

Evaluation of Cerebellopontine Angle Epidermoid Presenting with Cranial Nerve Deficit: A Surgical Perspective

Abstract

Context: Cerebellopontine angle (CPA) epidermoids are essentially benign tumors, and treatment is complete surgical excision. **Aims:** The aim of this study was to evaluate the surgical perspective and outcome analysis of CPA epidermoids. **Settings and Design:** This was a retrospective cohort study. **Subjects and Methods:** This study includes a cohort of 15 patients operated for CPA epidermoid in the Department of Neurosurgery of Institute of Medical Sciences, Banaras Hindu University, Varanasi, India, between August 1, 2016, and January 31, 2020. Each patient was evaluated in terms of demographic profile, clinical presentation, surgical management, and postoperative outcome characteristics. **Statistical Analysis Used:** Unpaired *t*-test and Chi-square test were used for analysis. Values with $P < 0.05$ were considered statistically significant. Statistical tests were done using GraphPad Prism version 8.3.0 software. **Results:** The mean age was 43 years, with the majority of patients being female (56.5%). The most common cranial nerve (CN) involved was CN VIII (67.7%), followed by CN VII (60%). Persisting CN deficit ($P = 0.0118$) was significantly ($P < 0.05$) associated with subtotal resection (STR). Gross-total resection was significantly associated ($P < 0.05$) to CN VII ($P = 0.0233$) and VIII ($P = 0.0157$) recovery. **Conclusions:** The extent of the tumor excision had no effect on the postoperative morbidity and the risk of recurrence. STR can be considered when there is dense adherence to blood vessels, nerves, or the brain stem to prevent the risk of serious neurological deficits. STR is significantly associated with persisting CN deficit postoperatively. During long-term follow-up, resolution or improvement of neurological deficits may be expected in most patients.

Keywords: Cerebellopontine angle epidermoid, gross-total resection, intracranial epidermoid, outcome analysis, retrosigmoid approach, subtotal resection

Introduction

Intracranial epidermoids are slow-growing, benign, and rare congenital neoplasms of the brain that may be derived of retained ectodermal rests.^[1] Epidermoid tumors comprise around 1% of all intracranial neoplasms and are also the most common entity among all embryonal intracranial tumors.^[1] The cerebellopontine angle (CPA) is one of the most commonly affected regions from epidermoid tumors.^[2] However, these lesions make up only 7% of the tumors in this region.^[2] Cranial nerve (CN) irritation due to epidermoids results in CN hyperactive dysfunctions. Trigeminal and other CN neuralgias may be precipitated due to CN irritation.

Epidermoid cysts consist of a connective tissue lamina lined with stratified squamous epithelium. Desquamation of epithelial cells leading to the formation of pearly shiny

debris, along with cholesterol and keratin secretion inside the cyst, results in an increase in the size of the tumor [Figure 1]. Epidermoid tumors are located in the subarachnoid space initially and fill the subarachnoid cisterns around the nerves and vessels. When all cisterns, fissures, and ventricles are filled, the mass effect becomes evident.^[3-5]

The imaging method of choice is magnetic resonance imaging (MRI). MRI with diffusion-weighted imaging (DWI) sequence is diagnostic.^[6] Epidermoids appear variable on MRI with T1-weighted images, the signal intensity is between the brain parenchyma and the cerebrospinal fluid (CSF), and in T2-weighted images, it exceeds both brain and CSF signals. There is no enhancement of capsule or cyst with contrast. Diffusion-weighted image sequence is diagnostic of

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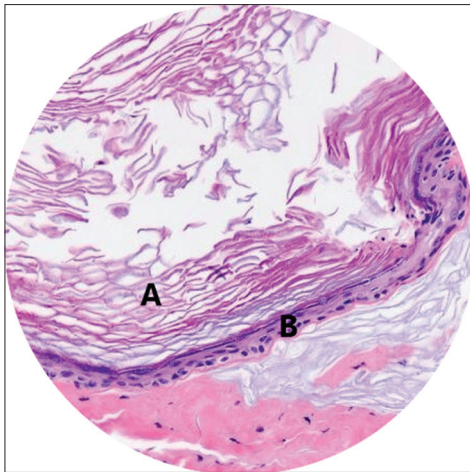


Figure 1: H and E staining (4X) cerebellopontine angle epidermoid. **A:** Keratin flakes and **B:** Stratified squamous epithelium

epidermoid [Figure 2]. In fluid-attenuated inversion recovery sequence, incomplete attenuation in contrast with CSF signal is seen. DWI is most useful for the diagnosis and differentiating epidermoid from other lesions, specifically arachnoid cysts, because the contents of the epidermoid cysts show prominent diffusion restriction (i.e., they are markedly hyperintense in DWI) due to layered microstructure of the debris.^[7]

Epidermoids are essentially benign tumors, and treatment is complete surgical excision. In this study, we aim to evaluate surgical and clinical perspective as well as postoperative outcome analysis of CPA epidermoids which will help in outcome prediction, prognostication, and rehabilitation of such patients.

