitive area infiltration, large size of the mass or transportation difficulties. As a result of these combined approaches, no mortality or additional neurological loss occurred in the cases. The sources, pathologies and combined surgical approaches of the masses are summarized in the table below (Table 4).

Table 4. Cases operated by combined surgery

Ventricle location	Pathology	First operation	Second operation
2 different mass in	Malignant	Temporal transcortical	Anterior

trunk and temporal horn	astrocytoma (grade III)		interhemispheric transcallosal
Trunk	Central neurocytoma	Anterior interhemispheric transcallosal	Posterior interhemispheric transcallosal
Trunk	Diffuse astrocytoma (grade II)	Anterior interhemispheric transcallosal	Posterior interhemispheric precuneal
Temporal, occipital horns and atrium	Metastasis	Transsylvian-transinsular	Posterior interhemispheric precuneal
Temporal, occipital horns and atrium	High grade glial mass	Temporal transcortical	Posterior interhemispheric precuneal
Temporal and occipital horns	Astrocytoma (grade II)	Transsylvian-transinsular	Posterior interhemispheric precuneal
Occipital horn and atrium	Yolk sac tumor	Supracerebellar infratentorial	Posterior interhemispheric precuneal
Trunk and atrium	Astrocytoma (grade II)	Posterior interhemispheric transcallosal	Anterior interhemispheric transcallosal

