Article

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Trigone ventricular meningiomas

Surgical approaches

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ABSTRACT

Objective: Report our experience with trigone ventricular meningiomas and review the surgical approaches to the trigone. **Method:** From 1989 to 2006, six patients with meningiomas of the trigone of the lateral ventricles underwent microsurgical resection. Their clinical features, image, follow up, and surgical approaches were retrospectively analyzed. **Results:** Five patients presented with large and one with small volume meningioma. Unspecific symptoms occurred in three patients; intracranial hypertension detected in three patients; homonymous hemianopsy in three; and motor deficit present in one patient. Three patients were operated by transparietal transcortical approach, two by middle temporal gyrus approach, and one by parieto-occipital interhemispheric precuneus approach. Total resection was achieved in all patients without additional deficits. **Conclusion:** Judicious preoperative plan, adequate knowledge of anatomy, and use of correct microsurgical techniques are fundamental in achieving complete resection of trigone meningioma with low morbidity.

Key words: meningioma, lateral ventricle, trigone, surgical approach.

Meningiomas do trígono ventricular: abordagens cirúrgicas

RESUMO

Objetivo: Relatar a experiência com seis meningiomas do trígono ventricular e discutir as várias vias de abordagem para o trígono descritos na literatura. **Método:** Seis pacientes com meningiomas do trígono ventricular operados entre 1989 e 2006 foram analisados quanto às suas características clínicas, de imagem, evolução e às vias de abordagem. **Resultados:** Cinco pacientes apresentaram meningiomas de grande volume e um pequeno. Sintomas inespecíficos ocorreram em três pacientes, hipertensão intracraniana em outros três pacientes; hemianopsia homônima em três e déficit motor em um paciente. Três pacientes foram operados por via transcortical transparietal, dois através do giro temporal médio, e um por abordagem interhemisférica precuneus. A ressecção total foi possível em todos os pacientes, sem défices adicionais. **Conclusão:** Planejamento operatório cuidadoso aliado ao uso de técnicas microcirúrgicas são fundamentais na ressecção completa dos meningiomas do trígono com baixa morbidade.

Palavras-chave: meningioma, ventrículo lateral, trígono, abordagem cirúrgica.

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Primary intraventricular meningiomas (IVM) are rare, corresponding to 0.5 to 5% of all intracranial meningiomas[1-4]; the most common location is the trigone (atrium). Due to the fluid cavity location and their slow growth they can became large tumors before proper diagnosis[5]. Trigone meningioma is in a deep-seated location surrounded by intact neural tissue, near to vital ventricular structures, and deeply vascularized. There is always a need for some kind of cortical incision

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and white fiber dissection to reach the tumor. Surgical resection is difficult without complications or new neurological morbidities. There is a high incidence (42%) of morbidity[1,6]. Many approaches to the trigone have been described and the challenge is to choose the best to provide wide tumor exposure and early access to the vascular pedicle to allow complete tumor resection causing less additional lesion.

We herein report six trigone meningiomas which were completely removed without additional morbidity, and we discuss the different routes used to access the ventricular trigone region.

METHOD

At the neurosurgical division of the Botucatu Medical School 158 patients with intracranial meningiomas underwent surgery between 1998 and 2006. Of these, five were located in the ventricular trigone (3.2%). Medical, imaging, surgical, and histopathological findings of these cases were analyzed, and included one patient operated at the neuroncology division of the Cancer Hospital of Barretos. All patients gave an informed consent for this publication. Table summarizes demographic data, clinical and image findings, surgical approach, and follow-up.

RESULTS

The clinical features and results from six cases of trigone ventricular meningiomas are showed in Table.

The average age of patients was 47.8 years (30-63 years), and equal gender distribution. Five cases were located on the right and one on the left side. Average follow up time was 23 months. Unspecific clinical manifestations and incidental findings were common (two cases after mild head trauma and one after syncope). Headache and intracranial hypertension were present in three cases (cases 2, 4, and 5). Others symptoms such visual disturbances, progressive hemiparesis, epileptic crises, and reduced conscience were present in these patients. Hydrocephalus was present in three patients, cerebral edema in three, and calcifications were detected in five tumors.