Subjects and Methods

This retrospective cohort study includes a cohort of 15 patients who underwent surgery for CPA epidermoid in the Department of Neurosurgery of Institute of Medical Sciences, Banaras Hindu University, Varanasi, India, between August 1, 2016, and January 31, 2020.

This is a retrospective cohort study in two phases: a cross-sectional phase where the patients included in the sample were evaluated for the following described variables and a follow-up phase at hospital discharge and at subsequent outpatient department (OPD) visits by the patient. Each patient was evaluated in terms of demographic profile, clinical presentation, surgical management, and postoperative outcome characteristics.

The inclusion criteria were all patients operated in elective settings in the Department of Neurosurgery, IMS BHU, Varanasi, India, having preoperative imaging (MRI brain and contrast-enhanced computed tomography [CT] brain) suggestive of CPA epidermoid between August 1, 2016, and January 31, 2020. Patients were excluded if they had undergone previous surgical

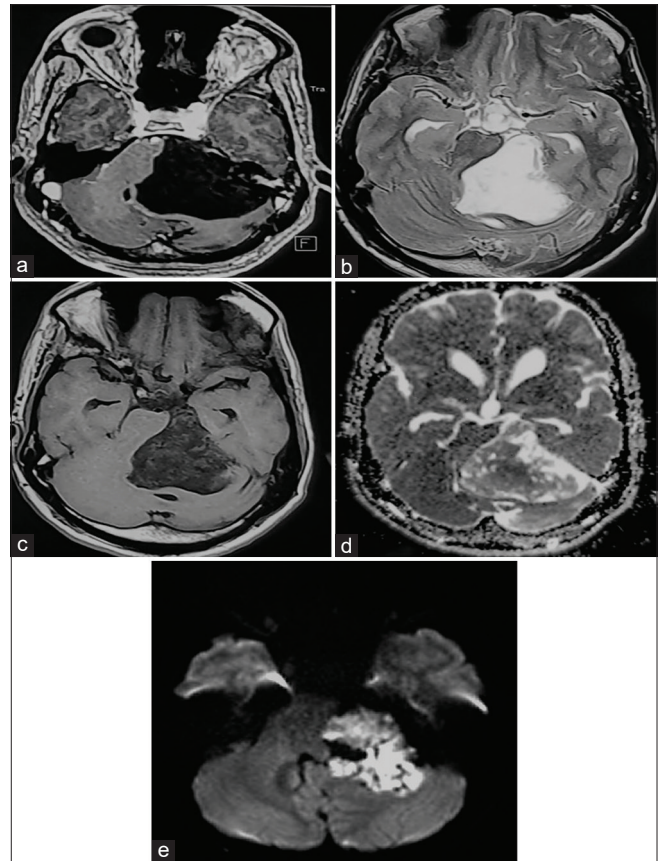


Figure 2: Magnetic resonance imaging of a patient with cerebellopontine angle epidermoid. (a) Axial T1 (showing a well-defined extra-axial hypointense cystic lesion in the left cerebellopontine angle region causing mass effect over the brain stem and cerebellum), (b) Axial T2 (the lesion is hyperintense on T2 showing near cerebrospinal fluid intensity), (c) Axial fluid-attenuated inversion recovery (the lesion shows incomplete suppression on fluid-attenuated inversion recovery with dirty heterogeneous signal), (d) Axial apparent diffusion coefficient (low signal on apparent diffusion coefficient confirms true restriction predominantly in the central region), and (e) Axial diffusion-weighted imaging (the lesion shows bright signal representing a combination of diffusion restriction and T2 shine through) magnetic resonance imaging sequences

intervention for the same lesion or had received radiotherapy.

Data were collected retrospectively by analyzing medical and surgical records of 15 operated patients of CPA epidermoid, submitted in the Medical Record Department, IMS BHU, Varanasi, India, between August 1, 2016, and January 31, 2020. Data included patient demographics, clinical findings, surgical details, and postoperative outcome characteristics. Follow-up data were collected from OPD records. Audiometry, postoperative MRI brain, and clinical neurological examination were done in follow-up to assess the recovery and recurrence. Permanent or persistent complications were considered as those complications that persisted for 6 months or more postoperatively.

