ISSN 1220-8841 (Print)
ISSN 2344-4959 (Online)

ROMANIAN
NEUROSURGERY

Vol. XXXIV | No. 4 December 2020

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DOI: 10.33962/roneuro-2020-093

Romanian Neurosurgery (2020) XXXIV (4): pp. 544-549
DOI: 10.33962/roneuro-2020-093
www.journals.lapub.co.uk/index.php/roneurosurgery

Comparative analysis of anterior third ventricle approaches

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ABSTRACT

Background. Third ventricle tumors are uncommon and account for only 0.6 - 0.9% of all the brain tumors[7]. In 1921, Dandy was the first neurosurgeon who successfully removed a colloid cyst from the third ventricle through a posterior transcallosal approach. Despite their unfavourable locations, these tumours can be removed successfully by proper knowledge of anatomical landmarks and by choosing the appropriate approach.

Methods. We performed a retrospective analysis of all patients (17 patients) who underwent surgery for anterior third ventricular masses between March 2018 to March 2020 in the Dr Ram Manohar Lohia Institute of Medical Science Lucknow, Uttar Pradesh.

Results: The most common symptom in our cases was headache, which was present in all (100%) patients, nausea/vomiting in 7 (41%), history of recurrent episodes of drop attacks in 4 (23%), h/o seizure in 2 (11.7%), visual disturbance in 1 (5.4%), memory disturbance in 1 (5.4%) and urinary incontinence in 1 (5.4%) patient. 6 patients were operated with transcallosal-transforaminal approach, 1 patient was operated with transcallosal interforniceal approach, 3 patients were operated with transcortical-transforaminal approach, 1 patient was operated with subfrontal translamina terminalis approach, 1 patient was operated with transcallosal-transchoroidal approach, 5 patients were operated with endoscopically. Gross total excision was achieved in 15 (88%) patients while in 2 (11.7%) patients subtotal resection was done due to their adherence to choroid plexus and optic chiasm. The most common post-operative complication was endocrine dysfunction in the form of diabetes insipidus.

Conclusions. Anterior Third ventricular tumours are mostly benign and best treatment modality is surgical resection. When we analyzed the results of various approaches, we found that despite their unfavourable location, the results were satisfactory for different tumours of different location in the anterior third ventricle, when treated with the carefully planned microsurgical or endoscopic approach with proper knowledge of anatomical landmarks.

Keywords
third ventricle, transcallosal

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ISSN online 2344-4959
© Romanian Society of Neurosurgery

First published
December 2020 by
London Academic Publishing
www.lapub.co.uk

INTRODUCTION

Third ventricle tumors are uncommon and account for only 0.6 - 0.9% of all the brain tumors[7]. Third ventricle includes wide variety of lesions ranging from benign to malignant. Majority of intra-ventricular tumors

are benign, surgery is therefore preferred and is curative. Most common entities for this location are colloid cysts, astrocytomas and craniopharyngiomas. Others lesions for this location are arachnoid cysts, pituitary adenomas, subependymomas, germinomas, central neurocytoma, teratomas, dermoids, meningiomas and choroid plexus papillomas[12,18]. Third ventricle can be divided into anterior and posterior third ventricle on the basis of an imaginary line connecting foramen Monro to aqueduct sylvius. Common tumors originating from anterior third ventricle are astrocytomas and craniopharyngiomas; from the posterior third ventricle are meningiomas, choroid plexus papillomas and colloid cysts at the level of foramen monro[8]. Anterior Third ventricular tumors can be classified as primary and secondary tumors.

Primary tumors: originating purely intraventricular - ependymoma, choroid plexus papilloma, colloid cysts.

Secondary tumors: originating adjacent to third ventricle and secondarily expand within the ventricular cavity – pituitary adenoma, craniopharyngioma, meningioma.

Patients of anterior third ventricular mass usually presents with symptoms secondary to hydrocephalus such as headache, vomiting, blurring or diminution of vision.