Patients 1 and 4 with a large tumor in the non-dominant hemisphere without hydrocephalus were operated by superior transparietal approach (Fig 1 and 2). Patient 2 presented the largest tumor in the dominant hemisphere with a lateral projection near the cortical surface. The tumor was located just under 0.3cm below the parietal cortical surface (Fig 3). A transtemporal approach through the middle temporal gyrus was made in two cases (patients 3 and 5) who presented an infero-lateral projection in the non-dominant hemisphere associated with temporal horn entrapment (Figs 4 and 5). The patient 6 with small meningioma was operated via parietocipital precuneus approach (Fig 6).

All were completely resected without additional neurological deficit. Three patients with preoperative unspecific symptoms remained assymptomatic postoperatively. The patients with previous intracranial hypertension and motor deficits improved after surgery. Three patients remained with the same preoperative visual deficit. Karnofsky functional score improved in all patients.

DISCUSSION

The origin of intraventricular meningiomas is uncertain. However they apparently originate from the stroma of the choroid plexus or from the remains of arachnoid cells within the choroid[7,8]. These cells are conducted together with the choroid plexus as the ventricular system invaginates during the embryonary period[1,4]. The atrium is the most common location for intraventricular meningiomas (77.8%), followed by the fourth (6.6%) and third

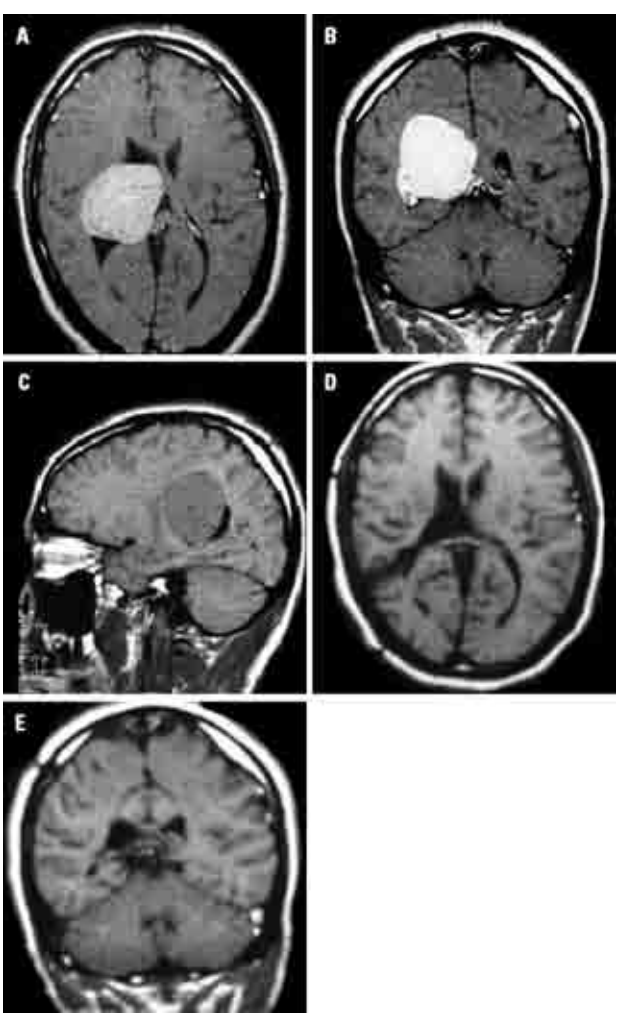

Fig 1. Case 1. A 30-year-old man developed moderated headache after mild head injury. He complained of forgetfulness for the last six months. [A, B and C] Pre-operative MRI. [D and E] Post-operative MRI after 6 months.

Table. Clinical features and results from six cases of trigone ventricular meningiomas.

Case	Age Sex	Symptoms	Neurological examination	KPS	Side	Size (cm)	Surgical approach	Histopathology	Follow-up/ KPS
1	30 M	Mild head trauma Forgetfulness	Normal	90	Right	5.2×5.1×6.5	Superior transparietal	Fibrous	Asymptomatic KPS 100
2	50 F	Convulsion, emotional lability, forgetfulness, and somnolence	Grade 4 right hemiparesis Babinski sign Right HH ICH	40	Left	7.2×6.0×6.5	Inferior transparietal	Fibroblastic	Motor deficit Omprovement Convulsion remission HH KPS 80
3	52 F	Headaches after mild head trauma	Normal	90	Right	4×4×4	Middle temporal gyrus	Fibrous	Asymptomatic KPS 100
4	45 M	Aborted surgery in another service	Left HH ICH	70	Right	8×7.5×6	Superior transparietal	Fibrous	Hemianopsy KPS 90
5	63 F	Headache Dizziness	Left HH ICH	80	Right	4.1×3×3.2	Middle temporal gyrus	Meningotelial	Asymptomatic KPS 100
6	47 M	Non specific syncope	Normal	90	Right	2×1.5×0.7	Parieto-occiptal intermispheric precuneus	Psammomatous	Asymptomatic KPS 100

HH: homonymous Hemianopsy; ICH: intracranial hypertension; KPS: Karnofsky performance scale score; MRI: magnetic resonance image.

