

Surgical Outcome of Intraventricular Meningiomas

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ABSTRACT

Objectives: Intraventricular meningiomas (IVMs) are rare and formidable lesions. Herein, a report of 11 intraventricular meningiomas is reported with a special emphasis on the clinico-radiological appearance and surgical outcome. **Methods:** Eleven patients with histologically verified IVMs underwent a retrospective study. Surgery was performed via parieto-occipital route in six patients with trigonal meningiomas, infratentorial supracerebellar approach in two patients with posterior third ventricular meningioma, while telovelar approach was utilized in three patients with fourth ventricular meningiomas. A retrospective study was conducted by analyzing clinical data, neuro-imaging studies, and operative findings. The degree of tumor removal, clinical outcome, and post operative complications are described. **Results:** Six of the 11 tumors were located in the trigone of the lateral ventricles (54.5%), three were in the fourth ventricle (27.3%), and two were in the posterior third ventricle (18.2%). There were seven females (63.6%), and four males (36.4%). Repeated vomiting was a characteristic symptom with fourth ventricular meningiomas, while bilateral tinnitus was present with posterior third meningiomas. Raised intracranial pressure was the commonest presentation. Pre operative CSF diversion was carried for patients with third and fourth ventricular meningiomas. Total tumor removal was achieved in all trigonal meningiomas via parieto-occipital craniotomy. Post operative intraventricular drain was sufficient to drain bloody CSF and permanent CSF diversion was not needed. For the posterior third ventricular meningiomas (Two cases), subtotal removal was obtained via infra-tentorial supracerebellar approach. Subtotal removal was complicated by post operative hematoma, and two patients died after hematoma evacuation. In fourth ventricular meningioma, telovelar approach allowed panoramic view for the fourth ventricle with uneventful total tumor removal. The mortality rate was 18.2% (Two of 11 cases). **Conclusions:** Intraventricular meningiomas are rare tumors. In the trigonal IVMs there are no specific clinical features, and the tumors often grow slowly to a substantial size before they become symptomatic. Repeated vomiting is a characteristic symptom with fourth ventricular meningiomas, while bilateral tinnitus is a unique feature with posterior third meningiomas. Surgery for these lesions is a challenging, and requires planning to avoid eloquent area damage. After considerable internal debulking of the tumor, control of the vascular supply to the tumor is a crucial point. For lateral intraventricular meningiomas with trigonal location, the parieto-occipital route is a safe surgical approach, while for posterior third ventricular meningioma, infratentorial supracerebellar offers limited exposure whenever conservative surgical strategy is attempted. For fourth ventricular meningiomas, telovelar approach is a safe and effective approach. **Keywords;** fourth ventricle, intraventricular meningioma, lateral ventricle, third ventricle.

INTRODUCTION

Meningiomas are usually benign tumors that are thought to originate from arachnoid cap cells (cells forming the outer lining of the arachnoid membrane), related cells such as arachnoidal fibroblasts, or perhaps the

meningeal precursor cell—the so-called meningoblast^[29]. They appear predominantly in women, with a female-to-male ratio of 2:1^[6,13,18]. The occurrence in the general population varies from 1.5 to 5.5 per 100 000 inhabitants, and they account for 13.4% to 40% of all intracranial

tumors, representing the second most common primary brain tumor in adults^[7,13,17,28,30]. The incidence of meningiomas increases with age and demonstrates a peak occurrence in the sixth and seventh decade^[18]. Intraventricular meningiomas (IVMs) account for 9.8% to 14% of all intraventricular tumors and for 20% of lateral ventricle tumors^[14,22]. Within the ventricular system, they are usually found in the trigone of the lateral ventricle (80%), followed by the third (15%) and fourth (5%) ventricles^[5,6,12,21,24]. They are commonly believed to arise either from the stroma of the choroids plexus or from the tela choroidea^[29]. Herein, a report of 11 intraventricular meningiomas is reported with a special emphasis on the clinico-radiological appearance and surgical outcome.