Patient 1

Patient 2

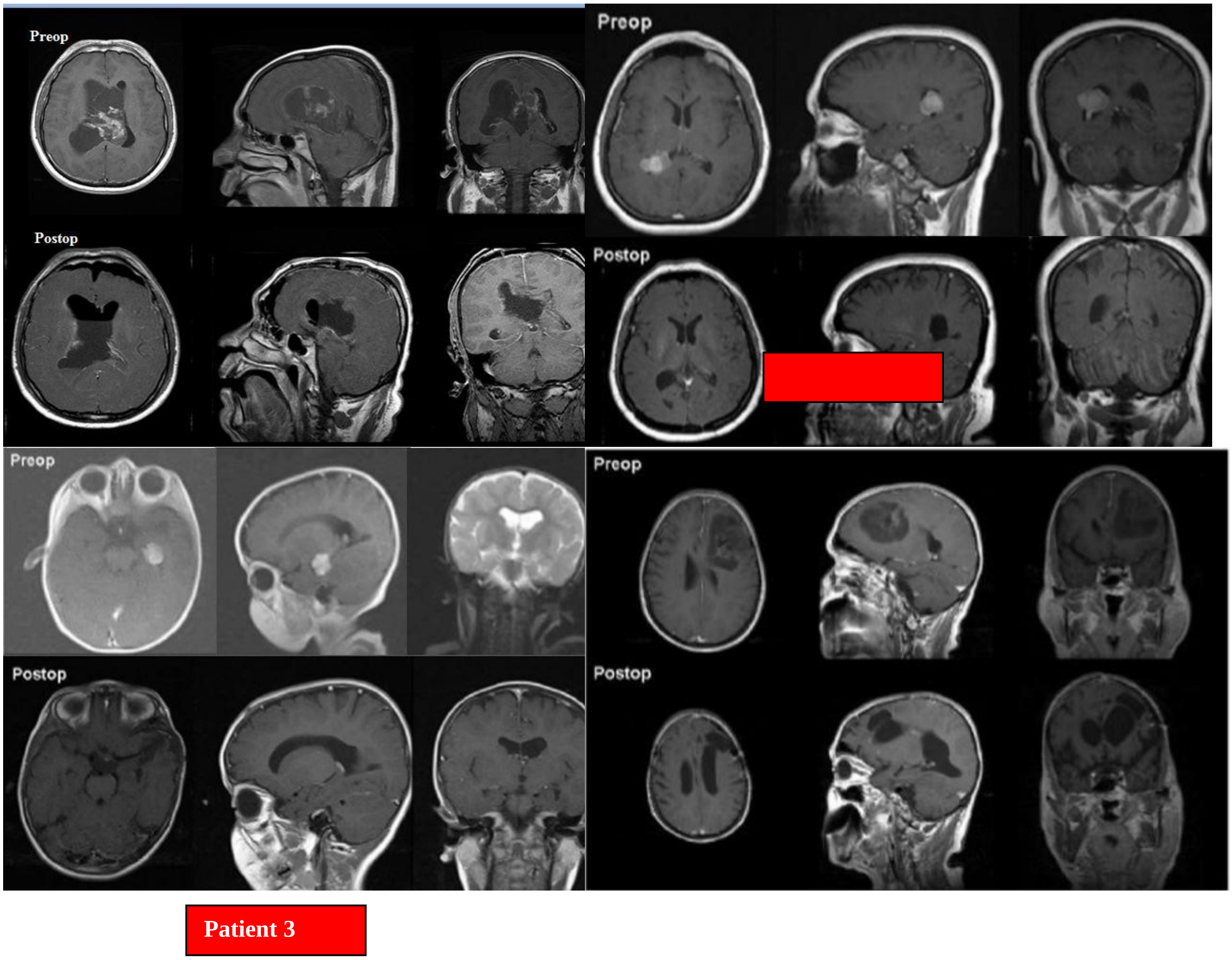

Figure 4. Preoperative and post-operative radiological images of some of the patients. **Patient 1:** Central neurocytoma originating from the third ventricle and extending to both lateral ventricles; **Patient 2:** Right lateral ventricle occipital horn with meningioma; **Patient 3:** Atypical choroid plexus papilloma located in the left lateral ventricle temporal horn; **Patient 4:** Anaplastic oligodendrioglioma WHO grade 3, originating from the left frontal horn and extending to the left lateral ventricle.

DISCUSSION

Third ventricle masses can be classified as arising in or immediately adjacent to one of five locations: anterior, posterior, inferior, foramen of Monro, and intraventricular. Anterior masses involve the optic and infundibular recesses, posterior masses affect or arise in the posterior commissure and pineal gland, and inferior masses involve or affect the ventricle floor. They stated that most commonly these anomalies represent neurohypophyseal malformations, which can manifest as hormonal abnormalities, or stenosis of the aqueduct of Sylvius, which manifests as dilatation of the third and lateral ventricles (hydrocephalus) [13]. Germ cell tumors are typically included in the differential of pineal region masses; However, they stated that other locations such as intraventricular and posterior fossa were rarely seen. It has been suggested that neurosurgeons and oncologists should be aware of this rare possible lesion to contribute to a broad differential diagnosis [14]. Ma et al. also retrospectively examined a total of 18 patients by evaluating their histopathologies using MRI imaging technique. In their immunohistopathological evaluation, atypical CNC tumor cells showed malignant behavior and more positive expression of Ki67 than benign cases. They stated that the first option in treatment is a surgical procedure, and that radiotherapy may be beneficial to patients after surgery [15].

In a study evaluating the surgical approach, the supracerebellar-infratentorial approach was preferred in the sitting position. They suggested that for pineal region lesions that displace the deep venous system downwards or have significant lateral extension, the occipital-transtentorial approach in the 3/4 prone or sitting position is effective. They also concluded that for lesions that do not extend posterior to the splenium and are truly located in the posterior third ventricle, an interhemispheric-transcallosal approach in the lateral position should be preferred [16]. The pathological spectrum of lateral ventricular tumors in children is wide, and it has been reported that pathology in malignant tumors is difficult to determine on imaging. It has been stated that the diagnosis of benign tumors such as subependymal giant cell astrocytoma, low-grade astrocytomas and choroid plexus papillomas is relatively easier. Significant interobserver differences in the radiological diagnosis of these tumors have also been reported [17]. In addition, Shahjouei et al. detected and treated 10 new cases of congenital foramen of Monro occlusion in patients with a mean age of 6.65 ± 10.51 months [18].

10% of central nervous system tumors occur in or near the ventricular system. 50% of these tumors in adults and 25% in children are in the lateral ventricle. Histological diagnosis varies with the age of the patients. While the histopathological diagnosis tends to be glioma in older children, choroid plexus tumors are usually seen in younger children [19]. However, when the cases between the ages of 0-16 were evaluated in our study, the majority of the pathologies were low-grade glioma (16/25). All SEGAs cases were detected in the pediatric age group.