Surgical treatment

The clinical status and preoperative magnetic resonance images of all patients were reviewed to determine the most

appropriate surgical strategy. Based on surgeon preference and radiological diagnosis, an appropriate surgical approach was selected. Written and informed consent was taken before surgery. The surgery involved the use of advanced microsurgical techniques and intraoperative navigation systems, as well as neuromonitoring.

Gross-total resection (GTR) is defined as the complete resection of the tumor with capsular excision of epidermoid and with no residual tumor on postoperative MRI or CT scan, whereas subtotal resection (STR) is defined as any residual tumor or residual capsular component of tumor with residual tumor on postoperative MRI or CT scan. Recurrent lesion was evaluated using postoperative MRI and characterized as a radiologically progressive tumor.

Statistical analysis

The data were summarized using medians/mean for continuous variables and counts and percentages for categorical variables. Differences of significance in continuous variables and categorical variables were evaluated using the unpaired *t*-test and Chi-square test, respectively. Values with $P < 0.05$ were considered statistically significant. Statistical tests were done using GraphPad Prism version 8.3.0 for Windows, (GraphPad Software, San Diego, California USA) software.

Results

Patient demographics and clinical presentation

A total of 15 patients underwent surgical treatment for CPA epidermoid during the 4-year period. The mean age was 43 years (range: 36–53 years), with the majority of patients being female (56.5%). The median duration of symptoms was 11.2 months (range: 5–36 months). The most common presenting symptom was loss of hearing (67.7%), followed by facial and eyelid muscle weakness/paralysis (60%), trigeminal neuralgia (46.7%), and ataxia (46.7%), respectively. The most common CN involved was CN VIII (67.7%), followed by CN VII (60%) and CN V (46.7%). Other CNs involved were CN IV, CN VI, and lower CNs (CN IX and X). Cerebellar signs were present in 80% of patients. Features of raised intracranial tension (ICT) were present in 5 patients (33.3%) [Table 1].

Surgical management

Two surgical approaches were used for the resection of these tumors [Table 2]. The most commonly used was the retrosigmoid approach (80%), followed by combined middle cranial fossa and retrosigmoid approach (20%). A combined approach was used in 3 patients (20%) with extension of tumor in the middle cranial fossa besides CPA. Medium pressure ventriculoperitoneal shunting was done preoperatively in 2 patients (13.3%). GTR was achieved in 13 patients (86.7%), in which complete excision of tumor with capsule was done. STR was done in

Table 1: Clinical presentation of cerebellopontine angle epidermoid (n=15)

	Number of patients (%)
Symptoms	
Facial and eyelid muscle weakness/paralysis	9 (60)
Loss of hearing	10 (67.7)
Tinnitus	6 (40)
Vertigo	6 (40)
Imbalance	7 (46.7)
Wasting of muscles of mastication	3 (20)
Trigeminal neuralgia	7 (46.7)
Diplopia	2 (13.3)
Symptoms of raised ICT	5 (33.3)
Signs	
Cranial nerve V involvement	7 (46.7)
Cranial nerve VII involvement	9 (60)
Cranial nerve VIII involvement	10 (67.7)
Cranial nerve IV involvement	1 (6.7)
Cranial nerve VI involvement	1 (6.7)
Lower cranial nerve involvement	3 (20)
Cerebellar signs	12 (80)
Signs of raised ICT	5 (33.3)
ICT – Intracranial tension	

Table 2: Surgical management

Surgical approach and management	Number of patients (%)
MPVP shunt before surgery	2 (13.3)
Retrosigmoid approach	12 (80)
Combined middle cranial fossa and retrosigmoid approach	3 (20)
Gross-total resection (with capsular resection)	13 (86.7)
Subtotal resection (with capsular remnant)	2 (13.3)
MPVP – Medium pressure ventriculoperitoneal	

2 patients (13.3%) in whom there were dense adhesions of tumor capsule to CNs and brain stem [Table 2].

Postoperative outcome

Surgical outcomes were divided into three groups of “good” (for cases with no CN deficit), “deficit” (for cases with CN deficit), and “death” (for cases of patient’s death).

Retrosigmoid approach yielded GTR of 11 patients and STR of 1 patient. GTR was associated with good outcome in 9 patients and deficit in 2 patients. STR was associated with deficit in 1 patient. There was no mortality in this group. The mean duration of follow-up was 7.2 months with no recurrence evident in either of GTR or STR group through this approach [Table 3].

Combined middle cranial fossa and retrosigmoid approach yielded GTR in 2 patients with good outcome and STR in 1 patient with deficit. There was no mortality in this group. The mean duration of follow-up was 13 months [Table 3].