PATIENTS & METHODS

Between 1999 and 2007, 11 cases of intraventricular meningiomas were operated on at the Department of Neurosurgery, Ain Shams University Hospitals. There were seven females, and four males ranging in age from 32 to 62 years (mean 40.7 years). Computed tomographic (CT) scan and magnetic resonance imaging (MRI) was performed for all cases. Cerebral angiography (DSA) was performed in five out of six cases with trigonal meningiomas, and one patient with 4th ventricular meningioma (Fig. 1 E, F & Fig. 4 C). Pre operative embolization was not done for any patient. Pre operative CSF diversion was carried for patients with third and fourth ventricular meningiomas (Five cases). Surgery was performed via parieto-occipital route in six patients with trigonal meningiomas, infratentorial supracerebellar approach in two cases with posterior third ventricular meningioma, while telovelar approach

was utilized in three patients with fourth ventricular meningiomas. Immediate 1st day post operative CT scan was performed routinely. Post operative follow up MRI in first 3 months was also done routinely. Periodic post operative clinical and radiological follow up period ranged from six to 80 months (mean 40 months).

Surgical approaches

Surgical approach was selected according the location of the tumor

Lateral Ventricular meningiomas

All of the tumors were in the atrium (trigone) of the lateral ventricle. They were approached via a transcortical route (Four from right side, and two from left side). Parieto-occipital approach was used classically as described previously in literature^[1], through an incision over the parieto-occipital cortex to open the ventricle. Pre operative ventricular dilatation usually provides rapid and accurate natural navigation to the tumor (Fig. 1 A, B). The capsule was coagulated using bipolar current, and the tumor capsule was emptied in the area of coagulation using ultrasonic aspiration (CUSA). After adequate internal debulking using the operating microscope, the capsule could be turned to expose its feeding vessels originating from the anterior and posterior choroidal arteries. These vessels were then coagulated and divided, and the tumor capsule was excised in one piece. Intraventricular catheterization to drain intraventricular bloody CSF was applied for 3- 5 days, and then removed (Fig. 2 C). No patient needed permanent CSF diversion.

Third Ventricular meningiomas

All of the tumors were in the posterior third ventricle. Falco-tentorial meningiomas with dural attachment were excluded. Midline infratentorial supracerebellar approach was used for

two cases with posterior third ventricular meningiomas in Concord position^[2]. Wide suboccipital craniectomy, with exposure of lower edge of transverse sinus is carried out. The dura is opened in Y-shaped fashion with base toward the transverse sinus. The arachnoid bands and the small bridging veins are microscopically divided to expose the arachnoid veils around the tumor. Internal debulking by ultrasonic aspirator is carried out microscopically. Conservative subtotal was attempted for these cases.

Fourth Ventricular meningiomas

The telovelar approach was used in three cases with fourth ventricular meningiomas in prone position. Telovelar approach is described previously in the literature^[10,23,25]. The medullotonsillar space of the cerebellomedullary fissure and the uvulotonsillar space are sharply dissected to release the tonsils from uvula and medulla oblongata bilaterally. The two cerebellar tonsils are then retracted laterally to expose the floor of the fissure i.e. inferior medullary velum and tela choroidea. The tela choroidea which forms the caudal part of the lower half of the roof of the fourth ventricle is incised from the foramen of Magendi and then followed laterally to the foramen of Luschka on both sides. The inferior medullary velum is then incised. After this step, the uvula is now free to be retracted from side- to side in a horizontal direction and also in an upward and downward direction to expose the fourth ventricle. Using ultrasonic aspiration, central tumor debulking is carried out till a considerable thickness of the tumor's wall is reached. After this step, feeders from PICA could be in view and could be safely coagulated and divided. Care should be taken not to perforate the wall during its dissection to avoid

brainstem injury. In the two fourth meningioma cases, the inferior medullary velum was thinned out and was stretched as a neural tissue sheet over the tumor surface.

RESULTS

Six of the 11 tumors were located in the lateral ventricles (54.5%) [Four at right side, and two at left side], three were in the fourth ventricle (27.3%), and two were in the posterior third ventricle (18.2%). There were seven females (63.6%), and four males (36.4%).

Clinical presentation

Headache was present in all cases. For lateral ventricular meningiomas, vague symptoms were present as vertigo (Five out of six patients representing 83.3%), unsteady gait (Four out of six patients representing 66.7%), homonymous hemi- anopsia was present in two of six patients (33.3%). In third ventricular meningiomas, headache, impairment of upward gaze movement, and bilateral tinnitus were present in the two cases. In patients with fourth ventricular, headache, repeated vomiting, and trunkal ataxia were present in the three patients. Papilledema was evident in the five patients with third and fourth ventricular meningiomas which necessitate shunting.