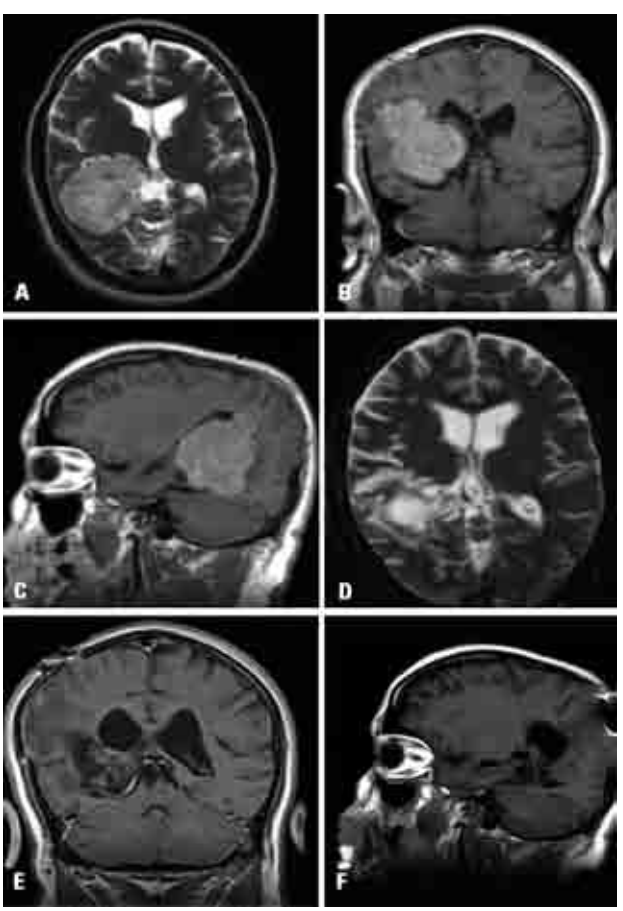

Fig 2. Case 4. A 45-year-old man with progressive decline of visual acuity. [A B and C] Pre-operative MRI. [D, E and F] Post-operative MRI after 2 years showed no residual tumor.

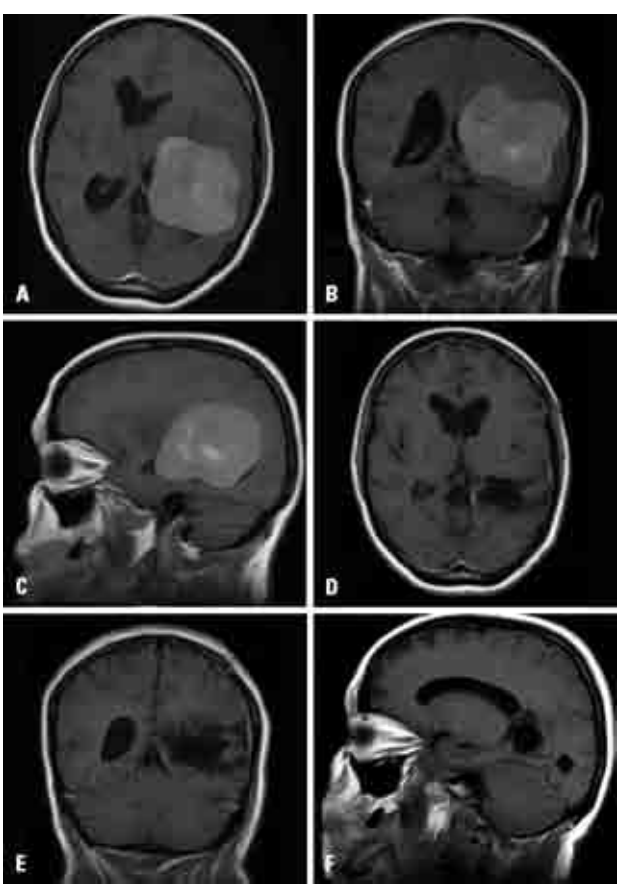

Fig 3. Case 2. A 50-year-old woman with a history of two weeks progressive weakness of the superior limbs, somnolence, and an episode of partial convulsion. [A, B and C] Pre-operative MRI. [D, E and F] Post-operative MRI after 8 months.