In 1921, Dandy was the first neurosurgeon who successfully removed a colloid cyst from the third ventricle through a posterior transcallosal approach, and stated that no treatment short of total removal could have any possible value in the treatment of tumors in this region[10]. The anterior transcallosal approach was suggested by Ehni who used this approach for different pathological entities[11].

Third ventricular tumors are difficult to treat due to their deep location and proximity to vital neural structures such as thalamus, hypothalamus and vascular structure such as internal cerebral vein and medial posterior choroidal artery. Despite their unfavorable locations, these tumors can be removed successfully by proper knowledge of anatomical landmarks, pre-operative planning and by choosing appropriate approach.

There are various approaches to anterior third ventricle including transcortical-transventricular approach through foramen of monro[22], Interhemispheric – transcallosal - interforniceal approach[2,5], Interhemispheric - transcallosal-transchoroidal trans-velum interpositum approach[9,14], subfrontal trans - laminaterminalis approach[21]and Endoscopic approach.

Common surgical complications are seizure following transcortical approach, memory deficit and venous cortical infarct following transcallosal approach. Other postoperative complications are mutism, hematoma, and hemiparesis. Some study suggests that unilateral damage to fornix produces no deficit. The inter-forniceal approach to a lesion of third ventricle carries the potential risk for bilateral damage o fornix, but memory deficit is usually transient by this approach[4,3].

Method

We performed a retrospective analysis of all patients who underwent surgery for anterior third ventricle mass between March 2018 to March 2020 in the Dr Ram Manohar Lohia Institute of Medical Science Lucknow Uttar Pradesh. 17 patients underwent for surgery of anterior third ventricular mass. We reviewed case sheets, radiological images, pathological reports, surgical reports of all the patients. We also collected data regarding their demographic data, preoperative symptoms and signs, surgical approaches, histopathological reports and postoperative complications.

Results

In our study we reviewed case sheets of 17 patients, who were operated for anterior third ventricle approaches in Dr Ram Manohar Lohia Institute of Medical Sciences Lucknow during a time period from March 2018 to March 2020. In our study there were 12 males and 5 females, age ranged from 9 years to 54 years with mean age of 27 years. Maximum patients (9) were in the age group of 20-30 years.

The most common symptom in our cases was headache, which was present in all (100%) cases, nausea/vomiting in 7(41%), history of recurrent episodes of drop attacks in 4(23%), h/o seizure in 2(11.7%), visual disturbance in 1(5.4%), memory disturbance in 1(5.4%), urinary incontinence in 1(5.4%). One patient presented with altered mental status [Table-1].

Symptoms	No of patients
Headache	17(100%)
Nausea/vomiting	7(41%)
h/o drop attacks	4(23%)

h/o seizure episode	2(11.7%)
Visual disturbance	1(5.4%)
Memory disturbance	1(5.4%)
Urinary incontinence	1(5.4%)

Table 1. Clinical presentation of patients of anterior third ventricle mass.

Surgical approaches	No of patients
Transcortical transforaminal	3
Transcallosal transforaminal	6
Transcallosal interforniceal	1
Transcallosal subchoroidal	1
Subfrontal translaminar	1
Endoscopic excision	5

Table 2. Surgical approaches in patients with anterior third ventricle mass.

Histopathological report	No of patients
Colloid cyst	11
Craniopharyngioma	4
Central neurocytoma	2

Table 3. Histopathological report.

6 patients were operated with transcallosal-transforaminal approach, 1 patient was operated with transcallosal interforniceal approach, 3 patients were operated with transcortical-transforaminal approach, 1 patient was operated with subfrontal translamina terminalis approach, 1 patient was operated with transcallosal-transchoroidal approach, 5 patients were operated endoscopically [Table 2]. Gross total excision was achieved in 15(88%) patients while in 2(11.7%) patients one of craniopharyngioma and one of colloid cyst subtotal resection was done due to their adherence to choroid plexus and optic chiasm.