Radiological features

On MRI, all tumors presented as a well-defined mass. After application of contrast medium, all tumors displayed a homogeneous strong enhancement. Calcification was present in four out 11 patients (36.4%). Bilateral hydrocephalus was observed in five patients (45.5%) [Three with 4th ventricular meningiomas, and two with 3rd ventricular meningiomas] which necessitates CSF diversion. Local ventricular dilatation (Trapped occipital horn) was present in four

patients with trigonal meningiomas (Fig. 1 A, B), while it was absent in the remaining two patients (Fig. 2 A, B). DSA was performed for the five patients with trigonal meningiomas (Fig. 1 E, F) and demonstrated feeders from choroidal arteries. Also DSA was performed with another patient with 4th ventricular meningioma (Fig. 4 C), and PICA feeders were demonstrated. Pre operative embolization was not done for any patient.

CSF diversion

Pre operative CSF diversion via V-P shunt was applied for five patients (Three with 4th ventricular meningiomas, and two with 3rd ventricular meningiomas) as supratentorial hydrocephalus and papilledema was evident.

Post operative Intraventricular catheterization to drain bloody CSF with trigonal meningiomas was applied for 3- 5 days, and then removed (Fig. 2 C). No patient needed permanent CSF diversion.

Degree of tumor removal and outcome in lateral ventricular meningiomas

Total tumor removal was achieved in all six cases of trigonal meningiomas via parieto-occipital craniotomy (Fig. 1 G, H& Fig. 2 C, D).

Intraventricular catheterization was effective in prevention of hydrocephalus in all cases. Transient mild contralateral hemiparesis was observed in three cases (50%) which then improved within two weeks.

Post operative seizures were encountered in two patients (33.3%),

which were controlled by antiepileptics, while transient dysphasia was observed in one patient (16.7%). Pre operative homonymous hemi-anopsia worsened in one patient, and unchanged in another one. Neither regrowth, nor recurrence was encountered during the follow up period.

Degree of tumor removal and outcome in third ventricular meningiomas

Conservative surgical strategy was attempted to deal with two cases with posterior third ventricular meningiomas (Fig. 3 A, B, C, D). Subtotal removal was achieved via infratentorial supracerebellar approach. Unfortunately, the two cases were complicated by post operative hematoma (Fig. 3 E) and died.

Degree of tumor removal and outcome in fourth ventricular meningiomas

Telovelar approach was used to deal with two cases with 4th ventricular meningioma (Fig. 4 A, B). One case was very vascular and hemangioblastoma was preoperatively suspected on DSA bases. Rapid internal debulking was sufficient to deal with this vascular problem (Fig. 4 C). After considerable internal debulking, controlling PICA feeders was achieved, and total removal with preservation of PICA was obtained (Fig. 4 D, E). Post operatively, the trunkal ataxia improved, and vomiting stopped. The mortality rate was 18. 2 % (Two of 11 cases)

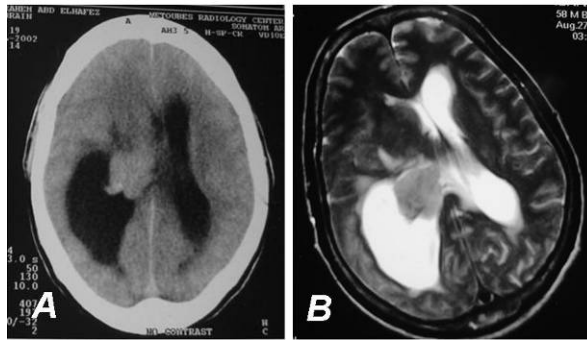


Fig.1 (A, B). In (A) axial C.T, and (B) axial pre operative T2- weighted MRI showing right lateral (trigonal) meningioma with localized hydrocephalic changes.