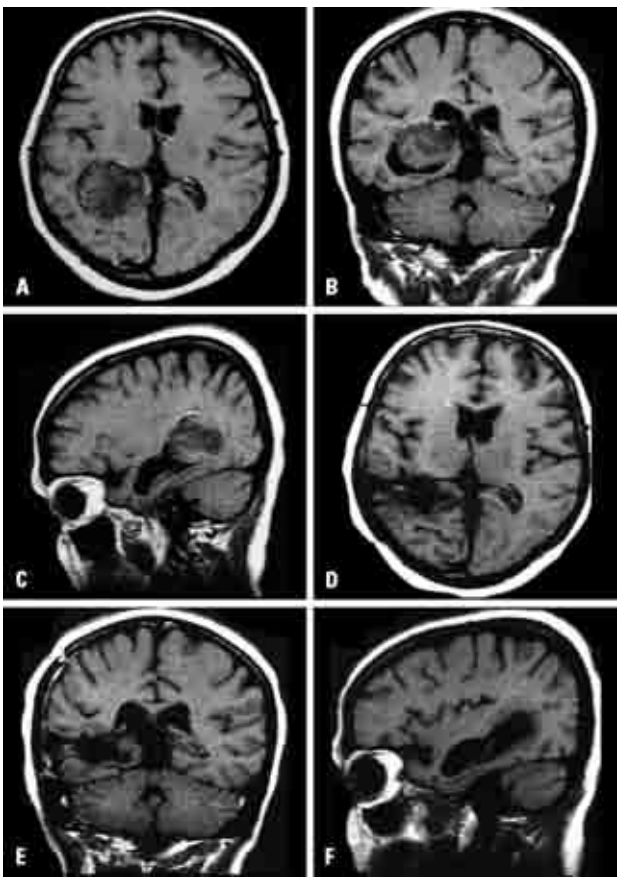

Fig 4. Case 3. A 52-year-old woman with a history of persistent and progressive headache after a cycle fall. [A, B and C] Pre-operative MRI. [D, E and F] Post-operative MRI after 6 months.

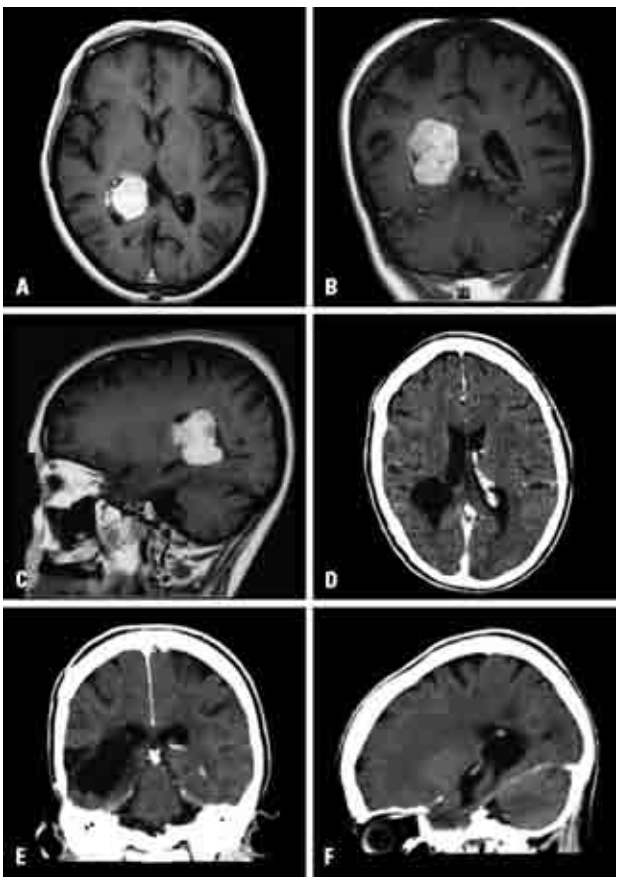

Fig 5. Case 5. A 63-year-old woman presenting three years history of intermittent headache and nonspecific dizziness, associated with progressive loss of visual acuity. [A B and C] Pre-operative MRI. [D, E and F] Post-operative MRI after 6 months showed no residual lesion or recurrence.

