Clinical Outcome of Microsurgical Excision of Tumors of the Ventricular Trigone

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ABSTRACT

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Background: Tumors of the trigone of the lateral ventricle are difficult challenge due to their location within eloquent brain surface especially on the dominant side. In addition the deep and often obscure arterial supply and deep venous drainage make surgical excision hazardous.

Objective: The aim of this study was to investigate the outcome of sixteen consecutive patients treated by microsurgical resection of trigone tumors.

Patients and Methods: The authors reviewed their clinic data archive from 2005 through 2015. Patients' symptoms, radiographs, intraoperative findings, and clinical results were evaluated. The surgical outcome was established with the modified Rankin Scale (mRS) measured at admission and postoperatively at the last follow-up.

Results: The study included seven men and nine women with a mean age of 35.8 years (range 2–59 years). Symptoms included headache, intracranial hypertension, convulsions and visual obscuration. All patients underwent microsurgical resection through posterior parietal cortical approach. Pathology showed nine meningiomas, three choroid plexus papillomas, two ependymomas and two glioblastoma multiforme. The neurological status according to the modified Rankin Scale improved in eleven patients and remained the same in three patients.

Conclusion: The parietal approach through the intraparietal sulcus is the best choice for virtually all cases with trigone ventricular tumors. It provides a straight line pathway to lateral ventricle's trigone, in the shortest route and avoids the neurological morbidity to the patient.

INTRODUCTION

Tumors of the lateral ventricle account for less than 1% of all brain tumors. The ventricular trigone is the most frequent location for lateral ventricular masses. Most of these lesions have a non-specific clinical manifestation and a late diagnosis. Tumors of the trigone or atrium of the lateral ventricle represent a distinct unique challenge for the neurosurgeon. Factors that contribute to the surgical difficulties of these lesions include their location within eloquent brain surface especially on the dominant side. The lack of cortical representation of the mass requires retraction or traversing of important brain tissue. In addition the deep and often obscure arterial supply and deep venous drainage make surgical excision hazardous.

Although tumors of the trigone represent a small subgroup of all intracranial tumors, the aforementioned difficulties have spawned a variety of operative approaches in their surgical management. The four basic approaches described by Rhoton et al. include the posterior transcortical, posterior transcallosal, occipital transcingulate, and transtemporal approaches. The location of the tumor in the ventricle, the size of the ventricles, and hemisphere dominance contribute to the selection of operative approach.

PATIENTS AND METHODS

During February 2005 to September 2015, we retrospectively followed a cohort of 16 patients with tumors in the trigone of the lateral ventricle in Department of Neurosurgery at Suez Canal University hospital. Information on the patients' clinical history and signs, surgical approach, pathology and outcomes were recorded.

All patients underwent an evaluation of the neurological functions and the results of which were compared to the post-operative findings. The surgical outcome was established with the modified Rankin Scale (mRS) measured at admission and postoperatively at the last follow-up (Table 1).

Preoperative neuroimaging investigations consisted of computerized tomography (CT) with tridimensional reconstruction and magnetic resonance imaging (MRI) using a 1.5-tesla unit, with and without contrast. (Fig. 1, 2, 3) CT scans were also obtained 24 h after surgery to identify immediately the presence of postoperative hematomas, pneumocephalus, or other surgical complications. Postoperative control MRI was performed three and six months after surgery, and then annually, if necessary.
**Table 1:** Modified Rankin Scale (MRS)

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No symptoms at all</td>
</tr>
<tr>
<td>1</td>
<td>No significant disability despite symptoms; able to carry out all usual duties and activities</td>
</tr>
<tr>
<td>2</td>
<td>Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance</td>
</tr>
<tr>
<td>3</td>
<td>Moderate disability; requiring some help, but able to walk without assistance</td>
</tr>
<tr>
<td>4</td>
<td>Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance</td>
</tr>
<tr>
<td>5</td>
<td>Severe disability; bedridden, incontinent and requiring constant nursing care and attention</td>
</tr>
<tr>
<td>6</td>
<td>Dead</td>
</tr>
</tbody>
</table>

**Fig. 1 a-c:** 2 years old female patient presented with symptoms of intracranial hypertension for 1 month. a&amp;b: T1 weighted image with gadolinium in axial and sagittal serial cuts showing left atrial homogeneous contrast enhanced mass 4.3 cm in max. diameter denoting choroid plexus papilloma. c: post-operative CT brain showing total removal. Patient Required VP shunt.

**Fig. 2 a&amp;b:** a: Preoperative MRI of 37 yrs old female with left trigone meningioma. b: Post-operative MRI after gross total resection.
Fig. 3 a-c: a: axial CT scan of the brain with contrast enhancement showing a 4.2 cm uniformly enhancing mass with edema of the surrounding white matter b: Preoperative T1 weighted image of MRI brain with gadolinium axial cuts showed trigone meningioma. c: Postoperative CT brain for the same patient showed total removal of the tumor via transcortical route (superior parietal lobule)

Surgical procedure:
Surgery is performed with general anesthesia, with the aid of an operating microscope and microsurgical instrumentation in all cases. Preoperative antiepileptic loading is mandatory.