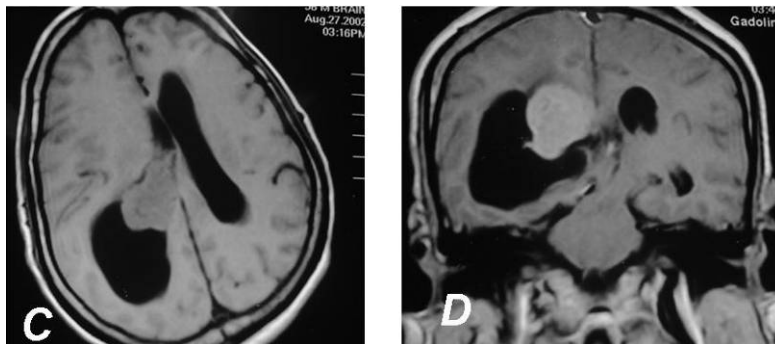


Fig. 1 (C, D). Pre operative T-1 weighted MRI without Gd- DPTA in (C), while in (D) showing bright enhancement after Gd- DPTA administration.

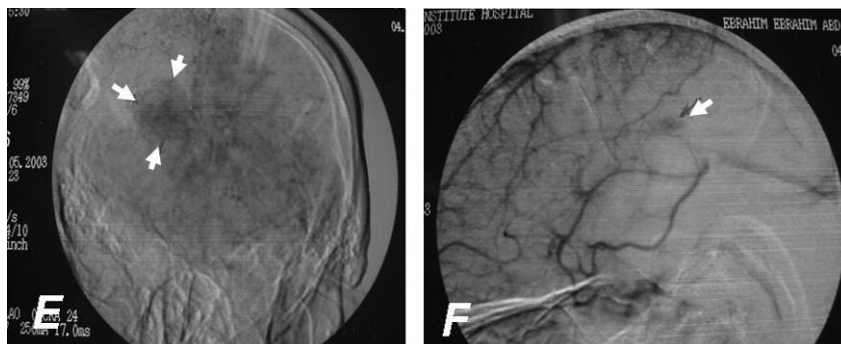


Fig. 1 (E, F). Pre operative right carotid angiography (DSA). White arrowheads demonstrate tumor blush and feeders from anterior and posterior medial choroidal arteries.

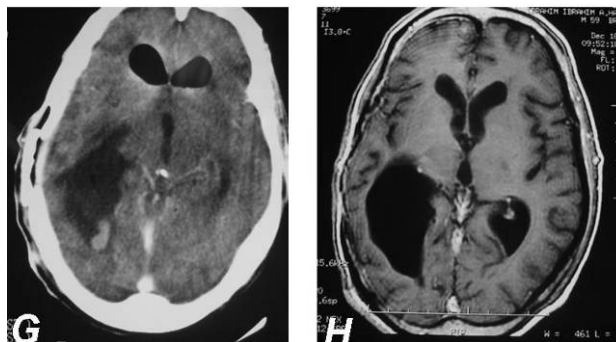


Fig. 1 (G, H). In (G), post operative C T scan showing air in the frontal horns, and residual blood in the trigone. In (H), post operative MRI axial cut with Gd- DPTA showing total tumor removal via right parieto-occipital route.

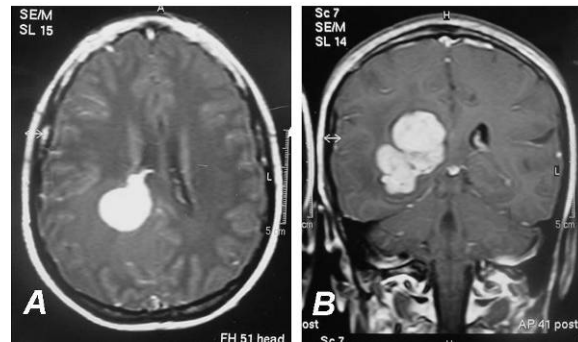


Fig.2 (A, B). In (A) axial, and (B) coronal pre operative T1- weighted MRI with Gd- DPTA showing trigonal meningioma with bright enhancement and without trapped ventricle.