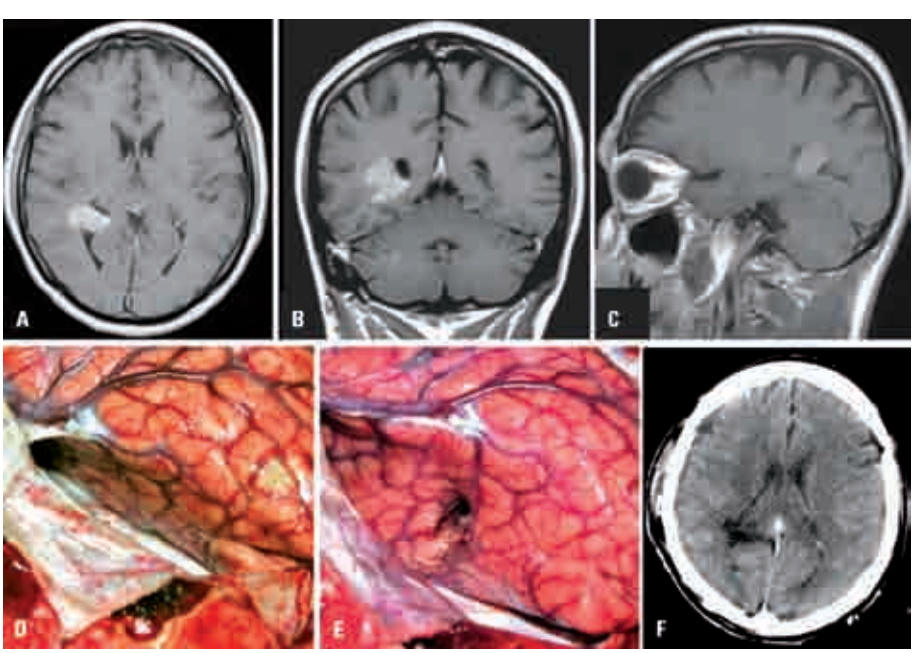

Fig 6. Case 6. A 47-year-old man with a five-year history of nonspecific syncope. [A, B and C] Preoperative contrasted MRI showed a small (2×1.5×0.7 cm) meningioma with irregular shape. [D and E] intraoperative photography of interhemispheric parieto-occipital approach was performed through a small (1.5 cm) incision in the precuneus. [F] Post-operative CT scan showed no residual tumor.

ventricles (5.6%)[9-11]. Trigone meningiomas do not present a well defined clinical syndrome. Their location inside a fluid cavity and the slow growing pattern of the meningiomas has a compensatory mechanism or accommodation which contributes to late symptom manifestation and attaining large volumes[12]. Alves et al.[13], reported a 17-year-old boy with a giant intraventricular meningioma removed *en bloc*, weighing 470 grams. Intracranial hypertension and visual loss are the most commonly described, with an incidence between 40 and 70%[1,12], since the optic radiations are located lateral and inferior to the ventricular trigone, they are affected by compression of large-volume tumors[4,9]. Imaging features demonstrates well delimited, globular tumor in the trigone with variable projection.

IVM are resistant to other non-surgical treatment methods. Radiosurgery is only appropriate for small tumors less than 2 cm. It can be used as an alternative for controlling residual tumors or recurrences[3]. Surgical resection is the main alternative to result in cure[12]. However a direct approach to the trigone region is complex due to deep anatomy, its relationship with neighboring neural structures, choroid arteries and the venous system[8].

Surgical approaches to the trigone may cause injury to motor tracts, sensory tracts, speech conduction tracts, and visual pathways. The visual system is particularly prone to injury due to its location. The visual fibers which originate from the lateral geniculate body in towards the visual cortex cover the roof and lateral wall of the temporal horn and the infero-lateral aspect of the atrium[5,8,14-17]. Meningiomas of the trigone receive their supply from the anterior and postero-lateral choroidal arteries. Large meningiomas are also often supplied by branches of the lenticulostriate and thalamoperforating arteries[3,5,8]. The trigone venous system is mainly formed by two groups of veins: the lateral and medial atrial veins, which sometimes join near the choroidal fissure to form a common trunk[18]. Large meningiomas usually displace the choroidal vessels inferior and medially, rendering their early control difficult[3]. There are many routes described in literature and the optimal surgical approach has not yet been defined[8,17]. All present advantages and disadvantages.