The most common post-operative complication was endocrine dysfunction in the form of diabetes insipidus in 4 patients and cortisol insufficiency and hypothyroidism in 1 patient due to hypothalamic injury. All four patients of post op endocrine dysfunction were of craniopharyngioma. 3 patients develop post-op seizure in the evening of day of surgery, 2 patients in which post-operative seizure developed were operated by transcortical approach and 1 patient was operated with transcallosal approach.

Histopathological reports of 11 patients were colloid cyst, craniopharyngioma was found in 4 patients and central neurocytoma was seen in 2 patients [Table 3].

Discussion

In current study of anterior third ventricular mass, in maximum patients 11(64%) the diagnosis was colloid cyst and most common symptom was headache seen in 100 % patients, vomiting in 41% patients and history of recurrent drop attacks in 23 % of patients. Similar results were reported by many authors[13,20].

The choice of the third ventricular tumors approach basically depends on the location of tumor, differential diagnosis, size, patient's clinical status and anatomical knowledge. It should be underlined that, although several corridors to the third ventricle exist, they all demand the incision of the neural tissue which may be relatively free from the underlying disease. Endoscopic approach remains the commonly used approach for the treatment of colloid cyst with chances of re-operation for residual cyst, but more cost effective and safer than open craniotomy for the resection of colloid cyst.

Surgical approaches

Transcallosal approach

Transcallosal approach allow removal of tumor from anterior third ventricle by incising the corpus callosum longitudinally in the direction of corpus callosum less than 2.5 cm (to avoid disconnection syndrome) between the two pericallosal artery at the level of foramen of monro. Genu of internal capsule touches the wall of ventricle in the area lateral to foramen of monro near the anterior pole of thalamus. Retraction should be done at this level minimally to avoid hemiplegia. After incising the corpus callosum we have multiple options to reach the third ventricle. We use trans-foraminal approach in 6 patients, in which 4 patients were of colloid cyst, 1 was of craniopharyngioma and 1 was of central neurocytoma, in all the cases foramen monro was already dilated, there was no need of enlarging the foramen of monro. Gross total excision was achieved in 5 cases; in one patient of craniopharyngioma gross total resection was not achieved due to adherence to choroid plexus and chiasma. Radiotherapy was given later to this patient. We used inter-forniceal approach in 1 patient of craniopharyngioma, located just behind the foramen of monro in midline. The point of entry was approximately 2 cm posterior to

foramen of monro to preserve the hippocampal commissure to avoid temporary or permanent problems with memory function. In this approach the body of the fornix is split in the midline, in the direction of its fibers, to expose the velum interpositum[3,15,27]. We used transchoroidal approach in 1 patient of craniopharyngioma, the entry was through the tenia fornicis as it has advantage that large veins like a thalamostriate vein which drains the internal capsule and central part of hemisphere and choroidal arteries can be dissected laterally, avoiding injury to these vessels. The transchoroidal and interforniceal approaches have the advantage of giving access to the central portion of the third ventricle behind the foramen of Monro by displacing it, rather than transecting the fibers in the fornix[19,29]. Transcallosal approach is superior to transcortical approach as it is not dependent on ventricle size, more direct and avoid incision over cortex. **(Figure 1)**

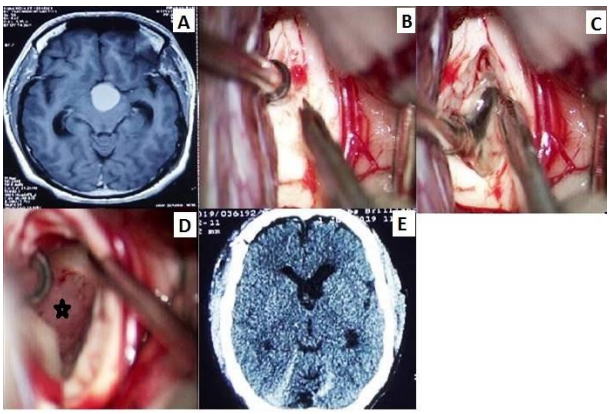

Figure 1. (A) Pre-operative contrast MRI axial scan showing contrast enhancing third ventricular mass (B) Anterior callosotomy between two pericallosal artery (C) Opening the right lateral ventricle(D) Lateral ventricle entered and tumor( )identified (E) Post-operative CT scan showing complete tumor removal.