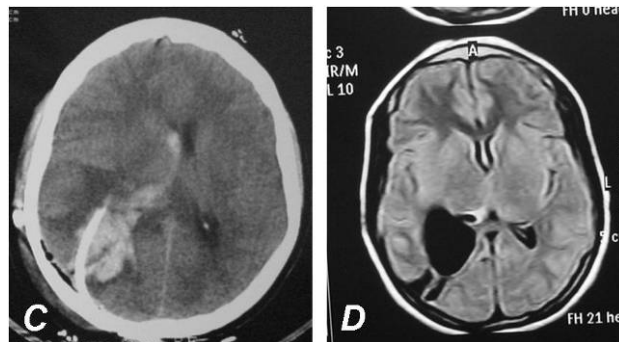


Fig.2 (C, D). In (C) post operative axial C.T scan showing blood within the ventricle with catheter tip is present. In (D), post operative MRI axial Flare image demonstrating total tumor removal via right parieto-occipital route.

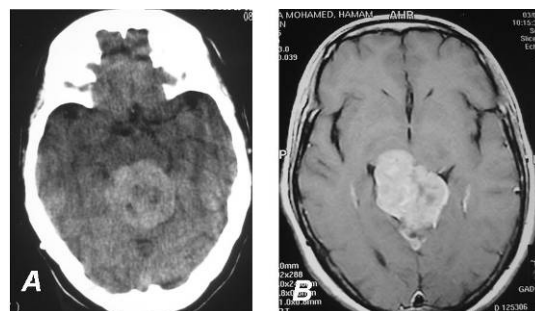


Fig.3 (A, B). In (A) pre operative C. T scan demonstrating posterior third ventricular meningioma after shunting. In (B), pre operative axial MRI with Gd- DPTA showing giant posterior third ventricular meningioma without dural tail sign.

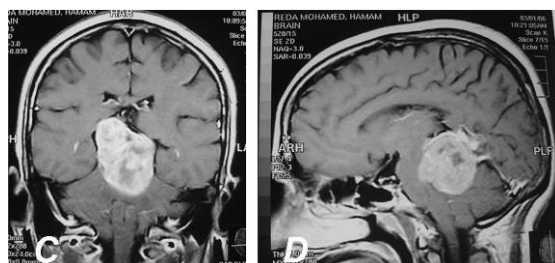


Fig. 3 (C, D). In (C) coronal, and (D) sagittal pre operative T-1 weighted MRI with Gd- DPTA showing degenerated posterior third ventricular meningioma without dural tail sign.

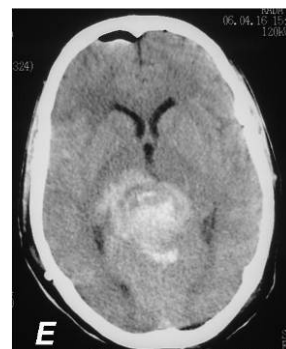


Fig. 3 (E). Post operative C.T scan showing partial resection via infratentorial supracerebellar approach with post operative hematoma.

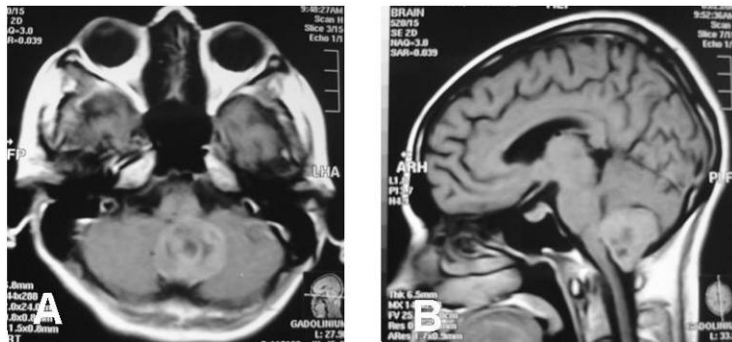


Fig. 4 (A, B). In (A) axial, and (B) sagittal pre operative T-1 weighted MRI with Gd-DPTA showing fourth ventricular meningioma without dural attachment after V- P shunting.

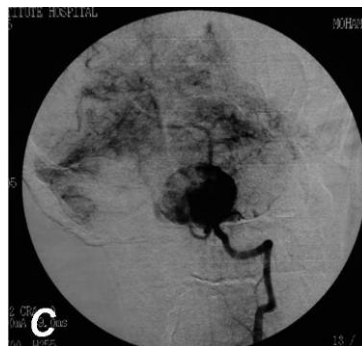


Fig. 4 (C) left vertebral DSA showing tumor blush. Hemangioblastoma was suspected. Intraoperatively, it was found to be meningioma. Rapid internal debulking was carried on, and when a considerable capsular remnant was seen, devascularization by coagulation and dividing feeders from PICA branches was achieved.