All cases had been operated through a posterior parietal transcortical approach. The superior parietal lobule is the site of small cortical incision (1.5–2 cm). The patient was positioned supine and fixed with Mayfield and the patients head was rotated 45-60 degree to the contralateral side. After craniotomy, the surgical corridor was opened by two retractors using Leyla holding system to visualize the tumor using a suitable piece of cottonoid for cortical protection; retractors are then fixed. The operating microscope was then introduced. Tumor debulking and removal was then started using suction and fine bipolar electrocautery with continuous irrigation which may be crucial hemostatic mechanism in ventricular surgeries. After the tumor mass was grossly excised and proper hemostasis was performed. The ventricular system was then well irrigated and filled with Ringer’s solution to ensure minimal amount of intraventricular blood. A ventricular catheter's tip is then placed in the atrium. The dura was then sutured with the ventricular catheter passing through, to be connected to the external ventricular drainage (EVD) system via a separate skin stab. Patients were admitted to the ICU for the 1st postoperative 48 hours. The EVD was followed for the amount of intraventricular blood until clearing in addition to ICP monitoring to determine the need for permanent CSF diversion.

RESULTS
Sixteen patients (seven males and nine females) with lesions located at the ventricular trigone were identified and analyzed. Patients' characteristics are displaced in (Table 2). The mean age was 35.8 ± 24 years (min=2, max=59). Three of the sixteen patients were children. The most frequent symptom was headache (81%) either as single presentation or as a sign of intracranial hypertension. Motor disturbances were seen in 45% of the patients, and visual field disturbances were present in 30% of the patients, whereas only 15% had some kind of cognitive impairment. Papilledema was present in 43% of patients. Only one patient got preoperative seizures. Most patients had a non-specific slow onset of symptoms with a course before diagnosis of more than 1 month in 65%.

All patients underwent CT and MRI of the brain. There were ninetight-sided and seven left-sided lesions of which fourteen were pure primarily ventricular lesions and two were paraventricular masses with
invasion of the ventricle. All cases showed some degree of contrast enhancement. The size was estimated by the maximal diameter. There were two small lesions (<3 cm), thirteen medium-sized lesions (3–5 cm) and one large lesion (>5 cm). The mean size was 3.8 cm. Hydrocephalus or trapped posterior or temporal horns were present in eight cases (50%).

In all cases, a complete tumor removal was achieved by using a microsurgical technique, which was demonstrated by postoperative CT and MRI. Different Pathologies of the study series is shown in (Table 2). Meningioma was the most common finding in nine patients (56%). All of the children harbored a choroid plexus papilloma (three cases) (Table 2). Two cases had ependymoma and the other two cases had glioblastoma multiforme.

The two cases with glioblastoma multiforme died during the follow up period after 10 months and 13 months respectively. Morbidity was reported in 6 patients (36%). One patient, who had only a slight right hemiparesis prior to surgery, had developed transient worsening of the motor deficit and transient dysphasias which returned to almost normal before discharge. A case of permanent hemiparesis occurred in a right-sided ependymoma. The patient had already a left-sided weakness before surgery. Postoperative bleeding appeared in a 3-year-old child with a right-sided plexus papilloma who developed an epidural hematoma in the first hours after surgery. The hematoma was surgically evacuated without neurological deficit. Three patients (16%) developed seizures that required long term treatment. There were two cases of new postoperative visual field disturbance documented on automated perimeter, one in a right-sided meningioma and one in a left-sided meningioma.

The neurological status according to the modified Rankin Scale (mRS) improved in eleven patients and remained the same in three patients. Of the sixteen patients studied, thirteen had no or only mild disability (mRS, 0–2) after surgery. (Figure 4)