Transcortical approach

We used transcortical-transforaminal approach in 3 patients. Out of 3, the diagnosis in 2 patients was colloid cyst and in one patient it was central neurocytoma. We entered through right middle frontal gyrus, after reaching lateral ventricle we used transforaminal corridor to remove the tumor as it is a natural orifice to enter third ventricle. Enlargement of foramen of monro was not required in any of the case as it was already dilated due to hydrocephalus. Gross total resection was achieved in all cases. Post-operative complication in the form of seizure developed in two patients. **(Figure 2)**

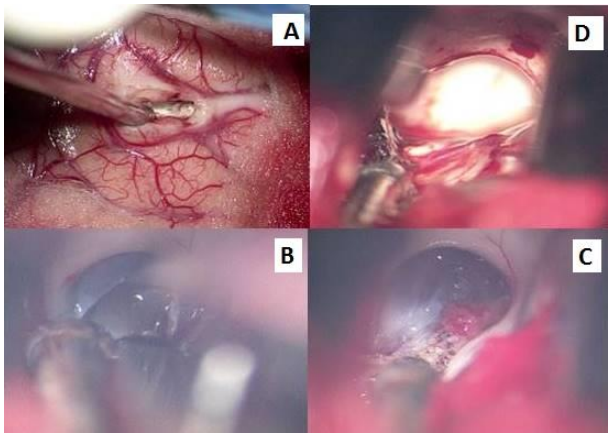

Figure 2. (A) Cortical incision around 1.5 cm in right middle frontal gyrus (B) Entry into right lateral ventricle and identification of cystic mass (C) Excision of cystic mass (D) Complete excision of mass.

Subfrontal translamina terminalis approach

We used subfrontal translamina terminalis approach in one patient of craniopharyngioma which was located in antero-inferior part of anterior third ventricle. After passing the planum sphenoidale, the optic nerves, the chiasm, and both internal carotid arteries are visualized. A1 was identified bilaterally and after incising the lamina terminalis above the chiasm up to the anterior commissure, tumor was seen which was internally decompressed initially and the remaining part of tumor was excised later**. (Figure 3)**

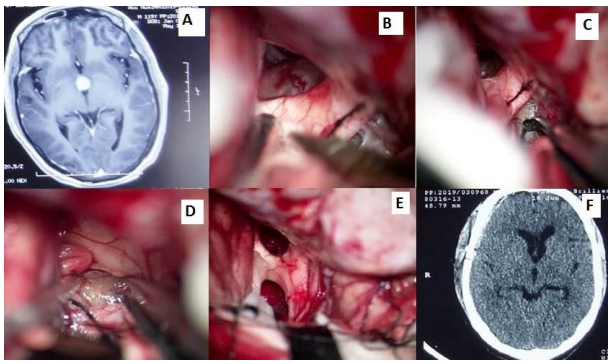

Figure 3. (A) Pre-operative Contrast MRI axial cut showing enhancing mass in third ventricle. (B) Identification and excision of the tumor in pre-chiasmatic and (C) optico-carotid cistern (D)Opening of lamina terminalis and excision of mass (E) complete excision achieved (F) Post-operative scan showing complete excision.