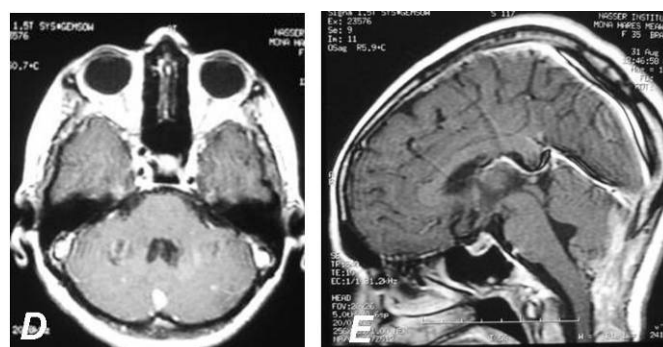


Fig. 4 (D, E). In (D) axial, and (E), sagittal post operative MRI with Gd- DPTA showing no residual after telovelar approach.

DISCUSSION

Meningiomas account for approximately 15% of all intracranial neoplasms. They are known to occur in various locations within the brain, originating from the arachnoid cap cells. The primary occurrence of meningiomas in the ventricular system without dural attachment is extremely rare, with an incidence of 0.5 to 3% among all intracranial meningiomas. According to previous reports, their distribution is 77.8% in the lateral ventricular trigone, 15.6% in the third ventricle and 6.6% in the fourth ventricle^[1,24]

Lateral ventricular meningiomas

The first IVM was reported by Shaw in 1854^[27]. Since then, more and more reports on IVMs have been published, and, in 1986, Criscuolo and Symon identified 400 cases in the literature^[6]. In a recent publication by Nakamura and associate, 132 additional cases were supplemented; resulting in a total of 532 reported IVMs^[24].

Usually, these tumors reach a large size before patients become symptomatic, and diameters of 6 cm and more are not uncommon^[11].

In this study, headache was present in all cases with lateral ventricular meningiomas. Other vague symptoms were present as vertigo (83.3%), and unsteady gait (66.7%). Homonymous hemianopsia was present in two of six patients (33.3%). Similar common symptoms are reported in literature^[6,7,11,20]

The deep location, the proximity of motor, sensory, optical, and language cortex, as well as the optic radiation and the anatomy of the blood supply, make the removal of that tumor a neurosurgical challenge. In the current study, total tumor removal was achieved in all six cases of trigonal

meningiomas via parieto-occipital craniotomy. All cases were located in trigone (neither frontal nor temporal were present). Many approaches are described to deal with lateral ventricular meningioma at the trigone. The most frequently used approaches are the parieto-occipital, the middle temporal gyrus and the trans-splenic^[21]

The parieto-occipital approach offers good overall access to the tumor but less access to the tumor's blood supply. It can be used in both the dominant and non-dominant hemisphere, and the risk of direct damage to the optic radiation is low. The middle temporal gyrus approach offers the advantage of early occlusion of the tumor feeders from anterior and posterior choroidal artery branches, as well as decompression of a possibly trapped temporal horn, but there is the disadvantage of damage to the inferior portion of the optic radiation, as well as language deficits, if such an approach is used in the dominant hemisphere. The trans-splenic approach causes fewer postoperative seizures than does the transcortical approach (Up to 29%), and speech as well as visual disturbances should not occur. However, it has the disadvantage of a possible visual-verbal disconnection syndrome^[6,11,12,15]. Due to the disadvantages of trans-splenic, and inferior temporal gyrus approaches, our six trigonal meningiomas were approached via parieto-occipital approach. Nevertheless, the size of the tumor often obscures early identification of the choroidal arteries. In giant tumors when parieto-occipital approach is used, early capsular cauterization and internal debulking of the tumor allow easy identification of the tumor vessels beneath the capsule. We achieved total tumor removal in six

trigonal cases with acceptable morbidity. This approach has been criticized by others^[8] because it does not allow prior access to the supplying vessels and because of the risk of damaging the optic radiation.