Interestingly, male gender was observed more frequently in our study. Although the histopathological diagnoses in both genders were approximately equal, all metastases were more common in men. In addition, while low grade glial mass were more common in men, high grade glial mass were more common in women. In the literature, subtotal excision has been reported as 19-50% and total excision as 33–79% in intraventricular tumors [6, 19]. In our study, 80% total and 20% subtotal excision was achieved. Primary ventricular tumors; While they arise from anatomical structures within the pure ventricle (choroid plexus, vascular structures, arachnoid structures, ventricular ependyma, etc.), secondary tumors are masses that originate from the parenchyma around the ventricle (paraventricular) and extend into the ventricle by passing the ependymal structures. It has also been reported that the majority of primary ventricular tumors are low-grade lesions [3, 20]. The most commonly reported lateral ventricle tumors are; astrocytoma, choroid plexus papilloma, meningioma and ependymomas, respectively [21]. When the histopathologies of the tumors seen in our study are listed according to their frequency of occurrence; They were high grade glial mass, low grade glial mass, mixed neuroglial tumor, and metastases. Histopathology was malignant in 50% of our cases.

The locations of tumors within the lateral ventricle have been reported as atrium, body, and frontal horn, in decreasing order of frequency [22]. In another series, the most common localizations of lateral ventricle tumors were atrium, frontal horn, temporal horn, and septum [23]. Gokalp et al. showed that in 112 cases; the most common locations of tumors have been reported to be the foramen of Monro, trunk, atrium, and frontal horn, with decreasing frequency [24]. In our study, the frequency order of the regions where the masses are seen is; It was in the form of atrium, body, occipital horn, frontal horn, and temporal horn. More than one region involvement was observed in four cases.

The choice of surgical approach for lateral ventricle tumors depends on various factors such as localization of the tumor within the ventricle, the direction of tumor expansion, whether the relevant hemisphere is dominant or not, the size of the tumor, the source of arterial feeders, its neighborhood with the choroid plexus and internal cerebral veins, its venous drainage and histopathological features [25]. In our study, the anterior interhemispheric transcallosal approach was largely preferred for masses located in the frontal horn and trunk. Transcortical approach was used only in 4 cases originating from the frontal lobe with tumor spread to the subpial distance.

Sometimes frontal horn tumors can reach very large sizes and cause ventricular enlargement due to obstruction of the foramen of Monro. In this case, it is easier to enter the lateral ventricles via the anterior interhemispheric transcallosal route [26]. In our study, it was observed that this condition facilitated entry into the ventricle in cases with preoperative hydrocephalus, as stated in the literature. Some authors have reported that in cases operated with the anterior interhemispheric transcallosal approach, hydrocephalus may persist in some cases due to arachnoid granulation obstruction or residual tumor obstructing the foramen of Monro [27]. In our study, there was no need for a V-P shunt after surgery in any of the cases in which we applied this approach.

Transcortical or transinsular approaches can be used for masses located in the temporal horn. These approaches provide a shortcut to reach the lesions, but the risk of neurological loss is higher with cortical incision. For this reason, it is more appropriate to intervene in masses located in the temporal horn via the transsylvian-transinsular route, especially in terms of preventing speech and vision-related losses [28]. We did not encounter any morbidity in the cases in which we applied the transinsular approach.

The disadvantage of the transsylvian-transinsular approach is that it provides a narrower working area, so combined surgery can be performed with the addition of the posterior interhemispheric precuneal approach, especially for large masses extending into the atrium. As a matter of fact, in one of our cases with a mass extending into the atrium, the total tumor could not be removed via the transinsular route, and the part in the atrium was removed with the precuneal approach. Although gross total resection was achieved after the transcortical approach used in 1 case with GBM extending to the subpial distance of the temporal lobe, the development of motor aphasia after surgery shows that the morbidity of lateral transcortical approaches to this region is also high. The transcortical approach is an acceptable route due to minimal morbidity in the non-dominant hemisphere. This technique can become a dangerous problem in the language cortex in the dominant hemisphere [29].

The posterior interhemispheric precuneal approach is a preferred surgical option for the excision of trigonal masses with a low risk of complications. The danger of this approach is the possibility of imminent memory impairment after surgery. The transcortical approach often causes motor and speech losses or optic radiation injury [3, 30]. Hussein resected atrial meningiomas using this approach in 8 cases and did not observe memory deficits in any of his patients [31]. In our study, the posterior interhemispheric precuneal approach was used in 30 cases, and right hemiplegia developed in 1 case with GBM with thalamus infiltration. We think that the neurological loss in this patient is due to capsule interna injury during excision due to infiltration in the thalamus.