<table>
<thead>
<tr>
<th>Case No</th>
<th>Age/ Sex</th>
<th>Side</th>
<th>Presentation</th>
<th>Papilledema</th>
<th>Size (max. diameter in Cm)</th>
<th>Pathology</th>
<th>mRS preop</th>
<th>mRS postop</th>
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<tbody>
<tr>
<td>1</td>
<td>40/F</td>
<td>R</td>
<td>headache</td>
<td>+</td>
<td>3</td>
<td>meningioma</td>
<td>0</td>
<td>0</td>
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<tr>
<td>2</td>
<td>32/F</td>
<td>L</td>
<td>Headache, visual obscuration</td>
<td>+</td>
<td>3.7</td>
<td>meningioma</td>
<td>1</td>
<td>0</td>
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<tr>
<td>3</td>
<td>3/M</td>
<td>R</td>
<td>decreased conscious level</td>
<td>+</td>
<td>4.1</td>
<td>choroid plexus papilloma</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>29/F</td>
<td>R</td>
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<td>+</td>
<td>2.9</td>
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<td>1</td>
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<tr>
<td>5</td>
<td>53/M</td>
<td>R</td>
<td>headache</td>
<td>+</td>
<td>5.1</td>
<td>GBM</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
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<td>38/F</td>
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<td>headache</td>
<td>+</td>
<td>3.5</td>
<td>meningioma</td>
<td>1</td>
<td>0</td>
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<tr>
<td>7</td>
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<td>+</td>
<td>2.8</td>
<td>meningioma</td>
<td>4</td>
<td>3</td>
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<tr>
<td>8</td>
<td>2/M</td>
<td>L</td>
<td>increased ICP, large head</td>
<td>+</td>
<td>4.1</td>
<td>choroid plexus papilloma</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>59/F</td>
<td>R</td>
<td>headache</td>
<td>+</td>
<td>3.6</td>
<td>meningioma</td>
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<td>0</td>
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<tr>
<td>10</td>
<td>42/F</td>
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<td>Headache, hemiparesis</td>
<td>+</td>
<td>4.2</td>
<td>Ependymoma</td>
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<td>1</td>
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<tr>
<td>11</td>
<td>37/F</td>
<td>L</td>
<td>headache, increased ICP</td>
<td>+</td>
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<td>meningioma</td>
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<td>1</td>
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<tr>
<td>12</td>
<td>48/M</td>
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<tr>
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<tr>
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<tr>
<td>16</td>
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<td>Headache, visual obscuration, hemiparesis</td>
<td>+</td>
<td>4.5</td>
<td>GBM</td>
<td>1</td>
<td>6</td>
</tr>
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</table>
DISCUSSION

The ventricular trigone is the preferred location of tumors affecting the lateral ventricles in most series especially in the series of meningioma, which are some of the most frequent tumors of the lateral ventricles. There was a report of a very high incidence at the ventricular trigone ranging from 69% to 90% of all ventricular masses. There are only a few series describing only lesions limited to the area of the ventricular trigone. Most of the larger series include infiltrating tumors such as low- and high-grade gliomas and lymphomas that may extend diffusely into the white matter of the parietal and temporal lobe. These lesions cannot be considered as purely intra- or paraventricular, and therefore, we focused on clearly circumscribed lesions like meningioma, Ependymoma and choroid plexus papilloma.

The usual surgical approaches for trigone lesions are transtemporal, transparietal, trans posterior-central sulcus, and posterior transcallosal. The choice of approach depends on the size of the lesion and whether the lesion is in the dominant hemisphere. Transtemporal approach provides the shortest distance to trigone and early identification of anterior choroidal artery. However, it could impair visual pathway. Transparietal approach spares the visual pathway somewhat. However, on the dominant hemisphere, either transtemporal or transparietal approach may damage tempoparietal junction and produce dyslexia, agnosia, agraphia, and acalculia.

Posterior transcallosal approach does not affect the visual pathway or eloquent cortex, but considerable brain retraction is required and the surgical corridor is long. Therefore, transposterior-central sulcus approach is advocated on both dominant and non-dominant hemispheres. Transparietal approach is suitable for large lesion on non-dominant hemisphere. MRI with diffusion tensor imaging can visualize fiber tracts. The future trend is using diffusion tensor imaging to protect the visual pathway during trigone tumor surgery. As long as the white matter is not resected, postoperative neurological deficits usually improve within months. Porencephalic cyst is a very rare complication of transcortical approach.

In our series, we describe the transcortical approach as a surgical pathway, which allows a safe and effective management of these lesions. The posterior parietal approach is started with a linear corticotomy along the superior parietal and temporal lobe. The dissection is carried downward entering the roof of the posterior part of the lateral ventricular body and the trigone. The ventricle can be punctured with a ventricular needle or catheter. This allows decompression of a trapped ventricle and location of the tumor. Once the ventricular wall is reached, self-retaining blade retractors are placed, always trying to put on as little pressure as possible. This approach runs medial to the majority of optic radiations. The anterior choroidal artery enters the temporal horn through the choroidal fissure near the choroidal point and then runs along the plexus which courses in the inferior and lateral aspect of the ventricular trigone. The posterior choroidal arteries reach the lateral ventricle behind the anterior choroidal artery and give frequent feeders to tumors at the ventricular trigone. The opening of the ventricular trigone happens away from the choroidal arteries which usually course underneath the tumor, thus preventing an early vascular control.

Recently, neuroendoscopy gained popularity for approaching ventricular tumors. It is suggested that better vision is provided with less cerebral damage and retraction. The method is challenging for large tumors, although it can be used for all tumors. It is particularly preferred for tumors < 2 cm. The density, consistency and the vascularity of the tumor should be taken into account for the approach.
account. It is stated that the method can be used for better visualizing the tumor as a supportive method of the microsurgical method 21.

CONCLUSION

The parietal approach through the intraparietal sulcus is the best choice for virtually all cases with trigone ventricular tumors. It provides a straight line pathway to lateral ventricle's trigone, in the shortest route and avoids the neurological morbidity to the patient.

Declaration

The author(s) declare no conflict of interest or any financial support and confirm the approval of the submitted article by the concerned ethical committee.

REFERENCES