Endoscopic approach

We used endoscopic approach in 6 patients, diagnosis of all patients were colloid cyst. The colloid cyst of the third ventricle is an ideal tumour for endoscopic removal due to its cystic nature. Hydrocephalous was present in all cases which helped us to cannulate the lateral ventricle through planned burr-hole on right side. After reaching the colloid cyst, choroid plexus which was attached to colloid cyst was coagulated. After cauterisation of cyst wall, we opened the cyst wall applying endoscopic micro-scissor and then content was aspirated after that cyst wall was excised with minimal traction.in one patient cyst wall was densely adhered to the choroid plexus which was left in-situ after coagulation to prevent recurrence. **(Figure 4)**

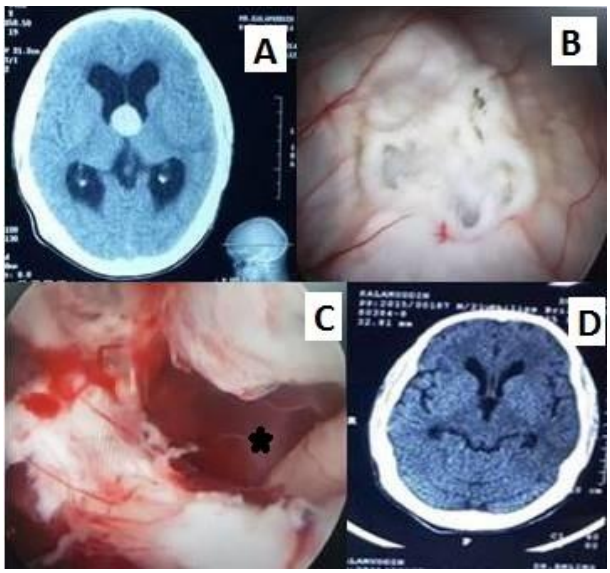

Figure 4. (A) Pre-operative CT scan showing hyperdense mass in third ventricle (B) Endoscopic view of mass filling the third ventricle, wall of the tumor cauterized at foramen of monro (C) Endoscopic view of the third ventricle after complete excision of mass and third ventriculostomy. Basilar artery seen in prepontine cistern ( ) (D) Postoperative scan showing complete excision.

Post-operative complications

In our retrospective study of anterior third ventricular mass patients we encountered with two complication. First complication was post op seizure which was seen in three patients of which two were operated with transcortical approach, one patient was intubated due to seizure and was extubated next morning and one was operated with transcallosal approach, concluded that there are less chances of post-operative seizure in transcallosal approach. In our study in 66% of patient of transcortical approach post op seizure developed which is very high, may be due to a smaller number of cases operated with transcortical approach. The incidence of postoperative seizures in the transcortical-transventricular approach in some series ranges from 11 to 13%[6,1,16,17]. Another complication was endocrine dysfunction in the form of diabetes insipidus in 4 patients which was transient and cortisol insufficiency and hypothyroidism in 1 patient due to hypothalamic injury, in these patients hormone replacement was given. All four patients of post op endocrine dysfunction were of craniopharyngioma. In multiple studies hormonal replacement therapy was required in approximately 80% of the children.[28,23,25,26,24].

Conclusion

Anterior Third ventricular tumors are mostly benign and best treatment modality is surgical resection. When we analyzed the results of various approaches, we found that despite their unfavorable location, in all techniques the results were satisfactory for different tumors of different location in anterior third ventricle, when treated with carefully planned microsurgical or endoscopic approach and with proper knowledge of anatomical landmarks with minimal complication. Transcallosal approach is a safer route, superior to transcortical approach as it is not dependent on ventricle size, direct and avoids incision over cortex. Transcortical approach had more chances of post-operative seizure. Endoscopic approach is good if done by an experienced hand but have limitation of wide visualization. Tumors originating from the antero-superior part of the third ventricle can be easily approached through a transcallosal transforaminal route, whereas lesions arising from the anteroinferior portion of the third ventricle might be safely and effectively approached through subfrontal translamina terminalis approach. In most of the craniopharyngioma patients, post-operative hormone replacement therapy usually needed.

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