The transcallosal approach offers an important surgical option for lateral ventricle lesions. During callosotomy, anterior genu, rostrum and anterior commissure should be avoided. Incisions that avoid the splenial section do not cause significant neurological losses [32]. When transcallosal approaches are compared with transcortical approaches, the incidence of post-surgical seizures, porencephalic cyst formation and subdural hygroma is less in transcallosal [26, 33]. It has been reported that posterior callosotomy is not appropriate in large tumors located in the occipital horn and atrium, as the interhemispheric approach cannot be adequately excluded and has disadvantages such as not being able to reach the proximal choroidal feeders and not providing adequate tumor resection in such tumors [34]. In our series, no complications related to callosotomy were observed in cases where the interhemispheric transcallosal approach was applied.

Transcortical middle frontal gyrus approach may cause speech and facial apraxia in the excision of lateral ventricle tumors in the dominant hemisphere . The reported risk of postsurgical seizures after transcortical approaches ranges from 19% to 75% [35]. The true incidence of postoperative seizure related to cortical incision is difficult to determine because there are many factors that cause seizures, including histological type of tumor, presence of preoperative seizures, residual tumor, subdural effusion, and electrolyte imbalance. In our study, no seizures were observed in the patients who underwent transcortical intervention, as antiepileptic medication was started before surgery and this treatment was continued after surgery.

Post-surgical ventriculomegaly is common, but not all patients require a shunt. Because even after a large tumor excision, intracranial pressure measured with a ventricular catheter may be normal or low. The number of patients requiring a shunt varies depending on different factors. Approximately 10-50% of patients will eventually require CSF drainage [36]. In our series, the need for V-P shunt was lower than reported in the literature and was 5%. This high shunt requirement in the literature may be due to CSF malabsorption due to inadequate mass excision, recurrence, or bleeding during surgery. Surgical mortality reported in lateral ventricle tumor surgery series varies between 0% and 12%, and morbidity rates, including general epilepsy rates, range between 10% and 70% [37-40]. In our series, the mortality rate is 7.5%, which is similar to the literature. Mortality rates have decreased due to advances in microsurgery and are usually secondary to intraventricular hemorrhage or pulmonary embolism after surgery [41].

CONCLUSIONS

Lateral ventricle tumors are very rare, grow slowly, and can reach quite large sizes before showing symptoms. The structure, size, location, expansion, and vascularization of intraventricular tumors are the main factors affecting the choice of surgical approach. Total resection is possible by transcortical or transcallosal route in most, but not all, of these lesions. When malignant tumors invade important areas, subtotal resection should be preferred. The incidence of postsurgical seizures is higher in transcortical approaches. A short and safe way for tumor excision should be preferred by evaluating all factors of the tumor, its vascularity, and all parenchymal structures near the tumor. Instead of transcortical approaches, we recommend using transcallosal, transsylvian-transinsular or precuneal approaches, depending on tumor location. However, in large tumors involving more than one part of the ventricle, combined approaches may be required.

REFERENCES

1. Abosch A, McDermott MW, Wilson BC. Lateral veritricle tumors. In: Kaye AH, Black PM. ed. Operative Neurosurgery. Harcourt Publishers Limited, London 2000: 799–812.
2. Ellenbogen R. Transcortical surgery for lateral ventricular tumors. Neurosurg Focus. 2001; 10(6): 1–13, doi: 10.3171/foc.2001.10.6.3.
3. Al-Umran MR, Al-Umran SR, Arab AF, et al. Lateral ventricular liponeurocytoma: Review of literature and case illustration. Neurochirurgie. 2021; 67(6): 579–586, doi: 10.1016/j.neuchi.2021.03.004.

4. Suh DY, Mapstone T. Pediatric supratentorial intraventricular tumors. Neurosurgical Focus. 2001; 10(6): 1–14, doi: 10.3171/foc.2001.10.6.5.

5. Dănăilă L. Primary tumors of the lateral ventricles of the brain. Chirurgia (Bucur). 2013; 108(5): 616–30, indexed in Pubmed: 24157104.

6. Gars DLe, Lejeune JP, Peltier J. Surgical anatomy and surgical approaches to the lateral ventricles. Adv Tech Stand Neurosurg. 2009: 147–187, doi: 10.1007/978-3-211-78741-0_6.

7. Amar AP, Albuquerque FC, MLJ A. Anterior third ventricle lesions (including colloid cysts). In: Kaye AH, Black PM. ed. Operative Neurosurgery. Churchill Livingstone, London 2000: 753–768.

8. Ibáñez-Botella G, Segura M, De Miguel L, et al. Purely neuroendoscopic resection of intraventricular tumors with an endoscopic ultrasonic aspirator. Neurosurg Rev. 2019; 42(4): 973–982, doi: 10.1007/s10143-018-1011-8, indexed in Pubmed: 30019320.