Out of 7 patients with involvement of the trigeminal nerve and 1 patient with CN IV and CN VI involvement who have undergone GTR, all showed recovery and remission of symptoms postoperatively. Out of 7 patients with CN VII and 8 patients with CN VIII involvement who underwent GTR, persistent CN deficit was seen in 1 patient from each group.

Two patients with CN VII and CN VIII involvement who underwent STR showed no recovery in CN deficit. Persisting CN deficit ($P = 0.0118$) was significantly ($P < 0.05$) associated with STR. GTR is significantly associated ($P < 0.05$) when compared to STR with respect to CN VII ($P = 0.0233$) and VIII ($P = 0.0157$) recovery. New CN deficit ($P = 0.6847$) was not significantly associated with either GTR or STR [Table 4].

The mean duration of recovery for CN V, VII, and VIII deficit was 7.4 days, 1.1 months, and 6.2 months, respectively [Table 5].

Among 9 patients with preoperative facial weakness, 6 patients (66.7%) improved to a House–Brackmann (HB) III or better (good outcome) after a mean of 1 month of recovery, whereas 33.3% remained HB IV or worse (poor outcome).

Discussion

Epidermoid cyst is considered a rare, congenital, slow-growing, extra-axial tumorous malformation. In

contrast with most neoplastic lesions, epidermoid is believed to grow at a linear rate similar to that of normal epidermis.^[8] For this reason, it requires more than usual time to make patients symptomatic. In our series, the median duration of symptoms was 11.2 months and the mean age was 43 years with slight female (56.5%) preponderance. Epidermoid cysts become symptomatic within 20–60 years, with a peak incidence of around 40 years.^[5,9] Their incidence is almost the same in women and men.^[5,10]

In our series, the most common presenting symptom was loss of hearing (67.7%), followed by facial and eyelid muscle weakness/paralysis (60%), trigeminal neuralgia (46.7%), and ataxia (46.7%), respectively. The most common CN involved was CN VIII (67.7%), followed by CN VII (60%) and CN V (46.7%). According to a review, the incidence of CN dysfunction was as follows: CN VIII 73% > CN V 56% > CN VII 24%.^[11] Studies have shown that although facial palsy is not a common feature in epidermoids, it usually happens at early stages of the disease and is mild in nature.^[12]

Symptoms and signs are caused by various mechanisms. Compression caused by the cyst wall and content results in stretching, bending, and kinking of the nerves and the brain stem. This will interfere with blood supply and axonal flow of the nerves leading to their demyelination. In larger tumors, raised intracranial pressure causes various neurological deficits.^[13] In cases with CN hyperactive

Table 3: Operative outcome and follow-up results in epidermoids

Surgical approach	Postoperative outcome			Follow-up results	
	Good	Deficit	Death	Mean follow-up duration (months)	Recurrence
Retrosigmoid (12)					
GTR	9	2	0	7.2	0
STR	0	1	0		
Combined approach (3)					
GTR	2	0	0	13	0
STR	0	1	0		
Preoperative shunting	1	1	0	9	0

STR – Subtotal resection; GTR – Gross-total resection

Table 4: Postoperative outcome and resectability analysis

Outcome	GTR (n=13), n (%)	STR (n=2), n (%)	P
Persisting cranial nerve deficit	2	2	0.0118*
New cranial nerve deficit	1	0	0.6847
Tumor progression	0	0	NS
Regional complications	2	1	0.2546
Systemic complications	2	0	0.5513
Cranial nerve recovery			
V (7)	7 (100)	0	
IV (1)	1 (100)	0	
VI (1)	1 (100)	0	
VII (9)	6 (66.7)	0 (0)	0.0233*
VIII (10)	7 (70)	0 (0)	0.0157*

* - Significant ($P < 0.05$). STR – Subtotal resection; GTR – Gross-total resection; NS – Not significant

Table 5: Mean duration of recovery

Cranial nerve	Mean duration of recovery
V	7.4 days
VII	1.1 months
VIII	6.2 months

dysfunction, the etiology might be more complicated. Different pathological tumor types show different characteristics for hemifacial spasm.^[14] Furthermore, there are variations in epidermoids with trigeminal neuralgia: nerve encasement by the tumor with/without displacement, compression and displacement of the nerve, pressing the arterial vessels to the nerve by moving the vessel or nerve by the tumor, or compression to the artery which is located in the opposite side of the tumor.^[11,15] The cyst capsule and its content may irritate the nerves as they induce chemical meningitis.^[16] Young age and presence of rapid progression in neurological deficit may indicate critical compression of the affected nerves by the cyst capsule. Immediate decompression leading to the release of strangulating band may prevent irreversible deficits in such patients.^[2]