Fornari et al. favoured the parieto-occipital approach, with complete tumor removal, in all 18 cases^[11]. They found a high mortality rate (22%) in the en-bloc-resection group, compared with that of piecemeal resection. They also stated that no approach permitted the preliminary occlusion of all the feeding vessels, which is also true for the temporal approach if the anterior choroidal artery (AchA) is displaced medial of the tumor, proven in half of their cases. With the parieto-occipital approach, occlusion of the feeding vessels becomes possible as soon as the size of the tumor is reduced by endotumoral piece-meal removal^[11]. Criscuolo and Symon preferred the middle or inferior temporal gyrus approach and achieved total tumor resection in all but one of their ten IVM, with good clinical results and amelioration of visual field defects in two cases. They observed no mortality; postoperative morbidity was the deterioration of memory in one patient and a new hemi-anopia in another patient, when the inferior temporal gyrus approach was used^[6].

Bertalanfy and associates, used neuronavigation to deal with such lesions^[1]. In our series, local hydrocephalus with trapped occipital horn acted as natural navigator, moreover, the phenomenon of brain shift after ventricular entry may affect the target.

In the current study, post operative morbidity as transient mild contralateral hemiparesis, post operative seizures, transient dysphasia, and worsening of pre operative homonymous hemi-anopsia were recorded in the literature^[1,6,11,24].

Posterior third ventricular meningiomas

Meningiomas of the pineal region are rare and the majority of cases arise from falcotentorial junction^[16]. However, meningiomas in this region without dural attachment were reported to arise either from the pineal gland stroma, or from velum interpositum in the roof of the posterior third ventricle. Only few cases with posterior third ventricular meningioma are reported in the literature^[9,16,19,26]. Third ventricular meningiomas represents about 15.6% of intraventricular meningiomas^[1,24]. In the present study, two cases with posterior third ventricular meningioma were included. Headache and impairment of upward gaze was observed. Bilateral tinnitus was also notice in the two patients. Compression of inferior colliculi and medial geniculate bodies could explain the tinnitus. Association of pineal region meningiomas and bilateral tinnitus is described in literature^[9,26]. Infratentorial supracerebellar approach was assigned despite the large tumor size, because conservative surgery was attempted in these two cases. Post operative hematoma in tumor bed was a complication in the two cases, and they died after evacuation.

Infratentorial supracerebellar approach is suitable for small, or medium sized lesions extending below the tentorium cerebelli^[2]. Large sized tumor in pineal region and posterior third ventricle could be approached by occipital trans-tentorial approach in a staged planned surgery with infratentorial supracerebellar, or via combined infratentorial supratentorial trans-sinus approach^[26,31]. In this approach, occipital craniotomy, and suboccipital craniotomy were done with division of the non dominant transverse sinus. Again we did not use these approaches (Combined, and staged planned surgery) in our two

meningiomas as conservative surgical strategy was planned.

Fourth ventricular meningiomas

Fourth ventricular meningioma represents 6.6% of all intraventricular meningiomas. They are arising from tela choroidea of the fourth ventricle, taking blood supply from PICA branches^[24]. Few cases were reported in the literature^[3,4,10,12,23,24,25]. We reported two cases in literature^[10], and herein an additional case is added to be totally three. Repeated vomiting was reported as a unique symptom in these three cases due to irritation of area postrema. The three cases were approached utilizing telovelar approach^[10,23,25]. Telovelar approach provides safe and effective panoramic view to the fourth ventricle; however, transvermian approach is still used by many surgeons^[3,4,12,24].

CONCLUSION

Intraventricular meningiomas are rare tumors. In the trigonal IVMs there are no specific clinical features, and the tumors often grow slowly to a substantial size before they become symptomatic. Repeated vomiting is a characteristic symptom with fourth ventricular meningiomas, while bilateral tinnitus is a unique feature with posterior third meningiomas. Surgery for these lesions is a challenging, and requires planning to avoid eloquent area damage. After considerable internal debulking of the tumor, control of the vascular supply to the tumor is a crucial point. For lateral intraventricular meningiomas with trigonal location, the parieto-occipital route is a safe surgical approach, while for posterior third ventricular meningioma, infratentorial supracerebellar offers limited exposure whenever conservative surgical strategy is attempted. For fourth ventricular meningiomas,

telovelar approach is a safe and effective approach.

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