The transparietal approach through the superior parietal lobe is the preferred route to the trigone[1,2,4-6,8,9,12], especially in the dominant hemisphere[5,6,17]. The optic radiations can be avoided because they are in the inferolateral aspect of the ventricle[6,9]. The trigone is exposed through a cortical incision along the longitudinal axis of the superior parietal lobe[10], medially to the interparietal fissure (sulci), and 3 to 4cm from the interhemispheric fissure. The cortical incision is made high enough to avoid the optic radiations and posterior enough to avoid the language region[5]. Some authors prefer an approach through the interparietal fissure to reduce the distance to the trigone. The disadvantage of this route is the long distance inside the white matter to the trigone and the difficult access to the vascular pedicle[8,12,17].

Transtemporal approach through the middle or inferior temporal gyrus are particularly suitable for tumors sited at the antero-inferior portion of the trigone and for tumors projecting into the posterior third of the temporal horn[3,6,8,9,12,17]. This route gives the quickest access to the choroidal vessels. In the presence of hydrocephalus or temporal horn entrapment, access and retraction is greatly facilitated[2,3,12]. However there is high risk of injury to the inferior aspect of the optic radiation (causing contralateral quadrantopsy) and to the sensory language cortical center in the dominant hemisphere (causing Wernicke aphasia)[6,12,15,17]. This risk may be decreased by retraction parallel to white matter fibers[12]. We used this route in cases 3 and 5, where the presence of dilated sequestered temporal horn facilitated tumor dissection with minor retraction. Subtemporal approaches to the trigone through the inferior surface of the temporal lobe were suggested to minimize risks of injury to optic radiations and language centers[5,8]. This can be achieved through the occipitotemporal (fusiform) gyrus, occipitotemporal sulci, or collateral sulci. However these routes increase the risks of complications due to temporal lobe retraction and venous occlusion (particularly the vein of Labé).

The interhemispheric parieto-occipital precuneus (para-esplenial) approach, described by Yasargil, provides a short route to the medial wall of the trigone, and at same time avoids injury to the optic radiations as well as avoiding disturbance of cortical functions, even in the dominant hemisphere[19,20]. The medial surface is retracted and an incision made in the precuneus cortex leaving a short distance (± 2 cm) to the medial wall of the trigone. This route is indicated for small or medium-size meningiomas with medial projection. The disadvantages are wider brain retraction is necessary, the narrow working angle, narrow surgical corridor and difficult access to the choroidal vessels[3,17,21]. We used this route in our case 6 with excellent evolution.

Judicious microsurgical techniques reduce damage to the surrounding brain. Transsulcal access is preferred by some authors[22,23] because the sulci is directed towards the ventricle cavities, reducing the entry distance. However others prefer to enter the cortex through a gyrus to avoid injury to the sulcal vessels[5]. In large meningiomas and in cases of increased intracranial pressure, the sulcus may be compressed and tight, impeding transsulcal approach. In these cases, we prefer to make a gyral corticectomy. The cortical incision is preferably made parallel to fiber trajectory to minimize visual deficits. When the ventricle has been opened, self-retaining retractors

are almost always necessary. Gentle retractions with curved blades are placed just within the ventricle to lift the brain after CSF emptying. To avoid injury to nearby structures prior debulking and piecemeal resection are recommended, especially for large tumors. An ultrasonic aspirator is very useful for this. Vascular pedicle control may be promoted just after tumor debulking and capsular deflection, where they are frequently adhering[1,4,9]. An extensive review of hemostasis must be made and ventricular drainage may reduce the risk of postoperative hydrocephalus caused by coagulum.

Very large tumors may compress or invade the parenchyma nearly to the cortical surface. Distorted and stretched white fibers cause preoperative symptoms, mainly motor and visual deficits. The gyrus can be flattened with the tumor just lying beneath. In this situation, access may be at the point nearest the tumor in the cortical surface. We used this in cases 2 and 4. For medium-size tumors, located within the limits of the ventricle walls, with or without ventricle dilation, the transparietal superior approach in the non-dominant hemisphere, and the interhemispheric approach for the dominant hemisphere appear to be the most appropriate approaches. For small tumors and asymptomatic patients, efforts must be made to preserve eloquent cortex and fibers. For these small tumors we prefer the transparietal superior or interhemispheric precuneus approaches.

In conclusion, the cure of meningioma of the ventricular trigone can be achieved with appropriate selecting surgical route according to the anatomical features of the region, characteristics of the individual presentation such as size, location, growing patterns, and clinical preoperative deficits.

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