The most commonly used approach for CPA epidermoid in our series was the retrosigmoid approach (80%), followed by combined middle cranial fossa and retrosigmoid approach (20%) depending on the extent of the tumor. GTR was achieved in 86.7%, whereas STR was feasible in 13.3% of patients in whom there were dense adhesions of tumor capsule to CNs and brain stem. The goal to cure CPA epidermoids is ideally total removal of the cyst content. Subtotal excision requires multiple reoperations for symptomatic tumor recurrences.^[17] However, their close proximity to the CNs and brain stem and their tendency to adhere to them make their complete removal a real technical challenge in some cases. In these cases, the primary surgical objective is decompression of the involved nerves and brain stem by evacuation of cyst contents and excising the nonadherent capsule, with parts of the capsule adherent to the surrounding critical structures being left behind.^[18] Surgical treatment is preferred in patients with symptomatic epidermoid cysts. However, few authors also operate asymptomatic patients with considerable size tumors having documented rapid growth. In this study, persisting CN deficit was significantly associated with STR. GTR was significantly associated with CN VII and VIII recovery. New CN deficit was not associated with extent of tumor removal. No difference in tumor progression or recurrence was noted in our series. Total tumor removal should be attempted as there is risk of recurrence,^[19] but many studies showed no difference in recurrence rate between GTR and STR.^[1,5] Risk of malignant transformation of epidermoids into squamous cell carcinoma favors GTR in these tumors.^[3,20]

Whatever may be the approach used, after opening of the dura, the tumor is reached and the tumor capsule along

with overlying arachnoid is opened and contents of the cyst are evacuated. As epidermoids are usually avascular, the keratinized debris can be evacuated with very little or no bleeding. The brain usually does not collapse after the evacuation of cyst contents, making the use of brain spatulas to minimum during the surgery. Opening of the involved arachnoid cisterns and removal of tumor is preferred. Tumor surrounding nerves and blood vessels causes distortion and displacement of these structures. Identification of involved CNs at places of their exit at the skull base facilitates the removal of epidermoid around these nerves. Surgical dissection is done along the nerves, separating it from the tumor. Electromyography is used intraoperatively for monitoring of the CN functions, and brain stem auditory evoked potentials for monitoring CN VIII function in patients with serviceable hearing. An increase in preoperative deficits and postoperative new CN deficits may be expected in some patients.^[5,9,11,19] In most cases, it resolves completely during long-term follow-up.^[5,9,11,19] This transient worsening of deficit may be related to nerve manipulation or partial damage without their physical injury during the surgery.

Cholesterol spillage from the cyst to the arachnoid cistern intraoperatively may lead to aseptic meningitis. Irrigation of the surgical field with corticosteroid solution at the end of surgery has been recommended by some authors,^[5,19] and long-term postoperative corticosteroid administration is universally recommended.^[5,9,11,19] Aseptic meningitis complicates around 0%–18.2% of patients postoperatively^[5,9,11,19] and was 6.7% in our study. In long-term follow-up, the neurological condition of a large majority of patients is better than before the surgery, and no or only minor neurological deficits, such as hearing impairment, are seen in most patients.^[1,5]

Successive follow-up MRI, obligatorily using the DWI sequence, is indicated to evaluate for recurrence.^[10] The mean duration of recovery of CN V was earlier than CN VII and VIII, respectively.

Modern radiological modalities and microsurgical advancements have made GTR more feasible and resultant reduced postoperative mortality and morbidity; however, in some cases, complete resection is not feasible without resulting severe neurological deficit.

Conclusions

CN deficits are the predominating symptoms in patients with CPA epidermoids. The most common presenting symptom is loss of hearing, followed by facial and eyelid muscle weakness/paralysis and trigeminal neuralgia. The most common CN involved was CN VIII, followed by CN VII and CN V. The extent of the tumor expansion had no effect on the postoperative morbidity and the risk of recurrence. Thus, leaving parts of the tumor capsule at places where it is densely adhered to critical

structures (blood vessels, nerves, or the brain stem) to prevent the risk of serious neurological deficits related to an unavoidable damage of these structures can be considered. However, STR is significantly associated with persisting CN deficit postoperatively. CN VII and VIII recovery is significantly associated with GTR. New CN deficit is not associated with extent of resection of tumor. During long-term follow-up, resolution or improvement of preoperative as well as new postoperative neurological deficits may be expected in most patients.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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