9. Sawaya R, Hawley DK, Tobler WD. Pineal and third ventricle tumors. In: Youmans JR, Hawley DK, Tobler WD. ed. Neurological Surgery. WB Saunders Company, Philadelphia 1990: 3171–3203.

10. Agarwal A, Kanekar S. Intraventricular tumors. Seminars in Ultrasound, CT and MRI. 2016; 37(2): 150–158, doi: 10.1053/j.sult.2015.12.003.

11. Zhang K, Gao M, Wang G, et al. Hydrocephalus in cblC type methylmalonic acidemia. Metab Brain Dis. 2018; 34(2): 451–458, doi: 10.1007/s11011-018-0351-y.

12. Edwards RJ, Dombrowski S, Luciano M, et al. Chronic hydrocephalus in adults. Brain Pathol. 2004; 14(3): 325–336, doi: 10.1111/j.1750-3639.2004.tb00072.x, indexed in Pubmed: 15446589.

13. Glastonbury C, Osborn A, Salzman K. Masses and malformations of the third ventricle: normal anatomic relationships and differential diagnoses. RadioGraphics. 2011; 31(7): 1889–1905, doi: 10.1148/rg.317115083.

14. Fiani B, Runnels J, Brazdzionis J, et al. De-differentiated metastatic adenosquamous carcinoma arising from germ cell tumor in the brain and spine. Acta Neurochirurgica. 2021; 164(7): 1973–1977, doi: 10.1007/s00701-021-04973-2.

15. Ma Z, Yan H, Shi H, et al. The typical and atypical MR imaging findings of central neurocytomas: Report on eighteen cases and review of the literature. Clin Neurol Neurosurg. 2016; 146: 18–23, doi: 10.1016/j.clineuro.2016.04.012.

16. Lozier A, Bruce J. Surgical approaches to posterior third ventricular tumors. Neurosurg Clin N Am. 2003; 14(4): 527–545, doi: 10.1016/s1042-3680(03)00061-5.

17. Pandey S, Mani S, Sudhakar S, et al. Reliability of imaging-based diagnosis of lateral ventricular masses in children. World Neurosurg. 2019; 124: e693–e701, doi: 10.1016/j.wneu.2018.12.196.

18. Shahjouei S, Habibi Z, Naderi S, et al. Congenital obstruction of foramen of Monro: report of 10 patients and literature review. Child's Nerv Syst. 2017; 34(4): 707–715, doi: 10.1007/s00381-017-3671-z.

19. Zakharov A, Papaiconomou C, Djenic J, et al. Lymphatic cerebrospinal fluid absorption pathways in neonatal sheep revealed by subarachnoid injection of Microfil. Neuropathol Appl Neurobiol. 2003; 29(6): 563–573, doi: 10.1046/j.0305-1846.2003.00508.x.

20. Pendl G, Ozturk E, Haselsberger K. Surgery of tumours of the lateral ventricle. Acta Neurochir (Wien). 1992; 116(2-4): 128–136, doi: 10.1007/bf01540865, indexed in Pubmed: 1502946.

21. D'Angelo VA, Galarza M, Catapano D, et al. Lateral ventricle tumors: surgical strategies according to tumor origin and development—a series of 72 cases. Neurosurgery. 2008; 62(6 (Suppl. 3)): 1066–1075, doi: 10.1227/01.neu.0000333772.35822.37, indexed in Pubmed: 18695527.

22. Sankhla S, Warade A, Khan G. Endoport-assisted endoscopic surgery for removal of lateral ventricular tumors: our experience and review of the literature. Neurology India. 2023; 71(1): 99, doi: 10.4103/0028-3886.370438.

23. Lapras C, Deruty R, Bret PH. Tumors of the lateral ventricle. In: Symon L, Deruty R, Bret PH. ed. Advances and Technical Standards in Neurosurgery. Springer- Verlag, Wien-New York 1984.

24. Gökalp HZ, Yüceer N, Arasil E, et al. Tumours of the lateral ventricle. A retrospective review of 112 cases operated upon 1970–1997. Neurosurg Rev. 1998; 21(2-3): 126–137, doi: 10.1007/bf02389318.

25. Clatterbuck R, Hsu F, Spetzler R. Supratentorial arteriovenous malformations. Operative Neurosurgery. 2005; 57(suppl_1): 164–167, doi: 10.1227/01.neu.0000164454.70131.3a.

26. Shucart WA, Heilman CB, Wolpert SM. Masses of the lateral and third ventricles: pathology, imaging, and treatment. In: Wilkins RH, Rengachary SS. ed. Neurosurgery. 2nd ed. McGraw-Hill, Health Professions Division, New York 1996: 1451–1463.

27. Patnaik A, Sekar A, Bansal S, et al. Rare case of hemorrhagic atypical choroid plexus papilloma of fourth ventricle in adult: a diagnostic dilemma. World Neurosurgery. 2023; 179: 43–44, doi: 10.1016/j.wneu.2023.08.012.

28. Yasargil MG. Microneurosurgery of CNS Tumors. In: Yasargil MG. ed. Microneurosurgery IVB. Georg Thieme, Stuttgart : 313–318.

29. Tokunaga K, Tamiya T, Date I. Transient memory disturbance after removal of an intraventricular trigonal meningioma by a parieto-occipital interhemispheric precuneus approach: Case report. Surg Neurol. 2006; 65(2): 167–169, doi: 10.1016/j.surneu.2005.06.036.

30. Schramm J. Meningiomas of the trigone. World Neurosurg. 2015; 83(4): 486–487, doi: 10.1016/j.wneu.2014.09.012.

31. Hussein S. Operative management of trigono-atrial lesions. Zentralbl Neurochir. 1998; 59(4): 243–255.

32. Secer HI, Duz B, Izci Y, et al. Tumors of the lateral ventricle: the factors that affected the preference of the surgical approach in 46 patiens. Turk Neurosurg. 2008; 18(4): 345–355.

33. Elshamy W, Burkard J, Gerges M, et al. Surgical approaches for resection of third ventricle colloid cysts: meta-analysis. Neurosurg Rev. 2021; 44(6): 3029–3038, doi: 10.1007/s10143-021-01486-5, indexed in Pubmed: 33590366.

34. Sethi A, Cavalcante D, Ormond D. Endoscopic versus microscopic transcallosal excision of colloid cysts: a systematic review in the era of complete endoscopic excision. World Neurosurgery. 2019; 132: e53–e58, doi: 10.1016/j.wneu.2019.08.259.

35. Rabb CH, Apuzzo MLJ. Options in the management of ventricular masses. In: Tindall GT, Cooper PR, Barrow DL. ed. The Practice of Neurosurgery. Williams & Wilkins, Baltimore 1996: 1229–1242.

36. Wang Y, Feng A, Xue Y, et al. Automated ventricle parcellation and evan's ratio computation in pre- and post-surgical ventriculomegaly. Proc IEEE Int Symp Biomed Imaging. 2023; 2023, doi: 10.1109/isbi53787.2023.10230729, indexed in Pubmed: 38013948.

37. Cikla U, Swanson KI, Tumturk A, et al. Microsurgical resection of tumors of the lateral and third ventricles: operative corridors for difficult-to-reach lesions. J Neurooncol. 2016; 130(2): 331–340, doi: 10.1007/s11060-016-2126-9, indexed in Pubmed: 27235145.

38. Asgari S, Engelhorn T, Brondics A, et al. Transcortical or transcallosal approach to ventricle-associated lesions: a clinical study on the prognostic role of surgical approach. Neurosurg Review. 2002; 26(3): 192–197, doi: 10.1007/s10143-002-0239-4.

39. Dang DD, Rechberger J, Leonel L, et al. Anatomical step-by-step dissection of common approaches to the third ventricle for trainees: surgical anatomy of the anterior transcortical and interhemispheric transcallosal approaches, surgical principles, and illustrative pediatric cases. Acta Neurochir (Wien). 2023; 165(9): 2421–2434, doi: 10.1007/s00701-023-05697-1, indexed in Pubmed: 37418043.

40. Nakasu Y, Isozumi T, Nioka H, et al. Mechanism of mutism following the transcallosal approach to the ventricles. Acta Neurochir (Wien). 1991; 110(3-4): 146–153, doi: 10.1007/BF01400683, indexed in Pubmed: 1927607.

41. Munoz-Gualan AP, Bektasoglu PK, Yamaner E, et al. The extreme anterior interhemispheric transcallosal approach for pure aqueduct tumors: an anatomical study. Turk Neurosurg. 2023; 33(5), doi: 10.5137/1019-5149.jtn.42429-22.3.